Draft

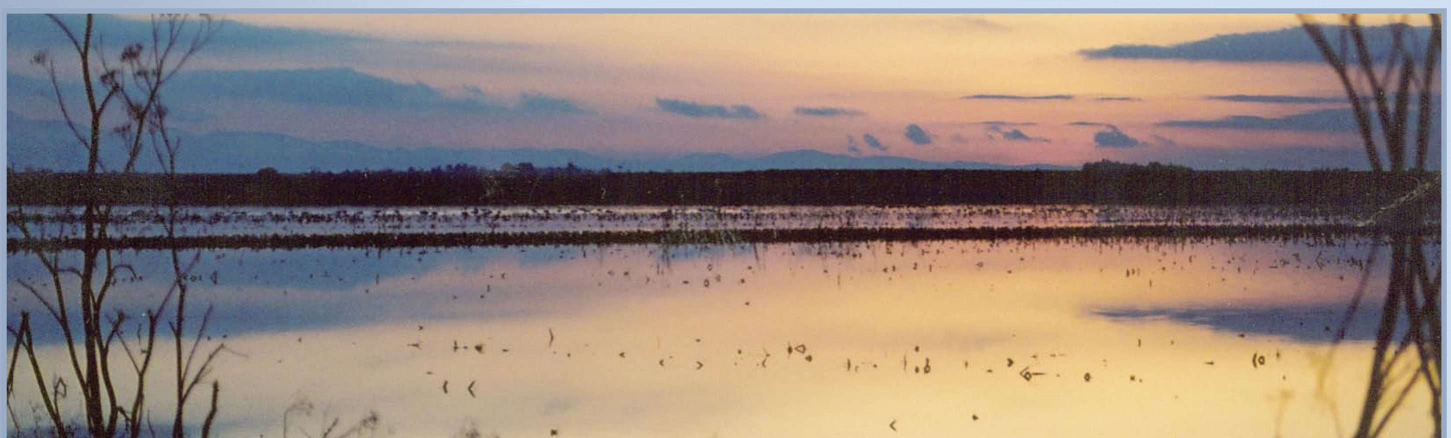
Environmental Impact Report

North Delta Flood Control and Ecosystem Restoration Project

VOLUME 1—EIR ANALYSIS

California Department of Water Resources

November 2007



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North Delta
Flood Control and Ecosystem Restoration Project

Volume 1—EIR Analysis

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
ADEIR	administrative draft EIR
AST	Aboveground Storage Tank
ASTM	American Society for Testing and Material
Authority	California Bay-Delta Authority
Bay-Delta Estuary	San Francisco Bay/Sacramento–San Joaquin River Delta Estuary
BDAC	Bay-Delta Advisory Council
BDPAC	Bay-Delta Public Advisory Committee
BMPs	best management practices
BP	before present
CA ML	Sacramento County Master List
CA SLIC	California Spills, Leaks, Investigation, and Cleanup Cost-Recovery System)
CA WDS	California Water Resources Control Board—Waste Discharge System
CAA	Clean Air Act
CALFED	CALFED Bay-Delta Program
CARB	California Air Resources Board
CBDA	California Bay-Delta Authority
CBSC	California Building Standards Code
CCMP	Comprehensive Conservation and Management Plan
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response and Liability Act
cfs	cubic feet per second
CGS	California Geological Survey
CHMIRS	California Hazardous Material Incident Report System

CNDDB	Natural Diversity Database
CNEL	Community Noise Equivalent Level
CO	carbon monoxide
CORTESE	Cortese Hazardous Waste and Substances Site List
CS	Sacramento County Contaminated Sites
CVP	Central Valley Project
CWA	Clean Water Act
cy	cubic yards
dB	Decibel
dBA	A-Weighted Decibel
DBP	disinfection byproducts
DCC	Delta Cross Channel
DEIR	draft EIR
Delta	The Sacramento–San Joaquin River Delta
DFA	Department of Food and Agriculture
DFG	California Department of Fish and Game
DHI	Danish Hydraulic Institute’s
DHS	Department of Health Services
DPC	Delta Protection Commission
DPR	California Department of Parks and Recreation
DRERIP	Delta Regional Ecosystem Restoration Implementation Plan
DSOD	Division of Safety of Dams
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utilities District
EDR	Environmental Data Resources Inc.
EIR	environmental impact report
EIS	environmental impact statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ERNS	Emergency Response Notification System
ERP	Ecosystem Restoration Program
ERPP	Ecosystem Restoration Program Plan
FEIR	final EIR
FRWP	Freeport Regional Water Project

ft/s	feet per second
FTA	Federal Transit Administration
FWCA	Fish and Wildlife Coordination Act
GCMs	general circulation models
GIS	geographic information system
HAZNET	Hazardous Waste Manifest Database
HCP	habitat conservation plan
HIST UST	Historical UST Registered Database
HMP	Hazard Mitigation Plan
HRs	hydrologic regions
I-5	Interstate 5
L_{dn}	Day-Night Level
L_{eq}	Equivalent Sound Level
L_{max}	Maximum Sound Level
Lmin	Minimum Sound Level
LUST	State of California Leaking Underground Storage Tank
Lxx	Percentile-Exceeded Sound Level
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MCWA	Mokelumne-Cosumnes Watershed Alliance
mgd	million gallons per day
MHHW	mean high high water
MHW	mean high water
MLLW	mean low low water
MLW	mean low water
MMP	mitigation monitoring and reporting plan
MOU	memorandum of understanding
MSCS	Multi-Species Conservation Strategy
MTL	mean tide level
NCCP	Natural Community Conservation Plan
NCCPA	Natural Community Conservation Plan Act
NDAT	North Delta Agency Team

NDFCERP	North Delta Flood Control and Ecosystem Restoration Project
NDIG	North Delta Improvements Group
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
NOC	Notice of Completion
NOD	Notice of Determination
NOI	Notice of Intent
NOP	Notice of Preparation
NOS	National Oceanic Service
Nox	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OPR	Governor's Office of Planning and Research
PG&E	Pacific Gas and Electric
PM10	particulate matter 10 microns or less in diameter
Porter-Cologne	Porter-Cologne Water Quality Control Act
PPV	Peak Particle Velocity
PRC	Public Resources Code
Project	North Delta Flood Control and Ecosystem Restoration Project
Prop	State Proposition
RCD	Resource Conservation District
RCRA	Resource Conservation and Recovery Act
Reclamation	U.S. Department of the Interior Bureau of Reclamation
ROD	Record of Decision
RSP	rock slope protection
SAFCA	Sacramento County Flood Control Agency
SARA	Superfund Amendments and Reauthorization Act
SB	Senate Bill
SCWA	Sacramento County Water Agency
SDIP	South Delta Improvements Program
SDWA	Safe Drinking Water Act

SET	Standard elutriate tests
SFEP	San Francisco Estuary Project
SIP	State Implementation Plan
SJCMVCD	San Joaquin County Mosquito and Vector Control District
SJCOG	San Joaquin County Council of Governments
SMARA	Surface Mining and Reclamation Act
SMUD	Sacramento Municipal Utility District
SPCC	Spill Prevention Control and Countermeasures
SR	State Route
SRFCP	Sacramento River Flood Control Project
SRRE	Source Reduction and Recycling Element
SVAB	Sacramento Valley Air Basin
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plan
SWR	Swift Water Rescue
S-YMVCD	Sacramento-Yolo Mosquito and Vector Control District
TMDL	total maximum daily load
TNC	The Nature Conservancy
TNM	Traffic Noise Model
TOC	total organic carbon
UBC	Uniform Building Code
UCD	University of California at Davis
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
WDRs	waste discharge requirements
WMU	Waste Management Unit
WQCPs	water quality control plans

Executive Summary

Introduction

The Sacramento–San Joaquin River Delta (Delta) is the focus of complex issues involving water supply, water quality, flood control requirements, and the environment. The Delta (Figure 1-1) provides water for a wide range of beneficial uses, including drinking water for millions of Californians, irrigation water for millions of acres of agricultural lands, and habitat for aquatic and terrestrial organisms. As the outlet point for California's major watersheds—the Sacramento and San Joaquin River systems—peak flows are often greater than the capacity of the levee-defined Delta waterways, resulting in seasonal flooding. The Delta also provides a permanent or seasonal home for a large variety of native plants and wildlife. Over the past several decades, increased demand for the Delta's water and other resources has exacerbated incompatibilities between human needs and efforts to sustain the Delta's fragile, unique ecosystem and recover special-status species.

The northern region of the Delta (North Delta) faces the need to balance the same issues and multi-use objectives as the larger estuary, particularly with regard to flood control and ecosystem restoration. Specifically, runoff from the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers during large storm events has caused flooding of homes, infrastructure, farms, and other businesses in the North Delta. Additionally, degradation and the loss of aquatic and terrestrial habitat are primary concerns in the North Delta. The California Department of Water Resources (DWR) proposes to implement the North Delta Flood Control and Ecosystem Restoration Project (Project) to address some of these complex issues.

Document Overview and Approach

This environmental impact report (EIR) is being prepared by DWR as the Project proponent and state lead agency under the California Environmental Quality Act (CEQA). As an EIR, this document discloses the program- and Project-level direct, indirect, and cumulative impacts of the Project alternatives, including a no-project alternative. The EIR also identifies mitigation measures to eliminate or reduce the magnitude of significant impacts.

This EIR effort was initiated as a joint document for compliance with both CEQA and the National Environmental Policy Act (NEPA). Therefore, it was intended to be released as a combined EIR and environmental impact statement (EIS) with the U.S. Army Corps of Engineers (USACE) as the lead agency for NEPA compliance. Under this structure, DWR and USACE conducted joint public scoping for the EIR/EIS.

However, USACE's involvement in the Project was subsequently deferred because of scheduling and budget constraints. Therefore, the current document is being prepared as an EIR only under CEQA, but in such a way as to comply also with NEPA to the extent possible in anticipation that a federal lead will eventually become involved, either as a funding partner with DWR or through its Project permitting authority. To that end, Project alternatives are analyzed on an equal, non-preferential basis and at an equal level of detail (consistent with NEPA standards). The proposed Project/preferred alternative will be identified in the Final EIR, with that selection to be informed through the CEQA process.

Background

Because of ongoing conveyance, flood control, and ecosystem health issues, improvements in the North Delta have been the focus of planning efforts for many years. A brief historical context leading to the current Project is summarized below.

In 1987, DWR launched a planning and environmental documentation process for the North Delta Program, which led to the release of a draft EIR/EIS in 1990. Many of the elements and objectives of the 1990 effort were similar to this EIR; however, one important difference is that the Draft 1990 EIR/EIS included water supply and conveyance benefits from modification of the Delta Cross-Channel (DCC). These elements are now being studied under separate efforts. The current Project improvements under this EIR are focused on flood control and ecosystem restoration benefits. The project will include elements that provide additional benefits, such as improved conveyance and recreational use, to the extent that meeting secondary goals does not interfere with the primary purpose of the project.

Relationship to the CALFED Bay-Delta Program

In 1995, DWR suspended the North Delta planning efforts in deference to the CALFED Bay-Delta Program. The goals of the 1990 North Delta EIR/EIS were substantially absorbed into the CALFED Program and restructured as the North Delta Flood Control and Ecosystem Restoration improvements (subject of this EIR) and the Delta Cross-Channel Re-operation and Through-Delta Facility studies. While the CALFED Bay-Delta Program was completing the Programmatic Bay-Delta EIR/EIS, CALFED staff convened the North Delta Improvements Group (NDIG) to initiate North Delta flood improvements planning. The group focused early planning efforts on preparation of the

"DRAFT White Paper on North Delta Improvements," (White Paper) dated July 2000, to capture the complex history of the area, the then-current related planning efforts, and preliminary planning research. Further alternatives development activities were described in the "Description of Alternatives Evaluation Process" document, which is included in this EIR as Appendix B.

The Project is being proposed as an element to implement the California Bay-Delta Program described in the CALFED Programmatic Record of Decision (ROD), issued August 28, 2000. The Preferred Program Alternative described in the ROD is a long-term plan that includes a variety of different potential actions to be implemented over 30 years by numerous public and private entities to improve the health of the Bay-Delta Estuary.

The Project is consistent with the implementation approach in the ROD. The Project has been developed in the context of the overall Bay-Delta Program and represents one of the ways to achieve the four equal CALFED objectives of improving water quality, ecosystem quality, levee system integrity, and water supply reliability. The Project meets the policy commitments described in the ROD that each project implementing the Bay-Delta Program will be subject to the appropriate type of environmental analysis and will evaluate and use the appropriate programmatic mitigation strategies described in the CALFED Programmatic EIS/EIR (PEIS/EIR) and the ROD. (Id., pp. 29–30, 32–35, and Appendix A.) Further, the Project is consistent with the recently enacted California Bay-Delta Act, which charges DWR with implementing the conveyance and levee system integrity elements of the Bay-Delta Program.

The CALFED PEIS/EIR provides a broad programmatic analysis of the general effects of implementing the multiple components of the Bay-Delta Program. The impact analyses in the PEIS/EIR were not intended to address any site-specific environmental effects of individual projects. The CALFED PEIS/EIR was therefore used to develop background information and for screening of program-level alternatives only. This Project EIR stands alone and includes an independently developed analysis of the impacts of the Project, including direct, indirect, and cumulative impacts, alternatives, and avoidance/mitigation measures.

Readers who desire more information about the Bay-Delta Program, the CALFED PEIS/EIR, and the ROD may wish to review the documents at the website:

<http://calwater.ca.gov>.

Acquisition of McCormack-Williamson Tract and Staten Island

In 1999, The Nature Conservancy (TNC) obtained $5.6 million in CALFED Ecosystem Restoration Program (ERP) funds to purchase the approximately 1,600-acre McCormack-Williamson Tract for ecosystem restoration and flood control. Also in 1999, University of California, Davis (UCD) researchers and DWR obtained CALFED ERP funds in complementary proposals. UCD researchers received $556,200 to conduct historical research and baseline studies for restoration planning and a monitoring program, and DWR received $355,000 for restoration planning and design of engineering alternatives. The UCD research included analysis of historical hydrogeomorphic conditions, the modern hydrologic and sedimentologic regime, baseline studies of aquatic resources and riparian resources, and development of data management and monitoring systems.

Staten Island was purchased by TNC in late 2002 with roughly $17.5 million in State Proposition (Prop) 13 funds and roughly $17.5 million in Prop 204 funds under the Flood Protection Corridor Program. Consistent with the funding sources for purchase of Staten Island, DWR committed to carefully balance use of Staten Island for ecosystem restoration and flood control protection and agricultural preservation. A crucial component of this balance is protection of the greater sandhill crane habitat on Staten Island.

Stakeholder Involvement and Public Outreach

The Project planning process has been enriched through the participation of stakeholders beyond DWR and the CALFED agencies as integral voices in Project development. Involvement and outreach efforts have been focused through facilitated meetings and a dedicated website.

DWR met with the CALFED ERP Steering Committee throughout 2001 and 2002 to obtain guidance on ecosystem restoration concepts for the Project. The Steering Committee advised DWR staff to submit ecosystem restoration proposals in the CALFED Ecosystem Restoration Proposal Solicitation Process. In 2003 and 2004, DWR convened a series of ecological coordination meetings with agency and nonprofit scientists to develop ecosystem restoration concepts for the Project and to address comments received in public scoping sessions. The ecological restoration coordination team consisted of representatives from the California Department of Fish and Game (DFG), the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), TNC, and the California Bay-Delta Authority (CBDA) and met regularly throughout 2003 and 2004.

The NDIG was specifically created as a forum for exchanging Project information, establishing goals and objectives, developing alternatives, and discussing analysis results. The NDIG’s noticing list has grown considerably from the initial Project planning and scoping meetings and now includes approximately 150 email addresses. Since 2001, the NDIG has been meeting with diverse and spirited involvement as Project needs dictate. The meetings are roughly bimonthly and are open to the public.

The North Delta Agency Team (NDAT) is a subgroup of the NDIG consisting of representatives of state and federal agencies that ultimately will have approval authority for elements of the Project based on various regulatory triggers. The NDAT has been convened roughly four times per year since 2001 and has provided guidance to ensure that regulatory considerations are factored into Project development to facilitate an efficient review and approval process.

Ad hoc subgroups have been convened as needed to address specific Project elements, such as hydraulic modeling.

In support of and in addition to direct meetings, Project information is readily available to the public at the Project website:

<http://www.dfm.water.ca.gov/dsmo/northdelta>.

A Science Panel chaired by Jeff Mount of UCD and consisting of academics from various disciplines was convened four times (November 2003 through January 2005) to review the ecological restoration conceptual ideas for the Project. The Science Panel provided feedback for refinement of the ecological restoration options and recommended modifications to improve the scientific basis of the Project. The results of the Science Panel are included as Appendix C.

Project Purpose, Need, and Objectives

Project Purpose

The purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Flood control improvements are needed to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures in the Project study area.

To be aligned with the overall goals of the CALFED program, the Project should also be compatible with and supportive of the other program elements outlined in the CALFED PEIS/EIR. Therefore, to the extent that meeting other goals does not interfere with the primary purpose of the Project, DWR will incorporate Project elements that are compatible and consistent with the following CALFED objectives:

- improve conveyance water supply reliability at the south Delta export pumps;
- improve water quality at the south Delta export facilities by facilitating reductions in salinity levels in the San Joaquin River;
- recommend ecosystem restoration and science actions in the Project area consistent with the CALFED ERP's strategic goals and objectives;
- improve levee stability and integrity within the Project area;

- minimize the conversion of prime, statewide-important, and unique farmlands to Project uses; and
- improve and enhance existing and future recreational use within the Project area.

Project Need

As described above, flood control improvements are needed to reduce damage from overflows caused by insufficient channel capacities and levee failures in the Project study area. The Project would address the need for flood control solutions that are integrated with ecosystem improvements. The existing and historical conditions that warrant flood control and ecosystem quality improvements are described below.

Flood Control

The Mokelumne and Cosumnes Rivers and the Morrison Creek stream group do not currently have sufficient channel capacity to safely convey peak historical flows from Sierra Nevada watersheds, such as occurred during the 1986 and 1997 flood events, through the North Delta to the San Joaquin River. Current channel capacities for the North and South Forks of the Mokelumne River are approximately 40,000 cubic feet per second (cfs). By comparison, the combined channel capacity required to safely convey flows from a 100-year flood event has been estimated at 90,000 cfs. During peak flows, water from the Mokelumne River backs up into a broad floodplain north of New Hope Tract, and the limited capacity further causes water to back up into Snodgrass Slough to the north toward Lambert Road.

The lack of channel capacity, combined with constrictions in vulnerable areas (e.g., bridge abutments) and an increase in sedimentation levels, makes a number of areas in the North Delta vulnerable to flooding. Since 1955, several areas have been flooded after levees failed (by breaches or overtopping), including the Point Pleasant area, McCormack-Williamson Tract, Tyler Island, Dead Horse Island, New Hope Tract, Canal Ranch Tract, Glanville Tract, and Franklin Pond area. The potential for flooding also threatens important public facilities and institutions in the North Delta area, including Interstate 5 (I-5), the Union Pacific Railroad line, and the Rio Cosumnes Correctional Center. Aside from these site-specific effects, failure of Delta levees can generally:

- result in flooding of Delta communities, farmland, habitat, and key roads and highways;
- expose adjacent islands to increased wave action, increased seepage, and possible levee erosion;
- degrade water quality through the exposure of contaminants that are otherwise trapped in or behind the levee;

- affect water supply distribution systems; and
- affect flow patterns, potentially resulting in adverse impacts on water quality, if the levee breach is not repaired.

A particular phenomenon associated with levee failure on McCormack-Williamson Tract is the “surge effect” created by the sudden rush of water over the island when the levee breaches or is overtopped. The force of the water from the surge effect rushes across the island from the northeast to the southwest, ultimately reaching the Walnut Grove and Wimpy’s/New Hope marinas. At this point, the surge can displace mobile homes, damage infrastructure, and break boats loose from their moorings. As evidenced in past flood events, flood damage can be considerable when this occurs, as the unmoored boats can become lodged against the New Hope Bridge, compounding the channel constriction with other debris. The channel constriction causes water surface elevation to rise and create a back-up condition upstream and unstable conditions on adjacent areas. The overall result historically has constituted substantial property damage and threat to human safety, both in the immediate area and potentially on adjacent islands.

Ecosystem Restoration

Degradation and the loss of habitats that support various life stages of aquatic and terrestrial species are a primary concern in the North Delta. These habitat changes come from many causes, including sedimentation from hydraulic mining, habitat conversion, water diversions, and the introduction of exotic species.

Thirty years of nineteenth century hydraulic mining in the river drainages along the eastern edge of the Central Valley have increased sedimentation levels in downstream watercourses, degrading valuable aquatic habitat. Many of the seasonally inundated lands in the Bay-Delta system that historically provided habitat to a variety of bird and animal species have been converted to agricultural, industrial, and urban uses. Levees constructed to protect lands in the Delta from inundation and to channelize flow to flush out sediment eliminated fish access to shallow overflow areas, and dredging to construct levees eliminated the tule bed habitat along the river channels. Upstream water development and use, depletion of natural flows by local diverters, and the diversion of water from the Bay-Delta system have altered hydrodynamic processes. This has resulted in changed seasonal patterns of inflow, reduced Delta outflow, and diminished natural variability of flows into and through the Bay-Delta system. Those facilities constructed to support water diversions may result in straying or direct losses of fish and can increase exposure of juvenile fish to predation.

Recreation

The Delta is highly attractive for numerous recreational uses, including motorized and non-motorized boating, fishing, hunting, and wildlife viewing. Much of the North Delta is privately owned, including the levees that contain its hundreds of miles of waterways. Because of these ownership patterns, designated public access points are relatively few. Safe and convenient public recreation access and infrastructure clearly are needed to meet current and future demand.

Project Objectives

Based on the purpose and need stated above, the Project is meant to satisfy the following objectives. Project alternatives are divided into two basic groups (Group I and Group II) for this analysis; objectives are subdivided by Project group, differentiating uniquely group-specific objectives where appropriate. A separate category is used to identify objectives applying to each group.

Flood Control

Both Groups

- Convey floodflows to the San Joaquin River without immitigable stage impacts.
- Reduce the risk of catastrophic levee failures based on the 1997 event for stage and the 1986 event for volume.

Group I

- Control floodwaters coming through McCormack-Williamson Tract in a way that minimizes the surge effect, i.e., avoids the historical occurrence when a large pulse of water from McCormack-Williamson Tract adversely affected adjacent island levees (e.g., Tyler and Staten Islands) and downstream flows and knocked boats loose from local marina moorings in flood events.

Group II

- Provide flood control benefits to I-5 and the Project area by achieving stage reduction, below or as close as possible to a water surface elevation of approximately 16.5 feet at Benson’s Ferry and approximately 12.0 feet at New Hope Landing, based on the 1997 event for stage and the 1986 event for volume. These objectives were developed through stakeholder consensus as reasonable stage targets to minimize North Delta area flood damages.

Ecosystem Restoration

Both Groups

- Implement science-driven pilot programs to restore ecologic, hydrologic, geomorphic, and biologic processes and self-sustaining habitats, including freshwater tidal marsh, seasonal floodplain, riparian, and other wetland habitats.
- Support special-status species.
- Limit exotic species establishment.
- Promote foodweb productivity.

Group I

- Promote natural flooding processes and tidal action.
- Promote processes to increase land surface elevations in areas of subsidence.

Group II

- Expand available floodplain area within the leveed channel.
- Minimize potential effects on greater sandhill cranes.

Recreation

Both Groups

- Enhance public recreation opportunities in a manner that does not compromise flood protection infrastructure or operations, compromise habitat integrity, or disturb wildlife.

Project Area

The Project area, shown in Figure 1-2, is approximately 197 square miles and is the area in which DWR is considering alternatives for flood control and restoration actions. Direct (on-the-ground) impacts of constructing the alternatives are evaluated within this area; however, certain impact analyses include evaluation of effects beyond these limits. The following criteria were used to develop Project area boundaries.

- The Project area must include the footprint area of each alternative.

- The Project area should be hydrologically contiguous.
- The Project area should include portions of all waterways where existing flow patterns could be substantially affected by one or more of the alternatives.
- The Project area should be compatible with flood control planning and implementation responsibilities of other flood control agencies.
- To the extent practicable, the Project area should be compatible with CALFED's ERP planning units.

A brief description of the Project area boundaries is presented below.

Northern Boundary	Line running east to west from the Sacramento–San Joaquin Delta Ecological Zone eastern boundary along the south bank of Morrison Creek to the west bank of the Sacramento River.
Western Boundary	Follows the west bank of the Sacramento River from Morrison Creek south to the confluence of Steamboat Slough. From here the boundary follows the east bank of the Sacramento River south to the confluence of Threemile Slough. From here, the boundary follows the north bank of Threemile Slough to its confluence with the San Joaquin River.
Southern Boundary	Follows east along the south bank of the San Joaquin River from Threemile Slough to Potato Slough, along the south bank of Potato Slough to White Slough, along the south bank of White Slough to the Upland Canal, along the south bank of Upland Canal to State Route (SR) 12, then along SR 12 east to the eastern boundary of the Sacramento–San Joaquin Ecological Zone.
Eastern Boundary	Follows the eastern boundary of the Sacramento–San Joaquin Ecological Zone north from State Route (SR) 12 to its intersection with I-5 near Point Pleasant. From here, the boundary follows I-5 north to its intersection with the Sacramento–San Joaquin Ecological Zone near the northeastern shore of Stone Lake. Then the boundary follows the Sacramento–San Joaquin Ecological Zone once again north to Morrison Creek.

Figures 1-3, 1-4, and 1-5 show McCormack-Williamson Tract, Staten Island, and the Grizzly Slough property, respectively, highlighting interior elevation ranges.

Project Description

Alternatives Screening

DWR is pursuing the development of the Project to achieve flood control and ecosystem restoration benefits in the North Delta, as well as additional benefits such as recreation improvements where practicable. In broad terms, the Project is intended to meet equal flood control and ecosystem restoration purposes and objectives by minimizing the surge effect across McCormack-Williamson Tract and providing additional capacity in the Project area to minimize the potential for catastrophic flooding, while substantially increasing opportunities for habitat and ecological processes.

DWR prepared a Description of Alternatives Evaluation Process Report (Appendix B) detailing the process by which a considerable range of Project-level measures have undergone screening as part of the identification of practicable alternatives to the Project, as well as providing a Project-specific evaluation independent of the CALFED documents. Based on the first screen of compatibility with the Project objectives, the alternatives and their components described below have been advanced for environmental analysis in the EIR.

Alternative Groups

Proposed Project actions and alternatives are divided into two basic groups for analysis in this EIR, under the following considerations.

- A grouped approach has been chosen to allow flexibility in implementation depending on determination of incremental Project need, available funding, and Project partnerships. It should be noted that the grouped analysis simply facilitates a phased implementation and would not preclude the implementation of the Project as a single phase.
- The groups are being developed to be independent, such that the proposed component actions are targeted to meet group-specific objectives and that the groups are not inter-reliant for mitigating impacts (i.e., Group II is not required for mitigation of Group I).
- Both groups are analyzed at the level of detail available; however, implementation of some elements may require additional CEQA analysis, depending on specific details discovered through Project development. Such additional analysis may be documented through a tiered negative declaration or technical addendum and may not require a supplemental or subsequent EIR.

Group I

Group I consists of modifications to levees on McCormack-Williamson Tract, downstream levee raising to offset potential hydraulic impacts caused by these modifications, restoration of McCormack-Williamson Tract and the Grizzly Slough property, and dredging of the Mokelumne River.

Flood Control

To achieve flood control objectives, the primary strategy for Group I is degrading portions of the levee system to allow controlled flow across McCormack-Williamson Tract and marina outreach to address boat hazards during floods. Secondarily, downstream levee modifications may be necessary to mitigate hydraulic impacts, and channel dredging may be implemented to increase flood conveyance capacity.

Ecosystem Restoration

Floodplain forests and marshes would be recreated at McCormack-Williamson Tract and the Grizzly Slough property. At McCormack-Williamson Tract, natural hydrologic processes would be restored through one of three pilot program strategies to meet different ecological objectives:

- maximizing fluvial and tidal processes to create a diverse network of riverine, floodplain, and tidal habitats based on natural sedimentation and channel formation;
- maximizing floodplain habitat to benefit fish that spawn and rear on the floodplain by allowing flooding (with some tidal action to maintain water quality) during the wet season; or
- creating floodplain habitat as described above, combined with a demonstration project to reverse subsidence and increase elevations on the tract.

Landside levee slopes would be planted with trees, shrubs, and native grasses to improve habitat for wildlife.

DWR has prepared a more complete description of the ecosystem restoration for McCormack-Williamson Tract as envisioned and articulated as a conceptual model for each of the three pilot program strategies. These conceptual models were developed with input from the science panel, resource agency representatives, and other stakeholders. The conceptual models are detailed in Appendix D.

Additional benefits to wildlife, fish, and healthy ecosystem functions would be achieved by recreating floodplain forests at the Grizzly Slough property. The Grizzly Slough restoration would maximize floodplain habitat to benefit fish that spawn and rear on the floodplain and reconnect the floodplain with adjacent sloughs.

Recreation

Opportunities for recreation would be developed to be compatible with flood control and ecosystem restoration through the development of public access for fishing, wildlife viewing, and boat use. Recreation could be enhanced by:

- opening up the southern portion of McCormack-Williamson Tract to boating and/or
- improving Delta Meadows property.

Group II

Group II consists of proposed Project actions on Staten Island and levee modifications, and dredging along the Mokelumne River.

Flood Control

To achieve flood control objectives, the strategy for Group II is to create an off-channel detention basin on Staten Island in one of three optional locations on the north, east, or west part of the island, or dredging in combination with levee modifications. Dredging may also be an optional component combined with detention to improve channel capacity. However, dredging combined with levee modifications is also being evaluated as a stand-alone action in lieu of off-channel detention.

Ecosystem Restoration

Benefits to ecosystem function in Group II would consist of expanded floodplain area within the leveed channel through the construction of a setback levee. By creating a setback levee on Staten Island to expand the flood conveyance capacity of the Mokelumne River to the detention basin and lowering and breaching the existing levee, additional floodplain habitats would be created, including shallow-water, shaded riverine aquatic, and riparian.

It is anticipated that broadening the floodplain to allow natural geomorphic processes would improve river-floodplain connectivity, promote sedimentation, allow channel migration, and promote foodweb productivity.

Recreation

Opportunities for recreation would be developed to be compatible with flood control and ecosystem restoration through the development of public access for wildlife viewing. Recreation would be enhanced by:

- access and interpretive kiosks for wildlife viewing and

- restroom, circulation, parking, and signage infrastructure to support such uses.

