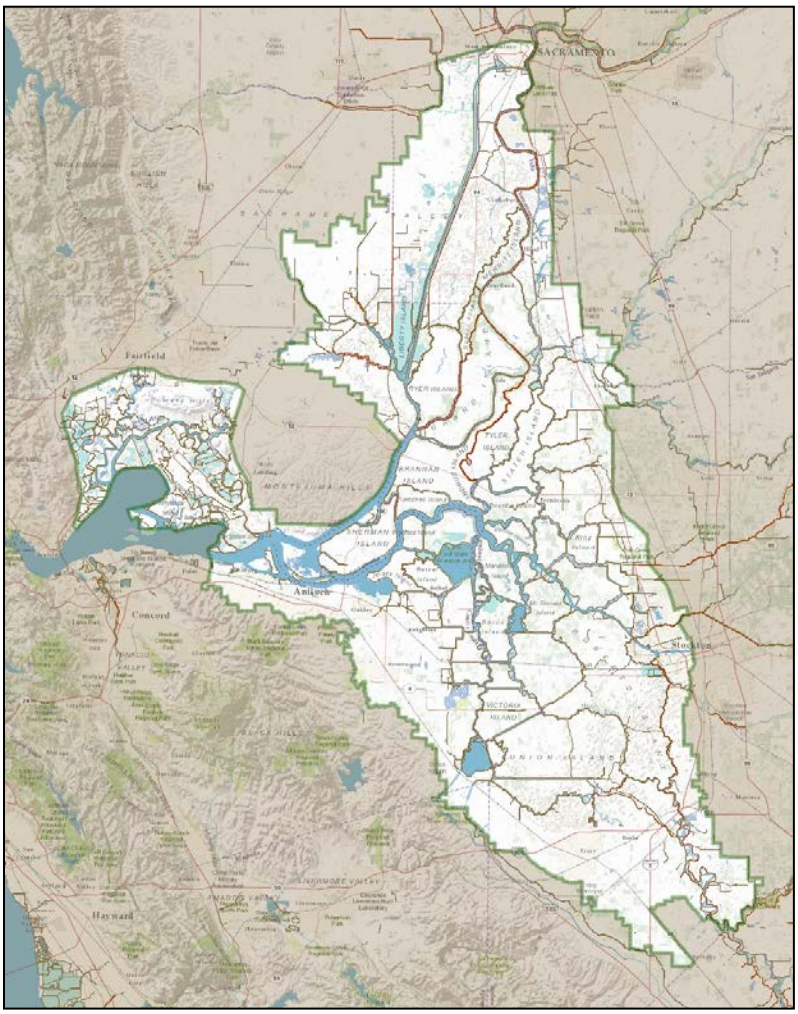
Delta Islands and Levees Feasibility Study, California

Draft Feasibility Report

and

Environmental Impact Statement

April 2014



U.S. Army Corps of Engineers
Sacramento District

Delta Islands and Levees Feasibility Study, California

Draft Feasibility Report and Environmental Impact Statement

April 2014

Type of Statement. Draft Feasibility Report and Environmental Impact Statement

Lead Federal Agency: U.S. Army Corps of Engineers, Sacramento District

Lead State Agency: California Department of Water Resources

Proposed Action: The U.S. Army Corps of Engineers and the California Department of Water Resources propose to restore approximately 89.5 acres of lost or degraded tidal marsh habitat in the west central portion of the Sacramento-San Joaquin Delta. The restoration work would involve transporting and placing dredged material into open water habitat to restore 80.3 acres and 9.2 acres of tidal marsh at Big Break and Little Franks Tract, respectively, in the Delta. The work would be conducted over 5 years as part of the annual operation and maintenance (O&M) dredging of the Stockton Deep Water Ship Channel. Previously stockpiled dredged material from existing dredged material storage sites would also be placed in conjunction with O&M.

Abstract: The draft report describes the affected environment in the Big Break and Little Franks Tract area; evaluates the direct, indirect, and cumulative environmental effects and the benefits of the tentatively selected plan and two alternative plans; and recommends avoidance, minimization, and mitigation measures. Most potential adverse effects would either be short term and insignificant, or would be avoided or reduced to less than significance using best management practices. Beneficial effects on vegetation and wildlife, special status species, other resources, and the historic floodplain from the alternative plans are also discussed.

Public Review and Comment: The draft report is available for a 45-day public review from April 18 to June 2, 2014. The document may be viewed on the Sacramento District's website at http://www.spk.usace.army.mil/Missions/CivilWorks/SacramentoSanJoaquinDelta. A CD copy of the draft report is also available upon request. The Corps will host public meetings in Clarksburg and Sacramento on May 7 and 9, 2014, respectively. All comments received will be considered and incorporated into the final report, as appropriate, and specific responses will be included in a comments and responses appendix. Questions and comments may be sent to: U.S. Army Corps of Engineers, Sacramento District, Attn: Mr. Robert Kidd, 1325 J Street, Sacramento, California 95814; phone: (916) 557-5100; or email: deltastudy@usace.army.mil.

EXECUTIVE SUMMARY

This report: (1) identifies flood risk management and ecosystem restoration problems and opportunities in the Sacramento – San Joaquin River Delta (Delta); (2) develops and evaluates measures to solve identified problems; (3) formulates and compares alternatives for ecosystem restoration; and (4) identifies a Tentatively Selected Plan (TSP) for implementation. This integrated Feasibility Report/Environmental Impact Statement (FR/EIS) describes the planning process followed to identify the Federal interest in the TSP and serves as the environmental compliance document under the National Environmental Policy Act (NEPA). This FR/EIS is being concurrently released for public review, internal policy review, Agency Technical Review (ATR), and Independent External Peer Review (IEPR). Pending comments received during these reviews, the FR/EIS will be finalized to present the recommended plan for eventual authorization.

Background

The U.S. Army Corps of Engineers (USACE) initiated the Feasibility Study in 2006 at the request of the California Department of Water Resources (DWR), the non-Federal sponsor for the study. USACE is the lead agency for the Feasibility Study and is also the lead under NEPA. Numerous other agencies, organizations, and individuals have participated in the study including the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS).

The Delta (Figure ES-1) is part of the largest estuary on the West Coast of the United States; is home to hundreds of species of fish, birds, mammals and reptiles; and is considered an ecosystem of national significance. Agricultural land irrigated by Delta water contributes billions of dollars in production for the Nation. Two deep water ports in the Delta serve as important marine terminals for dry bulk cargo vessels transporting agricultural products through the Delta's deep draft navigation channels to world markets. Delta levees protect thousands of acres of orchards, farms, and vineyards as well as critical infrastructure including state and interstate highways, major rail lines, natural gas fields, gas and fuel pipelines, water conveyance infrastructure, drinking water pipelines, and numerous towns, businesses and homes.

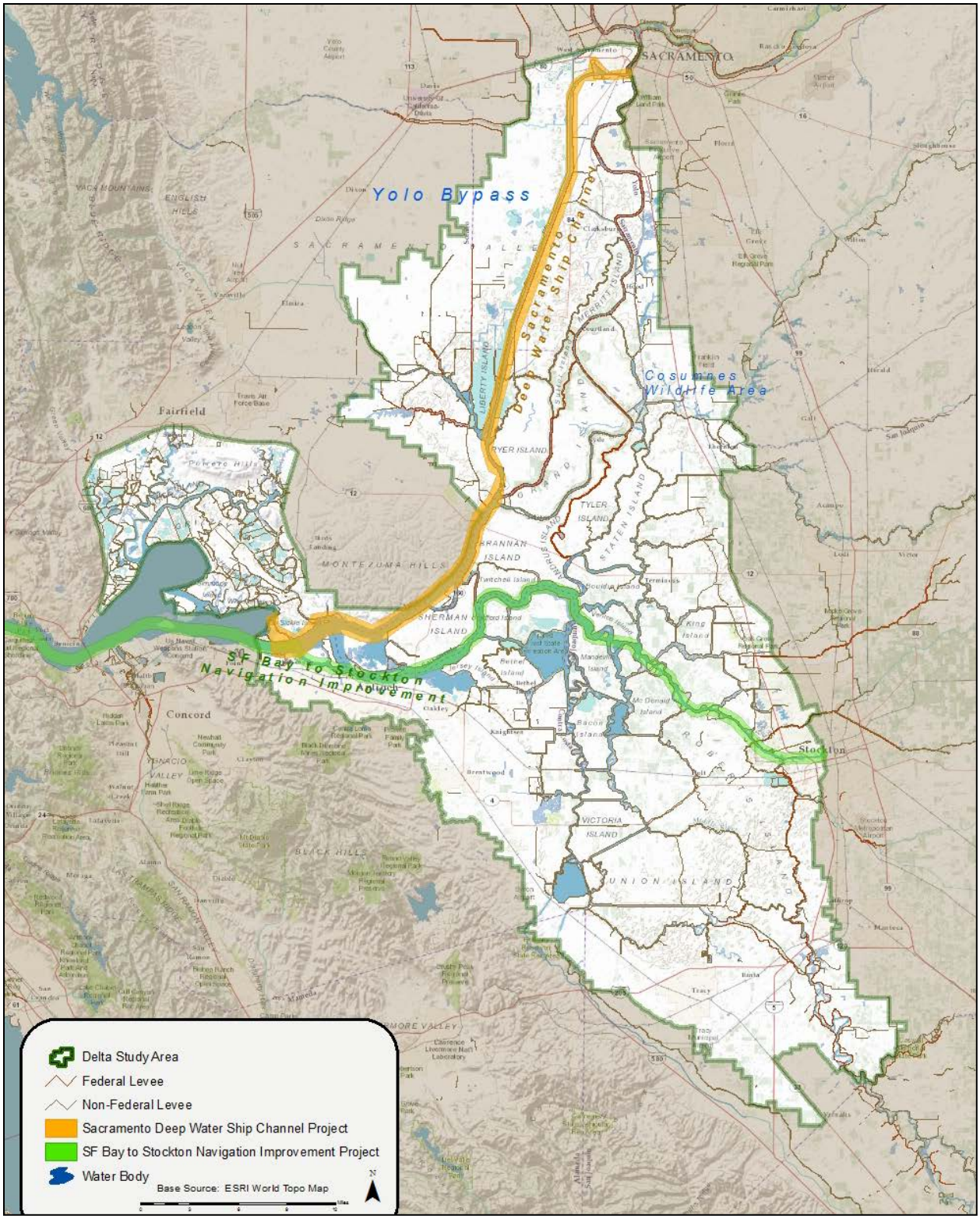


Figure ES-1. The Delta Study Area

The Delta is a web of channels and reclaimed islands at the confluence of the Sacramento, San Joaquin, Cosumnes, Mokelumne, and Calaveras Rivers. Forty percent of California's land area is contained within the watersheds of these rivers. The Delta covers about 738,000 acres and is interlaced with hundreds of miles of waterways. Much of the land is below sea level and protected by a network of 1,100 miles of levees which have been constructed over the past 150 years to manage the flow of water through the Delta. The land behind the levees is predominantly agricultural (corn, wheat, vineyards, cattle) and waterways provide recreational outlets for nearby urban areas and essential habitat for fish and wildlife, including Federally listed species under the Endangered Species Act. The Delta is also the largest single source of California's water supply, providing 25 million Californians with drinking water and irrigating millions of acres of farmland in the Central Valley. In addition, more than 500,000 people live within the Delta and rely upon it for water, recreation, and livelihood. The majority of that population is in the greater Sacramento and Stockton areas and is the focus of other USACE Flood Risk Management studies, though there are communities within the Delta. Several Delta towns, known as "legacy communities," are listed in the national registry of historic places.

Historically, the Delta was defined by tidal wetlands, primarily comprised of peat soils. The Swamp and Overflow Land Act of 1850 transferred ownership of all Federally owned swamp and overflow land, including Delta marshes, from the Federal Government to private parties agreeing to drain the land and turn it to productive, presumably agricultural, use. This Act began the reclamation of wetlands in the Delta through the construction of levees and drainage channels, typically by the new land owners. The majority of levees in the Delta are still privately owned and maintained. Nearly three fourths of the Delta is now in agriculture.

Consideration of Alternative Plans

During the feasibility study, the Federal planning process for development of water resource projects was followed to identify a TSP for implementation. Following definition of ecosystem restoration and flood related problems and opportunities, specific planning objectives and planning constraints were identified. Various management measures were then identified to achieve the planning objectives and avoid the planning constraints. Management measures were screened based on how well they met the study objectives and cost effectiveness. Several categories of measures were dropped from further consideration at that point, including structural flood risk management measures. The retained management measures were combined to form alternative plans, which were focused on restoration of intertidal marsh habitat. Alternative plans were then compared through cost effectiveness and incremental cost analyses based on costs and outputs.

Tentatively Selected Plan

The tentatively selected National Environmental Restoration (NER) plan (Alternative 6) is the most reasonably efficient contribution to the California Delta, an ecosystem of national significance, restoring 89.5 acres of intertidal marsh habitat in the Delta at a cost of $29M. The TSP (Figure ES-2) provides a unique opportunity to restore intertidal marsh, habitat which is

now largely non-existent in this ecosystem of national significance. Prior to levee construction in the late 19th and early 20th centuries, the Delta was comprised almost solely of tidal marsh. As levees were constructed, floodplains were disconnected from the waterways and land began to subside and compact as it was farmed and developed for human use. Delta lands are now as much as 20 feet below sea level, much too low for tidal marsh habitat without incorporation of subsidence reversal, which is typically cost prohibitive. For this reason, restoration of tidal marsh has been very limited throughout the central Delta in particular, where subsidence is most extensive and also where tidal marsh was historically most prevalent. The Tentatively Selected Plan links the proposed ecosystem restoration actions to historic and ongoing USACE navigation projects, providing a cost effective mechanism to implement otherwise costly subsidence reversal, resulting in restoration of habitat for multiple Federally listed species, notably salmonids and Delta smelt. The restored habitat would also benefit the millions of migratory fowl on the Pacific Flyway as they travel through the Delta, part of the largest estuary on the West Coast.

The national significance of the Delta has been demonstrated many times through decades of Federal authorizations and partnerships. The CALFED Bay-Delta Program, which emerged from water crises of the 1990s, is a unique collaboration among 25 State and Federal agencies to improve California's water supply and the ecological health of the Bay-Delta. The San Francisco Estuary Partnership is a coalition of resource agencies, non-profits, citizens, and scientists working to protect, restore, and enhance water quality and fish and wildlife habitat in the Bay-Delta. Most recently, the 2009 California Bay-Delta Memorandum of Understanding Among Federal Agencies named the Bay-Delta "among the most important estuary ecosystems in the Nation" and committed the Federal agencies to work in partnership with the State and stakeholders to carry out the vision of "a healthy and sustainable Bay-Delta ecosystem that provides for a high-quality, reliable, and sustainable long-term water supply for California, and restores the environmental integrity and sustainability of the system." The Tentatively Selected Plan recommends Federal action to restore 89.5 acres tidal marsh, one of the most sought after habitat types in this unique, important estuary.

The principle features of the TSP are: (1) placement of 500,000 cubic yards of fill material into Big Break from Operations and Maintenance dredging from the Stockton Deep Water Ship Channel to restore tidal habitat elevations; (2) placement of 124,000 cubic yards of fill material into Big Break via pumping previously dredged material from the McCormick dredged material placement site; (3) placement of 210,000 cubic yards of fill material into Big Break via pumping previously dredged material from the Scour dredged material placement site; (4) placement of 125,000 cubic yards of fill material into Big Break via pumping previously dredged material from the Decker dredged material placement site; and (5) placement of 153,000 cubic yards of fill material into Little Frank's Tract via pumping previously dredged material from the Bradford dredged material placement site.

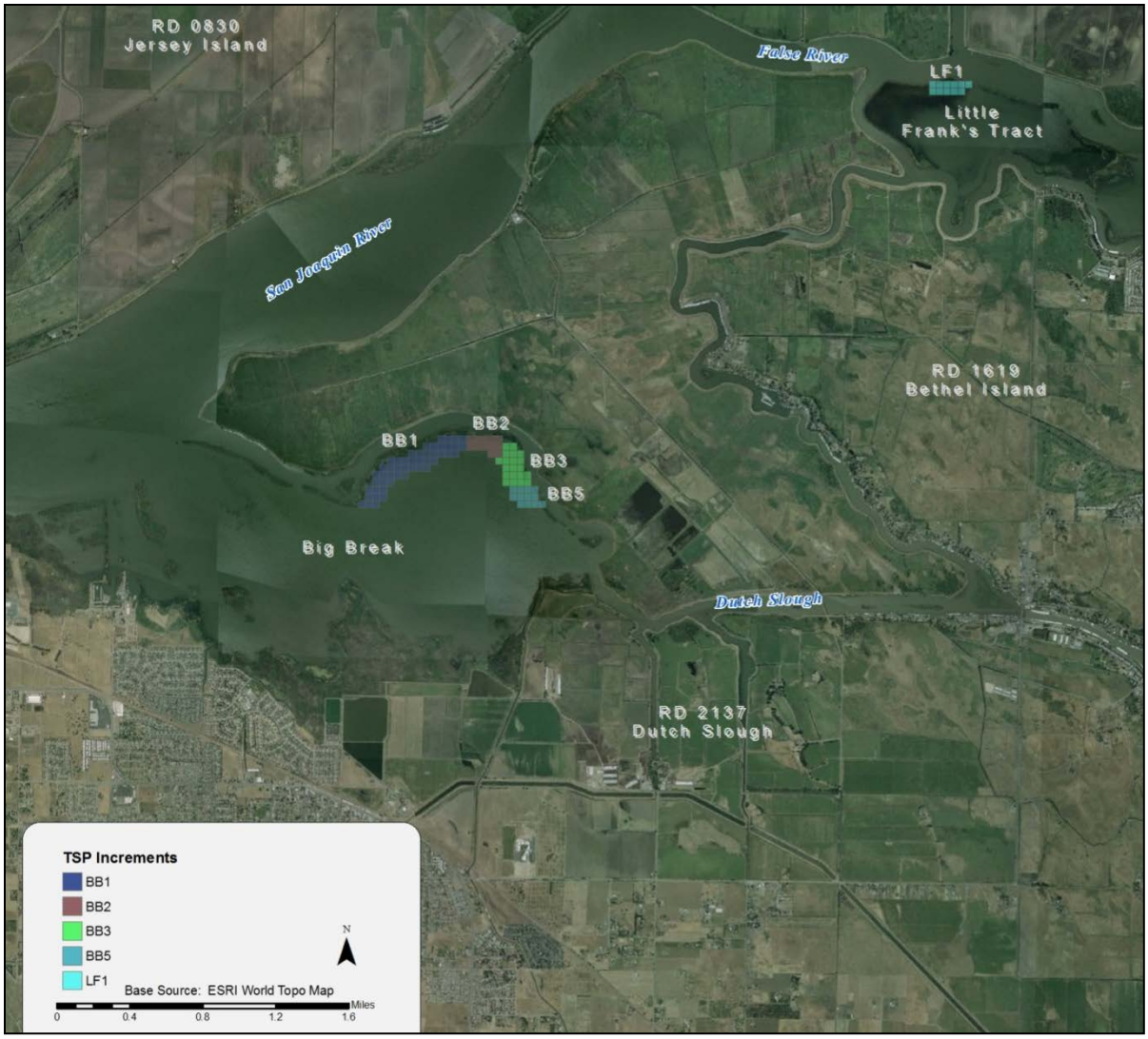


Figure ES-2. The Tentatively Selected Plan.

Environmental Effects

The effects to the environment have been considered throughout the study and opportunities have been evaluated to provide environmental restoration, as described above. The proposed alternatives, while providing long-term benefits to the Delta, would also have short-term effects on some resources. Various mitigation measures have been considered including construction timing, location of fill material placement, material source selection sites, and avoidance of certain areas. A summary of impacts, mitigation measures, and level of impacts with mitigation is provided in Table ES-1.

In all cases, the potential adverse environmental effects would be reduced to a less-than-significant level through project design, construction practices, preconstruction surveys and analysis, regulatory requirements, and best management practices. No compensatory mitigation would be required. A geotechnical analysis of underlying substrates and water quality analysis

of construction activities and methods would be conducted during the preconstruction, engineering, and design phase to further refine potential impact analysis. A National Pollutant Discharge Elimination System general construction permit would be required. A Storm Water Pollution Prevention Plan and Spill Prevention Control and Countermeasures Plan would be developed by the contractor prior to construction.

Jurisdictional wetlands occur in the proposed footprint of the TSP. A Section 404(b)(1) analysis has been conducted for the TSP (Alternative 6) to analyze potential effects that could occur from the placement of dredged materials in open water habitat. Potential impacts to vegetation communities and special status species have been greatly reduced through construction design. Direct impacts to nesting birds and other sensitive species would be avoided by implementing preconstruction surveys and scheduling of construction activities. USACE has determined that the TSP is likely to have adverse short-term effects to Delta smelt; however, it would have long-term benefits once the intertidal marsh habitat is established. The TSP would also affect, but is not likely to adversely affect listed salmonids, green sturgeon, giant garter snake and other special status species with the potential to occur in the area. Coordination with USFWS and NMFS has been ongoing throughout the study. A biological assessment was prepared for Delta smelt and submitted to USFWS to initiate consultation. Informal consultation with NMFS will take place during public and agency review of this document.

Impacts to agricultural land would be minimized by avoiding active farm lands when placing any temporary pipelines. If any land is temporarily disturbed during construction, it would be returned to agricultural production after construction. The TSP is located in an estuary area where urban populations are not present. Because of the lack of population in the area, it has been determined that no affect would occur to socioeconomics, environmental justice, noise, aesthetics, and public utilities and services. Additionally, the TSP proposes to create tidal marsh lands and therefore does not contribute to occupancy, modification, or development of flood plains, and therefore, the project is in compliance with Executive Order 11988.

Table ES-1. Summary of Potential Effects and Mitigation Measures.

Potential Effects	Mitigation Measures	Effects with Mitigation
VEGETATION AND WILDLIFE		
Alternative 2 & 6		
Construction related habitat disturbance or wildlife mortality, or increased invasive species spread	1 – Exclusion fencing to keep sensitive species away from construction activities. 2 – Removal of invasive species at existing remnant levees and at material source sites. 3 – Implementation of BMP's.	Less than Significant/ Beneficial
SPECIAL STATUS SPECIES		
Alternative 2 & 6		
Construction related disturbance effecting habitat, growth, survival or reproductive success of special status plants or wildlife	1 – Preconstruction surveys for special status plants. 2 – Preconstruction species surveys. 3 – Timing work windows between migratory and mating/spawning patterns. 4 – Installing construction buffers and exclusion fencing.	Less than Significant/ Beneficial
WATER QUALITY		
Alternative 2 & 6		
Placement of dredged material could degrade surface water quality, affect salinity, and/or alter erosion and sedimentation rates in the project area	1 – Placement of silt curtains, hay bales, or similar methods to contain dredge material. 2 – Implement a Storm Water Pollution Prevention Plan. 3 – Conduct water quality monitoring during construction.	Less than Significant
AIR QUALITY		
Alternative 2 & 6		
Temporary increase of criteria pollutants during construction	1 – Implement Sacramento Metropolitan Air Quality Management District and Bay Area Air Quality Management District basic construction emission	Less than Significant

	control practices. 2 – Implement fugitive dust mitigation measures. 3 – Implement basic construction emission control practices to control diesel exhaust emissions. 4 – Use electric equipment when possible.	
CLIMATE CHANGE		
Alternative 2 & 6		
Temporary increase in GHG emissions during construction	1 – Use electric vehicles and equipment when possible. 2 – Follow Sacramento Metropolitan Air Quality Management District and Bay Area Air Quality Management District recommended greenhouse gas reduction measures.	Less than Significant
TRANSPORATION AND NAVIGATION		
Alternative 2		
Temporary disruption to Deep Water Ship Channel (DWSC) commerce activities and creation of safety hazards	1 – Any in-water pipes will be weighted to the channel bottom to ensure necessary clearance for shipping vessel hulls.	Less than Significant
Alternative 6		
Temporary disruption to navigation and commerce activities in the DWSC, Sacramento River, and San Joaquin River, and creation of safety hazards	1 – Work vessels will coordinate with commerce shipping schedules and move all equipment clear of the channel to allow safe passage for other vessels. 2 – All equipment will be moved clear of the channel to allow safe passage for other vessels. 3 – Any in-water pipes will be weighted to the channel bottom to ensure necessary clearance for shipping vessel hulls. 4-Coordination with the California Department of Transportation (CalTrans) prior to the installation of the pipes across the road. Additionally, the contractor would be required to obtain any required permits and approvals from CalTrans.	Less than Significant
RECREATION		

Alternative 2 & 6		
Preclude recreational activities within and around Big Break and Little Franks Tract	1 – Preconstruction coordination with the U.S. Coast Guard to keep water sport activities safe. 2 – Preconstruction coordination with local recreation facilities to inform boaters and anglers of construction. 3-Provide project safety information including maps of any restricted access areas.	Less than Significant
CULTURAL RESOURCES		
Alternative 2 & 6		
CULTURAL RESOURCES		
Any adverse effects on cultural resources that are listed or eligible for listing in the National Registry of Historic Places (i.e., historic properties) are considered to be significant impacts. Effects are considered to be adverse if they alter, directly or indirectly, any of the characteristics of a cultural resource that qualify that resource for the NRHP so that the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association is diminished.	1 – The area of potential effects has been inventoried, and it has been determined that no significant cultural resources exist within it. 2 – Surface pipeline placement will be subject to archaeological monitoring to ensure that no previously unknown archaeological sites are impacted. 3 – If previously unidentified cultural resources are discovered during ground disturbing activities, all construction in the vicinity of the find would be halted immediately and the USACE would follow the procedures outlined under 36 CFR 800.	Less than significant

Estimated Cost and Cost Sharing

Investment cost accounts from the draft Micro Computer-Aided Cost Engineering System (MCACES) cost estimate for the TSP are displayed in Table ES-2 below.

Table ES-2. Estimated Costs of Tentatively Selected Plan.

MCACES Account[2]	Description	Total First Cost[1] ($1,000s)
01	Lands and Damages[3]	3,460
02	Relocations[4]	0
06	Fish and Wildlife[5]	20,547
18	Cultural Resources Data Recovery[6]	205
30	Planning, Engineering, Design[7]	3,091
31	Construction Management[8]	1,714
	Total First Cost	29,018

[1]Based on October 2013 price levels.
[2]MCACES is the software program and associated format used by the USACE in developing cost estimates. Costs are divided into various categories identified as "accounts." Detailed costs estimates are presented Cost Engineering Appendix.
[3]Real Estate land costs, which includes fees, but no damages.
[4]No relocations required in TSP.
[5]TSP categorized as Fish and Wildlife in its entirety.
[6] Assumes 1 percent of 06 Account.
[7]15 percent of 06 Account.
[8]8.5 percent 06 Account.

The estimated total project first cost for the recommended plan is $29,018,000. A summary of costs and benefits of the TSP is presented in Table ES-3. Federal costs are capped at 65% of the NER plan first cost plus Cultural Resource Data Recovery (100% Federal cost) which is estimated to be $18,933,000 (Table ES-4).

Table ES-3. Economic Costs and Benefits of Tentatively Selected Plan.

Item	Costs ($1,000s)	Benefits
Investment Cost		
First Cost[1]	29,018	
Interest During Construction (3.5%)	3,017	
Total	32,035	
Annual Cost		
Interest and Amortization (3.5% over 50 year period of analysis)	1,366	
OMRR&R[2]	TBD	
Subtotal	1,366	
Annual Benefits		88.1 AAHU's
Non-monetary (Ecosystem)		

[1]Excludes Cultural Resource Data Recovery; Oct 2013 price level.
[2] Operation, Maintenance, Repair, Replacement, and Rehabilitation; OMRR&R costs, anticipated to be minimal, will be determined through development of the Monitoring and Adaptive Management Plan prior to the Final Report.

Table ES-4. Summary of Cost-Sharing Responsibilities of the Tentatively Selected Plan (October 2013 Price Level).

Item	Federal	Non-Federal	Total First Costs ($1,000s) [1]
Fish & Wildlife Facilities	$20,547	$0	$20,547
Lands and Damages	$400	$3,060	$3,460
Planning, Engineering, & Design	$3,091	$0	$3,091
Construction Management	$1,714	$0	$1,714
Subtotal	*$25,752*	*$3,060*	*$28,812*
Additional Cash Contribution	-$7,024	$7,024	
Subtotal	*$18,728*	*$10,084*	*$28,812*
Percentage	*65%*	*35%*	
Cultural Resource Data Recovery[2]	$205	$0	$205
Total	*$18,933*	*$10,084*	*$29,018*

[1] Based on October 2013 price levels.

[2] 100% Federal cost.

Major Conclusions

The preliminary recommendation is that the report be finalized based on results of public review, internal policy review, ATR, and IEPR of this draft FS/EIS, and if warranted, recommended for authorization for implementation as a Federal project. The estimated first cost of the Tentatively Selected Plan is $29,018,000 and the estimated annual OMRR&R cost, anticipated to be minimal, are to be determined prior to the final report. The Federal portion of the estimated first cost, based on October 2013 price levels, is $18,933,000. The estimated fully funded Federal first cost, based on projected inflation rates specified by USACE budget guidance, and including Cultural Resource Data Recovery (100% Federal cost) is $19,324,000. The non-Federal sponsor portion of the estimated first cost is $10,084,000. The non-Federal sponsor's share of the fully funded first cost is $10,292,000.

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ACRONYMS AND ABBREVIATIONS

AAHU	average annual habitat units
AEP	Annual Exceedance Probability
AQMD	air quality management district
APCD	air pollution control district
APE	area of potential effects
ARPA	The Archaeological Resources Protection Act
BAAQMD	Bay Area Air Quality Management District
BCC	Birds of Conservation Concern
BDCP	Bay Delta Conservation Plan
CAA	Clean Air Act
CAR	Coordination Act Report
CCAA	California Clean Air Act
CDFW	California Department of Fish and Wildlife
CEQ	White House Council on Environmental Quality
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_{2e}	carbon dioxide equivalent
CNEL	Community Noise Equivalent Level
CNDBB	California Nature Diversity Data Base
CNPS	California Native Plant Society
CTR	California Toxics Rule
CVP	Central Valley Project
CVFPP	Central Valley Flood Protection Plan
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWC	California Water Code
dB	decibels
dBA	A-weighted decibels
DBCP	dinoseb, chlordane, dibromochloropropane
Delta	San Joaquin Delta
DO	dissolved oxygen
DPC	Delta Protection Commission
DPS	Distinct Population Segment
DRMS	Delta Risk Management Study
DWSC	Deep Water Ship Channel
DWR	California Department of Water Resources
EAD	expected annual damages
EBRPD	East Bay Regional Park District
ECTM	Economic Consequences Technical Memorandum
EFH	Essential Fish Habitat

EIS/EIR	Environmental Impact Statement/Environmental Impact Report
EO	executive order
EPBC	Environmental Protection and Biodiversity Conservation
ER	Ecosystem Restoration
ESA	Environmental Site Assessment
FDA	Flood Damage Analysis
FESA	Federal Endangered Species Act
FHWA	Federal Highway Administration
FRM	Flood Risk Management
FWCA	Fish and Wildlife Coordination Act
FWOP	future without project
GCID	Glenn-Colusa Irrigation District
GCR	General Conformity Rule
GHG	greenhouse gas
HAP	hazardous air pollutant
HEC	Hydrologic Engineering Center
HEP	Habitat Evaluation Procedure
HFC	hydrofluorocarbon
HFE	hydrofluorinated ether
HTRW	hazardous, toxic, and radiological waste
HU	habitat units
IITM	Impact to Infrastructure Technical Memorandum
IWR	Institute of Water Resources
LACMTA	Los Angeles County Metropolitan Transportation Authority
L_{dn}	day-night sound level
L_{eq}	equivalent sound level
M	Marine Highway
MBTA	Migratory Bird Treaty Act
MLLW	mean lower low water
MY	model year
N/A	not applicable
NO_2	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NED	National Economic Development
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NF_3	nitrogen trifluride
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice of Determination
NOI	notice of intent
NOP	Notice of Preparation
NO_2	nitrous oxides
NO_X	nitrogen oxides
NPDES	National Pollution Discharge Elimination System

NRHP	National Register of Historic Places
O_3	ozone
Pb	lead
PCB	polychlorinated biphenyls
PDT	project delivery team
PFC	perfluorocarbon
PFMC	Pacific Fisheries Management Council
PM10	particulate matter smaller than or equal to 10 microns in diameter
PM2.5	particulate matter smaller than or equal to 2.5 microns in diameter
ROD	Record of Decision
ROG	reactive organic gases
RWQCB	Regional Water Quality Control Board
SEIS	Supplemental Environmental Impact Statement
SF_6	sulfur hexafluoride
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Air Pollution Control District
SMAQMD	Sacramento Metropolitan Air Quality Management District
SO_2	sulfur dioxide
SVAB	Sacramento Valley Air Basin
SWP	State Water Project
TDS	total dissolved solids
TMDL	total maximum daily load
TOC	total organic carbon
TSP	tentatively selected plan
ULSD	ultra-low sulfur diesel
UPL	Urban Project Levee
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VELB	valley elderberry longhorn beetle
WQCP	Water Quality Control Plan
WRDA	Water Resources Development Act

CHAPTER 1 – INTRODUCTION

1.1 Purpose and Need

The communities and ecosystem within the Sacramento – San Joaquin Delta (Delta) rely on an existing levee network to contain flows in the Sacramento and San Joaquin Rivers. The 1,100 mile levee network is a mix of Federal and non-Federal levees that do not meet U.S. Army Corps of Engineers (USACE), or any other levee construction standard and could fail at water levels well below top of levee. The levee network holds water back from flooding the subsided islands/tracts during daily tidal fluctuations. Native habitat and natural river functions in the study area have suffered extensive degradation over more than a century of levee construction and conversion of the floodplain to agricultural and rural development, as well as management of the system for municipal, industrial, and agricultural water supplies. The purposes of a project for the Delta area are to reduce flood risk to life and property and to restore the ecosystem, as stated in Section 2 of the Flood Control Act of 1936 (Public Law [PL] 74-7380), "investigations and improvements of river and other waterways for flood control and allied purposes."

This report presents the findings of the Sacramento – San Joaquin Rivers Delta Islands and Levees, California, Feasibility Study (Feasibility Study). The purpose of the Feasibility Study is to determine if there is a Federal interest[1] in providing Flood Risk Management (FRM) and Ecosystem Restoration (ER) improvements to the Sacramento – San Joaquin Rivers Delta (Delta), California. This report integrates plan formulation with documentation of environmental effects. This report will also serve as an Environmental Impact Statement (EIS), by providing documentation and analysis required by the National Environmental Policy Act (NEPA) of 1969, as amended. The report describes the flooding, ecosystem, and related water resource problems and opportunities in the Delta area and expresses desired changes as planning objectives. Alternative plans to achieve these objectives are presented. These alternative plans include a plan of no action and various combinations of individual management measures[2]. The economic, social, and environmental effects of the alternative plans are described and a feasible plan is tentatively selected for recommendation. The report also details the roles of the USACE and non-Federal sponsor (California Department of Water Resources) in implementing the selected plan. The non-Federal sponsor is responsible for compliance with the California Environmental Quality Act (CEQA). The report concludes with a tentative recommendation for Congressional authorization of the Tentatively Selected Plan, pending public review, technical reviews, and subsequent revisions. This report will serve as an interim response to the study authority, stated below.

[1] A project is said to be in the **Federal interest** if it is consistent with the mission of the Corps of Engineers and the project benefits are in excess of the project costs.

[2] A **management measure** is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives.

1.2 Study Authority

Authority for this investigation has roots in longstanding flood control laws. The foundation for this investigation's authority comes from the Flood Control Act of 1936 (Public Law [PL] 74-7380). Section 2 of this Act states:

> *"[T]hat, hereafter Federal investigations and improvements of river and other waterways for flood control and allied purposes shall be under the jurisdiction of and shall be prosecuted by the War Department under the direction of the Secretary of War and supervision of the Chief of Engineers…".*

Section 6 of the 1936 Flood Control Act further states:

> *"The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control at the following named localities…Sacramento and San Joaquin River Valleys, California…Provided further, That after the regular or formal reports made as authorized on any examination, survey, project, or work under way or proposed are submitted to Congress, no supplemental or additional report or estimate shall be made unless authorized by law or by resolution of the Committee on Flood Control of the House of Representative or the Committee on Commerce of the Senate."*

The Chief of Engineers completed a report based on this authority relevant to this project. House Document No. 367, dated October 13, 1949, is a letter from the Secretary of the Army on the Sacramento-San Joaquin Basin Streams, California which states in part:

> *"A Letter from the Chief of Engineers, United Sates Army, Dated July 27, 1948, submitting a report, together with accompanying papers and illustrations, on preliminary examinations and surveys of Sacramento-San Joaquin River Basin Streams, California. For Flood Control and allied purposes listed in the Report. This investigation was authorized by the Flood Control Acts of June 22, 1936 and June 28, 1938."*

Following this Report, Congress directed additional study to be made of this region in 1964. As mentioned above, Section 6 of the 1936 Flood Control Act expressly permits additional reports to be authorized by House Resolution. Consistent with that statutory delegation a House Resolution adopted May 8, 1964 authorized the Corps to pursue further reviews of the Agency's report contained in House Document No. 367, referenced above. Specifically the May 8, 1964 House Resolution states:

> *"Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report on the Sacramento-San Joaquin Basin Streams, California, published as House Document No. 367, 81st Congress, 1st Session, and other reports, with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular*

reference to further coordinated development of the water resources in the San Joaquin River Basin, California."

Conference Report 108-357 accompanied the Energy and Water Development Appropriations Act of 2004 (P.L. 108-137) and provided both further congressional direction and funding relative to this study. Conference Report 108-357 states:

"The conferees have provided $1,100,000 for the Sacramento-San Joaquin Delta, California, study including $350,000 for a reconnaissance study to evaluate environmental restoration, flood protection, recreation, and related purposes for the California Bay-Delta Authority North Delta Improvements project, and $500,000 to initiate and complete a reconnaissance study to prioritize and evaluate environmental restoration, flood protection and related purposes for the Delta Islands and Levees. The remaining funding is provided for the Delta Special Study."

About this time Congress also passed the CALFED Bay-Delta Authorization Act of 2004 (P.L. 108-361). Section 103(f)(3) of the Act specifically authorized USACE participation in the CALFED Program. Accordingly the Sacramento District conducted a reconnaissance level study of the CALFED Levee Stability Program. USACE sent its report to Congress entitled "CALFED Levee Stability Program, California" in May 2006, recommending that the Corps perform a feasibility study of Delta Islands and levees to define a long-term strategy for Delta levee system improvements.

"Section 3015 of the Water Resources Development Act (WRDA) of 2007 amends Section 103(f)(3) of PL 108-361, which in part authorized this feasibility report. USACE published its implementation guidance for WRDA, 2007, Section 3015, on August 11, 2008."

1.3 Study Area Location

The study area (Figure 1-1) includes the entire Sacramento – San Joaquin Delta and Suisun Marsh, comprising parts of Sacramento, San Joaquin, Solano, Contra Costa, Alameda, and Yolo Counties, California. The area extends south from the City of Sacramento to the cities of Stockton and Tracy, and west from approximately Interstate Highway 5 to and including Suisun Bay, an eastward extension of the San Francisco Bay. The Delta consists of about 740,000 acres of agricultural and developed lands, wetlands and tidal marshes segregated into some 80 tracts and islands by 1,100 miles of levees and a labyrinth of navigation channels, rivers, tributaries, streams, sloughs, waterways and shallow open water expanses.

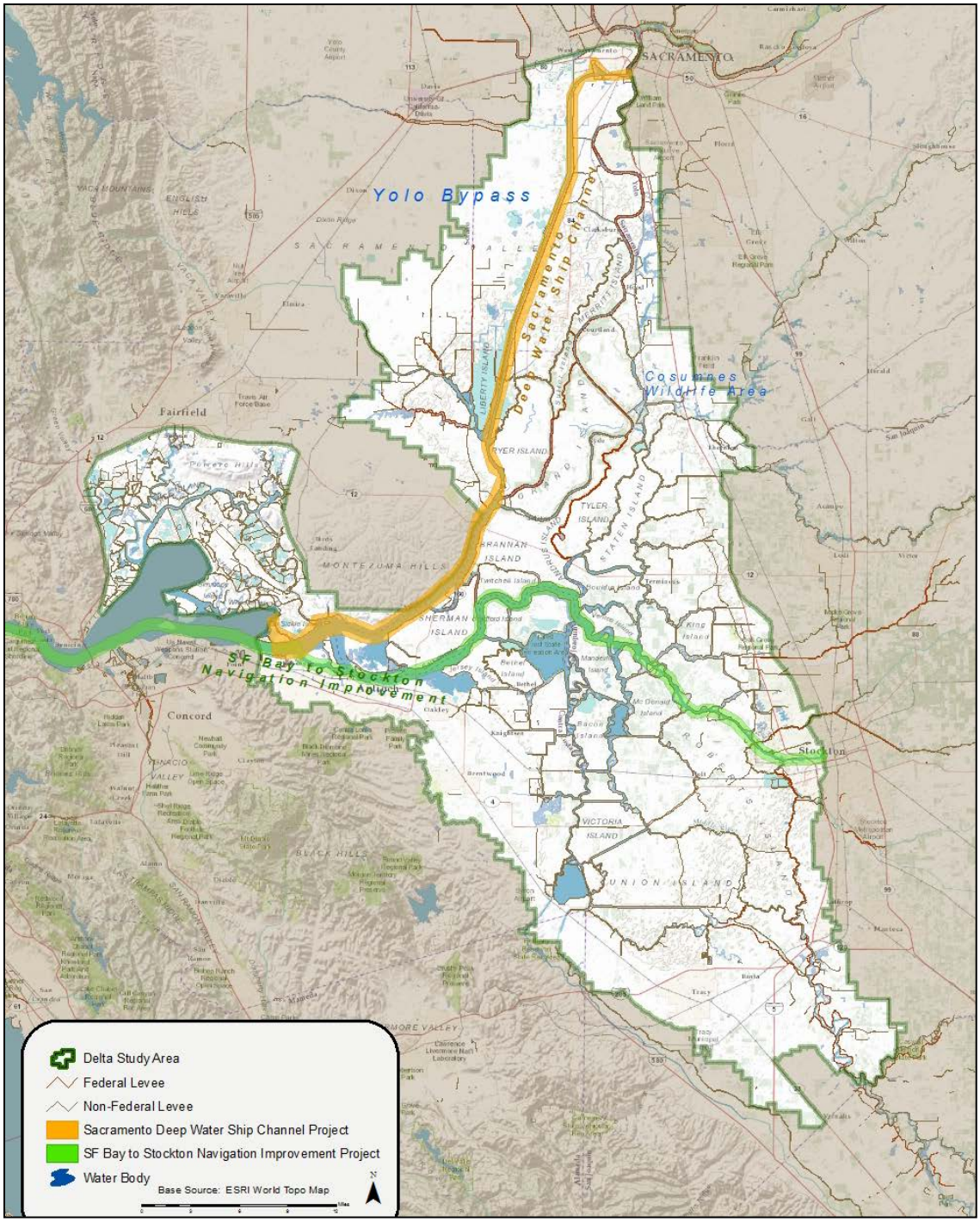

Figure 1-1. Delta Study Area.

1.4 Study Sponsor and Participants

USACE initiated the Delta Islands and Levees Feasibility Study at the request of the California Department of Water Resources (DWR), the non-Federal sponsor for the study. USACE and DWR are the lead agencies in the Feasibility Study and share the cost of the study equally (50% /50%), pursuant to the Feasibility Cost Sharing Agreement (FCSA) executed by the parties on May 25, 2006.

Numerous agencies, organizations, and individuals are participating in the study including the U.S. Bureau of Reclamation (Reclamation), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (USEPA), California Department of Fish and Wildlife (CDFW), Sacramento County, San Joaquin County, Contra Costa County, Yolo County, Alameda County, Solano County, numerous levee maintaining agencies, local landowners and residents.

1.5 Existing Programs, Studies, and Projects

There are many ongoing water resources related programs, studies, and projects that could affect flooding and ecosystem conditions in the study area. Those efforts that pertain directly to this feasibility study are summarized below.

1.5.1 Programs

Bay-Delta Conservation Plan (BDCP)

The BDCP is a part of California's overall water management portfolio. It is being developed as a 50-year habitat conservation plan with the goals of restoring the Sacramento-San Joaquin Delta ecosystem and securing California water supplies. The BDCP would secure California's water supply by building new water delivery infrastructure and operating the system to improve the ecological health of the Delta. The BDCP also would restore or protect approximately 150,000 acres of habitat to address the Delta's environmental challenges. The Draft BDCP and BDCP Draft EIR/EIS are being made available to the public for a 180-day review period (including a 60-day extension). The public review and comment period is effective December 13, 2013 through June 13, 2014.

CALFED Bay-Delta Program (CALFED)

CALFED was established in May 1995 as a cooperative effort among the State and Federal agencies that handle management and regulatory responsibilities in the Sacramento – San Joaquin Delta. CALFED's mission is to develop and implement a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta. In July 2003, the State of California formalized the cooperative effort by creating the CALFED Bay-Delta Authority, a State agency responsible for overseeing implementation of the Bay-Delta Program.

Central Valley Flood Protection Plan (CVFPP)

In 2012, the California Central Valley Flood Protection Board adopted the CVFPP, a comprehensive new framework for system-wide flood management and flood risk reduction in the Sacramento and San Joaquin River Basins.

Central Valley Integrated Flood Management Study (CVIFMS)

USACE, in conjunction with DWR, will jointly develop CVIFMS to define a long-range program for the Sacramento and San Joaquin River Basins and the corresponding level of Federal participation. This program will identify opportunities to reduce flood risk by improving the flood capacity of the system while restoring and protecting floodplain and environmental features including wetlands and other fish and wildlife habitat.

Sacramento River Bank Protection Program

This is a long-term program implemented to maintain the integrity of the Sacramento River Flood Control Project from erosion. It provides protection to existing levee and flood control facilities of the Sacramento River Flood Control Project.

1.5.2 Studies

American River Common Features General Re-evaluation Report

USACE and the Central Valley Flood Protection Board are conducting a comprehensive study to investigate further improvements to the flood risk reduction system throughout the Sacramento region. A draft report with a recommended plan for improvements is scheduled to be released for public comment in 2014.

Delta Long-Term Management Strategy

USACE, DWR, the California Bay-Delta Authority, the Delta Protection Commission, the State Water Resources Control Board (SWRCB), and the Central Valley Regional Water Quality Control Board (Central Valley RWQCB) are developing a long-term management strategy for sediment management in the Delta, including dredging and dredged material placement and reuse.

Dutch Slough Tidal Marsh Restoration Project

The study area, in an area formerly slated for urban development, will soon become 1,178 acres of critically needed habitat for fish and wildlife in the Sacramento-San Joaquin Delta. The project's location in the western Delta offers the opportunity, soil types, and lack of subsidence to create a large area of tidal marsh and complex intertidal channels favored by native Delta species. Shaded channels, native grasslands, and riparian forests will be restored in the

upland portions of the site. The restored habitats are like those that historically dominated the Delta, and their restoration is considered a critical action to increase numbers of native sensitive species and improve general ecological health of the Delta. The public comment period for the Supplemental Environmental Impact Report (EIR) is January 21, 2014 through March 07, 2014.

Lower San Joaquin River Feasibility Study

USACE and the San Joaquin Area Flood Control Agency are conducting a study to determine if there is a Federal interest in providing flood risk management and ecosystem restoration improvements along the Lower San Joaquin River.

Sacramento Deep Water Ship Channel Project

USACE and the Port of West Sacramento are conducting a study to investigate Federal investment in providing for more efficient and safe commodity transport along the existing deep draft navigation route extending from the Port of West Sacramento to New York Slough, thereby affording the Port of West Sacramento access to San Francisco Bay Area harbors and the Pacific Ocean.

San Francisco Bay to Stockton Navigation Improvement Project

USACE, the Port of Stockton, and Contra Costa County Water Agency are conducting a study to evaluate the efficiency of the movement of goods along the existing deep draft navigation route extending from the San Francisco Bay to the Port of Stockton. The project includes the John F. Baldwin and Stockton Ship Channels.

USGS Subsidence Research on Twitchell Island

DWR and the U.S. Geological Survey (USGS) constructed approximately 15 acres of wetlands in 1997 to evaluate land surface elevation changes and carbon accretion due to the accumulation and decay of plant materials. Ongoing research at this facility has shown that land surface elevation increases 1.3 to 2.2 inches per year, while surrounding areas used for agricultural purposes lost elevation due to subsidence. Decaying organic matter can not only eliminate subsidence but also reverse subsidence through utilization of appropriate land management practices. Research is ongoing.

West Sacramento General Re-evaluation Report

USACE and the West Sacramento Area Flood Control Agency (WSAFCA), the non-Federal sponsor, propose to provide flood damage reduction to West Sacramento by repairing the levees that surround the city. The draft EIS/EIR, which describes the environmental resources in the project area; evaluates the direct, indirect, and cumulative environmental effects of the three alternative plans; and recommends avoidance, minimization, and mitigation measures, is scheduled to be available in 2014.

1.5.3 Projects

Antioch Dunes Restoration

Project being implemented by USFWS, CDFW, the Port of Stockton, and USACE to benefit three endangered and endemic species—two plants and one butterfly. Material dredged through annual operations and maintenance dredging is being placed in the project area to restore dune habitat. Construction is underway and will continue for approximately ten years.

California State Water Project (SWP)

The California State Water Project is a water storage and delivery system of reservoirs, aqueducts, power plants and pumping plants. Its main purpose is to store water and distribute it to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. Of the contracted water supply, 70 percent goes to urban users and 30 percent goes to agricultural users. The Project makes deliveries to two-thirds of California's population. It is maintained and operated by the DWR. The Project is also operated to improve water quality in the Delta, control Feather River flood waters, provide recreation, and enhance fish and wildlife.

Central Valley Project (CVP)

The CVP is a Federal water management project in the state of California under the supervision of Reclamation. It was devised in 1933 in order to provide irrigation and municipal water to much of California's Central Valley—by regulating and storing water in reservoirs in the water-rich northern half of the state, and transporting it to the water-poor San Joaquin Valley and its surroundings by means of a series of canals, aqueducts and pump plants, some shared with the California SWP. Many CVP water users are represented by the Central Valley Project Water Association.

Donlon Island and Venice Cut Mitigation for the 1987 Widening and Deepening of the Stockton Deep Water Ship Channel

In 1987, USACE and the Port of Stockton completed widening and deepening the Stockton DWSC. Dredging and other construction techniques resulted in the movement of considerable volumes of dredged materials and some losses of existing marsh and riparian vegetation. The final design of the project included features selected to mitigate for habitat losses caused by the construction activities and to enhance fish and wildlife values beyond those present before modification of the channel. Dredged materials were used to create approximately 81 acres of new shallow water, wetland, and upland habitats within two flooded islands, Donlon Island and Venice Cut Island. The resulting dredged-material islands were the first created in the Delta specifically to benefit fish and wildlife. The newly created islands are used by a wide variety of birds, and the number of species generally increased proportionally with the extent and complexity of the habitats available. These findings have been translated into design guidelines that can be used with increased confidence to design new habitat using dredged material.

Sacramento River Flood Control Project, California

Congress directed the California Debris Commission in 1910 to prepare a flood management plan for the Sacramento River system. The proposal incorporated the leveed bypass concept, which became the basis of the present project. This major project was authorized by the 1917 Flood Control Act and was sponsored by The Reclamation Board. The Sacramento River Flood Control Project consists of a comprehensive system of 1,000 miles of levees, 5 major overflow weirs, 2 sets of outfall gates, 3 major drainage pumping plants, 95 miles of bypass floodways, overbank floodway areas, and channel enlargement in the lower reach of the Sacramento River. The levees constructed during this project are known as "project levees."

Lower San Joaquin River and Tributaries Project, California

The Lower San Joaquin River and Tributaries Project was authorized by the Flood Control Act of 22 December 1944, Public Law 534, 78th Congress, 2nd Session, Section 10. The project includes: (a) Federal levee and channel improvement and bank protection along the Lower San Joaquin River from the mouth of the Merced River to the Delta; (b) the preservation of natural overflow lands upstream of the mouth of the Merced River by the acquisition of flowage easements by the State of California, and/or by the construction of levees at specified locations by responsible local interests at no cost to the Federal Government; (c) Federal flood control storage on the Stanislaus River at the New Melones site; (d) the provision of flood control storage on the Tuolumne River by local interests with payment therefore by the United States; and (e) operation of the existing Federal Friant Reservoir for flood control.

1.6 Public and Agency Scoping

On January 31 2013, USACE published a notice of intent (NOI) in the Federal Register (Vol. 78, No. 921) to prepare an EIS. In February 2013, two scoping meetings were held for the project study. The meetings were held to educate the public about the study efforts and to garner input on the proposed scope, in accordance with NEPA. Refer to Table 1-1 for the USACE planning and NEPA process.

The meetings were open-house style workshops in which attendees could read and view the information about the two projects and interact with project staff, including representatives of USACE and DWR.

The views expressed in the scoping meeting are summarized as follows:

- Clarifications on data and history of the Delta
- Concerns of siltation in Delta channels
- Recommendation for coordination with other agencies and efforts in the Delta

- Recommendation to evaluate environmental effects of alternatives to water supply, water quality, and aquatic and terrestrial biology

For more detail on comments received, information available at the meetings, and a summary of key issues that were raised, see Appendix A which contains a scoping report. A similar open-house format will be used when this draft integrated feasibility report and EIS are made available for public review and comment. USACE will ensure all agencies, organizations, and individuals who provide comments will be provided a copy of the final integrated feasibility report and EIS.

Table 1-1. USACE Planning and NEPA Process

USACE Planning Process	Delta Islands and Levees Feasibility Study	NEPA Process
Step 1. Identify Problems and Opportunities	Scoping Charrette: Federal Interest Decision	Publish Notice of Intent (NOI)/Notice of Preparation (NOP)[a]
Step 2. Inventory and Forecast		Conduct scoping process[b] Prepare Statement of Purpose and Need/Project Objectives Describe existing conditions and affected environment
Step 3. Formulate Alternatives	Milestone 1: Alternatives	Identify reasonable alternatives
Step 4. Evaluate Alternatives		
Step 5. Compare Alternatives		Evaluate impacts and potential mitigation Compare alternatives
Step 6. Select Alternative	Milestone 2: Tentatively Selected Plan	Draft EIS: public notice and 45-day public review
	Milestone 3: Agency Decision	Final EIS: respond to public comments
	Milestone 4: Civil Works Review Board	Final EIS: public notice and 30-day public review
	Milestone 5: USACE Chief's Report ASA(CW) Transmits Chief's Report to OMB ASA(CW) Transmits Chief's Report to Congress Congressional Authorization	Record of Decision (ROD)

Notes:
[a] On January 31, 2013 USACE published a NOI in the *Federal Register* (Vol. 78, No. 21).
[b] Public Scoping Meetings were held by USACE on February 19, 2013 and February 20, 2013.
ASA(CW) = Assistant Secretary of the Army (Civil Works).
OMB = Office of Management and Budget.

1.7 Report Organization

The planning process consists of six major steps: (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.

This report documents the study process. It also serves as the EIS for compliance with NEPA. The chapter headings and analysis presented in this report generally follow the outline of an EIS. The report chapters relate to the six steps of the planning process as follows:

- The second chapter of this report, Need for and Objectives of Action, covers the first step in the planning process (Specification of water and related land resources problems and opportunities).
- The third chapter of this report, Alternative Plans, is the heart of the report and is therefore placed before the more detailed discussions of resources and effects. It covers the third step in the planning process (Formulation of alternative plans), the fifth step in the planning process (Comparison of alternative plans), and the sixth step of the planning process (Selection of the recommended plan based upon the comparison of the alternative plans). In addition, at the end of the chapter, a project description is provided for the purposes of the NEPA analysis.
- The fourth chapter of this report, Affected Environment, covers the second step of the planning process (Inventory, forecast and analysis of water and related land resources in the study area).
- And, the fifth chapter of this report, Environmental Consequences, covers the fourth step of the planning process (Evaluation of the effects of the alternative plans).
- The remaining chapters of the report discuss: compliance with Federal laws and executive orders (Chapter 6); public and agency involvement and review (Chapter 7); the tentatively selected plan (Chapter 8); recommendations (Chapter 9); the list of preparers (Chapter 10); references (Chapter 11); and an index to the report (chapter 12).

CHAPTER 2 – NEED FOR ACTION

2.1 Background

The Sacramento – San Joaquin Delta (Figure 1-1) is part of the largest estuary on the West Coast of the United States; is home to hundreds of species of fish, birds, mammals and reptiles; and is considered an ecosystem of national significance. Agricultural land irrigated by Delta water contributes billions of dollars in production for the Nation. Two deep water ports in the Delta serve as important marine terminals for dry bulk cargo vessels transporting agricultural products through the Delta's deep draft navigation channels to world markets. Delta levees protect thousands of acres of orchards, farms, and vineyards as well as critical infrastructure including state and interstate highways, major rail lines, natural gas fields, gas and fuel pipelines, water conveyance infrastructure, drinking water pipelines, and numerous towns, businesses and homes.

The Delta is a web of channels and reclaimed islands at the confluence of the Sacramento, San Joaquin, Cosumnes, Mokelumne, and Calaveras Rivers. Forty percent of California's land area is contained within the watersheds of these rivers. The Delta covers about 738,000 acres and is interlaced with hundreds of miles of waterways. Much of the land is below sea level and protected by a network of 1,100 miles of levees which have been constructed over the past 150 years to manage the flow of water through the Delta. The land behind the levees is predominantly agricultural (corn, wheat, vineyards, cattle) and waterways provide recreational outlets for nearby urban areas and essential habitat for fish and wildlife, including Federally listed species under the Endangered Species Act. The Delta is also the largest single source of California's water supply, providing 25 million Californians with drinking water and irrigating millions of acres of farmland in the Central Valley. In addition, more than 500,000 people live within the Delta and rely upon it for water, recreation, and livelihood. The majority of that population is in the greater Sacramento and Stockton areas and is the focus of other USACE FRM studies, though there are communities within the Delta. Several Delta towns, known as "legacy communities," are listed in the national registry of historic places.

Historically, the Delta was defined by tidal wetlands, primarily comprised of peat soils. The Swamp and Overflow Land Act of 1850 transferred ownership of all Federally owned swamp and overflow land, including Delta marshes, from the Federal Government to private parties agreeing to drain the land and turn it to productive, presumably agricultural, use. This Act began the reclamation of wetlands in the Delta through the construction of levees and drainage channels, typically by the new land owners. The majority of levees in the Delta are still privately owned and maintained. Nearly three fourths of the Delta is now in agriculture.

2.2 Problems and Opportunities

A problem is an existing undesirable condition to be changed. An opportunity is a chance to create a future condition that is desirable. Within the context of solving the problems, opportunities contribute to the overall beneficial outcome of the project. The difference between problems and opportunities is often indistinct, but in both cases a changed future condition is preferred. The purpose of this feasibility study is to develop an implementable and acceptable plan to change the future condition and address specific water and related land resources problems and opportunities in the Delta and Suisun Marsh.

Problems and opportunities to be addressed were identified in several ways. Based upon a review of plan formulation efforts for the BDCP, the Delta Risk Management Study (DRMS), the Delta Vision (Blue Ribbon Task Force), the CVFPP, USACE Special Study, USACE 180 Day Report to Congress, and other related state planning efforts, the PDT has identified two general types of problems—Flood Risk and Ecological—and identified corresponding opportunities and objectives. In order to understand – and display that understanding of – the integrated nature of water resources in and related to the Delta, problems and opportunities related to conveyance of water supply have been identified and will be qualitatively discussed as they relate to flood risk and ER; however, these elements will not be considered in, nor drive plan formulation for this study. Two Federal Deep Draft Navigation studies are also underway within the study area and will be discussed as they relate to this study. In addition to the review of the aforementioned references, several workshops and brainstorming meetings were held to help define the existing conditions and identify problems and opportunities. Participants in these meetings included:

- U.S. Army Corps of Engineers
- California Department of Water Resources
- Delta Stewardship Council
- Delta Conservancy
- U.S. Fish and Wildlife Service
- National Oceanic and Atmospheric Administration (NOAA) Fisheries
- California Department of Fish and Wildlife
- U.S. Bureau of Reclamation
- Sacramento County
- San Joaquin County
- Contra Costa County
- Yolo County
- Alameda County
- Solano County

- Yolo Basin Foundation
- City of Stockton
- Various Reclamation District Engineers

The problems and opportunities addressed in the feasibility study are defined in the following sections.

2.2.1 Flooding Problems

Delta levees protect such critical infrastructure as state highways, rail lines, natural gas fields, gas and fuel pipelines, drinking water pipelines, and numerous businesses and towns. Delta inhabitants are primarily located on six islands, although portions of Sacramento and Stockton are located in the Delta. Flood risk reduction for Sacramento and Stockton is the focus of other USACE studies. These studies are being closely coordinated to ensure assumptions, scopes, and alternative plans are compatible.

Problems associated with in-Delta flood risk are largely due to the potential for levee failure and overtopping. These risks are increased as a result of climate change, sea level change, subsidence (as much as 25 feet below sea level), and seismic risk. In particular:

- Population centers [such as those at Walnut Grove (1,542), Isleton (804), Locke (600), Courtland (355), Bethel Island (2,137), Hood (271), and Ryde (142)] and surrounding agricultural lands are located in deep floodplain areas, the flooding of which could result in loss of life and flood damages;
- Highways 4, 12, 5, and 160, as well as major railroads, are located in deep floodplain areas, the flooding of which could disrupt critical transportation routes for people and goods, as well as emergency evacuation and response;
- Critical infrastructure including aqueducts, natural gas transmissions, oil and gas wells, and high power transmission lines are located in deep floodplain areas, the flooding of which could cause damages and service disruptions.

About two thirds of the Delta levees were constructed without engineering specifications and are non-Project levees, while only 385 miles of levees are part of the Sacramento River Flood Control Project or the Lower San Joaquin River and Tributaries Project. Inherent weaknesses in Delta levees and foundations, due to construction practices, encroachments, abandoned pipes, and burrowing by various mammals, commonly result in seepage distress, internal erosion, and occasional levee failure and island inundation. Many of the reclaimed islands have subsided due to the oxidation and loss of peat soils and are now well below sea level. Agricultural use in the Delta has contributed to soil erosion and oxidation of peat soils. Oxidation of peat soils on a majority of Delta islands is causing levee foundations and the levees to consolidate. This consolidation, along with interior island subsidence causes uneven settling

and further weakening of the levees. It is apparent by the frequency of historical flood events (over 168 instances in the past 100 years) that the current levee system does not provide adequate flood protection for the 500,000 people living behind Delta levees. A single island failure can result in the "domino effect" of multi-island failures due to the extensive network of unstable levees.

Focus of BDCP/Delta Plan

Additionally, flood risk problems currently exist that will be resolved through the implementation of the BDCP/Delta Plan. These problems are described below to provide a general understanding of the study area; however, this report will only qualitatively discuss these problems and the likely solutions under consideration by others.

The impacts associated with failure of fragile Delta levees can reach beyond the geographic extent of the Delta and disrupt the water supply for 25 million Californians reliant on drinking water that passes through the Delta and billions of dollars of agricultural production that is reliant on Delta waters. For example, a levee failure on one island can have a domino effect, leading to the failure of levees on adjacent islands as the now subsided islands fill with water and experience water loading on interior levee walls. Reclaimed islands and land tracts act as a barrier between fresh and salt water, preventing sea waters from the San Francisco Bay and Pacific Ocean from entering into the State and Federal Water Project intake structures. A multi-island failure could result in the saltwater contamination of water supplies and could take a year to rectify. In particular:

- Levee failure(s) in the Delta could compromise the quantity and quality of water supplies for 25 million Californians as a result of the encroachment of saline waters into the Southern Delta; and
- Insufficient emergency response plans and resources for some areas in the Delta could increase the duration of loss of water supplies for San Joaquin Valley and Southern California in the event of multiple levee failures.

2.2.2 Ecosystem Problems

The Delta, an ecosystem of national significance, is a critical link in the Pacific Flyway, a major north-south route of travel for migratory birds in America, and is protected through the Migratory Bird Treaty Act of 1918. Natural resource specialists agree that the remaining ecosystems in the Delta no longer maintain the functions and richness that defined the pre-channelized system, and that the measures of ecological health will continue to decline without preventive action. Not only is it certain that these natural systems will not recover their defining attributes under current conditions, it is unlikely that even the current, degraded ecological conditions can be sustained into the future. For example, Delta smelt, key indicators of ecosystem health continue to decline in number throughout the watershed. Another example is the decline in populations of salmonids; commercially, recreationally, and culturally important fish species in the Delta.

There are numerous contributors to the ecological decline of Delta species and habitats, each of which has the capability to produce adverse impacts independently and/or in combination with other stressors. For example, pesticides, channelization, exotic and non-native invasive species, water supply diversions, agricultural and urban runoff, and wastewater discharges have all been identified as contributors of adverse impacts to the ecological health of the Delta ecosystem. Specifically, channelization of rivers and streams through the construction of levees has resulted in the widespread loss of tidal marsh, shaded riverine aquatic habitat, open water habitat, and the disconnection of floodplains from waterways, which has greatly reduced the amount of shallow, gently sloping near shore areas. If this loss of Delta habitats and disconnection from floodplains continues, the current substantial declines in the Delta's fisheries could result in the extinction of culturally and economically critical species. Many of the defining characteristics of the pre-channelized ecosystem (spatial extent, habitat heterogeneity, and dynamic storage) have either been lost or substantially altered as a result of land use and water management practices during the past 100 years in California. Nearly 95 percent of the historic wetland habitat in the Delta has been converted to agricultural and urban uses.

The conversion of the Delta for urban and agricultural uses, including levee construction, has resulted in:

- Substantial loss (95%) and fragmentation of historic intertidal and tidal habitat areas and linkages for native plants and wildlife, including over 35 Federal and State listed Threatened and Endangered species;
    - Subsidence in the Delta and Suisun Marsh which can cause significant adverse ecological impacts due to deeper flooding;
- Introduction and propagation of non-native invasive species;
- Separation of historic floodplains from natural hydrologic flooding events through channels within the Delta; and
- Degraded water quality conditions from various stressors.

Focus of BDCP/Delta Plan

Additionally, ecological problems exist that will be resolved through the implementation of the BDCP/Delta Plan. These problems are described below to provide a general understanding of the study area; however, this report will only qualitatively discuss these problems and the likely solutions under consideration by others. Solutions under consideration by the BDCP/Delta Plan include a dual water conveyance system, which would create options that would move water through the Delta's interior or around the Delta through an isolated conveyance facility (tunnel).

Current operation of the CVP and California SWP, as well as other export operations and diversions that result in consumptive losses, supply water to 25 million Californians and 4.5 million acres of irrigated land. At the same time, these water resource operations can have a damaging effect on the plants and animals inhabiting the Delta. For example, the operation of pumping facilities is known to alter the flow patterns, affecting the migration of salmonids passing through the river system. Delta smelt are drawn into the flow of water to the pumping facilities and can be entrained, resulting in the mortality of this Federally-listed species. The altered hydrology and operation of the State, Federal, and local water projects has resulted in:

- Altered natural water flows through the Delta and to Suisun Marsh and San Francisco Bay;
- Mortality of native species in/adjacent to water control structures (primarily delta smelt and salmonids);
- Changes to timing, volume and/or distribution of water throughout the Delta which has adversely affected the ecosystem and the habitat requirements of many native species; and
- Reduction in seasonal variability in the migration and concentrations of saline water.

2.2.3 Opportunities

The Delta Islands and Levees Feasibility Study provides an opportunity to:

- Restore, enhance, preserve, create, and maintain aquatic, riparian, and adjacent terrestrial habitats in the Delta for native plants and wildlife, including Federal and State threatened, endangered, and special-status species, with the potential secondary benefit to recreation
- Manage invasive and non-native species for the benefit of native plant and wildlife species, with the potential secondary benefit to recreation
- Restore floodplain functions and contiguous habitat in the Delta
- Reduce flood risk in the Delta to protect people, property, agriculture, habitat, and infrastructure, with the potential secondary benefit to recreation and navigation
- Address seismic and sea-level change risks to levees in the Delta that protect population centers, highways, railroads, and critical infrastructure
- Improve emergency management and response throughout the Delta
- Incidentally, improve water quality in the Delta
- Beneficially reuse available dredged materials

2.3 Federal and Sponsor Objectives

The Federal (USACE) and non-Federal sponsor (DWR) objectives for water resources implementation studies establish the overall goals for the feasibility study. The specific objectives for this feasibility study were derived from the identification of the study problems and opportunities and are discussed in Section 2.4.

The Federal objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net economic benefits that accrue in the planning area and the rest of the nation.

The USACE has added a second national objective for Ecosystem Restoration (ER) to contribute to the Nation's ecosystems (or National Ecosystem Restoration – NER) by restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Contributions to NER are increases in ecosystem value and productivity and are measured in non-monetary units such as acres or linear feet of habitat, average annual habitat units, or increased species number or diversity.

The DWR, as the non-Federal sponsor, has flood risk and ER objectives similar to the national NED and NER objectives. Additionally, DWR has water supply objectives being carried out by other related initiatives.

2.4 Planning Goals and Objectives

The planning objectives, which are developed specifically for this study, are statements of the study purpose. Planning objectives are more specific than the Federal and non-Federal objectives and reflect the problems and opportunities in the Delta Study area; an objective is developed to address each of the identified problems and opportunities. Planning objectives represent desired positive changes in the future without-project conditions. The planning objectives for the Delta Study would be attained within the period of analysis for the study, a 50-year timeframe beginning in 2018, pending identification of Federal interest and inclusion in a selected plan. All of the objectives focus on activity within the study area.

Goal 1 - Restore sustainable ecosystem functions in the Delta.

- **Ecosystem Restoration Objective 1**—Increase area, connectivity, and diversity of native tidal and non-tidal aquatic, riparian, and related habitats within the study area during the period of analysis.

Goal 2 - Improve flood risk management in the Delta.

- **Flood Risk Management Objective 1a –** Reduce the consequences and annual damages associated with flood risk in the study area during the period of analysis**.**
- **Flood Risk Management Objective 1b –** Improve resiliency and reduce the chance of loss of life and key infrastructure (transportation corridors, aqueducts, pipelines/wells, etc.)**.**
- **Flood Risk Management Objective 2** – Reduce risks to life loss within the study area during the period of analysis, focusing on areas with the greatest potential life loss impacts (such as areas with the greatest inundation).