Project Alternatives

Various actions and measures to meet the Project objectives have been developed and refined through technical brainstorming sessions, public and agency scoping input, hydraulic modeling, and stakeholder participation. These actions, termed *components* herein, have been packaged as alternatives, described below, and summarized in Table ES-1. To assist in distinguishing components from alternatives, each component title begins with an action word, such as *install* or *excavate*. Alternative titles are nouns and represent broader strategies or approaches, typically composed of numerous component actions.

Table ES-1. Summary of Project Alternatives by Group

Group	Alternative Code	Alternative Description
–	NP	No Project
1	1-A	Fluvial Process Optimization
1	1-B	Seasonal Floodplain Optimization
1	1-C	Seasonal Floodplain Enhancement and Subsidence Reversal
2	2-A	North Staten Detention
2	2-B	West Staten Detention
2	2-C	East Staten Detention
2	2-D	Dredging and Levee Modifications

One alternative from each group ultimately will be selected to advance as the preferred alternative. Comments received on the administrative draft and public EIRs will be considered in determining the preferred alternative, which will be identified in the Final EIR. The preferred alternative may also include optional components, which will be analyzed for inclusion in the Project but may or may not be implemented. A conceptual summary of each alternative is described below.

Alternative NP: No Project

Consideration of a no-project or no-action alternative is required for CEQA and NEPA. Herein called the No-Project Alternative, this alternative compares existing baseline conditions and the likely future conditions in the Project area without the implementation of the Project. Under the No-Project Alternative, the existing conditions are compared with projected future conditions at a planning horizon of 2025. If the Project were not implemented, the components described below for improvements to flood control, ecosystem restoration, and recreation would not be implemented. It is not definitively known whether farming would continue because of the presently marginal profitability; however, it is assumed for the future no-project condition that agriculture would continue and cropland would be the dominant cover type, consistent with the existing condition.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. See Figure 2-1 for a plan of this alternative.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. See Figure 2-15 for a plan of this alternative.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. See Figure 2-19 for a plan of this alternative.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all the detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. See Figure 2-22 for a plan of this alternative.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all the detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. See Figure 2-29 for a plan of this alternative.

Alternative 2-C: East Staten Detention

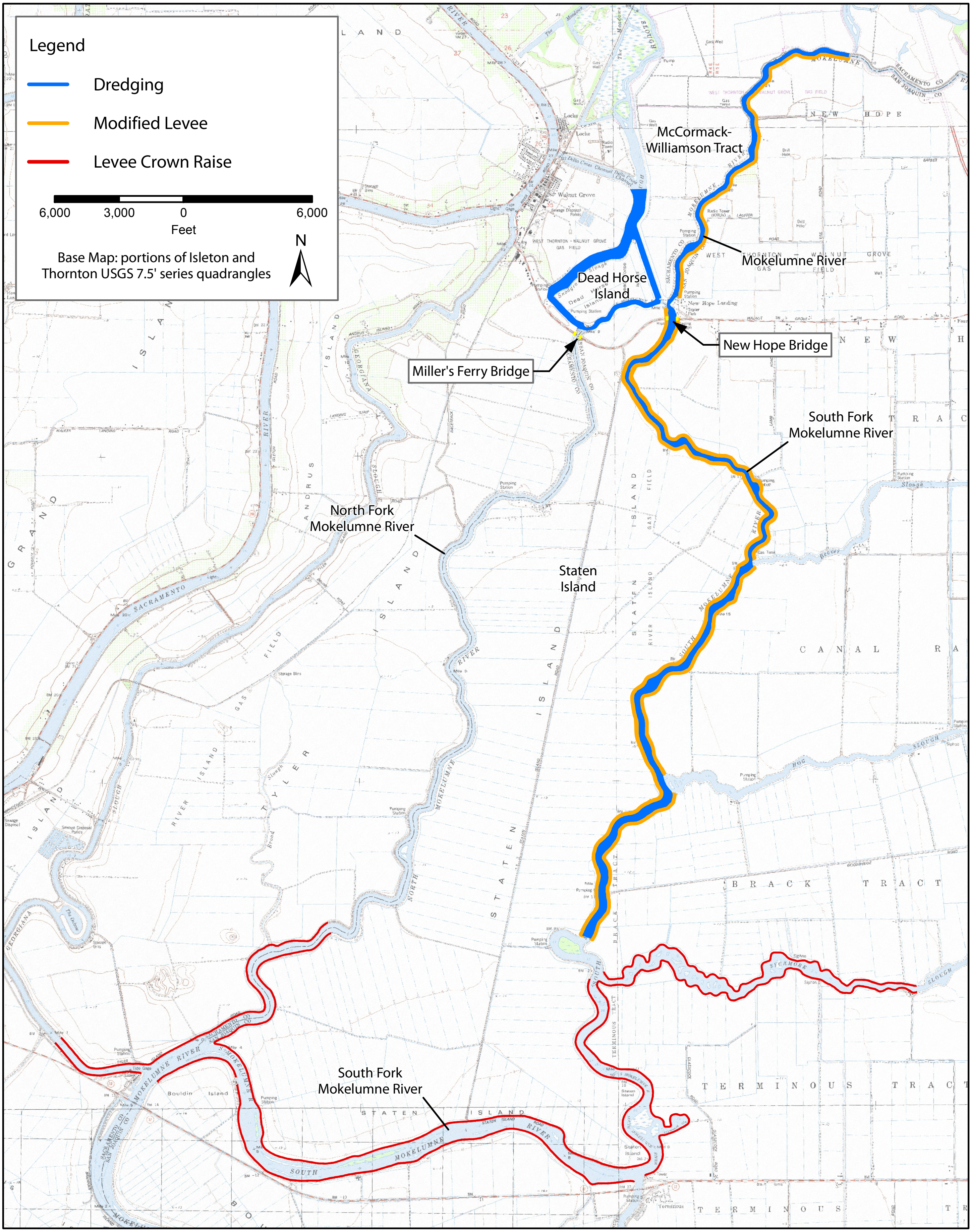
This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all the detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. See Figure 2-32 for a plan of this alternative.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. See Figure 2-33 for a plan of this alternative.

Alternative Components

The components composing each alternative are summarized below in Table ES-2a (Group I) and Table ES-2b (Group II), wherein *X* denotes that the component is included in the alternative and *OP* denotes the component is an optional within the alternative.



Jones & Stokes

Figure 2-33
Alternative 2-D: Dredging and Levee Modification Plan

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Table ES-2a. Summary of Group I Alternatives and Components

	1-A	1-B	1-C
	Fluvial Process Optimization	Seasonal Floodplain Optimization	Seasonal Floodplain Enhancement and Subsidence Reversal
Degrade McCormack-Williamson Tract East Levee to Function as a Weir	X	X	X
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir	X	X	X
Reinforce Dead Horse Island East Levee	X	X	X
Modify Downstream Levees to Accommodate Potentially Increased Flows	X	X	X
Construct Transmission Tower Protective Levee and Access Road	X	X	X
Demolish Farm Residence and Infrastructure	X	X	X
Enhance Landside Levee Slope and Habitat	X	X	X
Modify Landform and Restore Agricultural Land to Habitat	X	X	X
Modify Pump and Siphon Operations	X	X	X
Breach Mokelumne River Levee	X		
Allow Boating on Southeastern McCormack-Williamson Tract	X		
Construct Box Culvert Drains and Self-Regulating Tide Gates		X	X
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area			X
Import Soil for Subsidence Reversal			X
Implement Local Marina and Recreation Outreach Program	X	X	X
Excavate Dixon and New Hope Borrow Sites	X	X	X
Excavate and Restore Grizzly Slough Property	X	X	X
Dredge South Fork Mokelumne River	OP	OP	OP
Enhance Delta Meadows Property	OP	OP	OP

Table ES-2b. Summary of Group II Alternatives and Components

	2-A North Staten Detention	2-B West Staten Detention	2-C East Staten Detention	2-D Dredging and Levee Modifications
Construct Inlet Weir	X	X	X	
Construct Interior Detention Levee	X	X	X	
Construct Outlet Weir	X	X	X	
Install Detention Basin Drainage Pump Station	X	X	X	
Reinforce Existing Levees	X	X	X	
Construct Setback Levee		X	X	
Degrade Existing Levee	X	X	X	
Relocate Existing Structures	X	X	X	
Modify Walnut Grove–Thornton Road and Staten Island Road	X			
Retrofit or Replace Millers Ferry Bridge	OP	X	OP	OP
Retrofit or Replace New Hope Bridge	OP	OP	X	OP
Construct Wildlife Viewing Area	X	X	X	
Excavate Dixon and New Hope Borrow Sites	X	X	X	
Dredge South Fork Mokelumne River				X
Modify Levees to Increase Channel Capacity				X
Raise Downstream Levees to Accommodate Increased Flows				X

Related Actions, Programs, and Planning Efforts

The projects and programs described below are related to environmental conditions in the Delta and in upstream areas. Some of these projects are being implemented now, and others are in development. The description of these projects provides a context for understanding planning related to the Project and for analyzing cumulative environmental effects of the Project.

The following projects have been categorized by their *primary* purpose or function:

Flood Control

- Cosumnes River Task Force
- Delta Risk Management Strategy
- Interstate-5/Point Pleasant Flood Protection Project
- Cosumnes & Mokelumne Rivers Floodplain Integrated Resources Management Plan
- San Joaquin River Basin–South Sacramento County Streams Investigation
- South Sacramento County Streams Project
- Emergency bank protection sites along Sacramento River system

Ecosystem Restoration

- CALFED Ecosystem Restoration Program
- Canal Ranch Habitat Restoration Planning
- Grizzly Slough Project
- Joint Settlement Agreement for the Mokelumne River
- McCormack-Williamson Tract Wildlife-Friendly Levee Demonstration Project
- Lower Mokelumne River Partnership Projects
- Lower Mokelumne River Restoration Program
- Murphy Creek Restoration Project
- Staten Island Ducks Unlimited Project

Water Supply and Conveyance

- Delta Cross-Channel Re-Operation Study
- Freeport Regional Water Project
- Screened Through-Delta Facility Evaluation
- South Delta Improvements Project
- Los Vaqueros Expansion

Water Quality

- Assessment of Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed

Ongoing Watershed Studies

- The Cosumnes Consortium Research and Monitoring Program

Public Outreach

- The Lower Mokelumne River Stewardship Program
- Mokelumne-Cosumnes Watershed Alliance

Planning Documents

- The San Joaquin County Multi-Species Habitat Conservation and Open Space Plan Program

Summary of Environmental Impacts and Mitigation Measures

Table ES-3 is a summary of the impacts, mitigation measures, and determination of significance for the Project as analyzed in the EIR.

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
HYDROLOGY AND HYDRAULICS				
Impacts and mitigation discussed in other sections				
FLOOD CONTROL AND LEVEE STABILITY				
FC-1: Raise Flood Elevations and Increase the Frequency of Flooding	1-A–C	Less than significant	None required.	–
FC-1: Raise Flood Elevations and Increase the Frequency of Flooding	1-OP1*	Less than significant	None required as long as the alternative retains the features that minimizes impacts through implementation.	–
FC-1: Raise Flood Elevations and Increase the Frequency of Flooding	2-A–C	No impact	None required.	–
FC-2: Increase the Degree or Quantity of Seepage	1-A–C, 1-OP1, 2-A–D	Significant	FC-1: Develop a Seepage-Monitoring Program.	Less than significant
FC-3: Increase the Degree or Quantity of Levee Settlement	1-A–C, 1-OP1, 2-A–D	Less than significant	None required.	–
FC-4: Increase the Degree or Quantity of Wind Erosion	1-A–C, 1-OP1, 2-A–C	Less than significant	None required.	–
FC-5: Increase the Degree or Quantity of Scour	1-A–C, 1-OP1	Less than significant	None required.	–
FC-5: Increase the Degree or Quantity of Scour	2-A–C	–	The discussion and evaluation of potential scour impacts are presented again in Section 3.3, Geomorphology.	–
FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees	1-A–C, 1-OP1, 2-A–D	Less than significant	None required.	–
FC-7: Decrease Levee Inspection and Maintenance	1-A–C, 2-A–C	No impact	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
FC-8: Decrease in Levee Stability from Proposed Construction Activities	1-A–C, 1-OP1, 2-A–D	Less than significant	None required.	–
FC-9: Decrease in Levee Stability from Non-Motorized Boating Activities	1-A	Less than significant	None required.	–
FC-10: Temporary Decrease in Flood Control or Levee Stability during Channel Dredging	1-OP2*, 2D	Less than significant	None required.	–
GEOMORPHOLOGY AND SEDIMENT TRANSPORT				
GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications	1-A–C, 2-A–C	Less than significant	None required.	–
GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications	1-A–C, 2-A–C	Less than significant	None required.	–
GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Levee Modifications	1-A–C	Beneficial	None required.	–
GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Detention Basin Construction	2-A–C	Less than significant	None required.	–
GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications	1-A–C, 2-A–C	Less than significant	None required.	–
GEOMORPH-5a: Increase in Scouring on Land as a Result of Levee Modifications (McCormack-Williamson Tract East Levee)	1-A–C	Less than significant	None required.	–
GEOMORPH-5b: Increase in Scouring on Land as a Result of Levee Modifications (Mokelumne River Levee)	1-A	Beneficial	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
GEOMORPH-5c: Increase in Scouring on Land as a Result of Levee Modifications (Dead Horse Island)	1-A–C	Less than significant	None required.	–
GEOMORPH-5d: Increase in Scouring on Land as a Result of Detention Basin Construction (North Staten Island Inlet Weir)	2-A	Less than significant	None required.	–
GEOMORPH-5e: Increase in Scouring on Land as a Result of Detention Basin Construction (North Staten Island Interior Detention Levee)	2-A	Less than significant	None required.	–
GEOMORPH-5f: Increase in Scouring on Land as a Result of Detention Basin Construction (West Staten Island Inlet Weir)	2-B	Less than significant	None required.	–
GEOMORPH-5g: Increase in Scouring on Land as a Result of Detention Basin Construction (West Staten Island Interior Detention Levee)	2-B	Less than significant	None required.	–
GEOMORPH-5h: Increase in Scouring on Land as a Result of Detention Basin Construction (East Staten Island Inlet Weir)	2-C	Less than significant	None required.	–
GEOMORPH-5i: Increase in Scouring on Land as a Result of Detention Basin Construction (East Staten Island Interior Detention Levee)	2-C	Less than significant	None required.	–
GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring	1-A–C	Beneficial	None required.	–
GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring	2-A–C	Significant and unavoidable	None available.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
GEOMORPH-7: Scour and Deposition Associated with Excavation and Restoration of the Grizzly Slough Property	1-A–C	Beneficial	None required.	–
GEOMORPH-8: Increase in Scouring on South Fork Mokelumne River and Associated Increase in Deposition Downstream	1-A–C, 2-D	Less than significant	None required.	–
WATER QUALITY				
WQ-1: Release of Pollutants during Construction and Dredging	1-A–C, 2-A–D	Less than significant	None required.	–
WQ-2: Release of Organic Carbon	1-A–C	Less than significant	None required.	–
WQ-3: Release of Methylmercury	1-A–C	Significant	WQ-1: Participate in an Offset Program to Ensure No Net Increase in Methylmercury Loading.	Less than significant
WATER SUPPLY AND MANAGEMENT				
WSM-1: Changes in Water Uses as a Result of the Project	1-A–C, 2-A–D	Less than significant	None required.	–
GROUNDWATER				
GW-1. Potential Increase in Groundwater Levels as a Result of Conversion of Farmland to Ecosystem Restoration	1-A–C	Beneficial	None required.	–
GW-2. Potential Groundwater Seepage to Adjacent Islands/Tracts as a Result of Frequent Inundation of McCormack-Williamson Tract	1-A–C	Significant	GW-1: Control Seepage.	Less than significant
GW-3. Potentially Increased Groundwater Seepage to Adjacent Lands	1-C	Significant	GW-1: Control Seepage.	Less than significant
GW-4. Potentially Increased Groundwater Recharge	1-C	Beneficial	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
GW-5. Potential Increased Groundwater Seepage from Exposing High Permeability Sand Lenses	1-OP2, 2-D	Less than significant	None required.	–
GW-6. Potential Groundwater Contamination from Dredge Spoils	1-OP2, 2-D	Less than significant	None required.	–
GW-7. Potential Increase in Seepage of Groundwater to Adjacent Islands/Tracts from Flood Storage	2-A–C	Significant	GW-1: Control Seepage.	Less than significant
GEOLOGY, SEISMICITY, SOILS, AND MINERAL RESOURCES				
GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture	1-A–C, 2-A–D	Less than significant	None required.	–
GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking	1-A–C, 2-A–D	Less than significant	None required.	–
GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction	1-A–C, 2-A–D	Significant	GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.	Less than significant
GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities	1-A–C, 2-A–D	Less than significant	None required.	–
GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils	1-A–C, 2-A–D	Significant	GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.	Less than significant
GEO-6: Increase Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils	1-A–C, 2-A–C	Less than significant	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
GEO-7: Decrease Rate of Land Subsidence as a Result of Abandonment of Farming Activities	1-A–C	Beneficial	None required.	–
GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource	1-A–C, 2-A–C	No impact	None required.	–
TRANSPORTATION AND NAVIGATION				
TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns	1-A–C, 2-A–D	Less than significant	None required.	–
TN-2: Deterioration of the Roadway Surface	1-A–C, 2-A–D	Less than significant	None required.	–
TN-3: Construction of New or Improvement of Existing Roads	1-A–C, 2-A–D	Beneficial	None required.	–
TN-4: Changes in Circulation and Access	1-A–C, 2-A–D	Less than significant	None required.	–
TN-5: Changes in Navigation	1-A–C, 2-A–D	Less than significant	None required.	–
AIR QUALITY				
AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels	1-A–C, 2-A–D	Significant and unavoidable	AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR. AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel Powered Equipment. AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment. AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.	Significant and unavoidable

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions. AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.	
AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk	1-A–C, 2-A–D	Less than significant	AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel Powered Equipment.	Less than significant
AIR-3: Generation of Pollutant Emissions in Excess of *de minimis* Threshold Levels	1-A–C, 2-A–D	Significant and unavoidable	AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR. AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel Powered Equipment. AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment. AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee. AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD. AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.	Significant and unavoidable

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
NOISE				
NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities	1-A–C, 1-OP1, 1-OP2, 2-A–D	Significant	NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.	Less than significant
NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations	1-A–C, 1-OP1, 1-OP2, 2-A–C	Significant	NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.	Less than significant
NZ-3: Exposure of Noise-Sensitive Land Uses to Noise from Modified Pump Operations	1-A–C, 2-B, C	Less than significant	None required.	–
NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity	1-A–C, 1-OP1, 1-OP2, 2-A–D	Less than significant	None required.	–
NZ-5: Exposure of Noise-Sensitive Land Uses to Noise from Hydraulic Dredging Activities	1-OP2, 2-D	Significant	NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.	Less than significant
NZ-6: Exposure of Noise-Sensitive Land Uses to Noise from Clamshell Dredging Activities	1-OP2, 2-D	Significant	NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.	Less than significant
NZ-7: Exposure of Noise-Sensitive Land Uses to Noise from Dragline Dredging Activities	1-OP2, 2-D	Significant	NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.	Less than significant
NZ-8: Exposure of Noise-Sensitive Land Uses to Noise from Additional Pump Operations	2-A	Less than significant	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
VEGETATION AND WETLANDS				
VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types	1-A–C, 2-A–D	Significant	VEG-1: Replace Valley/Foothill Riparian Cover Types VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.	Less than significant
VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types	1-A–C, 2-A–D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources. VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.	Less than significant
VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types	1-A–C, 2-A–D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources. VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.	Less than significant
VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Type	1-A–C, 2-A–D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources. VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.	Less than significant
VEG-5: Establishment of Invasive Nonnative Plants	1-A–C, 2-A–D	Significant	VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.	Less than significant
VEG-6: Loss or Disturbance of Special-Status Species	1-A–C, 2-A–D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources. VEG-7: Conduct Preconstruction Surveys for Special-Status Plants. VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.	Less than significant

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
VEG-7: Loss or Disturbance of Perennial Grassland	1-A–C, 2-A–D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources. VEG-9: Replace Perennial Grassland.	Less than significant
FISHERIES AND AQUATICS				
Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities	1-A–C, 2-A–C, 2-OP1, 2-OP2*	Less than significant	None required.	–
Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials	1-A–C, 2-A–C, 2-OP1, 2-OP2	Less than significant	None required.	–
Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction	1-A–C, 2-A–C	Less than significant	None required.	–
Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction	2-OP1, 2-OP2	Significant	Fish-13: Limit Pile-Driving Activities to Daytime Hours and from June 1 to August 31.	Less than significant
Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction	1-A–C, 2-A–C	Significant	Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites. Fish-2: Replace Affected Shaded Riverine Aquatic Cover.	Less than significant
Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction	2-OP1, 2-OP2	Significant	Fish-2: Replace Affected Shaded Riverine Aquatic Cover.	Less than significant
Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail, Delta Smelt, and Other Floodplain-Spawning Species, as a Result of Project Operation	1-A–C, 2-A–C	Beneficial	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation	1-A–C, 2-A–C	Beneficial	None required.	–
Fish-7: Loss of Fish from Stranding as a Result of Project Operation	1-A	Significant	Fish-3: Monitor for and Fill Any Scour Pools Formed following Large Flood Events That Result in Significant Flooding of McCormack-Williamson Tract.	Less than significant
Fish-7: Loss of Fish from Stranding as a Result of Project Operation	1-B, C	Significant	Fish-5: Replace Existing Drainage Pumps on McCormack-Williamson Tract with Fish-Friendly Pumps. Fish-6: Conduct More Detailed Analysis of Box Culvert Design and Installation to Ensure Minimal Ponding Of Water On the Southern Portion of McCormack-Williamson Tract. Fish-7: Operate McCormack-Williamson Tract to Minimize Long-Term Storage of Floodwaters.	Less than significant
Fish-7: Loss of Fish from Stranding as a Result of Project Operation	2-A–C	Significant	Fish-9: Design and Operate Detention Basin Drainage Facility to Safely Pass and Return Fish to South Fork Mokelumne River. Fish-10: Fill or Grade Low-lying Areas in North Staten Detention Basin to Reduce Fish-Stranding Risks. Fish-11: Monitor for and Fill Any Scour Pools Formed following Operation of North Staten Island Detention Basin. Fish-12: Conduct More Detailed Analysis of Slot Channel Design, Fish-Friendly Pump Design, and Outlet Weir Design to Minimize Stranding of Fish.	Less than significant
Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation	1-A, 2-A–C	Significant	Fish-4: Develop and Implement a Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan.	Less than significant

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation	1-B, C	Less than significant	None required.	–
Fish-9: Reduced Pumping and Agricultural Discharges	1-A–C	Beneficial	None required.	–
Fish-10: Temporary Disturbance and Possible Mortality of Fish, Including Special-Status Species, from Increases in Sedimentation and Turbidity as a Result of Dredging Activities	1-OP2, 2-D	Less than significant	None required.	–
Fish-11: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Release of Pollutants during Dredging	1-OP2, 2-D	Less than significant	None required.	–
Fish-12: Temporary Disturbance and Possible Mortality of Fish, Including Special-Status Species, from Entrainment during Dredging	1-OP2, 2-D	Significant	Fish-8: Incorporate BMPs and Other Minimization Measures into the Dredging Sampling and Analysis Plan.	Less than significant
Fish-13: Changes in Habitat Availability and Quality for Fish as a Result of Disturbance and Water Surface Elevation Changes from Dredging	1-OP2, 2-D	Less than significant	None required.	–
Fish-14: Changes in Prey Availability for Fish as a Result of Disturbance to Channel Bed and Removal of Sediments during Dredging	1-OP2, 2-D	Less than significant	None required.	–
Fish-15: Changes in Prey Availability for Fish as a Result of Disturbance to Channel Bed and Removal of Sediments during Dredging	2-D	Less than significant	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILDLIFE				
WILD-1: Loss of Riparian-Associated Wildlife Habitat	1-A–C, 2-A–D	Significant	WILD-1: Replace Riparian Land Cover Types. WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources.	Less than significant
WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat	1-A–C, 2-A–D	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-4: Replace Wetland Land Cover Types.	Less than significant
WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat	1-A–C, 2-A–D	Significant	WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.	Less than significant
WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat	1-A–C, 2-A–D	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-6: Replace Nontidal Wetland Land Cover Types.	Less than significant
WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat	1-A–C, 2-A–D	Less than significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources.	Less than significant
WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities	1-A–C, 2-A–D	Less than significant	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands	1-A–C, 2-A–D	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.	Less than significant
WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle	1-A–C, 2-A–D	Significant	WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs. WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs. WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.	Less than significant
WILD-9: Potential Effects on Giant Garter Snake	1-A–C, 2-A–D	Significant	WILD-4: Replace Wetland Land Cover Types. WILD-6: Replace Nontidal Wetland Land Cover Types. WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake. WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.	Less than significant
WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat	1-A–C, 2-A–D	Significant	WILD-1: Replace Riparian Land Cover Types. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance. WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites. WILD-15: Replace or Compensate for the Loss of	Less than significant

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			Swainson's Hawk Foraging Habitat. WILD-16: Avoid Removal of Occupied Nest Sites.	
WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls	1-A–C, 2-A–D	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-17: Conduct Preconstruction Surveys for Burrowing Owls. WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites. WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites. WILD-20: Create New or Enhance Existing Suitable Burrows. WILD-21: Replace Lost Burrowing Owl Foraging Habitat.	Less than significant
WILD-12: Loss or Disturbance of Raptor Nest Sites	1-A–C, 2-A–D	Significant	WILD-1: Replace Riparian Land Cover Types. WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-4: Replace Wetland Land Cover Types. WILD-6: Replace Nontidal Wetland Land Cover Types.	Less than significant
WILD-13: Loss of Western Pond Turtle or Suitable Habitat	1-A–C, 2-A–D	Significant	WILD-4: Replace Wetland Land Cover Types. WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat. WILD-6: Replace Nontidal Wetland Land Cover Types.	Less than significant

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.	
WILD-14: Loss of Tricolored Blackbird Nesting Habitat	1-A–C, 2-A–D	Significant	WILD-1: Replace Riparian Land Cover Types. WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-4: Replace Wetland Land Cover Types. WILD-6: Replace Nontidal Wetland Land Cover Types. WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird. WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.	Less than significant
WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat	1-A–C, 2-A–D	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-4: Replace Wetland Land Cover Types. WILD-6: Replace Nontidal Wetland Land Cover Types. WILD-25: Conduct Preconstruction Surveys for California Black Rail. WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.	Less than significant

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries	1-A–C, 2-A–D	Significant	WILD-1: Replace Riparian Land Cover Types. WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-27: Conduct Preconstruction Surveys to Locate Rookeries. WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries. WILD-29: Avoid Removal of Occupied Rookeries. WILD-30: Replace Lost Breeding Habitat.	Less than significant
WILD-17: Loss or Disturbance of Aleutian Canada Goose	1-A–C, 2-A–D	Less than significant	None required.	–
WILD-18: Loss or Disturbance of Wintering Bald Eagle	1-A–C, 2-A–D	Less than significant	None required.	–
WILD-19: Loss or Disturbance of Migratory Birds	1-A–C, 2-A–D	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources.	Less than significant
WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities	1-A–C, 2-A–C	Significant	WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance. WILD-3: Minimize Impacts on Sensitive Biological Resources. WILD-23: Conduct Preconstruction Surveys for Bats.	Less than significant

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
LAND USE, RECREATION, AND ECONOMICS				
LU-1: Permanent Loss of Farmland	1-A–C 2-A-D	Potentially significant	Optional project features.	Less than significant
LU-2: Operations-Related Effects on Agricultural Production	1-A–C, 2-A–C	Less than significant	None required.	–
LU-3: Inconsistency with Agricultural Objectives of Local, Regional, and State Plans	1-A–C	Less than significant	None required.	
LU-4: Conflict with General Plan Designations or Zoning	1-A–C	Less than significant	None required.	
REC-1: Temporary Disruption of Recreational Boating Activities during Construction	1-A–C	Less than significant	None required.	–
REC-1: Temporary Disruption of Recreational Boating Activities during Construction	2-A–D	Significant	REC-1: Implement a Bridge Construction Phasing Schedule.	Less than significant
REC-2: Temporary Disruption of Recreational Boating Activities during Dredging Operations	1-A–C, 2-D	Less than significant	None required.	–
REC-3: Long-Term Increase in Recreational Boating Opportunities	1-A	Beneficial	None required.	–
REC-4: Upgrade of Recreational Facilities at the Delta Meadows Property	1-A–C	Beneficial	None required.	–
REC-5: Increased Public Awareness of Recreational Facilities and Public Access Points	1-A–C	Beneficial	None required.	–
REC-6: Occasional Temporary Loss of Wildlife-Viewing Opportunities	2-A–C	Less than significant	None required.	–
REC-7: Long-Term Improvements in Wildlife-Viewing Opportunities	2-A–C	Beneficial	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
POPULATION, HOUSING, AND ENVIRONMENTAL JUSTICE				
POP-1: Displacement of Housing	1-A–C, 2-A–C	Less than significant	None required.	–
POP-2: Displacement of People	1-A–C, 2-A–C	Less than significant	None required.	–
POP-3: Disproportionate Impacts on Low-Income or Minority Populations	1-A–C, 2-A–C	Less than significant	None required.	–
UTILITIES AND PUBLIC SERVICES				
PUB-1: Increase in Use of Energy	1-A–C, 2-A–D	Less than significant	None required.	–
PUB-2: Reduction in the Capacity of Local Solid Waste Landfills	1-A–C, 2-A–D	Less than significant	None required.	–
PUB-3: Disruption of Utility Services	1-A–C, 2-A–C	Less than significant	None required.	–
PUB-3: Disruption of Utility Services	2-D	No impact	None required.	–
PUB-4: Increase in Emergency Service Response Times	1-A–C, 2-A–D	Less than significant	None required.	–
POWER PRODUCTION AND ENERGY				
PPE-1: Change in Power Consumption	1-A–C, 2-A–D	Less than significant	None required.	–
VISUAL RESOURCES				
VIS-1: Temporary Visual Change as a Result of Construction Activities	1-A–C, 2-A–D	Less than significant	None required.	–
VIS-2: Permanent Changes in Viewshed	1-A–C, 2-A–D	Less than significant	None required.	–

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
PUBLIC HEALTH AND ENVIRONMENTAL HAZARDS				
PH-1: Releases of Hazardous Materials during Construction	1-A–C, 2-D	Less than significant	None required.	–
PH-1: Releases of Hazardous Materials during Construction	2-A–C	Significant	PH-3: Contain and Properly Dispose of Lead-Based Paint.	Less than significant
PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction	1-A–C, 2-A–D	Significant	PH-1: Properly Dispose of Contaminated Materials	Less than significant
PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times	1-A–C, 2-A–D	Less than significant	None required.	–
PH-4: Exposure of People to Mosquitoes	1-A–C, 2-A–C	Significant	PH-2: Design and Operate Project to Minimize Mosquito Breeding Habitat.	Less than significant
PH-4: Exposure of People to Mosquitoes	2-D	Significant	PH-2a: Design and Operate Dredged Material Drying Areas to Minimize Mosquito Breeding Habitat.	Less than significant
CULTURAL RESOURCES				
CR-1: Destruction of Archaeological Sites P-39-324, P-39-4419, and P-39-4420 as a Result of Ground Disturbance	1-A–C	Significant	Several mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-39-324, P-39-4419, and P-39-4420, namely mitigation strategies 3–5 and 7–8. Prior to approval and final design of the downstream levee modifications, DWR will authorize qualified archaeologists to map the sites (mitigation strategy 3), conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5), and prepare a report to document the results of mitigation strategies 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether the sites are historical resources or unique archaeological resources for the purposes of CEQA,	Less than significant to significant, depending

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			or are not significant cultural resources. If DWR determines the sites to be non-significant, no additional mitigation is required, and this impact will be reduced to a less-than-significant level. Conversely, if DWR determines that the any or all of the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of the site(s) deemed significant (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.	
CR-2: Destruction of Unevaluated Isolated Finds	1-A–C	Significant	Mitigation strategies 1 and 3, listed in the August 2000 CALFED Programmatic ROD, are feasible mitigation measures for impacts incurred on P-39-4421, P-39-4427, P-39-4428, P-39-4429, and P-39-4438. Prior to approval and final design of the downstream levee modifications, DWR will authorize qualified archaeologists to survey the isolate vicinities and map all archaeological materials identified to determine whether additional archaeological materials are present. If no additional archaeological materials are present, isolates P-39-4421, P-39-4427, P-39-4428, P-39-4429, and P-39-4438 would not qualify as historical resources or unique archaeological resources for the purposes of CEQA, and implementation of mitigation measures 1 and 3 would reduce this impact to a no-impact level. If additional archaeological materials are identified at any or all of the isolated finds, they will be considered archaeological sites and DWR will authorize qualified archaeologists to conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5), and prepare a report to document the results of mitigation strategies 3–5	Less than significant to significant, depending

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether the sites are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources. If DWR determines the sites to be non-significant, no additional mitigation is required and this impact will be reduced to a less-than-significant level. Conversely, if DWR determines that the any or all of the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of the site(s) deemed significant (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.	
CR-3: Destruction of Cultural Resources along Unexamined Portions of the Downstream Levees	1-A–C	Significant	Because the progress in defining this project action is provisional, mitigation strategies 1 and 7 listed in the August 2000 CALFED Programmatic ROD, are feasible mitigation measures for this impact, provided no cultural resources are identified as a result. Prior to approval and final design of the downstream levee modifications, DWR will authorize qualified cultural resource specialists to survey the areas slated for improvements (mitigation strategy 1). If no cultural resources are identified in the improvement areas, implementation of mitigation strategies 1 and 7 (report preparation) will reduce this impact to a no-impact level. If archaeological resources are identified as a result of survey work, DWR will authorize qualified archaeologists to conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5) and prepare a report to document the results of mitigation strategies 3–5 above	No impact, or less than significant to significant, depending

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			(mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether the sites are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources. If DWR determines the sites to be non-significant, no additional mitigation is required and this impact will be reduced to a less-than-significant level. Conversely, if DWR determines that the any or all of the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of the site(s) deemed significant (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites. If historic architectural resources are identified as a result of survey work, DWR will authorize qualified architectural historians to conduct an oral history research to determine, in consultation with DWR, whether the resources constitute historical resources for the purposes of CEQA. The results will be documented in an evaluation report (mitigation strategy 7). If DWR determines the historic architectural resources to be historical resources for the purposes of CEQA, DWR will authorize qualified architectural historians to document historic structures by preparing Historic American Engineering Records of Historic American Building Surveys (mitigation strategy 10), prepare public interpretive documents (mitigation strategy 9), and prepare mitigation reports (mitigation strategy 7). Options for avoidance through project design should be	

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			contemplated as well (mitigation strategy 2).	
CR-4: Damage to or Destruction of Site P-34-39 as a Result of Soil Removal	1-A–C, 2-A–C, Dixon	Significant	[See Impact CR-1]	No impact, or less than significant to significant, depending
CR-5: Damage to or Destruction of Cultural Resources in the Dixon Borrow Site	1-A–C, 2-A–C, Dixon	Significant	[See Impact CR-3]	No impact, or less than significant to significant, depending
CR-6: Damage to or Destruction of Architectural Resources in the New Hope Borrow Site	1-A–C, 2-A–C, New Hope	Significant	[See Impact CR-3]	No impact, or less than significant to significant, depending
CR-7: Damage to or Destruction of Archaeological Site P-34-36 as a Result of Soil Removal and Other Ground-Disturbing Activities	1-OP1	Significant	DWR archaeologists did not identify archaeological materials at the mapped location of P-34-36 as a result of the April 2005 survey. The lack of materials may represent agricultural disturbances and looting of artifacts or insufficient mapping at the time of original recordation (1929). Both scenarios leave open the possibility that buried archaeological materials are present at the mapped location of P-34-36. The lack of specificity in the original mapping suggests that presence-absence excavation to locate P-34-36 is unwarranted. Instead, DWR will map the vicinity of P-34-36 as an environmentally sensitive area on construction and design drawings. DWR will ensure that a qualified archaeologist with full stop-work authority monitors all construction activities in the vicinity of P-34-36.	Less than significant
CR-8: Damage to or Destruction of Archaeological Site P-34-37 as a Result of Grading	1-OP1	Significant	Two mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-34-37, namely mitigation strategies 2 and 3. Prior to approval and final design of the grading of the proposed borrow site, DWR will authorize qualified archaeologists to map the site (mitigation strategy 3) and fence the site	No impact

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			boundaries for avoidance during construction (mitigation strategy 2). DWR should task a qualified archaeologist with periodic examinations of the fencing to ensure that the barrier is not crossed and clearly delimits the site boundaries throughout the duration of grading.	
CR-9: Destruction of Architectural Resources along Unexamined Portions of the Grizzly and Bear Slough Levees	1-OP1	Significant	[See Impact CR-3]	No impact, or less than significant to significant, depending
CR-10: Destruction of Submerged Cultural Resources as a Result of Channel Dredging	1-OP2, 2-D	Significant	[See Impact CR-3]	No impact, or less than significant to significant, depending
CR-11: Destruction of Cultural Resources as a Result of Dredge Spoil Disposal	1-OP2, 2-D	Significant	[See Impact CR-3]	No impact, or less than significant to significant, depending
CR-12: Damage to or Destruction of Archaeological Site CA-Sac-76/H at the Delta Meadows Property	1-OP4	Significant	The full range of CALFED programmatic mitigation strategies discussed under Impact CR-5 are appropriate for the mitigation of impacts on CA-Sac-76/H. Mitigation will be developed by California Department of Parks and Recreation during preparation of the Delta Meadows specific plan document.	No impact, or less than significant to significant, depending
CR-13: Damage to or Destruction of Archaeological Sites CA-Sac-47 and P-34-102	1-OP4	Significant	The full range of CALFED programmatic mitigation strategies discussed under Impact CR-8 are appropriate for the mitigation of impacts on CA-Sac-47 and P-34-102. Mitigation will be developed by California Department of Parks and Recreation during preparation of the Delta Meadows specific plan document.	No impact, or less than significant to significant, depending
CR-14: Damage to or Destruction of Architectural Resources in the Delta Meadows Property Area	1-OP4	Significant	[See Impact CR-3]	No impact, or less than significant to significant, depending

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
CR-15: Damage to or Destruction of P-39-4423 as a Result of Detention Levee Construction (North Staten Island Detention)	2-A	Significant	Several mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-39-4423, namely mitigation strategies 2–5 and 7–8. Prior to approval and final design of the North Staten Island Detention, DWR will authorize qualified archaeologists to map the site (mitigation strategy 3), conduct surface collections and perform test excavations at the site (mitigation strategies 4 and 5), and prepare a report to document the results of 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether P-39-4423 is a historical resource or unique archaeological resource for the purposes of CEQA, or is not a significant cultural resource. If DWR determines the site to be non-significant, no additional mitigation is required. Conversely, if DWR determines that the site qualifies as a historical resource or a unique archaeological resource, DWR will cause the final design of the North Staten Island Detention to avoid the boundaries of P-39-4423 (mitigation strategy 2) or, in the event that avoidance is not feasible, authorize qualified archaeologists to conduct full-scale excavations of P-39-4423 (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of P-39-4423.	No impact, or less than significant to significant, depending
CR-16: Damage to or Destruction of P-39-356, P-39-4423, and P-39-4424 as a Result of Inundation	2-B	Significant	Several mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-39-356, P-39-4423, and P-39-4424, namely mitigation strategies 3–5 and 7–8. Prior to approval and final design of the North Staten Island Detention, DWR will authorize qualified archaeologists to map the	No impact, or less than significant to significant, depending

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
			sites (mitigation strategy 3), conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5), and prepare a report to document the results of mitigation strategies 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether P-39-356, P-39-4423, and P-39-4424 are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources. If DWR determines the sites to be non-significant, no additional mitigation is required. Conversely, if DWR determines that the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of P-39-356, P-39-4423, and P-39-4424 (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.	

* Optional Alternatives:

1-OP1 = Excavate and Restore Grizzly Slough Property.

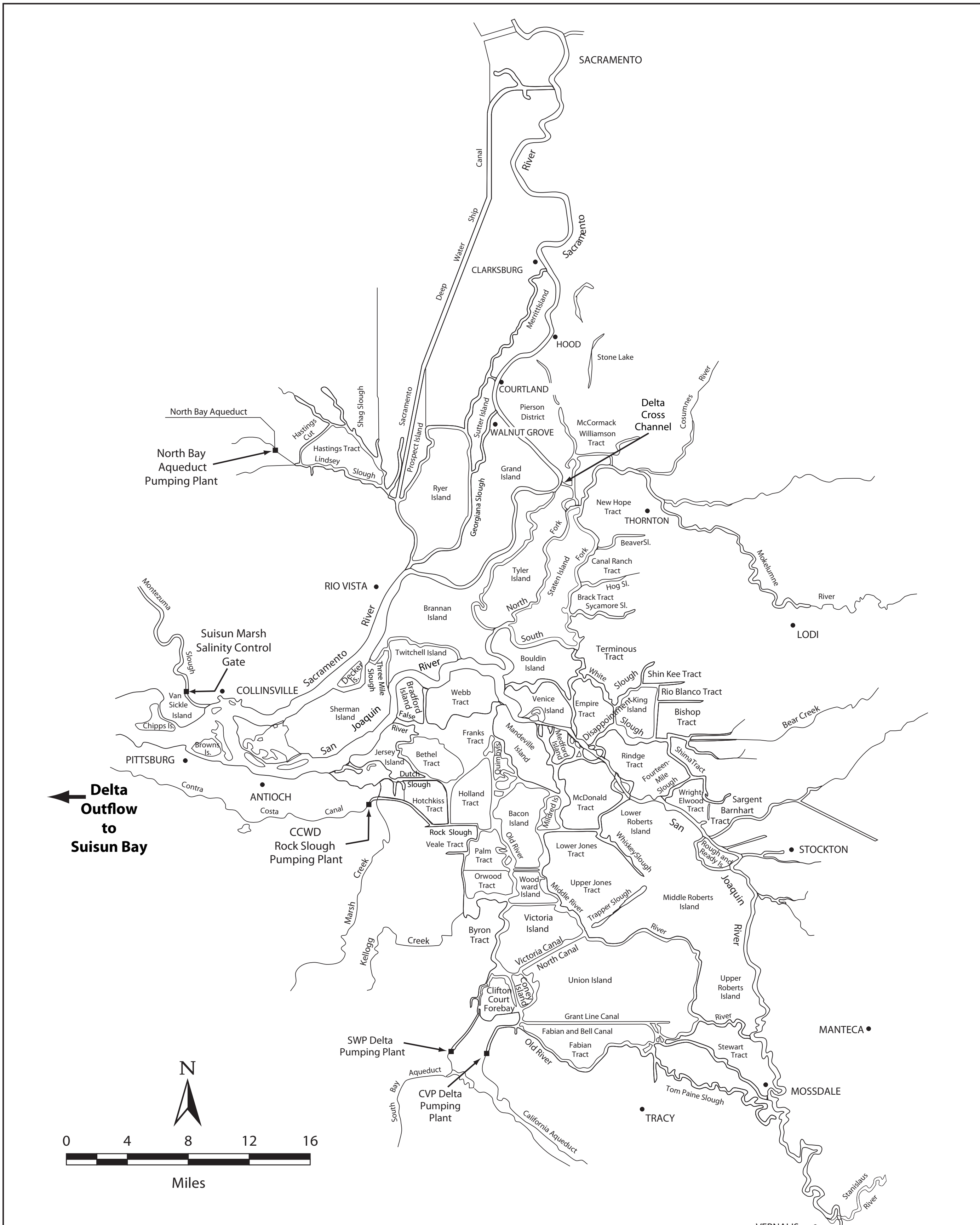
1-OP2 = Mokelumne River Dredging.

1-OP3 = Grizzly Slough Property Levee Breaches and Re-Grading.

1-OP4 = Enhance Delta Meadows Property.

2-OP1 = Retrofit or Replace Millers Ferry Bridge.

2-OP2 = Retrofit or Replace New Hope Bridge.



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SOURCE: Adapted from California Department of Water Resources 1993.

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Figure 1-1
The Sacramento – San Joaquin Delta

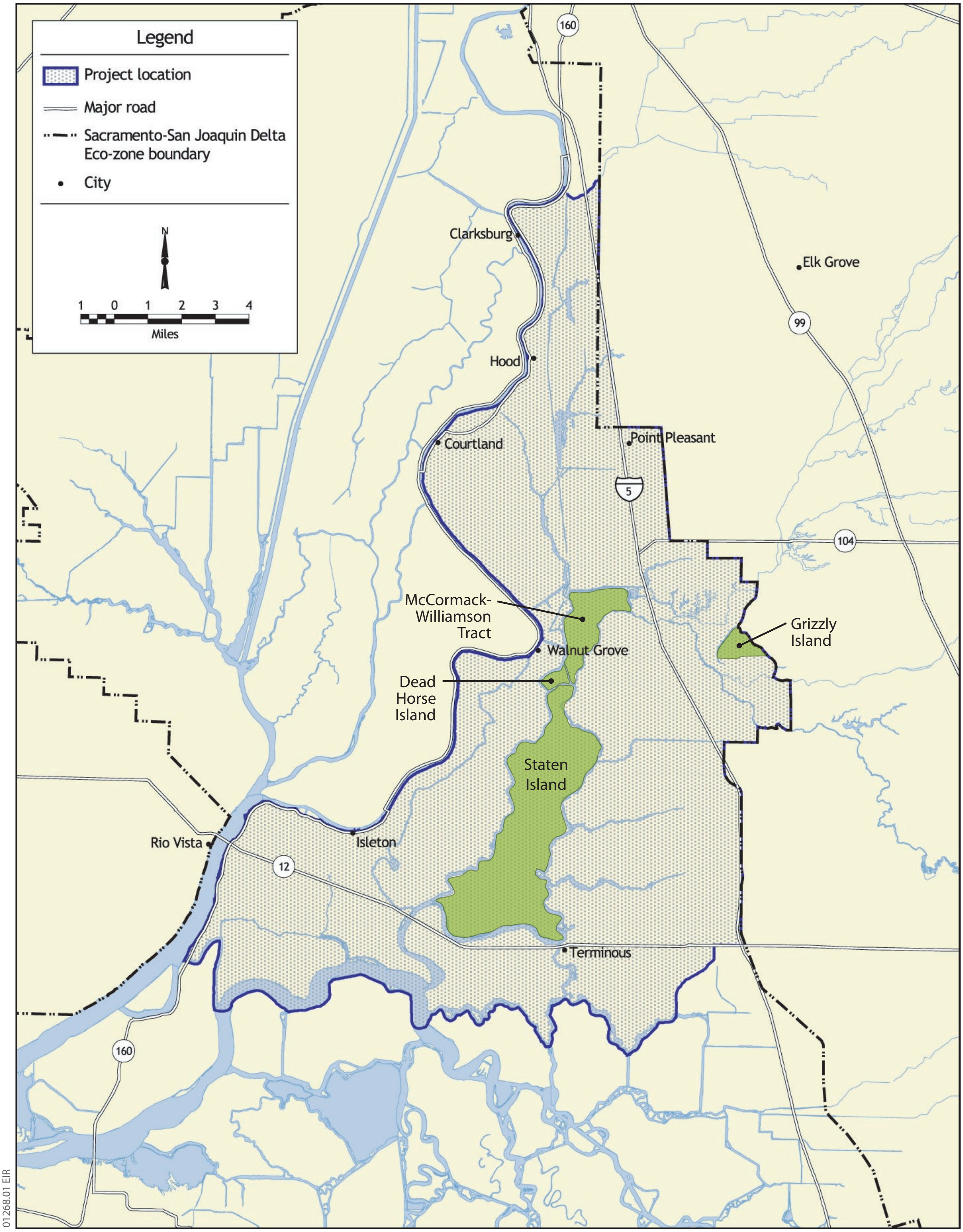

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Figure 1-2
North Delta Flood Control and Ecosystem Restoration Project
Project Area

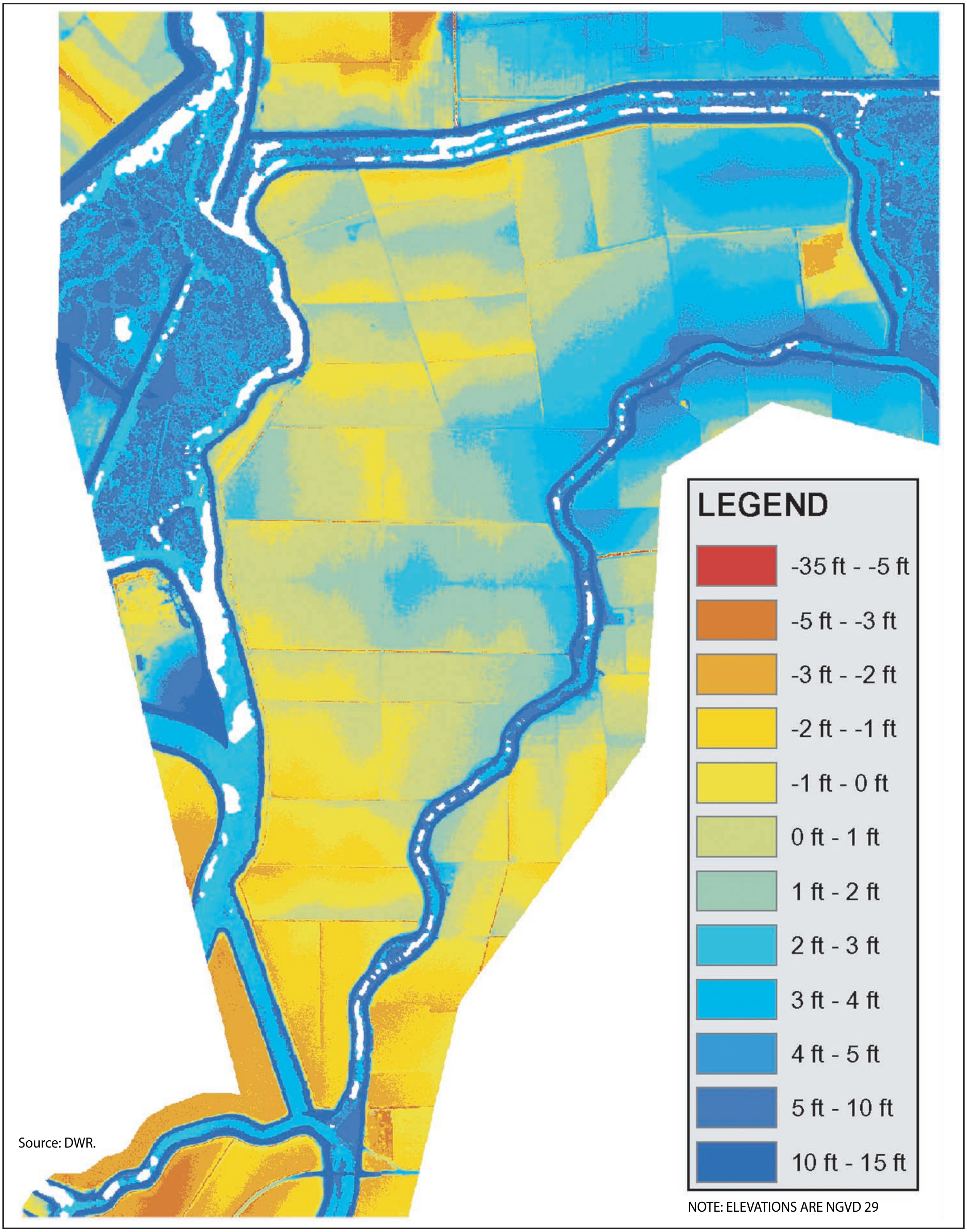

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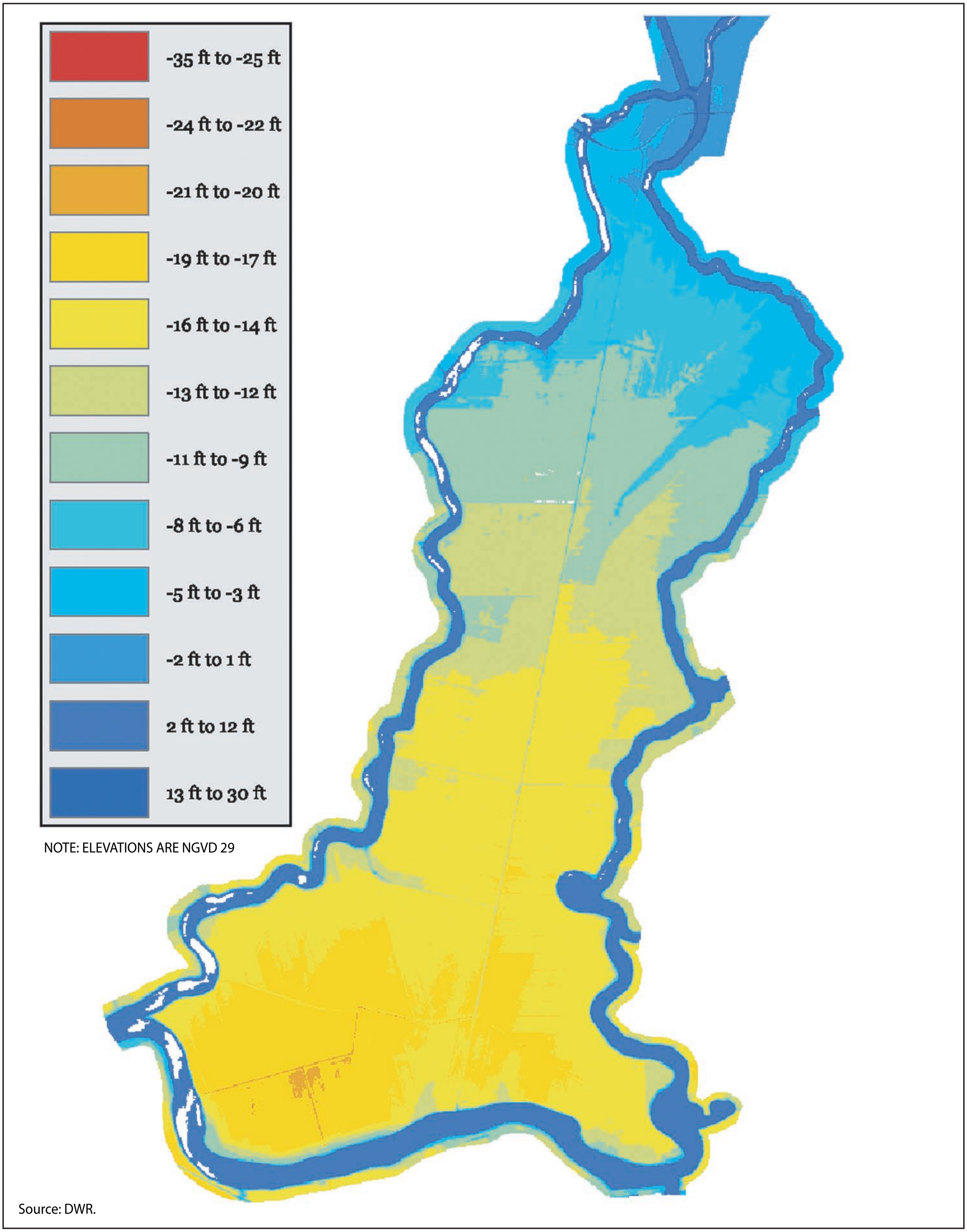
Figure 1-3
McCormack Williamson Tract Elevation Map



Source: DWR.

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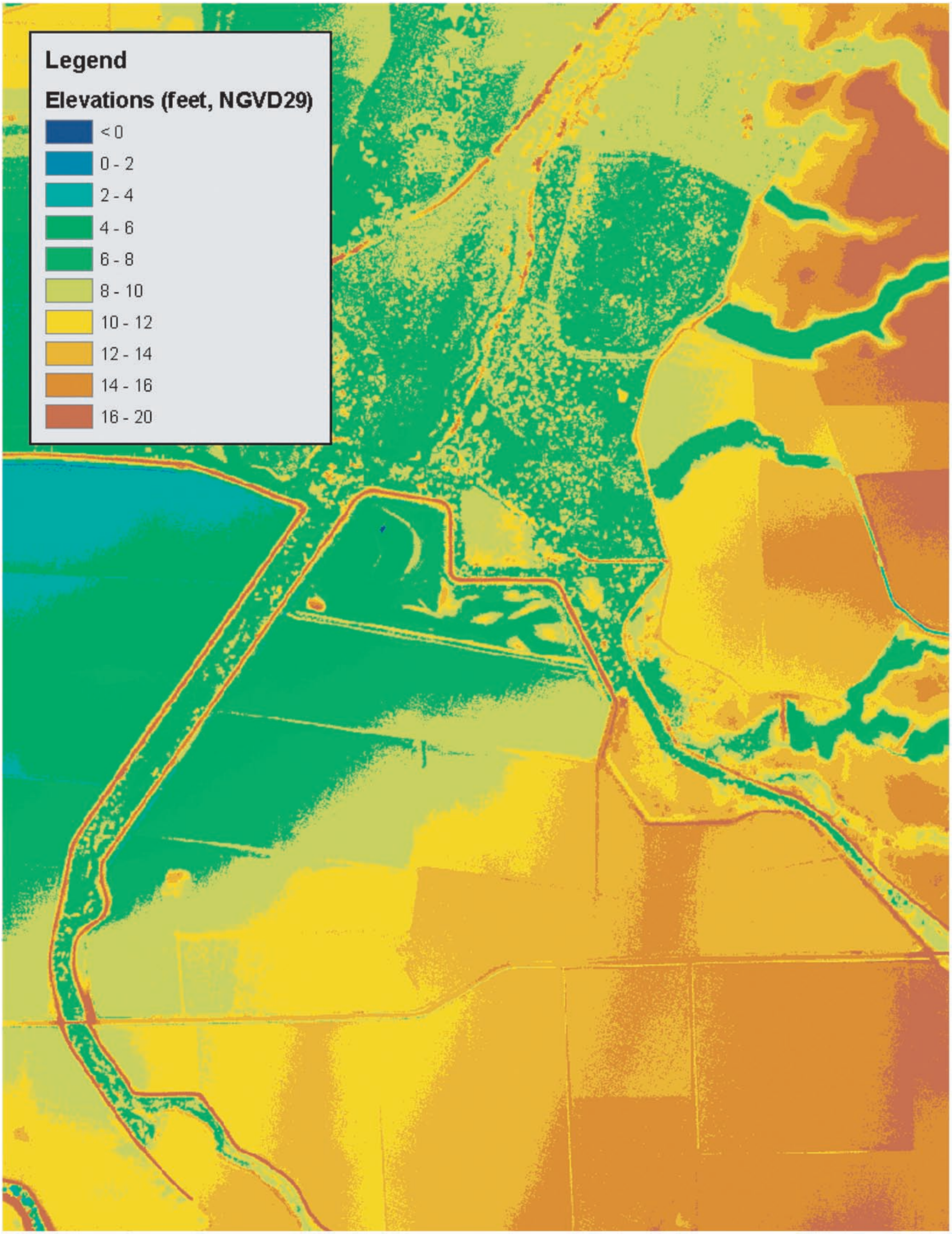
Figure 1-4
Staten Island Elevation Map

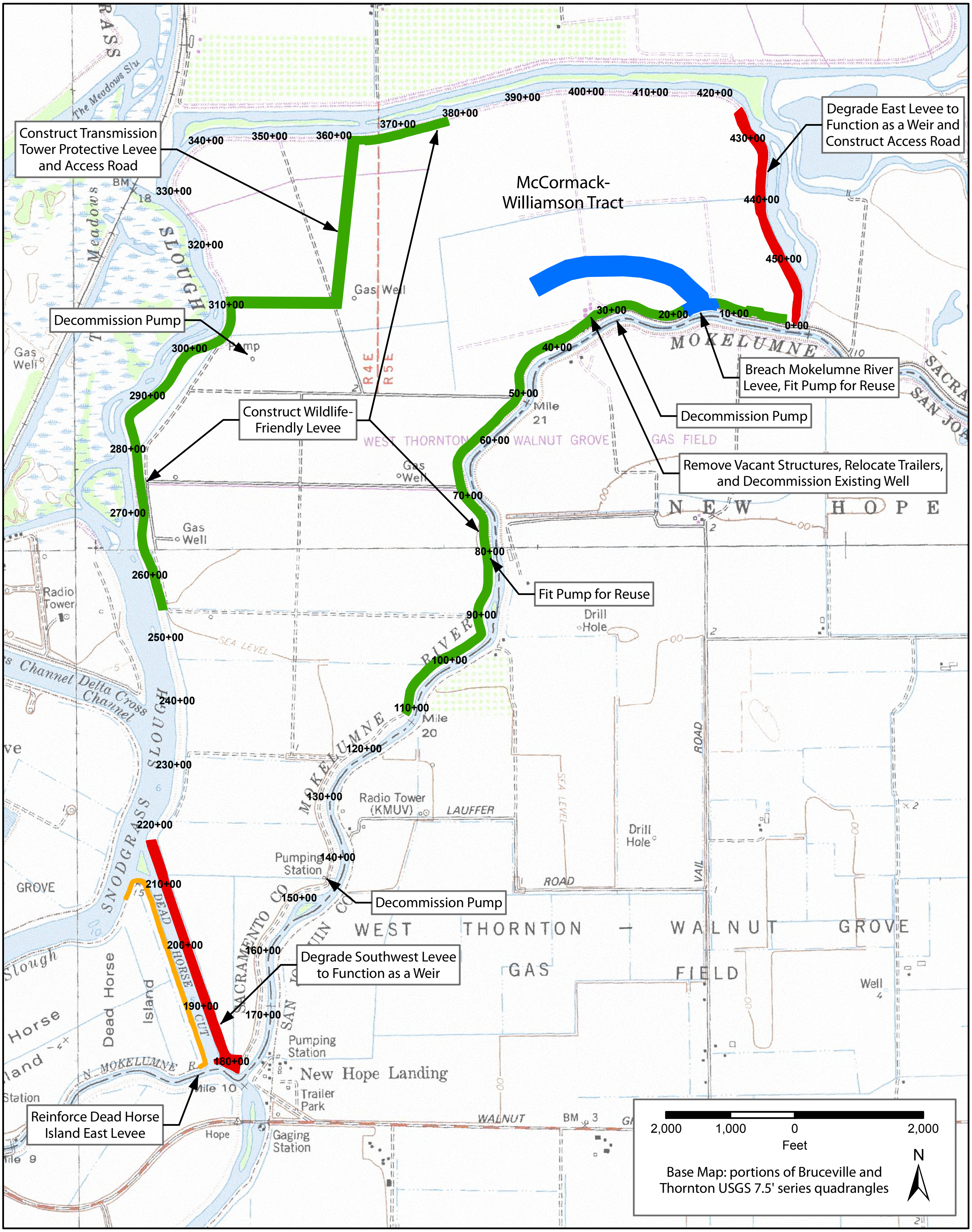


Source: DWR.