The goal of the feasibility study is to develop a range of alternative plans that balance the objectives and avoid conflicts or, where necessary, demonstrate the tradeoffs between conflicting objectives, enabling decisions to be made. The Federal objective is to maximize net benefits. Because of this, it is not appropriate to identify targets within objectives. For example, no target level of flood risk, minimum acreage of habitat, or minimum habitat value was identified for the project. Rather, the planning process includes formulation of alternative plans to maximize NED and NER benefits relative to costs.

2.5 Planning Constraints

A constraint is a restriction that limits the extent of the planning process. It is a statement of things the alternative plans should avoid. Constraints are designed to avoid undesirable changes between without and with-project future conditions.

In the development of the alternatives, the following constraints were identified to direct plan formulation efforts so that beneficial effects would be maximized and adverse effects would be minimized:

- Formulated alternatives and the recommended plan must not impede the BDCP/Delta Plan; and
- Formulated alternatives and the recommended plan must not be dependent upon the BDCP/Delta Plan.

CHAPTER 3 – ALTERNATIVE PLANS

3.1 Plan Formulation Process

The formulation, evaluation, and comparison of alternative plans comprise the third, fourth, and fifth steps of the USACE planning process. These steps are often referred to collectively as plan formulation. Plan formulation is an iterative process that involves cycling through the formulation, evaluation, and comparison steps several times to develop a reasonable range of alternative plans and then narrow those plans down to a final array of feasible plans from which a single plan can be identified for implementation.

Plan formulation for FRM and ER presents a challenge because alternative plans produce both monetary and non-monetary benefits. Comparison of the trade-offs among alternative plans is difficult because monetary and non-monetary benefits cannot be directly compared. To facilitate the plan formulation process, the methodology outlined in the USACE Engineer Circular 1105-2-404, "Planning Civil Work Projects Under the Environmental Operating Principles," 1 May 2003, was used. The steps in the methodology are summarized below:

- Formulate and screen management measures (referred to hereafter simply as measures) to achieve planning objectives and avoid planning constraints. Measures are the building blocks of alternative plans.
- Identify a primary project purpose. For this study, it is anticipated that ER will be identified as the primary purpose. This is because there is strong interest by the Federal and State governments in restoring this area, indicating that there is high restoration potential. Also, based on previous studies, it is unlikely a feasible plan can be developed for FRM only.
- Formulate, evaluate, and compare an array of alternative plans to achieve the primary purpose (ER) and identify a feasible plan that reasonably maximizes NER outputs relative to costs. This plan is called the National Ecosystem Restoration plan.
- Formulate and screen plans that achieve both ER and FRM (combined plans).
- Evaluate and compare trade-offs among the combined plans and rank them. The highest ranked combined plan is the plan that reasonably maximizes total net NER and NED outputs.
- Determine whether the highest ranked combined plan is justified; that is, whether the benefits of the plan exceed the costs. If the highest ranked plan is not justified, move to the next ranked plan. Continue to move down through the ranked plans until a justified plan is identified. The highest ranked, justified, combined plan is the NED/NER plan or the Combined Plan. If no combined plan is justified, the NER plan shall be recommended for implementation, pending public review and comments.

3.2 Planning Criteria

Planning criteria are used to formulate, screen, evaluate, and compare measures and alternative plans. Four specific formulation criteria are required in USACE water resource studies, as described in Planning Manual (Institute for Water Resources Report 96-R-21, November 1996): completeness, effectiveness, efficiency, and acceptability. These criteria are generally subjective and are useful in narrowing down the array of possible alternative plans. With the exception of completeness, these criteria are also useful in screening potential measures.

- **Completeness.** Completeness is a determination of whether or not the plan includes all elements necessary to achieve the objectives of the plan. It is an indication of the degree that the outputs of the plan are dependent upon the actions of others. Plans that depend upon the actions of others to achieve the desired output were dropped from consideration.
- **Effectiveness.** Effectiveness is the extent to which a measure or alternative plan achieves the planning objectives. Measures or alternative plans that clearly make little or no contribution to the planning objectives were dropped from consideration.
- **Efficiency.** Efficiency is a measure of the cost effectiveness of the plan expressed in net benefits. Benefits can be both monetary and non-monetary. Measures or alternative plans that provided little benefit relative to cost were dropped from consideration.
- **Acceptability.** Acceptability is a measure of the ability to implement a measure or alternative plan. In other words, acceptability means a measure or plan is technically, environmentally, economically, and socially feasible. Unpopular plans are not necessarily infeasible, just unpopular. Measures or plans that were clearly not feasible were dropped from consideration.

Measures and plans that pass the screening criteria are evaluated and compared against more specific evaluation criteria. Evaluation criteria are described later in this chapter. Evaluation criteria can include costs, outputs, or effects and reflect the planning objectives or constraints. Some or all of the evaluation criteria may be used at various stages in the plan formulation process to compare alternative plans. Effective evaluation criteria must be measurable and reveal differences or trade-offs between alternative plans.

3.3 Without-Project Future Conditions

Through the November 2009 Delta Reform Act, the State of California has established "two coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem." The Act also established the Delta Stewardship Council as a new, independent state agency tasked with delineating how to meet these goals through the development and implementation of the Delta Plan. The details of this plan are being developed in a public process and will incorporate the BDCP process. Although still under

development, these large-scale plans will result in a vastly changed Delta system upon implementation, posing a significant risk to this study regarding the uncertainty of future Delta conditions. In order to reduce this risk, this study will include the BDCP/Delta Plan in the future without project conditions to ensure that a recommended plan is successful if and when the BDCP/Delta Plan is implemented.

The future without project condition will include all authorized and funded projects, as well as the recommended plan from the BDCP/Delta Plan, as shown in Figure 3-1. For the purposes of this study, it is assumed that the final BDCP/Delta Plan will be completed in 2014, with implementation occurring 10 to 15 years after the final report. The assumptions regarding this future scenario are:

- 50-year planning horizon for future conditions.
- Include the large-scale BDCP/Delta Plan (preliminary draft released March 2013) which would drastically alter the study area upon implementation.
    - Dual conveyance system in place to convey water from the Sacramento River to Clifton Court Forebay in the south Delta for transfer to the Central Valley Project (Federal water management project) and the California State Water Project. The proposed dual conveyance system includes the existing operational through Delta pathway and a new alternative conveyance system with three 3,000 cfs pumping stations. Existing through Delta pathway (shown as the Armored Pathway in Figure 3-1) for water conveyance will continue to be armored/improved through levee improvements funded through DWR's Delta Levees Maintenance Subventions Program and Delta Levees Special Flood Control Projects.
    - Mitigation, habitat conservation, and ecosystem restoration features are implemented (145,000 acres to be implemented over 50 years) in the proposed "restoration opportunity areas" shown in Figure 3-1.
    - BDCP is being developed in compliance with the existing laws, biological opinions, and regulations governing the management of salinity that balance the sometimes conflicting salinity levels for the environment (with sometimes conflicting needs of between endangered species such as Delta smelt and salmonids), Delta water exports, and in-Delta water use/rights. Salinity management will continue based on these existing laws, biological opinions, and regulations.
- Ecosystem functions will be improved by restoration and conservation efforts focused along the perimeter of the Delta (BDCP/Delta Plan); however, system-wide ecosystem dynamics will continue to be impaired, affecting:
    - 47 special status species;
    - Multiple essential fish habitat areas;
    - Multiple critical habitat areas (Delta smelt, Winter and Spring run salmon, Central Valley Steelhead, and Green Sturgeon);

    - Migratory birds;
    - Tidal, inter-tidal, and riparian wetlands; and
    - Water quality.
- Population centers within the Delta will remain at risk of flooding.
- State and regional population growth will increase demands on Delta infrastructure (i.e. transportation, power transmission, water conveyance); however, water conveyance infrastructure will be improved through the implementation of the BDCP/Delta Plan.
- Development will continue to be limited by the Delta Protection Act.
- Agricultural practices will continue.
- Recovery from catastrophic failure of Delta levees will be undertaken by the State of California, if necessary, to manage salinity for the environment and human use, which will also protect the brackish Suisun Marsh. As described in DWR's Delta Flood Emergency Facilities Improvement Project, the State is working to ensure that it has the appropriate infrastructure and supplies in the Delta to respond to and recover quickly and effectively from major flood or earthquake disasters in the Delta. Locations of storage and transfer sites for stockpiled flood fight materials are shown in Figure 3-1 and include the follow features and actions:
    - Establish two new material storage and transfer facility sites:
        - Stockton West Weber Avenue; and
        - Brannan Island State Park.
    - Modify an existing material storage facility at Rio Vista.
    - Establish new flood fight supply facilities at all three locations.
    - Make site preparations to support Incident Command Posts at Stockton West Weber Avenue and Brannan Island State Recreation Area.
    - In addition to the 223,000 tons of quarry rock stockpiled by DWR at Rio Vista and within the Port of Stockton, DWR would also stockpile up to 40,000 tons of quarry rock material of variable gradations less than 24-inch-minus at Stockton West Weber Avenue and Brannan Island, and 20,000 tons of sand in Rio Vista for a total additional increment of 100,000 tons.

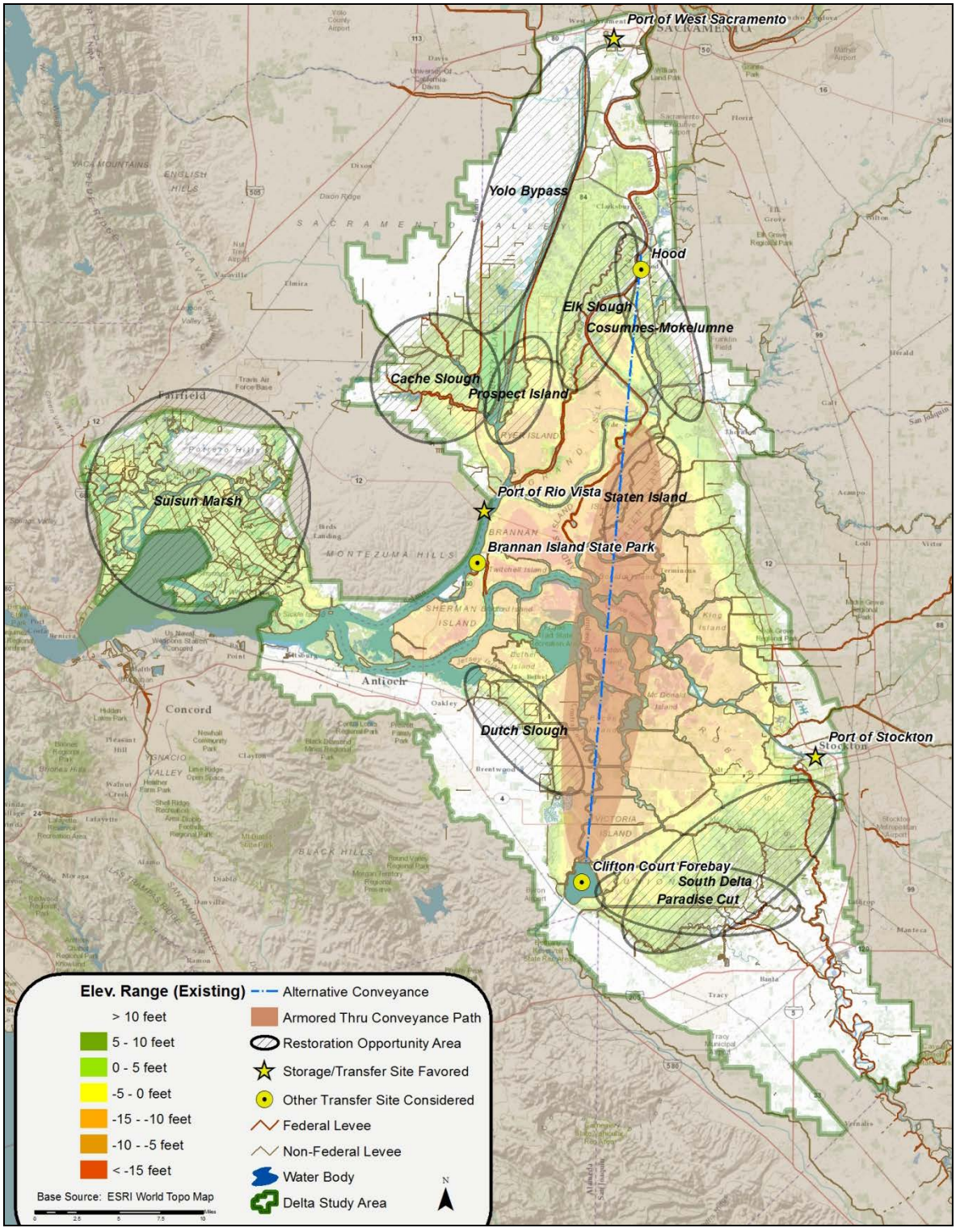

Figure 3-1. Future Without-Project Condition.

- Flood risk in the Delta will persist, if not increase, notwithstanding ongoing operations and maintenance activities and scattered flood risk management projects, namely DWR's Delta Levees Maintenance Subventions Program and Delta Levees Special Flood Control Projects
    - Probability for multiple levee failures from a seismic event will increase
    - Subsidence of reclaimed lands will continue to separate water and land elevations, further increasing the hydraulic load on Delta levees within dry, leveed islands and tracts
    - Seepage issues will continue
    - Climate change will put additional stress on Delta levees[3]
        - Mean water levels in the Delta will increase as sea level rises
        - Peak river inputs to the Delta will likely increase due to stronger winter river flows, as well as possible increases in mean precipitation rates and single-day precipitation amounts
        - In-Delta wind speeds may also increase, due to predicted increases in the large-scale temperature and pressure gradients that drive these flows
- Subsidence will not occur on submerged lands, consistent with current conditions
- Nonstructural flood risk management will continue through efforts of the Delta Protection Commission, to include:
    - Emergency preparedness and response planning
    - Land use management to manage growth in Delta floodplains

3.4 Identification and Screening of Measures

A measure is a feature or an activity that can be implemented at a specific geographic site to address one or more planning objectives. Table 3-1 lists the various general measures identified for this study and identifies the individual objectives to which they contribute.[4] Measures are the building blocks that are grouped together to form alternative plans. The wide variety of measures listed below was screened to determine whether each measure should be retained for use in the formulation of alternative plans. Descriptions of the measures and the decision to retain or drop each measure from further consideration are presented next.

[3] Source: Delta Risk Management Strategy Climate Change Technical Memorandum, 2008

[4] The U. S. House Report 108-357 (Conference Report accompanying the Energy and Water Development Appropriations Act, 2004, P.L. 108-137) urged the Secretary of the Army to incorporate locally preferred options that provide protection to agricultural lands and residential properties. Measures considered include such options.

These general measures were screened, as shown below, based on:

- Opportunity for implementation under future without-project conditions;
- Effectiveness at achieving an objective;
- General efficiency; and
- General acceptability.

3.4.1 Flood Risk Management

FRM measures primarily achieve FRM objectives in the study area, but may also contribute to the ER objectives. FRM measures can be nonstructural or structural. Nonstructural measures reduce flood damages without significantly altering the nature or extent of flooding. Damage reduction from nonstructural measures is accomplished by changing the use made of the floodplains, or by accommodating existing uses to the flood hazard. In contrast, structural measures alter the nature or extent of flooding. Structural measures accomplish FRM by modifying the magnitude, duration, extent, or timing of flooding. The general FRM measures considered in this study are:

- *Protect Utility/Highway Corridor(s).* Identify and reduce risk to a specific area/corridor that contains the largest portion of utilities and highways in the study area. This concept will be applied to other FRM measures through the evaluation process. This measure will be further developed through economic analysis of levee improvements. It is a reasonable measure for consideration to achieve FRM objectives, and will be carried forward.
- *Levee Improvements.* Reduce risk to life and assets through improvements to existing levees. This is a reasonable measure for consideration and will be carried forward.
- *Ring Levees.* Reduce risk to life and assets through construction of ring levees. This is a reasonable measure for consideration and will be carried forward.
- *Emergency Response Planning and Coordination.* Reduce risk to life loss through emergency response planning and coordination. This is a reasonable measure for consideration and will be carried forward.
- *Raise/Floodproof Communities.* There is no opportunity for this measure as a method of reducing flood damages due to the deep floodplains of the Delta. This measure will be dropped from further consideration.

Table 3-1. Screening of Measures.

Category	General Measures	Opportunity *	Effectiveness: Ecosystem Restoration Objective: Increase Habitat Area**	Effectiveness: Ecosystem Restoration Objective: Increase Habitat Connectivity	Effectiveness: Ecosystem Restoration Objective: Increase Habitat Diversity	Effectiveness: Flood Risk Management Objective: Reduce Consequences and Annual Damages	Effectiveness: Flood Risk Management Objective: Reduce Risk to Life	Efficiency	Acceptability	Retained (R) or Dropped (D)
ER	Restore Native Riparian Habitat	H	X	X	X			X	X	R
	Creation of New Channels to Connect Habitats	H	X	X				X	X	R
	Invasive Species Management	M			X			X	X	R
	Restore In-Channel Islands and Floodplains	M	X	X				X	X	R
	Restore Historic Marshes	M	X	X	X			X	X	R
	Salinity Management***	L			X					D
Multi	Construct Habitat Friendly Levees	H	X	X		X	X	X	X	R
	Setback Levees (Tidal/Riparian)	H	X	X	X	X	X	X	X	R
	Controlled Flooding of Appropriate Subsided Areas	M	X			X	X	X	X	R
	Create Bypasses	M	X	X	X	X	X	X	X	R
NONSTRUCTURAL FRM	Protect Utility/Highway Corridor(s)	H				X		X	X	R
	Levee Improvements	H				X	X	X	X	R
	Ring Levees	H				X	X	X	X	R
	Emergency Response Planning and Coordination	H					X	X	X	R
	Relocate Community****	L				X	X	X		D
	Relocate Individual Structures****	L				X	X	X		D
	Enhance Flood Risk Communication	H					X	X	X	R
	Raise/Floodproof Community*****	L				X	X			D
	Raise/Floodproof Individual Structures	M				X	X			R
	Reoperation and Transbasin Diversion******	L							X	D

* H indicates a high likelihood of potential opportunity; M indicates a medium likelihood of potential opportunity; L indicates a low likelihood of potential opportunity. This qualitative assessment was based on a professional judgment.
**X indicates the measure contributes to that objective, is efficient, or is acceptable.
*** "Salinity Management" was screened out due to conflict with the BDCP, future without-project condition, and planning constraint.
***** "Relocate Communities" and "Relocate Individual Structures" were screened out as this would be unacceptable because communities and structures would have to be relocated outside the Delta, severely impacting Delta culture and historic value.
***** "Raise/Floodproof Communities" and "Raise/Floodproof Individual Structures" were screened out as there is no opportunity for these measures as a method of reducing flood damages due to the deep floodplains of the Delta.
****** "Reoperation and transbasin diversion" was screened out because it does not contribute to an objective.

- *Raise/Floodproof Individual Structures.* There is no opportunity for this measure as a method of reducing flood damages due to the deep floodplains of the Delta. This measure will be dropped from further consideration.
- *Relocate Community.* This measure is considered unacceptable because communities would have to be relocated outside the Delta, as there are no flood-free areas within the Delta. Additionally, it would not be possible to truly relocate entire communities, but rather purchase estates and allow individual entities within the communities to relocate to a location of their choosing. Delta communities would be disbanded and scattered to various locations outside of the Delta. Implementation of this measure would impact the preservation of Delta history and eliminate the culture of the Delta, which has been proposed as a National Heritage Area. For these reasons, this measure will be dropped from further consideration.
- *Relocate Individual Structures.* This measure is considered unacceptable because structures would have to be relocated outside the Delta, as there are no flood-free areas within the Delta. Delta communities would be severely impacted and would likely be disbanded and scattered to various locations outside of the Delta. Implementation of this measure would impact the preservation of Delta history and the culture of the Delta, which has been proposed as a National Heritage Area. For these reasons, this measure will be dropped from further consideration.
- *Enhance Flood Risk Communication.* Retained for further consideration. Due to the large six county area, many agencies would be involved in a large scale response effort. Opportunity may exist to improve the flood risk communication.
- *Reoperation and Transbasin Diversion.* Reoperation of upstream reservoirs and transbasin diversions in order to reduce flood risk. Although this measure would likely reduce risk to the areas upstream of the tidal influence of the Delta, it would not contribute to reducing flood risk to the largely tidal Delta. This measure does not contribute to an objective and is therefore not effective. This measure will be dropped from further consideration.

Criteria were established to further screen the specific measures based on reduced risk to life loss, reduced annual damages, reduced infrastructure at risk, and if a measure was included in BDCP/FWOP. Measures were qualitatively assessed and rankings of "High-Medium-Low" were assigned based on professional judgment. These specific measures and criteria are shown below in Table 3-2. An overall ranking of "High-Medium-Low" is indicated by the "Green-Amber-Red" color scheme, respectively. "High" ranking measures ranked "high" for at least two criteria. "Medium" ranking measures ranked "medium" or "high" for at least one criterion. No measures ranked as "Low" overall; therefore all measures were retained through this screening process. Quantitative assessments will be refined as the study progresses.

Table 3-2. Screening of Flood Risk Management Measures.

Measure	Reduce Risk to Life Loss	Reduces Annual Damages	Reduce Infrastructure at Risk	Included in BDCP/FWOP?
Levee improvements	H	H	H	N
Ring levees	H	H	M	N
Protect utility/highway corridor(s)	L	L	H	N
Emergency Response Planning and coordination	M	L	L	N*
Enhance Flood Risk Communication	M	L	L	N*

*measure included in future without-project condition, but opportunity remains

Structural Flood Risk Management

Once general measures were screened for effectiveness, efficiency, and acceptability, the remaining general measures were refined to a greater level of detail. Locations were identified for consideration of application of measures based on the following.

Ratio of Total Inundation Repair Costs to Upgraded Levee Costs

To calculate the ratio of total inundation repair costs to upgraded levee costs, information was taken from both phases of DWR's Delta Risk Management Strategy (DRMS). The total inundation repair costs values are from the DRMS Phase I Impact to Infrastructure Technical Memorandum (IITM); these costs represent the repair cost for each asset on a particular Delta island, based on inundation depths, the percent damage incurred, and the original value of the asset. The assets considered in the IITM include: a) points assets: structures and buildings (and their contents), bridges, marinas, natural gas fields/storage areas, natural gas wells, commercial and industrial buildings, residences, and pump stations and b) linear assets: railroads, highways, shipping channels, transmission lines, aqueducts, and gas and petroleum pipelines. Since inundation repair costs are similar to the USACE concept of damages it was determined to be an appropriate numerator value for a screening criterion ratio. The upgraded levee costs were taken from DRMS Phase II report Upgraded Delta Levees (Section 4); these costs consist of upgrading non-project Delta Levees to PL 84-99 or Urban Project Levee (UPL) standards. In DRMS, levees protecting urban centers were selected for UPL upgrades and PL 84-99 upgrades were assumed for all other areas. The higher the relative ratio of total inundation repair costs to upgraded levee costs for a particular Delta island the higher the rating for this criterion.

Life Loss Risk

Life loss risk is based entirely on Delta island population data obtained from the DRMS Economic Consequences Technical Memorandum (ECTM). Delta islands that have higher populations were considered to have a greater potential for life safely issues and thus a higher rating for this criterion.

Significance of Statewide Importance

A measure's significance of statewide importance was determined qualitatively by using the findings contained in contained in the ECTM. If a Delta island contained an asset that would impact the region or state during and after a flood event, then that island was rated with a "Yes", otherwise the island was rated with a "NO." The categories of statewide significance include: deepwater ship channels, electric transmission lines, highways, natural gas transmission, Mokelumne Aqueduct, oil and gas wells, railroads, wastewater facilities, eight western islands, and legacy communities.

For criteria 1 and 2, each Delta island was assigned a rating of high, medium, or low. For criterion 3, each island was given a rating of Yes or No. The location measures that were assigned a "high" rating are generally populated areas with relatively higher economic values and therefore are likely to be included in the final array of measures as a more comprehensive, whole island levee improvement. The measures that were assigned a "medium" rating are generally somewhat populated with more limited economic values and therefore are likely to be included in the final array of measures as a more limited structural or non-structural solution. The measures that were assigned a "low" rating are sparsely populated areas with limited to no infrastructure/economic value and were therefore dropped from further considerations.

This qualitative assessment was based on existing data from the DRMS and is summarized below in Table 3-3 and Figure 3-2. Developed by DWR and completed in two phases, the overall purpose of the DRMS was to assess the performance of Delta and Suisun Marsh levees and evaluate the economic, environmental, and public health and life loss consequences of levee failures to California as a whole (Phase I); and to develop and evaluate risk reduction strategies (Phase II). The DRMS was chosen because it is the only recent comprehensive analysis on the local and statewide consequences of Delta levee failures.

Table 3-3. Location Screening of Flood Risk Management Measures.

Island Name	Total Asset Repair Costs/Construction Costs[5]	Life Loss Risk	Assets of Statewide Importance
Sacramento Urban Area*	High	High	Yes
West Sacramento*	High	High	Yes
Elk Grove*	High	High	Yes
Shima Tract*	High	Medium	Yes
Boggs Tract*	High	Medium	Yes
Pescadero*	High	Medium	Yes
Pico Naglee Tract*	High	Medium	Yes
Sargent Barnhart Tract*	High	Medium	Yes
Lincoln Village*	High	Medium	Yes
Paradise Junction*	High	Medium	Yes
Bethel Island*	High	Medium	Yes
Walnut Grove	High	Medium	Yes
Smith Tract*	High	Medium	Yes
Hotchkiss Tract	High	Medium	Yes
RD 17 (Mossdale)	High	Medium	Yes
Terminous Tract	High	Medium	Yes
Pierson District (aka Pearson)	High	Medium	Yes
New Hope Tract	High	Medium	Yes
Brannan-Andrus Island	High	Medium	Yes
Union Island	High	Medium	Yes
Bishop Tract	High	Medium	Yes
Tyler Island	High	Medium	No
King Island	High	Low	Yes
Walthall Tract	High	Low	Yes
Veale Tract	High	Low	Yes
Jones Tract	High	Low	Yes
Fabian Tract	High	Low	Yes
Canal Ranch	High	Low	No
Coney Island	High	Low	Yes
Rough and Ready Island*	High	Low	Yes
Little Egbert Tract	High	Low	Yes
Victoria Island	High	Low	Yes
Roberts Islands	Medium	Medium	Yes
Netherlands	Low	Medium	Yes
Discovery Bay	Low	Medium	Yes
Libby McNeil Tract	Low	Medium	Yes
Twitchell Island	Medium	Low	Yes
Sherman Island	Medium	Low	Yes
Bacon Island	Medium	Low	No
Rindge Tract	Medium	Low	Yes
Woodward Island	Medium	Low	Yes
Glanville Tract	Medium	Low	Yes

[5] Total Asset Repair Costs (Damages) in the event of a flood and the estimated Construction Costs to improve the existing levees are based on estimates from the Delta Risk Management Strategy Phase 1 Report. These two items were used as a proxy to rank islands in terms of potential benefit-to-cost ratio (BCR).

Island Name	Total Asset Repair Costs/Construction Costs[5]	Life Loss Risk	Assets of Statewide Importance
Stark Tract	Medium	Low	Yes
McDonald Tract	Medium	Low	Yes
Empire Tract	Medium	Low	Yes
Bradford Island	Medium	Low	Yes
Grand Island	Low	Low	Yes
Merritt Island	Low	Low	Yes
Kasson District	Low	Low	Yes
Sutter Island	Low	Low	Yes
Prospect Island	Low	Low	Yes
Ryer Island	Low	Low	Yes
Webb Tract	Low	Low	Yes
McMullin Ranch-River Junction Tract	Low	Low	Yes
Hastings Tract	Low	Low	Yes
Lisbon District	Low	Low	Yes
Glide District	Low	Low	Yes
Lower Roberts Island	Low	Low	Yes
Byron Tract	Low	Low	Yes
Van Sickle Island	Low	Low	Yes
Stewart Tract	Low	Low	Yes
Palm Tract	Low	Low	Yes
Egbert Tract	Low	Low	Yes
Cache Haas Tract	Low	Low	Yes
Orwood Tract	Low	Low	Yes
Liberty Island	Low	Low	Yes
Middle Roberts Island	Low	Low	Yes
Decker Island	Low	Low	Yes
Medford Island	Low	Low	Yes
Holland Tract	Low	Low	Yes
Bouldin Island	Low	Low	Yes
Rio Blanco Tract	Low	Low	Yes
Wright-Elmwood Tract	Low	Low	Yes
Venice Island	Low	Low	Yes
Jersey Island	Low	Low	Yes
McCormack Williamson Tract	Low	Low	Yes
Mandeville Island	Low	Low	Yes
Quimby Island	Low	Low	Yes
Atlas Tract	Low	Low	Yes
Chipps Island	Low	Low	Yes
Weber Tract	Low	Low	Yes
Wetherbee Lake	Low	Low	Yes
Holt Station	Low	Low	Yes
Stewart-Mossdale	Low	Low	Yes
Ehrheardt Club	Low	Low	Yes
Yolano	Low	Low	Yes
Zone 122	Low	Low	No
SM-132	Low	Low	No
Zone 162	Low	Low	No

Island Name	Total Asset Repair Costs/Construction Costs[5]	Life Loss Risk	Assets of Statewide Importance
Zone 206	Low	Low	No
Water Zone 5	Low	Low	No
Zone 148	Low	Low	No
Zone 197	Low	Low	No
Zone 216	Low	Low	No
SM-202	Low	Low	No
Simmons-Wheeler Island	Low	Low	No
SM-49, SM-50	Low	Low	No
Water Zone 1	Low	Low	No
SM-48, SM-49	Low	Low	No
SM-43	Low	Low	No
SM-54	Low	Low	No
SM-60	Low	Low	No
SM-199	Low	Low	No
SM-198	Low	Low	No
SM-53	Low	Low	No
SM-84	Low	Low	No
SM-124	Low	Low	No
Zone 75	Low	Low	No
Zone 31	Low	Low	No
Zone 33	Low	Low	No
Bixler Tract	Low	Low	No
Zone 160	Low	Low	No
Water Zone 4	Low	Low	No
Water Zone 2	Low	Low	No
Water Zone 3	Low	Low	No
Holland Land	Low	Low	No
Pittsburg	Low	Low	No
Zone 38	Low	Low	No
Zone 64	Low	Low	No
Zone 78	Low	Low	No
Zone 120	Low	Low	No
Schafter-Pintail Tract	Low	Low	No
Zone 185	Low	Low	No
SM-59	Low	Low	No
Zone 158 (Smith Tract 2)	Low	Low	No
SM-52	Low	Low	No
SM-44	Low	Low	No
SM-55	Low	Low	No
Zone 37	Low	Low	No
Yolo Bypass	Low	Low	No
SM-123	Low	Low	No
SM-57	Low	Low	No
Zone 77	Low	Low	No
SM-46	Low	Low	No
Zone 36	Low	Low	No
Clifton Court Forebay Water Assets	Low	Low	No

Island Name	Total Asset Repair Costs/Construction Costs[5]	Life Loss Risk	Assets of Statewide Importance
Zone 81	Low	Low	No
Zone 69	Low	Low	No
SM-40	Low	Low	No
SM-58	Low	Low	No
Zone 65	Low	Low	No
SM-56	Low	Low	No
Fay Island	Low	Low	No
SM-39	Low	Low	No
Zone 79	Low	Low	No
Zone 207	Low	Low	No
Zone 80	Low	Low	No
Zone 90	Low	Low	No
Zone 74	Low	Low	No
Zone 171	Low	Low	No
SM-85-Grizzly Island	Low	Low	No
Honker Bay Club	Low	Low	No
SM-42	Low	Low	No
SM-41	Low	Low	No
Zone 155	Low	Low	No
Zone 82	Low	Low	No
Water Canal	Low	Low	No
Zone 14	Low	Low	No
Zone 186	Low	Low	No
Zone 214	Low	Low	No
Peter Pocket	Low	Low	No
Brack Tract	Low	Low	No
Staten Island	Low	Low	No
Shin Kee Tract	Low	Low	No
Dead Horse Island	Low	Low	No
Browns Island	Low	Low	No
Little Holland Tract	Low	Low	No
SM-133	Low	Low	No
SM-134	Low	Low	No
SM-47	Low	Low	No
SM-51	Low	Low	No

* These areas may be included in other current USACE studies and may be not included as the Delta Island Feasibility Study moves forward.

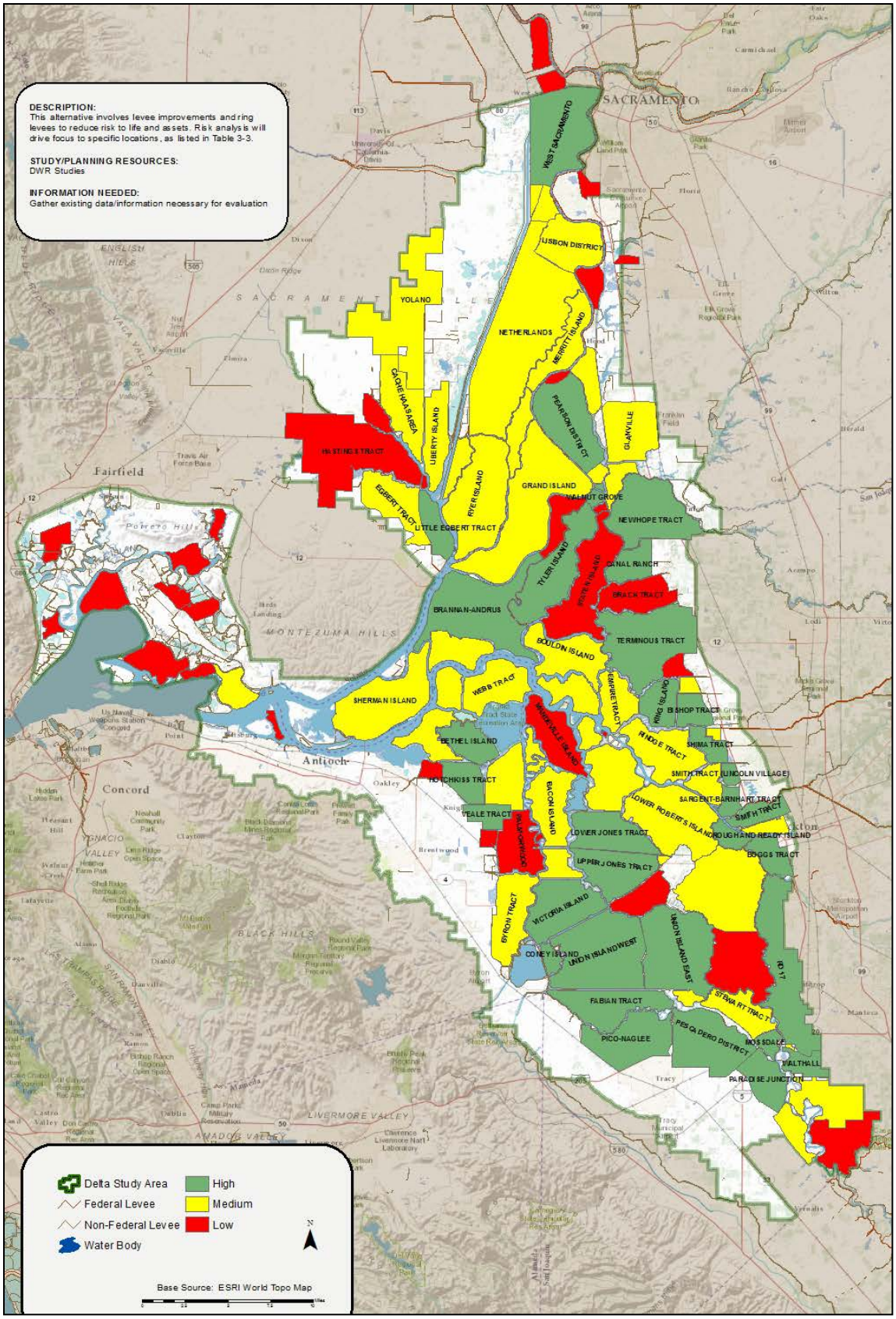

Figure 3-2. Specific Flood Risk Management Measures Considered – Locations.

Benefit-Cost Ratio Screening Analysis Criteria on the Focused Array

The three Delta Islands with the highest ratio of total asset repair costs to total construction costs (from DRMS data) and not included in another current USACE study were considered for further screening level benefit-cost analysis; the three islands include: Bethel Island, Walnut Grove, and the City of Isleton (on Brannon-Andrus Island). Based on suggestions from the local sponsor and its high population, a fourth island, Discovery Bay, was also considered for further analysis.

The main analytical tool used to perform the economic analysis was the USACE Hydrologic Engineering Center's Flood Damage Analysis (HEC-FDA) software. This program uses engineering data (hydrologic, hydraulic, and geotechnical) and economic data (structure/content inventory and depth-percent damage curves) to model flooding risk management problems and potential solutions in the study area. Through integration of the engineering and economic relationships HEC-FDA computes expected annual damages (EAD) and performance statistics. EAD is the metric used to describe the consequences of flooding on an annual basis considering a full range of flood events – from high frequency/small events to low frequency/large events over a long time horizon. Without project EAD by major damage area are reported in Table 3-4. All costs are based on the Fiscal Year 2013 Federal water resource discount rate of 3.75 percent.

Table 3-4. Without-Project Expected Annual Damages ($1,000, 2012 Prices).

Island	Autos	Commercial	Industrial	Public	Residential	Total
Bethel Island	1,497	208	96	132	15,526	**17,459**
Walnut Grove	37	209	233	113	544	**1,136**
Isleton	356	1,040	443	476	4,573	**6,888**
Discovery Bay	85	5	2	2	1,472	**1,566**

Annual exceedance probability (AEP) is a statistic used to describe the chance of flooding in any given year within a designated area. Annual exceedance probability is computed in HEC-FDA using engineering data; AEPs for the four islands are reported in Table 3-5.

Table 3-5. Annual Exceedance Probability- Without-Project Condition.

Island	AEP
Bethel Island	0.2840
Walnut Grove	0.0481
Isleton	0.1596
Discovery Bay	0.1640

For this screening level analysis, there were no floodplains or other engineering data developed for with-project conditions. To develop estimates for with-project damages, two scenarios were considered: 1) zero with-project damages (or best case scenario), the USACE project would yield no residual damages, and 2) 25 percent remaining damages (or a typical case scenario); the USACE project would eliminate 75 percent of without-project damages. The zero with-project damages scenario is the highest level of flood risk management performance any USACE project could yield; whereas, the 25 percent remaining with-project damages are more in line with the FRM performance of a typical USACE project. The with-project EAD for both scenarios are reported in Tables 3-6 and 3-7.

Table 3-6. With-Project Expected Annual Damages (Zero Remaining Damages) ($1,000, 2012 Prices).

Island	Autos	Commercial	Industrial	Public	Residential	Total
Bethel Island	0	0	0	0	0	**0**
Walnut Grove	0	0	0	0	0	**0**
Isleton	0	0	0	0	0	**0**
Discovery Bay	0	0	0	0	0	**0**

Table 3-7. With-Project Expected Annual Damages (25% Remaining Damages) ($1,000, 2012 Prices).

Island	Autos	Commercial	Industrial	Public	Residential	Total
Bethel Island	374	52	24	33	3,882	**4,365**
Walnut Grove	9	52	58	28	136	**284**
Isleton	89	260	111	119	1,143	**1,722**
Discovery Bay	21	1	1	1	368	**392**

Average annual FRM benefits for each island were determined by taking the difference between without-project EAD and with-project EAD. These results are shown in Tables 3-8 and 3-9.

Table 3-8. Expected Annual FRM Benefits (Zero Remaining Damages) ($1,000, 2012 Prices).

Island	Autos	Commercial	Industrial	Public	Residential	Total
Bethel Island	1,497	208	96	132	15,526	**17,459**
Walnut Grove	37	209	233	113	544	**1,136**
Isleton	356	1,040	443	476	4,573	**6,888**
Discovery Bay	85	5	2	2	1,472	**1,566**

Table 3-9. Expected Annual FRM Benefits (25% Remaining Damages) ($1,000, 2012 Prices).

Island	Autos	Commercial	Industrial	Public	Residential	Total
Bethel Island	1,123	156	72	99	11,645	**13,094**
Walnut Grove	28	157	175	85	408	**852**
Isleton	267	780	332	357	3,430	**5,166**
Discovery Bay	64	4	2	2	1,104	**1,175**

Parametric cost estimates for each island and measure were used. Annual FRM construction costs are shown in Table 3-10.

Table 3-10. Annual FRM Costs ($1,000, 2012 Prices).

Island/Measure	FRM Related Construction Costs
Bethel Island- Measure A	30,424
Walnut Grove- Measure A	4,408
Walnut Grove- Measure B	4,665
Isleton- Measure A	9,080
Discovery Bay- Measure A	5,737

Net Benefits

Net benefits are determined as the difference between the annual benefits and the annual costs. The net benefits and BCRs for each island and measure under both with-project scenarios are shown in Table 3-11. All island measures have negative net benefit; also, there is no island measure that has a BCR above unity; the highest BCR is 0.76 for the Isleton Measure A under the zero percent remaining damages with-project scenario.

Table 3-11. Delta Islands FRM Annual Net Benefits and BCRs ($1,000).

Island/Measure	Net Benefits Zero Percent Remaining Damages	Net Benefits 25 Percent Remaining Damages	BCR Zero Percent Remaining Damages	BCR 25 Percent Remaining Damages
Bethel Island- A	-12,965	-17,330	0.57	0.43
Walnut Grove- A	-3,272	-3,529	0.26	0.19
Walnut Grove- B	-3,556	-3,813	0.24	0.18
Isleton- A	-2,192	-3,914	0.76	0.57
Discovery Bay- A	-4,171	-4,563	0.27	0.20

Structural FRM Summary

The four Delta islands that have the highest potential for structural Flood Risk Management measures (based on the DRMS data) have negative net benefits and BCRs significantly below unity (with the highest being 0.76). Considering these results, there is no Federal Interest in structural Flood Risk Management in the Delta at this time based on applicable costs, water resources discount rate, and USACE policy.

Nonstructural Flood Risk Management

Nonstructural measures retained through previous screenings include: emergency response planning and coordination; and enhancements to flood risk communication. Emergency response planning and coordination, as well as enhancements to flood risk communication, are included in the future without project condition through ongoing actions by DWR, the Delta Protection Commission, USACE, and other Federal, state, and local agencies to develop preparedness plans, stockpile flood fight materials, and communicate flood risk through public outreach. In addition to these valuable ongoing efforts, an opportunity may exist for additional multi-agency response planning and public outreach. Advanced flood warning systems should also be considered for the Delta, as very little warning time exists for much of the region due to the nature of the isolated tidal levee systems and deep floodplains. The existing USACE Floodplain Management Services (FPMS) authority could allow for Federal support in implementation of these recommendations. For these reasons, these measures are provided as general recommendations and will not be included in a recommended plan for action, as sufficient authority exists to further explore these recommendations.

3.4.2 Ecosystem Restoration

Ecosystem restoration measures, described below, were developed to achieve ecosystem restoration objectives in the study area[6]. The ecosystem restoration measures address the critical nature of the ecological health of the Delta, address the cause of habitat degradation, and re-establish some of the critical ecosystem structure and functions. Addressing habitat degradation improves the overall ecosystem by reducing the negative stressors that have depleted the ecosystem functions and will allow the natural processes to restore some ecosystem structure and functions, improving the overall health of the ecosystem. Reviving ecosystem function typically involves actively restoring key hydrologic and geomorphic processes through physical modifications and reestablishing native vegetation to start the recovery process. The general ecosystem restoration measures considered in the study were:

- *Restore native riparian habitat.* Restoration of natural riparian habitat by active means such as resloping banks, planting vegetation, or controlling invasive species. In most, if not all cases, riparian habitat restoration would be connected to the levee and would involve work within the levee prism. Due to the potential for significant

[6] Due to the integrated nature of levees and habitat in the Delta, some ecosystem restoration measures may also incidentally contribute to flood risk management objectives.

habitat gains from increased riparian habitat, this measure was retained for further consideration.

- *Creation of new channels to connect habitat.* Creating new channels would involve dredging or otherwise creating new channels to improve stream connectivity and resulting connections for aquatic and terrestrial species. Creation of new channels would be connected to levees and would involve work within the levee prism. This measure would be consistent with and improve the integrated nature of levees and habitat in the Delta, therefore, this measure was retained for further consideration.
- *Invasive species management.* This measure would include removal of non-native plant species from existing or restored habitats. Generally, removal and continued management of invasive species is costly and significant habitat gains are not realized by this type of measure alone. Therefore, this measure will be dropped from further consideration as a standalone measure, but the concept may be incorporated into other restoration areas.
- *Restore in-channel islands and floodplains.* This measure includes the reconnection of floodplains to adjacent waterways through the partial or full removal of levees or setting back of levees, along with re-sloping and contouring as necessary. Work associated with this measure has the potential to realize significant habitat benefits. Therefore, this measure was retained for further consideration by this study.
- *Restore historic marshes.* This measure includes the creation of tidal and intertidal marsh habitat to benefit native aquatic and terrestrial species. This measure is included in the future without-project condition (which assumes BDCP implementation) for areas throughout the Delta that are currently of the appropriate elevation (range of depths) for this habitat type; therefore, little opportunity would exist under the assumed future conditions to implement this measure without incorporation of subsidence reversal. Additionally, opportunities may exist within already flooded islands, most of which are currently deep water (as opposed to marsh) due to subsidence that occurred prior to levee failure and subsequent flooding[7]. Subsidence reversal in conjunction with restoration of tidal and intertidal habitat provides an opportunity for restoration of historic marshes in areas not considered for BDCP implementation.
- *Salinity Management.* This measure would alter salinity patterns through the operation of a salinity control gate in the Delta or modifying upstream reservoir operations. Salinity management currently occurs in the Delta through a complex system of laws, biological opinions, and regulations that balance the sometimes conflicting salinity requirements for the environment (with sometimes conflicting needs between endangered species such as Delta smelt and salmonids), Delta water exports, and in-Delta water use/rights. The BDCP is being developed in compliance with the existing laws, biological opinions, and regulations governing salinity; therefore, salinity management is included in the future without-project condition for this study and will be dropped from further consideration.

[7] Subsidence largely results from the oxidation of peat during dry conditions; therefore, subsidence does not occur on flooded areas and/or submerged lands. Subsidence of flooded lands, as mentioned, occurred while those lands were dry/leveed.

- *Construct habitat friendly levees.* This measure would include constructing or modifying levees to include features such as benches for establishing native vegetation. This measure could include setback levees or other measures. Due to the connection between levees, floodplains, and associated habitat establishment, it was determined that as a standalone measure, habitat friendly levees would not provide as much ecosystem benefit as it would when combined with other measures. Therefore, this measure will be dropped from further consideration as a standalone measure. It will be incorporated into other restoration measures.
- *Setback levees (tidal/riparian).* This measure would include constructing setback levees that allow for tidal/riparian habitat to be restored in the area between the existing levee and the setback levee. This measure may require landside levee sloping and notching of the existing levee to allow for water to get to the restoration area. This measure would require work within the levee prism, has potential to provide incidental flood risk management benefits and achieve significant habitat benefits. Therefore, this measure was retained for further consideration.
- *Controlled flooding of appropriate subsided islands.* This measure includes degrading/removing/notching levees to allow restoration of the floodplain. Due to subsidence, flows would have to be managed in order to create habitat suitable for native species and prevent fish strandings. This measure would require work within the levee prism, has potential to be combined with flood risk management measures and achieve significant habitat benefits. Therefore, this measure was retained for further consideration.
- *Create bypasses.* This measure includes creating bypasses with riparian and intertidal habitats. Work may require levee modifications, removal, or minor channel construction. This measure has a high potential for aquatic restoration benefits associated with listed species for various life-stage functions. Therefore, this measure was retained for further consideration.

Ecosystem Restoration Measures Developed in Detail

Measures that were carried forward through the initial screening process were refined to a greater level of detail. Locations were identified for consideration of implementation of measures based on the following criteria:

- Geographic footprint must not coincide with restoration considered as part of the future without-project condition (i.e., BDCP Restoration Areas were excluded from ecosystem restoration analysis);
- Favor areas in closer proximity to potential fill material necessary to restore elevations to the appropriate range for habitat, when possible;
- Favor areas where potentially less fill material would be required;
- Avoid impacts to population centers and infrastructure (including islands in the western Delta that are considered critical for salinity management – known as the "eight western islands"); and

- Favor areas which provide connectivity to existing habitat, when possible.

Figure 3-3 provides a geographic representation of the limitations these criteria pose on the geographic extent of restoration considered.

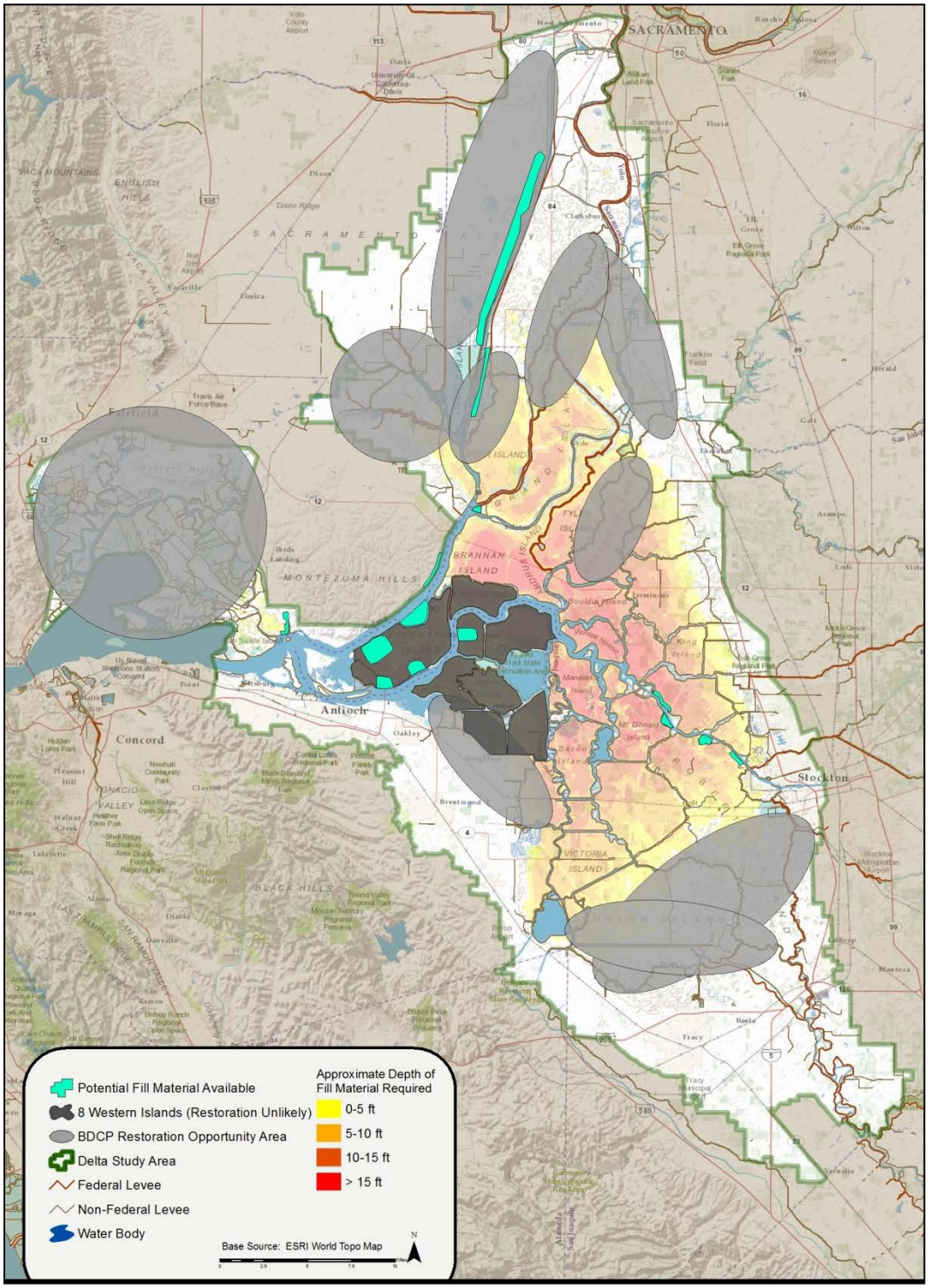

Figure 3-3. Geographic Limitations of Opportunities for Ecosystem Restoration.

Once locations were identified, increments (or scales) of measures were developed, when possible, in order to evaluate and determine the most cost effective scale of restoration necessary to achieve the study objectives. Descriptions of these detailed ecosystem restoration measures follow.

Restore Intertidal Habitat with Subsidence Reversal at Big Break (see Figure 3-4)

Restore habitat value to native species through subsidence reversal and subsequent restoration of intertidal habitat in the flooded Big Break. This location was selected because it is in close proximity to potential fill material, would likely require less fill material than other locations in the vicinity, would have no impacts to population centers or infrastructure, and could provide connectivity to existing habitat. Two scales of this measure were included for evaluation:

- Increment 1– The minimal restoration considered at Big Break would include 62 acres of tidal habitat restoration along the northern remnant levee adjacent to Jersey Island. In-water placement of material would be required to increase elevations to tidal range. Increment 1 is shown below in orange.
- Increment 2 (purple) – The larger scale of restoration considered would include the remaining 621 acres at Big Break. In-water placement of material would be required to increase elevations to tidal range. Increment 2 is shown below in purple.

Figure 3-4. Big Break Measure.

Restore Intertidal Habitat with Subsidence Reversal at Little Franks Tract and Franks Tract (see Figure 3-5)

Restore habitat value to native species through subsidence reversal and subsequent restoration of intertidal habitat in the flooded Little Franks Tract and Franks Tract. This location was selected because it is in close proximity to potential fill material, would likely require less fill material than other locations in the vicinity, and would have no impacts to population centers or infrastructure. Three scales of this measure were included for evaluation:

- Increment 1 – The minimal restoration considered would include 319 acres of tidal habitat restoration at Little Franks Tract. In-water placement of material would be required to increase elevations to tidal range. Increment 1 is shown below in orange.
- Increment 2 – The next larger scale of restoration considered would include 862 acres along the remnant levee on the northern edge of Franks Tract. In-water placement of material would be required to increase elevations to tidal range. Increment 2 is shown below in purple.
- Increment 3 – The largest scale of restoration considered would include the remaining 2,595 acres of Franks Tract. In-water placement of material would be required to increase elevations to tidal range. Increment 3 is shown below in blue.

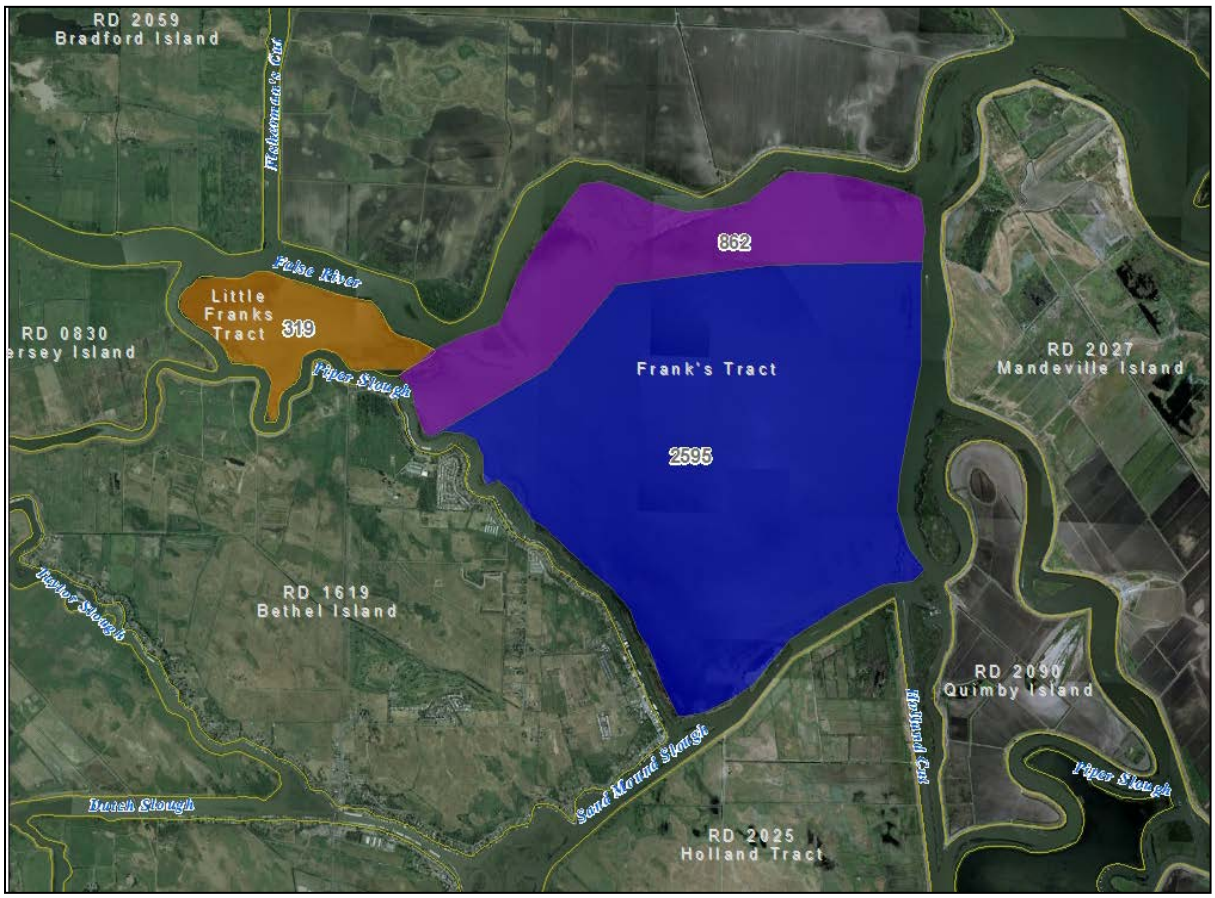

Figure 3-5. Little Franks Tract and Franks Tract Measure.

Restore Stream Connectivity and Riparian Habitat with Setback Levees at Steamboat and Sutter Sloughs (see Figure 3-6)

Restore connectivity/habitat to improve channel margin habitat through floodplain restoration including setback levee construction. This location was selected because it is in close proximity to (likely more limited) potential fill material, could require less fill material than other locations in the vicinity, and would have limited impacts to population centers or infrastructure. Four scales of this sub-measure were included for evaluation:

- Increment 1 – The minimal restoration considered at Steamboat and Sutter Sloughs would include 0.4 miles of setback levee on the northern most tip (at the southern extent of the Elk Slough restoration) of Sutter Island to improve connectivity between Sutter and Steamboat Sloughs and the Sacramento River through the restoration of 66 acres of riparian habitat. Increment 1 is shown below in orange.
- Increment 2a – This configuration of the next larger scale of restoration would include the adjacent 1,967 acres of Sutter Island (extending from the north to just south of Miner Slough), 732 acres on the southern tip of Netherlands (on the north bank of Miner Slough), and 1,217 acres on the northern tip of Ryer Island (on the south bank of Miner Slough). This 3,916 acre increment would connect the Elk Slough restoration to Steamboat Slough and Miner Slough, as well as existing and planned habitat areas on Prospect Island. This increment would require a 0.6 mile setback levee across Sutter Island, a 2.1 mile levee across the southern tip of Netherlands, and a 1.9 mile setback levee on the northern tip of Ryer Island. Increment 2a is shown below in purple hatch.
- Increment 2b – This configuration of the next larger scale of restoration would include all of Sutter Island (an additional 2,449 acres in addition to the 66 acres in Increment 1), as well as a 956 acre corridor (approximately 1,000 ft wide) along Steamboat Slough on Ryer Island requiring 7 miles of setback levee. This 3,405 acre increment would connect the Elk Slough restoration to Steamboat Slough and the Sacramento Deep Water Ship Channel at their confluence with the Sacramento River, restoring a corridor which could serve as an alternative migratory pathway for endangered salmon and Delta smelt. Increment 2b is shown below in purple hatch.
- Increment 3 – The maximum restoration considered would be implemented in conjunction with Increment 2b and would increase the restoration corridor on Ryer Island by 2,197 acres, requiring a 5.6 mile of setback levee. Additionally, 2,251 acres would be restored on the opposite bank of Steamboat Slough on Grand Island, requiring a 6.6 mile setback levee. This 4,448 acre increment would provide additional acres of restored habitat and connect the restoration to existing and planned restoration on the southwest tip of Grand Island at the confluence of the Sacramento River. Increment 3 is shown below in blue.

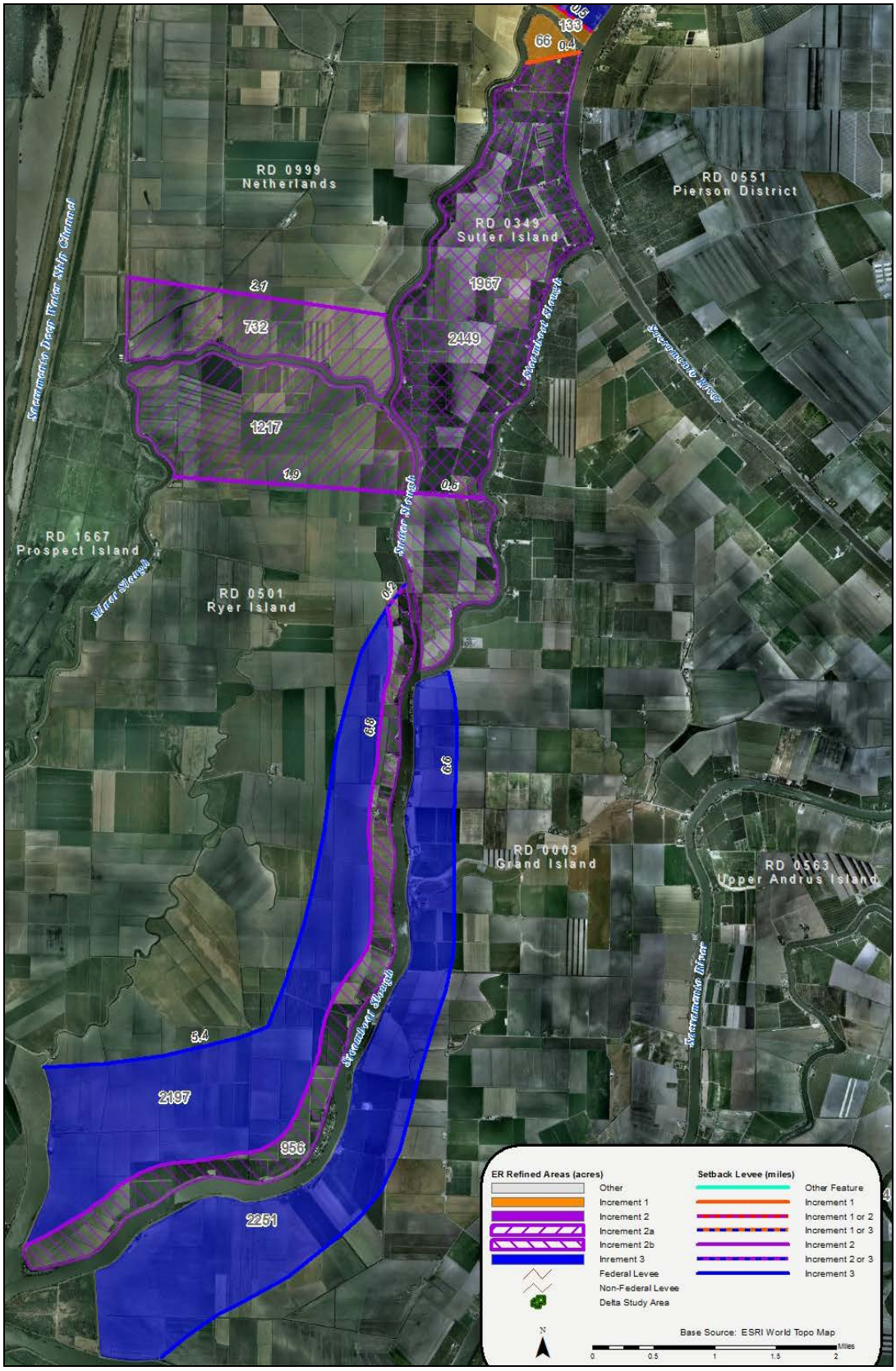

Figure 3-6. Steamboat and Sutter Sloughs Measure.

Restore Riparian/Intertidal Habitat, Floodplain Access, and Subsidence Reversal along the South Mokolumne River (see Figure 3-7)

Increase floodplain connectivity through the use of gates or setback levees. This location was selected because it would have limited impacts to population centers or infrastructure and could provide connectivity to existing habitat. Four scales of this measure were included for evaluation:

- Increment 1 – The minimum restoration considered for this measure includes 3,530 acres of riparian/intertidal habitat along the South Mokelumne River, requiring 7.3 miles of setback levees on four tracts. This increment would extend other existing and planned adjacent habitat areas to the north (Cosumnes Preserve, McCormack-Williamson Tract, Staten Island, and other BDCP proposed habitat areas). Increment 1 is shown below in orange. Portions of the following tracts would be included in this increment:
    - New Hope Tract – 563 acres of riparian/intertidal habitat, 2.4 miles of setback levee.
    - Canal Ranch – 868 acres of riparian/intertidal habitat, 2 miles of setback levee.
    - Brack Tract – 1216 acres of riparian/intertidal habitat, 1.4 miles of setback levee.
    - Terminous Tract – 883 acres of riparian/intertidal habitat, 1.5 miles of setback levee.
- Increment 2 – The next increment under consideration would extend Increment 1 south toward the San Joaquin River and would add an additional 1,217 acres of riparian/intertidal habitat, requiring 3.7 miles of three setback levees on two tracts. Two separate setback levees would be constructed on Terminous Tract. The eastern Terminous Tract habitat area would span 118 acres and would require a 0.5 mile setback levee. The southern Terminous Tract habitat area would encompass 471 acres and would require a 1.3 mile setback levee. The third habitat area in this increment includes the 628 acres on the eastern most portion of Empire Tract and would require a 1.9 mile setback levee. Increment 2 is shown below in purple.

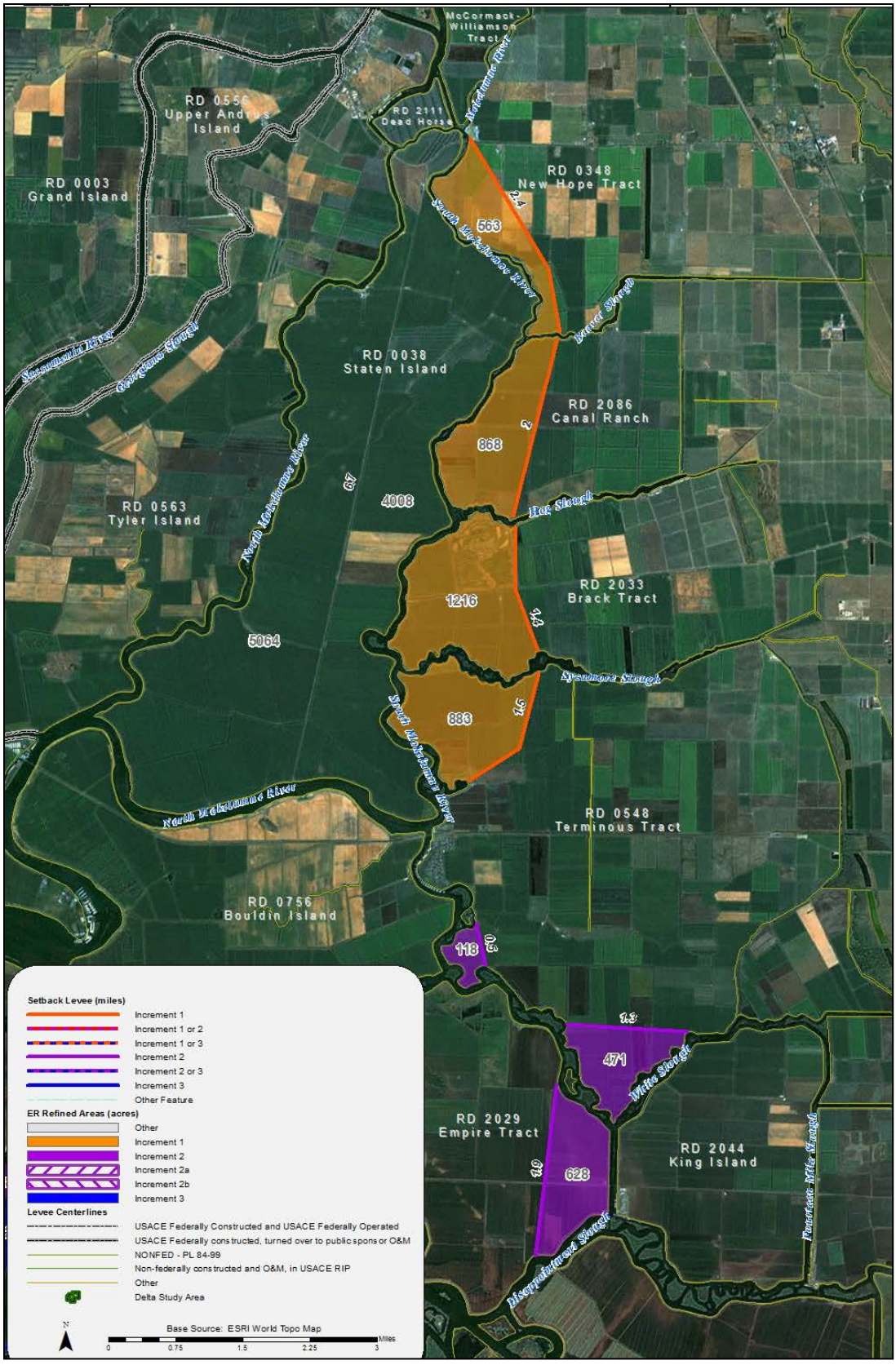

Figure 3-7. South Mokolumne River Measure.

Restore Riparian/Intertidal Habitat and Floodplain Access with Subsidence Reversal at Medford Tract (see Figure 3-8)

Increase floodplain habitat through subsidence reversal and subsequent restoration of riparian and intertidal habitat. This location was selected because it is in relatively close proximity to potential fill material, would have limited impacts to population centers or infrastructure, and could provide connectivity to existing habitat. Two scales of this measure were included for evaluation:

- Increment 1 – The minimum restoration considered for this measure includes 14 acres of subsidence reversal and subsequent restoration of intertidal and riparian habitat on the southeastern portion of Medford Island surrounded by an existing mitigation habitat area/preserve (approximately 200 acres). Increment 1 is shown below in orange.
- Increment 2 – The maximum restoration considered for this measure would include subsidence reversal and subsequent restoration of intertidal and riparian habitat on an additional 664 acres of Medford Island. This increment would restore Medford Island in its entirety, as approximately 512 acres of the island have already been restored through mitigation efforts. Increment 2 is shown below in purple.