01268.01 EIR

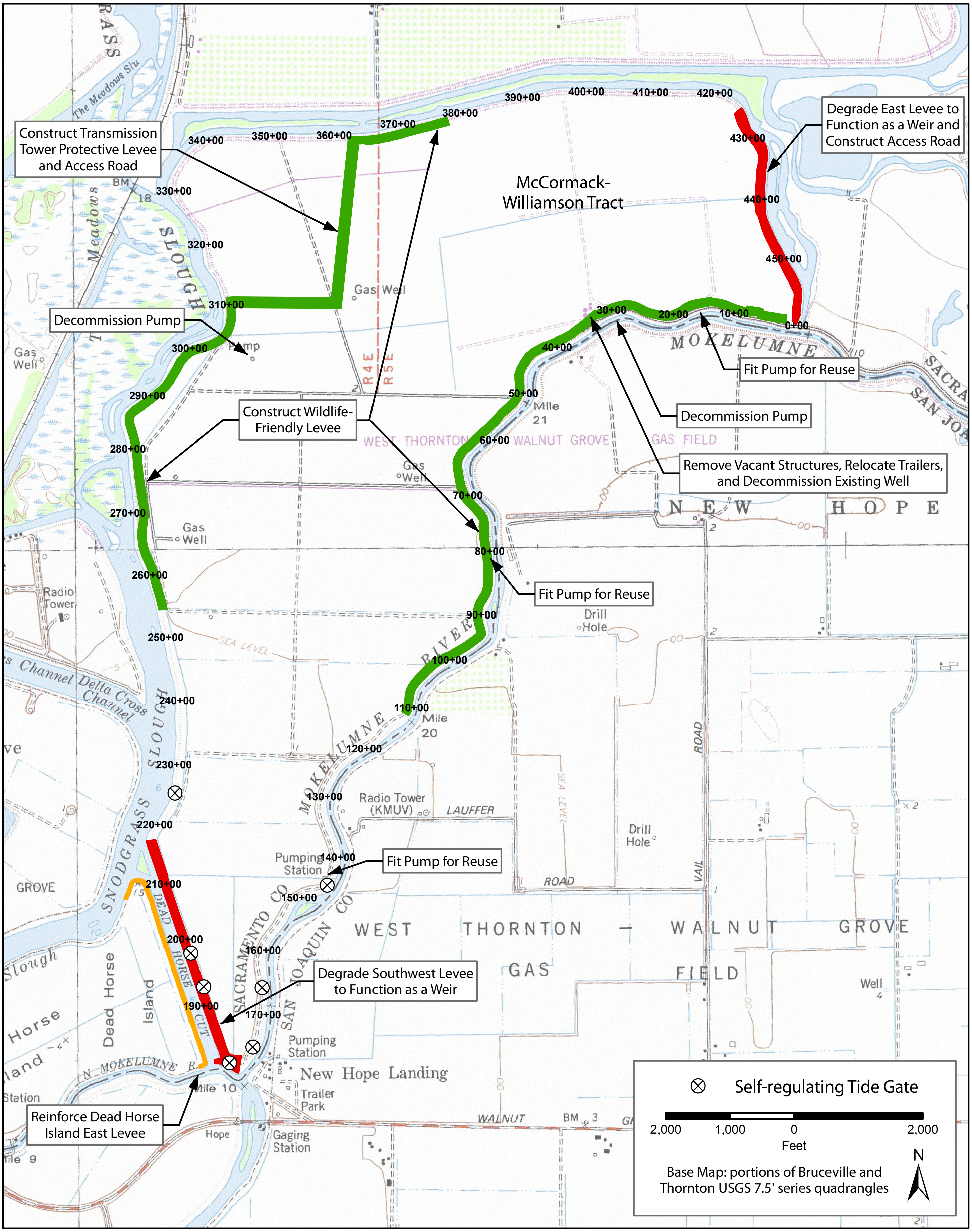
Jones & Stokes

Figure 1-5
Grizzly Slough Property Elevation Map



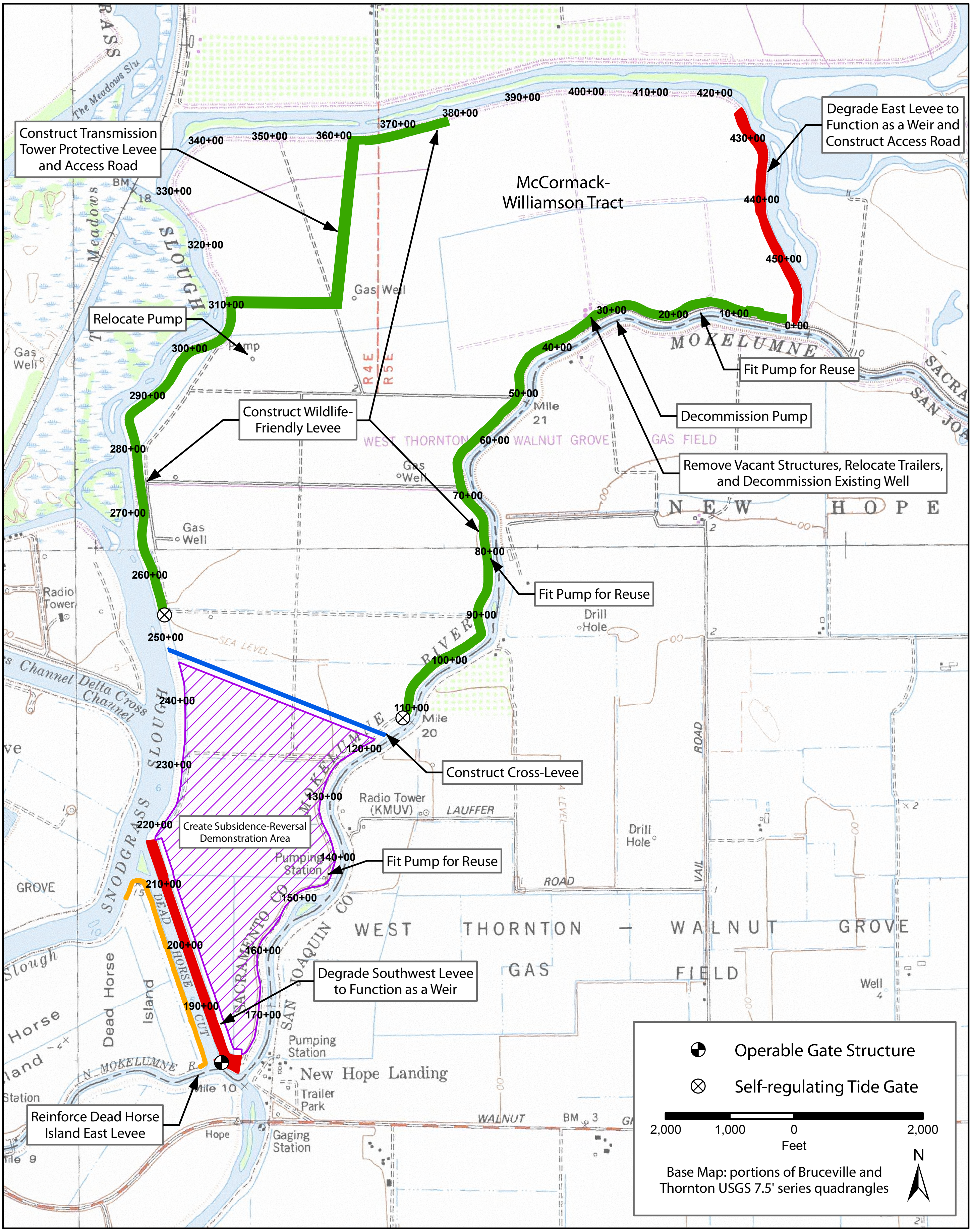
Jones & Stokes

Figure 2-1
Alternative 1-A: Fluvial Process Optimization Plan



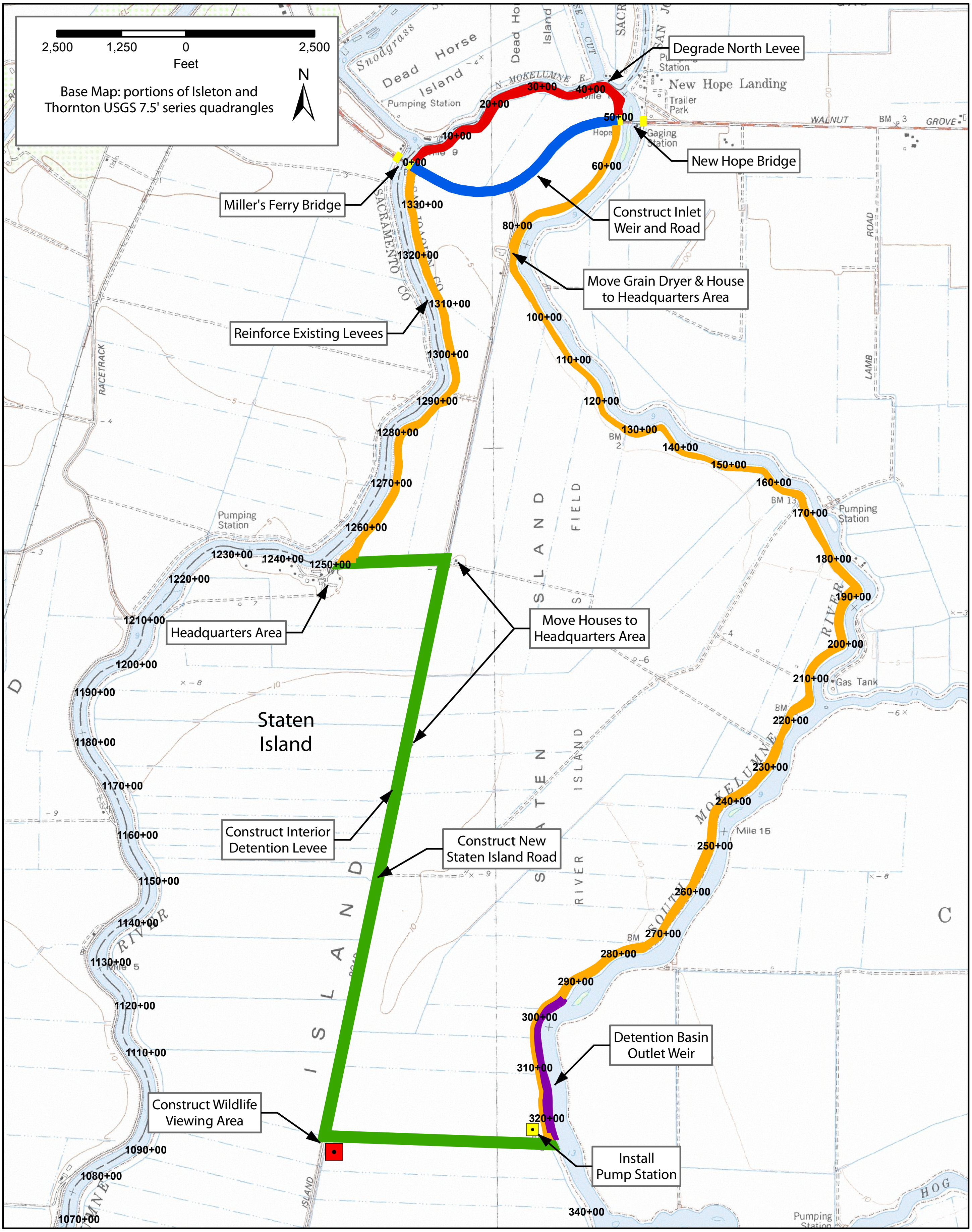
Jones & Stokes

Figure 2-15
Alternative 1-B: Seasonal Floodplain Optimization Plan



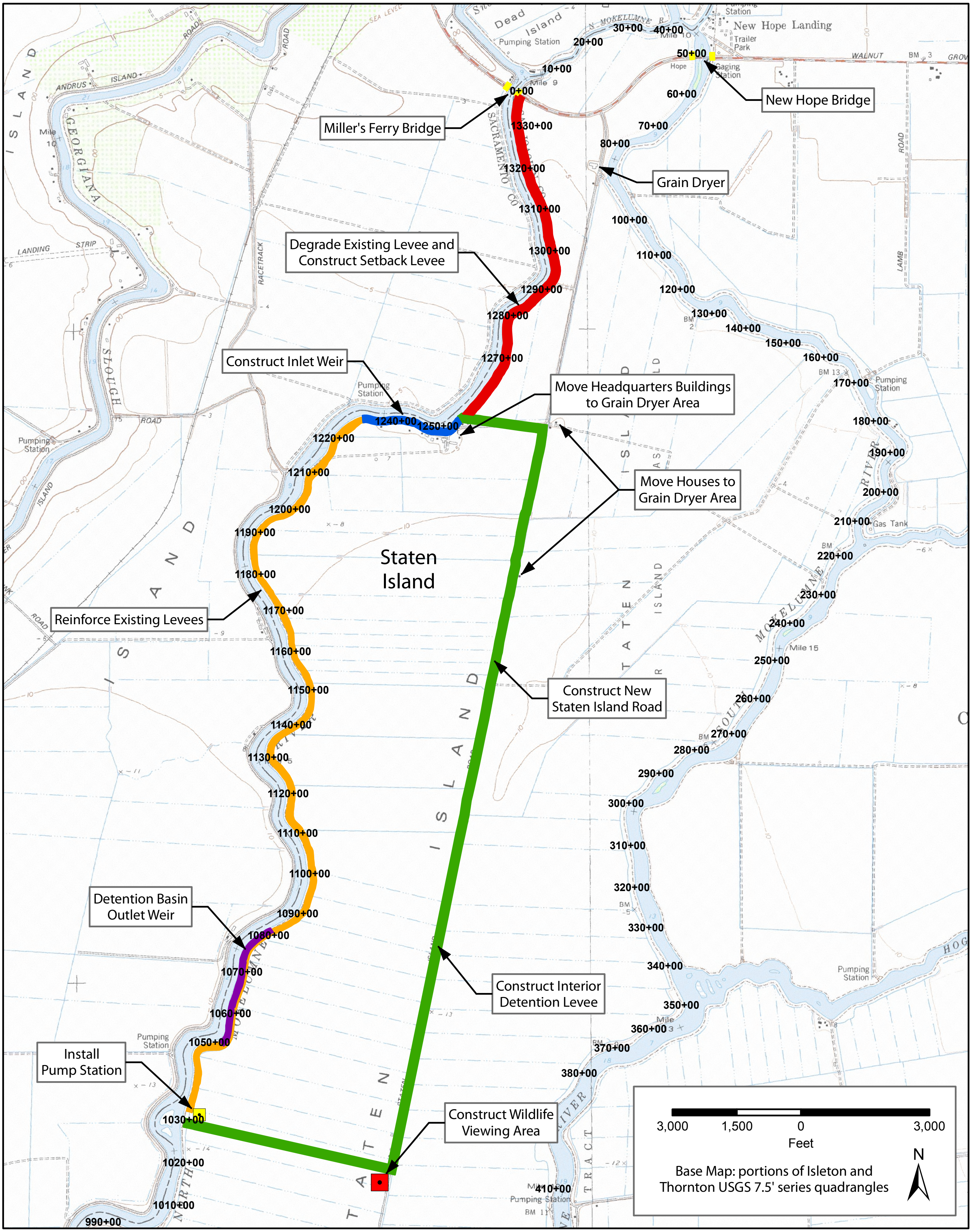
Jones & Stokes

Figure 2-19
Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal Plan



Jones & Stokes

Figure 2-22
Alternative 2-A: North Staten Detention Plan



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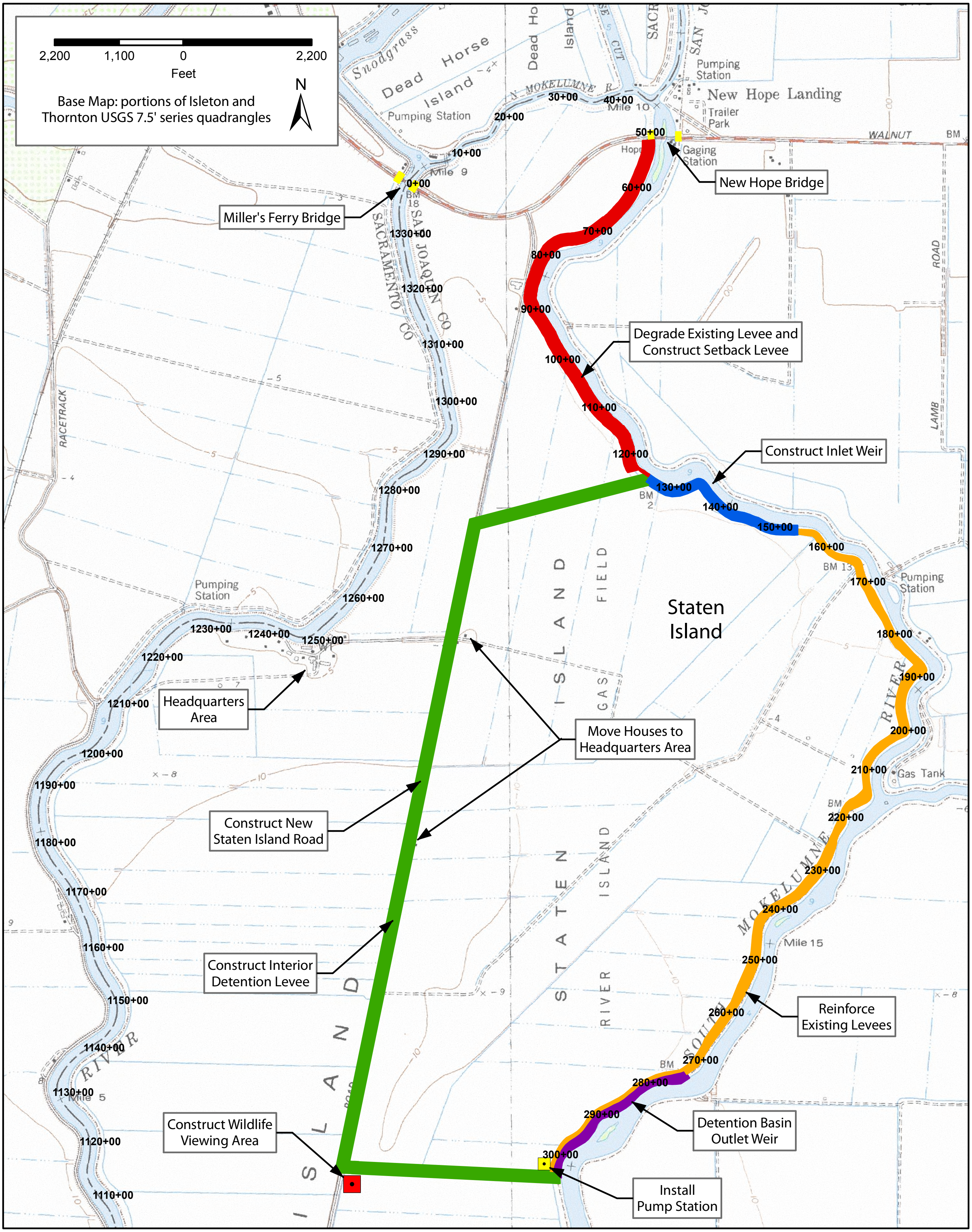
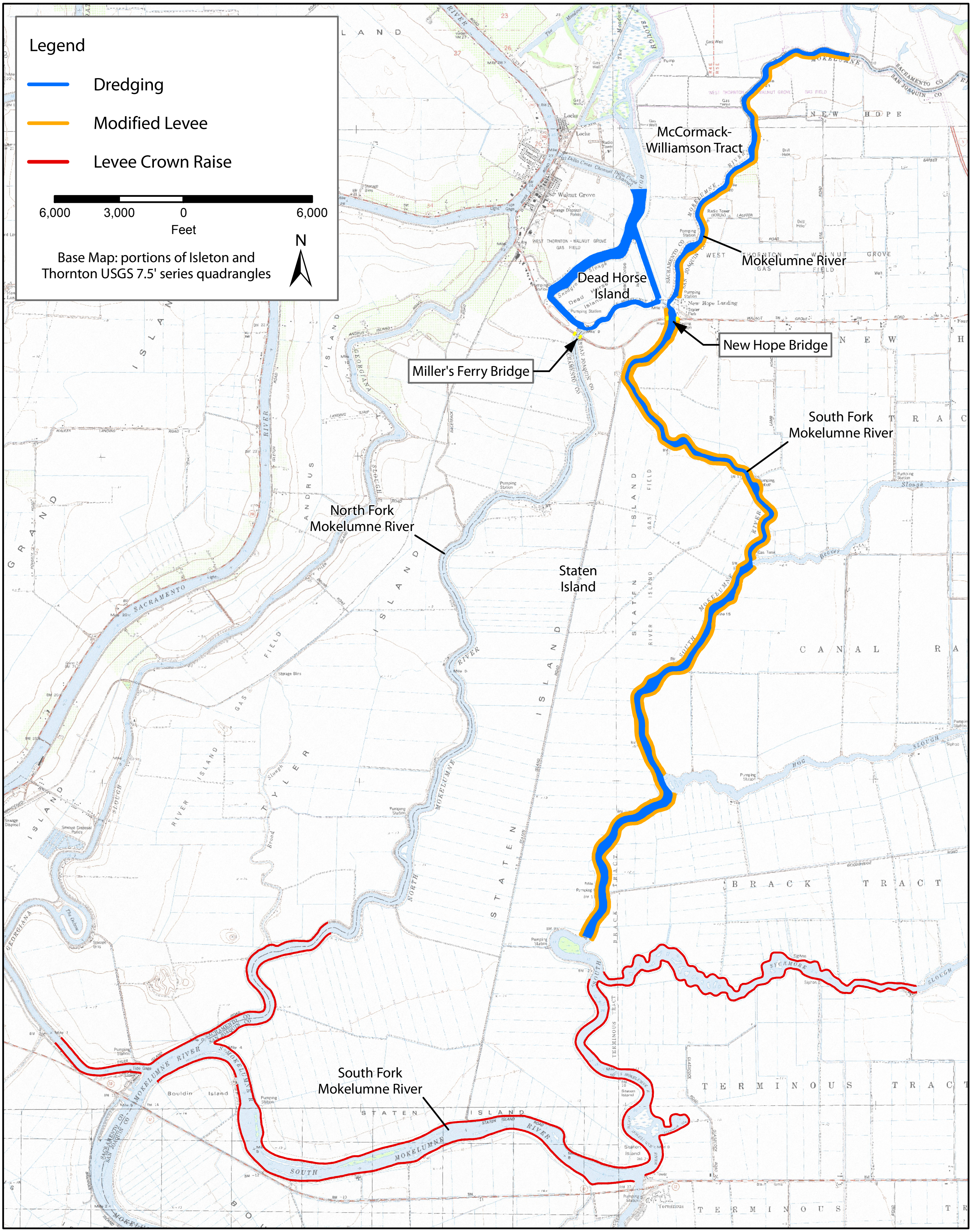
Jones & Stokes

Figure 2-29
Alternative 2-B: West Staten Detention Plan



Jones & Stokes

Figure 2-32
Alternative 2-C: East Staten Detention Plan



Jones & Stokes

Figure 2-33
Alternative 2-D: Dredging and Levee Modification Plan

Chapter 1
Introduction

The Sacramento–San Joaquin River Delta (Delta) is the focus of complex issues involving water supply, water quality, flood control requirements, and the environment. The Delta (Figure 1-1) provides water for a wide range of beneficial uses, including drinking water for millions of Californians, irrigation water for millions of acres of agricultural lands, and habitat for aquatic and terrestrial organisms. As the outlet point for California's major watersheds—the Sacramento and San Joaquin River systems—peak flows are often greater than the capacity of the levee-defined Delta waterways, resulting in seasonal flooding. The Delta also provides a permanent or seasonal home for a large variety of native plants and wildlife. Over the past several decades, increased demand for the Delta's water and other resources has exacerbated incompatibilities between human needs and efforts to sustain the Delta's fragile, unique ecosystem and recover special-status species.

The northern region of the Delta (North Delta) faces the need to balance the same issues and multi-use objectives as the larger estuary, particularly with regard to flood control and ecosystem restoration. Specifically, runoff from the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers during large storm events has caused flooding of homes, infrastructure, farms, and other businesses in the North Delta. Additionally, degradation and the loss of aquatic and terrestrial habitat are primary concerns in the North Delta. The California Department of Water Resources (DWR) proposes to implement the North Delta Flood Control and Ecosystem Restoration Project (Project) to address some of these complex issues.

CEQA Compliance

Document Overview

This environmental impact report (EIR) is being prepared by DWR as the Project proponent and state lead agency under the California Environmental Quality Act (CEQA).

CEQA requires that state and local government agencies consider the environmental consequences of projects over which they have discretionary authority before taking action on those projects. CEQA requires that the lead agency (DWR) prepare an EIR if any “potentially significant impacts” are identified that could not be mitigated to a less-than-significant level. As an EIR, this document discloses the program- and Project-level direct, indirect, and cumulative impacts of the Project alternatives, including a no-project alternative. The EIR also identifies mitigation measures to eliminate or reduce the magnitude of significant impacts.

Proposed Project actions and alternatives are subdivided into two basic groups for analysis in this EIR. A grouped approach has been chosen to allow flexibility in implementation depending on determination of incremental Project need, available funding, and Project partnerships. It should be noted that the grouped analysis simply facilitates a phased implementation and would not preclude the implementation of the Project as a single phase. Both groups are analyzed at the level of detail available; however, implementation of some elements may require additional CEQA analysis, depending on specific details discovered through Project development. Such additional analysis may be documented through a tiered negative declaration or technical addendum and may not require a supplemental or subsequent EIR.

Approach to Alternatives

As no federal lead agency is presently engaged in the Project, the EIR is being prepared as compatibly as possible with the National Environmental Policy Act (NEPA) in anticipation that a federal lead will eventually become involved, either as a funding partner with DWR or through its Project approval authority. To that end, Project alternatives are analyzed on an equal, non-preferential basis (i.e., there is no proposed project/preferred alternative) and at an equal level of detail (consistent with NEPA standards).

CEQA generally requires consideration of a range of alternatives to a proposed project that would feasibly attain most of the basic project objectives and accomplish the project purpose and need while avoiding or substantially lessening project impacts. The purpose of alternatives is to offer a reasoned choice in making the decision whether to proceed with the project or action. An EIR may evaluate on-site and off-site alternatives and must analyze the no-project alternative.

CEQA further requires that the lead agency consider alternatives that would avoid or reduce one or more of the significant impacts identified for the project in an EIR. The State CEQA Guidelines stipulate that the range of alternatives required to be evaluated in an EIR is governed by the “rule of reason”; the EIR needs to describe and evaluate only those alternatives necessary to permit a reasoned choice and to foster informed decision-making and informed public participation (Section 15126.6[f]). Consideration of alternatives focuses on those that can either eliminate significant adverse environmental impacts or reduce them to less-than-significant levels; alternatives considered in this context may include those that are more costly and those that could impede to some degree the attainment of all the project objectives (Section 15126.6[b]).

As stated above, although CEQA does not require the alternatives to be evaluated in the same level of detail as the proposed project, this document is being prepared with equal treatment of alternatives to facilitate efficient NEPA compliance documentation, if required. The proposed project/preferred alternative will be identified in the Final EIR, with that selection to be informed through the CEQA process.

Document Organization

The document organization is described below.

- Chapter 1, "Introduction," describes the CEQA compliance approach and process, Project purpose and need, Project objectives, Project area, and related programs and studies.
- Chapter 2, "Project Description," describes the Project groups, actions, alternatives, construction methods that will be employed, and the Project features (i.e., environmental commitments) that have been incorporated into the proposed Project to avoid or reduce potential Project effects.
- Chapter 3, "Physical Environment," includes the environmental analyses relative to physical parameters, specifically: hydrology and hydrodynamics; flood control and levee stability; geomorphology and sediment transport; water quality; water supply and management; geology, seismicity, soils, and mineral resources; transportation and navigation; air quality; and noise. Components of the studies are a setting discussion, impact analysis criteria, Project effects and significance, and applicable mitigation measures.
- Chapter 4, "Biological Environment," includes the environmental analyses relative to biological parameters, specifically vegetation and wetlands, wildlife, and fish. Components of the studies are a setting discussion, impact analysis criteria, Project effects and significance, and applicable mitigation measures.
- Chapter 5, "Social Environment," includes the environmental analyses relative to social parameters, specifically land use, agriculture, recreation, visual resources, utilities and public services, public health and environmental hazards, and cultural resources. Components of the studies are a setting discussion, impact analysis criteria, Project effects and significance, and applicable mitigation measures.
- Chapter 6, "Compliance with Applicable Laws, Policies, Plans, and Regulatory Framework," lists and describes the regulations and constraints affecting the proposed Project.
- Chapter 7, "Growth-Inducing Impacts," includes environmental analysis relative to the potential for promoting growth in the Project area from implementation of the Project alternatives.
- Chapter 8, "Cumulative Impacts," describes potential and existing projects that, together with the Project, may have a compounding impact on similar resources.

- Chapter 9, "References," provides information on all printed sources and personal communications used to prepare the document.
- Chapter 10, "List of Preparers," names those who assisted in the preparation of this document.