Figure 3-8. Medford Island Measure.

Additional Ecosystem Restoration Measures Considered

The following site-specific measure were considered, but dropped from further evaluation for the reasons noted.

- *Restore Stream Connectivity and Riparian Habitat with Setback Levees at Elk Slough.* Restore connectivity/habitat to improve channel margin habitat through floodplain restoration including setback levee construction. Upon investigation, it was determined that this action is currently under consideration in the BDCP and is therefore part of the future-without project condition. For this reason, it was dropped from further consideration.
- *Restore Floodplain/Bypass at Paradise Cut.* Widen access to floodplain to increase capacity and improve hydraulic conditions to benefit native species (consideration must be taken to avoid migration of fish into State and Federal Water Projects due to the proximity to these facilities). Upon investigation, it was determined that this action is currently under consideration in the BDCP and is therefore part of the future-without project condition. For this reason, it was dropped from further consideration.
- *Creation of Bypass at Prospect Island.* Increase floodplain connectivity through the use of gates or setback levees. Upon investigation, it was determined that this action is currently under consideration in the BDCP and is therefore part of the future-without project condition. For this reason, it was dropped from further consideration.
- *Restore Intertidal/Riparian Habitat, Floodplain Access, and Subsidence Reversal at Staten Island: Mokolumne River.* Increase floodplain connectivity through the use of gates or setback levees. Upon investigation, it was determined that this action is currently under consideration in the BDCP and is therefore part of the future-without project condition. For this reason, it was dropped from further consideration.
- *Restore Intertidal/Riparian Habitat, Floodplain Access, and Subsidence Reversal at 8 Western Islands.* Increase floodplain connectivity through the use of gates or setback levees. Although this general measure would contribute to the ecosystem restoration objective, this particular location was discussed due to its importance to the water delivery system rather than ecosystem restoration objectives. Other areas were identified for more suitable application of this general measure. For this reason, this site-specific measure was dropped from further consideration.
- *North Delta Bypass: Glide District and Netherlands.* Increase floodplain connectivity through the use of gates or setback levees to connect the shortest reach of landscape between the Sacramento River and the Yolo Bypass and include crossing the Sacramento Deepwater Ship Channel. The weir on the Sacramento This measure could provide flood risk benefits for the city of West Sacramento, the Pocket area and Sacramento downtown, and potentially Clarksburg, Hood, Courtland, Walnut Grove, Ryde, and Isleton on the Sacramento River downstream of the bypass and would provide additional access and connectivity to the floodplains of Yolo Bypass under specific flood conditions. Although this measure could contribute to the ecosystem restoration objective under certain operation criteria, the primary

formulation objective would be for flood risk management for areas outside of the study area. For this reason, this site-specific measure was dropped from further consideration.

Screening of Ecosystem Restoration Measures

In order to ensure that only implementable measures with a reasonable chance of achieving a significant increase in habitat value at a reasonable cost were included in the final array of alternatives, criteria were established to further screen these detailed measures. The criteria used to screen detailed ecosystem restoration measures are described below:

- *Land Availability Concerns.* Due to high value agricultural crops, competing land uses and interests in the Delta, and the ongoing land issues associated with the BDCP project, land availability is a major concern for implementing ecosystem restoration. Some areas have been in agriculture for generations, with the owners having no interest in selling even a portion of the land. Short of exercising eminent domain, these lands will not be available in the foreseeable future. Use of eminent domain to acquire large areas of private land for single-purpose ecosystem restoration that could be implemented elsewhere is generally not considered to be acceptable. Additionally, there are some very high value crops (i.e. vineyards) that would be cost prohibitive even if there were willing sellers. Other lands have greater opportunity, such as those with potentially willing sellers, public ownership, or limited current usage (flooded areas). A qualitative risk ranking of High (not likely to have a willing seller), Medium (likely to have a willing seller), or Low (public/state ownership) has been assigned to each measure based on input from non-Federal sponsor staff with extensive experience concerning Delta land acquisition and availability.
- *Likely Effects to Water Rights.* For any of the measures that involve diverting water or creating fish passage facilities or setback levees, an evaluation of water rights will be required for any additional water that would be needed during the non-flood season. Most of the water in the Sacramento River is either Federal Central Valley Project (CVP) water or State Water Project (SWP) water and there may not be "extra" water from the river for restoration or fish passage purposes.
- *Impacts to Existing Habitat.* In order to implement restoration, modifications to the existing habitats would likely occur. In some cases, there is some good to high quality habitat along the slough's edge that could be adversely impacted through the restoration activities. In order to avoid these impacts, a qualitative ranking of High (likely to adversely impact existing habitat), Medium (may adversely impact existing habitat), or Low (not likely to adversely impact existing habitat) has been assigned to each measure based general information about the sites and input from the non-Federal sponsor.
- *Gross Relative Real Estate Cost.* Purchase of the lands is likely to be a big driver in the cost of restoration. In order to avoid unrealistic areas for restoration, a general ranking of High (purchase of private lands with likely exponentially higher costs), Medium (purchase of private lands required), or Low (public/state ownership of

lands) has been assigned to each measure based on general land use information and input from the non-Federal sponsor.

- *Gross Relative Construction Cost.* Construction costs vary greatly between the measures under consideration, largely driven by the necessity of setback levees at some locations. In order to screen out measures that would have exponentially higher construction costs for similar benefits, parametric cost estimates were developed for each measure. Costs included active restoration costs and levee construction costs, as these were anticipated to be the drivers in relative costs per acre (other costs were anticipated to be relatively similar for each site). A summary of these parametric cost estimates is shown in Table 3-12.
- *Likely to Require Mitigation for Flood Impacts.* Changes to the system hydraulics would likely result from some ecosystem restoration measures under consideration. Some measures would have a higher likelihood of resulting in upstream or downstream impacts that would require hydraulic mitigation that could increase costs without providing additional ecosystem restoration benefits. In order to screen out measures that would most likely have high hydraulic mitigation costs for similar benefits, a general ranking of High (extensive levee work likely required), Medium (some levee work likely required), or Low (not likely to require hydraulic mitigation) has been assigned to each measure based general information about the site.

Table 3-12. Relative Parametric Costs of Detailed Ecosystem Restoration Measures (2012 prices, 3.75% interest rate).

Site	Increment	Acres	Volume (CY)	Total Subsidence Costs (1,000s)	Levee Costs (1,000s)	Ecosystem Restoration Costs (1,000s)	Total (1,000s)	Total Cost Per Acre	Annualized Cost Per Acre
Big Break	1	62	231,347	$11,567	$0	$1,008	$11,568	$187,000	$8,000
Big Break	2	621	2,317,204	$173,790	$0	$10,091	$173,800	$280,000	$12,000
Little Franks Tract	1	319	1,701,435	$127,608	$0	$5,184	$127,613	$400,000	$18,000
Franks Tract	1	862	4,782,997	$358,725	$0	$14,008	$358,739	$416,000	$19,000
Franks Tract	2	2,595	14,398,928	$1,439,893	$0	$42,169	$1,439,935	$555,000	$25,000
Medford	1	14	225,867	$11,293	$0	$228	$11,294	$807,000	$36,000
Medford	2	664	10,712,533	$1,071,253	$0	$10,790	$1,071,264	$1,613,000	$72,000
Steamboat/Sutter	2a	3916	63,178,133	$6,317,813	$517,253	$346,540	$6,835,413	$1,746,000	$78,000
Mokolumne	1	3530	56,950,667	$5,695,067	$624,694	$375,450	$6,320,136	$1,790,000	$80,000
Steamboat/Sutter	3	4448	71,761,067	$7,176,107	$1,120,377	$533,120	$8,297,017	$1,865,000	$83,000
Steamboat/Sutter	2b	2449	39,510,533	$3,951,053	$551,842	$299,185	$4,503,195	$1,839,000	$82,000
Mokolumne	2	1217	19,634,267	$1,963,427	$279,433	$153,105	$2,243,013	$1,843,000	$82,000
Steamboat/Sutter	1	66	1,064,800	$79,860	$23,373	$9,716	$103,243	$1,564,000	$70,000

The applications of these screening criteria to the detailed measures are shown below in Table 3-13. Measures that were classified as "high risk" in any category were dropped from further consideration. All measures not showing an "L" for "Low Risk" in each of the six listed criteria are dropped from further consideration. Restoration of flooded islands (Big Break, Little Franks Tract, and Franks Tract) clearly ranked the highest of all ecosystem restoration measures against these criteria and will be retained for further evaluation.

Table 3-13. Screening of Detailed Ecosystem Restoration Measures.

Measure	Land Availability Concerns	Likely Effects to Water Rights	Impacts to Existing Habitat	Gross Relative Real Estate Cost	Gross Relative Construction Cost	Likely to Require Mitigation for Flood Impacts
Restore Intertidal Habitat with Subsidence Reversal at Big Break	L	L	L*	L	L	L
Restore Intertidal Habitat with Subsidence Reversal at Little Frank's Tract	L	L	L*	L	L	L
Restore Intertidal Habitat with Subsidence Reversal at Frank's Tract	L	L	L*	L	L	L
Restore Riparian/Intertidal Habitat, Floodplain Access, and Subsidence Reversal at Medford Island	H	M	L	M	M	L
Restore Riparian/Intertidal Habitat, Floodplain Access, and Subsidence Reversal along the South Mokolumne River	H	H	L	M	H	M
Restore Stream Connectivity and Riparian Habitat with Setback Levees at Steamboat and Sutter Sloughs	H	H	M	H	H	M

* Although restoration of these flooded islands would restore native habitat, it should be noted that the area currently is popular for (invasive) bass fishing; restoration would require coordination with interested parties

Final Ecosystem Restoration Measures

The ecosystem restoration measures that were retained through all screenings include: restore intertidal habitat with subsidence reversal at Big Break, Franks Tract, and Little Franks Tract. Detailed descriptions and final increments of these measures follow.

Prior to levee construction in the 19th Century, Big Break, Franks Tract, and Little Franks Tract were comprised of intertidal marsh. Levees were constructed to drain the lands for agricultural use, resulting in subsidence of the land surface due to compaction, oxidation, and wind erosion. Levee failure occurred in the early to mid 20th Century and these areas were not reclaimed; however, enough subsidence had already occurred that these open water expanses now function ecologically as lakes, providing no value to native species.

The primary action required to restore habitat value to native species at Big Break, Frank's Tract, and Little Franks Tract is subsidence reversal. Similar restoration actions were undertaken by USACE in the 1990s at nearby Venice Cut and Donlon Island. This restoration has demonstrated that subsidence reversal to restore land surface to intertidal elevations, along with minimal plantings, can result in successful restoration of intertidal marsh with 80 percent vegetation coverage within 2 years. Measures considered at Big Break, Franks Tract, and Little Franks Tract are based on the success of these reference sites.

Subsidence Reversal

Studies conducted on reference sites at Donlon and Venice Cut Islands indicate that optimum marsh wren habitat (i.e., where vegetative cover is greater than 75 percent) is found at elevations ranging from approximately 2.8 to 4.8 feet. Therefore, using a conservative approach for estimating quantity of fill, a target elevation of 4.5 feet was used to estimate fill quantities.

While target elevations are consistent between the sites, current elevations vary from site to site, resulting in differing requirements for volume of material per acre. Intertidal marsh restoration at Big Break (1,064 acres of marsh with an additional 15 percent of open water) would require 12.7 million cubic yards of material, or 9,400 cubic yards of material per acre. Intertidal marsh restoration at Franks Tracts (2,470 acres of marsh with an additional 15 percent of open water) would require 42.6 million cubic yards of material, or 17,200 cubic yards of material per acre. Intertidal marsh restoration at Little Franks Tracts (273 acres of marsh with an additional 15 percent of open water) would require 4.6 million cubic yards of material, or 16,800 cubic yards of material per acre.

Increments were developed for each site based on availability and proximity of fill material, as this is the primary driver in restoring ecological function and the primary driver of cost. Based on monitoring results from the Donlon Island and Venice Cut reference sites, it is expected that placement of fill material to the appropriate elevations, followed by minimal plantings of rushes will be the only required actions to restore intertidal marsh. As elevations are relatively constant within each site, calculations were made to determine the volume of fill needed per acre at each site. Volumes of available material were matched to the most efficient potential site. Potential sources of material include:

- *Direct placement from Operations and Maintenance dredging of the Stockton Deep Water Ship Channel* – assumes normal hydraulic dredging operations with suspended material directly placed into the restoration area(s) via pipeline and contained in an enclosed area surrounded by either existing high ground (remnant levees) or sacrificial hay bales and silt curtains to allow suspended material to settle and water to filter through the silt curtains prior to exiting the site back into the waterways;
- *Pumping previously dredged material from nearby stockpiles* – utilize previously dredged material in nearby stockpiles by creating a slurry that can be pumped into the restoration area(s) via pipeline and contained in an enclosed area surrounded by either existing high ground (remnant levees) or sacrificial hay bales and silt curtains to allow suspended material to settle and water to filter through the silt curtains prior to exiting the site back into the waterways; and
- *Trucking and/or barging material from borrow sites within a 30 mile radius* – truck and/or barge material from borrow sites within a 30 mile radius and place material into the restoration area(s) either directly from trucks (where possible) or via excavators on barges into an enclosed area surrounded by either existing high ground (remnant levees) or sacrificial hay bales and silt curtains to allow suspended material to settle and water to filter through the silt curtains prior to exiting the site back into the waterways.

Vegetation

Soil material will be transported to the site as described above and placed to bring the tract soil depth to a target elevation of 4.5 feet mean sea level. This area will be conducive to aquatic vegetation and anchored to the adjacent existing levee. The planting design includes planting bulrush (Typha sp.) over the area and will be suitable to develop intertidal marsh habitat. Plantings will be installed at 3 feet on center over 10 percent of the intertidal marsh area. The plant material may be nursery grown, or collected from nearby sources and directly planted at the site. It is anticipated that cattails will self-propagate on site. Additionally, 25 acres of the adjacent existing levee will be treated to remove weed species, such as, Himalayan blackberry, pampas grass, pepper weed, etc.

Increments

Increments of restoration at each site were developed based on an acre grid system. Available fill material calculations were used to determine the size of increments, i.e., how many grid cells each increment included. It should be noted that the first increments at each site are relatively small, with a large increment for the remainder of the site. This sizing is a product of cost breakpoints associated with available fill material. The smaller increments were developed based on available material that could be transported to the site without major modifications (i.e., construction of a bridge, multiple transfers between trucks and barges, etc.). The larger increment includes the remainder of each site for which a more efficient source of available material could not be identified. Locations of increments are general within each site and are based on proximity to fill material, proximity to remnant levees for improved constructability,

and connectivity to existing habitat. Figures 3-9 through 3-11 show increments and available fill material. Table 3-14 provides a summary of all final increments/measures under consideration.

Table 3-14. Final Increments/Measures.

BIG BREAK					
INCREMENT	**ACREAGE**	**VOLUME (CY)**	**DEPTH (FT)**	**SOURCE**	**METHOD**
1	41.9	500,000	6.9	O&M	DIRECT PLACEMENT
2	10.4	124,023	6.9	McCORMICK	PUMPING
3	17.6	209,992	6.9	SCOUR	PUMPING
4	0.9	11,263	6.9	AUG. PIT	PUMPING
5	10.4	124,500	6.9	DECKER	PUMPING
6	4.2	49,500	6.9	RIO VISTA	PUMPING
7	978.5	11,666,297	6.9	VARIOUS	TRUCKING/BARGING
TOTAL SUM (1-7)	1,064.0	12,685,575			

FRANKS TRACT					
INCREMENT	**ACREAGE**	**VOLUME (CY)**	**DEPTH (FT)**	**SOURCE**	**METHOD**
1	19.7	339,020	10.3	ROBERTS 2	PUMPING
2	119.3	2,053,084	10.3	ROBERTS 1	PUMPING
3	2,331.0	40,255,878	10.3	VARIOUS	TRUCKING/BARGING
TOTAL SUM (1-3)	2,470.0	42,647,982			

LITTLE FRANKS TRACT					
INCREMENT	**ACREAGE**	**VOLUME (CY)**	**DEPTH (FT)**	**SOURCE**	**METHOD**
1	9.2	153,115	9.9	BRADFORD	PUMPING
2	263.9	4,414,248	9.9	VARIOUS	TRUCKING/BARGING
TOTAL SUM (1-2)	273.0	4,567,363			

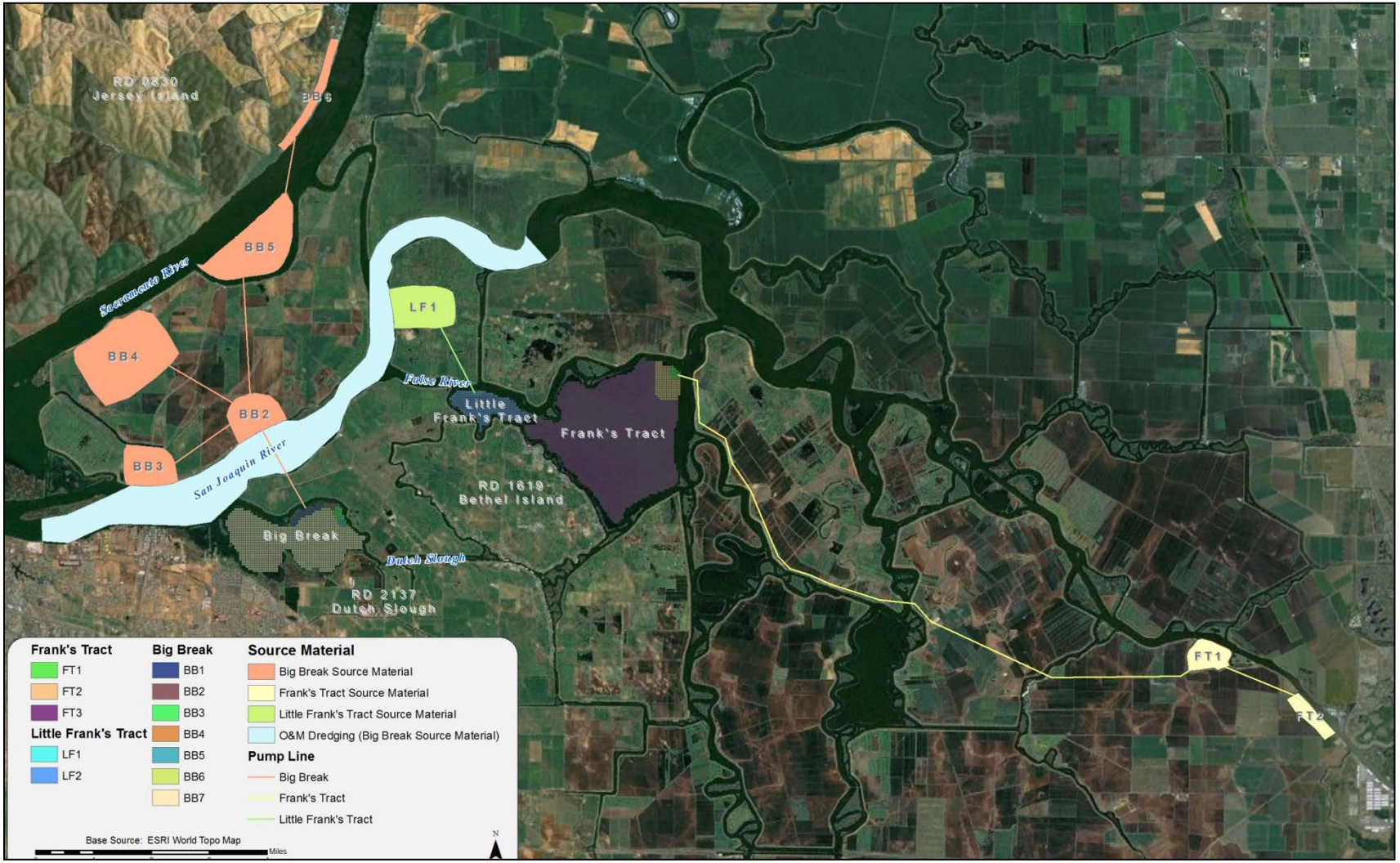

Figure 3-9. Map of Material Availability.

Figure 3-10. Map of Big Break Increments.

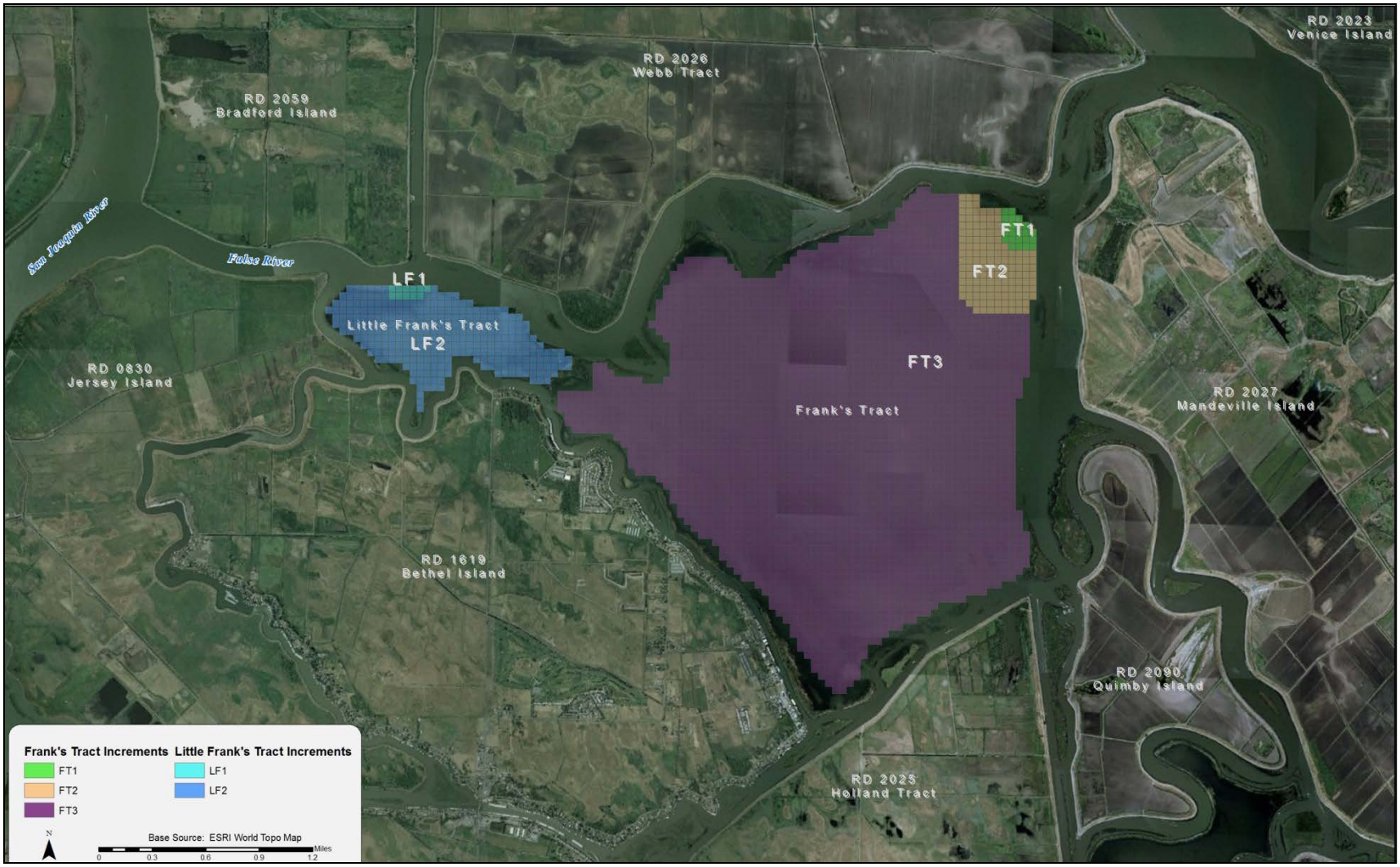

Figure 3-11. Map of Franks Tract and Little Franks Tract Increments.

Preliminary Costs

The overall strategy for generating preliminary costs was to utilize historical construction methodologies and current day prices for labor, equipment and materials. There are several important assumptions that were used to create the costs and generally serve to create a less conservative estimate of the cost, but are reasonably accepted to be true. The most influential assumptions are related to direct placement dredging: all costs associated with direct placement alternatives up to a distance of 15,000 feet of dredged material pumping are excluded from the cost estimate and will be funded by Federal Operations and Maintenance (O&M) funds (assume 100,000 CY per year O&M dredging direct placement), and that the likelihood of a significant cost increase for any potential environmental mitigation due to this feature of work is low.

The highest level of risk from these assumptions lies in the assumed low likelihood of any potential environmental mitigation costs because of the sensitivity of the Delta to the turbidity that these construction techniques have the potential to cause. It is assumed that the deployment of stacked hay bales, or similar technology, will be sufficient and cost effective at the point of placement to prevent a significant increase in environmental mitigation costs. Direct Placement dredging relative to the O&M measures are not stand alone projects and require full cooperation and partnership with other programs or projects.

The second most influential assumption is that moving the discharge point is the only practical means of placing slurried fine-grain material. Limited leveling of sand mounds at discharge points may be required if fine sands are also present in the material. Essentially, this reduces the scope of the earthwork to outflow pipe management. These assumptions reduce the exposure to costs for all in water placement through pumping outflow and are considered conservative based upon PDT discussion. A relatively low contingency of 25% was used until an abbreviated cost risk analysis can be conducted, but again is considered reasonable due to the low complexity of the project's features of work.

The highest risk to cost increases lies in trucking/barging material sourcing and the environmental mitigation for pumping from existing dredged material storage sites. Trucking/barging material sourcing is thought to be feasible for the 55+ Million CY within a 30 aerial mile radius with more weight given to the sites farther away due to typical Delta soil conditions. This will raise the weighted average contingency for increments utilizing trucking/barging, but these increments are already cost prohibitive.

For environmental mitigation, the hay bale/silt curtain method is not a complicated methodology, but in the tidal conditions, even the assumed robust cross sectional design may not be able to withstand the tidal forces and require an even more robust and costly mitigation plan. Fortunately, the cost of environmental mitigation is 4 to 10% of the total project cost, depending on the dredge/pumping increment and will not prohibitively alter the “per acre” cost or the weighted contingency.

The construction methodologies used to generate the cost estimate follow standard industry practices for standard wet and dry earthwork conditions. Earthwork crews were developed in MCACES MII with production quantities pulled from the Cost Engineering Section ProdQuant.xls spreadsheet. The dry earthwork techniques rely primarily on heavy earthmoving equipment including: Dozers, scrapers and hydraulic excavators. Pumping costs were generated from an MCACES MII model refined with bid information from multiple contractor proposals for similar work in the immediate area. Pumping techniques require pipes to be laid over land and secured to the river channel bottom as needed to maintain the most direct, cost efficient and low environmental and local impact. The material source sites placing at Big Break are assumed to be dependent on the McCormick dredged material storage site pumping operation in order to create cost savings by utilizing McCormick's infrastructure following completion of its pumping operation. The outflow of the pipe is considered mobile and would be repositioned regularly in order to spread materials throughout the site. Some leveling of deposited material may be required.

A summary of construction costs is included in Table 3-15.

Table 3-15. Costs of Increments/Measures (Sept 2013 Price Level).

BIG BREAK

INCREMENT	ACRE	VOLUME (CY)	DEPTH (FT)	SOURCE	METHOD	DEPENDENT ON:	INC TRANS DISTANCE (mi)	SLURRY AND PUMPING UNIT COST ($/CY)	INC TURBIDITY RADIUS(ft)	HAY BALE/SILT SCREEN (1,000s)	ALLOCATED ANCHORED DIST(ft)	PIPE ANCHORING (1,000s)	PLANTINGS (1,000s)	RIGHT OF WAY (1,000s)	SUB TOTAL (1,000s)	MOB / DEMOB (1,000s)	15%PED/ 8.5%CM/ CONT%* (1,000s)	TOTAL COST (1,000s)	TOTAL COST PER ACRE (1,000s)	TOTAL COST Annualized Costs ($) (1,000s)
1	41.9	500,000	6.9	O&M	DIRECT PLACEMENT	NONE	NO COST	$4.92	2,855.86	$242.25	0	$0	$220	$72	$2,995	$299	$1,149	$4,443	$106	$198.05
2	10.4	124,023	6.9	McCORMICK	PUMPING	NONE	1.70	$12.70	1,422.34	$120.67	4,900	$497	$55	$72	$2,320	$232	$884	$3,435	$330	$153.12
3	17.6	209,992	6.9	SCOUR	PUMPING	McCORMICK	2.60	$19.41	1,850.77	$160.51	0	$0	$92	$204	$4,533	$227	$1,702	$6,461	$367	$288.01
FOR COMPARISON	12.8	153,115	6.9	BRADFORD	PUMPING	NONE	3.25	$19.36	1,580.38	$138.52	500	$73	$67	$259	$3,502	$350	$1,573	$5,425	$422	$241.83
4	0.9	11,263	6.9	AUG. PIT	PUMPING	McCORMICK	2.80	$19.51	428.63	$40.57	0	$0	$5	$208	$473	$24	$104	$601	$636	$26.79
5	10.4	124,500	6.9	DECKER	PUMPING	McCORMICK	2.85	$19.53	1,425.07	$120.89	550	$76	$55	$136	$2,819	$141	$1,055	$4,015	$384	$178.96
6	4.2	49,500	6.9	RIO VISTA	PUMPING	McCORMICK	5.55	$26.23	898.57	$78.07	3,800	$391	$22	$72	$1,861	$93	$704	$2,658	$640	$118.48
SUM (1-6)	85.5	1,019,278																		
7	978.5	11,666,297	6.9	VARIOUS	TRUCKING	NONE	VARIES	$103.50	13,794.89	$1,126.84	0	$0	$5,127	$0	$1,213,716	$500	$588,652	$1,214,305	$1,241	$54,126.68
TOTAL SUM (1-7)	1,064.0	12,685,575																		

FRANKS TRACT

INCREMENT	ACRE	VOLUME (CY)	DEPTH (FT)	SOURCE	METHOD	DEPENDENT ON:	INC TRANS DISTANCE (mi)	SLURRY AND PUMPING UNIT COST ($/CY)	INC TURBIDITY RADIUS(ft)	HAY BALE/SILT SCREEN (1,000s)	ALLOCATED ANCHORED DIST(ft)	PIPE ANCHORING (1,000s)	PLANTINGS (1,000s)	RIGHT OF WAY (1,000s)	SUB TOTAL (1,000s)	MOB / DEMOB (1,000s)	15%PED/ 8.5%CM/ CONT%* (1,000s)	TOTAL COST (1,000s)	TOTAL COST PER ACRE (1,000s)	TOTAL COST Annualized Costs ($) (1,000s)
1	19.7	339,020	10.3	ROBERTS 2	PUMPING	NONE	10.5	$34.66	2,351.60	$196	1,600	$1,985	$88	$848	$14,868	$500	$6,800	$22,168	$1,126	$988
2	119.3	2,053,084	10.3	ROBERTS 1	PUMPING	ROBERTS 2	1.7	$35.96	5,787.02	$476	0	$0	$533	$144	$74,983	$250	$36,297	$111,530	$935	$4,971
SUM (1-2)	139.0	2,392,104																		
3	2331.0	40,255,878	10.3	VARIOUS	TRUCKING/BARGING	NONE	VARIES	$88.50	25,625.14	$2,089	0	$0	$10,408	$0	$3,575,142	$500	$1,733,944	$5,309,586	$2,278	$236,671
TOTAL SUM (1-3)	2470.0	42,647,982																		

LITTLE FRANKS TRACT

INCREMENT	ACRE	VOLUME (CY)	DEPTH (FT)	SOURCE	METHOD	DEPENDENT ON:	INC TRANS DISTANCE (mi)	SLURRY AND PUMPING UNIT COST ($/CY)	INC TURBIDITY RADIUS(ft)	HAY BALE/SILT SCREEN (1,000s)	ALLOCATED ANCHORED DIST(ft)	PIPE ANCHORING (1,000s)	PLANTINGS (1,000s)	RIGHT OF WAY (1,000s)	SUB TOTAL (1,000s)	MOB / DEMOB (1,000s)	15%PED/ 8.5%CM/ CONT%* (1,000s)	TOTAL COST (1,000s)	TOTAL COST PER ACRE (1,000s)	TOTAL COST Annualized Costs ($) (1,000s)
1	9.2	153,115	9.9	BRADFORD	PUMPING	NONE	1	$11.62	1,580.38	$228	500	$73	$55	$119	$2,254	$428	$886	$3,568	$390	$159
2	263.8	4,414,248	9.9	VARIOUS	TRUCKING/BARGING	NONE	VARIES	$84.10	8,485.55	$695	0	$0	$1,575	$0	$373,508	$500	$181,152	$555,160	$2,104	$24,746
TOTAL SUM (1-2)	273.0	4,567,363																		

3.5 Formulation of Alternatives

The array of alternatives was formulated for the single purpose of Ecosystem Restoration, with the incorporation of non-structural Flood Risk Management measures into all alternatives to address Flood Risk Management Objective 2, reduce risk to life loss. The following guiding Plan Formulation principles were used in development of alternatives:

- Use a systems context
- Adopt a watershed perspective
- Avoid the need for mitigation
- Keep land acquisition to a minimum
- Federal participation in monitoring and adaptive management consistent with Federal law and USACE policy. (Section 2039, WRDA 2007 requires monitoring to determine ecological success and allows for up to 10 years of Federal cost-sharing for monitoring.)

3.5.1 Ecosystem Restoration Alternative Formulation

USACE Institute for Water Resources (IWR) Planning Suite was used to formulate alternatives based on the final increments/measures. Increments/measures were developed and screened such that all measures meet planning objectives and avoid planning constraints. Cost effectiveness and incremental cost analyses (CE/ICA) were performed and generated 11 Best Buy Plans (alternatives) in addition to the no action alternative:

Alternative 1 is the no action plan and assumes no action is taken as the result of this study.

Alternative 2 includes only increment 1 at Big Break, which would result in 42 acres of restored intertidal marsh habitat, requiring 500,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years. The total cost of this alternative is $5.4 million.

Alternative 3 includes increments 1 and 2 at Big Break, which would result in 52 acres of restored intertidal marsh habitat, requiring 624,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick placement site. The total cost of this alternative is $8.8 million.

Alternative 4 includes increments 1, 2, and 3 at Big Break, which would result in 70 acres of restored intertidal marsh habitat, requiring 834,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick and Scour placement sites. The total cost of this alternative is $14.7 million.

Alternative 5 includes increments 1, 2, 3, and 5 at Big Break, which would result in 80 acres of restored intertidal marsh habitat, requiring 959,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick, Scour, and Decker placement sites. The total cost of this alternative is $18.5 million.

Alternative 6 includes increments 1, 2, 3, and 5 at Big Break and increment 1 at Little Franks Tract, which would result in 89.5 acres of restored intertidal marsh habitat, requiring 1,112,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick, Scour, Decker, and Bradford placement sites. The total cost of this alternative is $21.9 million.

Alternative 7 includes increments 1, 2, 3, 4, and 5 at Big Break and increment 1 at Little Franks Tract, which would result in 90.5 acres of restored intertidal marsh habitat, requiring 1,123,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick, Scour, Decker, Bradford, and Augusta Pit placement sites. The total cost of this alternative is $22.4 million.

Alternative 8 includes increments 1, 2, 3, 4, 5, and 6 at Big Break and increment 1 at Little Franks Tract, which would result in 95 acres of restored intertidal marsh habitat, requiring 1,173,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick, Scour, Decker, Bradford, Augusta Pit, and Rio Vista placement sites. The total cost of this alternative is $25.2 million.

Alternative 9 includes increments 1, 2, 3, 4, 5, and 6 at Big Break; increment 1 at Little Franks Tract; and increments 1 and 2 at Franks Tract, which would result in 234 acres of restored intertidal marsh habitat, requiring 3,564,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years and via pumping of previously dredged material from the McCormick, Scour,

Decker, Bradford, Augusta Pit, Rio Vista, Roberts 1, and Roberts 2 placement sites. The total cost of this alternative is $149.9 million.

Alternative 10 includes increments 1, 2, 3, 4, 5, 6, and 7 at Big Break; increment 1 at Little Franks Tract; and increments 1 and 2 at Franks Tract, which would result in 1,212 acres of restored intertidal marsh habitat, requiring 15,231,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years; via pumping of previously dredged material from the McCormick, Scour, Decker, Bradford, Augusta Pit, Rio Vista, Roberts 1, and Roberts 2 placement sites; and via trucking and barging from borrow sites within a 30 mile radius. The total cost of this alternative is $2,039.9 million.

Alternative 11 includes increments 1, 2, 3, 4, 5, 6, and 7 at Big Break; increments 1 and 2 at Little Franks Tract; and increments 1 and 2 at Franks Tract, which would result in 1,476 acres of restored intertidal marsh habitat, requiring 19,645,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years; via pumping of previously dredged material from the McCormick, Scour, Decker, Bradford, Augusta Pit, Rio Vista, Roberts 1, and Roberts 2 placement sites; and via trucking and barging from borrow sites within a 30 mile radius. The total cost of this alternative is $2,695.4 million.

Alternative 12 includes increments 1, 2, 3, 4, 5, 6, and 7 at Big Break; increments 1 and 2 at Little Franks Tract; and increments 1, 2, and 3 at Franks Tract, which would result in 3,807 acres of restored intertidal marsh habitat, requiring 59,901,000 cubic yards of fill material which would be placed via direct placement of dredged material from yearly Operations and Maintenance dredging from the Stockton Deep Water Ship Channel for a period of five years; via pumping of previously dredged material from the McCormick, Scour, Decker, Bradford, Augusta Pit, Rio Vista, Roberts 1, and Roberts 2 placement sites; and via trucking and barging from borrow sites within a 30 mile radius. The total cost of this alternative is $8,673.4 million.

A summary of alternatives is provided in Table 3-16.

Table 3-16. Final Array of Alternatives.

Material Source	Alt.	Marsh Wren Habitat Output (AAHU*)	Description (Increments Included)
N/A	1	0	No Action
O&M	2	41.3	Big Break – 1
Pumping	3	51.5	Big Break – 1,2
	4	68.8	Big Break – 1,2,3
	5	79.1	Big Break – 1,2,3,5
	6	88.1	Big Break – 1,2,3,5 & Little Frank's Tract 1
	7	92.2	Big Break – 1,2,3,5,6 & Little Frank's Tract 1
	8	93.1	Big Break – 1,2,3,4,5,6 & Little Frank's Tract 1
	9	229.9	Big Break – 1,2,3,4,5,6 & Little Frank's Tract 1 & Frank's Tract 1,2
Trucking/ Barging	10	1,193.1	Big Break – 1,2,3,4,5,6,7 & Little Frank's Tract 1 & Frank's Tract 1,2
	11	1,452.8	Big Break – 1,2,3,4,5,6,7 & Little Frank's Tract 1,2 & Frank's Tract 1,2
	12	3,747.5	Big Break – 1,2,3,4,5,6,7 & Little Frank's Tract 1,2 & Frank's Tract 1,2,3

*Average Annual Habitat Units

3.6 Evaluation of Final Array of Alternative Plans

A standard Habitat Evaluation Procedure (HEP) was used to quantify outputs for the CE/ICA. The Habitat Suitability Model for the Marsh Wren was used to assess outputs of each alternative. The marsh wren requires emergent herbaceous vegetation, typically cattails and bulrushes for nesting and cover in water greater than 15 centimeters. The intertidal marsh habitat being proposed would meet typical marsh wren requirements and is a scarce habitat type within the Delta. This model was selected because it is an approved bluebook model that has been used in other projects in the area, is focused on the target habitat type, and has been coordinated with the U.S. Fish and Wildlife Service.

Model assumptions were developed as the basis for the assessment. The assumption regarding existing and future without-project conditions is that little to no intertidal marsh habitat is or will be present at the sites; therefore, AAHU with-project are projected at 0. The future with-project assumption is that elevations are restored to support a robust intertidal marsh habitat. HEP outputs are shown in Table 3-17.

Table 3-17. Summary of HEP Outputs by Alternative.

ALT	AAHU Without Project	AAHU With Project	Net Change in AAHU
1	0	0.0	0.0
2	0	41.3	41.3
3	0	51.5	51.5
4	0	68.8	68.8
5	0	79.1	79.1
6	0	88.1	88.1
7	0	92.2	92.2
8	0	93.1	93.1
9	0	229.9	229.9
10	0	1,193.1	1,193.1
11	0	1,452.8	1,452.8
12	0	3,747.5	3,747.5

3.7 Comparison of Alternative Plans

3.7.1 Cost Effectiveness and Incremental Cost Analysis

Alternatives were compared based on costs and outputs, as well as other criteria such as contribution to planning objectives, environmental factors, completeness, effectiveness, efficiency, and acceptability were relatively consistent between alternatives. This comparison was made using IWR Planning Suite to conduct cost effectiveness and incremental cost analysis based on costs (dollars) and outputs (marsh wren AAHU). Incremental costs per unit of output were used to identify major breakpoints in cost efficiency among the alternatives. These outputs are shown in Table 3-18 and Figures 3-12 and 3-13:

Table 3-18. Incremental Cost and Outputs of Alternatives.

ALT	Marsh Wren Habitat Output (AAHU)	Total Annual Cost ($1,000)	Average Cost per AAHU ($1)	Incremental Annual Cost ($1,000)	Incremental Output (AAHU)	Incremental Annual Cost Per AAHU ($1)
1	0.0	$0	$0	$0	0	$0
2	41.3	$198	$4,794	$198	41.3	$4,794
3	51.5	$351	$6,816	$153	10.2	$15,000
4	68.8	$639	$9,288	$288	17.3	$16,647
5	79.1	$818	$10,341	$179	10.3	$17,379
6	88.1	$977	$11,090	$159	9	$17,667
7	92.2	$1,095	$11,876	$118	4.1	$28,780
8	93.1	$1,122	$12,052	$27	0.9	$30,000
9	229.9	$7,081	$30,800	$5,959	136.8	$43,560
10	1,193.1	$61,208	$51,302	$54,127	963.2	$56,195
11	1,452.8	$85,954	$59,164	$24,746	259.7	$95,287
12	3,747.5	$322,625	$86,091	$236,671	2294.7	$103,138

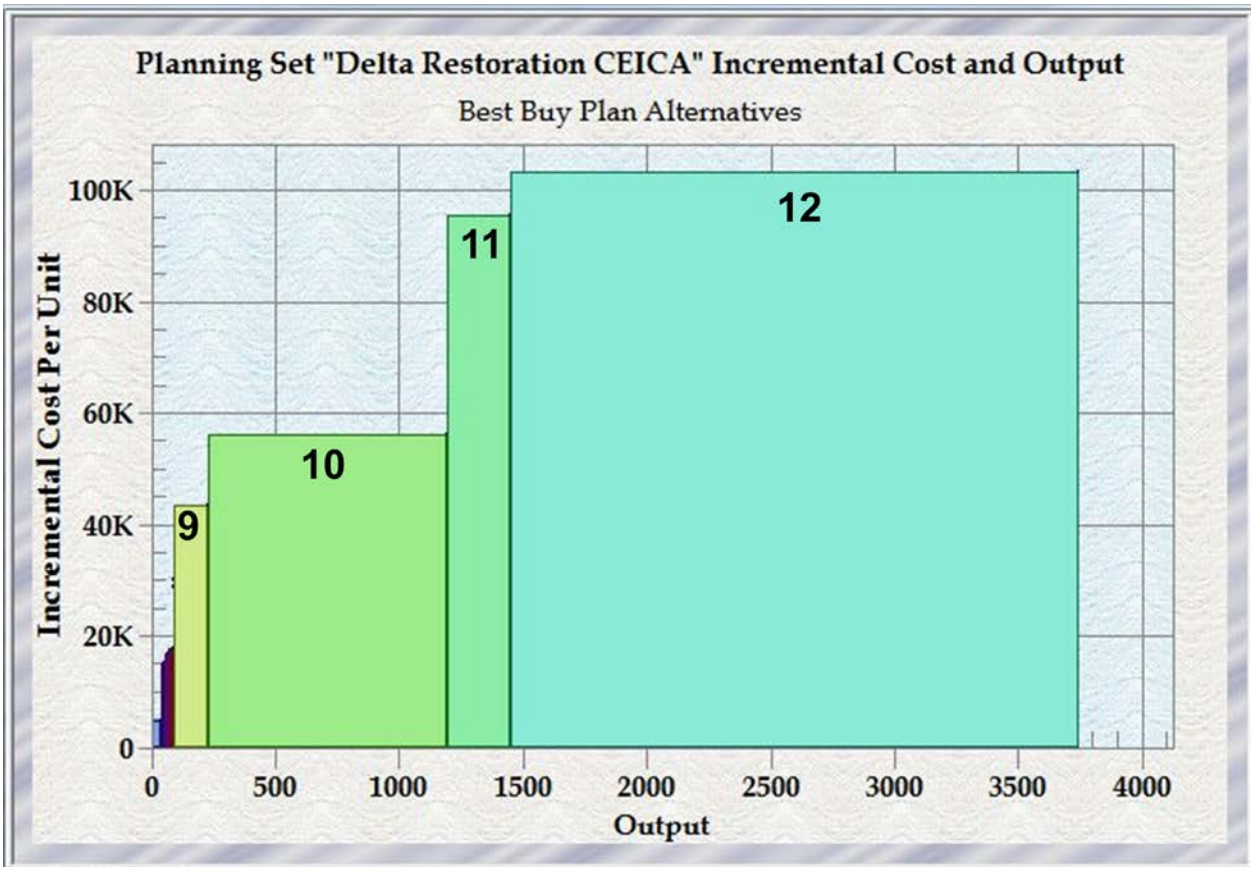

Figure 3-12. Incremental Cost and Outputs of Alternatives 1-12.

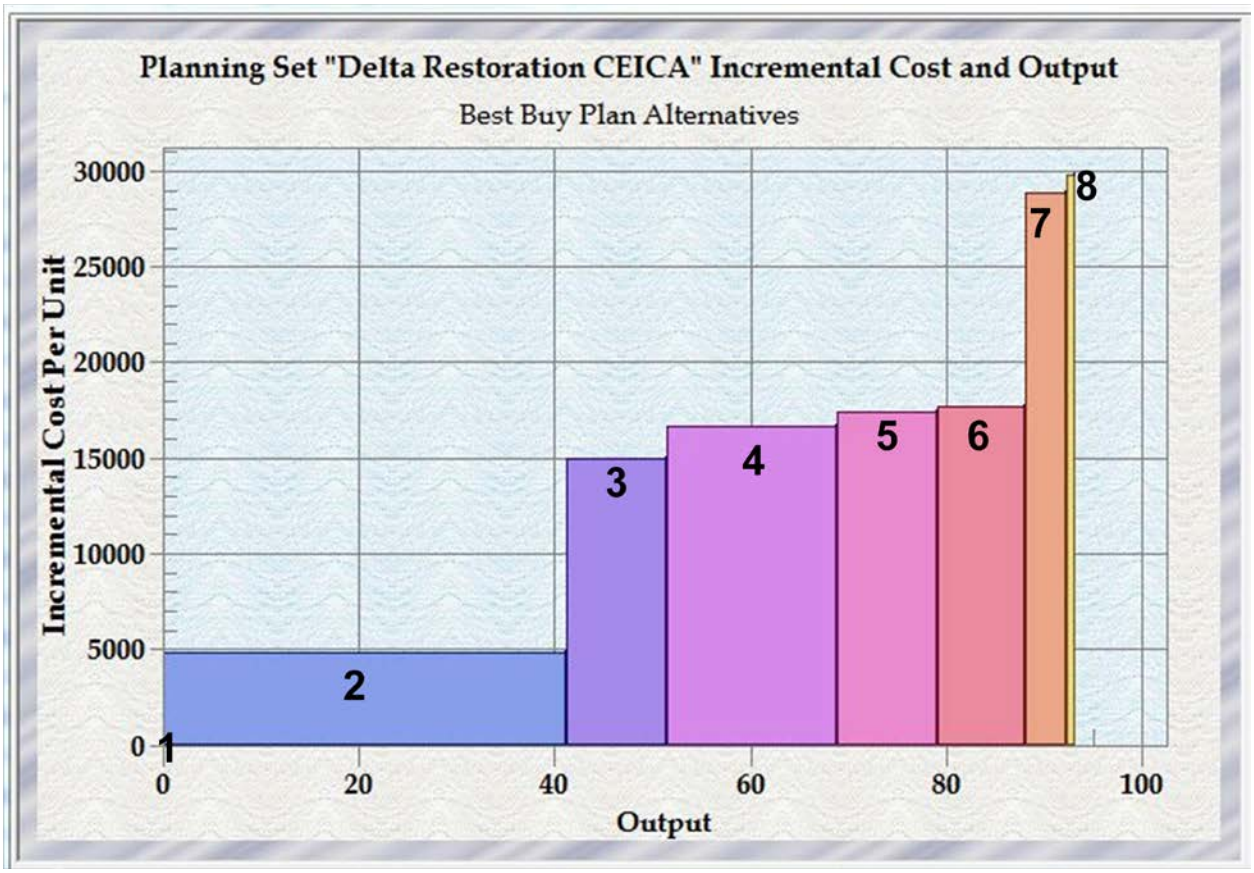

Figure 3-13. Incremental Cost and Outputs of Alternatives 1-8.

3.7.2 Contribution of Alternatives to Planning Objectives

All 11 action alternatives achieve the first ecosystem restoration planning objective of increasing area, connectivity, and diversity of native tidal aquatic and related habitats within the study area during the period of analysis. None of the alternatives achieve the second objective, which was to increase area, connectivity, and diversity of non-tidal or riparian habitats, as an effective opportunity did not exist under the assumed future without-project condition. The extent to which alternatives increase area of tidal habitat is the discriminating factor between alternatives. Historically, the Delta was comprised almost entirely of about 350,000 acres of tidal marsh, yet less than 5 percent of this remains. Any contribution to restoring tidal habitat would be seen as beneficial in this ecosystem of national significance. Although more habitat area would be viewed as better from an ecological perspective, the extent of Federal investment will be driven by incremental costs necessary to achieve those additional outputs.

3.8 Tentatively Selected Plan

A recommendation for plan selection was made by identifying the plan that reasonably maximizes environmental outputs relative to costs while meeting planning objectives and avoiding planning constraints. As all alternatives are cost effective, every alternative achieves the greatest number of outputs for a given cost; therefore, incremental costs per output were used to identify the NER Plan.

Outputs increase as alternatives progress (1-12); however, these outputs are achieved at increasingly higher incremental costs. Breaks in incremental cost are found at Alternatives 2, 6, 8, and 12; therefore, these alternatives were identified as the most logical candidates for plan selection. The incremental cost increase from Alternative 2 to Alternative 6 is $244,000, but this cost increase is accompanied by an increase in AAHU outputs from 42 to 88, more than doubling the outputs. The incremental cost increase from Alternative 6 to Alternative 8 is similar at $299,000, yet this cost increase is only accompanied by an increase in AAHU outputs from 88 to 93. The incremental cost increase from Alternative 8 to Alternative 12 is $1,849,000, which was determined to be unreasonable for the outputs achieved. For these reasons, Alternative 6 is recommended for plan selection and is shown in Figure 3-14.

Alternative 6 is the most reasonably efficient contribution to the California Delta, an ecosystem of national significance, restoring 89.5 acres of intertidal marsh habitat at a cost of $22 Million. Millions of Federal dollars have been spent in recent decades to study the Delta, yet very little restoration has occurred. This plan would allow progress to be made toward significant, cost-effective ecosystem restoration, while beneficially using previously dredged material and future dredged material from USACE projects. If the San Francisco Bay to Stockton Navigation Improvement Project, currently under investigation, is authorized and funded, this would produce readily available dredged material that could be used to restore an additional 2,000 acres. This could mean increments 4, 6, and 7 at Big Break; increment 2 at Little Franks Tract; and increments 2 and 3 at Franks Tract should be re-evaluated because they could become considerably more cost effective as additive to the current TSP.

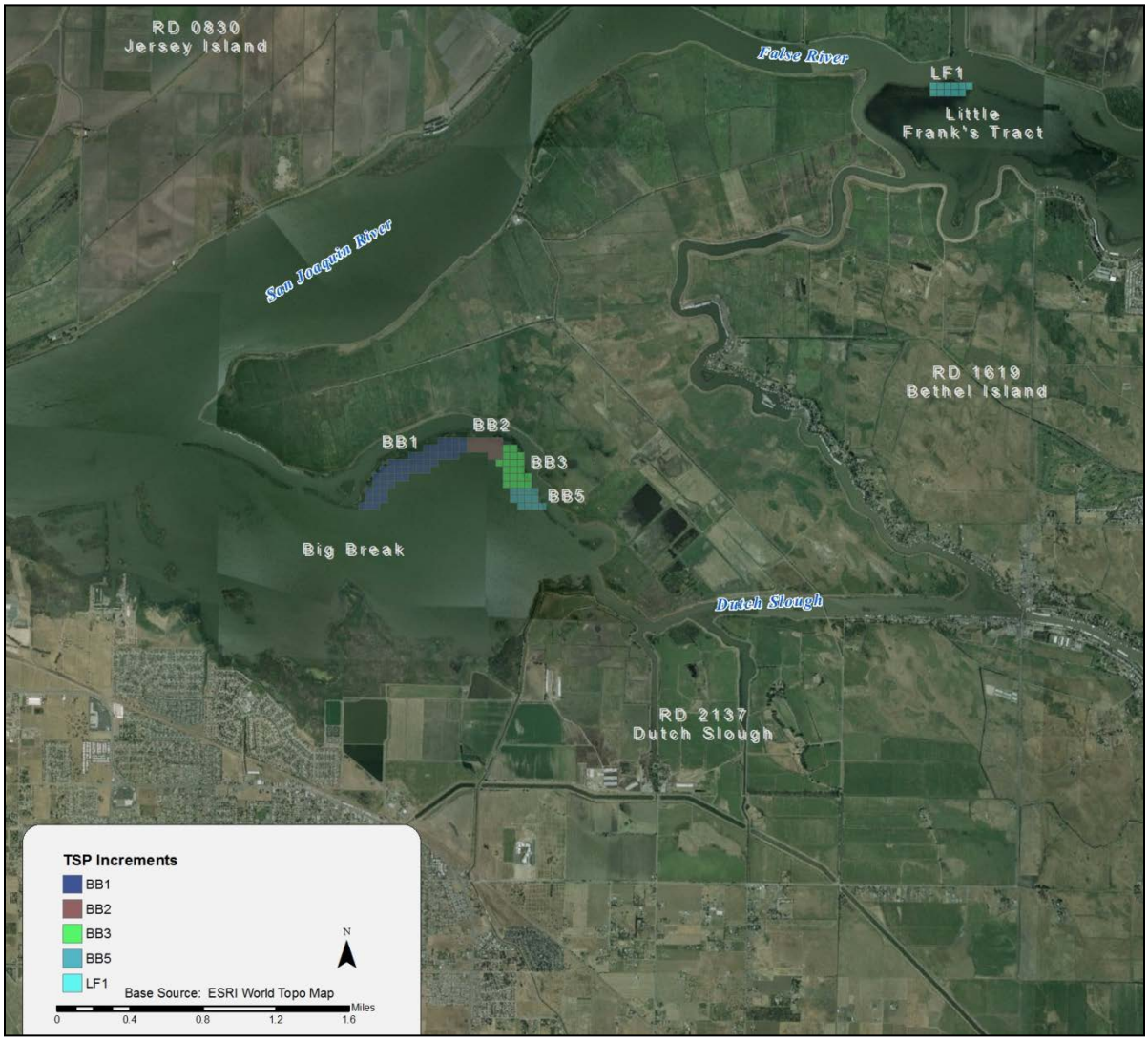

Figure 3-14. Tentatively Selected Plan (Alternative 6).

3.9 NEPA Project Description

NEPA requires a greater level of detail in order to properly analyze the potential effects of the proposed alternatives on the natural and human environment. Chapter 4 includes a description of the affected environment in the study area, followed by Chapter 5, which includes a discussion of the potential environmental effects of the proposed alternatives that are described below.

A final array of alternatives for Ecosystem Restoration was developed using cost effectiveness and incremental cost analysis (CE/ICA). As discussed in Section 3.5 above, 11 alternatives were developed in addition to the no action alternative for consideration and further analysis. These alternatives were later screened to eliminate alternatives from further analysis under NEPA. The NEPA screening process and detailed alternative descriptions are described below.

3.9.1 Alternatives not Considered in Detail

Alternatives 3, 4, and 5 were considered independently but were ultimately combined using the CE/ICA and included in Alternative 6, an action alternative and the TSP.

Alternatives 7 and 8 resulted in increased incremental cost per habitat unit that was nearly double that of the TSP and was considered to be too high to be carried forward. The increased cost for Alternative 7 was primarily due to having to pump a relatively small amount of material from the Rio Vista Pit across both the Sacramento River and San Joaquin River. Alternative 8 was eliminated from further consideration because the amount of available borrow material at Augusto Pit would provide less than an acre of tidal marsh habitat and the cost of pumping such a small amount of material doubled the incremental cost per output.

Alternative 9 included increments 1 and 2 at Franks Tract. The source of material would come from Roberts Island 1 and 2, and would require the material to be pumped approximately 6 miles across many small waterways and private property. The increased cost in pumping and real estate eliminated Alternative 9 from further consideration.

Alternatives 10, 11, and 12 would all require a large amount of borrow material to be trucked or barged to the restoration sites. The incremental cost per output of trucking and barging would be about five times higher than the TSP. Additionally, no borrow sites have been identified that could provide the material, and the environmental affects to local roads, waterways, and air quality would be much greater than the TSP. Therefore these alternatives were eliminated from further consideration.

3.9.2 NEPA Action Alternatives

In addition to Alternative 1, the no action alternative, Alternatives 2 and 6 are carried forward to be considered in detail. Alternative 2 proposes intertidal marsh restoration at Big Break via direct placement from annual operations and maintenance (O&M) dredging. Alternative 6 proposes, in addition to the tidal restoration via O&M dredging, to also use previously stockpiled material from four source material sites to create additional increments of intertidal marsh restoration at both Big Break and Little Franks Tract. Alternatives 1, 2, and 6 are described in greater detail in the following sections.

Alternative 1 – No Action

Under no action, the Corps would not participate in ecosystem restoration in the project area as part of the Delta Islands and Levees Feasibility Study. The ecosystems of the Delta, as represented by the project area, would continue to degrade over time, with

the associated decline and loss of Delta habitats and species. The no action alternative would not meet the planning goal to restore sustainable ecosystem functions in the Delta.

Ecological characteristics, such as spatial extent, habitat heterogeneity, and dynamic storage, would remain substantially altered as a result of past and present land use and water management practices in the Delta. Fragmentation and loss of shallow open waters, tidal marsh, and shaded riverine aquatic habitats due to past channelization and construction of levees would remain, as would the separation of historic floodplains from natural hydrologic flooding events through the channels in the Delta. Nearly 95 percent of the historic intertidal and tidal wetland habitats in the Delta remain converted to agricultural and urban uses.

This continuing loss and fragmentation of habitats would provide reduced habitat values, thus supporting fewer numbers and types of both plant and animal species. Native species, including Federally listed threatened, endangered, and proposed species, such as Antioch Dunes evening-primrose, Delta smelt, and salmonids, would likely continue to decline in overall health and numbers due to degraded soil and water quality conditions. In addition, degraded conditions have led to the introduction and propagation of non-native invasive species such as egeria and water hyacinth that out-compete and replace native species for limited resources.

Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

Alternative 2 includes only Big Break increment 1 using O&M dredging over a five year period to create 41.9 acres of intertidal marsh habitat. As part of a separate dredging project, the Sacramento District is currently updating a Biological Assessment for submittal to the U.S. Fish and Wildlife Service (USFWS). A subsequent Biological Opinion is expected to be issued by the USFWS allowing the Corps to begin maintenance dredging activities in 2015. Dredged material would come from O&M activities in the San Joaquin River between station points 200+00 and1000+00 (Figure 3-8). Wet material would be directly pumped to the restoration sites, rather than their typical dredged material placement sites. A chemical and granular composition analysis of the materials would be conducted in advance of placement. The environmental effects of the O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, a brief description of these activities is included in the following section.

O&M Wet Dredged Material

A pipeline hydraulic suction dredge will be used to accomplish the dredging project under the existing General Order (GO) Waste Discharge Requirement No. 05-01-116 for the Sacramento and Stockton Deep Water Ship Channels (DWSC). The General Order allows for clamshell dredging to be used if practicable and if contract or project conditions change. Dredging rates vary depending on the type of material being dredged,

but production rates of 300 to 600 cubic yards per operational hour are typical. The dredging operations are expected to be conducted 24 hours per day, 7 days per week. Typically, approximately 18 hours per day are considered 'operational,' during which dredging occurs.

Wet material would be pumped from the dredging ship directly to the placement sites at Big Break. Materials would be pumped to the proposed project areas through a floating 18 inch double wall high density plastic extrusion (HDPE) pipe. The piping system would be placed along the shoreline of the Stockton DWSC in the San Joaquin River. The pipeline would be submerged and anchored to the bottom when necessary to avoid navigation hazards. A floating repeater pump station would be positioned every 3 miles as necessary to aid slurry flow. Work boats would install and maintain the floating pipeline. An additional work boat and crew would tender the position of the outfall slurry pipe during pumping operations to ensure correct placement of materials. Placement would occur over a five year period from August 1 to November 30.

Material Placement

The hydraulic slurry would be discharged at the restoration sites at a rate of 450 cubic yards per hour or 4,000 cubic yards per day. Placement would begin using remnant levees as an anchor/starting point. Turbidity curtains and sacrificial hay bales would be used to control sediment plumes, comply with water quality requirements, and aid with settlement. The tops of the sacrificial hay bale line would be set at mean low tide level to allow fish an opportunity to escape the work area. Turbidity curtains float slightly above the bottom allowing aquatic species to escape entrapment. Pumped materials would be placed to bring the tract soil depth to 4.5 feet relative to mean sea level.

Plantings

The planting design includes planting bulrush (Typha sp.) installed over the newly created areas. Plantings would be installed at 3 feet on center over 10 percent of the intertidal marsh area. The plant material may be nursery grown or collected from nearby sources and directly planted at the site.

Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

The O&M dredging, material placement, and plantings for Alternative 6 would be the same as described above for Alternative 2. In addition to O&M dredging, stockpiled dredged material would also be used to create an additional 47.6 acres of intertidal marsh habitat at Big Break and Little Franks Tract for a total of 89.5 acres. Existing dredged materials stored at dry placement sites located at Sherman Island McCormack Pit, Sherman Island Scour Pond, Decker Island, and Bradford Island would also be used to provide the additional materials needed for this acreage (Figure 3-8). Tables 3-19 and 3-20 display the incremental material sources.

Table 3-19. Big Break Material Sources.

Increments	Source	Placement Method	Potential Acreage Creation	Volume (cubic yards)
1	O&M	Direct Placement	41.9	500,000
2	McCormick	Pumping	10.4	124,000
3	Scour Pond	Pumping	17.6	210,000
5	Decker	Pumping	10.4	125,000
Total			80.3	959,000

Table 3-20. Little Franks Tract Material Sources.

Increments	Source	Placement Method	Potential Acreage Creation	Volume (cubic yards)
1	Bradford	Pumping	9.2	153,000

Preparation and Equipment Mobilization

Site mobilization would commence in August of each construction year. The work window would be from August 1 to November 30. Work hours would be 7:00 am to 4:00 pm Monday through Thursday. The source material sites that contain vegetation, large rocks, snags, and uneven terrain would be cleared, grubbed, and in some cases leveled to provide a flatter working surface.

Following site preparations, the equipment and materials necessary for movement of dredged materials would be imported to designated staging areas and set up, assembled, parked, stored, and/or stockpiled for use. It is anticipated that throughout the multi-year construction period, construction equipment, materials, and supplies would be replenished, replaced, dismantled, removed, and changed-out as needed in the appropriate staging areas to support the various material pumping actions.

Staging Areas

It is anticipated that temporary diesel or propane 3-phase 120/240-volt electric power generator would be provided during the multi-year construction period to run construction equipment including conveyors, water pumps, slurry mixers, and pumping stations. To supply the necessary electrical power, a small temporary substation-switching station would be set up at the staging area.

Fluidization/Pumping Plant

Existing dredged materials from the stockpile sites would be pumped to the proposed project areas through 18" double wall HDPE pipe. A hydraulic slurry hopper at the stockpile site would create the fluidization process necessary to transport the dredged stockpile materials. Water necessary for the process would be siphoned from the adjacent rivers by a hydraulic pump and transferred to the slurry hopper. A loader would place dredged materials onto a conveyer system that deposits materials into the slurry hopper. The hopper mixes dredge materials with water creating a 90 percent water based slurry solution which is pumped through the HDPE piping network. In-water piping which is not anchored to the bottom would float at the surface by means of floatation devices. A work boat and crew would tender the position of the outfall slurry pipe during pumping operations to ensure correct placement of materials.

The stockpiled dredge materials would be pumped between August 1 and November 30 over four years. During the first year of construction dredge materials from the McCormack Pit site would be pumped to the Big Break restoration areas. The McCormack Pit site would then serve as a permanent repeater pump site for the subsequent years. An additional pump would be positioned at Sherman Island Scour Pond, and then moved the following year to Scour Pond, and finally Decker Island. The Bradford Island site would be pumped to Little Franks Tract in year one. Table 3-21 shows the pump station position by year and material destination.

The HPDE piping schematic (Figure 3-8) would require permissions and permits necessary to place pipe sections on private property, over levees, and through water courses. Major river crossings at navigable channels would require submerged piping. Pipe segments would be anchored to the bottom in order to avoid impacts to shipping and recreation. A specialized marine craft with a crane and underwater processing head would be required for the anchoring process. The crane and pipe processing head install and secure the segments on the river bottom. When possible, pipe sections crossing farmland would be positioned along the edge of farm roads in order to avoid impacts to farm operations or special status species populations.

Table 3-20. Pump Station Positioning by Year.

Source	Destination	Year	Length to Placement Site	Volume (cubic yards)	Accessibility
McCormick	Big Break	2019	2 miles	124,000	Ex. County Roads
Scour Pond	Big Break	2020	5 miles	210,000	Ex. County Roads
Decker	Big Break	2021	5 miles	125,000	River Access/Boat
Bradford Island	Little Franks	2022	2 miles	153,000	Ferry, Ex. County Roads

Site Restoration and Monitoring

Following construction material source sites would be graded for proper drainage and elevation as determined by construction plans and specifications. Construction and pumping equipment would be demobilized and removed from the site. The site would be cleaned and hydroseeded with native grasses to prevent erosion, if necessary.

At the intertidal marsh restoration sites, new vegetative plantings would not require maintenance. Soil accretion and vegetative recruitment have historically aided plantings on restored intertidal marsh habitats. Plantings typically survive and reach desired density within 2 years. Monitoring records and reports would be required to document planting processes and progress.

CHAPTER 4.0 – AFFECTED ENVIRONMENT

This section describes the pre-project conditions of the environmental resources in the project area. In Chapter 5.0, these pre-project conditions are compared to the with-project conditions in order to determine the effects of the proposed project. Resources less likely to be adversely affected by the project are described first, followed by the resources that may be affected by the alternatives. Although all resources are subject to some change over time, most of these resources are not expected to change significantly during the period of analysis for this study. Thus for most of the resources in the affected environment existing conditions are assumed in this environmental analysis to be the future without-project conditions as well.. Excepted resources which are likely to experience significant changes due to implementation of one of the proposed alternatives include vegetation and wildlife, special status species, land use, socioeconomics, and traffic and circulation. These resources are described in greater detail in Section 4.2 below.

4.1 Resources Not Considered In Detail

Initial evaluation of the effects of the project indicated that there would likely be little to no effect on several resources. These resources are discussed in Sections 4.1.1 through 4.1.10 to add to the overall understanding of the area. Sections 4.2.1 through 4.2.6 describe existing conditions for those resources that are more likely to be affected by implementation of the proposed alternatives.

4.1.1 Geology and Seismicity

Geology

The Delta and Suisun Marsh lie within California's Central Valley, which is approximately 465 miles long and 40 to 60 miles wide. The valley is bounded by the Sierra Nevada on the east and the Coast Ranges on the west. Paleogeographic reconstructions of this region indicate that Miocene sedimentation was similar to a modern fore-arc basin (a sea floor depression between a subduction zone and an associated volcanic arc), shedding arkosic (granular quartz and feldspar or mica), and volcanoclastic sediments westward from the continent. In the mid-Pliocene Epoch, a shift in plate tectonics triggered uplift of the Coast Ranges, which gradually closed the southern marine outlet to the basin. By the late Pliocene, sub-aerial conditions prevailed throughout the valley, resulting from marine regression (i.e., when the oceans were regressing seaward over land) and sedimentation from the west. During Pleistocene Epoch, the valley separated from the Pacific Ocean and developed internal drainage, the modern outlet being the Carquinez Strait, through which the Sacramento River flows to the San Francisco Bay (Lettis and Unruh 1991).

The historical Delta evolved at the inland margin of the San Francisco Bay Estuary as two overlapping geomorphic units. The Sacramento River Delta comprises about 30% of the total area and was influenced by the interaction of rising sea level and river floods that created channels, natural levees, and marsh plains. During large river flood events, silts and sands were deposited adjacent to the river channel, forming natural levees above the marsh plain. In contrast, the larger San Joaquin River Delta—located in the central and southern portions of the Delta and having relatively small flood flows and low sediment supply—formed as an extensive, unleveed freshwater tidal marsh dominated by tidal flows and organic soil (peat and muck) accretion (Atwater and Belknap 1980). Because the San Joaquin River Delta had less well defined levees, sediments were deposited more uniformly across the floodplain during high water, creating an extensive tule marsh with many small branching tributary channels. As a result of the differential amounts of inorganic sediment supply, the peats and mucks of the San Joaquin River Delta grade northward into peaty mud and then into mud as it approaches the natural levees and flood basins of the Sacramento River Delta (Atwater and Belknap 1980). The proposed alternatives are small-scale ecosystem restoration projects that would restore the proposed locations to historic conditions. As a result, the project would have no effect on the geologic features in the project area.

Seismicity

The California Coast Ranges physiographic province lies along the complex boundary between two tectonic plates: the North American Plate and the Pacific Plate. The geologic and tectonic conditions in the Delta and Suisun Marsh have been, and continue to be, controlled primarily by the interaction of these two massive blocks of the Earth's crust. Under the current tectonic regime, the Pacific Plate moves northwestward relative to the North American Plate at a rate of about 1.57 inches (40 millimeters) per year (Working Group on California Earthquake Probabilities 2003). Although relative motion between these two plates is predominantly lateral (strike-slip), an increase in convergent motion along the plate boundary within the past few million years has resulted in the formation of mountain ranges and structural valleys of the Coast Ranges province.

The San Andreas Fault system dominates the seismicity of the region, and it comprises several major faults including the San Andreas, Hayward–Rodgers Creek, Calaveras, Concord–Green Valley, and Greenville faults. In addition to these major faults, many other named and unnamed regional faults accommodate relative motion between the plates and relieve compression stresses that also act along the plate boundary.

The Delta and Suisun Marsh are in the eastern portion of the greater San Francisco Bay region, one of the most seismically active areas in the United States. Since 1800, several earthquakes with magnitudes greater than 6.5 have occurred in the immediate San Francisco Bay Area, including the 1868 magnitude 6.8 earthquake on the Hayward Fault, the 1906 magnitude 7.9 San Francisco earthquake on the San Andreas

Fault, and the more recent 1989 magnitude 6.9 Loma Prieta earthquake that occurred in the Santa Cruz Mountains.

The proposed alternatives are small-scale ecosystem restoration projects in rural areas. There are no permanent structures associated with the proposed alternatives that would require compliance with State seismic laws and regulations. As a result, the proposed alternatives would not be impacted by seismicity within the project area.

4.1.2 Topography and Soils

Topography

Soils formed in the Sacramento–San Joaquin Delta (Delta) as the result of geologic processes over approximately the past 7,000 years. These processes produced landward accumulation of sediment behind the bedrock barrier at the Carquinez Strait, forming marshlands comprising approximately 100 islands that were surrounded by hundreds of miles of channels (Weir 1950). Generally, mineral soils formed near the channels during flood conditions and organic soils formed on marsh island interiors as plant residues accumulated faster than they could decompose. Prior to the mid-1800s, the Delta was a vast marsh and floodplain, under which peat soils developed to a thickness of up to 30 feet in many areas (Weir 1950), with a thickness of approximately 55 feet in the vicinity of Sherman Island (Real and Knudsen 2009). The tidal portion of the Delta consisted of backwater areas, tidal sloughs, and a network of channels that supported highly productive freshwater tidal marsh and other wetland habitats (CALFED Bay-Delta Program 2000). The study area consists of sunken islands with remnant levees which are subject to tidal inundation. The majority of the study area is under water. While the proposed alternatives do involve reusing dredged materials to raise the elevation of these sunken islands, the purpose of the action is to restore these islands to historic conditions. As a result, the proposed alternatives would have no effect on the major topographic features in the project area.

Soils

Soils in the study area are extremely variable in texture and chemical composition. The soil composition of the islands surrounding the study are a combination of peat beds in the center of islands with relatively coarse textured inorganic sediments deposited in the channels and along the margins of the islands soils in perimeter marsh areas around islands are comprised of peat beds that accumulated and were preserved under anoxic conditions (lack the presence of oxygen). In contrast, soils in channels and along the higher energy channel margins of islands tend to be comprised primarily of mineral sediment. The peat soils have been largely drained, resulting in oxidation of organic matter and subsequent large-scale land subsidence on Delta islands (Deverel, S. J., and S. Rojstaczer. 1996). The soils that would be used as part of the proposed alternatives are dredged materials that originate from the waterways within the study

area. Reusing this soil to create intertidal marsh habitat would not have any impact on the existing soils in the study area.

4.1.3 Hydrology and Hydraulics

The Delta watershed includes the tributary rivers that flow into the Delta from the Sacramento River and the San Joaquin River basins (Figure 2-1). In general, the Delta watershed is represented by the drainage of the Central Valley except for the Tulare Lake area. Areas outside of the Delta that receive Delta water include Tulare Lake, San Francisco Bay, Central Coast, and Southern California. The project area is not isolated and subject to the overall hydrologic and hydraulic processes, both natural and human, which are present in the Delta.

Delta Hydrology

The hydrologic function of the Delta involves the interaction of streamflow runoff from the major rivers and tidal inflow of salt water from the Pacific Ocean. Two major rivers supply the majority of the freshwater: the Sacramento River from the north and the San Joaquin River from the south. The runoff of the Sacramento River is greater, accounting for 80% of the freshwater runoff by volume. The water in the San Joaquin River and its tributaries has been highly diverted for agricultural use, and much of the runoff is diverted upstream of the Delta. At their junction, runoff from the Sacramento River channel near Sherman Island flows southward to create a freshwater barrier across the mouth of the San Joaquin; without this barrier, it is postulated that saltwater inflow to the south-central Delta would increase significantly.

Sacramento River Basin

The Sacramento River flows generally north to south from its source near Mount Shasta to the Delta. The Sacramento River receives contributing flows from numerous major and minor streams and rivers that drain the east and west sides of the basin, including the Feather River, Yuba River, and American River. In addition, Putah and Cache Creeks flow into the Yolo Bypass, which subsequently flows into the Cache Slough complex prior to entering the Sacramento River upstream of Rio Vista. The Sacramento River basin topography ranges in elevation from approximately 14,000 feet above sea level on Mount Shasta to approximately 1,070 feet at Shasta Dam, to sea level in the Delta. Generally, precipitation occurs in the form of snow during winter and early spring at elevations above 5,000 feet. The snowmelt generally occurs in April and May.

San Joaquin River Basin

The San Joaquin River originates in the Sierra Nevada and then flows west into the San Joaquin Valley through Millerton Lake at Friant. The San Joaquin River turns north near Mendota and flows through the San Joaquin Valley and into the Delta near Vernalis. The San Joaquin River receives contributing flows from the Fresno,

Chowchilla, Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes Rivers. The Calaveras, Mokelumne, and Cosumnes Rivers flow into the San Joaquin River within the boundaries of the Delta. When Kings River in the Tulare Lake hydrologic region floods, the San Joaquin River also receives flood waters as high as 5,000 cfs from the Kings River via Fresno Slough.

The San Joaquin River basin topography ranges in elevation from over 10,000 feet above sea level in the Sierra Nevada to sea level in the Delta. Generally, precipitation occurs in the form of snow during winter and early spring at the upper elevations, and snowmelt occurs in the late spring and early summer months. Flows in the San Joaquin River are regulated by operation of Friant Dam, which diverts water into the Central Valley Project (CVP) Friant Division. The Friant Division conveys water in the Madera Canal to the north and the Friant-Kern Canal to the south for irrigation and municipal and industrial water supplies, and releases water in the San Joaquin River to meet downstream water rights and instream flow requirements. Hydropower generation facilities in the upper reaches of the San Joaquin River influence water flows into Millerton Lake (formed by Friant Dam).

Delta Hydraulics

The Delta is a complex network of over 700 miles of tidally influenced channels and sloughs. Four strong forcing mechanisms drive circulation, transport, and mixing of water in the Delta: (1) freshwater river flow from drainages to the Delta; (2) tides from the west propagating from the Pacific Ocean through San Francisco Bay; (3) State Water Project (SWP) and CVP water supply facilities operating in the Delta; and (4) collective effects of in-Delta agricultural diversions (U.S. Geological Survey 2005).

Influence of Delta Inflows

The Sacramento River is the primary contributor to Delta inflows. The San Joaquin River is the second biggest contributor to Delta inflows. Finally, east side streams (Mokelumne, Cosumnes, and Calaveras Rivers) provide inflow to Delta annually that join from east and flow towards west.

Influence of Delta Tidal Flows

Tidal flows have a major influence on Delta hydraulics and vary with the extent of high and low tides. On average, tidal inflows to the Delta are approximately equal to tidal outflows. All tidal flows enter and leave the Delta along the San Joaquin River at Chipps Island. Water levels vary greatly during each tidal cycle, from less than one foot on the San Joaquin River near Interstate 5 to more than five feet near Pittsburg. Sea level rise is another factor that has a notable influence on Delta hydraulics. Factors affecting sea level rise include tidal variations, storm surges, large-scale changes in water temperature and wind forces, and climate-related changes.

Influence of the State Water Project and Central Valley Project on Delta Operations

The withdrawal rates at the south Delta intakes influence Delta hydraulics and can change the direction of flow of some waterways in the south Delta. The most influential effects occur on Old and Middle Rivers. Reverse flows also occur in False River in the western Delta and Turner Cut in the San Joaquin River.

South Delta hydraulics are influenced by several channels that have been widened or connected and by barriers to reduce connectivity between other channels to protect agricultural water uses or aquatic resources. Operations of these facilities affect operations of the SWP/CVP south Delta intakes (DWR 2009a).

Influence of Delta Agricultural Diversions

There are over 1,800 diversions in the Delta area that are estimated to divert up to 5,000 cfs during peak summer months. Most of these diversions are related to agricultural operations. Surface water in the Delta also is influenced by consumptive use of groundwater by agricultural crops and by seepage from the surface water into the interior of the islands and tracts. A substantial portion of the water diverted from the Delta or that seeps into the islands and tracts is returned to the Delta surface water by agricultural and drainage flows and seepage that is pumped from the islands and tracts into the Delta (DWR 2009b).

The creation of 90 acres of intertidal marsh habitat in the Delta estuary would not have an effect on hydraulic or hydrologic processes because of the small size of the area being created and the tidal influence of the water levels. The project is very small relative to the entire Delta system. Salinity and hydraulic analysis taken from existing reports support a conclusion of no change to water levels Because the project would only include the placement of fill material into open waters to create intertidal marsh habitat surface water, flood plain boundaries, flood characteristics, or flood control structures (such as levees) adjacent or downstream of the study area are not expected to change.

4.1.4 Land Use and Agriculture

Land Use

The study area evaluated for potential effects on land use includes the portions of Contra Costa and Sacramento counties. Although the greater Delta study area includes portions of Solano, Yolo, and San Joaquin counties, local land use issues are analyzed only for the areas where Alternatives 2 and 6 are located.

Big Break

Big Break is located in Contra Costa County, California. The majority of the land use surrounding Big Break is privately owned and designated for agriculture (58%). The remaining land uses include industrial (16%), residential (15%), recreation (5%), marina (2%) and public education facilities (1%). Big Break is interior tidal open water area owned by the state and local governments (Contra Costa County 2013a).

Little Franks Tract

Little Franks Tract is located in Contra Costa County, California. The majority of the land use surrounding Little Frank's Tract is privately owned and designated for agriculture (94%). The remaining land use is residential (6%). Little Franks Tract is interior tidal open water area owned by the state and local governments (Contra Costa County 2013a).

Borrow Sites

The proposed borrow sites are shown on Figure 3-8. The McCormick, Scour Pond, and Decker Island borrow sites are located in Sacramento County, California. The Bradford Island borrow site is located in Contra Costa County, California. Land use designations for the disposal sites are agricultural (Sacramento County 2013; Contra Costa County 2013b).

County General Plans

This section identifies relevant land use designations, goals, objectives, and policies related to land use in adopted local general plans of Sacramento Country and Contra Costa counties within the study area. These counties have incorporated policies developed by the Delta Protection Commission (DPC) under the Delta Protection Act of 1992 (Public Resources Code (PRC) Section 29700), into their general plans and zoning codes, which enables implementation of the Land Use and Resource Management Plan for the Primary Zone of the Delta at the county level. The Primary Zone lands generally are designated for agriculture or special Delta resources in their respective general plans. The zoning codes allow a variety of uses in the Primary Zone: agriculture and agriculturally oriented uses; outdoor recreation; wildlife habitat; public facilities; and limited areas for commercial, industrial, and rural residential development. The parcel sizes specified in the general plans and zoning codes range from 5 to 160 acres, with most of the Primary Zone in the 20 to 80 acre minimum parcel sizes. General plan policies relevant to specific resource areas (e.g., aesthetics, cultural resources, minerals, visual resources, transportation) are discussed in the sections corresponding to those resources.

Sacramento County General Plan

The Sacramento County General Plan update was adopted on November 9, 2011. The plan seeks to provide a sustainable growth management program for the unincorporated territory through 2030. The area within Sacramento County potentially affected by the action alternatives is largely agricultural. The applicable general plan policies that are potentially affected by the action alternatives specifically address farmland of importance, preservation of agricultural practices, habitat preservation, and open space creation.

Contra Costa County General Plan

A comprehensive update to the Contra Costa County General Plan 2005–2020 was adopted on January 18, 2005, to guide future growth, development, and resource conservation through 2020 (Contra Costa County 2005). Amendments to the general plan occurred in 1996 and 2005 to reflect changes to the land use map and the incorporation of the city of Oakley, and the Housing Element was updated in 2009 (Contra Costa County 2013a).

The area within Contra Costa County potentially affected by the action alternatives is largely agricultural. The applicable general plan policies that potentially affected by the action alternatives specifically address farmland of importance, habitat preservation, open space creation, and providing Delta recreation opportunities.

The proposed alternatives involve restoring the open water habitat of sunken islands to their historic tidal marsh condition. There would be no changes in land use policies associated with any of the proposed alternatives. All restoration work would be consistent with local plans and policies. As a result, there would be no effect to land use and no mitigation would be required.

Agriculture

The California Department of Conservation uses the U.S. Department of Agriculture's modern classification when administering the Farmland Mapping and Monitoring Program to characterize the types and amounts of agricultural land in an area. Agricultural lands in the study area are primarily characterized as:

- Prime farmland: Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion (7 USC 4201[c][1][A]).
- Unique farmland: Land other than prime farmland that is used for the production of specific high-value food and fiber crops...such as, citrus, tree nuts, olives, cranberries, fruits, and vegetables (7 USC 4201[c][1][B]).

- Additional farmland of statewide or local importance: Land identified by state or local agencies for agricultural use, but not of national significance (7 USC 4201[c][1][C]).

The proposed alternatives would be consistent with existing general plan policies by restoring intertidal marsh areas, which would create habitat value for numerous Delta wildlife species. The created marshlands would offer new recreation possibilities while not hindering existing fishing and hunting activities. The pipes used to transport material from the borrow sites to the intertidal marsh restoration areas would be located adjacent to prime and unique farmlands. Where possible the pipes would be placed along existing farm roads or access areas so that no impacts to prime and unique farmland would occur. Some pipes may be placed in areas that are designed as prime and unique farmland, but they would be located there temporarily and would not alter the land use or degrade the value of the farmland. Habitat restoration is not proposed on land designated as prime farmland, unique farmland, farmland of statewide importance, and none of these farmlands would be converted to other land uses. As a result, no prime, unique, or farmland of statewide or local importance would be affected by implementation of the project and no mitigation would be required.

4.1.5 Socioeconomics

Delta Community Overview

Numerous communities with populations ranging from thousands (e.g., Pittsburg) to a few hundred (e.g., Locke) are located in the Delta. These communities comprise portions of Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties. Surrounding these communities are farms, ranches, orchards, and vineyards, most of which have residences associated with them that are not in a delineated community, but are socially tied to a community through general proximity or public services (e.g., school district boundaries and public service delivery areas). The California Delta Reform Act of 2009 designated a number of unincorporated towns and areas in the Delta, including Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove as “Legacy Communities.”. These communities exemplify the Delta’s unique cultural history and contribute to the sense of the Delta as a place. In addition to recognized cities and communities, the Delta also includes numerous small, recreational areas (including campgrounds, marinas, recreational vehicle parks, and vacation homes) that are popular throughout the spring and summer months.

Beyond the physical boundaries of the Delta, people are connected to the Delta through business enterprises, recreational interests, and social activities. For the people who reside outside the Delta, there is a sense of being part of the community because of the social interaction, common ties, and common appreciation of the Delta environment shared among residents and visitors. Different user groups may have a sense of being

part of the larger Delta community because of shared values that are linked to the Delta landscape and resources.

Geographic Distribution and Characterization of Population in the Delta

The demographic composition of the Delta varies greatly. It can be characterized by small towns and dispersed rural residences in the interior of the Delta, and large urban areas on the periphery. In general, the population density of the inner Delta is very low. Most of the population resides in or near the peripheral urban areas. The highest concentration of people is in the urban centers of Sacramento to the north, Antioch and Pittsburg to the west, and Stockton and Tracy to the southeast. The small rural communities of Freeport, Isleton, and Thornton also are in the interior of the Delta.

The population in the interior of the Delta is centered around several rural communities, including Clarksburg, Courtland, Hood, Isleton, and Walnut Grove/Locke/Ryde (Delta Protection Commission 1995). These communities have experienced land use restrictions that inhibit urban development within the Primary Zone of the Delta, an area generally representing the inner Delta, defined by the Delta Protection Commission for the purposes of land use planning.

In addition to more densely populated Delta communities in the Primary Zone, numerous residences are scattered throughout the Delta islands and are either associated with agricultural parcels or are more estate-style residences used as vacation or leisure residences. Among the Delta islands in the interior of the Delta, Brannan-Andrus Island, Bethel Island, Byron Tract, New Hope Tract, and Sargent Barnhart Tract historically have had the highest populations (California Department of Water Resources 1995), although determining the populations of these individual islands is difficult because of seasonal changes in the recreation-associated residency and the presence of temporary agricultural workers on some islands, which can skew census tabulations. Some islands in the Delta are dedicated solely to agriculture or natural habitat, including McCormack-Williamson Tract, Kimball Island, and Coney Island.

The population of the Delta is relatively diverse as a result of its unique cultural history, the presence of seasonal farm workers, and increasing development within the larger Delta communities. There are high proportions of minority residents in both urban and rural areas. Historically, many of the agricultural areas in the interior of the Delta exhibit high proportions of minority residents, including Hispanics, Asians, and African-Americans because of a combination of historical and recent settlement trends. The section on Environmental Justice further discusses the demographics of minority populations in the Delta.

Economy

The economy of the Delta is rooted in agriculture. Production of some of California's best-known crops, including asparagus and pears, occurs in Delta fields and farms. Agriculture became the primary economic driver in the Delta because of its rich

soil, ample water supply, and proximity to urban markets. In addition, agriculture fostered a diverse population in terms of race and ethnicity. The waterways of the Delta have been used historically to transport agricultural products to urban centers, such as Stockton or Sacramento for processing, packing, and shipment.

Tourism and recreation are the second most important sources of economic benefit in the Delta. The Delta is a destination for boating, fishing, waterskiing, and windsurfing. Because the communities in the interior of the Delta were established primarily for their easy access to the water, Delta communities are easily reached destinations for boaters and recreationists traveling through the area. As some areas have become key destinations for recreational users, the tourist activity supports additional services and businesses. Some of the recreationally-oriented communities have restaurants, cafes, retail shops, and service providers near the local dock or marina. Implementation of the various alternatives would not affect the local economy because the creation of intertidal marsh habitat would not affect recreation, jobs, homes, or other economic factors within the Delta.

Environmental Justice

Federal Executive Order (EO) 12898, Environmental Justice, requires that, to the greatest extent practicable and permitted by law,

> *…each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.*

EO 12898 charges each cabinet department to "make achieving environmental justice part of its mission," with the EPA responsible for implementation of EO 12898. The Council on Environmental Quality (CEQ) has oversight of the Federal government's compliance with Executive Order 12898 and NEPA. For purposes of this analysis, the definitions of minority and low-income populations provided in the CEQ's Guidance for Agencies on Key Terms in Executive Order 12898 (CEQ 1997) are used. Minority individuals are defined as members of the following population groups:

- American Indian or Alaskan Native,
- Asian or Pacific Islander,
- Black,
- Hispanic.

Minority populations are identified by the following.

- Where the minority population percentage of the affected area is meaningfully greater than the minority population percentage of the general population.
- Where the minority population percentage of the affected area exceeds 50% (CEQ 1997).
- Low-income populations are identified based upon poverty thresholds provided by the U.S. Census Bureau (CEQ 1997), and identified as one of the following.
- The population percentage below the poverty level is meaningfully greater than that of the population percentage in the general population.
- The population percentage below the poverty level in the affected area exceeds 50%.
- Significant concentrations of minority or low-income individuals are sometimes referred to as environmental justice populations.

The project sites are located in open water locations with the borrow sites located on relatively unpopulated privately owned islands. Construction activities and equipment placement would not result in disturbance to existing population centers or individuals. Therefore the alternatives would have no disproportionate and adverse human health or environmental effects on minority and low-income populations. The alternatives would have no adverse effects on the local, regional, state, or national economies.

4.1.6 Noise

This section describes the existing noise environment in the study area. This includes local, Federal, and State criteria; sources and levels of noise; and noise-sensitive land uses and receptors. Noise can be defined as unwanted sound, and effects are interpreted in relationship to noise level criteria for each county. The standard unit of sound measurement is the decibel (dB). Since the human ear is not equally sensitive to sound at all frequencies, a special rating scale has been devised to relate noise to human sensitivity. The A-weighted decibel scale (dBA) provides this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear.

Community noise (CNEL) is commonly described in terms of ambient noise level that constitutes the normal or existing level of environmental noise at a given location. The ambient noise level is measured as the average, or equivalent, sound level (L_{eq}) and is often expressed as the noise descriptor L_{dn}, which is a 24-hour average noise level with a 10-dB penalty adjustment used for nighttime noise.

State and Federal Criteria

The criteria for evaluating traffic effects on noise are contained in the Federal Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR 772) and the Caltrans Traffic Noise Analysis Protocol dated October 1998. The Category B criterion in these documents applies to residences, churches, schools, recreation areas and similar uses, and is an hourly sound level that approaches or exceeds 67 dBA L_{eq}. Other developed lands such as commercial or industrial are included in Category C, for which an hourly sound level criterion that approaches or exceeds 72 dBA L_{eq} has been established. There are no criteria for undeveloped land or construction noise. These sound levels are determined at the exterior of structures during peak-hour noise conditions.

The FHWA and Caltrans consider traffic to have an effect on noise if predicted peak-hour traffic noise levels approach or exceed the noise abatement criteria. Caltrans defines “approach or exceed” as noise levels within 1 dBA of noise abatement criterion, meaning 66 dBA for Category B. In addition to the criterion sound levels described above, the Federal Highway Administration (FHWA) and Caltrans consider traffic to have an effect on noise predicted sound levels "substantially" exceed existing noise levels. Caltrans defines "substantial" as an increase of 12 dBA over existing peak-hour noise levels. Caltrans and FHWA policies dictate that noise abatement measures must be considered when effects on noise are identified.

Local Criteria

Sacramento County

The Sacramento County 2030 General Plan Update Noise Element states that interior and exterior noise created by new non-transportation noise sources may not exceed the noise level standards shown in Table 00 at existing noise sensitive areas in a project’s vicinity (Sacramento County 2011). The Plan states that noise associated with construction activities shall adhere to County Code requirements. Sacramento County Code Section 6.68, Noise Control, states that exterior noise shall not exceed 50 dBA between 10:00 p.m. and 7:00 a.m. and 55 dBA between 7:00 a.m. and 10:00 p.m. for residential and agricultural areas. Construction activities between the hours of 6:00 a.m. and 8:00 p.m. Monday through Friday and 7:00 a.m. and 8:00 p.m. on weekends are exempt from this ordinance. Construction may be allowed to continue past these limits when an unforeseen or unavoidable condition occurs and the nature of the project requires work to continue until a specific amount of work is completed that will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner (Sacramento County 2009).

Contra Costa County

The Noise Element of the Contra Costa County General Plan (2005-2020) contains guidelines for Land use Compatibility for Community Noise Environments.

These guidelines assign appropriate noise levels for indoor and outdoor activities at various land use categories. According to this Noise Element, it is "normally acceptable" for low density residential lands to be exposed to a day-night average sound level (Ldn) of 60 dBA or less. These guidelines are normally used for planning new projects in noisy areas; they do not strictly apply to mechanical noise from the project affecting the existing residential land. However, they do provide an indication of noise sensitivity at neighboring residences.

Existing Sources of Noise

Noise sources in eastern Contra Costa County and eastern Antioch include transportation and non-transportation activities. Traffic noise occurs along the corridors of Highways 4 and 160. Rail operations and aircraft from the Byron Airport contribute to the noise environment. Motorized boats along the San Joaquin River also contribute noise. Non-transportation noise sources in the county include agricultural operations, commercial and industrial activities, parks and school playing fields, heating and cooling equipment, landscape maintenance, and heavy equipment use.

Existing Noise-Sensitive Land Uses

Contra Costa County land in the project area is primarily in agricultural and recreational use. Residential, commercial, industrial, and open space land uses also exist in both unincorporated and incorporated areas of the county. Residential, commercial, and industrial uses are concentrated in the city of Oakley, in eastern Contra Costa County. Residential uses are the primary noise-sensitive land uses in the county.

Existing Noise Levels

Existing noise measurements for portions of Contra Costa County in the vicinity of the study area, as described in the Contra Costa County General Plan (Contra Costa County 2005), include traffic noise levels from existing roadways in the area. The noise contour maps indicate that roadway noise near potential project-related activities evaluated in this EIS from 60 to 75 dB in 2005. Land uses near project components are primarily rural and consist of agricultural use and low-density residential development. As such existing noise levels are in the range of 40 to 50 dBA.

Noise-Sensitive Land Uses and Receptors

Noise effects are defined as those that can adversely affect sensitive receptors. Residences, schools, hospitals, nursing homes, religious facilities, libraries, and other areas of similar use are often considered to be sensitive to noise. Existing noise at the site is primarily caused by boat traffic along Taylor Slough, and routine agricultural activities on nearby farmland. No residential or industrial type activities occur within a quarter mile of the site. Residences would not be affected by the work on the levee. Temporary increases in ambient noise would not harm wildlife.

Because the project is located in an area that does not contain a sensitive receptor population there would be no affect from noise.

4.1.7 Esthetics

The statutory Delta encompasses 738,000 acres and consists of largely undeveloped islands and low-lying tracts of land surrounded by waterways and levees. Historically, more than 40% of the state's runoff flowed to the Delta through the Sacramento, San Joaquin, and Mokelumne Rivers (California Department Of Water Resources 1993). In addition to the natural waterways, the area contains a variety of water development facilities such as levees, aqueducts, and intake structures. The construction of levees resulted in the conversion of wetlands, riparian corridors, and open water to agricultural lands characterized by elevated and vegetated levees surrounding low-lying areas of farmland. Construction of these levees, completed before World War II, also allowed for urbanization, commercial shipping to the Ports of Stockton and West Sacramento, recreational boating, and marina development within the Delta (SacDelta 2009).

Lands contributing to the visual resources of the project area include State Recreation Areas, wildlife refuges and preserves, marinas and shoreline recreation facilities. Some large tracts are managed by duck hunting clubs. Although the Delta is largely agricultural, human-made structures of aesthetic value, such as bridges and historical homes and towns, are located along the roadways.

The attributes of the Delta landscape change over the course of a year in response to seasonal changes and weather. Vegetation, agricultural crops, and land use patterns vary according to the time of year and farming activities. For instance, a particular field may be fallow through winter and early spring and yet exhibit substantial vegetative growth through summer. Often stubble or crop remnant can be seen in fall after harvest.

Project Area Landscape Types

The Delta's landscape can be grouped into three main landscape categories: agricultural, waterways, and developed. Each of these categories has distinctive visual and scenic attributes that contribute to the dominant visual character of the Delta landscape. Within each category, specialized dominant features in the visual landscape combine to define more distinct landscape types that share similar visual elements.

Agricultural Landscapes

Agricultural lands account for the primary land use in the Delta. The extensive tracts of agricultural land shape the Delta's visual character. A wide mixture of crops, land management practices, and agricultural infrastructure create a pastoral visual landscape composed of a variety of colors, textures, and views from different distances.

Waterway Landscapes

Approximately 1,000 miles of waterways traverse the Delta, making them a defining and dominant feature of the landscape (Delta Science Center 2009a). Many of the waterways follow natural courses, while others have been constructed for navigation, flood control, water supply, and drainage. The predominant features constraining and defining these waterways are artificial levees. The Delta's waterways are unique in their diversity and wide range of distribution and abundance, adding substantially to the region's visual characteristics. Most Delta waterways have a general scenic quality that attracts and contributes to varied types of recreation. The three general types of Delta waterway visual landscapes consists of open river, channels and sloughs, and marsh.

The open river is a visual landscape dominated by a singular, expansive waterway. This landscape type is a common sight along Delta roadways that closely parallel the Sacramento and other rivers and offer views of the river corridor. In the study area where former islands have been inundated, (Little Franks Tract and Big Break) the open-river landscape expands broadly, creating an open-water visual landscape. Numerous channels and sloughs wind through the Delta as the large Sacramento and San Joaquin rivers mingle with smaller rivers that drain the Sierra Nevada and Coast Ranges (Delta Science Center 2009b). Sloughs meander through the landscape in a curvilinear fashion, while engineered waterways that have been channelized and diverted for agriculture and water conveyance tend to carve straighter paths. The marsh landscape type consists of intermixed open water and wetland vegetation. It is characterized by fluctuating water levels and/or seasonal flooding from tidal action, rain, and management actions.

Developed Landscapes

Settlement patterns in the Delta are generally rural; however, small towns and pockets of urban development are distributed throughout. The primary development or settlement patterns that contribute to the Delta visual landscape include landscape rural centers, urbanized development, and industrial development. Rural centers are characterized by the small, sometimes historic towns scattered throughout the Delta. These towns are typically clustered alongside a major waterway. Most of the interior Delta is rural; large, more urban development tends to occur only on its edges. The urbanized landscape type is also characterized by medium to larger cities. The industrial visual landscape type is scattered throughout the Delta and includes ports, water conveyance facilities, transmission lines, substations, and buildings with industrial uses, such as warehouses and storage silos.

The Delta area is primarily a viewshed of open waters, tidal marshes, wetlands, and shoreline habitat. Creating additional intertidal marsh habitat would be consistent with the existing viewshed of the Delta and therefore, there would be no affects to aesthetics with construction of the project.

4.1.8 Hazardous, Toxic, and Radiological Waste

Naturally Occurring Hazards

Historic geologic conditions in the study area have led to the formation of peat and other organic soils with thicknesses of up to approximately 55 feet on the western side of the Delta; peat deposits are not commonly found on the eastern side. The thick organic soils and peat have the potential to generate flammable gases such as methane that can pose hazards to workers during deep excavations and tunneling.

Hazards from Agricultural Practices

Agriculture has been the primary land use in the study area for more than a century. Approximately 538,000 acres of the 738,000 acres of agriculture land potentially affect the waters adjacent to the project areas.

A wide variety of pesticides, including insecticides, herbicides, and fungicides, have been used throughout the agricultural lands surrounding the project area for decades; and those chemicals still may be present in and near agricultural lands. While some pesticides that were used in 1974 were still in use in 2008 (e.g., sulfur, petroleum oils, 1,3-dichloropropene, diuron, and carbaryl), a number of new pesticides, such as chloropicrin, chlorpyrifos and propanil, are available and in use currently. Notably, a number of pesticides prevalently used in the 1970s are no longer prevalently used: dinoseb, chlordane, dibromochloropropane (DBCP), ethylene dibromide, parathion, and toxaphene.

The wide variety of pesticides that has been applied, the numerous crops grown in the region, and the fact that predominant land use across the Delta supports agriculture indicate that pesticides and their residues are likely to be found in the soils throughout the Delta. No comprehensive area-wide soil or sediment sampling program is known to have been conducted to evaluate pesticide residues from agricultural use. Further discussion of the fate, transport, and bioaccumulative properties of pyrethroid, organochlorine, and organophosphate pesticides that have been applied to the project area crop lands.

Hazards from Historical Mercury Mining

Mercury has been identified as a chemical of concern in Delta area sediments, resulting from gold and mercury mining operations in the watersheds upstream of the Delta. Mercury was used extensively upstream of the study area in mining to extract gold from ores and placer gravel deposits. Mercury released into the environment by historic gold mining practices has been flowing into the study area via water, primarily from the Sacramento River watershed, and sediments since the mid-1800s and is expected to continue to enter the study area. An unknown amount of mercury is present in sediments within the project area, but estimates of mercury flowing into the Delta area, mainly associated with suspended sediment (Alpers et al. 2008), range from approximately 200–400 kg/yr (CVRWQCB 2008).

Urban, Residential, and Recreational Land Use

In general, hazardous materials releases from cities and towns are associated with stormwater runoff and primarily affect water bodies. Cities and towns account for approximately 9% of the total study area. Urban stormwater discharges are generally characterized by varying levels of metals and hydrocarbons that can accumulate in river sediments over time. Historically, polychlorinated biphenyls (PCBs) have been associated with urban discharge, and these contaminants have been detected in fish tissues in San Francisco Bay.

Urban areas have many facilities with the potential for hazardous materials releases, including gas stations, dry cleaners, automotive repair facilities, and, in larger towns, manufacturing facilities. Stockton, for example, has large shipping and port facilities, as well as Federal facilities with a history of hazardous materials use, storage, and releases. Antioch and Oakley, located on the south side of the San Joaquin River near the project areas, have major power-producing facilities and several active or former industrial facilities with known groundwater impacts. Possible contaminants of concern from urban land uses are extensive, but the most common contaminants in soil and groundwater are petroleum and associated compounds (typically gasoline and diesel releases from USTs as the source), chlorinated solvents and degreasers (from dry cleaning and vehicle repair facilities), and various heavy metals, such as arsenic and lead. Marinas typically include bulk fuel storage and overwater fueling, various boat repair/maintenance facilities, stores, boat storage, and camping facilities. Typical chemicals associated with marinas include fuels, lubricants, cleaners, anti-fouling paints, and fiberglass components.

Borrow Materials

Historic chemical and granular test results previously dredged materials at placement sites indicated that the dredge materials are chemically cleaner than the existing baseline sampling from project area samples. Future materials from dredging operations would be sampled prior to operations and maintenance dredging. Materials meeting baseline criteria would be utilized for marsh habitat creation. Materials not meeting baseline criteria would be stored at existing dryland storage sites

Project construction activities are not expected to disturb existing HTRW sources that could lead to contamination of environmental resources. The placement of material into the sites would not cause disruption of the areas under the sites because placement would be directly on top of the existing soil. Additionally, the pipes that would carry any material to the placement sties would be placed directly on top of existing land and not disturb any material. The borrow material being used to create intertidal marsh habitat would be tested prior to any processing of the material. Only material meeting baseline criteria would be used and therefore no affects to HTRW would occur from use or transport of this material. Because no HTRW material or sites would be affected by the project no impacts to HTRW would occur with implementation of the project.

4.2 Resources Considered in Detail

4.2.1 Vegetation and Wildlife

This section describes the existing vegetation, wildlife, and habitats which occur in the study area. Biological resources such as plants and animals are important because they influence ecosystem functions and values, have intrinsic value, and are subject to a number of statutory and regulatory requirements.

Regulatory Setting

Federal

Fish and Wildlife Coordination Act. The Fish and Wildlife Coordination Act requires the USACE to coordinate with the USFWS on water resources related projects to obtain their views toward preservation of fish and wildlife resources and mitigation of unavoidable impacts.

USACE Mitigation Plans. USACE is required under Section 2036(a)(3)(B) of WRDA 2007, Public Law (PL) 110-114, § 2036(a)(3)(B), 121 Stat. 1093 (2007), Section 2036(a) to fully develop mitigation plans for water resource projects that include the following: 1) monitoring until successful; 2) criteria for determining ecological success; 3) a description of available lands for mitigation and the basis for the determination of availability; 4) the development of contingency plans (i.e., adaptive management); 5) identification of the entity responsible for monitoring; and 6) establishing a consultation process with appropriate Federal and state agencies in determining the success of mitigation.

Migratory Bird Treaty Act (MBTA) and Executive Order (EO) 13186, Conservation of Migratory Birds. The MBTA states that it is unlawful to kill, capture, collect, possess, buy, sell, trade, or transport any migratory bird, nest, young, feather, or egg in part or in whole, without a Federal permit issued in accordance with the MBTA's policies and regulations. Under EO 13186, Federal agencies are directed to evaluate the impacts of their actions on migratory birds in NEPA documents and to conserve migratory birds, giving priority to species of concern (listed by USFWS), and their important habitats.

EO 13112, Invasive Species. Dated February 3, 1999, this EO directs Federal agencies to expand and coordinate their efforts to combat the introduction and spread of "invasive species" (i.e., noxious plants and animals not native to the U.S.). Non-native flora and fauna can cause significant changes to ecosystems, upset ecological processes and relationships, and cause harm to our nation's agricultural and recreational sectors.

Those species that are likely to harm the environment, human health, or economy are of particular concern.

State

California Endangered Species Act (Fish and Game Code Section 2050 *et. seq.*) (CESA). This Act regulates the take of a species listed as threatened or endangered under the state act. CESA does not require formal consultation; however, CEQA does require that CDFW act as a reviewing agency for all CEQA documents if the fish and wildlife resources of the state may be affected by the proposed action. If take of a California listed species may occur, CDFW would require a Fish and Game Code Section 2081 Incidental Take Permit.

Affected Environment

Big Break and Little Franks Tracts are currently flooded islands that were historically tidal marsh before levees were constructed and reclaimed for agriculture and then became submerged when their levees failed. Before land reclamation for agriculture and flood control activities around the turn of the 20th century, the Delta supported a complex network of rivers and sloughs with in-channel islands and vast expanses of tidal marsh. Much of the vegetation of the Delta (approximately 380,000 acres; 1,538 square kilometers) was dominated by tidal marshes (Atwater 1980; Institute 1998). By 1930, island reclamation was complete, and by 1980, only about 16,000 acres (65 square kilometers) of marshes remained (Atwater 1980; The Bay Institute 1998). Today, these areas of former tidal marshes consist primarily of channelized waterways surrounding highly productive row-cropped agricultural islands that are protected from flooding by over 1,300 miles (2,093 kilometers) of levees.

Despite the loss of more than 95 percent of historic tidal marsh habitat in the Sacramento-San Joaquin Delta (The Bay Institute 1998), fish and wildlife diversity is high, with an estimated 200 species of birds, 55 species of fish, 22 species of reptiles, 58 species of mammals, and 9 species of amphibians occurring in the Delta (California Department of Water Resources et al. 2013).

Freshwater intertidal marsh is the vegetation type and habitat proposed for restoration under the current alternatives. Other planning efforts in the Delta are also underway, including the Delta Vision Strategic Plan, the CALFED Ecosystem Restoration Plan, and the Bay Delta Conservation Plan, to restore tidal marsh and improve the ecological health of the Bay-Delta Ecosystem. The proposed Dutch Slough Tidal Restoration Project, adjacent to and east of Big Break, will restore tidal wetlands and other habitats on 1,166 acres of land owned by DWR in eastern Contra Costa County near Oakley. The former dairy lands were slated for residential development, but were instead purchased by the State so that declining natural habitats of the Delta could be restored to the site. Restoration at Big Break and Dutch Slough would in combination create a large continuous block of restored habitat which would be important for dispersal of plant and wildlife populations and those species requiring large habitat blocks.

General Description of Habitat Types in the Study Area

This section describes the habitat types and the wildlife that occupy these habitats. The description of existing conditions is based on a literature review, field visits, and coordination with resource agencies.

Tidal Perennial Aquatic

The tidal perennial aquatic natural community is the dominant habitat cover type within the flooded islands. This aquatic community in the Delta is identified as deep water aquatic (greater than 10 feet deep from mean low low tide [lowest of the low tide in a day]), shallow aquatic (less than or equal to 10 feet deep from mean low low tide), and non-vegetated intertidal (mudflat) zones of estuarine bays, river channels, and sloughs (CALFED Bay-Delta Program 2000). Under present water operation conditions in the project area, tidal perennial aquatic is mainly freshwater, with brackish and saline conditions occurring at times of high tides and low freshwater inflows.

Vegetation. The tidal perennial aquatic natural community is largely unvegetated. Where vegetation exists, it can be separated into two categories: submerged aquatic vegetation and floating vegetation (both rooted and non-rooted) (Cowardin et al. 1979). The geographic extent of this vegetation is highly dynamic because it is largely dependent on physical factors that are highly variable, such as depth, turbidity, water flow, salinity, substrate, and nutrient with a nitrogen fixing bacteria that lives within its tissues (Armstrong 1979). Invasive water hyacinth grows in dense mats that can have harmful effects on native fish and plant species.

Wildlife. Zooplankton in the foodweb of the tidal perennial aquatic natural community consume phytoplankton and detritus, and are fed upon by other consumers, such as fish and macroinvertebrates. Water salinity is a major factor that influences the distribution of zooplankton species in the tidal perennial aquatic natural community. In the brackish portions of the project area, calanoid copepods, and cyclopoid copepods are the primary zooplankton species, and mysid shrimp is the dominant macrozooplankton. In freshwater regions, cladocerans and calanoid copepods are the dominant zooplankton present (Kimmerer and Orsi 1996; Kimmerer 2004; Gewant and Bollens 2005; Winder and Jassby 2010). It is used as habitat by fish for foraging, spawning, egg incubation and larval development, juvenile nursery areas, and migratory corridors. Most species spend their entire lives in the community while others may spend certain seasons or part of their lives in habitats outside of the tidal perennial aquatic natural community depending on the state of physical factors such as salinity, turbidity, dissolved oxygen, flow rates, and water temperature. The terrestrial species known to forage in tidal perennial aquatic habitat include Townsend's big-eared bat, California least tern, and giant garter snake.

In addition to its value as habitat for fish, the tidal perennial aquatic natural community provides reproduction, feeding, and resting habitat for many species of mammals and birds. Open water areas supply habitat for rest and foraging by water

birds, especially during heavy winter storms when open coastal waters become rough. Bird species that use the inland open water include loons, gulls, cormorants, and diving ducks (CALFED Bay-Delta Program 2000). A number of state and federally listed birds feed on fish in the tidal perennial aquatic natural community, including bald eagle, and California least tern.

Tidal Mudflat

The tidal mudflat natural community typically occurs as mostly unvegetated sediment deposits in the intertidal zone between the mean higher high tide and the mean lower low water tide. The community is typically associated with the tidal freshwater and tidal brackish emergent wetland communities at its upper edge and the tidal perennial aquatic community at its lower edge. The tidal mudflat natural community is ephemeral and owes its physical existence to sediment erosion and deposition processes that differ throughout the Delta and Suisun Marsh, and its biological characteristics to plant succession (Golden and Fiedler 1991; Fiedler and Zebell 1993; Witham and Kareofelas 1994; Zebell and Fiedler 1996; Cappiella et al. 1999; Meisler 2002; Ruhl and Schoellhamer 2004; McKee et al. 2006; Witham 2006). Inflows to the Delta import suspended sediment, and the resuspension and deposition of that sediment are critical accretion factors. Wave energy dissipation and levee maintenance are typical erosion factors. The rate of plant succession on the sediments will vary depending on the supply of plant propagules and the distance to plants that can colonize the sediment by extending their root systems.

Vegetation. The tidal mudflat natural community is generally not vegetated, but patches of two small special status plant species, Mason's lilaeopsis and delta mudwort, are found in this community type with the former being more abundant in brackish areas and the latter more abundant in freshwater areas (Golden and Fiedler 1991; Fiedler and Zebell 1993; Zebell and Fiedler 1996; Meisler 2002; Fiedler et al. 2007). Plant species in mudflats are quite sensitive to inundation period and the plant community changes with very slight changes in elevation and inundation period.

Wildlife. An important wildlife habitat function of the tidal mudflat natural community is as foraging habitat for probing shorebirds, including godwits, willets, and sandpipers. This habitat function only exists for shorebirds when the area of mudflat is exposed by the tides. This community supports an extensive invertebrate community that consists of benthic and interstitial species (crustaceans, bivalves, gastropods, aquatic insects, and polychaetes) that provide forage to shorebirds. Special status species that are supported by the tidal mudflat community include Townsend's big-eared bat, California clapper rail, delta mudwort, and Mason's lilaeopsis. These species are further discussed in Section 4.2.2. At lower intertidal elevations, the tidal mudflat natural community functions as foraging area for waterfowl and shorebirds.

Tidal Freshwater Emergent Wetland

The tidal freshwater emergent wetland natural community is typically a transitional community between the tidal perennial aquatic, and valley/foothill riparian and various terrestrial upland communities across a range of hydrologic and edaphic conditions. In the project area, the tidal freshwater emergent wetland natural community often occurs at the shallow, slow-moving or stagnant edges of freshwater waterways in the intertidal zone and is subject to frequent long duration flooding.

The tidal freshwater emergent wetland natural community is distributed in narrow, fragmented bands along island levees, in-channel islands, shorelines, sloughs, and shoals. Channelization, levee building, removal of vegetation to stabilize levees, and upstream flood management have also reduced the extent of this community and altered its ecological function through changes to flooding frequency, inundation duration, and quantity of alluvial material deposition.

The tidal freshwater emergent wetland natural community occurs along a hydrologic gradient in the transition zone between open water and riparian vegetation or upland terrestrial vegetation such as grasslands or woodlands. In the project area, there are often abrupt transitions to agricultural habitats and managed wetland natural communities and also along the boundaries formed by levees and other artificial landforms. The environmental conditions that support the tidal freshwater emergent wetland natural community are dynamic with frequent flooding disturbances and geomorphologic changes (i.e., alluvial deposition and scouring). Its constituent species composition and ecosystem functions are consequently variable in space and time (The Bay Institute 1998). As a result of the different sources of variability and the anthropogenically restricted area in which it can occur, the community vegetation may be distributed in small patches or in occasional large areas.

Soils underlying the tidal freshwater emergent wetland natural community are heavily influenced by inundation period, water flow, and alluvial deposition. They are hydric soils and when mineral based, their texture can vary from clay to sand; and when based on organic material, can form peat beds (Goman and Wells 2000; Hitchcock et al. 2005; Drexler et al. 2009a). The soils are typically anaerobic due to frequent or permanent saturation with slow decomposition rates resulting in the accumulation of organic debris in various stages of decomposition. The composition of the vegetation is limited to relatively few dominant species that are tolerant of inundation and anaerobic soil conditions and typically are not tolerant of saline or brackish conditions (Holland and Keil 1995).

Vegetation. The tidal freshwater emergent wetland natural community is characterized by erect herbaceous hydrophytes (Holland and Keil 1995). The typical vegetation of this type, as mapped by CDFW and adopted for vegetation mapping purposes, is dominated by tall, perennial monocots that reproduce by seed as well as vegetatively through rhizomes. However, the CDFW vegetation classification was based on vegetation structure and species composition and did not consider ecosystem functions

such as location within or above the intertidal region along drainages. In many areas of what is functionally tidal freshwater emergent wetland, woody species, especially willows (Salix spp.), occur in the intertidal region and co-dominate the vegetation (Atwater 1980; Watson 2006; EDAW 2007a; Watson and Byrne 2009). These intertidal areas with woody vegetation were not distinguishable in the CDFW data set.

Cattails dominate the vegetation of this community along the Sacramento River; while throughout the San Joaquin River area, bulrushes, tules, and common reed are more often the dominant species (Atwater 1980; Watson 2006; EDAW 2007a; Hickson and Keeler-Wolf 2007; Watson and Byrne 2009). In the far western portion of the Delta, where tidal waters are generally fresh but may be brackish during periods of low outflow, saltgrass becomes common (Boul and Keeler-Wolf 2008). Numerous native and nonnative dicots and rooted aquatics also commonly occur in the tidal freshwater emergent wetland natural community.

Wildlife. The tidal freshwater emergent wetland natural community provides productive habitat for wildlife. Its vegetation and associated waterways provide food and cover for numerous species of birds (e.g., waterfowl, wading birds), mammals, reptiles, emergent aquatic insects, and amphibians. Fish species use tidal freshwater emergent wetland habitat for foraging, juvenile rearing, and refugia. Terrestrial species that rely on tidal freshwater emergent wetland for habitat include Townsend's big-eared bat, California black rail, Suisun song sparrow, tricolored blackbird, giant garter snake, western pond turtle, California red-legged frog, delta mudwort, Delta tule pea, Mason's lilaeopsis, and Suisun marsh aster.

Although the remaining areas of tidal freshwater emergent wetlands in the project area are highly altered, they remain critical wintering grounds for migratory birds. A small number of wetland associated species, such as waterfowl and egrets, have successfully adapted to foraging on some types of croplands that were converted from historical wetland areas (California Department of Fish and Game 2005). Many of the species of fish that use the tidal perennial aquatic natural community for habitat will also use the tidal freshwater emergent wetland natural community as habitat. Younger stages (e.g., larvae and fry) of some species rear in shallow waters that support emergent vegetation. Many fish species use emergent vegetation as refuge from predation and high flows (Bay Institute 1998).

Existing Vegetation Types in the Project Area

The dominant vegetation types in the project area include emergent tidal marsh, riparian scrub/woodland, and submerged and floating aquatic vegetation. Big Break and Little Franks Tracts are currently characterized by vast expanses of open water habitat. Although these areas have been flooded for a number of years, these flooded islands have not accumulated enough sediment to support the reestablishment and expansion of tidal marsh vegetation. Vegetation cover type maps for each flooded island are shown in Figures 4-1 (Big Break) and 4-2 (Little Franks Tract).

Big Break

Big Break is subject to daily tidal fluctuations and is at a sufficient distance from the Bay that the tidal waters inundating this area have minimal salinity levels. A remnant levee runs along the southern border of the open-water area. Riparian scrub vegetation dominated by arroyo willow and Himalayan blackberry grows along the upper portions of this levee, but the lower elevations of the levee support a low cover of tidal marsh vegetation. Extensive stands of perennial emergent marsh are present within the open water habitat. Different elevations have created a mosaic of emergent species in this perennial freshwater marsh with common three-square in shallowly inundated areas, cattail and tule in deeper waters, and California bulrush in the deepest waters (Vollmar 2000).

Flats along the shore support large stands of arroyo willow scrub. Riparian habitats also support small stands of tree species such as Fremont cottonwood, Goodding's willow, northern California black walnut, coast live oak, prunus, and red alder. A portion of the Big Break study area supports upland habitat. This upland area is located in the southwestern corner of the study area and primarily supports alkali grassland. Alkali grassland is dominated by perennial grasses including saltgrass and creeping wildrye. Associated species are predominantly nonnative annual grasses and forbs such as perennial pepperweed, wild oats, ripgut brome, telegraph weed, and spring vetch.

Other upland habitats present at this location include nonnative tree stands and disturbed or developed areas. The scattered stands of nonnative trees are dominated by black locust, tree of heaven, and white poplar. Isolated individual trees are predominantly nonnative species such as eucalyptus, tamarisk and prunus. Disturbed/ developed areas are dominated by nonnative and invasive plant species or support buildings and/or paved roads. Infestations of egeria and water hyacinth are present within the extensive open water habitat of Big Break.

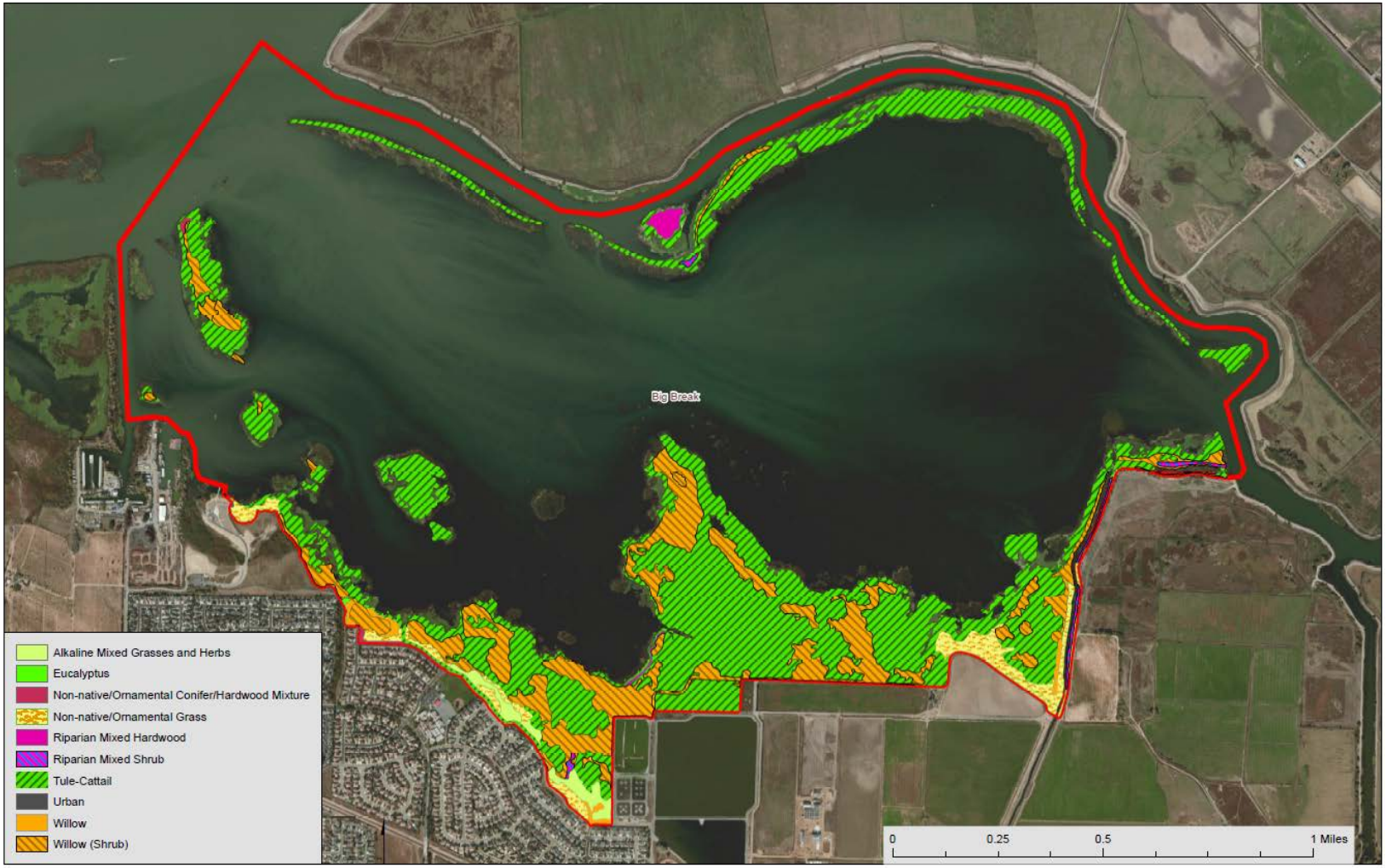

Figure 4-1. Big Break Vegetation Map.

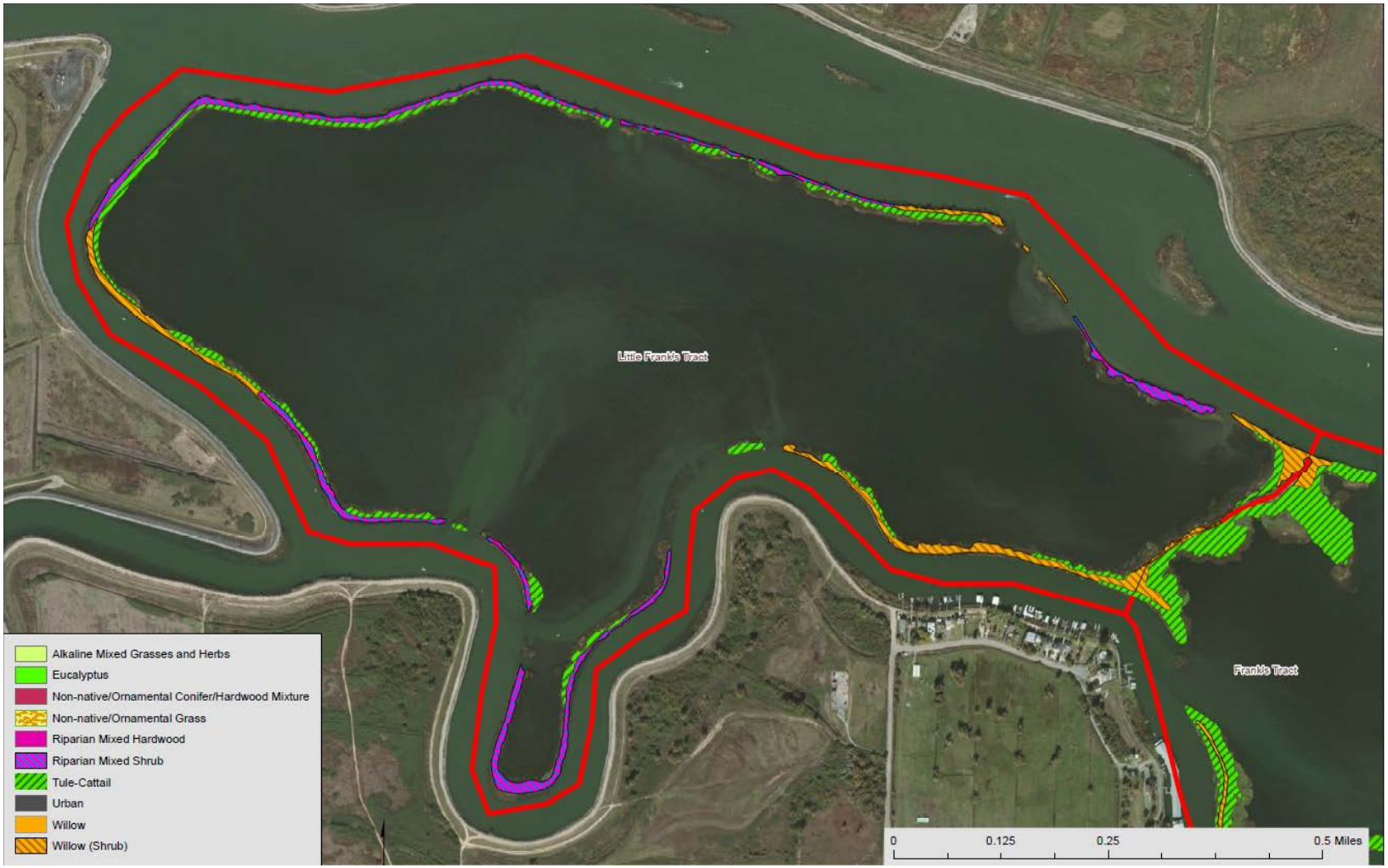

Figure 4-2. Little Franks Tract Vegetation Map.

Little Franks Tracts

The two dominant vegetation types occurring at Little Franks Tract are emergent marsh and riparian scrub. Tule and broadleaved cattail are the dominant species in the emergent marsh, which occurs on the lower portions of remnant levees and in-channel islands. Associated species in this vegetation type include sedges, rushes, smartweeds, and Delta mudwort. Riparian scrub is predominantly found along the higher elevations of remnant levees and in-channel islands. The dominant shrub/tree species in this area include willow and red alder, but scattered Fremont cottonwood may be present. The understory is extensively infested with Himalayan blackberry and nonnative thistles that create impenetrable thickets along the remnant levees. Native herbaceous wetland species in the understory include water horehound, Suisun Marsh aster, Delta tule pea, and California loosestrife. Although there was no description in the general plan, a small upland area was evident on the aerial photograph in the southern portion of the study area. The majority of this flooded island is open water, which supports infestations of egeria and water hyacinth (Center for Design Research et al. 1988).

Dredged Material Source Sites

Dredged material would be transported from existing dredged material O&M placement sites currently used by the Sacramento DWSC and Stockton DWSC (Figure 3-8). The project would confine areas of dredged material removal to only those usable portions of the sites that do not support sensitive habitats. Impacts to sensitive habitats would be minimized and/or avoided. The existing habitat conditions at these sites are described below.

Decker Island Site. This site encompasses most of Decker Island, except for a northern parcel owned by USFWS, which is a wetland restoration site. A large berm running from northeast to southwest through the site divides it into two distinctive parts: (1) the area east of the berm, which is characterized by wetlands that transition to an emergent marsh in the southern portion; and (2) the area west of the berm, which is dominated by non-native grassland, marked by a tamarisk community and recent disturbance at the site's center. At the time of survey, active pumping in the southern extent of the western portion led to flooding, creating a temporary wetland. A wetland margin borders the western edge of the site and the Sacramento DWSC. The usable portion of the site is located northwest of the berm that divides the site into two sections. This area is primarily composed of non-native grassland, irrigated agriculture, and general shrubs and dominated by peppergrass, bromes, and thistle (Silybum spp.) (USFWS 2010e). There is a large tamarisk community around the center of the northern half of the site, surrounding a recently disturbed area next to an old ferry landing. No wetlands occur within the usable portion of the site. Sensitive habitats occurring within the usable portion of the site include 0.87 acres of riparian habitat and 0.90 acres of open water.

Sherman Island - Scour Pond and McCormick Pit. Sherman Island is approximately 20 feet below sea level. The island is bounded by the San Joaquin River on the south and the Sacramento River on the north, and is protected by levees. Scour Pond and McCormack Pit are located along the southern boundary of Sherman Island as shown in Figure 3-8. Both sites have historically received dredge materials and has the material has used for levee rehabilitation and reinforcement on Sherman Island. The vegetation type at the Scour Pond site consists of non-native grassland. A small pond is situated on the southern boundary of the site. The vegetation type at the McCormack Pit site consists of non-native grassland and ruderal barren cover types.

Bradford Island. The Bradford Island dredged material storage site encompasses 110 acres. The site is specifically used for dredge materials from the Stockton Deep Water Ship Channel along the San Joaquin River. The vegetation type on the site consists of non-native grassland, ruderal barren cover types, and native willow stands. The site is frequently used for cattle grazing.

4.2.2 Special Status Species

This section describes special status species that either occur or have the potential to occur in the project area that may be potentially impacted by the project.

Regulatory Setting

Federal

Federal Endangered Species Act (16 U.S.C. 1531 et seq.)

The Federal Endangered Species Act requires that any action authorized by a Federal agency not be likely to jeopardize the continued existence of a threatened or endangered species, or result in the destruction or adverse modification of habitat of such species that is determined to be critical. Section 7 of the Endangered Species Act, as amended, requires Federal agencies to consult with the USFWS and NMFS to ensure that project actions do not jeopardize the continued existence of endangered or threatened species, or result in the destruction or adverse modification of the critical habitat of these species.

Migratory Bird Treaty Act (16 U.S.C. §703-712)

This act implements treaties that the United States has signed with a number of countries to protect birds that migrate across national borders. The act makes unlawful the taking, possessing, pursing, capturing, transporting, or selling of any migratory bird, its nest or its eggs.

Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c)

The Bald and Golden Eagle Protection Act prohibits anyone, without a permit issued by USFWS, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.

Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801) (Magnuson-Stevens Act)

The Magnuson-Stevens Act establishes a management system for national marine and estuarine fishery resources. This legislation requires that all Federal agencies consult with the National Marine Fisheries Service (NMFS) regarding all actions or proposed action permitted, funded, or undertaken that my adversely affect "essential fish habitat". Essential fish habitat is defined as "waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The legislation states that migratory routes to and from anadromous fish spawning grounds are considered essential fish habitat. The phrase "adversely affect" refers to the creation of any impact that reduces the quality or quality of essential fish habitat.

State

California Endangered Species Act (Fish and Game Code 2050 et seq.)

The California Endangered Species Act (CESA) generally parallels the main provisions of the Federal Endangered Species Act and is administered by CDFW. CESA prohibits take of listed species and state candidate species. State lead agencies are required to consult with CDFW to ensure that any action it undertakes is not likely to jeopardize the continued existence of any endangered or threatened species, or result in destruction or adverse modification of habitat.

California Native Plant Protection Act (Fish and Game Code 1900 et seq.)

The California Native Plant Protection Act was enacted in 1977 and allows the California Fish and Game Commission to designate plants as rare or endangered. There are 64 species, subspecies, and varieties of plants that are protected as rare under the NPPA. The California Native Plant Protection Act prohibits take of endangered or rare native plants.

Affected Environment

Information on special status species that may be affected by the project was gathered from various sources:

- The USFWS online services species list (US Fish and Wildlife Service, accessed on 16 December 2013);
- CDFW's California Natural Diversity Database (California Department of Fish and Game 2013);
- The California Native Plant Society's (California Native Plant Society 2013) online Inventory of Rare and Endangered Vascular Plants of California (California Native Plant Society .

Each database query for special-status species was based on a search of the USGS 7.5' quadrangles on which the study area is located (i.e., Jersey Island [480C], Bouldin Island

[480D]), and its surrounding ten quadrangles (i.e., Holt [462B], Woodward Island [463A], Brentwood [463B], Antioch South [464A], Thornton [479B], Terminous [479C], Isleton [480A], Rio Vista [480B], Birds Landing [481A], and Antioch North [481D]. The resulting USFWS queries, as well as the lists generated by the CNDDB and CNPS searches, are included in Appendix G. All lists were reviewed; habitat preferences for each species were compared with the affected areas and project site description. Those special status species known to occur, or with suitable habitat, in or near the project area are identified in Table 4-1 and discussed in detail below.

Table 4-1. Special Status Species with Potential to Occur at Project Sites.

Common Name ***Scientific Name***	**Status[1]** **Federal/State/CNPS**
Plants	
San Joaquin spearscale *Atriplex joaquiniana*	–/–/1B.2
Bristly sedge *Carex comosa*	–/–/2B.1
Bolander's water-hemlock *Cicuta maculata var. bolanderi*	–/–/2B.1
Hibiscus lasiocarpus Suisun Marsh aster, rose-mallow	–/–/1B.1
Mason's lilaeopsis *Lilaeopsis masonii*	–/–/1B.1
Delta mudwort *Limosella australis*	–/–/2B.1
Oenothera deltoides ssp. *Howellii* *Antioch Dunes evening-primrose*	E/E1B.1
Eel-grass pondweed *Potamogeton zosteriformis*	–/–/2B.2
Marsh skullcap *Scutellaria galericulata*	–/–/2B.2
Side-flowering skullcap *Scutellaria lateriflora*	–/–/2B.2
Suisun Marsh aster *Symphyotrichum lentum*	–/–/1B.2
Wildlife	
Tricolored black bird *Agelaius tricolor*	BCC/SSC (nesting)
Western pond turtle *Antinemys marmorata*	-/SSC
Burrowing owl *Athene cunicularia*	BCC/SSC (nesting)
Pallid bat *Antrozous pallidus*	-/SSC
Swainson's hawk	BCC/T (nesting)

Common Name *Scientific Name*	Status[1] Federal/State/CNPS
Buteo swainsoni	
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T/-
California black rail *Laterallus jamaicensis coturniculus*	BBC/T
Western red bat *Lasiurus blossevillii*	-/SSC
Giant garter snake *Thamnophis gigas*	T/T
Fish	
North American green sturgeon southern Distinct Population Segment (DPS) *Acipenser medirostris*	T/SSC
River lamprey *Lampetra ayresi*	–/SSC
Hardhead *Mylopharadon conocephalus*	–/SSC
Steelhead, Central Valley DPS *Oncorhynchus mykiss*	T/–
Chinook salmon, Central Valley spring-run ESU *Oncorhynchus tshawytscha*	T/T
Chinook salmon, Sacramento River winter-run *Oncorhynchus tshawytscha*	E/E
Chinook salmon, Central Valley fall/late fall-run ESU *Oncorhynchus tshawytscha*	NSC/SSC

[1] Status:

Federal
E = Listed as endangered under the ESA
T = Listed as threatened under the ESA
BBC= Birds of Conservation Concern

State
E = Listed as endangered under the CESA
T = Listed as threatened under CESA
SSC = State Species of Special Concern

California Native Plant Society Rank
1B = rare, threatened, or endangered in California and elsewhere.
2B = rare, threatened, or endangered in California only.
.1 = seriously endangered in California
.2 = fairly endangered in California

Special Status Plant Species

The Delta is home to many special status plant species, many of which are endemic. Eight special status plant species have been reported in the two USGS quadrangles (Jersey Island and Bouldin Island) that include Big Break and Little Franks Tract (Table 4-1). None of these species are Federally or State-listed as threatened or endangered. Information on these species, including distribution, habitat requirements, and known/potential presence in the project area is in Appendix G. Another 34 special status plant species occur in the 10 quadrangles that surround the 2 quadrangles where the project is located. These species were identified as unlikely to occur in the project area due to unsuitable habitat conditions and occurrence records. Information on these species is also in Appendix G.

Big Break

The field surveys conducted for the Big Break Marsh Restoration Project located two special status plant species within tidal marsh vegetation, the Suisun Marsh aster (one population) and Mason's lilaeopsis (two populations) (Vollmar Consulting 2000). The records search of CNDDB (2013) reports populations of the Suisun Marsh aster, Mason's lilaeopsis, Delta mudwort, Bolander's water-hemlock, and Antioch Dunes evening-primrose (*Oenothera deltoides* ssp. *howellii*) at or in the vicinity of Big Break.

Little Franks Tracts

The Franks Tract State Recreation Area 1988 General Plan reported the presence of the following special-status species: Suisun Marsh aster, rose-mallow (*Hibiscus lasiocarpus*), Delta tule pea, and Delta mudwort (Center for Design Research et al. 1988). The records search of (CNDDB 2013) reports occurrences of the Suisun Marsh aster, eel-grass pondweed, woolly rose-mallow, Delta mudwort, Delta tule pea, and Mason's lilaeopsis at or in the vicinity of Little Franks Tract.

Special Status Wildlife Species

Nine special status animal species have the potential to occur in the project area (Table 4-1). However, 24 special-status wildlife species were identified from database queries and literature searches as having potential to occur in the study area (Appendix G). Fifteen of these species were eliminated from further consideration since the alternatives are outside of the species range or no suitable habitat is present.

Tricolored Blackbird

Status. The tricolored blackbird is a USFWS Bird of Conservation Concern and California State Species of Special Concern. Tricolored blackbird is a medium-sized blackbird that is distinguished from other blackbirds by its distinctive white-tipped red shoulder patches on mature males. Females show varying amounts of red on the shoulders, and their plumage is sooty brown and streaked overall.

Distribution and Habitat. The species is largely endemic to California, with smaller populations in Baja California, Nevada, Oregon, and Washington. During the breeding season, tricolored blackbirds inhabit the Central Valley, the low foothills of the Sierra Nevada and Coast Range from Shasta County south to Kern County, the coast from Sonoma County south to the Mexican border (Beedy 1991).

Tricolored blackbirds nest in small-to-large colonies (up to 50,000 individuals). They often return to the same nesting areas in subsequent years, but will occasionally relocate their breeding colonies if suitable habitat is available elsewhere. The tricolored blackbird breeds in large colonies near fresh water, preferably in emergent wetland with tall, dense cattails or tules, but also in thickets of willow, blackberry, and wild rose. Nesting colonies of tricolored blackbird are highly susceptible to disturbance. Ideal breeding habitat for tricolored blackbird includes two elements: (1) dense nesting substrate (i.e., blackberry or aquatic emergent vegetation), which provides protection from predators; and (2) a large supply of insects within proximity to nests and occurring at the time of fledging. Tricolored blackbirds forage in large flocks and may travel up to 4 miles (6.4 km) from nest or roost sites to forage. Tricolored blackbirds forage on the ground in croplands, grassy fields, flooded land, and along edges of ponds (Zeiner et al. 1990). In the Delta and Central Valley, foraging habitat consists primarily of pastures and certain types of agricultural fields.