Appendices are:

- Public Scoping Report
- Description of Alternatives Evaluation Process Report
- Science Panel Executive Summary
- Habitat Conceptual Models
- Hydraulic Modeling Technical Report
- Adaptive Management Plan
- Mitigation and Monitoring Plan

CEQA and Project Development Process

The current CEQA effort was initiated as a joint document for compliance with both CEQA and NEPA. Therefore, it was intended to be released as a combined EIR and environmental impact statement (EIS) with the U.S. Army Corps of Engineers (USACE) as the lead agency for NEPA compliance. Under this structure, DWR and USACE conducted joint public scoping for the EIR/EIS. However, USACE's involvement in the Project was subsequently deferred because of scheduling and budget constraints. Therefore, the current document is being prepared as an EIR only under CEQA, but in such a way as to comply with NEPA also to the extent possible.

Notice of Preparation

DWR prepared a Notice of Preparation (NOP) for this EIR, which was filed with the California State Clearinghouse on January 28, 2003 (assigned SCH No. 2003012112). The NOP indicated a 30-day review period. The NOP was also mailed to local, state, and federal agencies. The NOP provided a general description of the proposed improvements and major environmental issues that would be addressed in the EIR. A Notice of Intent (NOI) was also published in the *Federal Register* in accordance with NEPA.

Public and Agency Scoping

In addition to the formal scoping period, DWR and USACE conducted two public scoping meetings to explain the environmental review process and to receive public and agency comments on the proposed Project. The first meeting was held at the Jean Harvie Community Center in Walnut Grove on February 19, 2003, followed on February 20, 2003, by the second meeting at the Bonderson Building in Sacramento. Approximately 70 participants attended the meetings, according to sign-in logs. Nineteen written comment letters were received in response to the NOP and are included in a scoping report (Appendix A).

Stakeholder Involvement and Public Outreach

The Project planning process has been enriched through the participation of stakeholders beyond DWR and the CALFED agencies as integral voices in Project development (the CALFED program and planning context are described later in this chapter). Involvement and outreach efforts have been focused through facilitated meetings and a dedicated website.

The North Delta Improvements Group (NDIG) was specifically created as a forum for exchanging Project information, establishing goals and objectives, developing alternatives, and discussing analysis results. The NDIG's noticing list has grown considerably from the initial Project planning and scoping meetings and now includes approximately 150 email addresses. Since 2001, the NDIG has been meeting with diverse and spirited involvement as Project needs dictate. The meetings are roughly bimonthly and are open to the public.

The North Delta Agency Team (NDAT) is a subgroup of the NDIG consisting of representatives of state and federal agencies that ultimately will have approval authority for elements of the Project based on various regulatory triggers. The NDAT has been convened roughly four times per year since 2001, and has provided guidance to ensure that regulatory considerations are factored into Project development to facilitate an efficient review and approval process.

On an as-needed basis, ad hoc subgroups have been convened to address specific Project elements, such as hydraulic modeling. Other groups with concerns in the Project area are described below under related planning efforts.

In support of and in addition to direct meetings, Project information is readily available to the public at the Project website:

http://baydeltaoffice.water.ca.gov/ndelta/northdelta

The website contains facts about the Project, maps, descriptions of the Project alternatives, complete copies of Project documents (such as meeting minutes), discussion of the scientific process guiding the Project, Project area photos, descriptions of technical analysis models, and staff contacts.

Alternatives Development

The Project represents an ambitious and innovative group of actions with a large planning area and multiple objectives. As such, a broad range of alternatives has been considered, building upon ideas generated among DWR, public and agency stakeholders, expert technical consultants, and an ad hoc scientific review panel. The alternatives have been shaped with equal goals of providing flood control and ecosystem restoration benefits. Alternatives that have demonstrated promise have been simulated using hydraulic models (summarized in Chapter 3) and reviewed by the science panel, the NDIG, and NDAT. A technical appendix describing the alternatives development and screening process is included in this document (Appendix B). The alternatives selected for consideration in this EIR are described in Chapter 2.

Administrative Draft Environmental Impact Report

This document is the administrative draft EIR (ADEIR) for the Project. It contains a description of the Project alternatives, environmental setting, identification of direct and cumulative impacts, and mitigation measures for impacts found to be significant. The ADEIR review process includes the participation of the implementing agencies for the associated programs under CALFED (described later in this chapter). These agencies include DWR, USACE, California Bay-Delta Authority (CBDA), U.S. Department of the Interior, Bureau of Reclamation (Reclamation), the California Department of Fish and Game (DFG), the U.S. Fish and Wildlife Service (USFWS), and National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS), Delta Protection Commission (DPC), and California Department of Food and Agriculture (DFA).

Public Draft Environmental Impact Report

After input is received from the ADEIR review process, the document will be revised and released as a public draft EIR (DEIR). The document will be filed with the State Clearinghouse with a Notice of Completion (NOC), publicly noticed, and circulated for a review period of 60 days.

Final Environmental Impact Report

Written and oral comments received in response to the DEIR will be addressed in a response-to-comments document that, together with the DEIR, will constitute the final EIR (FEIR). Public agencies will be provided a minimum 10-day opportunity to review responses prepared to their comments, as provided under CEQA. Upon completion of the FEIR, DWR may act to certify the document and adopt a project. Within 5 days of project adoption, a Notice of Determination (NOD) will be filed with the State Clearinghouse, triggering a 30-day period in which a legal challenge to the document may be filed.

Mitigation Monitoring and Reporting Plan

CEQA requires lead agencies to adopt a mitigation monitoring and reporting plan (MMP) for changes to the project that it has adopted in order to mitigate or avoid significant effects on the environment. Although a final MMP is not required to be included in the EIR, mitigation measures will have been clearly identified and described in a manner that will facilitate preparation of the MMP. The MMP may be adopted concurrent with certification of the FEIR by DWR.

Background

Because of ongoing conveyance, flood control, and ecosystem health issues, improvements in the North Delta have been the focus of planning efforts for many years. Specific information on these programs is provided later in this chapter under the headings of Preceding Environmental Documents and the CALFED Planning Context and Related Actions, Programs, and Planning Efforts; however, a brief historical context leading to the current Project is summarized below.

In 1987, DWR launched a planning and environmental documentation process for the North Delta Program, which led to the release of a draft EIR/EIS in 1990. Many of the elements and objectives of the 1990 effort were similar to this EIR; however, one important difference is that the Draft 1990 EIR/EIS included water supply and conveyance benefits from modification of the Delta Cross-Channel (DCC). These elements are now being studied under separate efforts, namely the DCC Re-operation studies and Through-Delta Facility studies (see later in this chapter and the CALFED Bay-Delta Program Programmatic Record of Decision, Volume 1, page 50, for background on implementation of the North Delta conveyance plan). The current Project improvements under this EIR are focused on flood control and ecosystem restoration benefits. The 1990 Draft EIR/EIS identified that any potential area conveyance benefits were derived largely from DCC modifications. Therefore, although DCC Re-operation studies, Through-Delta Facility studies, and North Delta Flood Control and Ecosystem Restoration actions are being coordinated, conveyance improvements are not a primary purpose of the Project.

In 1995, DWR suspended the North Delta planning efforts in deference to the CALFED Bay-Delta Program. The goals of the 1990 North Delta EIR/EIS were substantially absorbed into the CALFED Program and restructured as the North Delta Flood Control and Ecosystem Restoration improvements (subject of this EIR) and the Delta Cross-Channel Re-operation and Through-Delta Facility studies mentioned above. While the CALFED Bay-Delta Program was completing the Programmatic Bay-Delta EIR/EIS, CALFED staff convened the NDIG to initiate North Delta flood improvements planning. The group focused early planning efforts on preparation of the “DRAFT White Paper on North Delta Improvements,” (White Paper) dated July 2000, to capture the complex history of the area, the then-current related planning efforts, and preliminary planning research.

In 1999, The Nature Conservancy (TNC) obtained $5.6 million in CALFED Ecosystem Restoration Program (ERP) funds to purchase the approximately 1,600-acre McCormack-Williamson Tract for ecosystem restoration and flood control. Also in 1999, University of California, Davis (UCD) researchers and DWR obtained CALFED ERP funds in complementary proposals. UCD researchers received $556,200 to conduct historical research and baseline studies for restoration planning and a monitoring program, and DWR received $355,000 for restoration planning and design of engineering alternatives. The UCD research included analysis of historical hydrogeomorphic conditions, the modern hydrologic and sedimentologic regime, baseline studies of aquatic resources and riparian resources, and development of data management and monitoring systems.

Staten Island was purchased by TNC in late 2002 with roughly $17.5 million in State Proposition (Prop) 13 funds and roughly $17.5 million in Prop 204 funds under the Flood Protection Corridor Program. Consistent with the funding sources for purchase of Staten Island, DWR committed to carefully balance use of Staten Island for ecosystem restoration and flood control protection and agricultural preservation. A crucial component of this balance is protection of the greater sandhill crane habitat on Staten Island.

DWR met with the CALFED ERP Steering Committee throughout 2001 and 2002 to obtain guidance on ecosystem restoration concepts for the Project. The Steering Committee advised DWR staff to submit ecosystem restoration proposals in the CALFED Ecosystem Restoration Proposal Solicitation Process. In 2003 and 2004, DWR convened a series of ecological coordination meetings with agency and nonprofit scientists to develop ecosystem restoration concepts for the Project and to address comments received in public scoping sessions. The ecological restoration coordination team consisted of representatives from DFG, USFWS, NMFS, TNC, and the CBDA and met regularly throughout 2003–2004.

A Science Panel chaired by Jeff Mount of UCD and consisting of academics from various disciplines was convened twice (in 2003 and 2004) to review the ecological restoration conceptual ideas for the Project. The Science Panel provided feedback for refinement of the ecological restoration options and recommended modifications to improve the scientific basis of the Project. The results of the Science Panel are included as an appendix.

Project Purpose, Need, and Objectives

Project Purpose

The purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Flood control improvements are needed to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures within the Project study area.

To be aligned with the overall goals of the CALFED program, the Project should also be compatible with and supportive of the other program elements outlined in the CALFED Programmatic EIR/EIS. Therefore, to the extent that meeting other goals does not interfere with the primary purpose of the Project, DWR will incorporate Project elements that are compatible and consistent with the following CALFED objectives:

- improve conveyance water supply reliability at the south Delta export pumps;
- improve water quality at the south Delta export facilities by facilitating reductions in salinity levels in the San Joaquin River;
- recommend ecosystem restoration and science actions in the Project area consistent with the CALFED ERP's strategic goals and objectives;
- improve levee stability and integrity within the Project area;
- minimize the conversion of prime, statewide-important and unique farmlands to Project uses; and
- improve and enhance existing and future recreational use within the Project area.

Project Need

As described above, flood control improvements are needed to reduce damage to land uses, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures in the Project study area. The Project would address the need for flood control solutions that are integrated with ecosystem improvements. The existing and historical conditions that warrant flood control and ecosystem quality improvements are described below.

Flood Control

The Mokelumne and Cosumnes Rivers and the Morrison Creek stream group do not currently have sufficient channel capacity to safely convey peak historical flows from Sierra Nevada watersheds, such as occurred during the 1986 and 1997 flood events, through the North Delta to the San Joaquin River. Current channel capacities for the North and South Forks of the Mokelumne River are approximately 40,000 cubic feet per second (cfs). By comparison, the combined channel capacity required to safely convey flows from a 100-year flood event has been estimated at 90,000 cfs. During peak flows, water from the Mokelumne River backs up into a broad floodplain north of New Hope Tract, and the limited capacity further causes water to back up into Snodgrass Slough to the north toward Lambert Road.

The lack of channel capacity, combined with other constrictions in vulnerable areas (e.g., bridge abutments) and an increase in sedimentation levels, makes a number of areas in the North Delta vulnerable to flooding. Since 1955, several areas have been flooded after levees failed (by breaches or overtopping), including the Point Pleasant area, McCormack-Williamson Tract, Tyler Island, Dead Horse Island, New Hope Tract, Canal Ranch Tract, Glanville Tract, and Franklin Pond area. The potential for flooding also threatens important public facilities and institutions in the North Delta area, including Interstate 5 (I-5), the Union Pacific Railroad line, and the Rio Cosumnes Correctional Center. Aside from these site-specific effects, failure of Delta levees can generally:

- result in flooding of Delta communities, farmland, habitat, and key roads and highways;
- expose adjacent islands to increased wave action, increased seepage, and possible levee erosion;
- degrade water quality through the exposure of contaminants that are otherwise trapped in or behind the levee;
- affect water supply distribution systems; and
- affect flow patterns, potentially resulting in adverse impacts on water quality, if the levee breach is not repaired.

A particular phenomenon associated with levee failure on McCormack-Williamson Tract is the “surge effect” created by the sudden rush of water over the island when the levee breaches or is overtopped. The force of the water from the surge effect rushes across the island from the northeast to the southwest, ultimately reaching the Walnut Grove and Wimpy’s/New Hope marinas. At this point, the surge can displace mobile homes, damage infrastructure, and break boats loose from their moorings. As evidenced in past flood events, flood damage can be considerable when this occurs, as the loosed boats can become lodged against the New Hope Bridge, compounding the channel constriction with other debris. The channel constriction causes water surface elevation to rise and create a back-up condition upstream and unstable conditions on adjacent areas. The overall result historically has constituted substantial property damage and threat to human safety, both in the immediate area and potentially on adjacent islands.

Ecosystem Restoration

Degradation and the loss of habitats that support various life stages of aquatic and terrestrial species are a primary concern in the North Delta. These habitat changes come from many causes, including sedimentation from hydraulic mining, habitat conversion, water diversions, and the introduction of exotic species.

Thirty years of nineteenth century hydraulic mining in the river drainages along the eastern edge of the Central Valley have increased sedimentation levels in downstream watercourses, degrading valuable aquatic habitat. Many of the seasonally inundated lands in the Bay-Delta system that historically provided habitat to a variety of bird and animal species have been converted to agricultural, industrial, and urban uses. Levees constructed to protect lands in the Delta from inundation and to channelize flow to flush out sediment eliminated fish access to shallow overflow areas, and dredging to construct levees eliminated the tule bed habitat along the river channels. Upstream water development and use, depletion of natural flows by local diverters, and the diversion of water from the Bay-Delta system have altered hydrodynamic processes. This has resulted in changed seasonal patterns of inflow, reduced Delta outflow, and diminished natural variability of flows into and through the Bay-Delta system. Those facilities constructed to support water diversions may result in straying or direct losses of fish and can increase exposure of juvenile fish to predation.

Recreation

The Delta is highly attractive for numerous recreational uses, including motorized and non-motorized boating, fishing, hunting, and wildlife viewing. Much of the North Delta is privately owned, including the levees that contain its hundreds of miles of waterways. Because of these ownership patterns, designated public access points are relatively few. Illicit access (i.e., trespassing through private property) is highly common and problematic for several reasons such as:

- erosion of levee material and displacement of rock revetment, which compromises the integrity of the levee cross section;
- degradation of vegetation and habitat;
- fish and wildlife poaching;
- trash dumping;
- illegal campfires;
- unsafe parking and effects on circulation;
- difficult access for law enforcement and emergency services; and
- vandalism to agricultural and reclamation district infrastructure.

Safe and convenient public recreation access and infrastructure clearly are needed to meet current and future demand.

Project Objectives

Based on the purpose and need stated above, the Project is meant to satisfy the following objectives. Objectives are subdivided by Project group, differentiating uniquely group-specific objectives where appropriate (Group I and Group II). A separate category is used to identify objectives applying to each group.

Flood Control

Both Groups

- Convey floodflows to the San Joaquin River without immitigable stage impacts.
- Reduce the risk of catastrophic levee failures based on the 1997 event for stage and the 1986 event for volume.

Group I

- Control floodwaters coming through McCormack-Williamson Tract in a way that minimizes the surge effect, i.e., avoids the historical occurrence when a large pulse of water from McCormack-Williamson Tract adversely affected adjacent island levees (e.g., Tyler and Staten Islands) and downstream flows and knocked boats loose from local marina moorings in flood events.

Group II

- Provide flood control benefits to I-5 and the Project area by achieving stage reduction, below or as close as possible to a water surface elevation of approximately 16.5 feet at Benson’s Ferry and approximately 12.0 feet at New Hope Landing, based on the 1997 event for stage and the 1986 event for volume. These objectives were developed through stakeholder consensus as reasonable stage targets to minimize North Delta area flood damages.

Ecosystem Restoration

Both Groups

- Implement science-driven pilot programs to restore ecologic, hydrologic, geomorphic, and biologic processes and self-sustaining habitats, including freshwater tidal marsh, seasonal floodplain, riparian, and other wetland habitats.
- Support special-status species.
- Limit exotic species establishment.
- Promote foodweb productivity.

Group I

- Promote natural flooding processes and tidal action.
- Promote processes to increase land surface elevations in areas of subsidence.

Group II

- Expand available floodplain area within the leveed channel.
- Minimize potential effects on greater sandhill cranes.

Recreation

Both Groups

- Enhance public recreation opportunities in a manner that does not compromise flood protection infrastructure or operations, compromise habitat integrity, or disturb wildlife.

Project Area

The Project area, shown in Figure 1-2, is approximately 197 square miles and is the area in which DWR is considering alternatives for flood control and restoration actions. Direct (on-the-ground) impacts of constructing the alternatives are evaluated within this area; however, certain impact analyses include evaluation of effects beyond these limits. The following criteria were used to develop Project area boundaries.

- The Project area must include the footprint area of each alternative.
- The Project area should be hydrologically contiguous.
- The Project area should include portions of all waterways where existing flow patterns could be substantially affected by one or more of the alternatives.
- The Project area should be compatible with flood control planning and implementation responsibilities of other flood control agencies.
- To the extent practicable, the Project area should be compatible with CALFED's ERP planning units.

A brief description of the Project area boundaries is presented below.

Northern Boundary	Line running east to west from the Sacramento–San Joaquin Delta Ecological Zone eastern boundary along the south bank of Morrison Creek to the west bank of the Sacramento River.
Western Boundary	Follows the west bank of the Sacramento River from Morrison Creek south to the confluence of Steamboat Slough. From here the boundary follows the east bank of the Sacramento River south to the confluence of Threemile Slough. From here, the boundary follows the north bank of Threemile Slough to its confluence with the San Joaquin River.
Southern Boundary	Follows east along the south bank of the San Joaquin River from Threemile Slough to Potato Slough, along the south bank of Potato Slough to White Slough, along the south bank of White Slough to the Upland Canal, along the south bank of Upland Canal to State Route (SR) 12, then along SR 12 east to the eastern boundary of the Sacramento–San Joaquin Ecological Zone.
Eastern Boundary	Follows the eastern boundary of the Sacramento–San Joaquin Ecological Zone north from SR 12 to its intersection with I-5 near Point Pleasant. From here, the boundary follows I-5 north to its intersection with the Sacramento–San Joaquin Ecological Zone near the northeastern shore of Stone Lake. Then the boundary follows the Sacramento–San Joaquin Ecological Zone once again north to Morrison Creek.

Figures 1-3, 1-4, and 1-5 show McCormack-Williamson Tract, Staten Island, and the Grizzly Slough property, respectively, highlighting interior elevation ranges.

Preceding Environmental Documents and the CALFED Planning Context

Preceding Environmental Document

As discussed previously, DWR proposed a North Delta Program to alleviate flooding in the North Delta, improve water quality, and improve water supply reliability and flexibility for the State Water Project (SWP). The proposed program was analyzed in a draft EIR/EIS (California Department of Water Resources 1990). At that time, the preferred alternative included dredging the North and South Forks of the Mokelumne River, constructing setback levees along the North Fork Mokelumne River to enlarge the channel, and modifying the DCC gate structure. Subsequently, DWR suspended North Delta planning efforts in deference to the CALFED Bay-Delta Program (described below), and the goals of the original North Delta Program were subsumed by the CALFED Program. The scope and context of this EIR differ from those of the North Delta Program 1990 draft EIR/EIS, and the Project analyzed in this EIR does not include all elements of the previous North Delta Program; rather, the current Project emphasizes crucial elements for flood control and ecosystem restoration.

Relationship to the Bay-Delta Program Described in the CALFED Programmatic Record of Decision

The Project is being proposed as an element to implement the California Bay-Delta Program described in the CALFED Programmatic Record of Decision (ROD), issued August 28, 2000. The Preferred Program Alternative described in the ROD is a long-term plan that includes a variety of different potential actions to be implemented over 30 years by numerous public and private entities to improve the health of the Bay-Delta Estuary. Among the potential actions are several that would change the manner in which water is conveyed through the Delta. The Preferred Program Alternative employs a through-Delta approach to water conveyance, with modifications expected to result in improved water supply reliability, protection and improvement of Delta water quality, improvements in ecosystem health, and reduced risk of supply disruption as a result of catastrophic breaching of Delta levees. The flood control and ecosystem restoration actions that are part of the Project were contemplated as part of the through-Delta approach to conveyance and the ecosystem restoration in the Delta included in the ROD. However, the Project, as it has evolved since the issuance of the ROD, and independent of other through-Delta conveyance, levee system integrity, and ecosystem restoration actions, can contribute to the overall Bay-Delta Program objectives and provide benefits separate from other elements of the Bay-Delta Program. (CALFED Programmatic ROD, p. 23.)

The Project is consistent with the implementation approach in the ROD. The Project has been developed in the context of the overall Bay-Delta Program and represents one of the ways to achieve the four equal CALFED objectives of improving water quality, ecosystem quality, levee system integrity, and water supply reliability. The Project meets the policy commitments described in the ROD that each project implementing the Bay-Delta Program will be subject to the appropriate type of environmental analysis and will evaluate and use the appropriate programmatic mitigation strategies described in the PEIS/EIR and the ROD. (Id., pp. 29–30, 32–35, and Appendix A.) Further, the Project is consistent with the recently enacted California Bay-Delta Act, which charges DWR with implementing the conveyance and levee system integrity elements of the Bay-Delta Program.

Relationship to the CALFED Programmatic Environmental Impact Statement/ Environmental Impact Report

The CALFED PEIS/EIR provides a very broad, programmatic analysis of the general effects of implementing the multiple components of the Bay-Delta Program over a 30-year period, across two-thirds of the state. The impact analyses in the PEIS/EIR were not intended to address any site-specific environmental effects of individual projects. Accordingly, the CALFED PEIS/EIR's direct, indirect, and cumulative impact analyses are not sufficiently detailed for purposes of the Project document, which focuses on specific Project actions and specific affected geographic areas over a different time frame. The CALFED PEIS/EIR was therefore used to develop background information and for screening of program-level alternatives only. This Project EIR stands alone and includes an independently developed analysis of the impacts of the Project, including direct, indirect, and cumulative impacts, alternatives, and avoidance/mitigation measures.

Readers who desire more information about the Bay-Delta Program, the CALFED PEIS/EIR, the Programmatic ROD, or the CBDA may wish to review the following documents, which are available from the CBDA at 650 Capitol Mall, 5th Floor, Sacramento, CA 95814, (916) 445-5511, or view the documents on the Web at http://calwater.ca.gov.

- Final Programmatic Environmental Impact Statement/Environmental Impact Report (July 2000), including technical appendices; and
- Programmatic Record of Decision, Volumes 1–3, (August 28, 2000).

Related Actions, Programs, and Planning Efforts

The projects and programs described below are related to environmental conditions in the Delta and in upstream areas. Some of these projects are being implemented now and others are in development. The description of these projects provides a context for understanding planning related to the Project and for analyzing cumulative environmental effects of the Project.

The following projects are described below and have been categorized by their *primary* purpose or function:

Flood Control

- Cosumnes River Task Force
- Delta Risk Management Strategy

- Interstate 5/Point Pleasant Flood Protection Project
- Cosumnes & Mokelumne Rivers Floodplain Integrated Resources Management Plan
- San Joaquin River Basin–South Sacramento County Streams Investigation
- South Sacramento County Streams Project
- Emergency bank protection sites along Sacramento River system
- Cosumnes River Dry Dam Evaluation

Ecosystem Restoration

- CALFED Ecosystem Restoration Program
- Canal Ranch Habitat Restoration Planning
- Grizzly Slough Project
- Joint Settlement Agreement for the Mokelumne River
- McCormack-Williamson Tract Wildlife-Friendly Levee Demonstration Project
- Lower Mokelumne River Partnership Projects
- Lower Mokelumne River Restoration Program
- Murphy Creek Restoration Project
- Staten Island Ducks Unlimited Project

Water Supply and Conveyance

- Delta Cross-Channel Re-operation Study
- Freeport Regional Water Project
- Screened Through-Delta Facility Evaluation
- South Delta Improvements Project
- Los Vaqueros Expansion

Water Quality

- Assessment of Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed
- Delta Mercury Total Maximum Daily Load

Ongoing Watershed Studies

- The Cosumnes Consortium Research and Monitoring Program

Public Outreach

- The Lower Mokelumne River Stewardship Program
- Mokelumne-Cosumnes Watershed Alliance

Planning Efforts

- The San Joaquin County Multi-Species Habitat Conservation and Open Space Plan Program
- Delta Vision

Flood Control

Cosumnes River Task Force

The Cosumnes River Task Force was formed in 1997 as a result of the flooding along the Cosumnes River in January of that year. The mission of the Cosumnes River Task Force is to develop a long-term strategy that will encourage restoration of watershed health and improve flood management. Sacramento County provides staff and acts as lead agency on the Task Force, a joint venture of Sacramento County, Lower Cosumnes Resource Conservation District (RCD), Sloughhouse RCD, Florin RCD, and Amador RCD.

Delta Risk Management Strategy

DWR and its partner agencies, USACE and DFG are conducting the Delta Risk Management Strategy. This study was called for in the 2000 CALFED Programmatic Record of Decision as part of its Preferred Program Alternative. It is a two-part study to identify the risk to Delta levees and to propose strategies to minimize that risk.

The first phase of the study will involve constructing a risk model to analyze the probabilities of Delta levee failures associated with seismic events, flooding, subsidence, climate changes, and other natural and man-made hazards over the next 200 years. It will also assess the water supply, economic, and environmental effects of such failures. The second phase, to begin when the first phase is completed, is a risk management analysis that will systematically assess alternative risk-reduction strategies and propose risk management options for consideration by DWR and other local, state, and federal agencies.

Interstate 5/Point Pleasant Flood Protection Project

Sacramento County developed a conceptual plan for improvements to increase flood protection for the residents of the Point Pleasant and Franklin Pond areas. Key facilities that were designed to be protected in the plan include I-5, the Rio

Cosumnes Correctional Center, and the Union Pacific Railroad. The Interstate 5/Point Pleasant Flood Protection Project originally planned to raise Lambert Road and elevate and certify Glanville Tract levees. On October 2, 2001, the Sacramento County Board of Supervisors approved the project. Because construction of the project improvements was projected to increase water levels in the North Delta area during peak floods, the Board of Supervisors initiated the CEQA compliance process in parallel with the NEPA/CEQA process for the Project.

It now appears that the CALFED North Delta project will not significantly abate the flood threat in this area. In late 2005, with the support and staff assistance of DWR, the County Department of Water Resources initiated a consensus effort to consider options to reduce flooding risk in the study area. This stakeholder forum is intended to address and balance issues of flood damage reduction, habitat preservation and restoration, and preservation of the agricultural economy.

Cosumnes & Mokelumne Rivers Integrated Resource Management Plan

This study is designed to develop a management strategy that facilitates effective enhancement of floodplain conditions and functions of the lower Cosumnes and Mokelumne Rivers. The lead agency for this effort is the Southeast Sacramento County Agricultural Water Authority, with funding by CBDA, East Bay Municipal Utility District (EBMUD), Sacramento Area Flood Control Agency (SAFCA), and the Sacramento County Water Agency (SCWA). The study was initiated in March 2005. Additional study partners include TNC, University of California at Davis (UCD), San Joaquin County Resource Conservation District, and Reclamation District 800. The lead consultant is Robertson-Bryan, Inc. of Elk Grove.

San Joaquin River Basin—South Sacramento County Streams Investigation

USACE performed a feasibility study in this area known as the San Joaquin River Basin—South Sacramento County Streams Investigation. This investigation addressed flood problems in the Morrison Creek stream group and Beach Stone Lakes basins and led to the South Sacramento County Streams Project (see below).

South Sacramento County Streams Project

SAFCA is currently teamed with USACE to implement the South Sacramento County Streams Project, a flood improvement project on Morrison Creek, Florin Creek, Elder Creek, Unionhouse Creek, and the North Beach–Stone Lakes area. This project will allow safe passage of floodwaters from the upstream area through the City of Sacramento and into the North Beach–Stone Lakes area. SAFCA has determined that as a result of this project, peak flood stages could increase in the Point Pleasant and downstream areas. As part of mitigating the effects of the project on downstream properties, SAFCA has pledged to contribute $2 million toward a permanent solution to the flooding in Point Pleasant.

Cosumnes River Dry Dam Evaluation

As a part of their Beach Stone Lakes and Point Pleasant Flood Stakeholder Forum process, Sacramento County evaluated the potential flood control benefits of a dry dam on the Cosumnes River. The dry dam would allow free flow in the river during normal flow conditions, but would hold back excess water and reduce peak flows downstream during large storm events. The location of the dry dam considered in the study was approximately 1,600 feet upstream of Michigan Bar near the eastern boundary of Sacramento County.

The flood control effects of the dam were evaluated using two storm events: the January 1997 storm event and a hypothetical 100-year storm. The study found that a dry dam could significantly reduce peak flows in the Cosumnes River downstream of the dam during large storm events. For the 1997 storm event, the dry dam would reduce the peak flow from 93,000 cfs to approximately 35,000 cfs. The maximum pool depth behind the dam would be approximately 180 feet, resulting in the inundation of approximately 1,500 acres. The estimated water surface elevation reductions downstream of the dam varied by location. The largest reductions were predicted along the Cosumnes River between the dam site and Wilton Road. In that reach, the predicted reductions ranged between 4.6 feet and 11.2 feet. Downstream of SR 99 in the North Delta area, the reductions typically ranged between 0.5 feet and 2.8 feet. In the Point Pleasant area north of Lambert Road, the predicted reductions ranged between 0.2 feet and 0.5 feet.

An order of magnitude implementation cost for the dry dam was estimated based on the cost of the recently completed Olivenhain Dam in San Diego County. The estimated implementation cost of the dry dam was $70 million.

Ecosystem Restoration

CALFED Ecosystem Restoration Program

The CALFED program to address the CALFED objective of ecosystem quality is the ERP.

The CALFED vision for ecosystem restoration is broadly articulated in the Ecosystem Restoration Program Plan (ERPP), which is an element of the CALFED Programmatic EIS/EIR (CALFED Bay-Delta Program 1999). ERP strategic goals, as listed in the ERPP, follow.