Potential for Occurrence in Project Area. A California Natural Diversity Database (CNDDB) record search did not identify occurrences within the Jersey Island and Bouldin Island USGS quadrangles where the project is located. However, since there are recorded occurrences from other quadrangles near the project area their presence cannot be discounted. There is significant potential for future management and restoration work to encourage or generate suitable habitat for these species. Tricolored blackbirds in the proximity of dense nesting substrate or aquatic emergent vegetation may be present near the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

Western Pond Turtle

Status. The western pond turtle (*Emys marmorata*) is a California Species of Special Concern.

Distribution and Habitat. The western pond turtle is found west of the Sierra-Cascade crest from western Washington south to northwest Baja California (Stebbins 2003). Western pond turtles inhabit fresh or brackish water habitats characterized by areas of deep water, low flow velocities, moderate amounts of riparian vegetation, warm water and/or ample basking sites, and underwater cover elements such as large woody debris and rocks. Along major rivers, western pond turtles are often concentrated in areas of optimal habitat, often in side channel and backwater areas. Turtles may move to off-channel habitats, such as oxbows, during periods of high flows (Holland 1994).

Although adults are habitat generalists, hatchlings and juveniles require very specialized habitat for survival through their first few years. Hatchlings spend much of their time feeding in shallow water with dense vegetation of submergents or short emergents (Jennings and Hayes 1994). Habitats preferred by juveniles are relatively scarce and subject to disturbance (Jennings et al. 1992). Although an aquatic reptile, western pond turtles spend time on land basking, overwintering, and nesting, up to 1 km (0.6 mi) away from aquatic habitats (Holland 1994).

Western pond turtle eggs are typically laid in June and July, though may be laid as early as late April and as late as August (Holland 1994). Nests are generally located in grassy meadows, away from trees and shrubs (Holland 1994), with canopy cover commonly less than about 10 percent Incubating eggs are extremely sensitive to increased soil moisture, which can cause high mortality Egg-laying sites vary from sandy shoreline to forest soil types. Young hatch in late fall, or overwinter in the nest and emerge in early spring.

Although considered to be just one widely distributed species, it is likely that the pond turtle is a complex of closely related subspecies, each adapted for a different region. The western pond turtle is still common enough in the Bay-Delta watershed so that it is not difficult to find them in habitats ranging from sloughs of the Delta and Suisun Marsh to pools in small streams. The problem is that most individuals seen are large, old individuals; hatchlings and small turtles are increasingly rare. The causes of the poor reproductive success are not well understood, but factors that need to be considered include elimination of suitable breeding sites, predation on hatchlings by nonnative predators (e.g., largemouth bass, bullfrogs), predation on eggs by nonnative wild pigs, diseases introduced by nonnative turtles, and shortage of safe upland over-wintering refuges. If present trends continue, the western pond turtle will deserve listing as a threatened species (it may already) (CALFED 2000).

Potential for Occurrence in the Project Area. There are many CNDDB occurrence records for western pond turtle in Big Break and vicinity. The tidal sloughs and fresh water marshes of Big Break provide habitat for Western pond turtles which have been observed basking on rocks, logs, and exposed banks. The Big Break area has suitable breeding habitat for turtles, and females can lay their eggs in the sandy banks and well-drained upland soils. There are no CNDDB occurrence records of the turtle at Little Franks Tract despite the presence of prime riparian and marshy habitat. Western pond turtles in the proximity of sandy banks and well-drained upland soils may be near the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

Burrowing Owl

Status. The burrowing owl (*Athene cunicularia*) is California state species of concern.

Distribution and Habitat. Burrowing owls in California historically ranged throughout the Central Valley, in suitable habitat in coastal areas from Marin County to the Mexican border, and in lower numbers in desert areas of the northeastern and southeastern portions of the state. Throughout the vast majority of the burrowing owl's range in California, breeding owls now persist in only small, declining populations of birds that are highly susceptible to extirpation.

Western burrowing owls prefer open grasslands and shrublands with perches and burrows. They usually live and nest in the old burrows of California ground squirrels or other small mammals (Zeiner et al. 1990), but also can nest in piles of wood or other debris. Burrows can be found on the sides of hills, along roadside embankments, on levees, along irrigation canals, near fence lines, and on or near other raised areas of land. The breeding season for burrowing owls extends from February 1 through August 31 (CDFG 2012). Burrowing owls tend to be opportunistic feeders, with large arthropods, mainly beetles and grasshoppers, comprising a large portion of their diet. The species is primarily crepuscular (active at dusk and dawn), but will hunt throughout a 24-hour period.

Potential for Occurrence in the Project Area. There are three records of occurrence of the burrowing owl within the project 5 miles of the northern extent of the project area. Field and row crops and ruderal areas on Sherman and Brannan Islands provide suitable foraging habitat for burrowing owls where they may nest in burrows in ruderal areas and along the edges of agricultural areas. Burrowing owls in the proximity of agriculture and pasture lands may be present near the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

Swainson's Hawk

Status. The Swainson's hawk (*Buteo swainsoni*) is listed as a threatened species under the California Endangered Species Act (Fish and Game Code, Sections 2050 et seq.). The species was listed by the California Fish and Game Commission in 1983. The Swainson's hawk is not Federally listed, however, the species is covered under the Migratory Bird Treaty Act and is included on the USFWS list of Birds of Conservation Concern (BCC). BCC species are those that the USFWS considers potential candidates for federal listing.

Distribution and Habitat. Swainson's hawks nest in the grassland plains and agricultural regions of western North America from southern Canada (and possibly in the northern provinces and territories, and Alaska) to northern Mexico. Historically, it nested throughout lowland California. However, the current Swainson's hawk nesting distribution is limited to the Mojave Desert, northeastern California, the Central Valley, and a few isolated locations in the Owens Valley. Swainson's hawk typically occurs in California only during the breeding season (March through September) and winters in Mexico and Central and South America. The species was once thought to winter exclusively in Argentina; however, recent telemetry studies (satellite radio) have shown the species to winter in Mexico, with additional detections in Central America and South America. The Central Valley population migrates only as far south as Central Mexico (Estep 2008). Additionally, 30 individual hawks have been wintering in the Delta for several years (Estep 2008), and there are records of small numbers of Swainson's hawks wintering in southern Florida and Texas.

Throughout its range, the Swainson's hawk nests almost exclusively in only a few species of trees, such as oaks, cottonwoods, sycamores, or willows (Schlorff and Bloom 1983, CDFG 1994) near large, sparsely vegetated flatlands characterized by valleys, plateaus, broad flood plains, and large open expanses . Though Swainson's hawks are not an obligate riparian species, the availability of nesting substrate is closely tied to riparian areas, usually associated with main river channels. During the breeding season, Swainson's hawks require suitable foraging habitat in association with suitable nesting habitat. Swainson's hawk nesting preference is for large valley oaks (*Quercus lobata),* cottonwoods (*Populus fremontii*), or willow (*Salix goodingii*). In the interior of the Delta, the species will often nest in smaller trees owing to the lack of large trees (Estep 2001). Nesting sites tend to be adjacent or within close proximity to suitable foraging grounds, which may include recently harvested hay, wheat, or alfalfa crops, low-growing crops such as beets or tomatoes, open pasture, nonflooded rice fields, or post-harvest cereal grain crops (Bloom 1980; CDFG 1992, 1994). Swainson's hawks forage in open areas with reduced vegetative cover that provides good visibility of prey items such as voles, ground squirrels, pocket gophers, and deer mice.

Potential for Occurrence in Project Area. Swainson's hawks breed close to Franks Tract at Bouldin Island (CNDDB), however, due the lack of suitable trees for nesting at Big Break and Little and Franks Tract are not known to breed within the project area. Swainson's hawk in the proximity of agriculture and pasture lands may be present the near the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

Valley Elderberry Longhorn Beetle

Status. The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB) is Federally listed threatened is Federally listed as threatened. The USFWS has designated critical habitat for VELB along the American River Parkway and in an area within the Sacramento metropolitan area (54 FR 48229). The species has no State status (the State of California does not list insects).

Distribution and Habitat. The VELB is endemic to the Central Valley and is found in riparian habitats and associated uplands where the elderberry (*sambucus* spp.), the beetle's food plant, grows. The beetle is a pith-boring species that depends on elderberry plants during its entire life cycle. Larvae feed on tree pith, while adults eat the foliage and possibly the flowers of the plants. The adult stage of the VELB is short-lived, and most of the life cycle is spent in the larval stage. The adults are active from early March through early June with mating occurring in May. Eggs are laid singly, or in small groups, in crevices in elderberry bark and hatch in about 10 days. Larvae bore into the pith of elderberry roots, branches, and trunks to create an opening in the stem within which they pupate, remaining in this stage for one to two years before emerging as adults. After metamorphosing into an adult, the VELB chews a circular exit hole through which it emerges, sometime during the period of late March to June. It has been suggested that the VELB is a poor disperser, based on the spatial distribution of occupied shrubs (USFWS 1997).

Potential for Occurrence in Project Area. There are no CNDDB records in the project area or in the vicinity of the dredged material placement sites. Field surveys did not identify elderberry shrubs in the project area. Elderberry shrubs may be present in the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

California Black Rail

Status. The California black rail *(Laterallus jamaicensis coturniculus)* is a State-listed threatened species.

Distribution and Habitat. The California black rail is a rarely seen, year-round resident of saline, brackish, and fresh emergent wetlands. Aside from recently discovered populations in the Central Valley, viable populations of the species are found only in the Suisun Marsh, San Francisco Bay, and the Delta. The California black rail is associated with tidal and nontidal emergent wetlands. The population and distribution of this species have declined substantially, primarily as a result of reclamation of its wetland habitats. Habitat loss and declining population have warranted its listing as threatened under CESA. Historical and current loss or degradation of salt, brackish, and freshwater marshes are the major factors that limit this species in the Delta (CALFED 2000).

Important habitats for the species include tidal perennial and nontidal perennial aquatic, dead-end and open-ended sloughs, seasonal wetland and aquatic, saline and fresh emergent wetland, and midchannel islands and shoals. Many tidal habitats, including those that support pickleweed, bulrushes, and saltgrass, are critical types for this species that need to be protected, and only a small percentage of their historical extent remains. Upper wetland or upland areas adjacent to these habitat areas provide nesting and escape cover during high tides and floods. Black rails are especially abundant in undiked tidal marshes of Suisun Marsh. They are most often associated with dense stands of American bulrush (*Scirpus americanus*) immediately adjacent to high marsh meadows supporting pickleweed-saltgrass associations. They are often associated with soft bird's-beak, an endangered plant of the high tidal marsh (Grinnell and Miller 1944).

Potential Occurrence in Project Area. California black rails are reported to occur in fringing tidal marshes adjacent to Big Break, and they are known to occur in tidal marshes in the study area.

Pallid Bat

Status. The pallid bat is a California Species of Special Concern.

Distribution and Habitat. The pallid bat is widespread in California, except for the high Sierra Nevada Range from Shasta to Kern counties, and in the northwest corner of the state (Zeiner et al. 1990b). Pallid bats occupy a variety of habitats, from arid deserts to grasslands to conifer forests. At low- to mid-elevations, pallid bats are particularly associated with oak habitat (Pierson and Rainey 2002). Roosts (including day, night, and maternity roosts) are typically located in rock crevices and cliffs, but can also be found in tree hollows and caves (Hermanson and O'Shea 1983; Lewis 1994; Pierson et al. 1996, 2001). In more urban settings, roosts are frequently associated with human structures such as abandoned buildings, abandoned mines, and bridges (Pierson et al. 1996, 2001). Overwintering roosts require relatively cool and stable temperatures out of direct sun light. Pallid bats may forage 1 to 3 miles from their day roost, and glean prey from the ground (Zeiner et al. 1990b).

The pallid bat is a colonial species, with a typical maternal colony size of 50 to 300 (Hermanson and O'Shea 1983, Lewis 1994, Pierson et al. 1996). Breeding occurs from late October to February. With the average litter size of two, the young are born between April and July and are typically weaned in August (Sherwin and Rambaldini 2005).

Potential for Occurrence in the Project Area. Pallid bats may roost within the riparian forest near the study area, and may forage over the proposed sites and nearby fields. Big Break is strewn with old structures that provide potential roosting or hibernaculum habitat for several bat species, including the pallid bat (EBRPD 2001). Pallid bats in the proximity of riparian forests and structures may be present near the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

Western Red Bat

Status. The western red bat is a California Species of Special Concern.

Distribution and Habitat. In California, western red bats have been observed near the Pacific Coast, Central Valley, and the Sierra Nevada. Usually found at lower elevations, recent acoustic surveys in California have documented that western red bats, while relatively rare, are broadly distributed at elevations up to 8,202 feet in the Sierra Nevada (Pierson et al. 2000, 2001; Pierson and Rainey 2003). Western red bat roosts have often been observed in edge habitats—near streams, fields, orchards, or urban areas (Zeiner et al. 1990b). This species roosts non-colonially in dense canopies and within tree foliage, beneath overhanging leaves (Constantine 1959, Shump and Shump 1982), from 2 to 40 feet above ground level (Zeiner et al. 1990b). Studies in the Central Valley found that summering populations of red bats are substantially more abundant in remnant riparian stands of cottonwood or sycamore greater than 164 feet wide than in younger, less extensive stands (Pierson et al. 2000).

Western red bats may forage up to 0.3 to 0.6 of a mile from their day roost (Zeiner 1990b). Red bats forage at both canopy height and low over the ground (Shump and Shump 1982). This species feeds primarily on small moths, but its diet may include a variety of other insects such as crickets, beetles, and cicadas (Zeiner et al.1990b).

Western red bats mate in August and September. Breeding females are found in association with the same cover requirements as for other roost sites, and with cottonwood/sycamore riparian habitat along large river drainages in the Central Valley (Ziener et al. 1990b, Pierson and Rainey 2003). Fertilization is delayed until March or April. After an 80- to 90-day gestation period, pups are born from late-May through early-July.

Potential for Occurrence in the Project Area. Western red bats may roost near the study area in trees, and may forage in the nearby fields. CNDDB records indicate that the bats known to occur on Brannan Island and near Antioch.

Giant Garter Snake

Status. The giant garter snake (*Thamnophis gigas*) is Federally and State-listed as threatened.

Distribution and Habitat. The giant garter snake is endemic to wetlands in the Sacramento and San Joaquin valleys (Hansen and Brode 1980). The current distribution extends from near Chico in Butte County south to the Mendota Wildlife Area in Fresno County. No occurrences of giant garter snakes are known from the northern portion of the San Joaquin Valley north to the eastern fringe of the Sacramento-San Joaquin River Delta, where the floodplain of the San Joaquin River is limited to a relatively narrow trough (Hansen and Brode 1980, 58 FR 54053). The resulting gap of approximately 60 miles separates the southern and northern populations (Hansen and Brode 1980, CNDDB 2011).

Rice fields and their adjacent irrigation and drainage canals and ditches serve an important role as aquatic habitat for the snakes. During the summer, some snakes use the flooded rice fields as long as their prey is present in sufficient densities. In late summer, rice fields provide important nursery areas for newborns. In late summer/fall, water is drained from the rice fields and the snakes prey items become concentrated in the remaining pockets of standing water, which allow the snakes to gorge before the winter their period of winter inactivity (USFWS 1999). It appears that the majority of the snakes move back into the canals and ditches as the rice fields are drained, although a few may overwinter in

the fallow fields, where they hibernate within burrows in the small berms separating the rice checks (Hansen 1998).

Potential for Occurrence in Project Area. There are only two isolated records of giant garter snake on the south side of the San Joaquin River in the northern aspect of the species' range. Although the historical and current distribution of giant garter snake in the Delta is poorly understood, the south bank of the San Joaquin River lies within the apparent gap between the northern and southern populations (CNDDB 2011). The nearest locality record to the south lies more than 50 air miles distant in Madera County; no giant garter snakes are documented in Stanislaus County between the documented extremes of the documented extremes of the Sacramento Valley and San Joaquin Valley populations.

A giant garter snake was found on Webb Tract (adjacent to Franks Tract to the North) during April, 2002 near the ferry dock. Sherman Island (adjacent to Lower Sherman Island to the east) is identified for recovery efforts in the Draft Recovery Plan for Giant Garter Snakes (USFWS 1999). One giant garter snake was found in 1998 near Sherman and Decker Islands, but it is not known whether this snake represented a resident population in the western Delta or was washed into the Delta from high-water flows in the winter. Another garter snake was observed at the north end of the Antioch Bridge before the mid 1980s (IES 2000).

Intensive trapping surveys conducted within Contra Costa County independently by Eric Hansen and by Biological, Inc. have failed to detect giant garter snake. Likewise, Swaim intensively trapped in regions northeast of Oakley in 2003 and 2005, including Marsh Creek, Big Break, and Contra Costa Canal, without success (Swaim 2004, Swaim 2005a-f, Swaim 2006).

Giant garter snake in potentially using drainage and irrigation channels may be present near the overland pumping pipeline layout over Sherman, Jersey, and Bradford Islands.

Special Status Fish Species

The Bay–Delta estuary, including the Delta flooded islands, serves as habitat for a variety of special status fish species, several of which have been listed for protection under the Federal and/or California Endangered Species Acts. Central Valley steelhead trout are present seasonally within the Delta. Green sturgeon inhabit Suisun Bay and the Delta. Delta smelt and juvenile Chinook salmon identified as winter-run and spring-run Chinook salmon have been collected within Suisun Bay and the Delta, including the flooded islands.

Chinook salmon, (winter-run, federally- and state-listed as endangered; Central Valley fall/late-fall-run, a federal candidate species and California Species of Special Concern; and spring-run, federally- and state-listed as threatened) and steelhead, (Central Valley Evolutionary Significant Unit or ESU, federally-listed as threatened) use the Delta in the vicinity of Little Franks Tract and Big Break as a migratory corridor. In addition, Delta smelt, a threatened species, have been documented within the waters of Suisun Bay and the Delta, including the flooded islands. Suisun Bay and the Delta, including Big Break and Little Franks Tract are in the area designated as Essential Fish Habitat (EFH) for managed species, including Pacific salmon. Table 4-1 shows the listed species that have the potential to occur within the project area.

Green Sturgeon

Green Sturgeon are listed as a Federally threatened species under the Federal Endangered Species Act. Under the California Endangered Species Act green sturgeon are listed as a species of concern.

Distribution and Habitat. Green Sturgeon are found in the lower reaches of large rivers from British Columbia south to the Sacramento River. The southernmost spawning population is in the Sacramento River. Spawning populations existed historically in the Eel and Klamath-Trinity River systems (Adams et al. 2002). In the Central Valley, spawning habitat may have extended to the Butte Creek watershed. Currently, spawning occurs in the mainstem Sacramento River and some spawning may occasionally take place in the Feather River (Beamesderfer and Webb 2002). Green Sturgeon have been observed in the Sacramento River near RBDD, near Hamilton City, and in the Delta and San Francisco Bay (Moyle 2002). Fish monitoring efforts at RBDD and the Glenn-Colusa Irrigation District (GCID) pumping facility on the upper Sacramento River have recorded between zero and 2,068 juvenile North American Green Sturgeon per year (Adams et al. 2002). Catches of sub-adult and adult North American Green Sturgeon by the IEP investigations between 1996 and 2004 ranged from one to 212 Green Sturgeon per year, with the highest catch in 2001. No Green Sturgeon juveniles or adults have been documented in the San Joaquin River, although (Moyle 2002) suggests that reproduction may have taken place in the San Joaquin River because adults have been captured at Santa Clara Shoal and Brannan Island (Moyle 2002).

Little is known about movements, habitat use, and feeding habits of green sturgeon. Green sturgeon have been salvaged at the State and Federal fish collection facilities in every month, indicating that they are present in the Delta year-round. Juveniles and adults are reported to feed on benthic invertebrates, including shrimp and amphipods, and small fish (NMFS 2005c).

Potential for Occurrence in Project Area. Green Sturgeon may occur seasonally within Big Break and Little Franks Tract as juveniles and adults. The area may allow the upstream passage of adults and the downstream emigration of juveniles (NMFS 2006).

Delta Smelt

Status. Delta smelt are listed as a threatened species under both the California and Federal Endangered Species Acts.

Distribution and Habitat. Delta smelt are endemic to the Sacramento–San Joaquin Delta estuary. Delta smelt inhabit the freshwater portions of the Delta and Sacramento and San Joaquin rivers and the low-salinity portions of Suisun Bay. They typically are found in shallow water (less than 10 feet) where salinity ranges from 2 to 7 parts per thousand (ppt), although they have been observed at salinities between 0 and 18.4 ppt. Delta smelt have relatively low fecundity and most live for 1 year. They feed on planktonic copepods, cladocerans, amphipods, and insect larva (Moyle 2002).

Adult Delta smelt migrate upstream into channels and sloughs of the eastern Delta during fall and winter in preparation for spawning. Delta smelt live their entire life cycle in the Sacramento–San Joaquin Delta. USFWS has prepared a recovery plan for Delta smelt that identifies criteria for

evaluating the status of the Delta smelt population (USFWS 1996). These criteria include annual indices of abundance and geographic distribution in the estuary as determined through CDFW's fall mid-water trawl surveys. Indices of abundance and geographic distribution of Delta smelt have improved in recent years. USFWS continues to evaluate the available scientific information regarding the status of Delta smelt and the performance of various management actions designed to improve protection, reduce mortality, and enhance habitat quality and availability within the estuary.

Potential for Occurrence in Project Area. As a result of their life history and geographic distribution, Delta smelt may occur seasonally within Big Break and Little Franks Tract as eggs, larvae, juveniles, and adults. Juvenile and adult Delta smelt are most abundant in the central Delta in the vicinity of Little Franks Tract during the fall, winter, and spring (CDFW unpublished data). Larval, juvenile, and adult Delta smelt are most abundant in the western Delta and Suisun Bay in the vicinity of Big Break during spring, summer, and fall (CDFW unpublished data).

Sacramento River Winter-run Chinook Salmon

Status. Winter-run Chinook salmon is Federally and State-listed as an endangered species. The National Marine Fisheries Service (NMFS) designated critical habitat for Sacramento River winter-run Chinook salmon in 1993 (58 FR 33212). The critical habitat designation includes the Sacramento-San Joaquin Delta and the Sacramento River within all accessible reaches.

Distribution and Habitat. Sacramento River winter-run Chinook salmon spend 1 to 3 years in the ocean. Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from December through July, with peak migration in March. Adults spawn from mid-April through August, and egg incubation continues through October (Moyle 2002). The primary spawning habitat in the Sacramento River is above Red Bluff Diversion Dam at river mile (RM) 243, although spawning has been observed downstream as far as RM 218 (NMFS 2001). Spawning success below the Red Bluff Diversion Dam may be limited primarily by warm water temperatures (Yoshiyama et al. 1998). Sacramento River winter-run Chinook salmon smolts (i.e., juveniles that are physiologically ready to enter seawater) may migrate through the Delta and bay to the ocean from November through May (Yoshiyama et al. 1998). In general, juvenile abundance in the Delta increases in response to increased Sacramento River flow (Brandes and McLain 2001).

Potential for Occurrence in Project Area. Sacramento River winter-run Chinook salmon occur in the Delta either as adults migrating upstream to their spawning habitat or as juveniles, rearing and migrating towards the ocean. Winter-run Chinook salmon have the potential to occur in the study area. Although the majority of adult winter-run Chinook salmon migrate upstream in the main-stem Sacramento River, there is a probability, although low, that adults may migrate into the central Delta. The majority of adult winter-run Chinook salmon migrate upstream in the Sacramento River past Sherman Lake. The occurrence of adult winter-run Chinook salmon in the central Delta, including Big Break and Little Franks Tract, although expected to be very low, would be limited to winter and early spring adult upstream migration. Because winter-run Chinook salmon do not spawn within Suisun Bay or the Delta, there is no probability that habitat enhancement projects in the Delta flooded islands would adversely or beneficially affect winter-run Chinook salmon spawning or egg incubation.

Central Valley Spring-run Chinook Salmon

Status. The Central Valley spring-run Chinook salmon ESU was Federally listed as threatened on 16 September 1999 (64 FR 50394). Their threatened status was reaffirmed in the NMFS final listing determination issued on 28 June 2005 (70 CFR 37160). Critical habitat for Central Valley spring-run Chinook salmon was designated by NMFS on 2 September 2005 (70 FR 52488). Designated critical habitat includes the San Francisco Bay-Delta estuary, mainstem Sacramento River upstream to Keswick Dam, and most of the Sacramento Valley's perennial tributaries with established spring salmon runs, including the Feather River and Feather River Hatchery.

Distribution and Habitat. Spring-run Chinook salmon were historically widely distributed and abundant within the Sacramento and San Joaquin river systems (Yoshiyama et al. 1998). Spring-run Chinook salmon historically migrated upstream into the upper reaches of the main-stem rivers and tributaries for spawning and juvenile rearing (Moyle 2002). Construction of major dams and reservoirs on these river systems eliminated access to the upper reaches for spawning and juvenile rearing, and completely eliminated the spring-run Chinook salmon population from the San Joaquin River system (Moyle 2002). Spring-run Chinook salmon abundance has declined substantially (NMFS 2009), and the geographic distribution of the species in the Central Valley has also declined substantially. Spring-run spawning and juvenile rearing currently occur consistently in only a small fraction of their previous geographic distribution, including populations inhabiting Deer, Mill, and Butte creeks, the main-stem Sacramento River, several other local tributaries on an intermittent basis, and the lower Feather River (Moyle 2002). Recent genetic studies show that spring-run Chinook salmon returning to the lower Feather River are genetically similar to fall-run Chinook salmon. Hybridization between spring-run and fall-run Chinook salmon, particularly on the Feather River where both stocks are produced within the Feather River hatchery, is a factor affecting the status of the spring- run Chinook salmon population. NMFS is in the process of developing a recovery plan for Central Valley spring-run Chinook salmon.

Probability of Occurrence in Project Area. Central Valley spring-run Chinook salmon occur in the Delta either as adults migrating upstream to their spawning habitat, or as juveniles, rearing and migrating towards the ocean. Spring-run Chinook salmon have the potential to occur in the study area due to the presence of rearing and migratory habitat. Although the majority of adult spring-run Chinook salmon migrate upstream in the main-stem Sacramento River passing Sherman Lake, there is a probability, although low, that adults may migrate into the central Delta. The occurrence of adult spring-run Chinook salmon in the western and central Delta in the vicinity of Big Break and Little Franks Tract, although expected to be very low, would be limited to the late winter and spring adult upstream migration. Because spring-run Chinook salmon do not spawn in Suisun Bay or the Delta, there is no probability that habitat enhancement projects in the Delta flooded islands would adversely or beneficially affect spring-run Chinook salmon spawning or egg incubation.

Central Valley Steelhead

Status. The Central Valley steelhead is a Federally and State-listed threatened species. The Central Valley steelhead Distinct Population Segment DPS (formerly ESU) was Federally listed as threatened on 19 March 1998 (63 FR 13347) and its threatened status was reaffirmed in the NMFS final listing determination on 5 January 2006 (71 FR 834). Critical habitat for Central Valley steelhead was

designated on 2 September 2005 (70 FR 52488), and includes all river reaches accessible to steelhead in the Sacramento and San Joaquin rivers and their tributaries.

Distribution and Habitat. Central Valley steelhead historically migrated upstream to the high gradient upper reaches of Central Valley streams and rivers for spawning and juvenile rearing. Construction of dams and impoundments on most Central Valley rivers has created impassable barriers to upstream migration and substantially reduced the geographic distribution of steelhead. Although quantitative estimates of the number of adult steelhead returning to Central Valley streams to spawn are not available, anecdotal information and observations indicate that population abundance is low. Steelhead distribution is currently restricted to the main-stem Sacramento River downstream of Keswick Dam, the Feather River downstream of Oroville Dam, the American River downstream of Nimbus Dam, the Mokelumne River downstream of Comanche Dam, and a number of smaller tributaries to the Sacramento River system, Delta, and San Francisco Bay. The project areas within the San Joaquin river system serve as (EFH) for managed species, including Pacific salmon. Big Break and Little Franks Tract support juvenile rearing and migration.

Steelhead have one of the most complex life histories of any salmonid species, exhibiting both anadromous and freshwater resident life histories. Freshwater residents of the species are referred to as rainbow trout, and those exhibiting an anadromous life history are called steelhead. The Central Valley steelhead population is composed of both naturally spawning steelhead and steelhead produced in hatcheries.

In the Sacramento River, adult winter steelhead migrate upstream during most months of the year, beginning in July, peaking in September, and continuing through February or March. Spawning occurs primarily from January through March, but may begin as early as late December and may extend through April Individual steelhead may spawn more than once, returning to the ocean between each spawning migration. Juvenile steelhead rear a minimum of 1 year, but typically spend 2 or more years in fresh water before migrating to the ocean during smoltification (the process of physiological change that allows ocean survival). Juvenile migration to the ocean generally occurs from December through August. The peak months of juvenile migration are January to May (McEwan 2001).

Potential for Occurrence in Project Area. Central Valley steelhead occur in the Delta as adults, migrating upstream to their spawning habitat, and as juveniles and smolts rearing and migrating toward the ocean. Central Valley steelhead have the potential to occur in the study area due to the presence of rearing and migratory habitat. Although the majority of adult steelhead migrate upstream in the main-stem Sacramento River, there is a probability that adults migrate through the central Delta and would be present seasonally in the vicinity of Big Break and Little Franks Tract. The occurrence of adult steelhead within the Delta, and potentially within Delta flooded islands, would be limited to the winter and early spring adult upstream migration. Because steelhead do not spawn in Suisun Bay or the Delta, there is no probability that habitat enhancement projects in Delta flooded islands would adversely or beneficially affect steelhead spawning or egg incubation.

Essential Fish Habitat

The San Francisco Bay, Suisun Bay, and the western and central Delta, including Big Break and Little Franks Tract, have been designated as Essential Fish Habitat (EFH) by the Pacific Fisheries Management Council (PFMC) to protect and enhance habitat for coastal marine fish and macroinvertebrate species that support commercial fisheries. The Sustainable Fisheries Act (PL 104-297) requires all Federal agencies to consult with the Secretary of Commerce on proposed activities that may adversely affect any designated EFH (Office of Habitat Conservation 1999). The EFH provisions of the act are designed to protect fishery habitat from being lost as a result of disturbance and degradation. Under PFMC's Pacific Coast Salmon Fishery Management Plan, the entire San Francisco Bay–Delta estuary (including the flooded islands) has been designated as EFH for spring-, fall-, late fall- and winter-run Central Valley Chinook salmon (Pacific salmon). These areas serve as a migratory corridor, holding area, and rearing habitat for adult and juvenile salmon.

Critical Habitat

The Sacramento and San Joaquin Rivers and the Bay–Delta estuary serve as a migration corridor for anadromous salmonids, which have been listed for protection under the California and/or Federal Endangered Species Acts. Listed salmonids that occur seasonally in the Delta in the vicinity of the flooded islands include winter-run Chinook salmon, spring-run Chinook salmon, and steelhead trout. The Sacramento River and Bay–Delta estuary are designated as critical habitat by NMFS for winter-run Chinook salmon. These areas of the estuary were designated as critical habitat for spring-run Chinook salmon and steelhead; however, the designation has been suspended pending further review. The Bay–Delta estuary, including the flooded islands, has been designated as critical habitat by USFWS for Delta smelt.

4.2.3 Water Quality

This section describes the existing surface and groundwater water resources and quality, and jurisdictional wetlands in the project area. Water quality analysis is divided into conventional pollutants and bioaccumulation potential. For this analysis, conventional pollutants analyzed are:

- pH;
- Turbidity;
- Total dissolved solids (TDS);
- Dissolved oxygen (DO);
- Nutrients, including total organic carbon (TOC), nitrogen, and phosphorus;
- Trace elements including arsenic, cadmium, chromium, copper, lead, nickel, zinc.

Regulatory Setting

Federal

Clean Water Act

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 (USEPA 2002). In some states, such as California, the USEPA has delegated authority to regulate the CWA to state agencies.

Section 401 of the CWA regulates the water quality for any activity that may result in any in-water work or discharge into navigable waters. These actions must not violate Federal water quality standards. The Central Valley RWQCB administers Section 401 in California, and either issues or denies water quality certifications that typically include project-specific requirements established by the RWQCB to ensure attainment of water quality standards.

Section 404 of the CWA requires that a permit be obtained from the USEPA and the Corps when an action will result in discharge of dredged or fill material into wetlands and waters of the U.S. Under Section 404, the Corps regulates such discharges and issues individual and/or general permits for these activities. Before the Corps can issue a permit under Section 404, it must determine that the project is in compliance with the CWA Section 404(b)(1) guidelines. The 404(b)(1) guidelines 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 CFR 230.10[a]). The USEPA has "veto" authority over permits issued by the Corps.

When conducting its own civil works projects, the Corps does not issue permits to themselves. Rather, the Corps would comply with the guidelines and substantive requirements of the Clean Water Act, including Section 404, and Section 401. The discharge of fill material would be required to comply with 404(b)(1) guidelines with the inclusion of appropriate measures to minimize pollution or adverse effects on the aquatic ecosystem. A Section 401 water quality certification will be required from the Central Valley RWQCB.

The project would also require an NPDES permit since it would disturb 1 or more acre of land and involves possible storm water discharges to surface waters. Prior to construction, the contractor would be required to prepare a SWPPP and then submit a Notice of Intent form to the Central Valley RWQCB, requesting approval of the proposed work. This storm water plan would identify best management practices to be used to avoid or minimize any adverse effects of construction on surface waters. Once the work is completed, the contractor would submit a Notice of Termination in order to terminate coverage by the NPDES permit.

State

Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act of 1970 established the SWRCB and nine RWQCBs within the State of California. These groups are the primary state agencies responsible for protecting California water quality to meet present and future beneficial uses and regulating appropriative surface rights allocations. The preparation and adoption of water quality control plans, or Basin Plans, and statewide plans, is the responsibility of the SWRCB. State law requires that Basin Plans conform to the policies set forth in the California Water Code beginning with Section 13000 and any State policy for water quality control. These plans are required by the California Water Code (Section 13240) and supported by the Federal CWA. Section 303 of the CWA requires states to adopt water quality standards which "consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses." According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected and water quality objectives to protect those uses. Adherence to Basin Plan water quality objectives protects continued beneficial uses of water bodies.

Affected Environment

Primary Factors Affecting Water Quality

Primary factors affecting water quality in the project area include patterns of land use in the upstream watersheds and the Delta, operations of the State Water Project (SWP) and Central Valley Project (CVP). . The CVP is operated by the U.S. Bureau of Reclamation; it is one of the world's largest water storage and transport systems. The SWP is a federal water management project under the supervision of the United States Bureau of Reclamation. The SWP provides irrigation and municipal water to much of California's Central Valley by regulating and storing water in reservoirs in the water-rich northern half of the state, and transporting it to the water-poor San Joaquin Valley by means of a series of canals, aqueducts and pump plants, some shared with the SWP.

Point and nonpoint pollutant sources include historic and recent drainage from inactive and abandoned mines and related debris/sediment, industrial and municipal wastewater treatment plant discharges, agricultural drainage, urban stormwater runoff, atmospheric deposition, recreational uses, and metabolic waste (e.g., pathogens) from wildlife. Other major point sources consist primarily of municipal wastewater treatment plants and nonpoint sources consist of urban stormwater runoff of pollutants. Natural erosion and instream sediments, atmospheric deposition, and geothermal inputs also affect Delta water quality. The principal contaminants and conditions affecting water quality in the Delta are as follows (CALFED Bay-Delta Program 2000).

- Historical drainage and sediment discharged from upstream mining operations in the late 1800s and early 1900s has contributed metals, such as cadmium, copper, and mercury.
- Stormwater runoff can contribute metals, sediment, pathogens, organic carbon, nutrients, pesticides, dissolved solids (salts), petroleum products, and other chemical residues.

- Wastewater discharges from treatment plants can contribute salts, metals, trace organics, nutrients, pathogens, pesticides, organic carbon, personal care products, pharmaceuticals, and oil and grease.
- Agricultural irrigation return flows and nonpoint discharges can contribute salts (including bromide), organic carbon, nutrients, pesticides, pathogens, and sediment.
- Large dairies and feedlots can contribute nutrients, organic carbon, and pathogenic organisms.
- Water-based recreational activities (such as boating) can contribute hydrocarbon compounds, nutrients, and pathogens.
- Atmospheric deposition can contribute metals, nutrients, pesticides, and other synthetic organic chemicals, and may lower pH.
- Seawater intrusion can contribute salts, including bromide, which affect total dissolved solids (TDS) concentrations and can contribute to formation of unwanted chemical byproducts in treated drinking water. Additionally, seawater can contribute sulfate, which can influence the methylation of mercury.
- Miscellaneous contaminants and conditions from the San Joaquin River include selenium and low dissolved oxygen (DO).

Water quality can vary seasonally in response to winter spring runoff and summer-fall lower flow periods, and can also vary from year to year as a result of precipitation and snow pack levels in the upper watersheds, and the resulting releases from upstream reservoirs for water supply, flood management, and environmental obligations (e.g., fish flows, Delta water quality objective compliance), operations of the Delta Cross Channel, and seasonal and annual variations in SWP and CVP pumping rates.

As defined by USEPA, water quality standards consist of: (1) the designated beneficial uses of a water segment; (2) the water quality criteria (referred to as objectives by the state) necessary to support those uses; and (3) an antidegradation policy that protects existing uses and high water quality. Each Regional Water Board's Basin Plan identifies numeric and narrative water quality objectives, together with the beneficial uses assigned to water bodies and the state anti-degradation policy.

California Toxics Rule

CTR criteria are established only for the aquatic life and human health protection. CTR criteria for aquatic life protection for some constituents (i.e., most metals, cyanide, various organic compounds) are specified for freshwater and saltwater conditions. The CTR states that the salinity characteristics (i.e., freshwater versus saltwater) of the receiving water shall be considered in determining the applicable criteria. Freshwater criteria shall apply to waters with salinity equal to or less than 1 ppt at least 95% of the time. Saltwater criteria apply to waters with salinity equal to or greater than 10 ppt at least 95% of the time in a normal water year. For waters with salinity between these two categories, or tidally influenced freshwaters that support estuarine beneficial uses, the applicable criteria are the lower of the freshwater or saltwater values for each substance.

Water Quality Control Plan for the Delta Estuary

The Bay-Delta WQCP identifies beneficial uses of water in the Bay-Delta, water quality objectives for the reasonable protection of those beneficial uses, and a program of implementation for achieving the water quality objectives. The State of California is currently in the process of updating the plan including the area where the project would occur. Unless otherwise indicated, water quality objectives cited for a general area, such as for the south Delta, are applicable for all locations in that general area, and specific compliance locations are used to determine compliance with the cited objectives within the area.

The established water quality objectives provide reasonable protection for fish and wildlife. The beneficial uses in the Bay-Delta Estuary include the following:

- Shellfish Harvesting – Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.
- Commercial and Sport Fishing – Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
- Navigation – Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.
- Warm Freshwater Habitat – Uses of water that support warm water ecosystems including, but not limited to, preservation of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
- Cold Freshwater Habitat – Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancements of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
- Migration of Aquatic Organisms – Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.
- Spawning, Reproduction, and/or Early Development – Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.
- Estuarine Habitat – Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g. estuarine mammals, waterfowl, shorebirds).
- Wildlife Habitat – Uses of water that support estuarine ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
- Rare, Threatened, or Endangered Species – Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under State or federal law as being rare, threatened, or endangered.

Water Quality Control Plan for Sacramento and San Joaquin River Basins

The Basin Plan for the Sacramento and San Joaquin Rivers defines the beneficial uses, water quality objectives, implementation programs, and surveillance and monitoring programs for waters of the Sacramento and San Joaquin River basins. The Basin Plan contains specific numeric water quality objectives that are applicable to certain water bodies, or portions of water bodies. Numerical objectives have been established for bacteria, DO, pH, pesticides, EC, TDS, temperature, turbidity, and trace metals. The Basin Plan also contains narrative water quality objectives for certain parameters that must be attained through pollutant control measures and watershed management. Narrative water quality objectives also serve as the basis for the development of detailed numerical objectives.

Mercury

Mercury occurs as a result of both natural and anthropogenic sources in the environment and continually cycles in the aquatic environments of the Sacramento and San Joaquin River basins and Delta. The cycle involves different chemical forms and/or species of mercury as a result of both chemical and biological reactions in aerobic and anoxic microenvironments. On a world wide scale, mining sources are geographically localized but, in California's Central Valley, they are of great importance. Most additional mercury sources are part of a widespread, global cycle (Jones and Slotten 1996).

Sediment methyl mercury concentrations and methyl mercury to total mercury ratios were significantly greater in highly vegetated marsh habitats as compared to adjacent Delta channel and mudflat environments. Methylation potential experiments showed that flooded wetland sediments exhibited 2 to 30 times greater potential to produce methyl mercury than aquatic sediments of adjacent channels and flats (Slotten et al. 2003). However, biological findings indicate no distinct localized increase in net methyl mercury bioaccumulation in flooded wetland tracts vs. adjacent aquatic habitats within Delta sub-regions. Some of the most well developed, highly vegetated wetland tracts exhibited reduced levels of localized net mercury bioaccumulation. These results suggest that wetland restoration projects may result in localized mercury bioaccumulation at levels similar to, but not necessarily greater than, levels within their surrounding Delta sub-region (Slotten et al. 2003).

Salinity

Salinity concentrations within the Delta are primarily a function of the location of high-salt content ocean water with daily tidal action, freshwater inflow to the Delta, and the hydrodynamic processes in the Delta channels that govern channel flow conditions and mixing of water sources with variable salt content. During winter and early spring, freshwater inflows to the Delta are usually above the minimum required to control salinity. However, at least for a few months in summer and fall of most years when freshwater inflows to the Delta have declined, Delta salinity conditions must be carefully monitored and controlled. Broad-scale salinity control actions are taken in the Delta because its channels are at or below sea level and unless repelled by continuous seaward flow of fresh water, seawater can advance into the western Delta and adversely affect compliance with water quality objectives and beneficial uses provided by Delta water resources.

Additional influential factors of the Delta salinity conditions include the San Joaquin River inflow, in-Delta agricultural drainage, and other miscellaneous inputs (e.g., municipal wastewater, urban runoff, connate groundwater). San Joaquin River inflows are particularly influential to salinity conditions in the southern Delta after winter rainfall and runoff from the Sierra Mountains have ceased and the river is influenced primarily by drainage return flows from the San Joaquin Valley floor. High concentrations of salts are carried by the San Joaquin River into the Delta and much of the salt load represents recirculation and increased salt content of water diverted to the San Joaquin valley via the CVP Delta. Salinity problems in the western Delta result primarily from the incursion of saline water from the San Francisco Bay when freshwater inflow from the Delta to the bay is low. However, it should be noted that compared to historical conditions, Delta salinity during low-flow periods is much lower since the construction of the major dams on Delta tributaries in the Sierra Mountains and foothills, which allow storage and fresh-water releases during the summer to repel tidal seawater intrusion. For the Sacramento River in the north Delta, which is not substantially affected by sea-water intrusion due to the large flow of the Sacramento River, concentrations of all salinity parameters are uniformly much lower than other Delta locations.

4.2.4 Air Quality

This air quality section describes the pre-project air quality conditions in the project vicinity. The section first explains the air quality regulatory environment the existing physical air quality environment, including the area's climate and atmospheric conditions, the air pollutants of most concern, air quality conditions, and sensitive receptors in the project area.

Regulatory Setting

Air quality management and protection are regulated by federal, state, and local levels of government. The primary statutes that establish ambient air quality standards and establish regulatory authorities to enforce regulatory attainment are the Federal Clean Air Act (CAA) and California Clean Air Act (CCAA). Applicable air quality regulations and responsible agencies are described below.

Federal

Clean Air Act

The Federal 1970 CAA authorized the establishment of national health-based air quality standards, and also set deadlines for their attainment. The Federal Clean Air Act Amendments of 1990 (1990 CAAA) made major changes in deadlines for attaining National Ambient Air Quality Standards (NAAQS) and in the actions required of areas of the nation that exceeded these standards. Under the CAA, state and local agencies in areas that exceed the NAAQS are required to develop state implementation plans (SIP) to show how they will achieve the NAAQS for nonattainment criteria pollutants by specific dates. SIPs are not single documents; rather, they are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, state regulations and federal controls. The USEPA is responsible for enforcing the NAAQS primarily through reviewing SIPs that are prepared by each state.

As required by the Federal CAA, the USEPA has established and continues to update the NAAQS for specific criteria air pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), inhalable particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and lead (Pb). The NAAQS for these pollutants are listed under "Federal Standards" in Table 4-2 and represent the upper-bound levels of pollutant concentrations deemed necessary by the USEPA to protect the public health and welfare with an adequate margin of safety.

General Conformity Rule and de minimis Levels

Pursuant to CAA Section 176(c) requirements, USEPA promulgated the General Conformity Rule, which applies to most federal actions, including the Folsom JFP project. The General Conformity Rule is used to determine if federal actions meet the requirements of the CAA and the applicable SIP by ensuring that pollutant emissions related to the action do not:

- Cause or contribute to new violations of a NAAQS.
- Increase the frequency or severity of any existing violation of a NAAQS.
- Delay timely attainment of a NAAQS or interim emission reduction.

A conformity determination under the General Conformity Rule is required if the federal agency determines: the action will occur in a nonattainment or maintenance area; that one or more specific exemptions do not apply to the action; the action is not included in the federal agency's "presumed to conform" list; the emissions from the proposed action are not within the approved emissions budget for an applicable facility; and the total direct and indirect emissions of a pollutant (or its precursors), are at or above the de minimis levels established in the General Conformity regulations.

An action will be determined to conform to the applicable SIP if the action meets the requirements of 40 CFR 93.158(c). In addition, federal activities may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emissions reductions toward attainment.

State

The CARB is responsible for the development, implementation, and enforcement of California's motor vehicle pollution control program, administration of the state's air pollution research program, adoption and updating, as necessary, of California Ambient Air Quality Standards (CAAQS), review of local APCD activities, and coordination of the development of the SIP for achievement of the NAAQS.

California Clean Air Act

The CCAA establishes an air quality management process that generally parallels the Federal process. The CCAA, however, focuses on attainment of the CAAQS that, for certain pollutants and averaging periods, are more stringent than the comparable NAAQS. The CAAQS are included in Table 4-2 alongside the NAAQS.

Table 4-2. State and Federal Ambient Air Quality Standards.

Pollutant	Averaging Time	National Primary Standard[a]	California Standard[b]	Violation Criteria	
				National	California
CO	8 hour	9 ppm	9 ppm	Not to be exceeded more than once per year	Not to be exceeded
	1 hour	35 ppm	20 ppm	Not to be exceeded more than once per year	Not to be exceeded
NO_2	Annual	0.053 ppm	0.030 ppm	If exceeded	Not to be exceeded
	1 hour	0.100 ppm	0.18 ppm	The 3-year average of the annual 98th percentile of the 1-hour daily maximum concentrations at each site must not exceed 0.100 ppm.	Not to be exceeded
O_3	8 hour	0.075 ppm	0.070 ppm	The ozone standard is attained when the 4th highest 8-hour concentration measured at each site in a year, averaged over 3 years, is equal to or less than the standard.	Not to be exceeded
	1 hour	N/A	0.09 ppm	N/A	Not to be exceeded
PM_{10}	Annual	N/A	20 µg/m3	N/A	Not to be exceeded
	24 hour	150 µg/m3	50 µg/m3	The 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 µg/m3 is equal to or less than one.	Not to be exceeded
$PM_{2.5}$	Annual	12 µg/m3	12 µg/m3	The 3-year average of the weighted annual mean must not exceed	Not to be exceeded
	24 hour	35 µg/m3	N/A	The 24 hour standard is attained when 98% of the daily concentrations, averaged over three years, are equal to or less than the standard	N/A
SO_2	24 hour	0.14 ppm	0.04 ppm	Not to be exceeded more than once per year	Not to be exceeded
	3 hour	N/A[c]	N/A	N/A	N/A
	1 hour	0.075 ppm	0.25 ppm	The 3-year average of the annual 99th percentile of the 1-hour daily maximum concentrations at each site must not exceed 0.075 ppm.	Not to be exceeded
Pb	30 day	N/A	1.5 µg/m3	N/A	Not to be exceeded or equaled
	Quarter	1.5 µg/m3	N/A	Not to be exceeded more than once per year	N/A
	3 month	0.15 µg/m3	N/A	Not to be exceeded more than once per year	N/A

Source: CARB, 2012

[a] 40 CFR 50.4 through 50.13

[b] California Code of Regulations, Table of Standards, Section 70200 of Title 17

[c] No National Primary 3 hour standard for SO_2. National Secondary 3 hour standard for SO_2 is 0.5 ppm.

µg/m3 micrograms per cubic meter

ppm parts per million

N/A Not Applicable; State and Federal Standards do not exist.

The CCAA requires that AQMDs and APCDs prepare a clean air plan, or air quality attainment plan if the district violates CAAQS for CO, SO_2, NO_2, or O_3, showing strategies for and progress toward attaining the CAAQS for which it is in non-attainment. These plans are required to be updated triennially.

The CCAA requires that the CAAQS be met as expeditiously as practicable, but does not set precise attainment deadlines. Instead, the act established increasingly stringent requirements for areas that will require more time to achieve the standards. The air quality attainment plan requirements established by the CCAA are based on the severity of air pollution problems caused by locally-generated emissions. Upwind APCDs are required to establish and implement emission control programs commensurate with the extent of pollutant transport to downwind districts.

Air pollution problems in Sacramento County are primarily the result of locally-generated emissions. However, Sacramento's air pollution occasionally includes contributions from the San Francisco Bay Area or the San Joaquin Valley. In addition, Sacramento County has been identified as a source of ozone precursor emissions that occasionally contribute to air quality problems in the San Joaquin Valley Air Basin and the Northern Sacramento Valley Air Basin (SVAB). Consequently, the air quality planning for Sacramento County must not only correct local air pollution problems, but must also reduce the area's effect on downwind air basins.

Local

Air pollution problems in the greater Delta are primarily the result of locally-generated emissions. Sacramento's air pollution occasionally includes contributions from the San Francisco Bay Area or the San Joaquin Valley. In addition, Sacramento County has been identified as a source of ozone precursor emissions that occasionally contribute to air quality problems in the San Joaquin Valley Air Basin and the Northern Sacramento Valley Air Basin (SVAB). In addition to permitting and rule compliance, air quality management at the local level is also accomplished through an Air Quality Management District (AQMD) imposition of mitigation measures on project environmental impact reports and mitigated negative declarations developed by project proponents under CEQA. Specific to project construction emissions, CEQA requires mitigation of air quality impacts that exceed certain significance thresholds set by the local AQMD/APCD.

Local Agencies

The focused project area encompasses the following air basins: Sacramento Metropolitan Air Quality Management District (SMAQMD) and the Bay Area Air Quality Management District (BAAQMD). Air quality in each air basin is regulated by Federal, State, and regional agencies.

Each district is responsible for implementing Federal and State regulations at the local level, permitting stationary sources of air pollution, and developing the local elements of the SIP. Emissions from indirect sources, such as automobile traffic associated with development projects, are addressed through the AQMD's air quality plans, which are each air quality district's contribution to the SIP. In addition to permitting and rule compliance, air quality management at the local level is also accomplished through AQMD imposition of mitigation measures on project environmental impact reports and mitigated negative declarations developed by project proponents under CEQA. Specific to

project construction emissions, CEQA requires mitigation of air quality impacts that exceed certain significance thresholds set by the local AQMD.

Table 4-3 summarizes the applicable local conformity thresholds for SMAQMD and BAAQMD, as designated by the SIP.

Table 4-3. Local Air Quality Management District Conformity Thresholds

Agency	Maximum Daily Emissions, lb/day					
	NO_X	ROG	PM_{10}	$PM_{2.5}$	CO	CO_2
SMAQMD	85	none	50	12	9	N/A
BAAQMD	54	54	82	54	NA	N/A

Environmental Setting

The study area for the project is the SVAB, which includes Sacramento County, where the project site is located. Criteria air pollutants relevant to the project were determined based on the existing pollutant conditions in the SVAB. TACs relevant to the project were determined based on SMAQMD guidance and the project site conditions.

Criteria and Non-Criteria Air Pollutants

Pollutants are typically classified as either criteria or non-criteria pollutants. Federal and California regulators have established ambient air quality standards for criteria pollutants whereas no ambient standards have been established for non-criteria pollutants. For some criteria pollutants, separate standards have been set for different periods. Most standards have been set to protect public health. For some pollutants, standards have been based on other values such as protection of crops, protection of materials, or avoidance of nuisance conditions. The criteria pollutants of greatest concern in Sacramento County are carbon monoxide (CO), ozone, inhalable particulate matter less than 10 microns in diameter (PM_{10}), and fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$). A summary of State and Federal ambient air quality standards for criteria pollutants is shown in Table 4-2. Air pollutants relevant to the project and their health effects are discussed below and summarized in Table 4-4. In addition, sensitive receptors are defined and receptors near the project are identified.

Table 4-4. Summary of Air Pollutants of Concern for the Project.

Pollutant Class	Pollutant	Existing Condition
Criteria Pollutants	CO, NO_2, O_3 (precursors: NO_X, ROG), PM_{10}, $PM_{2.5}$, and SO_2	The SVAB has NAAQS and/or CAAQS non-attainment designations for PM_{10}, $PM_{2.5}$, and O_3. The SVAB is also a maintenance area (formerly non-attainment) for CO. Consequently, PM_{10}, $PM_{2.5}$, CO, and ozone precursor (ROG and NO_X) emissions are the primary criteria pollutants of concern associated with the project.
TACs	DPM	The primary DPM sources associated with the project are diesel-powered on-road haul trucks and off-road construction equipment.

Criteria Pollutants

For criteria pollutants, NAAQS and CAAQS have been established to protect public health and welfare. Criteria pollutants include CO, NO_2, O_3, PM_{10}, $PM_{2.5}$, and SO_2. Ozone is a secondary pollutant that is not emitted directly to the atmosphere. Instead, it forms by the reaction of two ozone precursors – reactive organic gases (ROGs) and nitrogen oxides (NO_X) – in the presence of sunlight and high temperatures. The sources of these pollutants, their effects on human health and the nation's welfare, and their annual emission to the atmosphere vary considerably and are detailed in Appendix I.

Toxic Air Contaminants

A TAC is defined by California law as an air pollutant that "may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health." The USEPA uses the term hazardous air pollutant (HAPs) in a similar sense. Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments, whereby Congress mandated that the USEPA regulate 188 air toxics. TACs can be emitted from stationary and mobile sources.

Ten TACs have been identified through ambient air quality data as posing the greatest health risk in California. Direct exposure to these pollutants has been shown to cause cancer, birth defects, damage to brain and nervous system and respiratory disorders. TACs do not have ambient air quality standards because often no safe levels of TACs have been determined. Instead, TAC impacts are evaluated by calculating the health risks associated with a given exposure.

Air Quality Standards and Attainment Status

Ambient air quality standards are set to protect public health. There are currently both Federal and State ambient air quality standards by USEPA and state air quality agencies, CALEPA for California. California air quality standards are generally more stringent that federal standards. The four designations are further defined as:

- Nonattainment—assigned to areas where monitored pollutant concentrations consistently violate the standard in question.
- Maintenance—assigned to areas where monitored pollutant concentrations exceeded the standard in question in the past but are no longer in violation of that standard.
- Attainment—assigned to areas where pollutant concentrations meet the standard in question over a designated period of time.
- Unclassified—assigned to areas were data are insufficient to determine whether a pollutant is violating the standard in question.

Table 4-5 summarizes the level of Federal and State pollutant attainment status for the project areas by county.

Table 4-5. Federal and State Pollutant Attainment Status.

Pollutant	SMAQMD		BAAQMD	
	Federal	State	Federal	State
Ozone (1 hr)		Na (Serious)		Na (Serious)
Ozone (8 hr)	N (Severe)	Na (Serious)	N (Severe)	Na (Serious)
CO	Ma (Moderate)	A/U	Ma (Moderate)	A/U
PM_{10}	Ma (Moderate)	Na (Serious)	Ma (Moderate)	Na (Serious)
$PM_{2.5}$	N	Na (Serious)	N	Na (Serious)

a Applies only to a portion of the air basin that the Plan Area crosses.
N = Nonattainment
M = Maintenance
A/U = Attainment/Unclassified
Sources: USEPA 2011b; CARB 2011b.

Local Air Quality Management and Sensitive Receptors

Project site standards would follow those enforced by the SMAQMD and the BAAQMD. Air quality in each air basin is regulated by Federal, State, and regional agencies. The existing air quality conditions in the project area can be characterized by monitoring data collected in the region. Table 4-6 summarizes air quality monitoring data from the SMAQMD, and the BAAQMD monitoring stations for 3 years for which complete data are available (2008–2010).

The NAAQS and CAAQS apply at publicly accessible areas, regardless of whether those areas are populated. For the purposes of air quality analysis, sensitive land uses are defined as locations where human populations, especially children, seniors, and sick persons, are located and where there is reasonable expectation of continuous human exposure according to the averaging period for the air quality standards (e.g., 24-hour, 8-hour, and 1-hour). Typical sensitive receptors include residences, hospitals, and schools.

Table 4-6. Air Quality Monitoring Data: Sacramento Valley, San Joaquin Valley, and San Francisco Bay Area.

Pollutant Standards	Sacramento Valley			San Francisco Bay Area		
	2008	2009	2010	2008	2009	2010
Ozone (O_3)						
Maximum 1-hour concentration (ppm)	0.166	0.122	0.198	0.141	0.113	0.15
Maximum 8-hour concentration (ppm)	0.123	0.104	0.112	0.11	0.094	0.097
Number of days standard exceeded[a]						
CAAQS 1-hour (>0.09 ppm)	41	29	16	9	11	8
CAAQS 8-hour (>0.070 ppm)	78	65	47	20	13	11
NAAQS 8-hour (>0.075 ppm)	54	45	30	12	8	9
Carbon Monoxide (CO)						
Maximum 1-hour concentration (ppm)	2.84	2.84	1.89	2.48	2.86	2.19
Maximum 8-hour concentration (ppm)						
Number of days standard exceeded[a]						
NAAQS 8-hour (>9 ppm)	0	0	0	0	0	0
CAAQS 8-hour (>9.0 ppm)	0	0	0	0	0	0

Pollutant Standards	Sacramento Valley			San Francisco Bay Area		
	2008	2009	2010	2008	2009	2010
NAAQS 1-hour (>35 ppm)	0	0	0	0	0	0
CAAQS 1-hour (>20 ppm)	0	0	0	0	0	0
Nitrogen Dioxide (NO_2)						
State maximum 1-hour concentration (ppm)	0.115	0.068	0.095	0.098	0.076	0.082
State second-highest 1-hour concentration (ppm)	0.09	0.062	0.079	0.083	0.07	0.079
Annual average concentration (ppm)	0.01	0.009	0.008	0.013	0.011	0.01
Number of days standard exceeded						
CAAQS 1-hour (0.18 ppm)	0	0	0	0	0	0
Particulate Matter (PM_{10})[b]						
National[c] maximum 24-hour concentration (mg/m3)	236.7	76	87.4	358.1	423.8	118.8
National[c] second-highest 24-hour concentration (mg/m3)	113.8	74	49.1	338.1	115.7	86.4
Stated maximum 24-hour concentration (mg/m3)	232	76	87.4	353.5	139.5	238
Stated second-highest 24-hour concentration (mg/m3)	111.2	74	48.2	125.6	116.6	112.8
National annual average concentration (mg/m3)	32.9	25.6	20.5	59.7	57.5	35
State annual average concentration (mg/m3)[e]	33.4	26.4	21	55.9	46.5	35
Number of days standard exceeded[a]						
NAAQS 24-hour (>150 mg/m3)[f]	1	0	0	3	1	0
CAAQS 24-hour (>50 mg/m3)[f]	11	3	2	33	31	67
Particulate Matter ($PM_{2.5}$)						
National[c] maximum 24-hour concentration (mg/m3)	220.2	49.8	72.2	100.3	195.5	107.8
National[c] second-highest 24-hour concentration (mg/m3)	127.3	45.9	33.9	99.3	16767	92.2
Stated maximum 24-hour concentration (mg/m3)	200.2	71.7	95.3	118.8	195.5	112
Stated second-highest 24-hour concentration (mg/m3)	190.9	59.2	43	106.8	167.7	107.8
National annual average concentration (mg/m3)	16.4	10.7	8.8	23.5	22.5	17.9
State annual average concentration (mg/m3)[e]	19.9	15.5	10.9	21.1	21.5	17.2
Number of days standard exceeded[a]						
NAAQS 24-hour (>35 mg/m3)	37	9	1	67	51	29
Sulfur Dioxide (SO_2)						
No data available						

[a] An exceedance is not necessarily a violation.

[b] National statistics are based on standard conditions data. In addition, national statistics are based on samplers using Federal reference or equivalent methods.

[c] State statistics are based on local conditions data, except in the South Coast Air Basin, for which statistics are based on standard conditions data. In addition, State statistics are based on California approved samplers.

[d] Measurements usually are collected every 6 days.

[e] State criteria for ensuring that data are sufficiently complete for calculating valid annual averages are more stringent than the national criteria.

[f] Mathematical estimate of how many days concentrations would have been measured as higher than the level of the standard had each day been monitored. Values have been rounded.

ppm = parts per million
NAAQS = National Ambient Air Quality Standards
CAAQS = California Ambient Air Quality Standards
g/m^3 = micrograms per cubic meter
mg/m^3 = milligrams per cubic meter
> = greater than
NA = not applicable
Source: California Air Resources Board 2011a

4.2.5 Climate Change

Regulatory Setting

Federal

The USEPA is responsible for Green House Gases (GHG) regulation at the Federal level. Key Federal GHG guidance and regulations relevant to the project are summarized below.

In Massachusetts v. U.S. Environmental Protection Agency, et al., 127 S.Ct. 1438 (2007), the United States Supreme Court ruled that GHGs fits within the CAA's definition of a pollutant, and that the USEPA has the authority to regulate GHGs.

On October 5, 2009, President Obama signed Executive Order (E.O.) 13514; Federal Leadership in Environmental, Energy, and Economic Performance, E.O. 13514 requires Federal agencies to set a 2020 GHG emissions reduction target within 90 days; increase energy efficiency; reduce fleet petroleum consumption; conserve water; reduce waste; support sustainable communities; and leverage Federal purchasing power to promote environmentally-responsible products and technologies.

On December 7, 2009, the Final Endangerment and Cause or Contribute Findings for Greenhouse Gases (endangerment finding), under Section 202(a) of the CAA went into effect. The endangerment finding states that current and projected concentrations of the six key well-mixed GHGs in the atmosphere, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and other fluorinated gases including nitrogen trifluoride (NF_3) and hydrofluorinated ethers (HFEs), threaten the public health and welfare of current and future generations. Furthermore, it states that the combined emissions of these GHGs from new motor vehicles and new motor vehicle engines contribute to the GHG pollution which threatens public health and welfare (USEPA 2012a).

Under the endangerment finding, the USEPA is developing vehicle emission standards under the CAA. The USEPA and the Department of Transportation's National Highway Traffic Safety Administration have issued a joint proposal to establish a national program that includes standards that will reduce GHG emissions and improve fuel economy for light-duty vehicles in model years (MYs) 2012 through 2016. This proposal marks the first GHG standards proposed by the USEPA under the CAA as a result of the endangerment and cause or contribute findings (USEPA 2012b). These emission reductions were incorporated into the project analysis.

On February 18, 2010, the White House Council on Environmental Quality (CEQ) released draft guidance regarding the consideration of GHGs in NEPA documents for Federal actions. The draft guidelines include a presumptive threshold of 25,000 metric tons of carbon dioxide equivalent (CO_2e) emissions from a proposed action to trigger a quantitative analysis. CEQ has not established when GHG emissions are "significant" for NEPA purposes; rather, it poses the question to the public (CEQ 2010).

State

CARB is responsible for the development, implementation, and enforcement of California's motor vehicle pollution control program, GHG statewide emission estimates and goals, and development and enforcement of GHG emission reduction rules. California has taken proactive steps, briefly described in Table 4-7, to address the issues associated with GHG emissions and climate change.

Table 4-7. Summary of Relevant California GHG Regulations.

Bill, Year	Description
Assembly Bill (AB) 4420, 1988	Directed California Energy Commission, in consultation with the CARB and other agencies, to "study and report…on how global warming trends may affect California's energy supply and demand, economy, environment, agriculture, and water supplies."
AB 1493, 2002	Requires CARB to develop and implement regulations to reduce automobile and light-truck GHG emissions. These stricter emissions standards apply to automobiles and light trucks beginning with the 2009 MY. Although litigation was filed challenging these regulations and EPA initially denied California's related request for a waiver, the waiver request has now been granted.
Executive Order (E.O.) S-3-05, 2005	The goal of E.O. S-3-05 is to reduce California's GHG emissions to: (1) year 2000 levels by 2010, (2) 1990 levels by 2020, and (3) 80% below the 1990 levels by 2050.
AB 32, California Global Warming Solutions Act of 2006	Sets overall GHG emissions reduction goals and mandates that CARB create a plan that includes market mechanisms and implement rules to achieve "real, quantifiable, cost-effective reductions of greenhouse gases." Requires statewide GHG emissions be reduced to 1990 levels by 2020. (The 1990 CO2e level is 427 million metric tonnes of CO2e (CARB 2012a)). Directs CARB to develop and implement regulations to reduce statewide emissions from stationary sources. Specifies that regulations adopted in response to AB 1493 be used to address GHG emissions from vehicles. Requires CARB to adopt a quantified cap on GHG emissions representing 1990 emissions levels. Includes guidance to institute emissions reductions in an economically efficient manner and conditions to ensure that businesses and consumers are not unfairly affected by the reductions.
E.O. S-01-07, 2007	Requires the carbon intensity of California's transportation fuels to be reduced by at least 10% by 2020.
Senate Bill 97	This bill directed the Natural Resources Agency, in coordination with the Governor's Office of Planning Research, to address the issues through Amendments to the CEQA Guidelines. The revised Guidelines were adopted December 30, 2009 to provide direction to lead agencies about evaluating, quantifying, and mitigating a project's potential GHG emissions.

Source: CARB 2012a, CARB 2012b, CARB 2012c, Office of the Governor 2007

Affected Environment

This section addresses the existing conditions of global climate change. Emissions of greenhouse gasses (GHGs) are a contributing factor, on a cumulative basis, to global climate change. Global climate change has the potential to result in sea level rise (which may result in flooding of low-lying areas), to affect rainfall and snowfall levels (which may lead to changes in water supply and runoff), to affect temperatures and habitats (which in turn may affect biological and agricultural resources), and to result in many other adverse effects. Although global climate change is inherently a cumulative impact, it is important to remember that any single project is unlikely to be able to generate sufficient GHGs by itself to have a significant impact on the environment. However, the cumulative effect of human activities has been clearly linked to quantifiable changes in the composition of the atmosphere, which in turn have been shown to be the main cause of global climate change.

Global Climate Trends and Associated Impacts

Global warming is the name given to the increase in the average temperature of the Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Warming of the climate system is now considered by a vast majority of the scientific community to be unequivocal, based on observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (IPCC, 2007).

Global mean surface temperatures have risen by 0.74 degrees Celsius (°C) ± 0.18°C when estimated by a linear trend over the last 100 years (1906 to 2005). The rate of warming over the last 50 years is almost double that over the last 100 years (0.13°C ± 0.03°C versus 0.07°C ± 0.02°C per decade). The causes of this measured warming have been identified as both natural processes and the result of human actions. For the next two decades, a warming of about 0.2°C per decade is projected for a range of emissions scenarios.

The Intergovernmental Panel on Climate Change (IPCC) concludes that variations in natural phenomena such as solar radiation and volcanoes produced most of the warming from preindustrial times to 1950 and had a small cooling effect afterward. However, since 1950, increasing GHG concentrations resulting from human activity such as fossil fuel burning and deforestation have been responsible for most of the observed temperature increase. These basic conclusions have been endorsed by more than 45 scientific societies and academies of science, including all of the national academies of science of the major industrialized countries. Since 2007, no scientific body of national or international standing has maintained a dissenting opinion (DWR, 2012).

Increases in GHG concentrations in the Earth's atmosphere are thought to be the main cause of human-induced climate change. GHGs naturally trap heat by impeding the exit of solar radiation that has hit the Earth and is reradiated back into space as infrared radiation. Some GHGs occur naturally and are necessary for keeping the Earth's surface habitable. However, increases in the concentrations of these gases in the atmosphere above natural levels during the last 100 years have increased the amount of infrared radiation that is trapped in the lower atmosphere, intensifying the natural greenhouse effect and resulting in increased global average temperatures.

The effects of warming of the Earth's atmosphere and oceans affect global and local climate systems. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, in addition to temperature increases (IPCC, 2007). Based on growing evidence, there is high confidence that the following effects on hydrologic systems are occurring: (1) increased runoff and earlier spring peak discharge in many glacier- and snow-fed rivers; and (2) warming of lakes and rivers in many regions, with effects on thermal structure and water quality (IPCC, 2008).

There is very high confidence, based on increasing evidence from a wider range of species, that recent warming is strongly affecting terrestrial biological systems, including such changes as earlier timing of spring events (e.g., leaf-unfolding, bird migration, egg-laying); and poleward and upward shifts in ranges in plant and animal species. Based on satellite observations since the early 1980s, there is high confidence that there has been a trend in many regions toward earlier "greening" of vegetation in the spring linked to longer thermal growing seasons resulting from recent warming (IPCC, 2007).

There is high confidence, based on substantial new evidence, that observed changes in marine and freshwater biological systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. These include shifts in ranges and changes in algal, plankton, and fish abundance in high-latitude oceans; increases in algal and zooplankton abundance in high-latitude and high-altitude lakes; and range changes and earlier fish migrations in rivers (IPCC, 2007).

Changes in the ocean and on land, including observed decreases in snow cover and Northern Hemisphere sea ice extent, thinner sea ice, shorter freezing seasons of lake and river ice, glacier melt, decreases in permafrost extent, increases in soil temperatures and borehole temperature profiles, and sea level rise, provide additional evidence that the world is warming (IPCC, 2007).

Climate Change Conditions in California

With respect to California's water resources, the most important effects of global warming have been changes to the water cycle and sea level rise. Over the past century, the precipitation mix between snow and rain has shifted in favor of more rainfall and less snow (Mote et al., 2005; Knowles et al., 2006), and snowpack in the Sierra Nevada is melting earlier in the spring (Kapnick and Hall, 2009). The average early-spring snowpack in the Sierra Nevada has decreased by about 10 percent during the last century, a loss of 1.5 million acre-feet of snowpack storage (DWR, 2008). These changes have major implications for water supply, flooding, aquatic ecosystems, energy generation, and recreation throughout the state.

Precipitation

Climate change can affect precipitation by changing the overall amount of precipitation, type of precipitation (rain versus snow), and timing and intensity of precipitation events. Changes to these factors propagate through the hydrologic system in California and have the potential to affect snowpack, runoff, water supply, and flood control.

Former State Climatologist James Goodridge compiled an extensive collection of longer-term precipitation records from throughout California. These data sets were used to evaluate whether there has been a changing trend in precipitation in the state over the past century (DWR, 2006). Long-term runoff records in selected California watersheds were also examined. Based on a linear regression of the data, the long-term historical trend for statewide average annual precipitation appears to be relatively flat (no increase or decrease) over the entire record. However, it appears that there might be an upward trend in precipitation toward the latter portion of the record. Precipitation in Northern California appears to have increased between 1 and 3 inches annually between 1890 and 2002 (DWR, 2006).

Snowpack

An increase in the global average temperature is expected to result in a decreased volume of precipitation falling as snow in California and an overall reduction in the Sierra Nevada's snowpack. Snowpack in the Sierra Nevada provides both water supply (runoff) and storage (within the snowpack before melting), which is a major source of supply for California. According to the California Energy Commission, the snowpack portion of the water supply has the potential to decline by 30 to 90 percent by the end of the 21st century (CEC, 2006). A study by Knowles and Cayan projects that approximately 50 percent of the statewide snowpack will be lost by the end of the century (Knowles and Cayan, 2002).

On average, California's annual snowpack has the greatest accumulations from November through the end of March. The snowpack typically melts from April through July. California's reservoir managers rely on snowmelt to fill reservoirs once the threat of large winter and early-spring storms and related flooding risks have passed.

An analysis conducted by DWR of the effect of rising temperatures on snowpack shows that a rise in average annual air temperature of 3°C (5.4°F) would likely cause snowlines to rise approximately 1,500 feet (DWR, 2006). This would result in the equivalent of approximately 5 million acre-feet of water per year falling as rain rather than snow at lower elevations.

Runoff

Runoff is directly affected by changes in precipitation and snowpack. If the amount of precipitation falling as rain rather than snow were to increase earlier in the year, flooding potential could increase. Water that normally would be held in the Sierra Nevada snowpack until spring would flow into the Central Valley concurrently with the rain from winter storm events. This scenario would place more pressure on California's flood control system (DWR, 2006).

Changes in both the amount of runoff and the seasonality of the hydrologic cycle also have the potential to greatly affect the heavily managed water systems of the western United States. The hydrology of the Sacramento River watershed is highly dependent on the interaction between Sierra Nevada snowpack, runoff, and management of reservoirs. Higher snow lines and more precipitation falling in the form of rain rather than snow will increase winter inflows to reservoirs. Higher winter inflows will also likely mean that a greater portion of the total annual runoff volume will occur in the winter, which would translate to higher flows in the Delta in the winter than those that currently occur.

Greenhouse Gas Emissions

As defined in Section 38505(g) of the California Health and Safety Code, the principal GHGs of concern are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). With the exception of NF_3, these are the same gases named in the USEPA's Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act. Each of the principal GHGs has a long atmospheric lifetime (one year to several thousand years), and is globally well mixed. In addition, the potential heat trapping ability of each of these gases varies significantly from one another. On a 100-year timescale, methane is about 25 times as potent as CO_2, nitrous oxide is about 298 times as potent as CO_2, and sulfur hexafluoride is about 22,800 times more potent than CO_2 (IPCC, 2007). Conventionally, GHGs have been reported as CO_2 equivalents (CO_2e). CO_2e takes into account the relative potency of non-CO_2 GHGs and converts their quantities to an equivalent amount of CO_2 so that all emissions can be reported as a single quantity.

The primary human-made processes that release these gases include: (1) the burning of fossil fuels for transportation, heating, and electricity generation; (2) agricultural practices that release methane, such as livestock grazing and crop residue decomposition; and (3) industrial processes that release smaller amounts of high global warming potential gases, such as sulfur hexafluoride, PFCs, and HFCs. Deforestation and land cover conversion have also been identified as contributing to global warming by reducing the Earth's capacity to remove CO_2 from the air and altering the Earth's surface reflectance. The major sources of GHGs that are relevant to the ARCF GRR project are transportation sources and construction emissions. These are discussed in greater detail below.

Transportation

Transportation is a major source of GHGs in California, accounting for 36 percent of the State's total GHG emissions in 2008 (CARB, 2011). Transportation emissions within California are generated primarily by combustion of gasoline, diesel, and some alternative fuels by mobile sources. The indicators of vehicular activity, and resulting GHG emissions, are vehicle miles traveled and the fuel economies of the individual vehicles composing the vehicular fleet. Vehicle miles traveled are associated with movement of people and goods on local, regional, and statewide scales.

Construction

Construction emissions are generated when materials and workers are transported to and from construction sites and when machinery is used for construction activities such as trenching, grading, dredging, paving, and building. Emissions from construction activities are generated for shorter periods than operational emissions; however, GHGs remain in the atmosphere for hundreds of years or more, so once released, they contribute to global climate change unless they are removed through absorption by the oceans or by terrestrial sequestration.

Construction emissions are not accounted for in a separate category in the California GHG inventory (or other inventories that use IPCC GHG emissions sectors for accounting purposes). However, based on the category "Transportation—Not Specified," which includes off-road vehicles and

associated diesel fuel combustion, construction emissions accounted for a maximum of 0.4 percent of California's GHG inventory between 2000 and 2008 (CARB, 2011).

Greenhouse Gas Emissions Inventories

A GHG inventory is a quantification of GHG emissions and sinks within a selected physical and/or economic boundary over a specified time. GHG inventories can be performed on a large scale (i.e., for global and national entities) or on a small scale (i.e., for a particular building or person).

Many GHG emission and sink specifications are complicated to evaluate because natural processes may dominate the carbon cycle. Although some emission sources and processes are easily characterized and well understood, some components of the GHG budget (i.e., the balance of GHG sources and sinks) are not known with accuracy. Because protocols for quantifying GHG emissions from many sources are currently under development by international, national, state, and local agencies, ad-hoc tools must be developed to quantify emissions from certain sources and sinks in the interim.

Table 4-8 outlines the most recent global, national, statewide, and local GHG inventories to help contextualize the magnitude of potential project-related emissions.

Table 4-8. Global, National, State, and Local GHG Emissions Inventories.

Emissions Inventory	CO_2e (metric tons)
2004 IPCC Global GHG Emissions Inventory	49,000,000,000
2009 USEPA National GHG Emissions Inventory	6,633,200,000
2008 CARB State GHG Emissions Inventory	477,740,000
2005 Sacramento County GHG Emissions Inventory	13,925,537
2006 Contra Costa County GHG Emissions Inventory	54,133

Sources: IPCC 2007; Contra Costa County 2008; ICF Jones & Stokes 2009

4.2.6 Transportation and Navigation

This section describes the existing transportation system within the study area shown in Figure 4-3. The existing system includes roadways, navigation channels, and bicycle and pedestrian facilities. In addition, roadway classification and annual daily traffic counts for various roadway segments in and near the study area are identified.

Regulatory Setting

Federal

Title 23 of the U.S. Code (USC)

Federal statutes specify the procedures that the U.S. Department of Transportation must follow in setting policy regarding the placement of utility facilities within the rights-of-way of roadways that received Federal funding. These roadways include expressways, most State highways, and certain local roads. In addition, 23 USC 116 requires State highway agencies to ensure proper maintenance of

highway facilities, which implies adequate control over non-highway facilities, such as utility facilities. Finally, 23 USC 123 specifies when Federal funds can be used to pay for the costs of relocating utility facilities in connection with highway construction projects.

Title 23 of the Code of Federal Regulations (CFR)

Federal Highway Administration (FHWA) regulations require that each state develop its own policy regarding the accommodation of utility facilities within the rights-of-way of such roads. After FHWA has approved a state's policy, the state can approve any proposed utility installation without referral to FHWA, unless utility installation does not conform to the policy. Federal regulations do not dictate specific levels of operation or minimum delays, however, which are primarily established by local jurisdiction.

U.S. Coast Guard

Title 14 of the United States Code (USC), Code of Federal Regulations (CFR)Title 33 and other portions of the CFR , give the U.S. Coast Guard authority for maritime law enforcement on the navigable waters of the United States, as well as responsibilities for search and rescue, marine environmental protection, and the maintenance of river aids to navigation, among other roles. Specific to the Delta, 33 CFR 162 provides regulations for the navigation by both commercial and noncommercial vessels on the San Joaquin River Deep Water Ship Channel (between Suisun Bay and Stockton) and the Sacramento River Deep Water Ship Channel (between Suisun Bay and West Sacramento).

State

California Streets and Highways Code

The California Streets and Highways Code authorize the California Department of Transportation (Caltrans), to control encroachment within the State highway right-of-way. Encroachments allow temporary or permanent use of a highway right-of-way by a utility, a public entity, or a private party.

Caltrans's Right of Way and Asset Management Program is primarily responsible for acquisition and management of property required for State transportation purposes. Transportation purposes may include highways, mass transit guideways and related facilities, material sites, and any other purpose that may be necessary for Caltrans operations. The responsibilities of the Right of Way and Asset Management Program include managing Caltrans' real property for transportation purposes, reducing the costs of operations, disposing of property no longer needed, and monitoring right-of-way activities on Federally assisted local facilities.

Affected Environment

Regional and Local Roadways

The main roadway and access route to the project areas and borrow sites is Highway 160. This two lane highway runs north to south through the Delta region. It provides access to most Delta cities while connecting Sacramento to Antioch. Highway 160 is used primarily by local travelers and some commuters who enjoy the tranquil setting of the Delta for traveling to and from the Bay Area. Vehicular access to Big Break and Jersey Island is possible using the existing two lane arterials which include Main Street, East Cypress Road, and Jersey Island Road in Oakley. Access to Bethel Island and Little Franks Tract is possible by Bethel Island Road, a two lane arterial. Table 4-9 displays the traffic volumes on roadways near the project area.

Table 4-9. Traffic Volumes on Roadways near the Project Area.

Roadway	Segments	Classification	Average Daily Traffic
Highway 160	Three Mile Slough to Highway 4	Major 2 lane highway	12,200
Main Street	Highway 160 to East Cypress Road	2 lane arterial	17,247
East Cypress Road	Main Street to Bethel Island Road	2 lane arterial	9,415
Jersey Island Road	East Cypress Road to San Joaquin River	2 lane arterial	546
Bethel Island Road	East Cypress Road to Piper Slough	2 lane arterial	5,550

Sources: Caltrans 2012, City of Oakley 2009

Ferry Services

One public access ferry service operates within the study area transporting passengers to private islands. The ferry travels from Jersey Island to both Webb Tract and Bradford Island (Caltrans 2009).

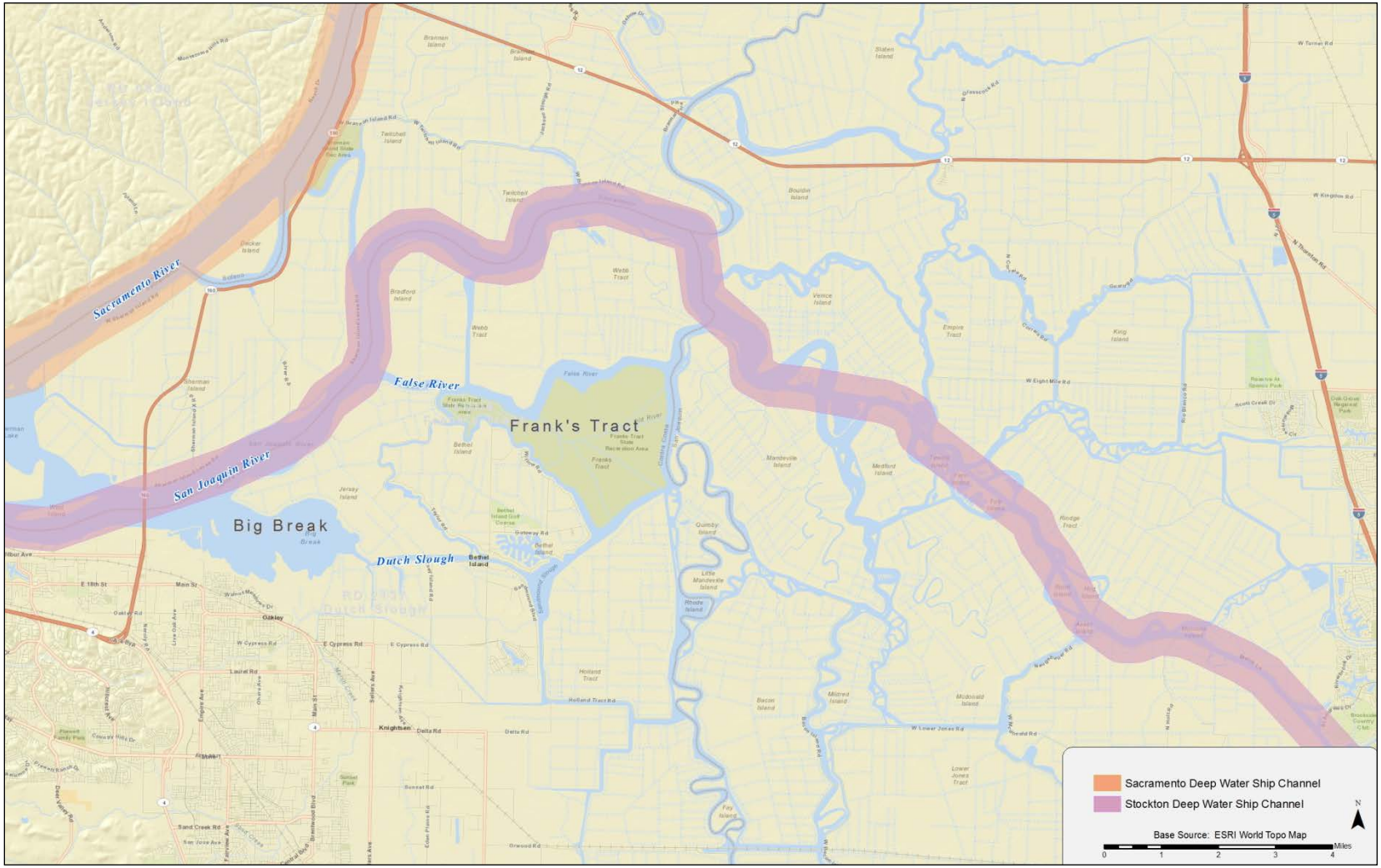

Figure 4-3. Transportation Infrastructure in the Study Area.

Port of Stockton

The Port of Stockton is located on the Stockton Deep Water Ship Channel (DWSC), 75 nautical miles due east of the Golden Gate Bridge. The port is a major transportation center with berthing space for 17 vessels, 1.1 million square feet of dockside transit sheds and shipside rail trackage, and 7.7 million square feet of warehousing served by rail. The Port of Stockton has the capacity to move cargo from vessels directly to truck and rail (Port of Stockton 2012). River access to the port is through the Suisun Bay, San Joaquin River, and the Stockton DWSC. The Stockton DWSC connects the Disappointment Slough with the Port of Stockton marine terminal facilities, a distance of approximately 14 miles (State Water Resources Control Board 2010). Stockton's DWSC has an average depth of 35 feet, and an average depth at high tide of 40 feet (Port of Stockton 2010).

Marine Highways

Marine highways are used for point to point cargo movements on inland waterways as well as inland to ocean ports for transhipment over oceans.One designated Marine Highway (M) corridors lies within the project area vicinity, the M-580 corridor. The M-580 corridor includes the San Joaquin River, Sacramento River, and connecting commercial navigation channels, ports, and harbors in Central California from Sacramento to Oakland. It connects to the M-5 Corridor at Oakland. Most commercial barge traffic within the transportation study area travels along the Sacramento River DWSC, which begins in Sacramento and heads southwest toward Suisun Bay, where the canal ends. A new Marine Highway container barge service began operating between the Port of Oakland and the Ports of Sacramento and Stockton in 2012.

4.2.7 Recreation

Regulatory Setting

Federal

U.S. Coast Guard.

Title 14 of the United States Code (USC), Code of Federal Regulations (CFR) Title 33 and other portions of the CFR , give the U.S. Coast Guard authority for maritime law enforcement on the navigable waters of the United States, as well as responsibilities for search and rescue, marine environmental protection, and the maintenance of river aids to navigation, among other roles. Specific to the Delta, 33 CFR 162 provides regulations for the navigation by both commercial and recreational vessels on the San Joaquin River Deep Water Ship Channel (between Suisun Bay and Stockton) and the Sacramento River Deep Water Ship Channel (between Suisun Bay and West Sacramento).

State

California Department of Parks and Recreation Plans Central Valley Vision

The Central Valley Vision project began in 2003, with the goals of understanding the recreation needs of Central Valley residents over the next 35 years and making recommendations for actions that the DPR might address through expansion of state park facilities in the region. Following the November 2006 release of the Central Valley Vision report, DPR released its Central Valley Vision Draft Implementation Plan in 2008 (California Department of Parks and Recreation 2008c). The draft 20-year plan provides a "catalog of potential future projects" that includes expanding existing parks and adding new parks in the Central Valley. The plan outlines these potential projects in the Delta: acquiring more land; developing facilities and improving access at Delta Meadows; developing interpretation and education opportunities at the Locke Boarding House; expanding facilities at Brannan Island State Recreation Area; and providing recreation at Twitchell, Sherman, and Lower Sherman islands. The implementation plan also recommends creation of the California Delta Heritage Corridor, which would link historic Delta towns, recreation sites, nature areas, and farm stands (California Department of Parks and Recreation 2008c).

Franks Tract State Recreation Area General Plan

The approved purpose of Franks Tract State Recreation Area is "to perpetuate as a recreation resource the flooded island in the Sacramento-San Joaquin Delta known as 'Franks Tract' and to provide permanently the opportunity for water-related recreational activities…" In addition, "the function of the Department of Parks and Recreation at Franks Tract State Recreation Area is to provide facilities and services for public enjoyment of the features and recreational opportunities afforded by this unit" (California Department of Parks and Recreation 1988).

Franks Tract State Recreation Area encompasses the inundated islands of Franks Tract and Little Franks Tract, and the policies focus on maintaining water quality, protecting soils, and protecting and enhancing habitat and species. Several policies mention considerations for placing new structures or facilities. Allowable use levels are "low" at Little Franks Tract and "moderate" on Franks Tract, except where wetland protection is of greater concern than providing recreation. The general plan also recommends two land use and development goals: creating additional land base for recreation activities and providing minimum needed recreation facilities. The plan outlines the concept of increasing the land base by creating islands in Franks Tract and Little Franks Tract. Facilities planned for the islands at Franks Tract include beaches, picnic areas, floating docks, interpretive signage, and an observation platform. The plan outlines interpretive signage along a water trail for Little Franks Tract. The general plan includes the following land use and development goals for Franks Tract State Recreation Area.

- Provide low intensity recreational opportunities by creating additional land base (especially beaches) for recreation activities.
- Provide only the minimum of recreation facilities to accommodate the needs of boat-in visitors.

Delta Protection Act and Delta Protection Commission Land and Resource Management Plan

The Delta Protection Act of 1992 (Act) (California Public Resources Code Section 21080.22, Division 19.5) established the DPC, a State entity to plan for and guide the conservation and enhancement of the Delta's natural resources while sustaining agriculture and meeting increased recreational demand. The Act defines a Primary Zone, which comprises the principal jurisdiction of the DPC. The Secondary Zone is the area outside the Primary Zone but within the "Legal Delta;" the Secondary Zone is not in the planning area of the DPC. The DPC has appeal authority over local government actions in the Delta's Primary.

Affected Environment

The Delta is a major destination for water based recreationists because of its climatic conditions, variety and abundance of fish, large maze of navigable waterways, and favorable water levels during summer. Activities in the Delta include cruising, waterskiing, wakeboarding, using personal watercraft, sailing, windsurfing, and kiteboarding, as well as fishing and hunting both from land and by boat.

Boating is the primary recreation activity in the Delta. Throughout the Delta, there are a variety of boat launching sites. Other recreation opportunities within the project area include hunting, fishing, hiking, day-use/picnicking, and wildlife observation. Boaters also participate in other related activities, such as boat camping (typically in houseboats or other large boats with sleeping accommodations). The area shelters more than 70 species of birds and a great variety of fish species. Winter temperatures range from 45 to 55 degrees. Summer days vary from 65 to 100 degrees. Cooling Delta breezes often gust to 25 mph, and tides can vary as much as six feet in one day (Department of Parks and Recreation 1997).

The specific recreation opportunities at Big Break and Little Franks Tract which may be affected by the project action are described in detail below.

Big Break

Big Break is a popular destination for wildlife viewing hiking/biking, boating, and fishing. The Big Break Regional Shoreline park facility offers the majority of recreational experiences within the Big Break area. General boating also takes place at Big Break estuary due to its accessibility to the rivers and sloughs of the Inland Coast. Numerous private marinas offer services to boaters and anglers. The facilities that exist in the Big Break area are shown on Table 4-10.

Table 4-10. Recreation Facilities in the Big Break Area.

Name	Access	Site Amenities	Site Characteristics
Private Facilities			
Big Break Marina	Public access	Berthing, boat launching, guest docks, covered storage	Tidal marsh, industrial, agriculture, open water.
Driftwood Marina	Public access	Berthing, boat launching, guest docks, covered storage, fuel	Commercial, industrial, open water
Lauritzen Yacht Harbor LLC	Public access	Berthing, boat launching, guest docks, covered storage, fuel	Commercial, industrial, open water
New Bridge Marina Inc	Public access	Berthing, boat launching, guest docks, covered storage, fuel	Commercial, industrial, open water
County Facilities			
Big Break Regional Shoreline Park	Public access	Hiking, kayaking, interpretive center, nature watching	Vegetation consists of tidal marsh, wetlands, riparian.

Big Break Regional Shoreline is located on the southern edge of Big Break in the City of Oakley and is operated by the East Bay Regional Park District. A visitor center includes temporary displays about the Delta and is staffed by Park District naturalists who can give information about the park and specific activities in the area including wetland walks and adjoining trails. Big Break Regional Shoreline offers picnic and meadow areas, a small shaded amphitheater, and boat and kayak launch facilities. In addition, the 100-foot long Antioch-Oakley fishing pier is very popular with local anglers. The park includes covered, outdoor use areas for interpretive and educational exhibits and programs highlighting Delta ecosystems and wildlife. A 1,200 square foot interactive map of the Delta allows visitors to see how water flows through the region (East Bay Regional Park District 2014). The Big Break Regional Trail, which runs along the southern edge of Big Break through the Ironhouse Sanitary District, provides access for hikers, bicyclists, and equestrians to the southeastern edge of the estuary. The trail connects to the northern end of the Marsh Creek Regional Trail, providing access to Brentwood and Oakley. The Marsh Creek Regional Trail connects to the Delta de Anza Regional Trail via West Cypress Road, providing access to Oakley, Brentwood, Antioch, Pittsburg, and Bay Point (East Bay Regional Park District 2014).

Bass fishing is currently the most popular recreational activity at Big Break. While shore fishing offers less success, boaters offshore catch primarily largemouth bass and striped bass, with some white catfish, bluegill, sunfish, and sturgeon also caught. Over the years Oakley has hosted hundreds of angling tournaments (Big Break Marina 2014).

Little Franks Tract

Franks Tract State Recreation Area (including Little Franks Tract) is only accessible by water and is known for excellent year-round fishing and seasonal waterfowl hunting. Due to the limited access, exposure to strong winds and shallow fluctuating water levels, recreational use is by anglers and waterfowl hunters. The tract is a popular striped bass fly fishing destination. Franks Tract is host to numerous bass fishing tournaments put on by charities and corporations. Fishing is an important recreational activity in the project area.

During the fall and winter, a large variety of waterfowl can be found in Franks Tract. The recreation area is located in a key position in the Pacific flyway. Year round residents include gulls, great blue herons, terns, swallows, crows, blackbirds, cormorants and kingfishers. Numerous marinas along the eastern shore of Bethel Island offer a variety of services for boaters and anglers. The waterside services provide economic benefits to the local communities. Table 4-11 shows the recreation facilities available at Little Franks Tract.

Table 4-11. Recreation Facilities in the Little Franks Tract Area.

Name	Access	Site Amenities	Site Characteristics
State Facilities			
Franks Tract State Recreation Area	Public access	Fishing, boating, swimming, camping, picnicking, hunting	Tidal marsh, agriculture, residential, recreation, open water.
Private Facilities			
Anchor Marina	Public access	Berthing, launching, guest docks, showers, mini-mart, campground	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Beacon Harbor	Public access	Berthing, boat launching, guest docks, ,dry storage, campground , fuel	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Bethel Harbor	Public access	Berthing, boat launching, guest docks, ,dry storage, campground , fuel	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Caliente Isle Harbor	Public access	Berthing, restrooms, showers, laundry, Caliente Isle Yacht Club	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Carol's Harbor	Public access	Berthing, guest dock,	Tidal marsh, commercial/industrial, agriculture, recreation open water.

Name	Access	Site Amenities	Site Characteristics
D’Anna’s Bethel Island Marina Resort	Public access	Berthing, restrooms, showers, boat repair, D'Anna Yacht Center	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Emerald Point Marina	Public access	Berthing, guest docks, electricity, overnight, snacks, fuel	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Frank’s Marina	Public access	Berthing, guest docks, electricity, overnight, RV's, camping, restrooms, showers, restaurant	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Harris Marina	Public access	Berthing, restrooms, showers, boat repair, D'Anna Yacht Center	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Hennis Marina	Public access	Boat launching, dry storage, guest docks	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Mariner Cove Marina	Public access	Berthing, guest docks, electricity, overnight, cabin rentals, restrooms, showers, laundromat, pumpout, ice, propane, fuel	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Mazikeen’s Landing	Public access	Berthing, guest docks, electricity, restrooms, showers	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Russo’s Marina	Public access	Berthing, dry storage, boat launching, guest docks, RV's, restrooms, showers, ice, groceries, bait, fuel	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Rusty Porthole Marina	Public access	Berthing, guest docks, electricity, overnight, restrooms, showers, Rusty Porthole restaurant	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Seahorse Marina	Public access	Berthing, restrooms	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Sugar Barge Resort	Public access	Berthing, boat launching, storage, guest docks, electricity, overnight, RV's, restrooms, showers, laundromat, pumpout, fuel, boat rentals	Tidal marsh, commercial/industrial, agriculture, recreation open water.

Name	Access	Site Amenities	Site Characteristics
Sunset Harbor	Public access	Berthing, boat launching, guest docks	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Willowest Harbor	Public access	Berthing, electricity, restrooms, laundromat	Tidal marsh, commercial/industrial, agriculture, recreation open water.
Wood's Yacht Harbor	Public access	Berthing, dry storage, guest docks, restrooms, showers	Tidal marsh, commercial/industrial, agriculture, recreation open water.

Adjacent Regional Recreational Facilities and Opportunities

Brannan Island State Recreation Area is the sister recreation facility to Franks Tract State Recreation Area. While it is not located in the direct study area, boat access to Franks Tract State Recreation Area for fishing and hunting is possible by launching from the Brannan Island State Recreation Area. The facility is located 5.5 miles from Little Franks Tract.

4.2.8 Cultural Resources

This chapter describes the environmental setting associated with cultural resources, assesses the effects to cultural resources that would result from implementation of the proposed program, and presents mitigation measures that would reduce these effects. The key sources of data and information used in the preparation of this chapter are listed below.

- A review of existing information.
- Consultation with interested parties.
- Archival research.
- Reconnaissance level surveys of the study area.

Cultural resources are defined in this chapter as prehistoric and historic archaeological sites, the historic built environment, and traditional cultural properties.

Regulatory Setting

National Historic Preservation Act

The proposed project would require that USACE comply with Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), and its implementing regulations (36 CFR 800, Section 106). Section 106 requires that, before beginning any

undertaking, a Federal agency must take into account the effects of the undertaking on historic properties (cultural resources listed or eligible for listing on the National Register of Historic Places [NRHP]) and afford the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on these actions. Federal agencies may comply with Section 106 by either completing the management steps indicated in the regulations (36 CFR Part 800) or preparing an agreement document that describes the particular process an agency will use to complete the same steps for a specific set of undertakings, as described below.

Cultural resources are eligible for the NRHP if they have integrity and significance as defined in the regulations for the NRHP. Four primary criteria define significance; a property may be significant if it displays one or more of the following characteristics (36 CFR 60.4). It is associated with events that have made a significant contribution to the broad patterns of our history (Criterion A); or is associated with the lives of people significant in our past (Criterion B; or embodies the distinct characteristics of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic values, or it represents a significant and distinguishable entity whose components may lack individual distinction (Criterion C); or it has yielded, or is likely to yield, information important in prehistory or history (Criterion D).

Some types of cultural resources are not typically eligible for the NRHP. These resources consist of cemeteries, birthplaces, graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years. These property types may be eligible for the NRHP, however, if they are integral parts of eligible districts of resources or meet the criteria considerations described in 36 CFR 60.4.

In addition to possessing significance, a property must also have integrity to be eligible for listing in the NRHP. The principle of integrity has seven aspects: location, design, setting, materials, workmanship, feeling, and association (36 CFR 60.4). To retain historic integrity, a property needs to possess several, and usually most, of these aspects (National Park Service 2002).The evaluation of a resource's integrity in relation to its significance will be conducted as prescribed in National Register Bulletin No. 15: How to Apply the National Register Criteria for Evaluation (National Park Service 2002).

The Section 106 review process typically consists of the following major steps.

- Identify the Federal agency undertaking.
- Identify the area of potential effects.
- Initiate Section 106 process.
- Identify historic properties.
- Evaluated effects to historic properties.
- Resolve adverse effects.

Study Area and Area of Potential Effects

The study area focused on Big Break and Little Franks Tract to determine the effectiveness of placing dredge materials. The area of potential effects (APE) is a smaller area within the study area and is defined as the soil placement areas within the TSP. In addition, linear alignments for the temporary pipelines to transport materials to the work areas are also considered part of the APE, as are any as yet unidentified staging areas, if needed. Areas not considered as part of the APE are the locations where the dredge materials will be taken from including McCormick, Scour, Decker, and Bradford disposal sites, as well as the Stockton Deep Water Ship Channel. These areas are established dredge spoils deposition areas or ongoing maintenance activities and are comprised entirely of displaced material from maintenance dredging and covered under their own consultation.

Affected Environment

The following Prehistoric, Ethnographic, and Historic Context sections, not including the specific history on Big Break and Little Franks Tract, are adapted from the following sources:

- Built Historical Resources Evaluation Report for the Bay Delta Conservation Plan Project: Sacramento, Yolo, Solano, San Joaquin, Contra Costa, and Alameda Counties California (ICF 2012a)
- Archaeological Survey Report for the Bay Delta Conservation Plan Project: Sacramento, Yolo, Solano, San Joaquin, Contra Costa, and Alameda Counties, California (ICF 2012b)
- Draft Environmental Impact Report/Environmental Impact Statement, Bay Delta Conservation Plan: Alameda, Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties, California (Bureau of Reclamation et al 2013)
- The Central Valley: A View from the Catbird's Seat (Rosenthal et al 2007)

The first three reports were prepared as joint Federal and State documents for the Bay Delta Conservation Plan and cover the entire Delta. More specific information concerning Little Franks Tract and Big Break follow the general overview.

Prehistoric Setting

Prior to the arrival of Europeans, inhabitants of the Delta occupied the riparian forest, marsh, alkali basins, oak savanna, and foothill woodland communities found throughout the Central Valley. In the Delta specifically, they located their main population centers on natural levees, mounds and other high spots. Their society developed a sophisticated material culture and established trade system involving a wide range of manufactured goods and raw materials, and their population and villages prospered in the centuries prior to historic contact (Rosenthal et al. 2007).

The following discussion uses a simple classification based on the three basic periods proposed by Fredrickson: the Paleo-Indian, Archaic, and Emergent (Fredrickson 1973, 1974). The Archaic period has been further divided into the Lower, Middle, and Upper Archaic based on newer radiocarbon dates, adjusted with modern calibration curves (Rosenthal et al. 2007).

Paleo-Indian

No evidence of the Paleo-Indian Period (11,550–8,500 BC) has been found in the Delta. However, basally thinned and fluted projectile points at three separate locations in the southern portion of the valley show that people were present in the Central Valley during that time (Rosenthal et al. 2007). Meyer and Rosenthal have shown through geoarchaeological studies that periodic episodes of erosion and deposition during the Holocene have removed or buried large segments of the Late Pleistocene landscape (Rosenthal and Meyer 2004; White 2003a). Therefore, archaeological deposits associated with these ancient landforms have either been destroyed or are buried beneath more recent alluvial deposits (Rosenthal et al. 2007).

Lower Archaic

Evidence of the Lower Archaic Period (8,000–5,550 BC) is likewise rare in the Delta, but is characterized by primarily by isolated finds, including stemmed points, chipped stone crescents, and early concave base points. Intact deposits are even rarer. Only one Lower Archaic deposit has been found in the Central Valley.

Middle Archaic

The physical Delta itself truly formed during the beginning of the Middle Archaic (5,550–550 BC) as a result of warmer, drier conditions in the Central Valley; sea level rise; and the stabilization of fans and floodplains around 5,550 BC (Rosenthal et al. 2007). Around this time, two distinct settlement-subsistence adaptations operating in central California developed—one centering on the foothills and the other on the valley floor (Fredrickson 1994; Rosenthal and McGuire 2004). Populations during this time sites appear to be increasingly sedentary, as indicated by refined and specialized tool assemblages and features, a wide range of non-utilitarian artifacts, abundant trade objects, and plant and animal remains indicative of year-round occupation (Moratto 1984; Ragir 1972; Schulz 1970, 1981; White 2003a, 2003b). Again, deposits dating to this time period are rare in the valley. After about 2,500 BC, sites become much more abundant, and have elaborate material cultural, diverse technology, and dietary assemblages (Rosenthal et al 2007). Additionally, procurement patterns become logistically based and populations have increasing residential stability (Rosenthal et al 2007).

Upper Archaic

A cooler, wetter Upper Archaic (550 BC–AD 1,100) led to renewed fan and floodplain deposition and soil formation in the Central Valley (Rosenthal et al. 2007). People in the Upper Archaic developed new, specialized technologies and there was widespread use of decorative items including shell beads, *Haliotis* ornaments, and ceremonial blades (Bennyhoff and Fredrickson 1994; Moratto 1984; Rosenthal et al 2007). There is evidence of regionalized

economies and a heavy reliance on acorns, salmon, fish and deer (Moratto 1984, Rosenthal et al 2007). Large villages also appeared during this time period (Lilliard et al 1939). Sites dating to this time typically contain large quantities of habitation debris and features (such as fire-cracked rock heaps, shallow hearths, house floors, and flexed burials) that reflect long-term residential occupation.

Emergent

The archaeological record for the Emergent/Historic Period (AD 1,000) is more substantial and comprehensive than those of earlier periods in the Central Valley, and the artifact assemblages are the most diverse (Bennyhoff 1977; Fredrickson 1974; Kowta 1988; Sundahl 1982, 1992). In part this is due to the increasingly complex societies developing in the Delta region; however, some of this may be because the rarity of earlier sites. The Emergent period can be divided into Lower and Upper periods. Aspects of culture include the reliance on acorn, pine nut, and Manzanita; the decentralization of bead production; use of Napa obsidian; and proliferation of baskets. Use of the bow and arrow also became common (Bennyhoff 1994). Village sites from the late Emergent were often used into the Ethnographic period.

Ethnographic Setting

Beginning with Euroamerican contact, at least two Native American cultural groups may have inhabited portions of the Study Area. These groups are the Plains, Bay or Eastern Miwok and Southern Patwin.

Plains Miwok

The Eastern Miwok, and more specifically the Plains or Bay Miwok, inhabited the lower reaches of the Mokelumne and Cosumnes Rivers, and the banks of the Sacramento River from Rio Vista to Freeport (Levy 1978). Although the Plains Miwok shared a common language subgroup, Utial, and cultural background, they were comprised of several separate, politically independent nations, or tribelets. The tribelet represented an independent, sovereign nation that defined and defended a territory. The tribelet chief, usually a hereditary position, served as the voice of legal and political authority in the tribelet (Levy 1978). Within the project area the people were likely part of the *Julpun* tribelet (Bennyhoff 1977).

The arrival of Europeans including trappers, gold miners, and other settlers to California, the Miwok suffered exposure to introduced diseases. Hostilities between the Miwok and Europeans took an additional toll on the population. The Spanish mission system forcibly assimilated many Plains Miwok circa 1811 to 1836 (Bennyhoff 1977). After California was annexed by the United States, some Miwok were displaced to Central Valley locations, yet many remained on the rancherias established in the Sierra Nevada foothills. During the late nineteenth and early twentieth centuries, the Miwok living on the foothill rancherias adapted to new lifestyles, such as seasonal wage labor on ranches and farms, to augment subsistence through hunting and gathering (Levy 1978). Since the early twentieth century, many persons of Miwok descent survive and maintain strong communities and action-oriented organizations including the Ione Band of Miwok and Wilton Rancheria (Bennyhoff 1977).

Southern Patwin

The Southern Patwin are a series of linguistically and culturally related tribelets that once occupied a portion of the lower Sacramento Valley west of the Sacramento River and north of Suisun Bay. The ethnographically documented villages nearest to the APE are *Aguasto* and *Tolenas*, both situated immediately north of San Pablo Bay to the west-northwest (Kroeber 1925, 1932).

The largest political unit for the Patwin was the tribelet. Patwin tribelets maintained their own autonomy and sense of territoriality and typically consisted of one primary and several satellite villages. Villages were located along waterways, often near the junction with another major topographic feature, such as foothills or another waterway (Kroeber 1925, 1932). While a common language unified these social units, the Southern Patwin language disappeared shortly after European contact, but may be related to a Wintuan language. Within the tribelet were several political and social distinctions, including a chief who oversaw village activities; this position was passed through inheritance from father to son (Johnson 1978).

The principal subsistence activities of the Patwin were hunting, fishing, and the gathering of wild plants. Along with the acorn, the primary staple, the Patwin gathered buckeye, pine nuts, berries, wild grapes, and other plants. Each village had its own location for these food sources, and the village chief oversaw the procurement of food for the village (Johnson 1978). Population estimates for Patwin groups, from pre-contact until 1833, are more than 15,000 (Kroeber 1932; Cook 1955). The Patwin were in contact with the Spanish missions by the late eighteenth century, and some of the earliest historic records of the Patwin are found among mission registers of baptisms, marriage, and deaths of Native American neophytes. Mission San Jose, established in 1797, along with Mission Dolores, actively proselytized Patwin from their southern villages, and Mission Sonoma, built in 1823, also baptized neophytes, until the secularization of all missions by the Mexican government in 1832–1836. Afterward, many tribal territories were divided into individual land grants (Johnson 1978).

The U.S. conquest of California (1846–1848) was followed by a massive influx of American settlers into Patwin territory. To facilitate the development of ranching, agriculture, mining, and large settlements, the Patwin were usually moved to reservations. However, some Patwin assimilated themselves, at least partially, into white culture by working as ranch laborers (Johnson 1978). Today, some Patwin descendants live on the Colusa, Cortina, and Rumsey Rancherias; although many of the people living on these rancherias are of general Wintun descent.

Historic Era Setting

The historic setting is intended to illustrate general themes in the development of the Delta as a place. The Delta's history is steeped in land reclamation and development of agriculture, but also includes commercial activities such as fishing, canning, and industrialized produce processing. At both Big Break and Little Franks Tract, the activities were limited to agriculture. Large and small scale agriculture was facilitated by development of transportation

routes, first focused on Delta waterways but eventually developing into land routes. The Delta's built environment has also been shaped by large-scale flood control and water management efforts, as well as recreational activities such as fishing and boating.

Spanish Era to Gold Rush

The first Spanish expedition to reach the Delta was led by Captain Pedro Fages in 1772; however, the Spanish presence in California remained concentrated mainly along the coastal strip of missions and *presidios*, the nearest of which was located west of the Delta. During the early nineteenth century, Spanish and Mexican soldiers would enter the Delta region on incursions to capture Native Americans who had fled missions. The Bay Miwok were the first to be missionized. When Mexico achieved independence from Spain in 1822, California became a territory of Mexico, but remained a remote frontier province. By the end of the decade, American fur trappers began to enter the San Joaquin Valley and the Delta after hearing reports of abundant beaver that circulated after Jedediah Smith's trapping expeditions through central California in 1827 and 1828. Fur trapping in and around the Delta resulted in a steep decline of beaver populations, and fur trappers introduced diseases in the region that heavily affected Native American tribes (Owens 1991; Sandos 2004; Thompson 1957).

By 1848, when gold was discovered at Sutter's Mill in Coloma, only a handful of people had settled in the Delta, but thousands of newcomers traveled Delta waterways en route to the foothill and mountain mines to the east. Some California newcomers chose to farm instead of mine. Farmers began to work land at the edge of the Delta, along the natural levees of the major rivers draining into it. Known as "rim landers," these early settlers built *shoestring levees* (3-5 feet tall) atop the natural levees to withstand the highest tidal rises. Later, more extensive levee construction downstream would transform the Delta (Paul 1973; Street 2004; Thompson 1957).

Land Reclamation

The Swampland Act of 1850 and creation of the State Board of Swamp Land Commissioners enabled the establishment of districts to reclaim land in the Delta. However, lack of cooperation among small landowners and later legislation allowed wealthy absentee owners to take over large portions of the Delta. The speculative, large-scale land reclamation brought thousands of Chinese workers to the Delta. They first helped with the construction of levees and then worked in the resulting agricultural fields (Garone 2011; Lund et al. 2007; Owens 1991; Thompson 1957). Chinese tenant farmers are known to have worked and lived within the once reclaimed lands of Big Break during the 1870s and 1880s (Busby 2001) and Little Franks Tract in the 1910s (Waugh 1986).

People reclaiming the Delta faced many challenges. Levees in the Delta have required constant and expensive maintenance and repair as they frequently failed and islands flooded. The beds of the Sacramento and San Joaquin Rivers and tributaries beds were raised and choked by tailings from hydraulic mining in the Sierra Nevada Mountains. The floors of the Delta's peat islands frequently underwent subsidence from farming and because they were no longer subject to deposition activities during annual inundation. Groundwater seepage increased, creating marsh areas. Irrigation for agriculture upstream caused saltwater intrusion deeper into the Delta.

New technology helped landowners build larger levees and move floodwater out more quickly. The introduction of clamshell dredges in 1879 enabled the construction of increasingly larger and more secure levees. Modern pumps and the introduction of electricity allowed for more efficient and thorough draining of flooded islands. By the early twentieth century, the rise of industrial agriculture across the Delta increased pressure for state and Federal action to protect and facilitate the region's agricultural economy through flood control efforts, transportation development, and large-scale water policy and development in the early twentieth century (Garone 2007; Thompson 1957; Thompson 2006). Subsidence and deteriorating levees are ongoing challenges today.

Agriculture

Agricultural activity in the Delta took place on higher lands near natural levees and rises along the Sacramento River, where farmers raised potatoes, onions, and beans, among other crops, and grazed cattle and sheep. From the 1860s through the 1880s, reclamation spread agriculture from alluvium lands upstream into the peat lands of the central Delta. With water access to a growing urban market in San Francisco, Delta agriculture boomed and crops were diversified (Lokke and Simmons 1980; Rawls and Bean 2002; Thompson 1957; Thompson 2006).

An ethnically diverse population farmed land created by large-scale speculative reclamation through time. These large land holdings were divided into smaller plots with a resident superintendent. Chinese, Italian, and Portuguese tenant farmers often specialized in garden or truck farming. Chinese agricultural laborers also became associated with row crops, especially nineteenth-century potato cultivation. In the twentieth century, Japanese farmers frequently engaged in potato and asparagus production. Beginning in the 1920s, Filipino and Mexican day laborers also worked Delta lands (Azuma 1994; Miller 1995; Thompson 1957).

Modern industrial farming in the Delta region began after World War I. Fuel-powered tractors became commonplace in the Delta, particularly among the large land companies. Although large acreage continued to be reclaimed, a good deal of island land was improved through the introduction of electric pumps. The sale of field crops by consignment to wholesale markets or shippers nurtured the rise of canneries and wholesale produce houses with product standards and field buyers. Urban factories were developed in the Delta during this period, which often employed ethnic laborers to help make sugar out of sugar beets or can fruit, asparagus, and other vegetables (Armentrout-Ma 1981; Thompson 1957).

Transportation Development

During the Gold Rush, most Americans who encountered the Delta did so as passengers of sailboats and steamers en route between San Francisco and the mines east of the Delta. A few trails and later roadways complemented the water traffic. Only after the start of the twentieth century did roads begin to dominate traffic in the Delta with the introduction of the automobile and truck. Ferries connected roads with agriculture on remote islands. Early trails evolved into roads traveled by stages hauling freight back and forth between the farms and the small towns

that took shape behind recently constructed levees. Railroads also played an important role in the development of agriculture, especially after the beginning of the twentieth century. After 1900, county and state investment nurtured bridge construction, which in turn enabled the development of year-round roads serving Delta residents and visitors. During the 1910s and early 1920s, additional bridge construction and road development connected the era's increasing automobile traffic from the earlier established roads to new routes extending to Isleton and Rio Vista. No longer extant electric interurban railroads also extended into portions of the Delta during the early twentieth century (Blow 1920; Caltrans 1990; Thompson 1980).

Water Management

The Delta became a focal point of increasingly large-scale water engineering and management during the early twentieth century. Pressure to ameliorate ongoing flood threats due to the legacies of hydraulic mining led to 1917 legislation creating the first Federal flood control project. The plan included nearly two hundred miles of levees, several hundred miles of bypass channels, and ultimately the rerouting of floodwaters of the Sacramento, Yuba, and American Rivers. Large dredges in use in the Delta for decades were now employed to build new levees and create channels for flood control.

Numerous canals and straightened and widened river channels were by-products of the islands and levees created by Delta reclamation. These functioned as an important water source for irrigation and provided both recreational boating waterway and dredge access for levee construction and maintenance. Most Delta canals appear to have been opportunistically created rather than being formally engineered, hence no design or "as-built" drawings for early canals and levees have been located. Nevertheless, with Federal involvement in flood control after 1917, and especially in the 1920s, plans were drawn and implemented for standard levees and canals for the Sacramento Delta (Pisani 2002).

At the end of the 1920s, state engineer Edward Hyatt developed a State Water Plan to respond to growing water problems. In 1928 the state's voters approved a constitutional amendment that limited the holders of riparian water rights to reasonable use of their water, which opened the way for the state legislature to pass the Central Valley Project Act in 1933. Most of the Central Valley Project was completed by the early 1950s, including more than 500 miles of canals and 20 dams and reservoirs.

After World War II, the SWRCB began planning for additional large-scale water management projects. Then state engineer Arthur D. Edmonston developed a state water plan entailing major new water impoundment and conveyance development. Known as the State Water Project (SWP), Edmonston's plan promised to augment flows to the Delta during dry years and develop state-funded canals to convey additional water to the San Joaquin Valley and new supplies to Santa Clara and Alameda Counties. The plan also called for the development of pumps to transmit Delta water to what would become known as San Luis Reservoir and to a huge aqueduct conveying water south to be pumped over the Tehachapi Mountains into Southern California. In 1960, voters approved the financing for the project, and the first phase was implemented between 1962 and 1971 (Cooper 1968; Kahrl 1979; Rarick 2005).

Recreation

By the first decades of the twentieth century the Delta became a haven for sportsmen and by the 1920s, with the construction of year-round roads, bridges, hotels, and campsites, it had become a destination for the recreational driver, the car camper, and the sightseer. In the post-World War II era, the widespread development of tract housing bypassed the Delta, primarily due to land ownership patterns, limited transportation options, and the overabundance of water. At the same time, those factors helped to foster an increased demand for recreational opportunities and the proliferation of house and party boats. Recently, wetlands restoration has made the Delta a destination for bird watchers as several communities have embraced rare and endangered birds (Schell 1979; Gardner 1964; Steienstra 2012; Thompson 1957; Young 1969).

History of Big Break

The area currently known as Big Break was most likely occupied by peoples of the *Julpun* tribelet of the Plains or Eastern or Bay Miwok (Busby 2001) and is just east of what is considered to be the tribelet center of *Chupcan* at what is now Antioch (Bennyhoff 1977, Levy 1978). This village was first noted by Europeans visiting the area, including Captain Pedro Fages and Fray Juan Crespi in 1772, and Juan Bautista de Anza, Lt. Jose Moraga and Fray Pedro Font in 1776. A map by Jose de Carnizares noted that this village was abandoned in 1776 (Busby 2001). The *Julpunes* are thought to have occupied the islands and west bank of the San Joaquin River and may have moved their main village to the islands due to mission contact (Bennyhoff 1977). The Bay Miwok were among the earliest American Indians to be missionized and were primarily taken to Mission San Jose, although some were taken to Mission San Francisco (Beck and Haase 1974; Levy 1978; Milliken 1995).

Dredging along Dutch Slough between 1904 and 1910 connected Dutch Slough, Sandmound Slough, Taylor Slough and Piper Slough. The building of levees along the southern shore of Dutch Slough is largely undocumented in the available literature, but inferences can be made. Levees were built along the mouth of Marsh Creek, which forms the eastern boundary of the Big Break Regional Shoreline, as early as 1859, but the unleveed land south of Jersey Island was flooded by Marsh Creek in 1876 (Thompson 1957). The1910 Jersey Island USGS 7.5' topographic map shows levees along the southern shore of Dutch Slough. Therefore, it can be surmised that they were constructed between 1876 and 1910, and probably between 1904 and 1910 when Dutch Slough was being dredged. A clamshell dredge was likely used as they had come into widespread use during that time.

Agriculture was originally pursued in the APE; but not much is known about crops grown at Big Break, however, asparagus is reported to have been grown there (East Bay Regional Park District 2014). According to a letter report prepared by Ward Hill for the East Bay Regional Park District (2000), the property known as Big Break flooded in 1921 (Little Break). The levees broke again in 1928, flooding a 2.5 square mile area, which was never reclaimed, effectively ending any agricultural pursuits.

Howard Lauritzen acquired a 40 acre parcel of remaining uplands and the flooded area near Oakley in the 1930s through a trade with Pittsburg Steel. During the 1930s and 1940s, Lauritzen used this area to dismantle Navy pontoons and target barges as part of a scrap metal business. As many as 30 to 40 hulls are still present within the open water of the park area and along the San Joaquin River shoreline (Hill 2000; Moran 2013).

The property was most recently acquired by the East Bay Regional Parks District and currently is operated as the Big Break Regional Shoreline.

History of Little Franks Tract

Little Franks Tract, like Big Break, likely fell under the tribelet lands of the *Julpun* (Waugh 1986). No villages have been recorded on the tract either through ethnographic or historic literature. Additionally, no prehistoric archaeological sites indicating ethnographic villages were recorded prior to inundation.

In 1869, George Roberts planned to reclaim the greater Webb Tract which included Webb, Franks, and Bethel Tracts as well as Bradford and Jersey Islands by a steam paddy, a prototype steam powered machine (Thompson 1957). At the time these areas were contiguous with dry land and the costs associated with levee construction would be reduced because one wouldn't have to build levees on the land side. Levees surrounding the greater Webb Tract were built between 1870 and 1872. Flooding was a common occurrence. Jersey Island was flooded in 1878 and it is likely that the entire greater Webb Tract was inundated at the same time (Thompson 1957). Franks Tract was again reclaimed between 1902 and 1906 by modern methods, but flooded in 1907. The levee breaches were repaired and remained intact until February of 1936, when Franks Tract flooded once again (Thompson 1957). Repairs were made by the following October , but a combination of high river flows, tides and high winds caused a levee breach of several hundred feet in February of 1938 (Thompson 1957). Due to the cost of reclamation the levees were never repaired. A short cross levee, built by John Franks in 1936, to protect his western holdings, was constructed across the Northwestern arm of the tract and preserved what became known as Little Franks Tract.

Prior to inundation, agriculture was the primary occupation of those on the island. These activities supported a racially diverse population on the island which typified that seen in agricultural settings throughout the delta, especially among migrant workers. The U.S. census data from 1910 indicate that the island was inhabited by Japanese, Chinese, Korean, Hindu, Italians, and Americans (Waugh 1986).

Little Franks Tract continued to be used for farming until its acquisition by the State of California. In 1953, the island was reputed to have little improvement, four barns, a windmill, a ranch house, siphons, and pumping equipment (Waugh 1986). Little Franks Tract later flooded in 1981 and again in 1983 and has never been reclaimed (DWR 2009).

Franks Tract's flooding introduced new activities to the region. Peat dredging for soil conditioning material followed soon after inundation (Waugh 1986). A portion of the island was used as a Naval bombing target for air to ground rockets and miniature bombs (California State

Military Museum 2008). The island is now a State Recreation Area and activities such as boating, hunting, and fishing are practiced here.

Methods for Resource Identification

In 2012, a record search for the entire Delta was completed at California Historic Resources Information Centers for the Bay Delta Conservation Plan (ICF 2012b). A second search to update this information and retrieve survey data was completed in March 2014 at the North Central Information Center and the Northwest Information Center. Additional research was undertaken using in house records and those held by the East Bay Regional Park System, the State Lands Commission, and National Register of Historic Places.

As both work areas within the APE are completely submerged, no pedestrian survey could be undertaken. However, a reconnaissance survey in the form of boat trips which included photographing the remnant levees and other features were undertaken to document the current condition of these resources. The potential pipeline alignments were not surveyed because their actual alignment is not currently known, there would be minimal temporary effects to any cultural resources, and the pipe used is flexible enough to be routed around areas of concern.

Known Cultural Resources

The cultural resources study identified three cultural resources within the APE: the remnant levees surrounding Little Franks Tract and Big Break and the Sherman Island Levee (CA-SAC-553H). Each is described and evaluated for its eligibility for listing in the NRHP separately, below.

Big Break

The levees surrounding Big Break were recorded and evaluated by USACE in November 2013. The current state of the levees is very degraded. Current (2012) aerial photos show that approximately 20,740.9 feet (3.9 miles) remains of the levees in at least 13 segments. As discussed above, the levee surrounding Big Break breached in 1928 and the land was never reclaimed. USACE has determined that while the levee was peripherally related to the themes of reclamation and agricultural development in the Delta, it does not retain enough integrity of location, setting, feeling, association, workmanship, materials, and design to be eligible under Criterion A. It is not associated with any person or persons significant to history (Criterion B). The levee likewise does not embody the distinct characteristics of a type, period, nor method of construction, nor represent the work of a master, nor do they possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C). The levee has not yielded, nor is it likely to yield, information important in prehistory or history (Criterion D). Therefore, USACE has determined the levee is not eligible for listing in the NRHP.

Little Franks Tract

The levees surrounding Franks Tract, including those around Little Franks Tract, were recorded in November 2013. USACE subsequently evaluated the levees and determined that they were not eligible for listing in the NRHP. Current (2012) aerial photos show that levees around Little Franks Tract measure approximately 16,863 feet (3.2 miles) in 14 segments ranging from 53 to 6694 feet long. The current state of the levees is very degraded. While part of the larger Franks Tract early in its history, Little Franks Tract was saved from inundation in 1938 by a cross levee on the eastern edge built in 1936. However, the levees were overtopped in 1981 and 1983 and the island was never reclaimed. USACE has determined that while the levee was peripherally related to the themes of reclamation and agricultural development in the Delta, it does not retain enough integrity of location, setting, feeling, association, workmanship, materials, and design to be eligible under Criterion A. It is not associated with any person or persons significant to history (Criterion B). The levee likewise does not embody the distinct characteristics of a type, period, nor method of construction, nor represent the work of a master, nor do they possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C). The levee has not yielded, nor is it likely to yield, information important in prehistory or history (Criterion D). Therefore, USACE has determined the levee is not eligible for listing in the NRHP.

Sherman Island Levee

The Sherman Island Levee is located in the Sacramento-San Joaquin River Delta. It is an earthen levee with an approximate length of 18 miles. A two lane paved roadway exists on the crown. The recording of this levee in 2013 recommended this levee as not eligible for listing in the NRHP. Likewise, the USACE has determined that while the levee was peripherally related to the themes of reclamation and agricultural development in the Delta, it does not retain enough integrity of location, setting, feeling, association, workmanship, materials, and design to be eligible under Criterion A. It is not associated with any person or persons significant to history (Criterion B). The levee likewise does not embody the distinct characteristics of a type, period, nor method of construction, nor represent the work of a master, nor do they possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction (Criterion C). The levee has not yielded, nor is it likely to yield, information important in prehistory or history (Criterion D). Therefore, USACE has determined the levee is not eligible for listing in the NRHP. Therefore, USACE has determined the levee are not individually eligible for listing in the NRHP. It may be eligible for its connection to the larger flood control project, but only as a contributing element, however, the placement of pipes over the levee has no potential to effect historic properties.

Areas not Surveyed

Materials from existing dredge spoils locations are proposed be piped along unknown corridors to the work areas at Big Break and Little Franks Tract. Because the alignment of these pipes is currently unknown, only a record search of potential alignments has been performed at this time. The record search showed that only one known cultural resource is within the potential corridors: the Sherman Island Levee described above.

Consultation

Native American

Native American Tribes with interests in the Delta were contacted by USACE in May 2013. USACE received one response from the Wilton Rancheria with a request for more information and stated desire to continue to be involved. More detailed information was sent to all the Tribes in March 2014.

State Historic Preservation Officer

USACE determined that the proposed undertaking would result in no historic properties affected. Consultation with the State Historic Preservation Officer will be completed prior to the final EIS.

5.0 – ENVIRONMENTAL CONSEQUENCES

5.1 Introduction

This chapter discusses the potential effects of the alternative plans on the significant environmental resources described in Chapter 4. The present condition of each resource analyzed in this chapter is compared with the estimated future condition of the resource after the following alternative plans are in place:

- Alternative 1 – No Action
- Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement
- Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Project effects on these significant environmental resources are measurable over the entire restoration footprint or over specific project areas depending upon the configuration of each resource.

Both beneficial and adverse effects are considered, including direct effects during construction and indirect effects resulting from the alternatives. Each section, where appropriate, contains a discussion of the methods used to analyze effects. In addition, the bases of significance (criteria) for each resource are identified to provide a basis for evaluation of the significance of any adverse effects. Finally, mitigation measures are proposed reduce any significant adverse effects for each resource. A summary of the effects and their level of significance is included in Section 5.7, Irreversible and Irretrievable Commitment of Resources.

The bases of significance follow NEPA requirements. USACE has integrated NEPA requirements into its regulations, policies, and guidance. Engineering Regulation 1105-2-100, "Planning Guidance Notebook," April 2000, establishes the following significance criteria:

- Significance based on institutional recognition means that the importance of the effects is acknowledged in the laws, adopted plans, and other policy statements of public agencies and private groups. Institutional recognition is often in the form of specific criteria.
- Significance based on public recognition means that some segment of the general public recognized the importance of the effect. Public recognition may take the form of controversy, support, conflict, or opposition expressed formally or informally.
- Significance based on technical recognition means that the importance of an effect is based on the technical or scientific criteria related to critical resource characteristics.

For this EIS, the above three NEPA criteria apply to all resources and are not repeated under each resource section.

5.2 Vegetation and Wildlife

This section evaluates the effects of the proposed alternatives on vegetation and wildlife resources in the project area and potential mitigation measures to reduce impacts to a less-than-significant level. Effects of the proposed alternatives were analyzed during coordination with the USFWS under the Federal Fish and Wildlife Coordination Act. Biological field surveys were conducted at each Project site and in the project vicinity by USFWS, NMFS, and USACE in November of 2013 to assess vegetation cover types, existing habitat for special status and wildlife species, and the presence of special status species and invasive plant species. A Habitat Evaluation Procedures (HEP) analysis was conducted to determine the effects of the proposed alternatives on vegetation and wildlife resources. This section includes a summary of the HEP analysis. The HEP analysis is included with the document as Appendix F.

5.2.1 Methodology and Basis of Significance

Methodology

The impacts of the different project alternatives were assessed primarily by the application of HEP to quantitatively measure habitat value and quality of the habitat for wildlife at baseline or current conditions, and compares that value with the estimated habitat value at various points in time throughout a 50-year period of analysis for each project alternative. The HEP analysis is based on the assumption that the value of habitat to a selected species or group of species can be described in models using variables that represent habitat suitability of wildlife. The models produce a Habitat Suitability Index, which is multiplied by the area of available habitat to obtain habitat units (HUs). The HUs and average annual habitat units (AAHUs) over the life of the project are then used in the comparison of the effects of the alternatives and in the quantification of any project-related mitigation.

Under NEPA, the significance of project impacts is a function of context and intensity. For biological resources, context refers to the importance (ecological, commercial, scientific, recreational, etc.) or regulatory (i.e. legally protected) status of the resource, and intensity refers to the magnitude – scale and duration – of the impact. Both beneficial and adverse impacts are recognized; either can be significant.

In the study area, the habitats of greatest importance are tidal marsh and seasonal wetlands. These habitats are most important because of their scarcity and high value to fish and wildlife species. Substantial long-term net reductions in the acreage and/or value of these habitats would represent significant adverse impacts, underscoring the importance to the ecosystem of the project's contribution of new intertidal marsh converted from lesser-valued open water or grassland habitat. Losses or gains of population and habitat for special status species may also be significant, depending on the magnitude of the impact relative to the population size and distribution of the species in the region. Finally, any impact leading to new

introductions or the expansion of invasive species would also be considered significant in terms of potential far-reaching effects on the ecosystem of the project area.

Because the purpose of the project is habitat restoration, the habitat functions and values that would be provided upon maturity of the habitats proposed for restoration are also described. The project is designed to establish intertidal marsh habitat at the proposed restoration sites and that context was considered in evaluating the impacts to vegetation and wildlife.

Basis of Significance

Adverse effects on vegetation and wildlife were considered significant if implementation of an alternative plan would result in any of the following:

- Result in a substantial loss of native vegetation or species.
- Removal, or substantially disturbance of a sensitive natural community (wetlands, tidal marsh)
- Substantial reduction in the quality and quantity of important habitat or access to such habitat for wildlife species.

5.2.2 Alternative 1 – No Action

Under the no action alternative, it is assumed that no action would be taken to restore intertidal marsh habitat to the flooded islands. It is assumed that restoration action currently proposed under BDCP and other projects would still be constructed, but not at these locations. Therefore, overall, vegetation and wildlife resources in the study area are expected to remain similar to existing conditions.

5.2.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channel) Final Environmental Impact Statement from September 1980.

Effects on Existing Habitats

Under Alternative 2, 42 acres of open water habitat would be converted to freshwater intertidal marsh habitat via the direct placement of O&M dredged material, as described in Section 3.9.2. It is anticipated that sensitive vegetative habitat types located on the periphery of

Big Break such as existing tidal marsh and riparian vegetation, would be avoided because placement of dredged material would be restricted to open water, outside these habitats.

Habitat growth at Big Break would occur gradually over time as dredged material placement occurs. Because dredged material placement is dependent on annual O&M dredging, which is estimated to produce 100,000 cubic yards per year, project construction would require at least 5 years. Only clean dredged material found suitable for direct placement for the purpose of habitat restoration, would be accepted at the project site. As the restoration site progresses over time, the restored intertidal marsh would become established in 2 to 4 years and provide valuable new habitat for fish and wildlife species.

The gain of higher value intertidal marsh habitat would more than offset the loss of open water habitat (Table 5-1). Accordingly, permanent loss of open water habitat would result in a less-than-significant impact. Because of uncertainties regarding the rate of intertidal marsh vegetation development to offset the temporary loss of habitat values, a monitoring plan is proposed as part the project to measure the establishment rate and the quality and quantity of habitat gained. No mitigation would be required because the project's conversion of open water habitat to intertidal marsh habitat would result in a net increase in HU's and AAHU's over the life of the project, a positive environmental effect. See Table 5-1 for net changes to habitat types.

Effects on Non-Special Status Wildlife Species

The permanent conversion of wetland habitats would result in a substantial improvement to the wetland functions and values on the project site for fish and wildlife, including special status species. The creation of intertidal marsh habitat within Big Break would likely create high-quality habitat for common species of amphibians, reptiles, birds, and mammals. Common fish and wildlife species present within the study area may be directly or indirectly affected by construction. Direct impacts may include mortality or injury to individuals present within the proposed sites due to dredged material placement, movement of heavy equipment, construction noise, and turbidity. Indirect impacts would include alteration of habitat conditions after the completion of construction. The risk of a potential increase in the bioavailability of contaminants carried in dredged materials is addressed in the water quality section.

Although common fish and wildlife species are not afforded the same levels of protection as special status species and do not have the same agency consultation requirements under applicable laws, regulations, and policies described in the regulatory section, common species generally would receive some protection from measures prescribed for special status wildlife species. Non-special status species would benefit from the installation of exclusion fencing and orange barrier fencing along the edge of the construction area that is within 200 feet of suitable special species habitats and best management practices. Because the proposed restoration would benefit other fish and wildlife species in addition to special status species, and because measures would be implemented to reduce impacts, the resulting effect is considered less than significant, and no mitigation is required.

Table 5-1. Net Change in Habitat Types at Big Break, Little Franks Tract, and Dredged Material Source Sites under the Proposed Alternatives.

	Alternative 1: No-Action Alternative	Alternative 2		Alternative 6	
Community or Habitat Type	**Acres**	**Acres**	**Net Change**	**Acres**	**Net Change**
Flooded Island Restoration Sites					
Big Break					
Tidal perennial aquatic (open water)	1,490.0	1,448.1	-42	1,409.7	-80.3
Intertidal marsh	305.7	347.6	42	386.0	80.3
Valley foothill riparian	100.2	100.2	0	100.2	0
Annual grassland	19.3	19.3	0	19.3	0
Coastal Scrub	2.6	2.6	0	2.6	0
Little Franks Tract					
Tidal perennial aquatic	294.8	294.8	0	285.6	-9.2
Intertidal marsh	103.4	103.4	0	112.6	9.2
Valley foothill riparian	5.2	5.2	0	5.2	0
Coastal Scrub	7.9	7.9	0	7.9	0
Tidal marsh	54.3	-	-	54.3	0
Valley Foothill Riparian	52.1	-	-	52.1	0
Urban	11.9	-	-	11.9	0
Barren	10.5	-	-	10.5	0
Tidal perennial aquatic (open water)	0.3	-	-	0.3	0
Non-native/Ornamental Conifer/Hardwood Mixture	0.2	-	-	0.2	0
Bradford Island					
Annual grassland	55.6	-	-	55.6	0
Valley foothill riparian	48.6	-	-	48.6	0
Barren	20.3	-	-	20.3	0
Tidal marsh	4.6	-	-	4.6	0
Coastal Scrub	0.5	-	-	0.5	0

Introduction or Spread of Invasive Plants as a Result of Project Construction

Invasive plants are already present throughout project area. However, construction activities could introduce new invasive plants to the project area or contribute to the spread of existing invasive plants to uninfested areas outside the project area. Invasive plants or their seeds may be dispersed by construction equipment if appropriate prevention measures are not implemented. The introduction or spread of invasive plants as a result of the project could have a significant effect on sensitive natural communities within and outside the project area by displacing native flora. The implementation of the appropriate best management practices

(BMPs) to avoid or minimize the spread or introduction of invasive plants would ensure that the proposed alternative would not have a significant adverse effect on sensitive natural communities from the introduction or spread of invasive plants. With implementation of BMPs listed in Section 5.2.5 below to avoid and minimize the spread or introduction of invasive plant species, this would be a less-than-significant effect. Terrestrial invasive species at the material source sites, whether in seed or mature form, would not survive in the aquatic environment after transfer to the project site. The wet conditions would not allow terrestrial invasive species to germinate. No additional mitigation is required.

5.2.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channel) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from the source material sites are analyzed below. The dredged materials from the DWSCs are sampled prior to O&M activities and tested for HTRWs. Existing stockpiled materials were previously tested and records show granular and chemical analyses. The test results are compared against baseline sampling from the restoration sites. Dredged materials not meeting the chemical baseline would not be used. Under Alternative 6, 89.5 acres of open water habitat would be permanently converted to intertidal marsh habitat as shown in Table 5-1.

Effects on Existing Habitats

As in Alternative 2, it is anticipated that sensitive vegetative habitat types located on the periphery of Big Break such as existing tidal marsh and riparian vegetation, would also be avoided. However, because this alternative relies on obtaining sediment from dredged material source sites in addition to O&M dredged material, this alternative could potentially disturb vegetative habitats located on the dredged material sites. Table 5-1 and Figures 4-1 and 4-2 identify the terrestrial habitats present at the proposed dredged material source sites. The impact analysis assumes that construction activities required to excavate and transport material would be designed to avoid disturbance to sensitive habitats by limiting construction activities to usable non-sensitive areas within these sites.

The excavated material would be transported from the dredged material placement sites to the restoration sites via a pipeline. While the final locations of the pipeline's placement have yet to be determined, it can be assumed that whenever feasible the pipelines will be installed along the edge of farm roads to avoid disturbance to additional habitats. As a result, since the farm roads are disturbed dirt roads with no vegetation, there would be no effect associated with

this action on vegetation and wildlife. With implementation of the BMPs described in Section 5.2.5 to avoid and minimize the effects to existing habitats, this would be a less-than-significant effect and no additional mitigation would be required.

As described for Alternative 2, habitat development at Big Break would occur gradually over time as dredged material placement occurs. As in Alternative 2, construction would require at least 5 years to complete. Restored intertidal marsh would gradually establish and provide habitat for fish and wildlife species.

Overall, the permanent conversion of wetland habitats would result in a substantial improvement to the wetland functions and values on the project site for fish and wildlife, including special status species. The gain of higher value intertidal marsh habitat would more than offset the loss of open water habitat (Table 5-1). Accordingly, permanent conversion of open water habitat to intertidal marsh would result in a net beneficial environmental impact. No mitigation would be required because the conversion of open water habitat to intertidal marsh habitat would result in a net increase in HU's and AAHU's over the life of the project, which is a beneficial effect on vegetation and wildlife. Vegetation surveys at Donlan Island, a similar beneficial use dredge material intertidal marsh restoration project 1.5 miles west of the proposed project, confirmed an 80 percent or more survival/establishment rate of intertidal marsh vegetation within two years. The intertidal marsh vegetation at the Donlan project was naturally recruited. No planting was installed. Given the close proximity to Donlan and identical tidal flows, the proposed project has the propensity to meet or exceed habitat modeling results, as shown on Table 5-1.