Goal 1: Achieve recovery of at-risk native species dependent on the Delta and Suisun Bay as the first step toward establishing large, self-sustaining populations of these species; support similar recovery of at-risk native species in San Francisco Bay and the watershed above the estuary; and minimize the need for future endangered species listings by reversing downward population trends of native species that are not listed.

Goal 2: Rehabilitate natural processes in the Bay-Delta estuary and its watershed to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities.

Goal 3: Maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest, consistent with the other ERP strategic goals.

Goal 4: Protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics.

Goal 5: Prevent the establishment of additional nonnative invasive species and reduce the negative ecological and economic impacts of established nonnative species in the Bay-Delta estuary and its watershed.

Goal 6: Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts on aquatic organisms, wildlife, and people.

The California Bay-Delta Authority and its ecosystem restoration implementing agencies (DFG, NMFS, and USFWS) have funded hundreds of restoration projects throughout the Bay-Delta watershed, either through a competitive grant process or through directed actions. In addition, they are currently in the initial stages of developing the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). DRERIP is an effort to develop a strategy and plan for implementing ecosystem restoration in the Delta based on an adaptive management framework.

Mokelumne River Joint Settlement Agreement

The Mokelumne River Joint Settlement Agreement (JSA) is a cooperative effort by EBMUD, DFG, and USFWS to enhance the anadromous fishery and ecosystem of the lower Mokelumne River. Actions being implemented under the agreement include flow enhancement, riparian restoration, aquatic habitat restoration, construction of a new fish hatchery, and reduction and eradication of invasive nonnative vegetation from riparian corridors. The JSA created the Lower Mokelumne River Partnership composed of representatives of EBMUD, DFG, and USFWS and established the Partnership Fund to support partnership programs. This fund supports ecosystem restoration and enhancement throughout the lower Mokelumne River watershed.

Lower Mokelumne River Partnership Projects

These projects are designed to protect and enhance the natural production of anadromous fish and the ecosystem of the lower Mokelumne River. Current projects are listed below.

- Implementation of a fencing and riparian vegetation restoration project conducted by the San Joaquin County RCD in the lower Mokelumne River. In 2002 and 2003, fencing was placed at a site about seven miles downstream of Camanche Dam. After fencing was complete, goats were used to reduce nonnative vegetation. At another project site, native shrubs, trees, and grasses have been planted. Project work was completed in 2005. A portion of this project was recognized by the U.S. Department of Interior and featured at the White House Conference on Cooperative Conservation in August 2005.
- Enhancement of riparian and upland habitat at the Mokelumne River Day Use Area through fencing, removing non-native vegetation, and seeding. Fields have been fenced, burned, treated, and seeded. During July 2004 approximately 2.5 acres of yellow star thistle were cleared by hand. In fall of 2004, 430 trees were planted in the habitat corridor. This project was completed in Fall 2005.
- San Joaquin County RCD Watershed Coordinator. In spring 2004, the RCD was awarded the Watershed Coordinator Grant from the Department of Conservation and the Partnership Fund committed matching funds to this effort. The RCD's watershed coordinator continues to provide leadership and facilitation for the lower Mokelumne River Watershed Stewardship Steering Committee, one of the primary stakeholder outreach mechanisms for the Partnership.
- Salmonid Rearing Habitat Restoration Project. This project reestablished off-channel juvenile salmonid rearing habitat by reconnecting a site that has become isolated from the main channel of the lower Mokelumne River. The project was completed in 2005.
- Spawning Gravel Enhancement Program. This project provides funding for spawning gravel enhancement in the lower Mokelumne River. This enhancement work has been continuing annually since 1990. This supplemental funding supported implementation in 2005 and also will in 2006 and 2007.
- Gill Creek Landowners Riparian Enhancement. This project consists of the riparian enhancement of approximately 4 acres of valley/foothill riparian habitat on Gill Creek, a tributary of the Mokelumne River. Enhancement will consist of the removal of a portion of a vineyard and the planting of native plants throughout the riparian zone. Enhancement will be phased over

a 2-year period. Restoring the native riparian habitat will improve habitat for anadromous fish.

- Calvary Bible Church Riparian Enhancement. This project consists of the understory enhancement of approximately 11 acres of riparian valley oak woodland. Enhancement will consist of the removal of approximately 4 acres of invasive Himalayan blackberry and other non-native plant species; and the planting of native plants throughout the 11 acres of riparian woodland. The existing understory is sparse and not as dense as understory shrubs in reference riparian areas in City and County parks along the Mokelumne River. Restoring the native riparian habitat will improve habitat for anadromous fish. This project will be implemented over a 3-year period.
- Mokelumne River Law enforcement. This project, which provided an additional 252 hours of DFG law enforcement in the lower Mokelumne River, was completed in 2003.
- Landowner Education. Under this project, the Yolo County RCD developed a book titled, *Bring Farm Edges Back to Life*. The book was provided to the Lodi-Woodbridge Winegrape Commission for distribution to growers in the lower Mokelumne River area. The books were distributed in 2002.
- Lower Mokelumne River Watershed Stewardship Award. The purpose of this award, co-sponsored by the Lower Mokelumne River Partnership and the Lower Mokelumne River Stewardship Steering Committee, is to recognize individuals within the lower Mokelumne River watershed that show outstanding leadership and action in promoting wide stewardship of the watershed.

Lower Mokelumne River Restoration Program

This program, sponsored by the Woodbridge Irrigation District and the City of Lodi, is intended to remove barriers to anadromous fish migration, support riparian restoration efforts, minimize ecological stressors, and restore spawning grounds. This effort received partial funding through a CALFED Category III grant, producing a final EIR/EIS in 2000 (Jones & Stokes 2000) and obtaining all necessary permits thereafter. The EIR/EIS included project-specific analysis of three elements of the program: replacement of Woodbridge Dam and its accompanying fish ladders, construction of new fish screens at the dam and at the entrance to Woodbridge Canal, and construction of a new bypass pipeline from the screen at Woodbridge Canal to below Woodbridge Dam. Although funding has not yet been identified for the entire project, Woodbridge Irrigation District has obtained funding for the dam replacement and the construction of new fish ladders.

McCormack-Williamson Tract Wildlife-Friendly Levee Demonstration Project

The purpose of this project is to support the eventual full-scale restoration of the McCormack-Williamson Tract by resloping up to 20,000 linear feet of interior levee slope. The eventual full-scale restoration of the McCormack-Williamson Tract will include levee breaches that will allow habitat and flood waters into the interior of the island. In order to accommodate this flooding all interior levees must be resloped to a minimum of a 5:1 slope. These reconstructed interior slopes will prevent erosion during periods of inundation and provide excellent upland-type habitat.

Murphy Creek Restoration Project

The landowners adjoining Murphy Creek in San Joaquin County have initiated this project to:

- restore rearing and/or spawning habitat for Chinook salmon and steelhead;
- restore native riparian vegetation to encourage the reestablishment of neotropical migratory birds and other special-status wildlife species;
- improve water quality and improve water flows in the creek; and
- promote sustainable agricultural practices that continue to support livestock and vineyard production in the watershed.

To achieve the purpose of the project, the following actions were identified as necessary to improve fish and wildlife habitat, water quality and water flows, and to enhance ecosystems while preserving agricultural production in the Murphy Creek watershed, and are currently underway:

- remove fish barriers with drops greater than 1 foot located within 3 miles of the reach,
- increase native vegetation canopy cover to encourage coldwater fish, and native shrubs to increase habitat for neotropical migratory birds,
- reduce nonnative plant species,
- limit livestock access to riparian zones, and
- repair minor erosion/bank instability to reduce creek sedimentation.

The project was funded by CALFED, the National Fish and Wildlife Foundation, and USFWS. The San Joaquin RCD manages the project.

Staten Island Ducks Unlimited Project

The purpose of the project is to enhance the wildlife habitat on Staten Island by improving the water management infrastructure. The project has two basic components, construction of a new pumping facility and construction of over three miles of interior cross levees. These new features will allow Staten Island management to increase quality, quantity and duration of flooded habitat for waterfowl and sandhill cranes. The project also includes a monitoring component, which will evaluate habitat use and water quality effects of the new infrastructure.

Water Supply and Conveyance

Delta Cross-Channel Re-Operation Study

The DCC is a gated canal that, when the gates are open, draws water from the Sacramento River into the lower Mokelumne River in the northern part of the Delta. The DCC is intended to provide fresh Sacramento River water to the central and southern Delta. However, historical operation of the DCC has allowed the straying of migrating salmonids, diverting them into the central Delta where studies have indicated they have a lower rate of survival. This project includes initial steps to study possible ways of re-operating the DCC to protect fish while improving Delta water quality. As information is collected over a 3-year period, operational plans will be developed and further studies will be conducted. A team of engineers and biologists will make a recommendation to CALFED as to whether re-operation can achieve the fishery benefits and drinking water quality goals CALFED has set, or whether additional cross-Delta conveyance facilities are needed. Reclamation leads the coordination with CALFED agencies, including the U.S. Environmental Protection Agency (EPA), NMFS, USFWS, DFG, and DWR. Further study and development of DCC reoperation and completion of an EIR/EIS would be pursued at the earliest possible date once study results have identified feasible alternatives.

Freeport Regional Water Project

The Freeport Regional Water Project (FRWP) is a cooperative effort of the SCWA and EBMUD of Oakland to supply surface water from the Sacramento River to customers in central Sacramento County and the East Bay of California. The basic project purpose is to increase water service reliability for customers, reduce rationing during droughts, and facilitate conjunctive use of surface water and groundwater supplies in central Sacramento County.

Water will be drawn from the Sacramento River at an intake facility and pumping plant located in Sacramento, upstream of the town of Freeport, and transported east and southeast through Sacramento and San Joaquin Counties by new large-diameter pipelines.

When operational in 2010, the FRWP will provide SCWA with up to 85 million gallons per day (mgd) of water. SCWA will supply this water to its customers in central Sacramento County to supplement groundwater use in the central part of the county.

EBMUD will use up to 100 mgd of water during dry years only, estimated to be three out of every 10 years, as a supplemental water source to complement existing conservation programs.

Screened Through-Delta Facility Evaluation

The purpose of this project is to complete a thorough evaluation of the technical viability of a screened through-Delta facility. The historical emphasis has been on a screened diversion at Hood. Potential sites to be considered as part of this evaluation are between, and include, Hood and Georgiana Slough. CALFED will then make a decision as to whether it is appropriate to begin preparation of the project-specific EIR/EIS for the through-Delta facility.

The decision to proceed with preparation of the project-specific EIR/EIS for the through-Delta facility would be made only if:

- a thorough assessment of the potential for re-operation of the DCC concludes it is not possible to re-operate the cross-channel to meet target Delta drinking water quality goals,
- the evaluation of the technical viability of a through-Delta facility concludes that it is feasible, and
- Delta fish concerns about the through-Delta facility have been resolved satisfactorily.

DWR will manage the project, and Reclamation will provide staff support for the study.

South Delta Improvements Program

The South Delta Improvements Program (SDIP) addresses the needs of the Delta aquatic environment, as well as longstanding statewide, regional, and local water supply needs. Flows into and out of the Delta can have a major effect on these resources. Fish survival as well as water quality and quantity is affected by the natural split of the San Joaquin River flows at the head of Old River, tidal fluctuation; local diversions; local agricultural return flows; channel capacity resulting in restricted circulation; and water exports. DWR and Reclamation have, therefore, identified the following project objectives:

- Reduce the movement of San Joaquin River watershed Central Valley fall-/late fall–run juvenile Chinook salmon into the Delta via Old River.

- Maintain adequate water levels and, through improved circulation, water quality available for agricultural diversions in the south Delta, downstream of the head of Old River.
- Increase water deliveries and delivery reliability for SWP and CVP water contractors south of the Delta and provide opportunities to convey water for fish and wildlife purposes by increasing the maximum permitted level of diversion through the existing intake gates at Clifton Court Forebay.

Meeting these objectives will provide increased operational flexibility and the ability to respond to real-time fish conditions while improving water supply reliability.

The SDIP consists of a physical/structural component combined with an operational component designed to meet the purpose and objectives of the project. The physical/structural component consists of a permanent operable fish control gate on Old River; operable flow control barriers on Middle River, Grant Line Canal, and Old River; and dredging portions of Middle River, Old River, and West, Grant Line, North, and Victoria Canal to improve flows in the south Delta channels. The operational component (Stage 2) includes increasing the permitted diversion into CCF from 6,680 cfs to 8,500 cfs and increasing south of Delta transfers.

DWR and Reclamation have divided the decision making process into two stages. Stage 1 will include a decision on the physical/structural component. Stage 2 will include a decision on the operational component. The Stage 2 decision-making process will not begin until after the Stage 1 decision is made. This reflects the current uncertainty regarding the heath of pelagic organisms in the Delta.

Water Quality

Assessment of Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed

DFG is sponsoring this study in cooperation with the UCD Department of Environmental Science and Policy to provide information that will lead to reduction of mercury levels in resident fish throughout the Delta, including the Mokelumne and Cosumnes River inflow areas. The potential to create conditions for the methylation of mercury has been identified as a significant issue of concern in North Delta area planning efforts. This effort received partial funding through a CALFED Category III grant.

Delta Mercury Total Maximum Daily Load

The CVRWQCB has identified the Delta as impaired for mercury because Delta fish have elevated levels of methylmercury that pose a risk for human and wildlife consumers. In August 2005, the CVRWQCB released a total maximum daily load (TMDL) for mercury titled the Sacramento–San Joaquin Delta Estuary TMDL for Methyl & Total Mercury Draft Report to the public (Central Valley Regional Water Quality Control Board 2005). The mercury TMDL includes the portion of the Delta within the CVRWQCB's boundaries. The report includes the development of a proposed mercury fish tissue water quality objective and an aqueous methylmercury goal, a description of the amount of reduction necessary to meet the proposed objective, and a technical analysis of the sources, fate, and transport of total mercury and methylmercury (Central Valley Regional Water Quality Control Board 2005). The report will be used to create an amendment to the CVRWQCB's basin plan for mercury. The revised June 2006 report can be downloaded from the RWQCB website at: http://www.waterboards.ca.gov/centralvalley/programs/tmdl/deltahg.html.

Ongoing Watershed Studies

The Cosumnes Consortium Research and Monitoring Program

UCD Center for Integrated Watershed Science and Management is sponsoring this program to conduct fluviogeomorphic-ecological studies of the Cosumnes and Mokelumne Rivers. This effort received funding through a CALFED Category III grant.

Public Outreach

Lower Mokelumne River Stewardship Program

The Lower Mokelumne River Watershed Stewardship Program, completed in May, 2002, is a voluntary, stewardship-based program sponsored by the Woodbridge Irrigation District and the City of Lodi. It guides landowners, residents, and stakeholders in maintaining and improving the resources of the lower Mokelumne River watershed. The San Joaquin County RCD's Watershed Coordinator is responsible for coordinating the implementation of the many programs contained in the plan. This program is also implementing an Environmental Farm Plan, which encourages voluntary assessment and reduction of nonpoint-source pollutants and biological monitoring. This effort received partial funding through a CALFED Category III grant.

Mokelumne-Cosumnes Watershed Alliance

There has been widespread acknowledgement that coordination between various efforts in the Mokelumne-Cosumnes watershed is mutually beneficial. The San Joaquin County Council of Governments (SJCOG) developed a CALFED

Category III proposal outlining a Mokelumne-Cosumnes watershed coordination effort. Also, SAFCA produced a "White Paper on Proposed North Delta Coordination and Integration Committee" outlining a similar effort. CALFED since has teamed up with these and other interested parties to form the Mokelumne-Cosumnes Watershed Alliance (MCWA), building on the SJCOG and SAFCA efforts. The MCWA aims to support communication, partnership, and integration of the numerous ongoing and proposed projects in the Mokelumne-Cosumnes watershed area. Activities of the MCWA include development and management of a stakeholder database and creation of a Web page to disseminate project and other pertinent information. Additionally, information from focused subgroups will allow the participants to maximize resources by sharing information and data on hydraulic and hydrologic modeling and GIS. CALFED has taken administrative lead of the MCWA; however, the Alliance has agreed that funding or in-kind service provisions for the effort will be shared among the participating entities.

Planning Efforts

The San Joaquin County Multi-Species Habitat Conservation and Open Space Plan Program

The key purpose of this program is to provide a strategy for balancing the need to conserve open space and the need to convert open space to non–open space uses, while protecting the region's agricultural economy rights and providing for the long-term management of plant, fish, and wildlife species (especially those that are currently listed). This program was adopted by all the local jurisdictions and SJCOG, Inc., a non-profit joint powers authority administers the program. The San Joaquin County Multi-Species Habitat Conservation Plan is based on a 50-year planning horizon and encompasses all of San Joaquin County except for federally owned lands. Conversion of 109,302 acres of open space to non–open space uses is projected to occur between 2001 and 2051. A majority of the funding for this project will come from developer fees, and the remaining funding will come from grants, future mitigation, lease programs, revolving funds, and investments.

Delta Vision

Delta Vision is intended to identify a strategy for managing the Delta as a sustainable ecosystem that would continue to support environmental and economic functions that are critical to the people of California. Although it builds on work done through the CALFED Bay-Delta Program, Delta Vision will broaden the focus of past efforts in the Delta to recommend actions that will address the full array of natural resource, infrastructure, land use, and governance issues necessary to achieve a sustainable Delta.

Delta Vision is based on a growing consensus among scientists, supported by recent legislation and other information, indicating that:

- environmental conditions and current Delta “architecture” are not sustainable;
- current land and water uses and related services dependent on the Delta are not sustainable based on current management practices and regulatory requirements;
- current environmental conditions and current and ongoing services (e.g., utility, transportation, and water conveyance services) are reliant on an aging and deteriorating levee system;
- major “drivers of change” that are largely outside of our control will affect the Delta during the coming decades, including seismic events, land subsidence, sea level rise, regional climate change, and urbanization;
- the current fragmented and complex governance systems in the Delta are not conducive to effective management of the fragile Delta environment in the face of the cumulative threats identified above; and
- failure to act to address identified Delta challenges and threats will result in potentially devastating environmental and economic consequences of statewide and national significance.

A key component of Delta Vision will be the independent Blue Ribbon Task Force, appointed by the Governor, which is be responsible for recommending future actions to achieve a sustainable Delta. Task Force recommendations will not be constrained by past decisions or policies relating to the Delta and will benefit by the advice of science advisors selected by the Delta Vision Committee. The Committee includes the Secretary of Resources as Chair, and the Secretaries of Business, Transportation and Housing; Food and Agriculture; and Cal-EPAand the President of the California Public Utilities Commission.

The Task Force will submit recommendations to the Delta Vision Committee by October 31, 2008, and the Committee will review Task Force recommendations and report its findings to the Governor. Based on the work of the Task Force and Committee, the Governor will submit a report to the Legislature by December 31, 2008.

Chapter 2
Project Description

Overview of Project Groups

DWR is pursuing the development of the Project to achieve flood control and ecosystem restoration benefits in the North Delta, as well as additional benefits such as recreation improvements where practicable. In broad terms, the Project is intended to meet equal flood control and ecosystem restoration purposes and objectives by minimizing the surge effect across McCormack-Williamson Tract and providing additional capacity in the Project area to minimize the potential for catastrophic flooding, while substantially increasing opportunities for habitat and ecological processes. As described in Chapter 1, the Project may be implemented in two distinct groups. The groups are being developed to be independent, such that the proposed component actions are targeted to meet group-specific objectives and that the groups are not inter-reliant for mitigating impacts (i.e., Group II is not required for mitigation of Group I).

Group I

Group I consists of modifications to levees on McCormack-Williamson Tract, downstream levee raising to offset potential hydraulic impacts caused by these modifications, restoration of McCormack-Williamson Tract and the Grizzly Slough property, and dredging the Mokelumne River.

Flood Control

To achieve flood control objectives, the primary strategy for Group I is degrading portions of the levee system to allow controlled flow across McCormack-Williamson Tract and marina outreach to address boat hazards during floods. Secondarily, downstream levee modifications may be necessary to mitigate hydraulic impacts, and channel dredging may be implemented to increase flood conveyance capacity.

Ecosystem Restoration

Floodplain forests and marshes would be recreated at McCormack-Williamson Tract and the Grizzly Slough property. At McCormack-Williamson Tract, natural hydrologic processes would be restored through one of three pilot program strategies to meet different ecological objectives:

- maximizing fluvial and tidal processes to create a diverse network of riverine, floodplain, and tidal habitats based on natural sedimentation and channel formation;
- maximizing floodplain habitat to benefit fish that spawn and rear on the floodplain by allowing flooding (with some tidal action to maintain water quality) during the wet season; or
- creating floodplain habitat as described above, combined with a demonstration project to reverse subsidence and increase elevations on the tract.

Landside levee slopes would be planted with trees, shrubs, and native grasses to improve habitat for wildlife.

DWR has prepared a more complete description of the ecosystem restoration for McCormack-Williamson Tract as envisioned and articulated as a conceptual model for each of the three pilot program strategies. These conceptual models were developed with input from the science panel, resource agency representatives, and other stakeholders. The conceptual models are detailed in Appendix D.

Additional benefits to wildlife, fish, and healthy ecosystem functions would be achieved by recreating floodplain forests at the Grizzly Slough property. The Grizzly Slough restoration would maximize floodplain habitat to benefit fish that spawn and rear on the floodplain and reconnect the floodplain with adjacent sloughs.

Recreation

Opportunities for recreation would be developed to be compatible with flood control and ecosystem restoration through the development of public access for fishing, wildlife viewing, and boat use. Recreation could be enhanced by:

- opening up the southern portion of McCormack-Williamson Tract to boating and/or
- improving Delta Meadows property.

Group II

Group II consists of proposed Project actions on Staten Island and levee modifications and dredging along the Mokelumne River.

Flood Control

To achieve flood control objectives, the strategy for Group II is to create an off-channel detention basin on Staten Island in one of three optional locations on the north, east, or west part of the island, or dredging in combination with levee modifications. Dredging may also be an optional component combined with detention to improve channel capacity. However, dredging combined with levee modifications is also being evaluated as a stand-alone action in lieu of off-channel detention.

Ecosystem Restoration

Benefits to ecosystem function in Group II would consist of expanded floodplain area within the leveed channel through the construction of a setback levee. By creating a setback levee on Staten Island to expand the flood conveyance capacity of the Mokelumne River to the detention basin and lowering and breaching the existing levee, additional floodplain habitats would be created, including shallow-water, shaded riverine aquatic, and riparian.

It is anticipated that broadening the floodplain to allow natural geomorphic processes would improve river-floodplain connectivity, promote sedimentation, allow channel migration, and promote foodweb productivity.

Recreation

Opportunities for recreation would be developed to be compatible with flood control and ecosystem restoration through the development of public access for wildlife viewing. Recreation would be enhanced by:

- access and interpretive kiosks for wildlife viewing and
- restroom, circulation, parking, and signage infrastructure to support such uses.

Alternatives Screening

The Project was analyzed at the program level as part of the preferred alternative in the CALFED Programmatic EIS/EIR, as described in Chapter 1. The CALFED programmatic documents (i.e., the certified Final EIS/EIR, its findings, and the ROD) provide information developed at the programmatic level for environmental review purposes and to be used as background and context for the screening of alternatives. The programmatic documents include the review and screening of broader alternatives such that this document may be focused at the project level, consistent with and in the context of the CALFED program.

DWR prepared a Description of Alternatives Evaluation Process Report (Appendix B) detailing the process by which a considerable range of project-level measures have undergone screening as part of the identification of practicable alternatives to the Project, as well as providing a project-specific evaluation independent of the CALFED documents. Based on the first screen of compatibility with the Project objectives, the alternatives and their components described below have been advanced for environmental analysis in the EIR.

Alternatives Descriptions

Various actions and measures to meet the Project objectives have been developed and refined through technical brainstorming sessions, public and agency scoping input, hydraulic modeling, and stakeholder participation. These actions, termed *components* herein, have been packaged as alternatives, described below, and summarized in Table 2-1. To assist in distinguishing components from alternatives, each component title begins with an action word, such as *install* or *excavate*. Alternative titles are nouns and represent broader strategies or approaches, typically composed of numerous component actions.

Table 2-1. Summary of Project Alternatives by Group

Group	Alternative Code	Alternative Description
–	NP	No Project
1	1-A	Fluvial Process Optimization
1	1-B	Seasonal Floodplain Optimization
1	1-C	Seasonal Floodplain Enhancement and Subsidence Reversal
2	2-A	North Staten Detention
2	2-B	West Staten Detention
2	2-C	East Staten Detention
2	2-D	Dredging and Levee Modifications

One alternative from each group ultimately will be selected to advance as the preferred alternative. Comments received on the administrative draft and public EIRs will be considered in determining the preferred alternative, which will be identified in the FEIR. The preferred alternative may also include optional components, which will be analyzed for inclusion in the Project but may or may not be implemented.

The alternatives are described in this chapter by component. As many components are common among alternatives, each component is described only at its first occurrence and is referred to by title thereafter unless there are distinctions about the component specific to that alternative. The alternatives and components are summarized in Table 2-2a (Group I) and Table 2-2b (Group II), wherein *X* denotes that the component is included in the alternative and *OP* denotes the component is optional to the alternative.

Table 2-2a. Summary of Group I Alternatives and Components

	1-A	1-B	1-C
	Fluvial Process Optimization	Seasonal Floodplain Optimization	Seasonal Floodplain Enhancement and Subsidence Reversal
Degrade McCormack-Williamson Tract East Levee to Function as a Weir	X	X	X
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir	X	X	X
Reinforce Dead Horse Island East Levee	X	X	X
Modify Downstream Levees to Accommodate Potentially Increased Flows	X	X	X
Construct Transmission Tower Protective Levee and Access Road	X	X	X
Demolish Farm Residence and Infrastructure	X	X	X
Enhance Landside Levee Slope and Habitat	X	X	X
Modify Landform and Restore Agricultural Land to Habitat	X	X	X
Modify Pump and Siphon Operations	X	X	X
Breach Mokelumne River Levee	X		
Allow Boating on Southeastern McCormack-Williamson Tract	X		
Construct Box Culvert Drains and Self-Regulating Tide Gates		X	X
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area			X
Import Soil for Subsidence Reversal			X
Implement Local Marina and Recreation Outreach Program	X	X	X
Excavate Dixon and New Hope Borrow Sites	X	X	X
Excavate and Restore Grizzly Slough Property	X	X	X
Dredge South Fork Mokelumne River	OP	OP	OP
Enhance Delta Meadows Property	OP	OP	OP

Table 2-2b. Summary of Group II Alternatives and Components

	2-A	2-B	2-C	2-D
	North Staten Detention	West Staten Detention	East Staten Detention	Dredging and Levee Modifications
Construct Inlet Weir	X	X	X	
Construct Interior Detention Levee	X	X	X	
Construct Outlet Weir	X	X	X	
Install Detention Basin Drainage Pump Station	X	X	X	
Reinforce Existing Levees	X	X	X	
Construct Setback Levee		X	X	
Degrade Existing Levee	X	X	X	
Relocate Existing Structures	X	X	X	
Modify Walnut Grove–Thornton Road and Staten Island Road	X			
Retrofit or Replace Millers Ferry Bridge	OP	X	OP	OP
Retrofit or Replace New Hope Bridge	OP	OP	X	OP
Construct Wildlife Viewing Area	X	X	X	
Excavate Dixon and New Hope Borrow Sites	X	X	X	
Dredge South Fork Mokelumne River				X
Modify Levees to Increase Channel Capacity				X
Raise Downstream Levees to Accommodate Increased Flows				X

Alternative NP: No Project

Consideration of a no-project or no-action alternative is required for CEQA and NEPA. Herein called the no-project alternative, this alternative compares existing baseline conditions and the likely future conditions in the Project area without the implementation of the Project. Under the no-project alternative, the existing conditions are compared with projected future conditions at a planning horizon of 2025. If the Project were not implemented, the components described below for improvements to flood control, ecosystem restoration, and recreation would not be implemented. It is not definitively known whether farming would continue because of the presently marginal profitability; however, it is assumed for the future no-project condition that agriculture would continue and cropland would be the dominant cover type, consistent with the existing condition.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Table 2-8a summarizes the construction operations anticipated to implement Alternative 1-A, including work sequence and schedule, equipment, material volume, and duration.

Degrade McCormack-Williamson Tract East Levee to Function as a Weir

Objective

Extensive hydraulic modeling shows that it is necessary to degrade a portion of the east and southwest levees on McCormack-Williamson Tract to achieve desired flood control benefits in the upper portion of the Project area measured as stage reductions at Benson’s Ferry. Because the North Delta study area is limited by channel capacity, and McCormack-Williamson Tract levees are legally restricted in height, water may overtop the east levee on McCormack-Williamson Tract during large storm events. When the east levee is overtopped, McCormack-Williamson Tract fills and causes the southwest levee to breach catastrophically, causing a surge effect downstream that displaces boats and precipitates further levee failures. Lowering the elevation of the McCormack-Williamson Tract levees would allow flow to move through the tract in a controlled manner, eliminating this surge effect. To convey high river stages into McCormack-Williamson Tract, the degraded east levee would be reinforced as a hardened weir to direct flow and minimize erosion.

Location

This Project component would affect the east levee of McCormack-Williamson Tract, about 1,000 feet west of I-5 (see Figure 2-1). The affected portion of the levee is approximately 3,700 feet long.

Design and Construction

The east levee of McCormack-Williamson Tract would be lowered to allow floodflows onto the tract (see Figure 2-2). Three thousand feet of the east levee would be degraded to an elevation of 8.5 feet (from an existing elevation of 17 feet to 18.5 feet). This elevation has been established to maintain the current level of access to the transmission tower via the east levee, including a 30-inch layer of rock slope protection (RSP) consisting of 24-inch angular rock placed along the entire face and crest of the degraded levee as prescribed by the USACE (USACE 1991). The levee crest would also include a paved access road with 1-foot concrete retaining walls to serve as a pavement-containment edge and to prevent undercutting.

The riverside levee slope would be over-excavated an additional 30 inches from the crest to 10 feet down the slope, in which RSP of the size specified above would be placed to protect against erosion caused by turbulence in the approaching flow.

On the landside toe of the levee, a 3-foot-deep sill would be excavated to dissipate the energy of overtopping water cascading down the landside levee face. RSP would be placed from the crest of the levee down the landside face, in the toe sill, and onto the floor of the island for an additional 6 feet beyond the toe sill. RSP placed on the landside face of the levee and on the floor of the island would be placed directly on the existing land surface to avoid unnecessary excavation. One or more filter layers would be placed under all RSP areas to prevent scour of the underlying soil. Grading and excavation of exit channels would ensure that fish are not entrapped in the toe sill as floodwaters recede from the island.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically.

Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir

Objective

The southwest levee of McCormack-Williamson Tract would be lowered to allow floodflows to pass out of the tract without causing a surge effect, as described above. To convey high river stages out of McCormack-Williamson Tract, the degraded southwest levee would be reinforced as a hardened weir to direct flow and minimize erosion. During low-flow seasons, the lowered southwest levee would allow tidal exchange on the island from the south.