Effects on Non-Special Status Wildlife Species

Common fish and wildlife species present within the study area may be directly or indirectly affected by construction. Direct impacts may include mortality or injury to individuals present within the sites due to dredge material placement, movement of heavy equipment, construction noise, and turbidity. In addition, temporary disturbance to wildlife from noise and movement of construction equipment would occur at the dredge material source sites. Indirect impacts may also include alteration of habitat conditions after the completion of construction.

As described for Alternative 2, common fish and wildlife species would receive some protection from measures prescribed for special status animals. Exclusion fencing and BMPs, as described in Section 5.2.5, would minimize impacts. The resulting effect is considered less than significant, and no mitigation is required because the project's conversion of open water habitat to intertidal marsh habitat would result in a net increase in HU's and AAHU's over the life of the project, a positive environmental effect.

Introduction or Spread of Invasive Plants as a Result of Project Construction

As described for Alternative 2, colonization of invasive non-native plant species as a result of construction could result. However, because Alternative 6 would disturb a larger area due to the excavation and transport of dredge material from dredged material source sites, the potential for invasive species to displace or prevent establishment of native species is greater.

Construction activities could introduce new invasive plants to the project area or contribute to the spread of existing invasive plants to uninfested areas outside the study area. Invasive plants or their seeds may be dispersed by construction equipment if appropriate prevention measures are not implemented. The introduction or spread of invasive plants as a result of the project could have a significant effect on sensitive natural communities within and outside the project area by displacing native flora. The implementation of the appropriate BMPs to avoid or minimize the spread or introduction of invasive plants will ensure that the proposed project would not have a significant effect on sensitive natural communities from the introduction or spread of invasive plants. With implementation of the BMPs described in Section 5.2.5 to avoid and minimize the spread or introduction of invasive plant species, this would be a less-than-significant effect and no additional mitigation would be required.

5.2.5 Mitigation

The following measures would be implemented to reduce potential short-term impacts that could result from the introduction or spread of invasive plant species as a result of project construction:

- The adjacent existing levee would be treated with EPA and State-approved herbicides to remove weed species and invasive species.
- Mowing and spraying would be implemented in the restoration areas to control and reduce continued weed growth.
- Terrestrial wildlife species would benefit from the installation of exclusion fencing along the edge of the construction area that is within 200 feet of suitable giant garter snake habitat.
- Records and reports would be required to document any actions to maintain the site and the annual progress of the site.

5.3 Special Status Species

This section evaluates the effects of the proposed alternatives on special status species in the project area. Initial evaluation determined that several species have the potential to occur, or that suitable habitat exists, in the project area.

5.3.1 Methodology and Basis of Significance

Methodology

Special-status species are defined as animals that are legally protected under the ESA, CESA, or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. Based on the USFWS (2013) species list and CNDDB (California Department of Fish and Game 2013) records search for the quadrangles overlapping

the affected area, nine special-status plant and wildlife species were identified as having potential to occur in the affected area (Table 4-2).

Basis of Significance

Adverse effects on special status species were considered significant if implementation of an alternative plan would:

- Directly or indirectly reduce the growth, survival, or reproductive success of species listed or proposed for listing as threatened or endangered under the Federal or State Endangered Species Act.
- Directly or indirectly reduce the growth survival, or reproductive success of substantial populations of Federal or State species of concern or regionally important species.

5.3.2 Alternative 1 – No Action

The no action alternative assumes that no action would be taken by the USACE to restore intertidal marsh habitat to the flooded islands. The flooded islands would remain in their current state. Under the future without project condition, BDCP restoration actions are assumed to improve habitat conditions in the Delta for special status species populations as described in Section 3.3.

5.3.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. In-water work would occur over a 5-year period from August 1 to October 31 each year in association with annual O&M ship channel dredging operations.

Special Status Plant Species

Because the areas of physical disturbance caused by the project would be largely confined to open water, there is a low potential for the impacts to special-status plants, but if one or more of these species are present in adjoining areas of higher ground necessary for staging and project construction, project construction could result in their removal. The dredged material placement component of Alternative 2 has the potential to significantly impact special status plant species in tidal marsh fringing the construction site. Species that have been documented in

the local area that could be affected include Suisun Aster, Mason's Lilaeopsis, and Delta Mudwort.

Because the presence and extent of any special status plants in the project construction area is unknown, this effect is potentially significant. However, the USACE would conduct surveys of the study area to document the presence of special status plants before project implementation. Qualified botanists would conduct a floristic survey that follows the CDFW botanical survey guidelines. If special status plant populations are detected where construction would have unavoidable impacts, USACE will modify the project design to avoid indirect or direct effects and/or prepare and implement a compensatory mitigation plan in coordination with USFWS or CDFW. Such plans may include salvage, propagation, on-site reintroduction in restored habitats, and monitoring. If there are no special status plant populations detected during the preconstruction surveys, then there would be no effects to special status plant species from implementation of Alternative 2.

Special-Status Fish Species

Effects of the proposed Project on special-status fish include both short- and long-term effects. Short-term effects include direct impacts from construction activities (e.g., increased suspended sediment and turbidity). Long-term or permanent impacts would result from the conversion of open water habitat to intertidal marsh habitat.

Short-term Effects on Fish Habitat and EFH

Construction would occur over a 5-year period during the summer and fall of each year, a time when salmonid juveniles and smolts may be rearing and outmigrating through the Delta, and when adult salmonids are likely to be moving upstream through the Delta. Adult and juvenile Chinook salmon and steelhead primarily migrate upstream and downstream within the main-stem Sacramento River. Juvenile Chinook salmon and steelhead may migrate from the Sacramento River to the central Delta during their downstream migration and may also inhabit flooded islands as a temporary foraging area and migration pathway during the winter and early spring migration period. The occurrence of juvenile Chinook salmon in the Delta would be expected to occur during late fall through early spring when Delta water temperatures would be suitable for juvenile Chinook salmon migration. Short term effects to juveniles and smolts during construction would be temporary. The project area is very small in comparison to the overall central Delta, and there is significant rearing and feeding habitat present in adjacent aquatic areas. Therefore short-term effects from project construction would be less than significant. The project would increase primary productivity to juveniles and smolts, which would be a long-term beneficial effect.

Although the majority of adult Chinook salmon migrate upstream in the main-stem Sacramento River, there is a probability, although low, that adults may migrate into the central Delta. The occurrence of Chinook salmon in the central Delta, including Big Break and Little Franks Tract, although expected to be very low, would be limited to winter and early spring adult upstream migration. Adult green sturgeon are not expected to be affected by construction

activity, since green sturgeon are believed to spawn in the deepest and fastest portions of the channel (70 FR 17386).

When fish migration timing coincides with the in-water work window, the presence of overhead equipment and the sound generated by construction activities could temporarily disrupt essential behavior patterns (e.g., feeding, escape from predators, migration) of adult and juvenile fish at the construction sites and the surrounding areas. Noise effects may occur at the project site and general vicinity. Construction would result in elevated levels of suspended sediment, causing increased turbidity and potential sedimentation of benthic (bottom) habitat used by juvenile and adult fish for feeding, cover, and other essential behaviors. Direct mortality of individuals could occur to fish present during construction. Placement of dredged sediment may also potentially disturb, injure, or kill any fish migrating though the area of the construction sites during construction.

Non-mobile benthic organisms that are food sources for fish would be smothered by the placement of dredged material and potentially from placement and anchoring of the sediment transport pipelines on the bottom and potential up and down movement of the pipeline with the tides. These areas affected should recover quickly after placement of the dredged material and removal of the pipelines as these areas are recolonized by benthic organisms. Survival studies at the nearby Donlon Island project demonstrated that benthic organisms recolonized within a two year period, providing sufficient primary productivity (food web) benefits.

Resulting short-term effects could include reduced feeding success, and compromised ability to escape from predators. Toxic substances used by construction equipment including gasoline and diesel, lubricants, and other petroleum-based products, could enter the waterways adjacent to the project site as a result of spills or leakage from machinery or storage containers. The contractor would be required to submit and adhere to a Storm Water Pollution Prevention Plan (SWPPP) and an in-water work plan subject to approval by the Central Valley RWQCB. The SWPPP and associated BMPs are discussed further in the Water Quality section (Section 5.4.5). Mortality or physiological impairment of fish or disruption of essential behavior patterns is possible if exposure to sufficient concentrations occurs.

Short-term direct impacts to special status fish would be considered significant, if construction were to occur outside of the species work windows. However, USACE would adhere to the specified species work windows from USFWS and NMFS for salmonid species. As a result, there would be no effect to listed species, as all work would be occurring outside of the species migration season.

Long-term Effects on Fish Habitat and EFH

The restoration of intertidal marsh habitat would increase instream structure and aquatic habitat complexity and the quality of EFH. Planted aquatic vegetation would begin to infiltrate the shallow water habitat created by dredged material placement and gradually cover the site. These factors in combination would provide high quality habitat for all life stages of all species present in the study area and most life stages of special status fishes (except for migrating green sturgeon). The intertidal marsh habitat would provide escape cover, creating ideal refugia from

large predators for small larval and juvenile fishes. The intertidal marsh habitat would be especially valuable as holding and rearing habitat for all life stages of all special-status species (except for migrating green sturgeon). Inundated intertidal marsh habitat should provide an increase in potential delta smelt spawning habitat. Overall, the proposed alternative would have a net long-term benefit for all life stages of all special-status species. Because the project is anticipated to result in a long-term benefit to listed species, the project would have a less-than-significant impact and no mitigation is required.

Special Status Wildlife Species

A number of special status wildlife species have some potential to occur in the study area. Only a small number of special status wildlife species have the potential to occur in the area proposed for intertidal marsh restoration since the existing areas proposed for beneficial placement of dredged material are currently open water. Rather, adjoining areas may support special status aquatic species that may be disturbed by construction. Since this alternative relies solely on dredged material placed directly from O&M dredging, no disturbance would result from the removal and transport of sediment from dredged material source sites. Under Alternative 2, no project action would occur on land since material would be transferred from the river channel bottom directly to the restoration site at Big Break. Effects to special status wildlife species are discussed in the subsections below.

Short-term Effects to Special Status Bird and Bat Species

Noise, vibration, visual, and proximity-related disturbances associated with construction could adversely affect special status bird and bat species if they are nesting on or adjacent to the restoration site during construction. Since construction would occur in the August 1 through October 31 time period outside of the spring nesting season, it is unlikely that nesting birds would be present. However, if individuals of these species nest during the construction period, construction disturbances could cause them to abandon their nests or young. The breeding success of these species could be diminished if disturbances reduce ability of adults to properly care for their young. Therefore this impact is considered significant. To reduce this impact to a less-than-significant level, mitigation measures, as discussed in Section 5.3.5 below, would be implemented.

Mudflats and shallow water (less than 6 inches deep) are important foraging and resting habitat areas for shorebirds. The project would initially create mudflat habitat by the placement of dredged material before intertidal marsh vegetation becomes established. The benthic organisms that colonize these areas would become prey for shorebirds. This impact would be beneficial to migratory birds.

Long-term Effects to Special Status Reptiles and Amphibians

The creation of intertidal marsh along the northern periphery of Big Break adjacent to Jersey Island could result in long-term benefits to several special-status species. The intertidal marsh habitat would provide slower moving aquatic habitat suitable for western pond turtles and giant garter snakes. The intertidal marsh habitat may provide suitable nesting habitat for tricolored blackbird.

5.3.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channel) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below. Water used to pump dredged material would come from onsite and would pass through a fish screen in compliance with NMFS, USFWS, and CDFW guidance to minimize entrainment of fish. As in Alternative 2, in-water work would take place from August 1 to October 31 each year for 5 consecutive years .

Special Status Plant Species

As described for Alternative 2, dredged material placement has the potential to significantly impact special status plant species that may be present in the tidal marsh fringing the project site. Species that have been documented in the local area that could be affected include Suisun aster, Mason's lilaeopsis, and Delta mudwort. The potential for loss of individual plants is substantially greater than Alternative 2 because Alternative 6 would disturb about twice as much area to create additional marsh habitat and could impact special status plants if present at or near the existing dredged material source sites due to the excavation of material. In addition, there is the possibility of impacting special status plant species from the placement of miles of pipeline to pump material to Big Break and Little Franks Track. However, whenever possible, these pipelines would be placed on farm roads that are previously disturbed, therefore the likelihood of impacts to special status plant populations is very low.

USACE will retain qualified botanists to survey the project area to document the presence of special status plants before project implementation. The botanists will conduct a floristic survey that follows the CDFW botanical survey guidelines. If special status plant populations are detected where construction would have unavoidable impacts, USACE will modify the project design to avoid indirect or direct effects and/or prepare and implement a compensatory mitigation plan in coordination with USFWS or CDFW. Such plans may include

salvage, propagation, on-site reintroduction in restored habitats, and monitoring. Implementation of these protective measures should prevent any significant adverse impact to these special status plant species in the event Alternative 6 is constructed.

Special Status Fish Species

Short-term Effects on Fish Habitat and EFH

Chinook Salmon, Central Valley Steelhead, and Green Sturgeon

As described above under Alternative 2, effects to green sturgeon, Chinook salmon (winter-run, Central Valley fall/late fall-run, and spring-run), and steelhead would be significant if construction would occur during the migratory season. However, with the implementation of USACE and NMFS recommended in-water work windows, there would be no effects to special status fish species. There would be no additional impacts to fish species from restoration of the additional acreage under Alternative 6, or from the pumping of previously dredged materials from the stockpile sites. There is the potential for increased turbidity resulting from excavation activities at the stockpile sites; however, water quality BMPs, as discussed in Section 5.4.5, would be implemented to reduce these impacts to less than significant. Long-term impacts would be consistent with the analysis under Alternative 2.

Delta Smelt

Construction would occur over a 5-year period during the summer and fall of each year, a time when Delta smelt may be rearing. Construction-related effects on delta smelt rearing and migration will be minimized by restricting in-water construction activities to the August 1 through November 30 work window, thereby avoiding the seasons when these life stages are most likely to occur. Construction activities would not occur during spawning (January through July).

Direct mortality of individuals could occur to fish are present during construction. Placement of dredged sediment may also potentially disturb, injure, or kill any fish in the area of the construction sites during construction. The sound generated by construction activities could temporarily disrupt essential behavior patterns (e.g., feeding, escape from predators, migration) of adult and juvenile fish at the project sites and the surrounding areas. Noise effects may occur at the project site and general vicinity.

Construction would result in elevated levels of suspended sediment, causing increased turbidity and potential sedimentation of benthic (bottom) habitat used by juvenile and adult fish for feeding, cover, and other essential behaviors. Increased turbidity may decrease feeding opportunities and increased suspended solids could clog and abrade gill filaments (*USFWS* 2008). Decreased light penetration through the water column may reduce photosynthesis and reduce the extent of aquatic vegetation upon which delta smelt spawn, as well as the amount of phytoplankton which are fed upon by the delta smelt's zooplankton prey. Resulting short-term effects could include reduced feeding success, and compromised ability to escape from predators.

Toxic substances used by construction equipment including gasoline and diesel, lubricants, and other petroleum-based products, could enter the waterways adjacent to the project site as a result of spills or leakage from machinery or storage containers. Mortality or physiological impairment of fish or disruption of essential behavior patterns is possible if exposure to sufficient concentrations occurs.

Non-mobile benthic organisms that are food sources for fish would be smothered by the placement of dredged material and potentially from placement and anchoring of the sediment transport pipelines on the bottom and potential up and down movement of the pipeline with the tides. These areas affected should recover quickly after placement of the dredged material and removal of the pipelines as these areas are recolonized by benthic organisms.

Alternative 6 is likely to adversely affect Delta smelt because construction activities may result in the injury and mortality of individual fish. The proposed action is not likely to adversely affect designated critical habitat because the project has been designed to minimize any impacts to the extent feasible. An approved stormwater management plan will be in place to minimize any increase in sediment flow and turbidity, as will a plan to prevent the spill of toxic or potentially toxic materials (including concrete) into the water during all construction. Details on these measures proposed to reduce impacts to turbidity are included in the Water Quality section (Section 5.4.5).

Long-term Effects on Fish Habitat and EFH

Chinook Salmon, Central Valley Steelhead, and Green Sturgeon

The restoration of intertidal marsh habitat will increase instream structure, aquatic habitat complexity, and the quality of EFH. Planted aquatic vegetation will begin to infiltrate the shallow water habitat created by dredged material placement and gradually cover the site. These combined factors would provide high quality habitat for all life stages of all species and most life stages (except for migrating green sturgeon) of special status fishes. The intertidal marsh habitat would provide escape cover, creating ideal refugia from large predators for small larval and juvenile fishes. The intertidal marsh habitat would be especially valuable as holding and rearing habitat for all life stages of all special status fish species (except for migrating green sturgeon). Inundated intertidal marsh habitat should provide an increase in potential delta smelt spawning habitat. Overall, Alternative 6 would have a net long-term benefit for all life stages of all special status fish species. Because Alternative 6 is anticipated to result in a long-term benefit to listed species, the alternative would have a less-than-significant impact on special status fish species and no mitigation is required.

Delta Smelt

The restoration of intertidal marsh habitat will increase instream structure and aquatic habitat complexity. Planted aquatic vegetation will begin to infiltrate the shallow water habitat created by dredged material placement and gradually cover the site. These factors in combination would provide high quality habitat. The intertidal marsh habitat would provide

escape cover, creating ideal refugia from large predators for small larval and juvenile fishes. Inundated vegetated wetland should provide an increase in potential Delta smelt spawning habitat. Overall, the project would have a net long-term benefit to Delta smelt. While incidental take of Delta smelt may occur during construction, the proposed action to restore intertidal marsh is anticipated to have long-term benefits to Delta smelt.

Special Status Wildlife Species

A number of special status wildlife species have some potential to occur on the project sites or within the project vicinity. Only a small number of special status wildlife species, however, are likely to occur at the proposed intertidal marsh restoration sites since the area is currently open water. Adjoining areas however may support special status wildlife species that may be disturbed by construction. Since this alternative relies on both dredged material placed directly from O&M dredging and material obtained from existing dredged material source sites, implementation of Alternative 6 would potentially result in effects on wildlife species that would be greater than Alternative 2 because of the larger construction footprint.

Short-term Effects to Special Status Bird and Bat Species

Noise, vibration, visual, and proximity-related disturbances associated with construction could adversely affect special status bird and bat species if they are nesting on or adjacent to the restoration site and dredged material source sites during construction. Since construction would occur in the August 1 through October 31 time period outside of the spring nesting season, it is unlikely that nesting birds would be present. However, if individuals of these species nest during the construction period, construction disturbances could cause them to abandon their nests or young. The breeding success of these species could be reduced if disturbances reduce the ability of adults to properly care for their young. Because Alternative 6 has a larger construction footprint than Alternative 2, the magnitude of potential adverse effects to nesting birds is greater. Therefore this impact is considered significant. To reduce this impact to a less-than-significant level, mitigation measures would be implemented as described in Section 5.3.5 below.

Burrowing owls could at the source material sites. Construction activities, including grading and excavation activities at the source material sites could result in nesting failure, death of nestlings, or loss of eggs. Effects on burrowing owls could be significant, if they are present at these sites. Prior to initiation of any excavation activities at the source material sites, a preconstruction survey for burrowing owls would be completed, in accordance with CDFW guidelines described in the Staff Report on Burrowing Owl Mitigation. If no burrowing owls are located during these surveys, then effects to burrowing owls would be less than significant, and no mitigation would be required. If burrowing owls are located on or immediately adjacent to the site, then coordination would occur with CDFW to determine the proper measures that would need to be implemented to ensure that burrowing owls are not impacted by the project. Potential mitigation measures that could be implemented are discussed in Section 5.3.5 below.

Burrowing owls could be present at the source material sites. If owls are present construction activities, including grading and excavation could result in nesting failure, death of nestlings, or loss of eggs. Effects on burrowing owls could be significant, if they are present at

these sites. Prior to initiation of any excavation activities at the source material sites, a preconstruction survey for burrowing owls would be completed, in accordance with CDFW guidelines described in the Staff Report on Burrowing Owl Mitigation. If no burrowing owls are located during these surveys, then no effect would occur and no mitigation would be required. If burrowing owls are located on or immediately adjacent to the site, coordination would occur with CDFW to determine the proper measures needed to be implemented to ensure that burrowing owls are not impacted by the project. Potential mitigation measures are discussed in Section 5.3.5 below.

The increase of primary productivity from new intertidal marsh could benefit burrowing owls in the vicinity of the project. Burrowing owls tend to be opportunistic feeders, consuming numerous insects (arthropods, beetles and grasshoppers, etc). The newly developed intertidal marshes would further support the local food chain.

Construction activities have the potential to result in direct impacts to western red bat and the pallid bat. Though construction activities are restricted to a localized area and tree removal or trimming would not occur at the restoration sites, one or more trees may be removed at the source material sites resulting in direct disturbance or mortality to western red bat maternity roosts. Indirect impacts to western bat maternity roosts could also occur from noise and vibration caused by construction activity near maternity roosts. Impacts to the western red bat would be considered significant; however, implementation of the mitigation measures described in Section 5.3.5 below would reduce impacts to this species to a less-than-significant level.

Mudflats and shallow water (less than 6 inches deep) are important foraging and resting habitat areas for shorebirds. The project would initially create mudflat habitat by the placement of dredged material. The mudflats would then gradually convert to intertidal marsh habitat as vegetation becomes established. The benthic organisms that colonize these areas would become prey for shorebirds. This impact would be beneficial to migratory birds. The intertidal marsh habitat may provide suitable nesting habitat for tricolored blackbird.

Long-term Effects to Special Status Reptiles and Amphibians

The creation of intertidal marsh along the northern periphery of Big Break adjacent to Jersey Island and at Little Franks Tract could result in long-term benefits to several special-status species. Because significantly more intertidal marsh habitat is created, Alternative 6 would result in greater benefits to wildlife than Alternative 2. The intertidal marsh habitat would provide slower moving aquatic habitat and cover suitable for western pond turtles and giant garter snakes.

Much of the study area is unlikely to provide giant garter snake aquatic habitat, because the giant garter snake is typically absent from larger rivers and other water bodies that support introduced populations of large predatory fish. As a result, the snake is unlikely to be present at Big Break or Little Franks Tract. Short-term and long-term effects on the snake from construction activities within the restoration areas are therefore unlikely.

Supporting aquatic habitat has a greater potential to occur in areas adjacent to the source material sites or in the areas where the pipelines would be installed. These areas may include drainage ditches and irrigation canals. Suitable habitat may be impacted by project construction within 200 feet of these features. Direct impacts include the removal of basking sites necessary for thermoregulation, and destruction of burrows or crevices that provide hibernacula. Individual snakes may be killed or hurt by moving construction equipment and personnel. Construction disturbance may also cause giant garter snakes to move into areas where they have a greater chance of being killed by vehicles (i.e., roads) or predation. Because there are only a few documented sightings of giant garter snake in the general area, there is a low potential for injury or mortality of the snake during construction activities.

USACE has initiated consultation with USFWS on potential effects to the giant garter snake from construction of the proposed alternatives. USACE has determined that the proposed alternatives are not likely to adversely affect the giant garter snake. In the event that project construction would occur within 200 feet of any drainage ditches or irrigation canals, the standard mitigation measures, as detailed in Section 5.3.5 below, would be implemented. With the implementation of these measures, any effects to giant garter snake would be less than significant.

5.3.5 Mitigation

Special Status Fish Species

The following measures would be implemented to reduce short-term impacts to special status fish species, including Delta smelt, from construction of the proposed alternatives:

- During construction, stockpiling of construction materials, portable equipment, vehicles, and supplies shall be restricted to the designated construction staging areas.
- A qualified biologist shall provide worker environmental awareness training to contractors and construction crews regarding all special status fish species known to potentially occur near the construction sites.
- A representative (onsite monitor) shall be appointed by USACE to be the point of contact for any worker who observes a dead, injured, or entrapped special status fish. Dead or injured fish shall be photographed and the photographs provided to the USACE, NMFS, and USFWS. If a live specimen is captured in good condition, and a positive identification cannot be made in the field because of size or lack of other distinguishing characteristics, the fish shall be immediately returned to the river downstream of the construction site.

Special Status Bird Species

USACE will conduct surveys to locate nest sites of the above mentioned species in suitable breeding habitats in the spring of each construction year. Surveys will be conducted by a qualified biologist using survey methods approved by USFWS. Survey results will be submitted to USFWS before construction is initiated. If nests or young of these species are not located, construction may proceed. If nest sites or young are located, USACE will consult with USFWS and CDFW to determine what mitigation measures could be implemented to avoid or reduce potential disturbance-related impacts to these species. Measures could include a no-disturbance buffer zone established around the nest site. The width of the buffer zone would be determined by a qualified biologist in coordination with the USFWS. No construction activities would occur within the buffer zone. The buffer zone would be maintained until the young have fledged (as determined by a qualified biologist).

Burrowing Owl

Prior to initiation of any excavation activities at the source material sites, a preconstruction survey for burrowing owls would be completed, in accordance with CDFW guidelines described in the Staff Report on Burrowing Owl Mitigation. If no burrowing owls are located during these surveys, then effects to burrowing owls would be less than significant, and no mitigation would be required. If burrowing owls are located on or immediately adjacent to the site, then coordination would occur with CDFW to determine the proper measures that would need to be implemented to ensure that burrowing owls are not impacted by the project. Potential mitigation measures that could be implemented include:

- A CDFW-qualified biologist shall conduct appropriate surveys at and around material source sites, to determine the presence/absence of burrowing owls. At least one survey shall be conducted no more than one week prior to the onset of any construction activity.
- A 250-foot buffer, within which no new activity would be permissible, would be maintained between project activities and nesting burrowing owls. This protected area would remain in effect until August 31, or at the CDFW discretion, until the young owls are foraging independently.
- No burrowing owls could be evicted from burrows during the nesting season (February 1 through August 31). Eviction outside the nesting season could be permitted pending evaluation of eviction plans and receipt of formal written approval from CDFW authorizing the eviction.
- If accidental take (disturbance, injury, or death of owls) occurs, the DFG would be notified immediately.
- Conduct mandatory worker awareness training for construction personnel.

Special Status Bat Species

The following measures would be implemented to reduce short-term impacts to special status bat species from construction of the proposed alternatives:

- A qualified biologist would examine trees to be removed or trimmed for suitable bat roosting habitat before removal or trimming. High quality features (large tree cavities, basal hollows, loose or peeling bark, larger snags, palm trees, with intact thatch, etc.) would be identified and the area around these features would be searched for bats, and bat signs (guano, culled insect parts, staining, etc.). If suitable habitat and/or bat signs are detected, biologists would conduct evening visual emergence surveys from half an hour before sunset to 1 to 2 hours after sunset for a minimum of 2 nights. The survey shall be conducted no more than one week prior to the onset of any construction activity. If no bat roosts are located, no further mitigation is necessary.
- If active roosting western red bats are identified within the survey area, CDFW shall be immediately notified to determine what mitigation measures could be implemented to avoid or reduce potential disturbance-related impacts to these species.

Special Status Reptile and Amphibian Species

The following mitigation measures are proposed for the protection of the giant garter snake and its aquatic habitat:

- Construction activities would be kept to a minimum of 200 feet from the banks of giant garter snake aquatic habitat.
- The construction area will be surveyed for giant garter snakes 24 hours prior to construction activities by a qualified biologist. Survey of the project area would be repeated if a lapse in construction activity of two weeks or greater occurs. If a giant garter snake is encountered during construction, then activities would cease until appropriate corrective measures have been completed or it has been determined that the snake would not be harmed.
- In order to prevent harm to giant garter snake, construction activities will be prohibited within a 200-foot buffer zone around the small pond, which is situated on the southern boundary of the Scour Pond site, is appropriate. In addition, prior to commencing construction activities, the Scour Pond site shall be surveyed for giant garter snake by a qualified biologist. If a giant garter snake is encountered, then all construction activities must cease until corrective measures are taken and the site is resurveyed.

5.4 Water Quality

This section evaluates the effects of the proposed alternatives on the water resources, surface and ground water quality conditions, and jurisdictional wetlands in the project area. Qualitative effects on water quality were estimated based on construction practices and materials, location, and duration of construction. Standard pollution prevention measures including erosion and sediment control measures, proper control of non-stormwater discharges, and hazardous spill prevention and response measures would be implemented as part of the project design.

Jurisdictional wetlands are located throughout the Delta area. A wetlands delineation has not been performed for this project area, however, ground surveys have been conducted to determine the potential for wetlands. The area where intertidal marsh restoration will occur in open waters and not wetlands so no affects to wetlands would occur at the placement sites. The source material sites are existing piles of material that were placed in areas that are not considered wetlands. There are areas adjacent to the source material sites that could potentially be mapped as jurisdictional wetlands, however, work will not be allowed in these areas for either removal of material or pipeline system. No fill material will be placed in drainage ditches. Because the project would not impact jurisdictional wetlands it is not discussed further in this section.

5.4.1 Methodology and Basis of Significance

Methodology

Effects on water quality resources were analyzed qualitatively based on existing water quality monitoring data Coordination with the Central Valley Regional Water Quality Control Board (CVRWQCB) would occur prior to placement to determine if additional testing would be required. This coordination would evaluate the source material for hazardous substance thresholds as applied to in-water fill material and determine if project placement activities would affect water quality.

Basis of Significance

Adverse effects on water quality were considered significant if implementation of an alternative plan would:

- Substantially degrade surface water quality such that it would violate criteria or objectives identified in the CVRWQCB basin plan or otherwise substantially degrade water quality to the detriment of beneficial uses.
- Adversely affect salinity flow patterns at water conveyance facilities (affect the X2 line).

- Disturb existing channel banks, channel beds, or levees to the extent that erosion and sedimentation could be accelerated.
- Remove, fill, or substantially disturb a jurisdictional wetland.

5.4.2 Alternative 1 – No Action

The no action alternative assumes that no action would be taken by the Corps to restore intertidal marsh habitat to the flooded islands. The flooded islands would remain in their current state and water quality would not change from current conditions. However, features associated with the BDCP and other authorized water purveyance projects could still be constructed; any effects on water quality associated with those projects would still occur.

5.4.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980.

At the restoration site silt curtains, hay bales, or similar tools would be used to keep the dredged material contained within the placement zone and to prevent leakage into adjacent waterways. USACE is currently working the CVRWQCB to obtain Clean Water Act Section 401 Certification. The conditions set forth in the certification would be followed to prevent adverse affects to water quality. Water quality monitoring would occur during construction activities to ensure that the project is in compliance with 401 Certification conditions. Similar activities currently being performed by USACE in the Delta (dredging) were coordinated with the CVRWQCB and a Section 401 Certification was obtained. Conditions of Section 401 Certifications for similar projects included monitoring to comply with the Basin Plan, reporting monitoring results, and maintaining low turbidity, pH, and dissolved oxygen levels.

Coordination with the CVRWQCB would establish construction requirements to prevent violation of water quality standards set forth in the Basin Plan and to ensure that water quality is not substantially degraded through project activities. Standard dredging protocol for testing of material prior to dredging activities will be followed. This protocol includes the testing of materials before dredging begins to determine if they meet standards for placement in water and upland areas. If material being dredged meets the criteria, it would be used to create the intertidal marsh habitat. If material does not meet the water quality standards, it would be processed under the dredging standards and not used for this project. The placement of material to restore intertidal marsh habitat at Big Break would not affect salinity in the study area. No channel banks, channel beds, or levees would be altered in a way that would cause additional

erosion. As a result, effects to water quality from implementation of Alternative 2 would be less than significant, with the implementation of the conditions of the Section 401 Certification.

5.4.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from the source material sites is analyzed below.

A pipe system would be constructed to transport soil from the source material site to Big Break and Little Franks Tract to create intertidal marsh habitat. The pipe system under Alternative 6 would be the same as the one used for O&M dredging. The pipe system would be constructed to prevent the transported material from entering the waterways. Monitoring of the pipe would be required during all pumping activities. The system is pressurized with shutoff capabilities in the event of an unexpected leak or break in the pipe.

Material from the source material sites has been tested during the dredging process and met all the standards for placement in upland areas. Coordination with the Central Valley RWQCB is on-going and may require additional testing of the materials prior to use for intertidal marsh restoration. If testing is required, it would occur at the source materials sites. Only material that meets RWQCB standards for in-water placement would be used for this project. Only materials that meet approval for placement would be used and material would be placed in a manner that it would not migrate into other areas, using measures such as turbidity curtains and sacrificial hay bales to control sediment plumes. As a result of the implementation of these measures, impacts to water quality are anticipated to be less than significant, with mitigation.

5.4.5 Mitigation

The contractor would be required to prepare a National Pollution Discharge Elimination System (NPDES) permit and prepare and implement Storm Water Pollution Prevention Plan (SWPPP) and an in-water work plan. The SWPPP and in-water work plan details actions that would be taken during construction to reduce the risk of discharge into waterway and mitigation measures that would be taken in the event of an unforeseen spill. The Section 401 Certification permit is provided by the Central Valley RWQCB and will include requirements for any testing and monitoring for the project. The conditions set forth in the permit would be followed to reduce impacts to less than significant. The exact conditions are unknown as USACE is still in

the process of working with the Central Valley RWQCB for certification. By implementing the conditions and requirements set forth in the applicable Section 401 Certification no significant impacts to water quality are likely during construction of either alternative.

5.5 Air Quality

This section evaluates the effects of the proposed alternatives on air quality in the project vicinity. Both construction and operation emissions were estimated and then compared with Federal, State, and local air quality criteria for the area. Based on the results of the comparison, best management practices and mitigation measures are identified to offset and/or reduce air quality emissions from the project. The air quality project area encompasses the following air basins: Sacramento Metropolitan Air Quality Management District (SMAQMD) and the Bay Area Air Quality Management District (BAAQMD).

5.5.1 Methodology and Basis of Significance

Methodology

To complete the analysis, information was collected on projected construction activities, duration, and timing, equipment use, and activities for each construction year. Emissions associated with vehicle exhaust for employee commute vehicles and delivery trucks were estimated using SMAQMD's Road Construction Emission Model Version 7.1.5, (Appendix I). Construction equipment usage from similar projects was analyzed to estimate daily and annual exhaust emissions. Emissions are considered significant if emissions exceed the thresholds established by the applicable air quality agencies. Modeling assumptions for each project alternative and methodology are provided in Appendix I.

The following emission sources and activities were analyzed:

- On-site construction off-road equipment emissions (all criteria pollutants) – based on OFFROAD2011 emission factors and estimated equipment schedules.
- On-site pickup trucks (all criteria pollutants) – based on EMFAC2011 models and estimated vehicle miles traveled.
- Off-site worker vehicle emissions (all criteria pollutants) – based on EMFAC2011 models and estimated vehicle miles traveled.
- On-site pickup trucks and off-site worker vehicles entrained fugitive dust emissions for paved and unpaved road entrained dust (PM_{10} and $PM_{2.5}$) – based on AP-42 methodology and estimated vehicle miles traveled.

Basis of Significance

Adverse effects on air quality were considered significant if implementation of an alternative plan would:

- Conflict with or obstruct implementation of an applicable air quality plan.
- Violate any local or State air quality management district CEQA standard or contributes substantially to an existing or projected air quality violation.
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project is in nonattainment under applicable Federal or state ambient air quality standards (including releasing emissions which exceed quantitative thresholds for ozone precursors).
- Expose sensitive receptors to substantial pollutant concentrations.
- Create objectionable odors affecting a substantial number of people.
- Generate greenhouse gas (GHG) emissions that exceed thresholds.
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

State Implementation Plan and General Conformity De Minimis Thresholds

Federal actions need to demonstrate conformity to any SIPs of the regional air basin. Each action must be reviewed to determine whether it: 1) qualifies for an exemption listed in the General Conformity Rule (GCR); 2) results in emissions that are below GCR de minimis emissions thresholds; or 3) would produce emissions above the GCR de minimis thresholds applicable to the specific area. The General Conformity de minimis levels for this project are shown below (Table 5-2). These thresholds were applied to the project's estimated emissions and used to determine effect significance as detailed below.

Table 5-2. General Conformity De Minimis Thresholds.

Pollutant	Federal Attainment Status	Threshold Values (tons/yr)[1]
Ozone precursor (NO_X)	Nonattainment: Severe	25
Ozone precursor (ROGs)	Nonattainment: Severe	25
CO	Maintenance	100
SO_2	Attainment	N/A
$PM_{2.5}$	Nonattainment	100
PM_{10}	Nonattainment: Moderate	100
Pb	No designation	N/A

Source: USEPA 2011

[1] Thresholds from 40 CFR Parts 51 and 93.

SMAQMD Thresholds

Relevant SMAQMD thresholds of significance are summarized below. The project would not include any operational and maintenance activities that generate emissions, only thresholds applicable to construction are presented.

The SMAQMD has established an emission significance threshold for NO_X from construction activities. If the project construction emissions exceed the daily NO_X threshold of 85 pounds per day (lbs/day) after on-site mitigation, the project applicant must pay mitigation fees to offset any excess emissions. The SMAQMD currently assesses mitigation fees of $17,080 per ton of NO_X but these fees may change annually depending on updates to the applicable guidance.

For construction projects disturbing more than a maximum daily area of 15 acres, PM_{10} CAAQS are applied as thresholds except for areas with existing or projected nonattainment designations for the PM_{10} CAAQS. Due to the SVAB's nonattainment designation, SMAQMD has determined that a project's emissions in the SVAB would be significant and considered substantial contributors if they equal or exceed 5 percent of the PM_{10} CAAQS. The substantial contribution thresholds of the PM_{10} CAAQS are 2.5 micrograms per cubic meter over 24 hours or more than 1 microgram per cubic meter averaged over a year project.

If a construction project implements SMAQMD's Basic Construction Emission Control Practices (SMAQMD 2011) and does not exceed a maximum daily disturbed area of 15 acres, SMAQMD does not consider a project to have the potential to exceed or contribute to the concentration-based threshold of significance for PM_{10}. In this situation, PM_{10} impacts are considered less-than-significant with incorporation of mitigation.

SMAQMD has also designated the CAAQS as construction thresholds for $PM_{2.5}$, CO, and SO_2. SMAQMD has not designated a construction threshold for ROG. The CAAQS thresholds for PM_{10}, $PM_{2.5}$, CO, and SO_2 are shown in Table 5-3. Because $PM_{2.5}$ is a subset of PM_{10}, SMAQMD assumes that construction projects that do not generate concentrations of PM_{10} that exceed the concentration-based threshold of significance would also be considered less-than-significant for $PM_{2.5}$ impacts. For other criteria pollutants, NO_X, SO_2, and CO, SMAQMD requires that the proximity of a project to sensitive receptors and the duration of emissions be used to determine whether concentrations need to be estimated (SMAQMD 2011). Because the project's emission sources would originate more than 500 feet from sensitive receptors, the project meets the CARB guidance distance and no further roadway-related air quality evaluation of pollutant concentrations is recommended (SMAQMD 2011).

Emissions generated by O&M dredging are analyzed in a separate NEPA document. Past and proposed O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below.

BAAQMD Thresholds

The BAAQMD thresholds of significance were obtained from the CEQA Guide to Air Quality Assessment, which lists a threshold of 54 pounds per day or 10 tons per year for ROG, NO_X, and $PM_{2.5}$ construction emissions and a PM_{10} threshold of 82 pounds per day or 15 tons per year (BAAQMD 2010). Table 5.3 shows the thresholds for criteria pollutants for the BAAQMD. There are no quantitative thresholds for construction dust emissions; instead, impacts are considered less than significant if the BAAQMD Best Management Practices are employed to control dust during construction activities, including excavation.

The BAAQMD TAC threshold is an increased cancer risk of more than 10 in 1,000,000 for a person with maximum exposure potential and increased non-cancer risk of 1.0 Hazard Index (chronic or acute). The BAAQMD also has a concentration threshold of 0.3 μg/m3 for $PM_{2.5}$. These thresholds are applicable to both construction emissions and operations emissions. Unlike the volume-based thresholds for criteria air pollutants, the TAC thresholds are used for specific receptor locations when a risk analysis is required for specific project components, such as stationary sources or the use of diesel-powered equipment, including construction equipment. There are no sensitive receptors located in the vicinity of the Delta Study alternatives, therefore there would be no impacts associated with TAC exposures due to implementation of this project.

The 2010 BAAQMD CEQA Guidelines recommend analyzing localized CO concentrations for projects that would increase traffic volumes at affected intersections to more than 44,000 vehicles per hour. However, given the minimal increase in vehicle trips due to newly required maintenance activities, the proposed project would not affect local CO concentrations during operations Therefore, CO concentrations have not been quantified in this analysis.

BAAQMD considers projects that exceed these criteria air pollutant standards also to result in a cumulatively considerable air quality impact upon the region. According to BAAQMD, no further cumulative analysis should be required beyond the analysis of whether a proposed project's impacts would contribute considerably to ambient levels of pollutants or GHGs. Analysis of effects from GHGs is included in the Climate Change section below (Section 5.6).

Table 5-3. SMAQMD and BAAQMD Thresholds for Criteria Pollutants.

	NO_X	**ROG**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**
SMAQMD Threshold	85	N/A	N/A	N/A	N/A	N/A
BAAQMD Threshold	54	54	82	54	N/A	N/A

Federal General Conformity Criteria

The USEPA developed the General Conformity Rule, which became effective on January 31, 1994, to implement Section 176c of the Federal Clean Air Act. The underlying principle of the General Conformity Rule is that Federal actions must not cause or contribute to any violation

of a NAAQS. A conformity determination is required for each pollutant where the total of direct and indirect emissions caused by a Federal action in a nonattainment area could exceed de minimis threshold levels listed in the General Conformity Rule (40 CFR 93.153). If the total direct emissions associated with the project are below the de minimis levels indicated in Table 5-2, general conformity requirements do not apply, and the project is considered in conformity and would not result in an adverse effect.

Because the project region is in attainment for the criteria pollutants indicated in Table 5-4 except ozone (serious) and PM_{10} (moderate), a conformity assessment for ozone and PM_{10} must be completed. That assessment will evaluate whether the project's construction or operational emissions would exceed 25 tons per year of ROG or NO_X, or 100 tons per year of PM_{10}. The Sacramento area is currently a serious non-attainment area for the Federal 8-hour ozone standards; therefore, the 50 tons per year threshold applies for ozone precursors.

Table 5-4 Emission Rates for Criteria Pollutants in Nonattainment Areas.

Pollutant	**Emission Rate** (tons per year)
Ozone (Volatile organic compounds or NO_X)	
Serious nonattainment areas	50
Severe nonattainment areas	25
Extreme nonattainment areas	10
Other ozone nonattainment areas outside an ozone transport region	100
Marginal and moderate nonattainment areas inside an ozone transport region	
Volatile organic compounds	50
NO_X	100
CO: All nonattainment areas	100
SO_2 or NO_2: All nonattainment areas	100
PM_{10}	
Moderate nonattainment areas	100
Serious nonattainment areas	70
Pb: All nonattainment areas	25

Note: De minimis threshold levels for conformity applicability analysis.
Source: 40 CFR 51.853

Construction Schedule

Though the project has not been approved and funded. A tentative project construction schedule has been created for modeling and cost estimating purposes. The schedule applies to both alternatives. Alternative 2 requires O&M dredging source materials for years 2018 through 2022. Alternative 6 includes the Alternative 2 schedule in conjunction with the pumping schedule of stockpiled materials to their respective restoration sites. The tentative schedule is shown on Table 5-5 below.

Table 5-5. Tentative Construction Schedule.

Restoration Site	Material Source*	Year
Big Break Increment 1	O&M Dredging	2018-2022
Big Break Increment 2	McCormick	2019
Big Break Increment 3	Scour Pond	2020
Big Break Increment 5	Decker Island	2021
Little Franks Tract Increment 1	Bradford Island	2022

*In the air quality analysis below, emissions are displayed by material source and construction year rather than by restoration increment.

5.5.2 Alternative 1 – No Action

The no action alternative assumes that no action would be taken by the Corps to restore intertidal marsh habitat to the flooded islands and the flooded islands would remain in their current state. Consequently, no construction emissions would result, and there would be no direct short-term air quality effects as a result of this alternative. However, features associated with the BDCP and other authorized water purveyance projects could still be constructed and any effects on air quality associated with those projects would still occur.

5.5.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980.

Equipment exhaust emissions would be generated by worker vehicles, marine, pumping, and placement equipment. Details of the equipment types or construction activities required for each project activity, as well as the resulting criteria pollutant emissions from these equipment types or construction activities, are provided in Table 5.7. The primary sources of each criteria pollutant from this alternative's activities are:

- NO_X: placement activities, marine vessels; and
- ROG and CO: placement activities, marine vessels.

Table 5-6 describes the potential emission sources for Alternative 2.

Table 5-6. Alternative 2 Emission Sources.

Emission Source	Alternative 2 Pumping/Placement of Dredge Material
Pumping and Placement	Placement of dredged material at Big Break
Employee Commute Trips Per Contract Area	12 employee trips per day, 20 miles each way
Combustion Engine Construction Equipment	Generators (2) Water pumps (1) Work Boats (2)

In considering the potential effects associated with Alternative 2, the following considerations are incorporated into this analysis from the O&M dredging:

- O&M in 2018 would be conducted in a manner consistent with the current dredging operation, with equipment and BMPs being gradually upgraded over time, as necessary.
- Dredging and pumping for Alternative 2 would occur in the same manner as current O&M dredging.
- No additional pumps would be required for Alternative 2 beyond what is currently being used for O&M dredging.
- No additional boats would be required beyond what is currently being used for O&M dredging
- Current O&M dredging requires additional earthwork to prepare and manage the dredged material placement sites that would not occur during construction of Alternative 2. This would include the use of land-based equipment such as dozers, scrapers, and loaders, which would generate additional levels of criteria pollutants that would not occur as a part of Alternative 2.

Based on the assumptions listed above, as well as the equipment list provided in Table 5-6, Alternative 2 would generate lower emissions of criteria pollutants than current O&M dredging. As a result, construction of Alternative 2 would generate beneficial effects to air quality, because it would prevent the pollution that would otherwise occur during standard dredging operations. As a result, there would be no impact to air quality under Alternative 2 and no additional modeling needs to occur.

5.5.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below.

As discussed above, Alternative 2 would have no effects on air quality; therefore, the work proposed under Alternative 2 is not included in the analysis below. Each construction year would include the placement of material from O&M dredging at Big Break as a part of standard annual O&M.

Alternative 6 includes actions in both Sacramento and Contra Costa Counties. Big Break and Little Franks Tract are both located in Contra Costa County, as is the Bradford Island dredged material placement site. The source material sites for Big Break increments 2, 3, and 5 are located in Sacramento County. Therefore, air quality emissions in the analysis below are compared to the thresholds for both SMAQMD and BAAQMD.

Alternative 6 criteria pollutant construction equipment exhaust emissions include PM_{10}, $PM_{2.5}$, NO_X, ROG, CO_2, and CO. Equipment exhaust emissions would be generated by worker vehicles, marine vessels, pumping, loading, and placement equipment. Details of the equipment types or construction activities required for each project activity, as well as the resulting criteria pollutant emissions from these equipment types or construction activities, are provided in Table 5.9. The primary sources of each criteria pollutant from this alternative's activities are:

- NO_X: Pumping, placement activities, marine and off-road equipment;
- ROG and CO: placement activities, marine;
- PM_{10} and $PM_{2.5}$: off-road equipment (at existing dry land placement sites)

Emissions estimates for Alternative 6 represent a worst case scenario for the purpose of estimating potential mitigation costs. Actual emissions estimates would be calculated after the award of contract. The contractor and air quality district would work together to calculate more precise emissions based on the contractors proposed project equipment inventory. Table 5-9 describes the potential emission sources for Alternative 6.

Table 5-7. Alternative 6 Emission Sources.

Emission Source	Alternative 6 Pumping/Placement of Dredge
Pumping and Placement	Placement of dredged material at Big Break Pumping of stockpiled materials from McCormack, Bradford, Scour Pit, and Decker source sites to Big Break and Little Franks Tract. Placement at Big Break and Little Franks Tract
Employee Commute Trips Per Contract Area	12 employee trips per day, 20 miles each way
Combustion Engine Construction Equipment	Generators (3) (for conveyers, water pumps, and slurry hoppers) Pump (2) Dozer (1) Grader (2) Loader (2) Work Boats (2)

Alternative 6 estimated daily criteria pollutant emissions are provided in Tables 5-8 through 5-11 for construction in years 2019 through 2022. Construction year 2018 is not discussed below, as the only proposed work in 2018 is the annual O&M dredging work at Big Break. The estimated emissions for the remainder of the construction years are presented below and compared to the applicable local air district's thresholds. In addition, a 20 percent reduction is shown from the use of the required SMAQMD Best Construction Emission Control Practices and BAAQMD Basic Construction Mitigation Measures.

Table 5-8. Alternative 6 2019 Air Emissions from Construction Activities.

	Criteria Pollutant Emissions in lbs/day					
	NO_X	**ROG**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**
2019 McCormack Island to Big Break	63.2	6.2	22.9	6.8	44.6	8,863.8
2019 McCormack Island to Big Break after Reductions for Equipment (20% NO_X)	-12.6	0	0	0	0	0
Total Estimated Emissions for 2019 After Mitigation	50.5	6.2	22.9	6.8	44.6	8,863.8
2019 BAAQMD Thresholds	54	54	54	82	N/A	N/A
2019 SMAQMD Thresholds	85	N/A	N/A	N/A	N/A	N/A
Exceed Thresholds	**No**	**No**	**No**	**No**	**No**	**No**

Table 5-9. Alternative 6 2020 Air Emissions from Construction Activities.

	Criteria Pollutant Emissions in lbs/day					
	NO_X	**ROG**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**
2020 Scour Pond to Big Break	62.7	6.3	22.9	6.8	49.0	9,600.7
2020 Scour Pond to Big Break after Reductions for Equipment (20% NO_X)	-12.5	0	0	0	0	0
Total Estimated Emissions for 2020 After Mitigation	50.2	6.3	22.9	6.8	49.0	9,600.7
2020 BAAQMD Thresholds	54	54	54	82	N/A	N/A
2020 SMAQMD Thresholds	85	N/A	N/A	N/A	N/A	N/A
Exceed Thresholds	**No**	**No**	**No**	**No**	**No**	**No**

Table 5-10. Alternative 6 2021 Air Emissions from Construction Activities.

	Criteria Pollutant Emissions in lbs/day					
	NO_X	**ROG**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**
2021 Decker Island to Big Break	55.5	5.6	22.5.	6.4	48.5	9,602.2
2021 Decker Island to Big Break after Reductions for Equipment (20% NO_X)	-11.1	0	0	0	0	0
Total Estimated Emissions for 2021 After Mitigation	44.4	5.6	22.5.	6.4	48.5	9,602.2
2021 BAAQMD Thresholds	54	54	54	82	N/A	N/A
2021 SMAQMD Thresholds	85	N/A	N/A	N/A	N/A	N/A
Exceed Thresholds	**No**	**No**	**No**	**No**	**No**	**No**

Table 5-11. Alternative 6 2022 Air Emissions from Construction Activities.

	Criteria Pollutant Emissions in lbs/day					
	NO_X	**ROG**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**
2022 Bradford Island to Little Franks Tract	47.9	5.0	22.1	6.1	48.4	9,606.4
2022 Bradford Island to Little Franks Tract after Reductions for Equipment (20% NOX)	-9.58	0	0	0	0	0
Total Estimated Emissions for 2022 After Mitigation	38.32	5.0	22.1	6.1	48.4	9,606.4
2022 BAAQMD Thresholds	54	54	54	82	N/A	N/A
Exceed Thresholds	**No**	**No**	**No**	**No**	**No**	**No**

Alternative 6 would increase the emissions of criteria pollutants in the study area. For construction years 2019 through 2021, these emissions would exceed the BAAQMD threshold for NO_X. All construction years would be below the SMAQMD thresholds. However, with the implementation of the BAAQMD Basic Construction Mitigation Measures, Alternative 6 would not exceed any of the local thresholds.

Table 5-12 presents the annual emissions by construction year in tons per year. Alternative 6 unmitigated emissions would comply with the Federal general conformity thresholds for all criteria pollutants.

Table 5-12. Alternative 6 Unmitigated Annual Construction Emissions.

Project Component	Maximum Emissions, tons/year					
	NO_X	**ROG**	**PM_{10}**	**$PM_{2.5}$**	**CO**	**CO_2**
2019 Dredging & Placement Work	1.6	0.2	0.7	0.2	1.6	317.0
2020 Dredging & Placement Work	2.1	0.2	0.8	0.2	1.6	316.8
2021 Dredging & Placement Work	1.8	0.2	0.7	0.2	1.6	316.9
2022 Dredging & Placement Work	1.6	0.2	0.7	0.2	1.6	317.0
Federal de minimus Threshold	25	25	100	100	100	N/A

Alternative 6's implementation of the required BAAQMD Basic Construction Mitigation Measures and exhaust emission mitigation measures would reduce the NO_X emissions associated with the restoration of intertidal marsh habitat at Big Break and Little Franks Tract and the excavation of the Bradford Island dredged material placement site to below the thresholds. In addition, the required SMAQMD Best Construction Emission Control Practices would also be implemented to further reduce construction emissions associated with the excavation of the Sacramento County source material sites. Therefore, Alternative 6 construction-related emissions would be less than significant with mitigation. The required BAAQMD Basic Construction Mitigation Measures and the SMAQMD Best Construction Emission Control Practices are presented in Section 5.5.5 below.

5.5.5 Mitigation

Based on the estimates shown in Tables 5-8 through 5-11, construction would result in the temporary increase in emissions of criteria pollutants. In order to reduce the emissions to less than significant, the contractor would be required to implement the BAAQMD Basic Construction Mitigation Measures and the SMAQMD Basic Construction Emissions Control Practices listed below. In addition, USACE would require the project's contractors to implement the following BMPs to further reduce the emissions from the project. The Delta Study would not exceed any local air quality thresholds or the Federal de minimis thresholds.

BAAQMD Basic Construction Mitigation Measures

In accordance with BAAQMD guidelines, all proposed projects should implement the Basic Construction Mitigation Measures listed below whether or not construction-related emissions exceed applicable thresholds.

- All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day.
- All haul trucks transporting soil, sand, or other loose material off-site shall be covered.
- All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads shall be limited to 15 mph.
- All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
- Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.
- All construction equipment shall be maintained and properly tuned in accordance with manufacturer‘s specifications. All equipment shall be checked by a certified visible emissions evaluator.
- Post a publicly visible sign with the telephone number and person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District‘s phone number shall also be visible to ensure compliance with applicable regulations.

SMAQMD’s Basic Construction Emissions Control Practices

The SMAQMD requires construction projects to implement basic construction emission control practices to control fugitive dust and diesel exhaust emissions (SMAQMD 2011). USACE would implement the following measures for the project:

- Water all exposed surfaces twice daily. Exposed surfaces include but are not limited to: soil piles, graded areas, unpaved parking areas, staging areas, and access roads.
- Cover or maintain at least two feet of free board space on haul trucks transporting soil, sand, or other loose material on the site.

- Use wet power vacuum street sweepers to remove any visible trackout mud or dirt from adjacent public roads at least once a day. Use of dry power sweeping is prohibited.
- Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to 5 minutes [required by California Code of Regulations, Title 13, sections 2449(d)(3) and 2485]. Provide clear signage that posts this requirement for workers at the site entrances.
- Maintain all construction equipment in proper working condition according to the manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.

Fugitive Dust Emission Mitigation Measures

Fugitive dust mitigation would require the use of adequate measures during each construction activity and would include frequent water applications or application of soil additives, control of vehicle access, and vehicle speed restrictions. USACE would implement the dust mitigation measures listed below.

- Limit vehicle speeds on unpaved roads to 15 miles per hour, or
- Water at least every two hours of active construction activities or sufficiently often to keep the area adequately wetted.
- Remove any visible track-out from a paved public road at any location where vehicles exit the work site: this removal effort shall be accomplished using wet sweeping of a HEPA filter-equipped vacuum device daily.
- Suspend any excavation operations when wind speeds are high enough to result in dust emissions across the property line, despite the application of dust mitigation measures.
- To mitigate stockpile handling and stockpile wind erosion fugitive dust emissions, active storage pile would be kept adequately wetted using wet suppression controls.
- To mitigate fugitive dust emissions from storage piles that would remain inactive for more than seven days, USACE would ensure implementation of one or more of the following measures:
    - Wet suppression controls
    - Cover with tarp(s) or vegetative cover, and/or
    - Install wind barriers across open areas.

Exhaust Emission Mitigation Measures

The project will ensure that emissions from all off-road diesel powered equipment used on the project site do not exceed 40% opacity for more than three minutes in any one hour. Any equipment found to exceed 40 percent opacity (or Ringelmann 2.0) shall be repaired immediately. Non-compliant equipment will be documented and a summary provided to USACE and SMAQMD monthly. A visual survey of all in-operation equipment shall be made at least weekly, and a monthly summary of the visual survey results shall be submitted throughout the duration of the project, except that the monthly summary shall not be required for any 30-day period in which no construction activity occurs. The monthly summary shall include the quantity and type of vehicles surveyed as well as the dates of each survey.

Use of Electric Equipment

Construction equipment powered by electricity, rather than diesel fuel, eliminates criteria pollutant emissions from diesel combustion.

Mitigation Fees

The Contractor would provide payment of the appropriate SMAQMD and BAAQMD required NO_X mitigation fee to offset the project's NO_X emissions if they exceed SMAQMD's threshold of 85 lbs/day and BAAQMD threshold of 54 lbs/day.

5.6 Climate Change

This section identifies the basis of significance for impacts to climate change, discusses how these criteria are determined for NEPA, provides specific emissions standards, thresholds, or other measurements for the various pollutants and, as necessary, applicable mitigation measures.

5.6.1 Methodology and Basis of Significance

Methodology

The methods for evaluating impacts are intended to satisfy Federal and State requirements, including NEPA. As discussed in the air quality assessment (Section 5.2.4), emissions were estimated based on the type of equipment being used, the level of equipment activity, and the associated construction schedules.

Emission estimates for on-road vehicles were based on emission data from SMAQMD's Road Construction Emission Model Version 7.1.5 model for on and off-road vehicle emissions. Project marine construction equipment emissions (all criteria pollutants) were based on data from CARB's Harbor Craft Emissions Model.

In addition, the following four criteria were considered and incorporated into the GHG analysis:

- Is the design of the proposed project inherently energy efficient?
- Are all applicable BMPs that would reduce GHG emissions incorporated into the design of the proposed project?
- Would the proposed project implement or fund its fair share of a mitigation strategy designed to alleviate climate change?
- Would implementing the proposed project improve processes or efficiency, resulting in a net reduction of GHG emissions?

Basis of Significance

SMAQMD has not established thresholds for GHG emissions; instead, each project is evaluated on a case-by-case basis using the most up-to-date methods of calculation and analysis. The impacts of the proposed project alternatives related to climate change should be evaluating using the criteria listed below. According to CEQA Guidelines, the proposed project could result in significant impacts if it would:

- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment.
- Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.
- The following significance criteria will be used to determine the significance of GHG emissions from this project:
- If the relative amounts of GHG emissions resulting from implementation of the proposed project are substantial compared to emissions major facilities are required to report (25,000 CO_2e per year).
- If the proposed project has the potential to contribute to a lower carbon future.

No existing threshold levels for GHGs have been developed at the Federal level for NEPA projects. USEPA has established a reporting threshold of 25,000 metric tons of CO_2 that applies to most entities that emit more than 25,000 metric tons per year.

5.6.2 Alternative 1 – No Action

The no-action alternative assumes that no action would be taken by the Corps to restore intertidal marsh habitat to the flooded islands. The flooded islands would remain in their current state. Therefore, there would be no GHG emissions associated with construction activities under

the project. Similarly, there would be no long term operational (indirect) GHG emissions under this alternative.

5.6.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980.

GHG emissions would be emitted from the project due to fuel combustion from marine vessels and construction equipment, and workforce vehicles. Workers would commute from their homes to the construction site and park in one of the staging areas.

While the emissions associated with this alternative would not violate the GHG reporting threshold of 25,000 metric tons per year, these emissions would still contribute to the overall cumulative GHG emissions, as discussed in the cumulative analysis discussion below (Section 5.3). As a result, USACE would implement mitigation measures, as discussed below, to increase this alternative's energy efficiency and further reduce the GHG emissions from this alternative. Consequently, this alternative's GHG emissions, with mitigation, would be reduced from the estimated emission levels. Therefore, Alternative 2 construction-related GHG emissions would be less-than-significant with mitigation.

5.6.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below.

While the emissions associated with Alternative 6 would be greater than Alternative 2, the total emissions would not exceed the GHG reporting limit for stationary sources of 25,000 metric tons per year. While this reporting limit is not a formal threshold for construction projects, it offers a point of comparison to consider in climate change analyses.

The emissions associated with Alternative 6 would still contribute to the overall cumulative global GHG emissions, as discussed in the cumulative analysis discussion below (Section 5.10). As a result, USACE would implement mitigation measures, as discussed in Section 5.6.5 below, to increase this alternative's energy efficiency and further reduce GHG emissions from this alternative. Consequently, this alternative's GHG emissions, with mitigation, would be reduced from the estimated emission levels as much as practicable. Therefore, Alternative 2 construction-related GHG emissions would be less than significant with mitigation.

5.6.5 Mitigation

USACE would implement the following mitigation measure to reduce potential impacts to climate change:

- Improve fuel efficiency of construction equipment by minimizing idling time either by shutting equipment off when not in use or reducing the time of idling to no more than 3 minutes (5 minute limit is required by the state airborne toxics control measure [Title 13, sections 2449(d)(3) and 2485 of the California Code of Regulations]. Provide clear signage that posts this requirement for workers at the entrances to the site.

The following mitigation measures are relevant to impacts, but will likely not be required by USACE. However the selected contractor will be encouraged to implement these measures where practical:

- Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated.
- Train equipment operators in proper use of equipment.
- Use the proper equipment size for the job.
- Use equipment with new technologies (repowered engines, electric drive trains).
- Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines).
- Use a CARB approved low carbon fuel for construction equipment. (NO_X emissions from the use of low carbon fuel must be reviewed and increases mitigated.)
- Encourage and provide carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes.
- Use SmartWay certified trucks for deliveries and equipment transport.
- Develop a plan to efficiently use water for adequate dust control.

5.7 Transportation and Navigation

This section evaluates the construction-related effects of the alternatives on the transportation system and commercial navigation within the project area. This analysis considers short and long-term disruptions to traffic and shipping commerce.

5.7.1 Methodology and Basis of Significance

Methodology

This section evaluates the construction-related effects of the alternatives on roads and traffic in the study area. Also analyzed are affects to deep draft navigation during construction. This analysis considers short-term effects to navigation along the San Joaquin and Sacramento Deep Water Ship Channels.

Basis of Significance

Adverse effects on transportation were considered significant if implementation of an alternative plan would result in any of the following:

- Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system;
- Substantially increase hazards due to a design features or incompatible uses;
- Result in inadequate emergency access;

Adverse effects on navigation were considered significant if implementation of an alternative plan would result in any of the following:

- Disruptions to any deep water ship channel commerce activities;
- Increase or creation of safety hazards;
- Disruption of the DWSC O&M activities.

5.7.2 Alternative 1 – No Action

The no action alternative assumes that no action would be taken by the Corps to restore intertidal marsh habitat to the flooded islands. The flooded islands would remain in their current state. Alternative 1 would have no effects on existing transportation and navigation or related operations and maintenance in the project area.

5.7.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

Transportation

There would be no affects on transportation under this alternative because all of the work would be accomplished using piping along waterways and agricultural lands. Therefore no mitigation would be required.

Navigation

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. The location where placement would occur is not part of the navigation channel and therefore, no affects to navigation would occur under this alternative.

5.7.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below.

Transportation

Alternative 6 includes the pumping of the previously dredged material from Decker Island to Big Break. In order to pump the material to Big Break pipes would be placed across Highway 160, which is also the levee. Because Highway 160 is also the levee structure, degrading the levee to place the pipes even with the existing road is not feasible. Therefore, the piping would be placed across the road and plated with large steel sheets to allow for traffic to continue use of Highway 160. The pipes and steel plates would be installed during evening hours when traffic in this area is very minimal. Coordination with the California Department of Transportation (CalTrans) would occur prior to the installation of the pipes across the road. Additionally, the contractor would be required to obtain any required permits and approvals from

CalTrans. Piping would also be required from the Scour Pond to Big Break, however, it can be placed under the Antioch Bridge and would not affect traffic. The project would not result in a significant increase in traffic, as there is no hauling associated with the project. The completed project would not generate additional traffic. As a result, with the required coordination with CalTrans and by installing the pipelines over Highway 160 at night, this impact would be considered less than significant, and no additional mitigation would be required.

Navigation

Temporary pipeline crossing at the Stockton DWSC would be required to pump materials to Big Break from the source materials site. The pipeline would be submerged for the life of the project. Pipe segments would be weighted to the channel bottom at an elevation low enough to ensure that the top of the pipe would remain below the authorized channel depth in order to avoid impacts to commerce ships. A specialized marine craft with a crane would be required for the pipe weighting process. Temporary weighting would occur at the Decker Island to Sherman Island (Sacramento River), Sherman Island to Jersey Island (San Joaquin River), and Jersey Island to Big Break (Dutch Slough) crossings. Additional in-water pipelines would be floated along the channel edges for the duration of the project. The pipelines would be moved as necessary by tender boat crews for safety, vessel passage, and pumping logistic purposes.

Pipeline crossing the Stockton Deep Water Ship Channel would be placed in locations which would not impact the authorized channel depth. The contractor would be required to work with Coast Guard, Port of Stockton, and USACE representatives to determine proper channel bottom locations of temporary pipelines crossing based on recent sounding reports All marker buoys and safety requirements of the U.S. Coast Guard would be met. As a result, impacts to navigation from the piping of material would be less than significant with mitigation.

5.7.5 Mitigation

Transportation

The placement of steel plates over the pipe on Highway 160 would be included as part of the construction contract. A traffic control plan would be submitted to CalTrans for approval and any permits required would be obtained by the contractor. The traffic control plan would include measures taken to allow for emergency vehicle access during placement of the pipe and steel plates across Highway 160. This would reduce impacts to less than significant and no additional mitigation would be required.

Navigation

The anchored pipeline would remain in place and would not be moved for the duration of the project. The pipeline would be anchored so that it would not impact the authorized navigation channel. Because the pipeline would be placed so that ships can pass, no impacts to the navigation channel would occur and no mitigation is required.

5.8 Recreation

5.8.1 Methodology and Basis of Significance

Methodology

This section evaluates the construction-related effects of the alternatives on recreation resources. This analysis considers short-term recreation effects within the project area at Big Break and Little Franks Tract and discusses long-term beneficial effects to recreation. None of the alternatives would affect recreation associated with local marinas because access to these recreational facilities and opportunities would not be affected by implementation of any of the alternatives.

Basis of Significance

Adverse effects on recreation were considered significant if implementation of an alternative plan would:

- Substantially disrupt any institutionally recognized recreational facility or activity.
- Precludes existing recreational users from long-term use of existing recreation resources within and around Big Break and Little Franks Tract.

5.8.2 Alternative 1 – No Action

The no-action alternative assumes that no action would be taken by the Corps to restore intertidal marsh habitat to the flooded islands and the flooded islands would remain in their current state. Alternative 1 would have no effect on existing recreation in the project area. The public would continue to use existing recreation facilities consistent with present conditions.

5.8.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980.

The restoration of intertidal marsh habitat at Big Break would not require the closure of any local recreation facilities such as harbors, parks, marinas, or resorts. Many people use the area around the project for multiple recreation activities, and would continue to use these areas

during construction and once restoration has been completed. Therefore, impacts to recreation facilities are less than significant.

The shallow waters of Big Break provide prime bass fishing habitat, like many areas throughout the Delta. Creation of 42 acres of intertidal marsh habitat at Big Break would remove a small portion of bass habitat, but a much larger portion of Big Break would remain prime habitat. Because a large portion of habitat would remain available for bass fishing, the effects are considered less than significant. Additionally, there are sufficient areas in the Delta that will continue to provide bass fishing habitat to anglers. Bass fishing in the Delta is an institutionally recognized activity and would continue without affects because of the small amount of land being converted to intertidal marsh habitat. Therefore, with the coordination actions discussed in Section 5.8.5 below, effects to recreation would be less than significant.

5.8.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below.

Piping the source material to the restoration sites would require the pipes to cross the San Joaquin River, Dutch Slough, and False River. These waterways are used for recreation activities such as boating, fishing, and personal water craft. The pipe would be weighted to the river bottoms at these crossing locations so that recreation boating can safely pass along the waterway. Any areas that pose a danger to boaters would be property marked with U.S. Coast Guard approved markings. Prior to any construction activities, coordination would occur with the U.S. Coast Guard to determine the appropriate actions to keep water sport activities safe. Because boaters would continue to have access to the San Joaquin River, Dutch Slough, Big Break, and False River impacts are considered less than significant. Once construction is complete the pipes and hazard markers would be removed from the waterway.

No recreation facilities would be temporarily or permanently closed with the restoration of the islands. Due to the vast amount of recreation facilities and activities available in the area, people would continue to use facilities during and after restoration is complete.

Big Break and Little Franks Tract are currently shallow waters that provide prime bass fishing habitat. The replacement of open shallow water with intertidal marsh habitat in these tracts would force local bass to relocate to other shallow waters of the Delta. There are many

areas adjacent to the restoration site that would continue to provide prime bass fishing for anglers. Although prime bass fishing habitat would be lost, the Delta offers many other locations in close proximity to the project that include bass habitat. Therefore this impact is considered less than significant and no mitigation is required.

5.8.5 Mitigation

The creation of intertidal marsh habitat could be controversial with bass fisherman due to the consequent reduction of prime bass habitat in the project area. However, extensive bass habitat remains throughout adjacent shallow water areas, providing ample opportunities for anglers. Additionally, the restoration would provide shoreline habitat for other fish species, in turn providing new food sources for bass.

During pumping operations equipment personnel would be required to provide safe passage to recreational boaters. All obstacles and hazards to recreational boaters would be clearly identified with U.S. Coast Guard approved markers and buoys. Coordination with the U.S. Coast Guard to ensure that boaters can safely pass along the rivers in the project area would occur prior to the start of any restoration activities. Equipment would be moved if necessary to accommodate recreational boaters.

Prior to construction, coordination would occur with local recreation facilities to:

- Inform boaters and anglers of project activities;
- Provide project safety information including maps of any restricted access areas; and
- Maps would be updated, as needed, to identify the new intertidal marsh restoration areas.

Coordination with recreational fisherman and boaters, as described above, would ensure that impacts associated with construction of the project would be reduced to less than significant.

5.9 Cultural Resources

5.9.1 Methodology and Basis of Significance

Methodology

Analysis of the impacts was based on evaluation of the changes to the existing historic properties that would result from implementation of the project. The term “historic property” refers to any cultural resource that has been found eligible for listing, or is listed, in the NRHP. Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), outlines the process in which Federal agencies are required to determine the effects of their undertakings on

historic properties. In making a determination of the effects to historic properties, consideration was given to:

- Specific changes in the characteristics of historic properties in the study area.
- The temporary or permanent nature of changes to historic properties and the visual study area around the historic properties.
- The existing integrity considerations of historic properties in the study area and how the integrity was related to the specific criterion that makes a historic property eligible for listing in the NRHP.

Basis of Significance

Any adverse effects on cultural resources that are listed or eligible for listing in the NRHP (i.e., historic properties) are considered to be significant. Effects are considered to be adverse if they:

- Alter, directly or indirectly, any of the characteristics of a cultural resource that qualify that resource for the NRHP so that the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association is diminished.

5.9.2 Alternative 1 – No Action

Under the no action alternative, it is assumed that no action would be taken to restore intertidal marsh habitat to the flooded islands. It is assumed that restoration action currently proposed under BDCP and other projects would still be constructed, but not at these locations. As there are no historic properties within the APE no effects to historic properties would occur. No further action would be required by USACE.

5.9.3 Alternative 2 – Intertidal Marsh Restoration at Big Break via Direct Placement

In order to create intertidal marsh habitat, material from O&M dredging would be pumped to the restoration site and placed to raise the submerged surface of portions of Big Break, as described in Section 3.9 and shown on Figure 3-9. O&M dredging and the piping of material to the placement site is an ongoing USACE operation that is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. As no historic properties have been identified within the APE, no effects to historic properties would occur. No further action would be required by USACE.

5.9.4 Alternative 6 – Intertidal Marsh Restoration at Big Break and Little Franks Tract via Direct Placement and Pumping of Previously Dredged Materials

Alternative 6 includes Alternative 2 with the addition of further increments of intertidal marsh restoration at both Big Break and Little Franks Tract. In order to construct these additional increments, previously dredged material would be acquired from past O&M placement sites, as shown on Figure 3-8. The dredged material would be excavated and pumped from these source material sites to the restoration sites, and placed to raise the submerged surface of portions of Big Break and Little Franks Tract, as described in Section 3.9 and shown on Figure 3-13. Similar to Alternative 2, past O&M dredging is covered under the San Francisco Bay to Stockton (John F Baldwin and Stockton Ship Channels) Final Environmental Impact Statement from September 1980. However, effects associated with the pumping of material from these source material sites is analyzed below.

The USACE would avoid any cultural resources discovered when placing the pipes between the dredge spoils stockpiles and the placement sites. There would be little or no ground disturbance associated with the placement of pipes. Therefore, these actions would not affect any buried sites that may or may not be present. An archaeological monitor will be present for the placement of cross channel temporary pipelines to intervene in the event cultural resources are discovered within the path of the pipeline. If a site cannot be avoided the USACE will reopen consultation with the SHPO. As no historic properties have been identified within the submerged portions of the APE, USACE has determined that there are no historic properties affected. No further action would be required by USACE.

5.9.5 Mitigation

USACE has determined that no historic properties exist within the APE of the project. Therefore, none of the alternatives considered will result in an adverse effect to historic properties. If unanticipated discoveries are made USACE will follow 36 CFR §800.13.

5.10 Growth-Inducing Effects

NEPA regulations require an EIS to consider the potential indirect effects of a proposed action. These indirect effects occur later in time or farther away in distance, but are still reasonably foreseeable, and “may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate” (40 CFR Section 1508.8[b]). For this project, any growth-inducing effects would be related to: (1) the relative magnitude of temporary and permanent jobs created by the project; (2) the need for new workers in the project area; (3) the need for additional housing to accommodate new workers and families; and (4) the economic stimulus or growth due to an increase in population, recreational demand, and/or tourist-oriented land development.

However, based on the small size and type of project, the restoration work would be not expected to induce any growth in or near the project area. The regional work force would be adequate to provide sufficient workers for the relatively small number of temporary construction jobs (approximately 20 temporary positions) created by the project. No new temporary or permanent jobs would be needed to maintain or monitor the restored habitat once construction is completed. As a result, no additional housing would be needed. Since the project would only restore wildlife habitat in a rural part of the Delta, no increase in population, recreational demand, and/or tourist-oriented land development is expected. Consequently indirect project effects for Alternative 2 or Alternative 6, if measurable at all, would be extremely minor and well below any reasonable threshold of significance. Therefore, growth-inducing effects would be less than significant and no mitigation is required.

5.11 Cumulative Impacts

The Council on Environmental Quality's regulations for implementing NEPA define a cumulative effect as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

This section discusses the potential cumulative effects of the Delta Study when added to other past, present, and reasonably foreseeable future actions. As presented in Section 5.1, eight resources (vegetation and wildlife, special status species, water quality, air quality, climate change, transportation and navigation, recreation, and cultural resources) are identified as potentially impacted by the project. These resources could experience a cumulative effect related to the project, and are therefore evaluated below. As described in Section 4.1, other resources (hazardous and toxic waste, hydrology and hydraulics, land use, socioeconomics, utilities and services, and geology) would not be affected, and are therefore not evaluated below.

5.11.1 Methodology and Geographic Scope of the Analysis

Methodology

The cumulative effects analysis determines the combined effect of the proposed project with other closely related, reasonably foreseeable projects. Cumulative effects were evaluated by identifying projects in and around the Delta region that could have significant adverse or beneficial effects. These potential effects are compared to the potential adverse or beneficial effects of the proposed alternatives to determine the type, length, and magnitude of potential combined cumulative effects of the proposed project together with the other related reasonable foreseeable projects. Significance of cumulative effects is determined by meeting Federal and State mandates and specific criteria identified in this document for the affected resources.

Geographic Scope

The geographic area that could be affected by the project varies depending on the type of environmental resource being considered. Potentially affected air and water resources extend beyond the confines of the project footprint due to the dynamic nature of these resources. Table 5-23 presents the general geographic areas associated with the different resources addressed in this cumulative effects analysis.

Table 5-23. Geographic Areas that Would Be Affected by the Delta Study.

Resource Area	Geographic Area
Vegetation and Wildlife	Big Break, Little Franks Tract, Dutch Slough, False River, Sacramento River, and San Joaquin River
Special Status Species	Big Break, Little Franks Tract, Dutch Slough, False River, Sacramento River, and San Joaquin River
Water Quality	Big Break, Little Franks Tract, Dutch Slough, False River, Sacramento River, and San Joaquin River
Air Quality	Regional Air Quality Districts (SMAQMD and BAAQMD)
Climate Change	Global Environment
Navigation	Stockton Deep Water Ship Channel/San Joaquin River, Sacramento Deep Water Ship Channel/Sacramento River
Recreation	Local (facilities near construction sites)
Cultural Resources	Immediate vicinity of the individual sites of construction activity

5.11.2 Past, Present, and Reasonably Foreseeable Future Projects

This section briefly describes other projects in the project area. The exact construction timing and sequencing of these projects are not yet determined or may depend on uncertain funding sources. All of these projects are required to evaluate the effects of the proposed project features on environmental resources in the area. In addition, mitigation or mitigation measures must be developed to avoid or reduce any adverse effects to less than significant based on Federal and local agency criteria. Those effects that cannot be avoided or reduced to less than significant are more likely to contribute to significant cumulative effects in the area.

The Delta Islands and Levees Feasibility Study and Related Projects would be located in a rapidly growing area of eastern Contra Costa County. Relevant projects are projects that are related or similar projects that are reasonably foreseeable, and have the potential to affect the same resources and fall within the same geographic scope. A cumulative impact refers to two or more individual effects which, when considered together, are significant or compound or

increase other environmental impacts. The individual effects may be changes resulting from a single project or a number of separate projects.

U.S Army Corps of Engineers Projects

Sacramento River Deep Water Ship Channel Operations and Maintenance (Port of Sacramento)

The U.S. Army Corps of Engineers, Department of Water Resources, and the Port of Sacramento, conduct annual maintenance dredging of the Sacramento Deep Water Ship Channel. Fine sediments cause shoaling, which must be removed to maintain adequate depth for commercial shipping traffic using the navigation channels. Failure to perform maintenance dredging would result in unsafe conditions and a restriction to access to the Port of Sacramento from the San Francisco Bay. Failing to dredge the channel poses both a substantial risk to human safety, as well as an economic harm to the Port and the commercial activities that use the Ports' facilities.

Dredged materials are removed by using a hydraulic cutter head suction dredge for dredging, and a dragline and clamshell crane are used for rock placement. The material is then deposited at previously authorized dredged material placement (DMP) sites. Dredge slurry is routed to the DMP sites via pipelines. DMP sites are diked and dredge slurry is allowed to settle and consolidate at these sites. Decant water is then discharged back into the waterway, from some sites, as determined during annual coordination. Dredged spoils are allowed to dry and remain stockpiled at the sites for periodic use for levee repairs, livestock grazing, and other purposes.

San Francisco Bay to Stockton Deep Water Ship Channel Operations and Maintenance (San Joaquin River)

The U.S. Army Corps of Engineers, Department of Water Resources, and the Port of Stockton, conduct annual maintenance dredging of the Stockton Deep Water Ship Channel. Annual maintenance dredging is performed in the same general manner as described above for the Sacramento Deep Water Channel.

In addition, maintenance bank protection work is needed to maintain the integrity of existing bank protection placed to prevent erosion of the ship channel levees. Such bank erosion usually occurs due to wave action caused by ship traffic. Maintenance bank stabilization, in the form of rock replenishment, would stabilize the channel alignment and preserve the general uniformity of the bank lines. The levees protect ship channel traffic from adverse crosscurrents during the occurrence of flood flows in the Yolo Bypass and also protect adjacent lands from flooding during high flows. Implementation of the Delta Study is highly dependent upon the availability of dredged material from O&M operations within the Stockton DWSC. The availability of dredged material could affect the timing and completion of the Delta Study.

Department of Water Resources/State of California Projects

Bay Delta Conservation Plan

The BDCP is a comprehensive conservation strategy for the Delta to advance the planning goal of restoring ecological functions of the Delta and improving water supply reliability in the state of California. The conservation strategy is designed to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework. The BDCP reflects the outcome of a multiyear collaboration between DWR, Reclamation, State and Federal fish and wildlife agencies, State and Federal water contractors, nongovernmental organizations, agricultural interests, and the general public. The BDCP sets out a comprehensive conservation strategy for the Delta designed to restore and protect ecosystem health, water supply, and water quality within a stable regulatory framework.

Dutch Slough Tidal Marsh Restoration Project

The Dutch Slough Tidal Marsh Restoration Project, in an area formerly slated for urban development, will soon become 1,178 acres of critically needed habitat for fish and wildlife in the Sacramento-San Joaquin Delta. The project is a cooperative effort between State, Federal, and private agencies, including DWR, CDFW, State Coastal Conservancy, Reclamation Districts, Natural Heritage Institute, City of Oakley, Ironhouse Sanitary District, and private consultants. In 2013, the Dutch Slough Tidal Marsh Restoration Project began construction. The project's location in the western Delta offers the opportunity, soil types, and lack of subsidence to create a large area of tidal marsh and complex intertidal channels favored by native Delta species. Shaded channels, native grasslands, and riparian forests will be restored in the upland portions of the site. The habitats to be restored are like those that historically dominated the Delta, and their restoration is considered a critical action to increase numbers of native sensitive species and improve general ecological health of the Delta. This project will not only provide critical habitat for native plants, fish, and wildlife that are in rapid decline in the Delta, but will also provide outdoor recreation and resources for the residents of the Delta and Bay Area.

City of Oakley Projects

City Community Park

The City of Oakley is proposing a Community Park and Public Access Conceptual Master Plan (hereinafter referred to as “City Community Park Project”) for 55 acres adjacent to the Dutch Slough Restoration Project and four miles of levee trails on the perimeter of the project lands. The City Community Park will provide parking and trailheads for the public access components of the Dutch Slough Restoration Project. The project is currently under design.

Cypress Grove

The Cypress Grove EIR was certified by the City of Oakley in 2003. This development is under construction and will consist of 637 new residential units on approximately 147 acres. The project is adjacent to and south of the Contra Costa Canal and adjacent to and east of Marsh Creek.

Oakley Westerly Annexation

In 2005, the Contra Costa County Local Agency Formation Commission approved annexation of approximately 80 acres south of East Cypress Road and east of Sellers Avenue to the City of Oakley. Subdivision 8904 (24 acres known as Tuscany Estates and formerly the Baldocchi property) is undergoing tentative map review. Tuscany Estates consists of 100 homes.

East Cypress Corridor Specific Plan and Summer Lake

The City of Oakley prepared a Supplemental EIR for the East Cypress Corridor Specific Plan which was finalized in February 2009. The specific plan proposed the development of up to 5,759 residential units on an approximately 2,500-acre site adjacent to 1.5 miles of the Contra Costa Canal, from the Rock Slough trash rack to Cypress Road. The specific plan area is within the City of Oakley's sphere of influence. The City of Oakley proposed to annex the entire specific plan area. Approximately 500 homes are in the East Cypress Corridor Specific Plan area. Most of the existing homes are along Sand Mound and Dutch Sloughs.

Dutch Slough Properties Development

The City of Oakley has approved plans to develop approximately 1,342 residential units on approximately 300 acres immediately south of the Dutch Slough Restoration Project site between the Contra Costa Canal and Cypress Road. The development area south of the Contra Costa Canal consists of 140 acres of the Emerson property, which is estimated to have approximately 662 residential units. The City certified an EIR and approved a tentative map in November of 2007 for 506 residential units on 120 acres of the Gilbert property and 44 acres of the Burroughs property, which is anticipated to have approximately 174 residential units. The project was completed in 2012.

5.11.3 Cumulative Impacts Analysis

Vegetation and Wildlife

Implementation of the proposed alternatives would contribute to restoration and expansion of sensitive marsh habitat and would benefit aquatic and wildlife species in decline due to the steady loss of this habitat type in the Delta. The minimization and avoidance measures would be implemented during construction to minimize impacts to biological resources by preventing the spread of non-native plant species to the greatest extent practicable. As a result, the Delta Study would not contribute to a cumulative impact on vegetation and wildlife.

The Delta Study, in combination with the other restoration projects discussed in Section 5.11.2, such as the Dutch Slough Restoration Project, would contribute to the overall future health of the Delta and would improve overall habitat conditions. As a result, any cumulative impacts associated with the Delta Study would be beneficial.

Special Status Species

Implementation of the project has the potential to contribute to the loss or degradation of sensitive habitats and to adversely affect special-status species, but planned project mitigation measures, described in Section 5.3 above, would limit adverse impacts to a less-than-significant level. By creating new intertidal marsh habitat, the Delta Study would bring significant ecosystem benefits to special status fish species, such as salmonids, steelhead, and green sturgeon. In conjunction with the restoration actions proposed by other projects, such as the Dutch Slough Restoration Project, the proposed restoration project will assist in recovery of species listed under the Federal Endangered Species Act (ESA) and California Endangered Species Act (CESA) by creating new nearshore habitat for these species and improving the overall health of the Delta's ecosystem.

Aquatic Species

Proposed projects could have potential impacts on Delta Smelt and other listed fish species in the greater project vicinity. The new housing developments would increase the human population in the area, potentially leading to more recreation pressure at the site (boating, fishing, and litter). The increased volume of municipal sewage from the new developments would likely introduce more pollutants to the waters. In the context of these adverse development pressures on Delta ecosystems, implementation of the project, together with other regional marsh and wetlands restoration projects, would provide long-term net benefits to listed fish species through the construction of primary productivity areas and mud flats,

Reptilian Species

The Delta Study could affect, but is not likely to adversely affect the giant garter snake. The other related projects discussed above could cause adverse impacts to the giant garter snake in the greater project vicinity. Multiple shoreline projects may contribute to disturbance of giant garter snake refugia and over wintering habitat. Implementation of the Delta Study and other regional restoration projects would result in long-term net benefits to the giant garter snake by expanding primary productivity areas and refugia.

Water Quality

Construction activities have the potential to temporarily degrade water quality through the direct release of soil and construction materials into water bodies or the indirect release of contaminants into water bodies through placement activities. Related projects, including the San Joaquin River Deep Water Ship Channel Operations and Maintenance, the Dutch Slough Tidal Marsh Restoration Project, the Dutch Slough Properties Development, and the Ironhouse

Sanitary District project could be under construction during the same timeframe as this project. If construction occurs during the same timeframe water quality could be diminished primarily due to increased turbidity.

Further urban development could increase runoff as the amount of impervious surfaces is increased. The new housing developments may cause more stormwater runoff laden with contaminants common in urban/suburban areas (i.e. pesticides, lawn fertilizers, hydrocarbons). The increased volume of municipal sewage from the new developments could also introduce more pollutants to Delta waters. The method by which treated wastewater is discharged would determine the severity of the impact to water quality from new and proposed residential subdivisions near the study area. All projects would be required to coordinate with the RWQCB and overall water quality will be required to meet the Basin Plan objectives. The proposed marsh restoration activities associated with the Delta Study would result in less-than-significant effects to water quality. Degradation of water quality from the project would be short term and limited to the construction period. The project would not cumulatively contribute to long-term adverse effects that may result from development projects.

Air Quality

Construction of the proposed alternatives would result in emissions of criteria pollutants; however, with the implementation of mitigation measures these emissions are expected to be below the thresholds of the CAA and the CCAA. All of the related projects discussed above would cumulatively contribute to emissions of criteria pollutants throughout the region, particularly if projects are constructed concurrently, which could have a significant cumulative effect on air quality. It is anticipated that each of these projects would implement separate mitigation plans, as required by air quality control agencies, to reduce the emissions to below significance levels.

Construction of the Delta Study is tentatively scheduled for 2018 through 2023, depending upon Congressional authorization and appropriation. However, on a regional level, local area projects would still contribute to a significant cumulative effect, and coordination with the SMAQMD and BAAQMD would need to occur prior to construction to reduce these effects.

Climate Change

It is unlikely that any single project by itself could have a significant impact on the environment with respect to GHGs. However, the cumulative effect of human activities has been linked to quantifiable changes in the composition of the atmosphere, which, in turn, have been shown to be the main cause of global climate change (IPCC 2007). Therefore, the analysis of the environmental effects of GHG emissions is inherently a cumulative impact issue. While the emissions of one single project will not cause global climate change, GHG emissions from multiple projects throughout the world have a cumulative effect on global climate change.

It is expected that the primary GHG impacts from present and planned Delta area projects would arise from their construction phases. On an individual basis, each of these projects would mitigate emissions below the general reporting threshold. If these projects are implemented

concurrently, it is possible that the combined cumulative effects could be above reporting requirements for GHG emissions. However, with the implementation of mitigation measures, which would be required for each of these projects, it is possible that the effects could be reduced to less than significant.

Transportation and Navigation

The Delta Study would not have a significant impact on local roadways in the study area. The only potential impacts are associated with the piping of material over Highway 160. While the local projects do include housing development projects, which would increase roadway useage, none of these projects are located on Sherman Island, where Highway 160 would be impacted. The Delta Study would not impact any roadways in the vicinity of the development projects. As a result, there is no cumulative effect from the construction of these proposed projects.

USACE does not anticipate any cumulative effects as a result of the dredging and placement activities of the Sacramento DWSC, the operations and maintenance activities on the Stockton DWSC along the San Joaquin River, and the Delta Study. The operations and maintenance activities on the Stockton DWSC are essential to the proposed alternatives. Project activities near the Sacramento DWSC would not interfere with ship movement since dredging and pumping equipment must be positioned to allow ship passage. Overall cumulative effects to navigation would not be significant.

Recreation

The proposed project would provide a variety of recreational opportunities for both active and passive recreation and education. Cumulative impacts to recreation are primarily related to other construction projects that could occur during the same time frame as those considered for this study and within the same vicinity as this study. Temporary construction effects would be minimized through design modifications and coordination with the public and recreation agencies ensuring that any residual effects would be minimized. The specific placement sites do not offer unique ‘sense of place’ recreation experiences; adjacent open water areas can provide similar or identical recreation experiences. During dredging and pumping operations equipment personnel are required to provide safe passage to recreational boaters. All obstacles and hazards to recreational boaters would be clearly identified by flagging and buoys. Equipment would be moved if necessary to accommodate recreational boaters. Therefore, the project would not result in significant cumulative impacts to recreation.

Cultural Resources

Cumulative impacts to cultural resources would be primarily related to other construction projects that could occur during the same timeframe as those considered for this study and within the same vicinity as this study. A cumulative overall impact to cultural resources is not likely, since the project does not have significant cultural resources.

5.12 Unavoidable Significant Effects

The CEQ's NEPA Compliance Guide states that any significant adverse environmental effects that cannot be avoided if the project is implemented must be described. This description includes significant adverse effects that can be mitigated, but not reduced to a level of insignificance.

The analysis indicates that one or more of the alternatives could result in unavoidable significant effects on water quality, air quality, and recreation.

- Turbidity may adversely affect aquatic listed species.
- Bass anglers may be temporarily affected by the temporary loss of fishing areas.

Most of these significant effects could be reduced to a level of insignificance by implementing appropriate conservation and mitigation measures. However, some unavoidable effects to air quality cannot be reduced to less than significant even when mitigation measures are implemented.

5.13 Relationship Between Short-Term Uses of the Environment and Long-Term Productivity

In accordance with NEPA (40 CFR 1502.16), this section discusses the relationship between local short-term uses of the human environment and maintenance of long-term productivity for the project. Short-term effects on vegetation and wildlife, water quality, and air quality would be limited to the construction phase of the project. No short-term uses of the environment are expected after the project is placed in operation. The water quality and air quality would return to pre-project levels after construction is completed.

In addition, the long-term productivity of the environment in the Delta would be increased by restoring aquatic, riparian, and adjacent terrestrial habitats for native plants and wildlife, including special status species.

5.14 Irreversible and Irretrievable Commitment of Resources

In accordance with NEPA (40 CFR 1502.16), this EIS discusses any irreversible and irretrievable commitment of resources that would be involved in the alternative plans. Significant irreversible environmental changes are defined as uses of nonrenewable resources during the initial and continued phases of the alternatives that cannot be undone.

The alternatives would result in the irretrievable commitment of open water habitat. In addition, they would result in the irretrievable commitment of construction materials, fossil fuels, and other energy resources needed to construct the project. Operation and maintenance are not expected to increase the use of construction materials or fossil fuels

CHAPTER 6. COMPLIANCE WITH APPLICABLE LAWS AND REGULATIONS

The status of the proposed action's compliance with applicable Federal environmental requirements is summarized below. Prior to initiation of construction, the work would be in compliance with all applicable Federal laws and Executive Orders.

6.1 Federal Laws

Bald and Golden Eagle Protection Act, PL 86-70; 16 U.S.C. 668, *et seq*. *Full Compliance.* The USFWS is the Federal agency responsible for administering this act, which prohibits possessing, selling, transporting, or trading a bald or golden eagle or eagle part, alive or dead. Areas in the Delta have both foraging and breeding habitat for these eagles. Prior to initiation of construction, surveys would be conducted by a USFWS-approved biologist to determine the presence of these eagles and/or their nests in or near the work areas. If active nests are found, the USFWS would be contacted for advice and recommendations for how to avoid disturbance and whether a permit is necessary. Unless eagles are found in the project area prior to construction, the project would be in full compliance with this Act.

Clean Air Act, as amended, PL 91-604; 42 U.S.C. 1857h-7, *et seq.* *Full Compliance.* The USEPA is the Federal agency responsible for managing the Nation's air quality. USEPA establishes national ambient air quality standards, and oversees the air quality plans developed and implemented by the states. SMAQMD and BAAQMD are responsible for developing local district air quality management plans and enforcing regulations pertaining to air emissions in the Delta. As discussed in Section 5.2.5, the proposed action would not exceed national air quality standards based on modeled estimates of emission rates during construction of the project.

On November 30, 1993, the USEPA promulgated final general conformity regulations at 40 CFR 93B for Federal activities. These regulations apply to a Federal action in a non-attainment or maintenance area if the total emissions of the criteria pollutants and precursor pollutants caused by the action equal or exceed certain *de minimis* amounts, thus requiring the Federal agency to make a determination of general conformity. As discussed in Section 4.2.5, at least part of the Delta is in non-attainment for ozone, $PM_{10,}$ and $PM_{2.5}$. As discussed in Section 5.5, the proposed action would not exceed *de minimis* thresholds based on modeled estimates of emission rates during construction of the project, and would be in full compliance with the CAA.

Clean Water Act, PL 92-500; 33 U.S.C. 1251, *et seq*. *Partial Compliance.* The USEPA is the Federal agency responsible for managing the Nation's water quality. USEPA establishes national water quality standards and oversees the water quality plans developed and implemented by the states. The CVRWQCB and SFRWQCB are responsible for developing local district water quality management plans, issuing permits, and enforcing regulations pertaining to water quality in the Delta. In addition, USACE is responsible for issuing Section 404 permits for projects that involve discharge of fill material into Waters of the U.S.

The proposed action would involve discharge of fill material into Waters of the U.S. in the Delta. Although USACE does not issue permits for their own projects, USACE does comply with the guidelines and substantive requirements of Section 404, including Sections 404(b)(1) and 401. As discussed in Section 5.2.4, a Section 404(b)(1) analysis was conducted on the TSP and is included in Appendix H. The analysis concluded that the project would not result in significant effects to water quality. The construction contractor would be required to implement the measures listed in the analysis to avoid or minimize adverse effects on the aquatic ecosystem. Section 401 water quality certification would be obtained from the RWQCB prior to initiation of construction.

The proposed action would also require an NPDES permit since it would disturb 1 or more acre of land and involve possible storm water discharges to surface waters. Prior to initiation of construction, the contractor would be required to prepare a Storm Water Pollution Prevention Plan and then submit a Notice of Intent form to the RWQCB, requesting approval of the work. This storm water plan and an In-Water work plan would identify the measures to be implemented by the contractor to avoid or minimize any adverse effects of construction on surface waters.

After the issuance of a 401 certification the project would be in compliance.

Endangered Species Act of 1973, as amended, PL 93-205; 16 U.S.C. 1531, *et seq.* *Partial Compliance.* The Corps obtained a list of the Federally threatened, endangered, proposed, and candidate species that have the potential to occur in the Delta via the USFWS website on December 16, 2013. Based on the locations of the proposed work, the listed species that could be affected by the proposed action include the Delta smelt and the giant garter snake under the jurisdiction of the USFWS and green sturgeon, Central Valley steelhead, Central Valley spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon under the jurisdiction of NMFS. The Corps has determined that the proposed alternatives would have no effect to the listed fish species under the jurisdiction of NMFS. A letter will be sent to NMFS on requesting concurrence with the no effect determination. The Corps is currently preparing a Biological Assessment discussing the potential effects of the proposed action on Delta smelt and giant garter snake. The Biological Assessment was submitted to USFWS, along with letters requesting initiation of formal consultation with each of these agencies on April 2, 2014. The consultation letters and BA are included in Appendix G. Once USFWS has issued a Biological Opinion, the Delta Study will be in full compliance with this Act.

Farmland Protection Policy Act, PL 97-98; 7 U.S.C. 4201, *et seq*. *Full Compliance.* The NRCS is the Federal agency responsible for administering this act, which requires Federal agencies to coordinate a Farmland Conversion Impact form with the NRCS whenever their projects or programs would affect land designated as prime or unique farmland. The proposed action would not remove or alter any land that is protected under this Act. As a result the project is in full compliance with this Act.

Fish and Wildlife Coordination Act of 1958, as amended, PL 85-624; 16 U.S.C. 661, *et seq.* *Partial Compliance.* The USFWS is the Federal agency responsible for administering this act, which requires Federal agencies to coordinate with USFWS and State wildlife agencies

during the planning of projects that would result in the control or modification of a natural stream or body of water. The FWCA intends that wildlife conservation be given equal consideration with other features of these projects. Because of the sensitivity of the Delta, USACE initiated coordination with USFWS early in the planning process.

As discussed in Section 5.2.1, the USFWS is preparing the draft CAR. This report details the vegetation, wildlife, and fisheries resources in the project area; evaluates the potential effects of the proposed action on those resources; determines required mitigation for adverse effects; and provides recommendations for consideration by USACE. Although adoption of the recommendations is not required by the act, USACE usually adopts the recommendations unless there is an overriding consideration not to do so. The CAR will be included in the Final EIS to be distributed for public and agency review. Once the CAR is finalized and the recommendations are considered by USACE, the Delta Study would be in full compliance with the FWCA.

Magnuson-Stevens Fishery Conservation and Management Act of 1996, as amended, PL 104-267; 16 U.S.C. 1801, *et seq*. *Full Compliance*. The Magnuson-Stevens Act establishes a management system for national marine and estuarine fishery resources. This legislation requires that all Federal agencies consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect Essential Fish Habitat (EFH). Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon Fishery Management Plan must also be considered. USACE has determined that the proposed action would not adversely affect EFH for Federally managed fisheries.

Migratory Bird Treaty Act of 1928, as amended; 16 U.S.C. 715, *et seq*. *Full Compliance.* USFWS is the Federal agency responsible for administering this act, which implements a treaty between the U.S. and Great Britain (for Canada), Mexico, Japan, and the Soviet Union (now Russia) for the protection of migratory birds. Unless permitted by regulations, this law prohibits anyone to "pursue, hunt, take, capture, kill, attempt to take, capture or kill … any migratory bird …or any part, nest, or egg of any such bird" (16 U.S.C. 703). Areas in the Delta have foraging, resting, nesting, and breeding habitat for numerous migratory birds. To the extent possible, the Corps would schedule construction outside periods of migration or nesting to avoid or minimize effects on migratory birds. In any case, prior to initiation of construction, surveys would be conducted by a USFWS-approved biologist to determine the presence of migratory birds and/or their nests in or near the work areas. If active nests are found, the USFWS would be contacted for advice and recommendations for how to avoid disturbance and whether a permit is necessary. With the implementation of these actions, the Delta Study would be in full compliance with this Act.

National Environmental Policy Act of 1969, as amended, PL 91-190; 42 U.S.C. 4321, *et seq*. *Partial Compliance.* The Council on Environmental Quality (CEQ) is responsible for ensuring that Federal agencies operate in accordance with NEPA, which requires full disclosure of the environmental effects, alternatives, potential mitigation, and environmental compliance procedures of most Federal management, regulation, or funding activities that affect the environment. NEPA requires the preparation of an environmental document to ensure that Federal agencies accomplish the law's purposes. This draft EIS is in partial compliance with

NEPA. Full compliance will be achieved when the final EIS and Record of Decision are filed with the USEPA.

National Historic Preservation Act of 1966, as amended, PL 89-655; 16 U.S.C. 470a, *et seq.* *Partial Compliance.* The SHPO in each state is responsible for ensuring that Federal agencies comply with Section 106 of this act, which requires that they consider the effects of a proposed undertaking on properties that have been determined to be eligible for, or included in, the National Register of Historic Places. The Section 106 review process consists of four steps: (1) identification and evaluation of historic properties; (2) assessments of the effects of the undertaking on historic properties; (3) consultation with the SHPO and appropriate agencies to develop a plan to address the treatment of historic properties; and (4) concurrence from the SHPO regarding the agreement or results of consultation.

As discussed in Section 4.2.12, both archeological and historic sites are found in the Delta. The Corps has reviewed records for the Big Break and Little Franks Tract areas, which include the proposed work areas for this study. No cultural or historic sites were identified during document research or during a site inspection by water craft. Correspondence with interested Tribes regarding the study was initiated via letter dated April 2013. Based on this documentary research, consultation with local Indian Tribes, and field work the project is in partial compliance with the National Historic Preservation Act of 1966 until concurrence of no effect is received from the SHPO.

Resource Conservation and Recovery Act of 1976, PL 94-580; 7 U.S.C. 1010, *et seq.* *Full Compliance.* The USEPA is the Federal agency responsible for administering this act, which regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. To date, no potentially hazardous materials areas or spills have been observed during field visits to the Delta. The Delta Study is currently in full compliance with this Act.

During PED, a Phase I Site Assessment of the proposed work areas will be conducted, including a database search of recorded spills and a windshield survey of the areas. Any identified hazardous waste at the work sites would be required to be cleaned up completely by the local sponsor prior to initiation of construction of the proposed action. The contractor would also be required to develop a spill prevention, containment, and countermeasures plan to avoid or minimize any effects due to minor accidental spills of fuels, lubricants, and other supplies during construction. Completion of these commitments would put the Delta Study in full compliance with this Act.

Wild and Scenic Rivers Act, as amended, PL 90-542; 16 U.S.C. 1271, *et seq.* *Full Compliance.* The National Wild and Scenic Rivers Act of 1968 was enacted to preserve selected rivers or sections of rivers in their free-flowing condition in order to protect the quality of river waters and to fulfill other national conservation purposes. There are no designated Wild and Scenic Rivers in the Delta. The Delta Study is not subject to this Act.

6.2 Executive Orders

Executive Order 13112, Invasive Species, February 3, 1999. *Full Compliance.* This EO directs Federal agencies to prevent the introduction of invasive species, provide for their control, and minimize their economic, ecological, and human health effects. As discussed in Section 4.2.1, invasive species, including aquatics and weed species, are found throughout the Delta. Prior to construction, the construction contractor would be required to prepare an invasive species control plan to be approved by the Corps and acceptable to appropriate Federal and State resource agencies. The Delta Study would be in full compliance with this order.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, February 11, 1994. *Full Compliance.* This EO directs Federal agencies not to exclude persons from participation in, deny persons the benefits of, or subject persons to discrimination under their programs, policies, and activities because of their race, color, or national origin. As discussed in Section 4.1.5, the proposed action would have no disproportionate effects on minority or low-income populations in the Delta, as there are no populations of this kind in the study area. Therefore, the Delta Study would not be subject to this order.

Executive Order 11988, Floodplain Management, May 24, 1977. *Full Compliance.* This EO directs Federal agencies to avoid, to the extent possible, long- and short-term adverse effects associated with the occupancy or modification of the base flood plain (1% annual event), as well as to avoid direct and indirect support of development in the base flood plain, wherever there is a practicable alternative. As discussed in Section 4.1.3, the proposed action would have no measurable effect on the (FEMA's 100-year) floodplain in the Delta. In addition, because of the nature of the proposed work, the proposed action would not directly or indirectly support development in the floodplain. The Delta Study would be in full compliance with this order.

Executive Order 11990, Protection of Wetlands, May 24, 1977. *Full Compliance.* This EO directs Federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance their natural and beneficial values. As discussed in Section 5.2.1, the proposed action would have a net positive effect on Delta wetland by adding approximately 97 acres of new intertidal marsh to the aquatic ecosystem. Consequently the Delta Study would be in full compliance with this order.

CHAPTER 7 – PUBLIC AGENCY INVOLVEMENT AND REVIEW

This chapter describes the public involvement activities associated with the Delta Islands and Levees Feasibility Study. These activities included agency meetings and coordination; a community outreach program with public workshops, notices, and media; and distribution of the draft documents for public review and comment.

7.1 Agency Coordination

USACE has been coordinating with various agencies throughout the duration of the Delta Study to discuss the concerns and issues of these agencies regarding the project. The other agencies involved in the coordination include:

- U.S. Bureau of Reclamation;
- U.S. Fish and Wildlife Service;
- National Marine Fisheries Service;
- U.S. Environmental Protection Agency;
- California Department of Water Resources;
- California Department of Fish and Wildlife;
- Central Valley Regional Water Quality Control Board;
- Sacramento County;
- San Joaquin County;
- Contra Costa County;
- Yolo County;
- Alameda County; and
- Solano County.

7.2 Public Meetings and Workshops

On January 31 2013, USACE published a notice of intent (NOI) in the Federal Register (Vol. 78, No. 921) to prepare an EIS. In February 2013, two scoping meetings were held for the project study. The meetings were held to educate the public about the study efforts and to garner input on the proposed scope, in accordance with NEPA. On February 19, 2013, the first meeting was conducted from 5:00 to 7:00 p.m. at the Old Sugar Mill in Clarksburg. The second meeting was conducted on February 19, 2013 from 2:00 to 4:00 p.m. at the Sheraton Grand Hotel in Sacramento.

The meeting locations were chosen because they are central to the region. The meeting times were chosen to accommodate both the workday schedules of public agency representatives and the general public, including residents and business owners.

The meetings were open-house style workshops in which attendees could read and view the information about the proposed alternatives and interact with project staff, including representatives of USACE and DWR. The views expressed in the scoping meeting are summarized in Section 7.4 below.

For more detail on comments received, information available at the meetings, and a summary of key issues that were raised, see Appendix A which contains a scoping report. A similar open-house format will be used for the public feasibility study draft report and EIS. USACE will ensure all agencies, organizations, and individuals who provide comments will be provided a copy of the final integrated report.

7.3 Comments on the NOI

Under NEPA, no time limit exists to receive written comments in response to the NOI. Appendix A contains the NOI and the comments received at the February 2013 scoping meetings. The views expressed in the scoping meeting are summarized as follows:

- Clarifications on data and history of the Delta;
- Concerns of siltation in Delta channels;
- Recommendation for coordination with other agencies and efforts in the Delta; and
- Recommendation to evaluate environmental effects of alternatives to water supply, water quality, and aquatic and terrestrial biology.

7.4 Public Review and Comments on the Draft Report

This draft Integrated Report will be circulated for a 45 day review to Federal, State, and local agencies; organizations; and individuals who have an interest in the project. A notice of availability of the draft EIS will be published in the Federal Register following distribution for public review. Public workshops will be held during the public review period to provide additional opportunities for comments on the draft document. These meetings will be held at the following times and places:

- Wednesday May 7, 2014, 5 p.m. to 7 p.m. at the Old Sugar Mill in Clarksburg, California.

- Friday May 9, 2014, 2 p.m. to 4 p.m. at the Sheraton Grand Hotel in Sacramento, California.

All comments received during the public review period will be considered and incorporated into the final EIS, as appropriate.

7.5 Document Recipients

The following Federal, State, and local agencies and organizations would either receive a copy of the draft EIS/EIR or a notification of the document's availability. Individuals who may be affected by the project or have expressed interest through the public involvement process would also be notified.

7.5.1 Elected Officials and Representatives

Governor of California
Honorable Edmund G. Brown, Jr.

United States Senate
Honorable Barbara Boxer
Honorable Dianne Feinstein

United States House of Representatives
Honorable Doris Matsui
Honorable Michael Thompson
Honorable Ami Bera
Honorable Tom McClintock
Honorable Jared Huffman

California State Senate
Honorable Darrell Steinberg
Honorable Ted Gaines
Honorable Lois Wolk
Honorable Loni Hancock
Honorable Mark James DeSaulnier

California State Assembly
Honorable Roger Dickinson
Honorable Mariko Yamada
Honorable Marc Levine
Honorable Richard Pan
Honorable Joan Buchanan
Honorable Jim Frazier

Sacramento County
Supervisor Phil Serna
Supervisor Jimmie R. Yee
Supervisor Susan Peters
Supervisor Roberta MacGlashan
Supervisor Don Nottoli

Contra Costa County
Supervisor John Gioia
Supervisor Mary Piepho
Supervisor Karen Mitchoff
Supervisor Federal Glover
Supervisor Candace Andersen

City of Oakley
Mayor Randy Pope
Vice Mayor Doug Hardcastle
Councilmember Diane Burgis
Councilmember Carol Rios
Councilmember Kevin Romick

7.5.2 Government Departments and Agencies

Federal Government Agencies

- U.S. Environmental Protection Agency
- Council on Environmental Quality
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service
- Federal Emergency Management Agency
- U.S. Geological Survey
- National Resources Conservation Service
- U.S. Bureau of Reclamation

State of California Government Agencies

- California Air Resources Board
- California Bay-Delta Authority
- Central Valley Flood Protection Board

- Central Valley Regional Water Quality Control Board
- California Department of Conservation
- California Department of Fish and Game
- California Department of Parks and Recreation
- California Department of Transportation
- California Department of Water Resources
- Native American Heritage Commission
- California State Office of Historic Preservation
- California State Clearinghouse
- California State Lands Commission
- California State Water Resources Control Board
- Governor's Office of Emergency Services
- Delta Protection Commission
- Delta Stewardship Council

Regional, County, and City Agencies

- Sacramento County
- Sacramento Metropolitan Air Quality Management District
- Contra Costa County
- Bay Area Air Quality Management District
- City of Oakley
- Bethel Island Municipal Improvement District
- Delta Counties Coalition
- Save the Delta
- The Delta Conservancy
- East Bay Regional Water Quality Control District

CHAPTER 8 – TENTATIVELY SELECTED PLAN

This chapter describes the Tentatively Selected Plan (also called the preferred alternative for NEPA purposes), as well as procedures and cost sharing requirements to implement the plan. A schedule and list of further studies are also included.

8.1 Tentatively Selected Plan

The plan identified as the Tentatively Selected Plan is Alternative 6 (see Figure 8-1). The Tentatively Selected Plan is described in detail below.

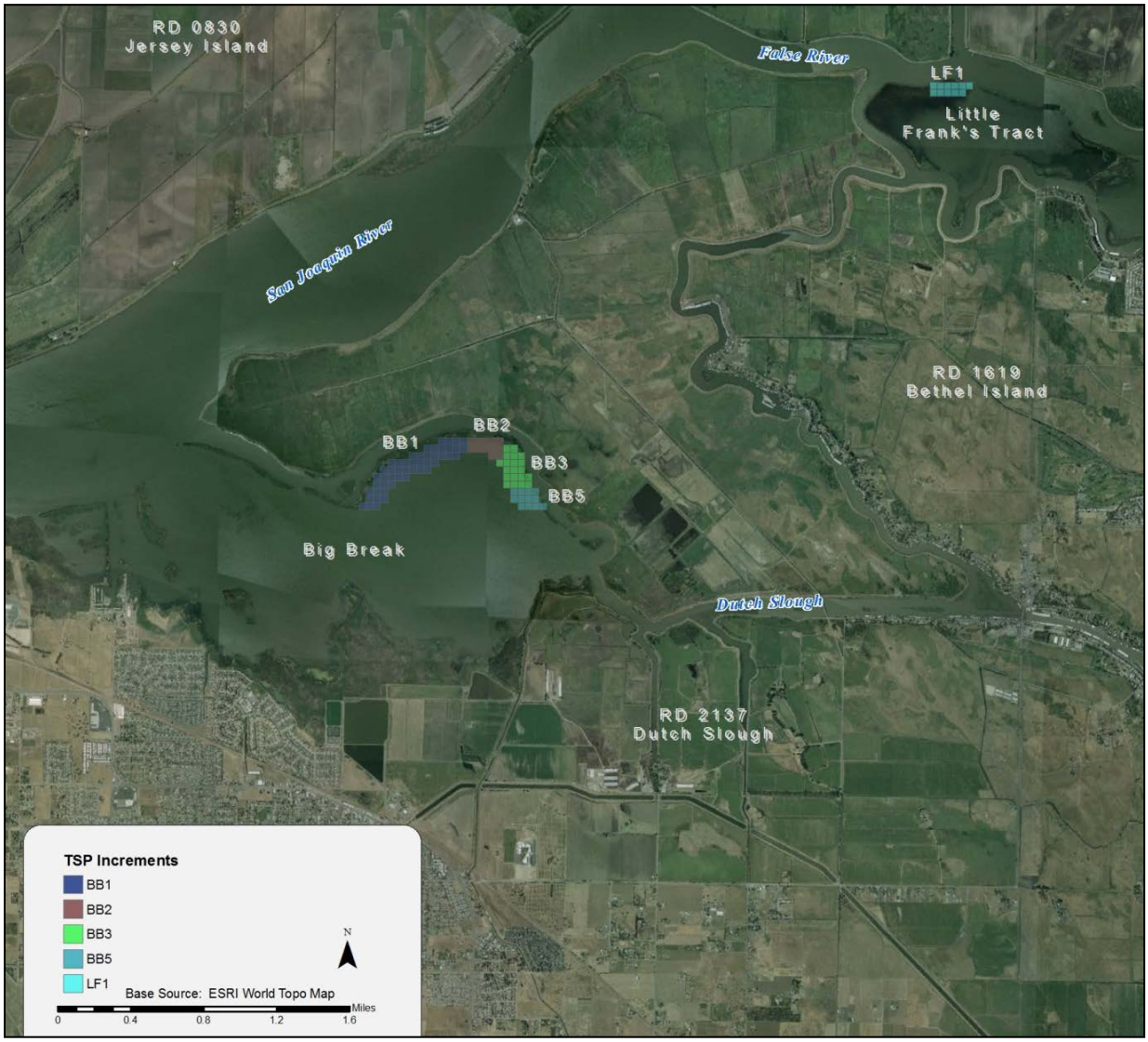

Figure 8-1. Tentatively Selected Plan.

8.1.1 Features and Accomplishments

The principle features of the Tentatively Selected Plan are: (1) placement of 500,000 cubic yards of fill material into Big Break from Operations and Maintenance dredging from the Stockton Deep Water Ship Channel to restore tidal habitat elevations; (2) placement of 124,000 cubic yards of fill material into Big Break via pumping previously dredged material from the McCormick dredged material placement site; (3) placement of 210,000 cubic yards of fill material into Big Break via pumping previously dredged material from the Scour dredged material placement site; (4) placement of 125,000 cubic yards of fill material into Big Break via pumping previously dredged material from the Decker dredged material placement site; and (5) placement of 153,000 cubic yards of fill material into Little Frank's Tract via pumping previously dredged material from the Bradford dredged material placement site. Additionally, a Monitoring and Adaptive Management Plan will be developed and included in the final report. Monitoring and Adaptive Management costs, which are anticipated to be minimal, will be included in first costs and operations, maintenance, repair, replacement, and relocations (OMRR&R) costs, as appropriate. The preliminary total first project cost of this alternative is $29.0 million.

The Tentatively Selected Plan provides a unique opportunity to restore 89.5 acres of intertidal marsh in the Delta, habitat which is now largely non-existent in this ecosystem of national significance. Prior to levee construction in the late 19th and early 20th centuries, the Delta was comprised almost solely of tidal marsh. As levees were constructed, floodplains were disconnected from the waterways and land began to subside and compact as it was farmed and developed for human use. Delta lands are now as much as 20 feet below sea level, much too low for intertidal marsh habitat without incorporation of subsidence reversal, which is typically cost prohibitive. For this reason, restoration of tidal marsh has been very limited throughout the central Delta in particular, where subsidence is most extensive and also where tidal marsh was historically most prevalent. The Tentatively Selected Plan links the proposed ecosystem restoration actions to historic and ongoing USACE navigation projects, providing a cost effective mechanism to implement otherwise costly subsidence reversal, resulting in restoration of habitat for multiple Federally listed species, notably salmonids and Delta smelt. The restored habitat would also benefit the millions of migratory fowl on the Pacific Flyway as they travel through the Delta, part of the largest estuary on the West Coast.

The national significance of the Delta has been demonstrated many times through decades of Federal authorizations and partnerships. The CALFED Bay-Delta Program, which emerged from water crises of the 1990s, is a unique collaboration among 25 State and Federal agencies to improve California's water supply and the ecological health of the Bay-Delta. The San Francisco Estuary Partnership is a coalition of resource agencies, non-profits, citizens, and scientists working to protect, restore, and enhance water quality and fish and wildlife habitat in the Bay-Delta. Most recently, the 2009 California Bay-Delta Memorandum of Understanding Among Federal Agencies named the Bay-Delta *"among the most important estuary ecosystems in the Nation"* and committed the Federal agencies to work in partnership with the State and stakeholders to carry out the vision of "a healthy and sustainable Bay-Delta ecosystem that provides for a high-quality, reliable, and sustainable long-term water supply for California, and restores the environmental integrity and sustainability of the system." The Tentatively Selected

Plan recommends Federal action to restore 89.5 acres intertidal marsh, one of the most sought after habitat types in this unique, important estuary.

Specific features of the Tentatively Selected Plan include:

Big Break Operations and Maintenance Dredged Material Placement

For an estimated period of five years, material from Operations and Maintenance dredging in the Stockton Deep Water Ship Channel will be directly placed via pipeline into a 41.9 acre area of Big Break adjacent to the north remnant levee. The area would be contained by a perimeter of sacrificial hay bales and silt curtains to contain the suspended material and minimize turbidity. Material would be placed in the area until a target elevation of 4.5 ft (NAVD 88) is achieved, which would require 500,000 cubic yards of material. Bulrush (Typha sp.) will be planted over the area (10% coverage) to develop intertidal marsh habitat.

Pumping Previously Dredged Material from McCormick Placement Site

Previously dredged material from the McCormick placement site will be mixed into slurry and pumped into a 10.4 acre area of Big Break adjacent to the north remnant levee. The area would be contained by a perimeter of sacrificial hay bales and silt curtains to contain the suspended material and minimize turbidity. Material would be placed in the area until a target elevation of 4.5 ft (NAVD 88) is achieved, which would require 124,000 cubic yards of material. Bulrush (Typha sp.) will be planted over the area (10% coverage) to develop intertidal marsh habitat. A general schematic of the pumping process is shown in Figure 8-2:

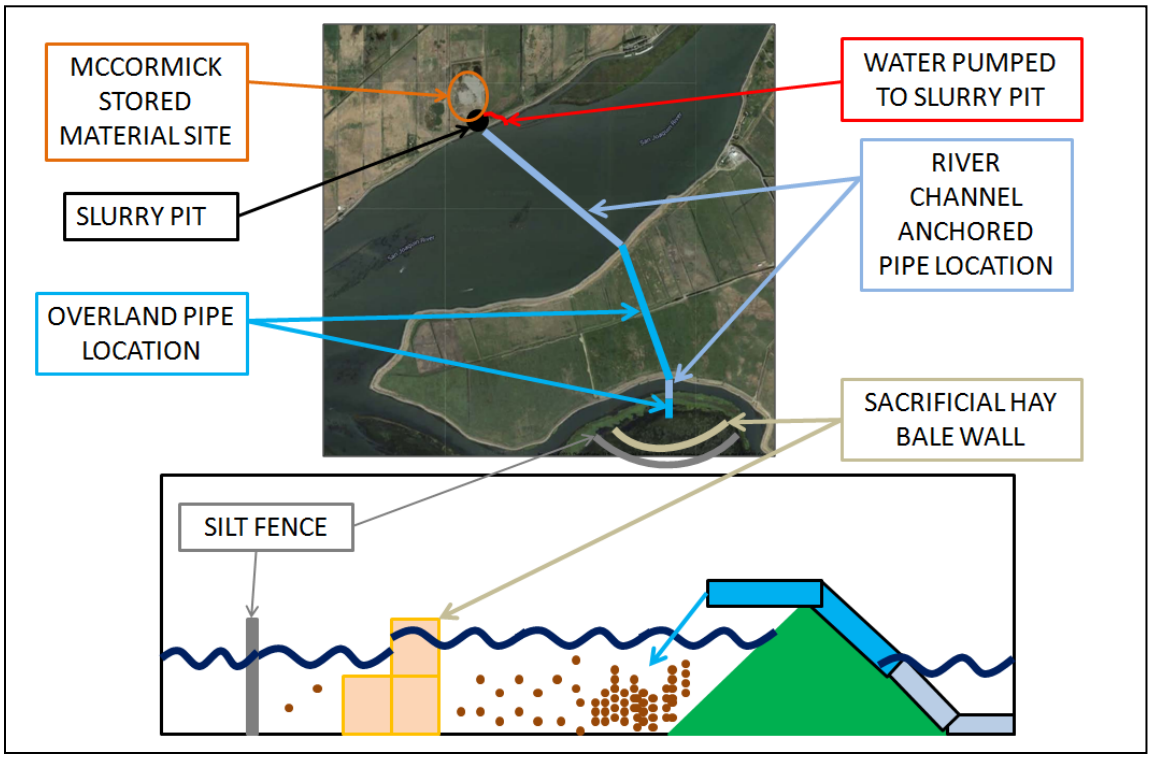

Figure 8-2. Pumping Diagram.

Pumping Previously Dredged Material from Scour Pit Placement Site

Previously dredged material from the Scour placement site will be mixed into slurry and pumped into a 17.6 acre area of Big Break adjacent to the north remnant levee. The area would be contained by a perimeter of sacrificial hay bales and silt curtains to contain the suspended material and minimize turbidity. Material would be placed in the area until a target elevation of 4.5 ft (NAVD 88) is achieved, which would require 210,000 cubic yards of material. Bulrush (Typha sp.) will be planted over the area (10% coverage) to develop intertidal marsh habitat.

Pumping Previously Dredged Material from Decker Placement Site

Previously dredged material from the Decker placement site will be mixed into slurry and pumped into a 10.4 acre area of Big Break adjacent to the north remnant levee. The area would be contained by a perimeter of sacrificial hay bales and silt curtains to contain the suspended material and minimize turbidity. Material would be placed in the area until a target elevation of 4.5 ft (NAVD 88) is achieved, which would require 125,000 cubic yards of material. Bulrush (Typha sp.) will be planted over the area (10% coverage) to develop intertidal marsh habitat.

Pumping Previously Dredged Material from Bradford Placement Site

Previously dredged material from the Bradford placement site will be mixed into slurry and pumped into a 9.2 acre area of Little Frank's Tract adjacent to the north remnant levee. The area would be contained by a perimeter of sacrificial hay bales and silt curtains to contain the suspended material and minimize turbidity. Material would be placed in the area until a target elevation of 4.5 ft (NAVD 88) is achieved, which would require 125,000 cubic yards of material. Bulrush (Typha sp.) will be planted over the area (10% coverage) to develop intertidal marsh habitat.

Flood Risk Communication and Emergency Response Planning and Coordination

In addition to the Tentatively Selected Plan, continued flood risk communication and flood warning and preparedness planning through the existing USACE FPMS Program authority are recommended to reduce the consequences of flooding in the Delta as described in Chapter 3.

8.1.2 Regional Benefits

Although designed to stand alone, the Tentatively Selected Plan complements other efforts underway in the California Bay-Delta. The State of California, U.S. Bureau of Reclamation, resource agencies, and other agencies are developing the Bay Delta Conservation Plan to achieve the co-equal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The Tentatively Selected Plan was formulated to not impede or be dependent upon the Bay Delta Conservation Plan; however, the Tentatively Selected Plan does contribute to the goal of restoring the Delta ecosystem.

Specifically, restoration of intertidal marsh is a high priority for the Delta as less than 5% of the historic tidal marsh remains throughout the Delta.

8.1.3 Operation, Maintenance, Repair, Replacement, and Rehabilitation

Once construction of each operable project element is complete, that project element would be turned over to the non-Federal sponsor. The non-Federal sponsor would then be responsible for the OMRR&R of the completed project elements in accordance with the OMRR&R manual.

Maintenance requirements, which are anticipated to be minimal, will be discussed in detail in the OMRR&R manual. Based on the high rate of vegetative success at the nearby Donlon Island reference site, the restoration plantings are expected to be self-sufficient, therefore requiring no maintenance. A minimal amount of maintenance of such items as signs, containment barriers, and other items that protect the restoration areas could be required. Also, periodic checklist type inspections on an annual or biannual basis would be required to monitor the site for severe adverse effects. A description of monitoring activities will be included in the Monitoring and Adaptive Management Plan, which will include criteria for ecosystem success, as well as the estimated cost and duration of the monitoring. Monitoring will continue until criteria for ecosystem restoration success have been met. Monitoring activities will be cost shared for a period of ten years; however, if monitoring is required beyond the ten year period, the cost of monitoring will be a non-Federal sponsor responsibility, per Section 2039 of the Water Resources Development Act of 2007.

OMRR&R costs will be developed in conjunction with the Monitoring and Adaptive Management Plan and included in the final report. Subsequent to the completion of the design of the project features and prior to construction, a draft OMRR&R manual would be prepared in coordination with the non-Federal sponsor and affected agencies. A final OMRR&R manual would be prepared after the completion of construction and provided to the non-Federal sponsor.

8.1.4 Real Estate

Acquisition of about 103.05 acres in fee title along with about 955.76 acres of temporary work area easements and 35.45 acres of temporary pipeline easements are required for the Tentatively Selected Plan. Fee title would be acquired over submerged lands at Big Break and Little Frank's Tract; temporary work area easements at borrow sites and staging areas; and temporary pipeline easements for placement of dredged material slurry pipelines where the navigational servitude is unavailable. The non-Federal sponsor would acquire these estates as part of its project obligations.

Real estate acquisition for the Tentatively Selected Plan is split among 16 landowners. All fee acquisitions are located on currently flooded islands with no infrastructure, therefore relocations are not required.

8.1.5 Plan Economics

The project first cost was estimated on the basis of October 2013 price levels and amounts to $29,018,000. Table 8-1 shows this cost by primary project feature. Estimated average annual costs were based on a 3.5 percent interest rate, a period of analysis of 50 years, and physical construction ending in 2022. Table 8-2 shows the average annual costs and outputs.

Table 8-1. Estimated Costs of Tentatively Selected Plan.

MCACES Account[2]	Description	Total First Cost[1] ($1,000s)
01	Lands and Damages[3]	3,460
02	Relocations[4]	0
06	Fish and Wildlife[5]	20,547
18	Cultural Resources Data Recovery[6]	205
30	Planning, Engineering, Design[7]	3,091
31	Construction Management[8]	1,714
	Total First Cost	29,018

[1]Based on October 2013 price levels.
[2]Micro Computer-Aided Cost Engineering System (MCACES) is the software program and associated format used by the Corps in developing cost estimates. Costs are divided into various categories identified as "accounts." Detailed costs estimates are presented in the Cost Engineering Appendix (Appendix E).
[3]Real Estate land costs, which includes fees, but no damages.
[4]No relocations required in TSP.
[5]TSP categorized as Fish and Wildlife in its entirety.
[6] Assumes 1 percent of 06 Account.
[7]15 percent of 06 Account.
[8]8.5 percent 06 Account.

Table 8-2. Economic Costs and Benefits of Tentatively Selected Plan.

Item	Costs ($1,000s)	Benefits
Investment Cost		
First Cost[1]	29,018	
Interest During Construction (3.5%)	3,017	
Total	32,035	
Annual Cost		
Interest and Amortization (3.5% over 50 year period of analysis)	1,366	
OMRR&R[2]	TBD	
Subtotal	1,366	
Annual Benefits Non-monetary (Ecosystem)		88.1 AAHU's

[1]Excludes Cultural Resource Data Recovery; Oct 2013 price level.
[2] Operation, Maintenance, Repair, Replacement, and Rehabilitation; OMRR&R costs, anticipated to be minimal, will be determined through development of the Monitoring and Adaptive Management Plan prior to the Final Report.

8.1.6 Cost Sharing

The apportionment of costs between the Federal Government and the sponsor is presented in Tables 8-3 and 8-4. Table 8-3 shows costs apportioned as either Federal or non-Federal costs based on October 2013 price levels. Cost apportionment based on the fully funded cost estimate is presented in Table 8-4 using the current project schedule and projected future rates of price escalation at the mid-point of construction.

Table 8-3. Summary of Cost-Sharing Responsibilities of the Tentatively Selected Plan (October 2013 Price Level).

Item	Federal	Non-Federal	Total First Costs ($1,000s) [1]
Fish & Wildlife Facilities	$20,547	$0	$20,547
Lands and Damages	$400	$3,060	$3,460
Planning, Engineering, & Design	$3,091	$0	$3,091
Construction Management	$1,714	$0	$1,714
Subtotal	*$25,752*	*$3,060*	*$28,812*
Additional Cash Contribution	-$7,024	$7,024	
Subtotal	*$18,728*	*$10,084*	*$28,812*
Percentage	*65%*	*35%*	
Cultural Resource Data Recovery[2]	$205	$0	$205
Total	*$18,933*	*$10,084*	*$29,018*

[1] Based on October 2013 price levels.
[2] 100% Federal cost

Table 8-4. Summary of Projected Cost-Sharing Responsibilities of the Tentatively Selected Plan (Fully Funded).

Item	Federal	Non-Federal	Total First Costs ($1,000s) [1]
Fish & Wildlife Facilities	$20,897	$0	$20,897
Lands and Damages	$407	$3,112	$3,519
Planning, Engineering, & Design	$3,211	$0	$3,211
Construction Management	$1,780	$0	$1,780
Subtotal	*$26,295*	*$3,112*	*$29,407*
Additional Cash Contribution	-$7,180	$7,180	
Subtotal	*$19,115*	*$10,292*	*$29,407*
Percentage	*65%*	*35%*	
Cultural Resource Data Recovery[2]	$209	$0	$209
Total	*$19,324*	*$10,292*	*$29,616*

[1]Based upon Total Project Cost which incorporates the mid-point of construction escalations; see Total Project Cost in the Cost Engineering Appendix (Appendix E).
[2] 100% Federal cost

8.1.7 Risk and Uncertainty

In general, the ability of the Tentatively Selected Plan to provide the expected accomplishments depends on the validity of pertinent assumptions, base data, and analytical techniques used in this study; the successful completion of future studies, designs, and construction; and appropriate operation, maintenance, and repair after construction.

Other risks include constructability and resiliency to sea level rise. Subsidence reversal techniques have several factors that could affect constructability, such as estimated volumes of available material and containment of sediments in open water; however, successful implementation of similar projects (Donlon Island and Venice Cut) in the vicinity of Big Break and Little Frank's Tract indicate these risks are low. As the detailed designs of the Tentatively Selected Plan are developed during Preconstruction Engineering and Design (PED), these risks will be addressed as appropriate. Additionally, Delta water levels are projected to rise during the life of the project; however, the life cycle of the intertidal marsh vegetation is expected to be more than sufficient to accrue organic material and increase land elevation, naturally compensating for changes in sea level.

The HEP, used to quantify ecosystem restoration benefits, provides a reasonable representation of the outputs of the project. During detailed design of the project, hydraulic modeling would be performed to develop the specific habitat regime. The use of the well documented, successful reference sites for the basis of the HEP model increases the certainty of expected benefits.

8.2 Plan Implementation

This section describes the remaining steps to potential authorization of the project by Congress and implementation by USACE and the sponsor.

8.2.1 Report Completion

The draft feasibility report/EIS will be circulated for public and agency review for 45 days. A public meeting will be held to obtain comments from the public, agencies, and other interested parties. After completion of the public review period, comments will be considered and incorporated into the feasibility report/EIS, as appropriate. Comments received during the public and agency review, as well as responses, will be included as an appendix to the final report. The final feasibility report/EIS will be provided to any public agency that provided comments on the draft report.

8.2.2 Report Approval

As required by NEPA, USACE would issue a notice of availability of the final report and file the report with the USEPA. The USEPA notice of availability published in the *Federal Register* starts a 30-day public review period. USACE Headquarters would receive comments from Federal and State agencies, and complete its policy review of the final report.

After its review of the final feasibility report/EIS, including consideration of public, state and agency comments, USACE Headquarters would prepare the Chief of Engineers Report. This report would be submitted to the Assistant Secretary of the Army for Civil Works, who would coordinate with the Office of Management and Budget and submit the report to Congress. Assuming that the non-Federal sponsor remains willing to cost-share the project on the agreed terms, and assuming availability of Federal funding, detailed engineering studies and design efforts for the selected plan would be initiated, pending future Federal authorization and appropriations. A project management plan outlining Federal and non-Federal obligations, requirements, tasks, costs, and schedule from design through construction would also be prepared.

8.2.3 Project Authorization and Construction

If the project is authorized by Congress, construction funds must be appropriated for the project by Congress before a Project Partnership Agreement (PPA) can be signed by the USACE and sponsor and before project design and construction could begin.

8.2.4 Division of Responsibilities

Federal Responsibilities. The USACE would accomplish PED studies. After the PPA is signed and the non-Federal sponsor provides the required cash contribution, lands, easements, rights-of-way, relocations, and disposal areas the Federal Government would construct the project.

Non-Federal Responsibilities. Under the PPA, the non-Federal sponsor would be responsible to USACE for all costs and maintenance requirements.

Views of Non-Federal Sponsor. The non-Federal sponsor supports the Tentatively Selected Plan.

Financial Capability of Sponsor. The non-Federal sponsor has indicated that it intends to fund the project, pending further development through the final report and supporting documents.

Project Cost-Sharing Agreements. After Congressional approval, a Design Agreement must be executed between the USACE and the non-Federal sponsor in order to cost share the development of detailed plans and specifications. Before construction is started, the Federal Government and the non–Federal sponsor would execute a Project Partnership Agreement (PPA). The PPA defines the responsibilities of the parties throughout the project's design, construction and operational phases and specifies the non-Federal sponsor's required financial and real estate contributions.

8.2.5 Schedule

If the project is authorized in 2016, construction activities could start as early as 2018. Following is a schedule showing the approval and construction phases of the project, assuming optimal funding.

Division Commander's Notice	**September 2014**
Chief of Engineers Report	**December 2014**
Potential Authorization	**October 2016**
USACE and Sponsor sign Design Agreement	**September 2016**
PED	**2016-2018**
Initiate Construction	**2018**
Complete Physical Construction	**2022**
Complete Plant Establishment Period	**2024**
Complete Monitoring	**2028**

8.2.6 Further Studies

During PED, some additional studies would be undertaken as part of developing detailed designs for the project. Upon initiation of PED, any new information that has been collected by others would be considered before undertaking these additional studies. These studies include:

- Hydraulic modeling for project design;
- Topographic surveys for project design;
- Investigation (by the USACE Engineering Research and Development Center - Waterways Experiment Station) of installation of sacrificial hay bales for cost-effective erosion protection;
- Cultural resource surveys;
- Develop operation and maintenance manual.

CHAPTER 9 – RECOMMENDATIONS

The following text will be included in the final report, pending public review, policy review, technical reviews, and subsequent comments and revisions:

I recommend that the recommended plan (Tentatively Selected Plan – Alternative 6) be authorized for implementation, as a Federal project, with such modifications thereof as in the discretion of the Commander, U.S. Army Corps of Engineers, may be advisable. The estimated first cost of the recommended plan is $29,018,000 and the estimated annual OMRR&R cost is to be determined in the final report (October 2003 price levels). The Federal portion of the estimated first cost is $18,933,000. The estimated fully funded Federal first cost, based on projected inflation rates specified by Corps budget guidance, is $19,324,000. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide 35 percent of total project costs as further specified below:

    1. Provide 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

    2. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

    3. Provide, during construction, any additional funds necessary to make its total contribution equal to 35 percent of total project costs;

b. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefor, to meet any of the non-Federal obligations for the project unless the Federal agency providing the funds verifies in writing that the funds are authorized to be used to carry out the project;

c. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the outputs produced by the project, hinder operation and maintenance of the project, or interfere with the project's proper function;

d. Shall not use the project or lands, easements, and rights-of-way required for the project as a wetlands bank or mitigation credit for any other project;

e. Comply with all applicable provisions of the Uniform Relocation Assistance and Real

Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

f. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, 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 Federal Government;

g. Give the Federal 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, maintaining, repairing, rehabilitating, or replacing the project;

h. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

i. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, 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 Code of Federal Regulations (CFR) Section 33.20;

j. Comply with all the requirements of applicable Federal laws and implementing regulations, including, but not limited to: Title VI of the Civil Rights Act of 1964, Public Law 88-352, as amended (42 U.S.C. 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; the Age Discrimination Act of 1975 (42 U.S.C. 6102); the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Army Regulation 600-7 issued pursuant thereto; 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 substantial change the provisions 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 *et seq.*);

k. 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 Liabil-

ity Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations 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;

l. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

m. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

n. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213[j]), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Michael J. Farrell
Colonel,
Corps of Engineers
District Engineer

CHAPTER 10 – LIST OF PREPARERS

The individuals listed in the following table were primarily responsible for the preparation of this report.

Table 10-1. List of Preparers.

Name	Discipline	Credentials	Role in the Study
Anne Baker, Environmental Manager	7 years Corps of Engineers; Civil Works Projects; Planning and Environmental; California	BA: English	EIS Report Preparation and Integrated Report Editorial Review
Mike Dietl, Chief Flood and Storm Risk Reduction Section	15 years Corps of Engineers; Military and Civil Works Projects; Planning, Environmental, and Engineering; US and International	BS: Fisheries Biology	District Quality Control
Erik James, Sr Geotechnical Engineer, Levee Safety Section	6 years Corps of Engineers, 2 years private consulting, Civil/Geotechnical Engineering for Civil Works	BS Geology UC Davis 1997, BS Civil Engineering Sacramento State 2007	Lead Geotechnical Engineer
Bradley Johnson, Environmental Manager	3 years Corps of Engineers, Civil Works Projects, Environmental, California.	BS Landscape Architecture, UC Davis	EIS Report Preparation
Daniel Killip, Cost Engineer	6 years Corps of Engineers; Military and Civil Works Projects; Hydraulic Design; California & AED	BS: Civil Engineering, Cal Poly SLO, 2008; EIT, LSIT	Lead Cost Engineer
Cory Koger, Toxicologist, Environmental Chemistry Section	12 years Corps of Engineers; Military, Civil Works, Support for Others, FUDS, Dredging, HTRW and Environmental	PhD Pharmacology and Toxicology, UC Davis 2002; MS Chemistry, UC Irvine 1995; BS Chemistry, UC Irvine 1993; BS Biology UC Irvine 1993	HTRW and Dredging Lead
Kevin Lee, Hydraulic Analysis Section	6 years Corps of Engineers; Civil Works Projects, Hydraulic Design/Analysis	BS Civil Engineering , UC Davis 2007	Engineering Tech Lead
Brian Luke, Senior Environmental Manager/Biologist	7 years Corps of Engineers; Military and Civil Works Projects; Planning and Environmental	BS Biological Conservation, CSUS 2007.	HEP and CE/ICA

Gene Maak, Hydraulic Analysis Section			Hydraulic Lead (Flood Risk Management)
Dean McLeod, Economist, Water Resources Branch	15 years Water Resource Economics	MA Economics, BS Finance	Lead Economist
Scott Miner, Regional Technical Specialist, Water Resources Branch	33 years Corps of Engineers; Civil Works Projects; Planning and Environmental	MS Wildland Resource Science, UC Berkeley 1981; BA Biology, San Francisco State Univ 1979	District Quality Control
Nikki Polson, Archaeologist	5 years Corps of Engineers, 15 years archaeologist	MA Anthropology CSU Sacramento 2009, BS Anthropology Utah State University 2000	Lead Cultural Resources
Brooke Schlenker, Lead Planner	11 years Corps of Engineers; Military and Civil Works Projects; Planning, Environmental, and Engineering; California and Georgia	MS: Physical Science, Marshall University, 2006; BS: Integrated Science and Technology, Marshall University, 2001	Lead Planner; plan formulation and evaluation, report preparation, graphic preparation

CHAPTER 11 – REFERENCES

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