Location

The southwest levee of McCormack-Williamson Tract is located on the southwest side of the island adjacent to Dead Horse Cut (see Figure 2-1). The affected portion of the levee is approximately 3,500 feet long.

Design & Construction

The McCormack-Williamson Tract southwest levee would be degraded along the entire length of Dead Horse Cut to match the elevation of the island floor (between –1 foot and –2.5 feet) from an existing elevation of 15 feet (see Figure 2-3). This would allow floodflows to pass out of the tract without causing a surge effect. This would also allow tidal water onto the tract from the southern end, facilitating the formation of dendritic intertidal channels at elevations near sea level and keeping the southernmost portion of the tract as shallow open water.

The potential for scour along the embankment between the untouched levee and the breach requires the placement of 24-inch angular RSP (USACE 1991) to a depth of 30 inches along the 3:1 grade-matching slope as well as the adjacent levee faces. A 60-inch launchable RSP toe should be placed along the base of the 3:1 grade and in the river channel along the levee toe. *(Note: Launchable RSP refers to an approach of placing rock in piles or rows in anticipation of erosion, such that it seeks its own resting place where needed by gravity or hydraulic force.)* The area of protection required will vary with levee geometry, the invert of the Mokelumne River, and landform elevation within the tract. One or more filter layers would be placed under all RSP to prevent scour of the underlying soil.

Operations & Maintenance

This feature will be adaptively managed to avoid inducing growth of nonnative invasive species. Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically.

Reinforce Dead Horse Island East Levee

Objective

Because of increased lateral flows and higher velocities from water flowing through McCormack-Williamson Tract, the riverside face of the eastern levee on Dead Horse Island may require additional erosion protection.

Location

This levee is located along the eastern edge of Dead Horse Island, directly across Dead Horse Cut from the southwestern end of McCormack-Williamson Tract (see Figure 2-1).

Design and Construction

The entire Dead Horse Island east levee (approximately 3,000 feet) is currently protected with RSP. To withstand the increased lateral flows and velocities associated with water flowing through McCormack-Williamson Tract, the Dead Horse east levee would be reinforced with the placement of 18-inch RSP to a depth of 24 inches (see Figure 2-4). A 48-inch launchable toe would be placed in the river channel to prevent scour of the waterside toe of the levee. One or more filter layers would be placed under all RSP to prevent scour of the underlying soil.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) is currently required to maintain the Dead Horse levee. After reinforcement of the Dead Horse east levee, similar vegetation management may be required periodically.

Modify Downstream Levees to Accommodate Potentially Increased Flows

Objective

To address the hydraulic effects of opening McCormack-Williamson Tract to more frequent inundation and flow, downstream levees would be raised as needed on the North Fork Mokelumne River to maintain freeboard.

Location

Levees are proposed to be raised as needed along portions of the North Fork Mokelumne River (see Figure 2-5). Levees on opposite sides of the waterway are proposed to be raised in parallel (i.e., matching in profile).

Design and Construction

Hydraulic modeling results indicate that the implementation of Alternative 1-A would require minor levee raises along portions of the North Fork Mokelumne River on the order of 1 to 2 inches (see Appendix E for more information on hydraulic modeling for the Project). These modest increases could be accomplished by adding stabilized and compacted aggregate base to the levee crown and would not affect the footprint or sideslopes of the levee.

Operations and Maintenance

The levees affected by this component would continue to be managed as they are under existing conditions. These activities include vegetation management (by herbicide application, mowing, or removal with hand tools), placement of RSP to address waterside erosion, and restoration of the aggregate base patrol road with new material placed and graded to maintain a drivable surface.

Construct Transmission Tower Protective Levee and Access Road

Objective

Construction of a protective levee would be needed to maintain the current level of flood protection for the property being leased by KCRA-3. All alternatives are required to maintain the current level of flood protection and road access with no additional flood risk for the property being leased. The levee would protect the transmission tower and associated control building. Degrading the McCormack-

Williamson east levee would necessitate constructing a new access road to the transmission tower.

Location

The transmission tower protective levee would be constructed in the northwest corner of McCormack-Williamson Tract (see Figure 2-1). The access road would be constructed along the degraded portion of the east levee on McCormack-Williamson Tract.

Design and Construction

The length of the levee would be 4,000 feet. The elevation of the levee is to be set to maintain the current level of protection and would key into the existing north and south levees. Borrow from the Grizzly Slough property and the Dixon and New Hope borrow sites, both described below, would provide the extra soils needed to build this levee. The access road would be integrated with the hardened weir structure constructed on the degraded portion of the east levee. The road surface would provide all-weather access, proposed to be concrete at the weir and compacted aggregate base on the levee crown.

Operations and Maintenance

The levee would be maintained according to current levee standards for vegetation control, erosion protection, slope stability, and patrol access, in a similar condition to existing levees. The access road would be managed for vegetation, either by mowing or herbicide application at the shoulders and side-slopes. The aggregate base surface would be periodically refreshed with new material and graded to maintain a drivable surface. In the event that the transmission tower lease were not continued, maintenance may be terminated or the levee may be removed.

Demolish Farm Residence and Infrastructure

Objective

A multi-family farmworker residence (the two-story, wood-frame type commonly used for housing migrant farmworkers) and associated farm outbuildings (sheds) would be removed to allow water to flow unimpeded through the tract, to prevent the structures from being dislodged during high flows, and to complement restoration of the tract to habitat.

Location

The structures are located in two concentrations on the southeast levee in the upper half of McCormack-Williamson Tract (see Figure 2-1).

Design and Construction

The structures would be demolished with bulldozers, and the material would be hauled away by dump trucks to an appropriate permitted disposal site. Select material, such as doors, windows, siding, lumber, timbers, and steel, may be salvaged. It should be noted that fuel tanks are present and it is likely that agricultural chemicals have also been stored on site; therefore, these locations would need to be evaluated for the potential to contribute hazardous materials into the aquatic environment from inundation. These fuel tanks would be removed, and any legacy contamination would be safely removed before flooding is allowed to occur.

Operations and Maintenance

No operations or maintenance would be required for this component.

Enhance Landside Levee Slope and Habitat

Objective

“Wildlife-friendly” levees are proposed to provide a diversity of vegetative cover for wildlife habitat and to provide additional levee stability and interior erosion protection from periodic inundation.

Location

This component is proposed on the landside levee slopes around McCormack-Williamson Tract (see Figure 2-1).

Design and Construction

The landside of all McCormack-Williamson Tract levees (where there are no other treatments proposed) would be reconfigured with a varying slope, ranging from 3:1 to 6:1 and undulate in planform and profile to create a more naturalistic land surface (see Figure 2-6). Borrow from the Grizzly Slough property and the Dixon and New Hope borrow sites, both described below, would provide the extra soil material needed to achieve a more gentle slope on the landside of the McCormack-Williamson Tract levees. Approximately 21,600 linear feet of levee would be modified in this manner. In total, approximately 70 acres would be planted with native trees, shrubs, and grasses. The levee habitat is intended in part to be dedicated and managed as mitigation of Project impacts. The plantings may be irrigated for an establishment period of approximately 3 years.

The exterior slopes of the levees would not be affected.

Operation and Maintenance

A Standard Operating Procedure (SOP) would be developed as part of the AMP to preferentially remove nonnative invasive species and retain native vegetation on the slopes of the levees. Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically.

Modify Landform and Restore Agricultural Land to Habitat

Objective

The cultivation of agricultural crops on McCormack-Williamson Tract would be discontinued, and the land would be restored to native vegetation types for wildlife habitat. Restoration activities would include modifying the landform to ensure positive drainage and minimize the potential for fish-stranding.

Location

The interior of McCormack-Williamson Tract would be affected by this action, except for levee slopes and the area included by the transmission tower protective levee (see Figure 2-1).

Design and Construction

Under the fluvial process optimization scenario, hydrologic and hydraulic forces as allowed by degrading and breaching the levees are envisioned to reform the interior of McCormack-Williamson Tract and facilitate conditions for natural revegetation (see Figure 2-7 for anticipated cover types).

To assist these processes and facilitate habitat benefit, minor grading would occur to ensure positive drainage and provide more diverse geomorphic surfaces. At the upper end of the tract on the landside of the east levee, large depressions resulting from scour caused by previous levee failure events would be filled with material from the degraded east levee to reduce the risk of fish-stranding when high flows recede. Smaller depressions along the west side of the tract would be treated similarly.

At the lower end of the tract, starter channels would be graded at intertidal elevations to encourage formation of natural dendritic tidal channels and to ensure positive drainage to minimize the potential for fish-stranding. It is intended that a dendritic channel network would provide a maximum amount of edge habitat for native fish as well as provide positive draining of the tract after high-flow events to avoid fish-stranding. The channels would be located within the intertidal zone, which would be inundated at mean high high water (MHHW) levels but dry at mean low low water (MLLW) levels. This range is approximately 0.23 feet to 3.31 feet National Geodetic Vertical Datum (NGVD). The channels therefore would dry out on a daily basis, preventing the establishment of exotic submerged aquatic vegetation. The channel system would be designed to mimic natural dendritic systems, in which surface drainage streams branch randomly at various angles. Excess material would be used to fill depressions described above.

To facilitate conversion to native vegetative cover types, a combination of passive and active approaches likely would be used. It is acknowledged that risk inevitably is associated with natural revegetation. Many factors contribute to this risk, such as proliferation of weed species in Central Valley wetland systems that are adapted to more aggressive colonization than native species, an altered hydrologic regime that is unpredictable relative to native seed dispersal, and uncertainty of the actual hydrologic and hydraulic patterns caused by the Project. These and other details will be evaluated during engineering design with the goal of ensuring establishment of desirable native vegetation; however, it should be noted that sites in the Project watershed are successfully recolonizing with native species, such as those at the upstream Cosumnes River Preserve.

To reduce risk and minimize potential for colonization by exotic vegetation species, native and non-invasive starter vegetation would be planted, such as tule in the wetter southern portion of the island and grasses in the drier northern part. Over time, flooding events would import propagules such as willows, cottonwoods, and perennial herbs that would naturally colonize on higher areas and tules and other water plants at intertidal and subtidal elevations. Planting of other woody and herbaceous species may be proposed in the final Project design, if further study shows they are warranted to ensure native vegetative cover and preclude nonnative invasive species. A supplemental irrigation system may also be implemented to facilitate vegetation establishment. These active approaches to revegetation would likely focus on compensatory habitat required for mitigation of Project impacts.

Operations and Maintenance

The overall approach to land management would be relatively “hands off,” similar to practices at TNC’s upstream Cosumnes River Preserve. Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically. Prescribed burning and strategic grazing will be evaluated as elements of the Project’s adaptive management plan.

Herbivore protection shelters and fencing may also be needed to prevent plant predation from beavers, although beavers may provide a benefit by thinning forested areas to maintain diverse cover. These actions will be elements of the Project's adaptive management plan.

Irrigation, if needed, would use existing agricultural siphons with a pressurized closed delivery system (i.e., pipes and nozzles).

Modify Pump and Siphon Operations

Objective

McCormack-Williamson Tract contains water management infrastructure to facilitate agricultural practices, including approximately five irrigation pumps and siphons that draw water out of adjacent waterways and two drainage pumps that return excess water to the surrounding waterways, in addition to portable pumps and a domestic well pump. These devices would be selectively decommissioned or reused to facilitate habitat development. The remaining pumps and siphons would be screened to reduce impacts on fish.

Location

The irrigation and drainage pumps are located around the perimeter of McCormack-Williamson Tract (see Table 2-3 and Figure 2-1).

Table 2-3. Existing Pumps at McCormack-Williamson Tract

Station Number or Item Code	Water Body	Purpose	Rating
15+00	Mokelumne River	Direct pumping for irrigation	25 HP (electric)
30+00	Mokelumne River	Direct pumping for irrigation	10 HP (electric)
80+00	Mokelumne River	Direct pumping for irrigation	20 HP (electric)
145+00	Mokelumne River	Drainage	60 HP (electric)
260+00	Snodgrass Slough	Siphon priming for irrigation	5 HP (gasoline)
305+00	Snodgrass Slough	Drainage	50 HP (electric)
360+00	Lost Slough	Siphon priming for irrigation	5 HP (gasoline)
PD	Interior ditches	Two portable pumps of this type for irrigation distribution	2 each 105 HP (diesel)
PP	Interior ditches	Two portable pumps of this type for irrigation distribution	2 each 60 HP (propane)
DW	Underground well	Domestic use	1 HP (electric)

Design and Construction

Under Alternative 1-A, the change in use for each pump is described in Table 2-4.

Table 2-4. Change in Pump Use under Alternative 1-A

Station Number or Item Code	Baseline Use	Proposed Use
15+00	75% during June, July, and August for crop irrigation	25% during June, July, August, September, and October to establish native vegetation
30+00	back-up only for crop irrigation	Decommission
80+00	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	25% during June, July, August, September, and October to establish native vegetation
145+00	1 hour per day throughout year, continuous during high-water events for drainage	Decommission
260+00	20 minutes per week during June, July, and August to prime crop irrigation siphon	Same as baseline to establish native vegetation
305+00	1 hour per week throughout year, continuous during high-water events for drainage	Decommission
360+00	20 minutes per week during June, July, and August to prime crop irrigation siphon	Same as baseline to establish native vegetation
PD	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission
PP	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission
DW	2 hours per day throughout year for domestic use	Decommission

Decommissioned pumps would be removed from the site and salvaged for reuse. The network of distribution ditches for irrigation and collection ditches for drainage would be filled, concurrent with activities described above to modify the landform to facilitate positive drainage. Pipes through the levee would be filled with concrete or soil, capped at the ends, and abandoned in place. The electrical distribution system to decommissioned pumps would be demolished and removed from the tract.

Irrigation pumps proposed for reuse would be screened and fitted with a pressurized delivery system to irrigate the revegetation areas (primarily on the enhanced levee slopes) through a 3-year establishment period; the delivery system would be left in place for potential future use to be determined through adaptive management. The screens would be designed to meet DFG and NOAA fish screen criteria. It should be noted that the pumps on the southeast levee of the tract (between the proposed levee breach and degraded southwest levee) would become isolated and may be accessible only by boat (under Alternative 1-A only).

Operations and Maintenance

Pumps proposed for reuse would be operated as described above and would be maintained consistent with existing operations, including semiannual inspection for operability. Any abandoned facilities would be inspected annually to ensure their anchoring is sound and that they do not pose a threat to safety.

Breach Mokelumne River Levee

Objective

The Mokelumne River levee of McCormack-Williamson Tract would be breached to allow a secondary channel of the Mokelumne River to meander through the tract and establish hydraulic connectivity between the breach and the southwestern end of McCormack-Williamson Tract. A starter channel would be excavated to facilitate channel-forming processes in the interior of the tract. Riparian forest should colonize the channel banks.

Location

The 300-foot breach would be cut into the southern levee on McCormack-Williamson Tract at approximately Station 15+00 on the Mokelumne River (see Figure 2-1).

Design and Construction

The breach would be broken down into two side tiers at elevation 3.5 feet and one central tier at 0 feet NGVD (see Figure 2-8). The lower tier would remain unprotected so that it could scour and eventually form into a natural channel inlet. The side tiers would be planted to protect against erosion and to precipitate colonization of the area by appropriate species.

To protect the interface between the breach and the existing levee, 24-inch RSP (USACE 1991) would be placed to a depth of 30 inches along the exposed 3:1 slope that matches the different grades. A 60-inch launchable RSP toe would be placed in the river channel to prevent undercutting of the RSP. One or more filter layers would be placed under all RSP to prevent scour of the underlying soil.

A starter channel also would be excavated on the floor of the tract for approximately 3,000 feet to encourage flow through the inlet. The starter channel would be graded to integrate with the topography on the floor of the tract to minimize potential for fish-stranding and would drain toward the bottom of the tract.

Operations and Maintenance

This feature will be adaptively managed to avoid inducing growth of nonnative invasive species. Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically.

Allow Boating on Southeastern McCormack-Williamson Tract (Optional)

Objective

The degradation of the southwest levee to below sea level would open up the southern portion of the island to tidal influence. Boating would be allowed on the southern half of the island to enhance recreation opportunities in the North Delta.

Location

The southern portion of McCormack-Williamson Tract subject to hydrology sufficient to float small recreational craft would be open to recreational use (see Figure 2-1).

Design and Construction

No construction would be required to facilitate boat use. No new facilities for parking or launching would be developed, as it is assumed that users would come from facilities existing nearby (however, a separate optional component is proposed to enhance the Delta Meadows property, including the existing boat launch facility). Signage would be placed on the levee ends, or buoys may be anchored in the water to limit speeds to less than 5 miles per hour, consistent with the surrounding Delta Meadows property.

Operations and Maintenance

No active operations or maintenance would be required. Periodic monitoring (inspections) may be conducted to ensure habitat features are not being adversely affected by boating.

Implement Local Marina and Recreation Outreach Program

Objective

Anecdotal information from prior flood events indicates that one of the key factors influencing increasing water surface elevation and exacerbating flood damage has been boats that have come adrift from local marinas during floods and consequently become lodged upon the structures of the Millers Ferry Bridge and New Hope Bridge. This phenomenon results in trapping additional debris and constricting conveyance capacity, thereby raising upstream water surface elevation as well as putting increased pressure on the bridges themselves.

The Project would include a DWR-sponsored local marina outreach program in coordination with the Delta Protection Commission (DPC) to educate marina operators and boat owners on precautions to minimize flood damage risks and to coordinate high-flow forecasting with marina operators to give warning about pending floods, with the intent that boats could be adequately secured or relocated.

Early discussions in formulating Project components included consideration of closing or relocating one or both of the marinas in the Project area. Marina relocation or closure is no longer under consideration as an action of the Project for the following reasons.

- Marina closure or relocation does not directly address the purpose and objectives of the Project, as it more closely treats a symptom of the surge effect rather than the cause (uncontrolled flow) and does not directly lower stage or increase capacity in a substantial way.
- Because of local business interests and North Delta recreational use represented by the marinas, closure is not considered to be a sound political or economic option at this time.
- No readily identifiable site opportunities for relocation have emerged as viable or suitable while still meeting local needs and demands.

Therefore, marina closure or relocation will not be carried forward as a component of the Project in the scope of this document; however, it is recommended that actions to address the marinas be evaluated further for potential to incrementally reduce flood risk. Specifically, a special study to evaluate boating facility needs in terms of type, capacity, location, amenities, and recommended alternatives for the Walnut Grove area should be commissioned to further relative studies including the Delta Recreation Master Strategy: Aquatic Resources Focus prepared by the DPC in 2005.An additional element of outreach would be highlighting existing recreational opportunities and facilities available to the public, such as fishing access, wildlife viewing, and boat launches to promote lawful public use.

Location

The two area marinas, the Walnut Grove marina (on Snodgrass Slough) and the Wimpy's/New Hope marina complex (on the Mokelumne River), are shown on Figure 2-9.

Design and Construction

No facility construction would be required.

Operations and Maintenance

This component approaches the marinas' role in flooding in two ways: coordinated operations with local flood control officials and marina operators, and evaluation of a relocation study. Consideration will be given to developing conditions for inclusion in marina leases to mitigate potential marina-related flood issues. Provisions could include requirements such as a bond to cover the costs of damages if required precautions are not taken or the marina facilities are not maintained to standard.

Coordinated Operations

Each fall, DWR will coordinate with local flood control officials to visit the marinas to warn of the hazard created when boats break free from their moorings during floods. Marina operators will be asked to:

- remind tenants of the hazard created when boats break free from their moorings during floods through signage, notices, or mailings to tenants;
- temporarily relocate boats moored in locations where they are prone to break free during floods into vacant berths where they will be safer during floods or into upland storage areas; and
- inspect moored boats when local rivers reach flood stages to ensure that they are safely moored.

When floods are forecast, DWR will coordinate with local flood control officials and marina operators to warn of pending high flows. To facilitate this program, DWR will develop and maintain a communication directory and protocol, including flow standards that would trigger response.After floods, DWR will coordinate with local flood control officials to meet with marina operators to review any hazards created by their moorings or boats during the flood and, if necessary, to suggest additional measures to mitigate flood hazards related to the boats or moorings.

DWR will further coordinate with local flood control officials to report incidents of boats breaking loose from moorings during floods and any recommendations about improving the marinas' flood safety to the Department of Boating and Waterways, county building department, the sheriff, the State Lands

Commission, or other agencies with regulatory responsibility or other duties regarding the marinas. This authority is provided in the Harbors and Navigation Code Section 523(a), stipulating, in part, that a peace officer, an appropriately designated employee of the State Lands Commission, or a county or city marine safety officer may remove and, if necessary, store a vessel under the following circumstances: (1) when the vessel is left unattended and is moored or docked in a condition that creates a hazard to … public safety or to the property of another; (5) when the vessel … poses a danger to navigation or to the public health, safety, or welfare; or (6) when the vessel poses a threat to adjacent … levees.

Relocation Study

DWR will work with the DPC and other state and local entities to determine need and interest in a study of relocation of the area marinas. The scope of the study may include background information on the marina use (including identifying user groups, activities, and trends), analysis of economic feasibility, comparison to other marinas in the Project area, evaluation of operating constraints, identification of alternative sites, and recommendations (including measures to improve the marinas in their current location).

Outreach

DWR will coordinate with the California Department of Parks and Recreation (DPR), DPC, Boating and Waterways, and the California Coastal Commission Clean Boating Network to define key locations available to the public that have recreational benefit. Emphasis would be on promoting recreational opportunities where there is a lack of public awareness. Public outreach would be achieved by communicating with the public through focus discussion meetings and workshops, the Internet, mailings, signage, and providing willing public and private entities (e.g., post offices, marinas, and bait shops) with flyers/pamphlets to make available to the public.

Excavate Dixon and New Hope Borrow Sites

Objective

Levee construction proposed under the Project necessitates more borrow than is available on site. Thus, additional borrow would be excavated and transported from two parcels owned by DWR in the Project area.

Location

Figure 2-10 shows the location of the two proposed borrow sites owned by DWR and the routes that would be used to haul the borrow to the Project sites (Note: This figure also shows the Grizzly Slough property and associated haul routes, as described under the next component). The Dixon site is located immediately east of the McCormack-Williamson Tract east levee, and the New Hope site is located on New Hope Tract, south of McCormack-Williamson Tract and east of Staten Island.

Design and Construction

The first step in borrow operations would be clearing and grubbing the land surface to remove any woody vegetation. The top 2 feet of the soil profile would then be stockpiled on site for replacement at the conclusion of borrow excavation to allow recolonization by the on-site seedbank.

Earthmoving between the Dixon site and McCormack-Williamson Tract is a short distance over private unpaved roads; therefore, it is assumed that material would be excavated, transported, and placed with scrapers. Earthmoving between the Dixon site and Staten Island is a greater relative distance over public paved roads; therefore, it is assumed that material would be excavated by excavators, transported by truck, and placed with dozers.

Earthmoving between the New Hope site and McCormack-Williamson Tract or Staten Island is a greater relative distance over public paved roads; therefore, it is assumed that material would be excavated by excavators, transported by truck, and placed with dozers.

Following excavation, sideslopes at the borrow sites would be graded to a maximum steepness of 3:1 (horizontal to vertical), and the stockpiled topsoil would be replaced to allow natural revegetation.

Operations and Maintenance

The sites would be monitored to ensure erosion is not contributing to sedimentation of local waterways and to ensure that revegetation is occurring.

Excavate and Restore Grizzly Slough Property

Objective

The objectives for breaching the Grizzly Slough property (see Figure 2-11) levees and regrading the land surface are:

- recreating a frequently flooded riparian woodland to provide habitat for birds and fish,
- improving local ecosystem health by reconnecting Grizzly and Bear Sloughs to the floodplain,
- mitigating impacts on riparian woodland associated with other Project components, and
- generating borrow material for use on McCormack-Williamson Tract to construct wildlife-friendly levees and/or the transmission tower protective levee.

Breaching or degrading portions of levees along the Grizzly Slough property adjacent to Bear and Grizzly Sloughs would increase flood frequency and provide annual connection to the adjacent sloughs. These actions would maximize floodplain habitat to benefit fish species that spawn on the floodplain and to reestablish natural floodplain processes. Potential additional work to encourage floodplain processes and maximize floodplain habitat includes excavating and regrading the floodplain terrace in Grizzly Slough to encourage formation of a secondary channel system. Over time, riparian habitat is expected to establish itself on the Grizzly Slough property (see Figure 2-12). Material from Grizzly Slough levee breaches, degradation, or regrading would provide a source of material for construction of other Project elements.

Location

The levee breaching or degradation would be performed on the DWR-owned Grizzly Slough property (see Figure 2-11) along the northeast and northwest levees adjacent to Bear and Grizzly Sloughs, respectively. The Grizzly Slough breach would be in the vicinity of the DFG mitigation wetlands near the northernmost tip of the Grizzly Slough property. The Bear Slough breach would be located on the western bank of the Bear Slough levee just north of the New Hope Bridge on the eastern edge of the property. Excavation and regrading would occur on the interior of the Grizzly Slough property.

Design and Construction

The northeast and northwest Grizzly Slough property levees, adjacent to Bear and Grizzly Sloughs, respectively, would be breached or degraded at the locations described above to allow more frequent floodflows onto the property (see Figure 2-11). Each breach would be approximately 60 feet wide. The Grizzly Slough property currently floods during all flood events greater than roughly 2- to 3-year frequency, so the breaches and regrading would not affect the property’s function in high-flow events.

In addition, a shallow starter channel would be excavated across the southeast portion of the site from Bear Slough toward Grizzly Slough. Additional grading may lower a more extensive portion of the site by up to 1 foot (see Figure 2-11). The most open scenario would entail complete removal of both the Grizzly and Bear levees, making approximately 220,000 cubic yards of fill available for other Project elements and providing the greatest hydraulic connectivity (see Figure 2-10 for potential haul routes). The least open scenario would include a 60-foot breach on each of the Grizzly and Bear Slough levees, making 1,900 cubic yards of fill available.

The most extensive excavation scenario would include excavation of an approximately 200- to 900-foot varied-width swale to increase the inundated area and provide 286,000 cubic yards of borrow as well as a uniform 1-foot excavation across the property to provide an additional 648,000 cubic yards of borrow.

A low levee paralleling New Hope Road may be proposed in final design if needed to mitigate flooding of the roadway. However, one-way or manually operated gate or culvert structures would be constructed in this levee to maintain the natural hydrology of the area and ensure that floodflows from the south are able to flow onto the Grizzly Slough property, as thought to occur under the existing conditions, so as not to increase flooding potential south of New Hope Road. This levee would be constructed to the north of the ditch paralleling New Hope Road in order to preserve habitat currently in the ditch.

An outlet would be excavated for the toe drain running parallel to the Grizzly Slough levee in order to decrease the risk of fish-stranding on the property. The outlet would be excavated on the north end of the channel, in the direction of flow.

Provisions to maintain access to a privately owned parcel landlocked within the property will be included in final design.

Flooding events would import propagules such as willows, cottonwoods, and perennial herbs that would naturally colonize frequently flooded portions of the site. Once established, young willows and cottonwoods should be able to access the relatively shallow groundwater in these areas. On higher areas, planting oaks, elderberries, native grasses, or other species may be proposed in the final Project design, if further study shows they are warranted; however, other sites in the area have exhibited successful native colonization (such as the "Accidental Forest" at TNC's adjacent Cosumnes River Preserve).

Operations and Maintenance

The overall approach to land management would be relatively "hands off," similar to practices at the adjacent Cosumnes River Preserve. Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically. Prescribed burning and strategic grazing will be evaluated as elements of the Project's adaptive management plan. Herbivore protection shelters and fencing may also be needed to prevent plant predation from beavers, although beavers may provide a benefit by thinning forested areas to maintain diverse cover. These actions will be elements of the Project's adaptive management plan.

Dredge South Fork Mokelumne River (Optional)

Objective

This component is optional in Group I and provides additional channel capacity through dredging the river bottom to remove accumulated sediment. The cross-sectional area of the channel would be increased to improve conveyance without change to the levees.

Although occurring within the same geographic limits and using the same methods as Alternative 2-D (discussed later in this chapter), this component is distinguished from that alternative in that the volume and area limits would be established during detailed engineering so that dredging under this component would be limited and not require downstream levee raises or modifications based on increased upstream conveyance capacity caused by dredging; Alternative 2-D combines dredging and levee modifications to increase overall conveyance capacity.

Location

Dredging is proposed along portions of the Mokelumne River, Snodgrass Slough, and Dead Horse Cut, as shown in Figure 2-13. The specific volume and area limits would be established during detailed engineering to ensure no measurable increases in downstream water surface elevation.

Design and Construction

Dredging would increase channel capacity in locations where sedimentation has occurred. The cross-sectional limits would be determined during detailed engineering to minimize potential effects on shallow aquatic habitat and levee stability but would generally follow the channel centerline with side slopes of 2:1 (horizontal:vertical) or steeper and dredged to a depth of approximately 2–3 feet.

The dredged material would be sidecast over adjacent levees into landside drying basins to be effectively dried for beneficial reuse, such as constructing Project features, providing stability berms on the landside of levees, or similar uses on the island or tract. It is assumed that up to 10% of the dredge spoils would be transported to McCormack-Williamson Tract after drying to be used for levee construction and subsidence reversal, or would be piped directly to that location. Drying operations are described below after the dredging methods.

The Project may use one or more dredging methods determined through a balance of regulatory constraints, effectiveness, and efficiency. The methods are described below.

Hydraulic Dredging

The hydraulic dredging method would siphon a water-sediment mix (roughly four parts water for every one part sediment) from the channel bottom and deposit it into a drying basin. The operation is staged from a barge floating in the channel with a mobile pipe that can be lowered into the sediment. The pipe siphons the water-sediment mix into a flexible delivery pipe that may be extended up to 1,000 feet up or down the channel from the barge to deposit the siphoned sediment.

The delivery pipe may be weighted down to avoid interfering with boat navigation. The delivery pipe is attached to a semi-permanent, stationary pipe that is braced to the waterside of the levee, extends across the top and down the landside of the levee into the primary basin of a drying basin. The stationary pipe would range from 8 to 18 inches in diameter and would require that gravel be placed on either side to create a ramp over the pipe to maintain vehicular access on the levee crown. The direct deposition of the material into drying basins on adjacent lands allows uninterrupted dredging up to the capacity of the drying basin. Barges may also be used to transport the dredged sediment, up to 5,000 cubic yards per barge.

Hydraulic dredging is used in situations where there are large areas to be dredged, the concern for induced turbidity and harm to benthic vegetation is great, and there is ample area available for drying basins, as this method entrains more water in the sediment and requires greater drying capacity. This dredging method does not cause excessive turbidity in the channel and causes only minimal disruption to vegetation and other benthic organisms. It also allows flexibility in disposal sites, as flexible piping may be extended to allow dredging to occur some distance from the drying basins. Therefore, land-based or water-based transport and other operations are minimized.

Clamshell Dredging

The clamshell dredging method would excavate a water-sediment mix (roughly equal parts water and sediment) from the channel bottom with a clamshell bucket and deposit it either into a drying basin or onto a barge to be transported to a drying basin. A hydraulic long-reach excavator arm controls the clamshell bucket, which can hold up to 5 cubic yards of material per scoop. The use of the clamshell method requires sufficient height and swing clearance for the excavator arm.

The operation may be staged from a barge floating in the channel or from the top of the levee, depending on restrictions in habitat and channel width. Barges are not self-propelling and therefore would need tugboats to maneuver within the channel.

The clamshell dredging method can cause greater disruption to channel vegetation than hydraulic dredging when the bucket scrapes layers of sediments from the channel bottom. This method would likely be used in situations where there is limited space for drying basins, the likelihood of major disruption to vegetation and other organisms in the channel bottom is minimal, the area to be dredged is small, there are channel islands, or when there are no issues concerning temporary turbidity and sedimentation in the water. It is possible, however, to reduce turbidity generated by this method through careful bucket management.

Dragline Dredging

The dragline dredging method would excavate a water-sediment mix (roughly equal parts water and sediment) from the channel bottom with a bucket and deposit it either into a drying basin or onto a barge to be transported to a drying basin. A crane controls the bucket with cables. The boom swings to position the bucket, which is then lowered and dragged horizontally across the bottom of the channel to collect sediments until the bucket is full. The cables are used to maneuver the bucket as it moves horizontally and to open it so that spoils may be deposited in the desired location. The use of the dragline method requires sufficient height and swing clearance for the crane.

The operation may be staged from a barge floating in the channel or from the top of the levee, depending on restrictions in habitat and channel width. Barges are not self-propelling and would therefore need tugboats to maneuver within the channel.

The dragline method is effective in shaping the channel bottom with relative control. Other considerations are substantially similar to the clamshell dredging method.

Drying Operations

Drying basins would be constructed on the landside of the levees, typically adjacent to the channel or suitable interior low areas, and would be used for the decanting and drying process, effectively separating the sediment from the water and allowing dried material to be put to beneficial use. The basins would be constructed of on-site soil and compacted to minimize basin slope erosion.

For hydraulic dredging, drying basins typically are composed of three parts: primary, secondary, and return basins. The primary and secondary basins serve to settle sediments out of the dredged mix. When water reaches the return basin, most suspended sediment has settled out of it and the water is then pumped back into the channel from which it was taken. The sediment would take between 24 and 36 days to settle out of the water.

A single drying basin, 3,600 feet long, 1,600 feet wide, and up to 6 feet deep, can hold up to 285,000 cubic yards of the water-sediment mix if the basin is filled up to 4 feet with dredged material. As water moves from the primary to the secondary basins, more area becomes available for additional dredged material. The absolute capacity of a single basin will be determined by the rate at which the sediments settle, the rate at which the water is pumped from the return basin, and the rate of dredging. The basin is then reused or left to dry.

For clamshell and dragline dredging, a single-purpose basin may be used. The water-sediment mixture would reach 25% moisture content (half of its original rate) in 2 to 6 weeks for re-use depending on weather and the thickness at which it is placed.

Operations and Maintenance

Recurring dredging needs will be assessed and a maintenance dredging trigger will be developed as part of the adaptive management plan. This effort will take into account any new requirements of the forthcoming Delta Mercury TMDL (described in Chapter 1). It is currently estimated that dredging is expected to be repeated on a roughly 15-year interval, with approximately 20% of the channel area dredged per episode.

Enhance Delta Meadows Property (Optional)

Objective

This component would help improve recreation in the North Delta area by upgrading existing recreation facilities and amenities, including boat launch facilities, parking areas, signage, and public restrooms.

Location

This plan envisions that eventually upgrades to recreation facilities would occur at Delta Meadows, an unclassified State Park property north of the DCC and west of McCormack-Williamson Tract (see Figure 2-14). Delta Meadows is considered one of the last remaining areas of the northern Delta that exhibit remnants of the natural conditions that existed prior to settlement. DPR has managed the area since 1985. DPR acquired the park property primarily to protect and preserve the natural resources on the property, including riparian habitat and wildlife, sloughs, and other wetlands. The property contains Native American occupancy sites and remnants of early farming and ranching activities. The property provides public access to boating, fishing, and hiking along levee trails, and DPR offers guided canoe tours during the summer season.

Planning, Design, and Construction

Prior to the development of any permanent improvements at Delta Meadows, a General Plan for the property must be prepared by DPR. DPR has not yet identified funding for the preparation of a General Plan for the Delta Meadows property. As an optional component of the Project, DWR commits to working cooperatively with DPR to assist in preparation of the General Plan, development of a funding strategy, and implementation. DPR anticipates that passive recreation activities would be developed. These types of recreation activities are hiking, nature viewing, non-motorized boating, and fishing. Physical improvement may include upgrading boat launch facilities, parking improvements, trails, interpretive signage, and public restrooms.

Operations and Maintenance

In addition to the canoe tours, current operations and maintenance activities at Delta Meadows include patrol by state park rangers, survey and inventory of natural and cultural resources, and some natural resource management activities. Protection and management of natural and cultural resources, such as the control of invasive exotic weeds, would be ongoing operation activities. Future operation and maintenance activities might include cleaning restrooms and replacing supplies, picking up litter, periodically re-sealing and re-striping any paved surfaces, and maintaining boat launch facilities trails, and signs.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Table 2-8b summarizes the construction operations anticipated to implement Alternative 1-B, including work sequence and schedule, equipment, material volume, and duration.

Degrade McCormack-Williamson Tract East Levee to Function as a Weir

This component would be the same as described under Alternative 1-A.

Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir

Objective

The southwest levee on McCormack-Williamson Tract would be lowered to 5.5 feet NGVD to allow floodflows to pass out of the tract without causing a surge effect, yet remain high enough to prevent tidal flooding of the island during low-flow seasons. To convey high river stages out of McCormack-Williamson Tract, the degraded southwest levee would be reinforced as a hardened weir to direct flow and minimize erosion. Tidal action and water levels would be controlled using self-regulating tide gates and existing drainage pump stations (described separately below).

Location

The southwest levee on McCormack-Williamson Tract is located on the southwest side of the island adjacent to Dead Horse Cut. The affected portion of the levee is approximately 3,500 feet long (see Figure 2-15).

Design and Construction

The levee would be built to withstand bi-directional flows, with RSP placed accordingly, as the levee would be regularly overtopped from Dead Horse Cut during minor flood events (see Figure 2-16). During flood events large enough to overtop the east levee on McCormack-Williamson Tract, the flow over the southwest levee would reverse, and water within the tract would discharge back into Dead Horse Cut. Although the structure would be submerged under these conditions, turbulence on the waterside face of the levee would likely initiate local scour.

The levee would be degraded and reshaped, followed by installation of 24-inch angular rock placed to a depth of 30 inches along the entire face and crest of the degraded levee (USACE 1991). The RSP would be placed directly on the existing levee face both on the landside and on the waterside to avoid unnecessary excavation. Additional erosion protection (a 60-inch launchable toe) would be placed on the riverside toe of the levee. An integrated end sill would be constructed at the landside toe of the levee to help dissipate energy and protect against scour. One or more filter layers would be placed under all RSP to prevent scour of the underlying soil.

A 10-foot-wide access road may be integrated into the crest design and would include 30-inch-deep cut-off walls to prevent scour at the interface of the RSP and road.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically.

Reinforce Dead Horse Island East Levee

This component would be the same as described under Alternative 1-A. See Figure 2-15, depicting this component in the context of Alternative 1-B.

Modify Downstream Levees to Accommodate Potentially Increased Flows

This component would be the same as described under Alternative 1-A. See Figure 2-15, depicting this component in the context of Alternative 1-B.

Construct Transmission Tower Protective Levee and Access Road

This component would be the same as described under Alternative 1-A. See Figure 2-15, depicting this component in the context of Alternative 1-B.

Demolish Farm Residence and Infrastructure

This component would be the same as described under Alternative 1-A. See Figure 2-15, depicting this component in the context of Alternative 1-B.

Enhance Landside Levee Slope and Habitat

This component would be the same as described under Alternative 1-A. See Figure 2-15, depicting this component in the context of Alternative 1-B.

Modify Landform and Restore Agricultural Land to Habitat

This component would be similar to Alternative 1-A except for design and construction, which would not include subtidal components, and intertidal action is anticipated only during seasonal high water in the winter. The overall species composition would be less aquatic and more mesic. See Figure 2-17 for the anticipated cover types for Alternative 1-B.

Modify Pump and Siphon Operations

This component would be the same as described under Alternative 1-A, except that pumping would be required to facilitate drainage of the tract during warm weather. See Figure 2-17, depicting this component in the context of Alternative 1-B. Under Alternative 1-B, the change in use for each pump is described in Table 2-5.

Table 2-5. Change in Pump Use under Alternative 1-B

Station Number or Item Code	Baseline Use	Proposed Use
15+00	75% during June, July, and August for crop irrigation	25% during June, July, August, September, and October to establish native vegetation
30+00	Back-up only for crop irrigation	Decommission
80+00	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	25% during June, July, August, September, and October to establish native vegetation
145+00	1 hour per day throughout year, continuous during high-water events for drainage	Continuously for 5 days for up to three episodes per year during April and May, and as needed throughout year for drainage
260+00	20 minutes per week during June, July, and August to prime crop irrigation siphon	Same as baseline to establish native vegetation
305+00	1 hour per week throughout year, continuous during high-water events for drainage	Continuously for 5 days for up to three episodes per year during April and May, and as needed throughout year for drainage
360+00	20 minutes per week during June, July, and August to prime crop irrigation siphon	Same as baseline to establish native vegetation
PD	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission
PP	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission
DW	2 hours per day throughout year for domestic use	Decommission

Construct Box Culvert Drains and Self-Regulating Tide Gates

Objective

Self-regulating tide gates at the south end of McCormack-Williamson Tract would allow tidal action during winter through spring. These gates would allow the tract to partially fill during incoming tide and fully drain during outgoing tide. In combination with pumping stations, the self-regulating tide gates would be used to drain the tract of floodwaters by June to avoid fish-stranding, address aquatic weed and or mosquito concerns, and allow other adaptive management actions as needed.

Location

Up to seven self-regulating tide gates would be placed in box culvert drains in the levees on the southern portion of McCormack-Williamson Tract (see Figure 2-15).

Design and Construction

To prevent backflow into the island during high tides, two 3.5-by-4-foot horizontal tide gates would be installed at the outlets of each of the seven 4- by 8-foot box culvert drains (see Figure 2-18). The invert of the culverts would be placed at 0 feet NGVD or lower to take advantage of low tides. The inlet and outlet boxes of the culverts would be constructed to match the grade of the existing levee in which they are installed to avoid unnecessary local scour. The levee faces on both the outlet and inlet sides would be protected with 18-inch angular rock (USACE 1991) placed to 24 inches deep.

Operations and Maintenance

The tide gates would be operated to drain the island of floodwaters by June, taking advantage of low tides to let the island drain by gravity, and to help facilitate conditions for desired vegetation on the tract. The tide gates would not allow water to enter the island during high tide when they are being operated to drain the island. At other times during the year, the tide gates may be used to provide muted tidal action to McCormack-Williamson Tract. The gates would require periodic inspection to ensure appropriate operation, as a component of a comprehensive adaptive management plan.

Implement Local Marina and Recreation Outreach Program

This component would be the same as described under Alternative 1-A.

Excavate Dixon and New Hope Borrow Sites

This component would be the same as described under Alternative 1-A.

Excavate and Restore Grizzly Slough Property

This component would be the same as described under Alternative 1-A.

Dredge South Fork Mokelumne River (Optional)

This component would be the same as described under Alternative 1-A.

Enhance Delta Meadows Property (Optional)

This component would be the same as described under Alternative 1-A.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites

- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Table 2-8c summarizes the construction operations anticipated to implement Alternative 1-C, including work sequence and schedule, equipment, material volume, and duration.

Degrade McCormack-Williamson Tract East Levee to Function as a Weir

This component would be the same as described under Alternative 1-A. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir

This component would be the same as described under Alternative 1-B. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Reinforce Dead Horse Island East Levee

This component would be the same as described under Alternative 1-A. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Modify Downstream Levees to Accommodate Potentially Increased Flows

This component would be the same as described under Alternative 1-A. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Construct Transmission Tower Protective Levee and Access Road

This component would be the same as described under Alternative 1-A. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Demolish Farm Residence and Infrastructure

This component would be the same as described under Alternative 1-A. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Enhance Landside Levee Slope and Habitat

This component would be the same as described under Alternative 1-A. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Modify Landform and Restore Agricultural Land to Habitat

This component would be similar to Alternative 1-B. See Figure 2-20 for the anticipated cover types for Alternative 1-C.

Modify Pump and Siphon Operations

This component would be the same as described under Alternative 1-B, except that the drainage pump station would be relocated from Station 305+00 to facilitate drainage of the tract during warm weather, because the tract is proposed to be separated by a cross-levee and operated as two distinct hydrologic cells at low flow. See Figure 2-19, depicting this component in the context of Alternative 1-C. Under Alternative 1-C, the change in use for each pump is described in Table 2-6.

Table 2-6. Change in Pump Use under Alternative 1-C

Station Number or Item Code	Baseline Use	Proposed Use
15+00	75% during June, July, and August for crop irrigation	25% during June, July, August, September, and October to establish native vegetation
30+00	Back-up only for crop irrigation	Decommission
80+00	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	25% during June, July, August, September, and October to establish native vegetation
145+00	1 hour per day throughout year, continuous during high-water events for drainage	Operated continuously for 3 days for up to three episodes per year during April and May, and as needed throughout year for drainage
260+00	20 minutes per week during June, July, and August to prime crop irrigation siphon	Same as baseline to establish native vegetation
305+00	1 hour per week throughout year, continuous during high-water events for drainage	Relocated downstream to location just north of subsidence-reversal area cross-levee on Snodgrass Slough; operated continuously for 3 days for up to three episodes per year during April and May, and as needed throughout year for drainage
360+00	20 minutes per week during June, July, and August to prime crop irrigation siphon	Same as baseline to establish native vegetation
PD	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission
PP	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission
DW	2 hours per day throughout year for domestic use	Decommission

Construct Box Culvert Drains and Self-Regulating Tide Gates

This component would be the same as described under Alternative 1-B, with the possible addition of two box culvert drains with self-regulating tide gates to facilitate drainage of the northern portion of the island and an operable gate structure near the downstream tip of the island to drain the subsidence reversal area. An adjustable structure at this location would allow flexibility to optimize the water level for vegetative growth and provide movement of the water to reduce the potential for mosquito growth. The adjustable structure may include flashboards to regulate the water level and an operable gate to regulate outflow. See Figure 2-19, depicting this component in the context of Alternative 1-C.

Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area

Objective

A cross-levee would be constructed across McCormack-Williamson Tract to isolate the bottom third of the island for a subsidence-reversal demonstration project. This levee would allow bi-directional flow during small to large flood events in the winter months but would prevent any tidal action on the upper two-thirds of the island during the dry months. Thus, during low flow, the tract could be drained and operated as two distinct hydrologic cells.

Location

The cross-levee would run west to east across McCormack-Williamson Tract, from just north of the DCC on the west side of the island to roughly Station 116+15 of the Mokelumne River on the east side of the island (see Figure 2-19). The resulting cross-levee would be approximately 3,000 feet long.

Design and Construction

The cross-levee would be constructed across McCormack-Williamson Tract at an elevation of 5.5 feet NGVD with a crest of 10 feet and side slopes at 3:1 (see Figure 2-21). The levee footprint would vary according to the local elevation of the island on which it is constructed. Similar to the conditions of the southwest levee as described under Alternative 1-B, flow over the cross-levee would be bi-directional depending on hydraulic conditions, so erosion protection would be provided on both faces. The entire structure would be protected with 18-inch angular rock (USACE 1991) placed to a depth of 24 inches. One or more filter layers would be placed under all RSP to prevent scour of the underlying soil. Because discharge over the levee would likely occur from the southern side first, an end sill would be constructed on the north toe for energy dissipation. Grading and excavation of exit channels would ensure that fish are not entrapped in the toe sill as floodwaters are removed from the island. The footprint width of the cross-levee would be approximately 70 feet. Borrow from the Grizzly Slough property and the Dixon and New Hope borrow sites would provide the extra material needed to build this levee.

Operations and Maintenance

The box culverts with self-regulating tide gates would drain the upper two-thirds of the island of floodwaters before June to prevent fish-stranding. No water would be allowed in through the tide gates during the dry months.

Import Soil for Subsidence Reversal

Objective

Imported soil would increase land-surface elevation on the lower portion of McCormack-Williamson Tract to accelerate accretion.

Location

Fill soil would be placed in roughly the lower third of McCormack-Williamson Tract, in the area delineated by the cross-levee described above (see Figure 2-19).

Design and Construction

Soil may be imported by a number of methods, including pumping of dredged sediments through a pipe system, waterborne placement by barge and bucket, or landborne placement by truck and tractor. Soil would be placed in lifts and cells for incremental accretion. The desired finished elevation is sea level; roughly 300 af are below this level. The approximate volume of material imported could be up to 160,000 cubic yards. Depending on method (pumped or dredged), the soil may be placed in a slurry, resulting in use of drying basins and runoff management basins as described under the dredging component.

Operations and Maintenance

The soil profile would be monitored for elevation change. Placement of soil would recur as material is available and further accretion is desired, as determined through comprehensive Project adaptive management.

Implement Local Marina and Recreation Outreach Program

This component would be the same as described under Alternative 1-A.

Excavate Dixon and New Hope Borrow Sites

This component would be the same as described under Alternative 1-A.

Excavate and Restore Grizzly Slough Property

This component would be the same as described under Alternative 1-A.

Dredge South Fork Mokelumne River (Optional)

This component would be the same as described under Alternative 1-A; however, dredged material may be pumped or dried and transported to provide fill material for the subsidence reversal component.

Enhance Delta Meadows Property (Optional)

This component would be the same as described under Alternative 1-A.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Table 2-8d summarizes the construction operations anticipated to implement Alternative 2-A, including work sequence and schedule, equipment, material volume, and duration.

Construct North Staten Inlet Weir

Objective

To convey high river stages into the detention basin on the northern tip of Staten Island, the degraded levee would be reinforced as a hardened weir to direct flow and minimize erosion. It would also serve as an elevated platform for a relocated Walnut Grove–Thornton Road.

Location

A weir would be constructed adjacent to the existing alignment of Walnut Grove–Thornton Road to direct flows from the Mokelumne River into the Staten Island detention basin, across the river from Dead Horse Island (see Figure 2-22). The resulting weir would be approximately 4,600 feet long.

Design and Construction

The weir would have a crest elevation set to 10 feet NGVD, approximately 12 feet above the surrounding land surface (see Figure 2-23). The crest would be approximately 74 feet wide (to accommodate the realigned roadway of Walnut Grove–Thornton Road atop the weir with 22-foot-wide pavement and 8-foot-wide shoulders on either side), and the slopes of the weir would be 3:1 on either side. See description later in this chapter regarding modifications to Walnut Grove–Thornton Road and Staten Island Road.

On the southern toe of the weir, a 3-foot-deep sill would be excavated to help dissipate the energy of overtopping water cascading down the landside levee face. Grading and excavation of exit channels would ensure that fish are not entrapped in the toe sill as floodwaters are removed from the detention basin. Twenty-four-inch angular RSP would be placed to a depth of 30 inches from the southern edge of the road to the crest of the weir, down the landside face, in the toe sill, and onto the floor of the island for an additional 6 feet beyond the toe sill. Additional RSP of the size specified above would be placed from the northern edge of the road to the crest of the weir and 10 feet down the north face of the weir to protect against erosion caused by turbulence in the approaching flow. One or more filter layers would be placed under all RSP areas to prevent scour of the underlying soil. A concrete retaining wall would be constructed at the road-RSP interface to protect against undercutting of the pavement when the structure is overtopped. The approximate total width of the footprint would be 180 feet.

Operations and Maintenance

The weir itself has no operable devices. The weir would be maintained in a manner similar to current levee management practices in the area for vegetation control. As a component of the AMP, DWR will develop a Flood Recovery Plan to ensure the land in the detention basin is restored for farming as quickly as possible after flood events. The roadway would be maintained consistent with current county practices for the existing Walnut Grove–Thornton Road.

Construct North Staten Interior Detention Levee

Objective

A detention basin is proposed on Staten Island to contain flows greater than the 10-year event but less than the 100-year event.

Location

The detention levee would key into and connect the Staten Island east and west levees approximately 16,000 feet south of Walnut Grove–Thornton Road (see Figure 2-22). It would key into the levee on the South Fork Mokelumne River near the inlet of Beaver Slough, and into the levee on the North Fork Mokelumne River near Station 1251+65. The resulting detention levee would be approximately 16,000 feet long.

Design and Construction

The capacity of the detention basin would be designed based on the 1997 flood event. Hydraulic modeling during Project design would assist in sizing the basin relative to the 1997 event while minimizing required acreage and frequency of inundation. A levee patrol road would be constructed on the crown of the levee. The road surface would provide all-weather access, proposed to be compacted aggregate base.

The detention levee may be classified as a dam per the definition and jurisdiction of the DWR Division of Safety of Dams (DSOD). A conceptual design report has been prepared for the detention levee and has been submitted to DSOD staff for a final determination.

The detention levee would be constructed with low-permeability materials (lean clay or clayey sand to sandy clay), and would use the existing levees along the North Fork Mokelumne River and South Fork Mokelumne River as abutments.

An outlet weir (spillway) would be constructed on the existing South Fork Mokelumne River levee near the pump station, although the exact location has yet to be determined. The outlet weir height would be the same as the inlet weir height. To meet DSOD criteria for dams, the crest of the levees should be at least 1.5 feet above the maximum water level that develops when water flows over the outlet weir. To achieve this, the interior detention basin levees would be at least

2 feet above the height of the outlet weir, accounting for a water depth of 0.5 feet flowing over the outlet weir.

Two cross sections for the detention levee are being evaluated. It is known that Staten Island contains peat soils, which would easily compress under the weight of a detention levee. However, it is unknown at this time how deep the peat soils are on the island. Case 1 (as shown in Figure 2-24) assumes that the peat is shallow enough to fully excavate under the footprint of the detention levee, and Case 2 (as shown in Figure 2-25) assumes the peat is too deep to fully excavate. For the purposes of this EIR, it is assumed that Case 2 would be used, as it has the greatest potential for impacts and is therefore the most conservative approach for analysis. A description of Case 1 is offered as an information item only.

Case 1

This cross section assumes that the peat is shallow enough (about 5 feet thick or less) to fully remove it below the footprint of the detention levee. It is assumed that the peat would be replaced with the same fill material used for the embankment materials. It is also assumed that the peat would be removed to a distance of 20 feet beyond either toe of the detention levee. The detention levee would then be constructed on the underlying stiffer sands and clay. The height of the constructed detention levee would be 26 feet, with a 3:1 slope on the detention basin side, a 2.5:1 slope on the dry side, and a 16-foot-wide crest. The detention basin side of the detention levee would be protected from erosion by placement of conventional RSP or by placement of soil treated with cement or lime as facing material. The dry side of the detention levee would be covered with vegetation to provide erosion protection and allow ready examination of the slope. The width of the construction footprint, including excavation of peat, would be approximately 200 feet.

To prevent the effects of liquefaction in the case of seismic activity, potentially liquefiable sands could be densified with conventional earthwork equipment or other techniques such as deep dynamic compaction. The liquefaction hazard could be reduced to a level that would keep deformation sufficiently small to maintain the integrity of the detention levee under operating conditions. During final design, a thorough seismic analysis of the detention levee would be needed.

Case 2

This cross section assumes that the peat is too thick to effectively remove. The island is well below sea level, and dewatering to remove the peat may not be practical. For conceptual design of Case 2, it has been assumed that the detention levee would be constructed on 10 feet of peat. It is assumed that the material below the peat is potentially liquefiable, but there is no cost-effective method to densify the underlying sand and eliminate the liquefaction hazard. Case 2 therefore features an oversized detention levee. During final design, a thorough seismic analysis of the detention levees would be needed.

The height of the constructed detention levee would be 26 feet, with a 30-foot wide crest to allow for additional building up of the levee crown if the levee foundation were to settle. It is assumed that the peat would compress about 4 to 5 feet under the crest of the detention levee. The settlement of the detention levee may introduce tensile stresses within the fill, which may cause cracking. Plastic geogrids would be placed within the core of the detention levee to stiffen the embankment and reduce differential settlement and cracking in the core area.

The detention levee would be built with a 3:1 slope on the detention basin side and a 2.5:1 slope on the dry side, both buttressed by toe berms inclined at 10:1 starting at one-half the height of the detention levee to reduce to a safe level the risk of liquefaction-induced slope failure. The detention basin side of the detention levee would be protected from erosion by placement of RSP. The dry side of the detention levee would be covered with vegetation to provide erosion protection and allow ready examination of the slope. The width of the construction footprint, including the toe berms, would be approximately 370 feet.

Placement of soil to construct the levee would occur in lifts to facilitate compaction.

Abutments

As mentioned above, the detention levee would abut the existing levees along the North Fork Mokelumne River and South Fork Mokelumne River. The existing levees consist of fill over peat, and options to improve the existing levees are limited because the levee foundations are below the river water surface. The peat would be removed to near the toe of the existing levees for construction of the detention levee, but any peat beneath the existing levees would remain below the abutment.

Seepage through the abutment is a concern, as placing the detention levee against the existing levees may cause the levees to settle and may cause differential settlement with adjacent sections of the levee. To provide protection against settlement-induced cracking and seepage, a soil-bentonite slurry cut-off wall would be constructed through the existing levee and foundation (see Figure 2-26). The soil-bentonite slurry is a low-permeability material to reduce seepage, yet it is sufficiently flexible to resist cracking from differential settlement.

The cut-off wall would extend along the axis of the existing levee to at least 20 feet beyond the toes of the detention levee. The cut-off wall would also extend through the axis of the detention levee approximately 20 feet beyond the toes of the existing levees. The total length of cut-off wall at each abutment under Case 1 would be approximately 340 feet, and under Case 2 approximately 480 feet.

Soil from the Dixon and New Hope borrow sites would provide the extra material needed to build the detention levee.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically. Soil periodically may be replaced and regraded to maintain the levee cross section. RSP may be placed on the levee slope to control erosion. The access road would be managed for vegetation, which is anticipated to be mowed or treated with herbicide at the shoulders and side-slopes. The aggregate base surface periodically would be refreshed with new material and graded to maintain a drivable surface.

Construct North Staten Outlet Weir

Objective

In order to control the water level in the detention basin during flood events, an outlet weir would be constructed to pass excess water through the basin once it has filled to capacity.

Location

The outlet weir would be constructed on approximately 3,000 feet of the existing levee along the South Fork Mokelumne River near the drainage pump station, lowered to 10 feet NGVD (see Figure 2-22).

Design and Construction

A concrete-armored outlet weir would be constructed on the lowered portion of the levee to convey flows out of the detention basin when it has filled to capacity. Engineering design of this feature per DSOD criteria has not been completed; however, it is envisioned that the outlet weir would be an operable weir structure. To facilitate the operable weir, the levee profile may be lowered 2 feet and replaced with an outlet works of flashboards that could be removed in the event the detention basin reaches capacity, or a similar design. The outlet works would be located toward the channel side of the levee section to accommodate the levee patrol road on the basin side.

Operations and Maintenance

The weir is currently envisioned as a manually operated structure. When it is anticipated that the basin would fill to an internal water surface elevation that would spill over the weir back to the river channel, crews would remove the flashboards by truck from the levee patrol road, using mobile hoists if necessary. The structure would be inspected annually for functionality. The flashboards may require painting or other treatment to protect against weathering, anticipated at a 5-year interval.

Install Detention Basin Drainage Pump Station

Objective

Because the floor of Staten Island is well below the water levels in surrounding channels, the detention basin would not be able to drain by gravity. Permanent or portable pumps would lift the water out of the detention basin after flood events and discharge it back to the river.

Location

The drainage pump station would be located at the southeast end of the detention basin, on the South Fork Mokelumne River levee across from the inlet of Beaver Slough (see Figure 2-22).

Design and Construction

Engineering design of this feature is not complete; however, portable pumps are proposed for use on a permanent concrete pad integrated with the outlet weir structure. Under Alternative 2-A, the detention basin area would be approximately 2,350 acres, and capacity would be approximately 48,350 af, requiring seven 42-inch-diameter pumps, each rated at 350 to 400 horsepower running continuously to drain the basin within 30 days. Each diesel-powered pump would consume 15 to 18 gallons of fuel per hour and would generate 95 to 105 decibels of sound. The permanent pump facility (integrated with the outlet weir) would have intake pipes leading to an elevated pump pad on the landside of the levee, withoutflow pipes over the crown of the levee to discharge to the channel side. The outfall would likely be reinforced with a rock dissipation apron.

To avoid fish entrainment and mortality at the pumps, at least one of the pumps would be a fish-friendly design, such as a centrifugal type. This determination will be made as a part of the detailed Project design process. A slot channel would be excavated in the basin to direct fish toward the fish-friendly pump at extreme low flow to avoid stranding. The slot channel would be vegetated to provide wildlife cover at times when the basin is not inundated. The other pumps would be screened and barricaded to prevent fish attraction and entrainment. DWR is continuing to research pumping facilities and evaluate new technologies to ensure a fish-friendly design is incorporated during detailed Project engineering.

Operations and Maintenance

After flood events during which the detention basin is filled, the pumps would be used to lower the water level as soon as possible to at least 3 feet below the crests of the existing levees. This action would protect the existing levees and the detention levee from excessive erosion and overtopping from wind-generated waves. The basin would then be drained of half its volume within approximately 26 days. The water in the basin would be fully removed before saturation of the levees occurs and to allow farming to resume in the spring.

Reinforce Existing Levees

Objective

Alternative 2-A proposes using the existing levees along the North Fork Mokelumne River and South Fork Mokelumne River as the eastern and western walls of the detention basin. Approximately 37,000 feet of these levees would be reinforced to safely contain floodwaters in the detention basin.

Location

The levees on the eastern and western sides of Staten Island (along the North Fork Mokelumne River and South Fork Mokelumne River) would be reinforced from the new weir in the north to the detention levee in the south (see Figure 2-22).

Design and Construction

Interior slopes surrounding detention areas are vulnerable to erosion from drawdown of the detained waters, especially where steepened slopes are susceptible to vertical sloughing. Wind and wave wash are an additional threat to these slopes. Designs under consideration for the Project are placement of additional material to reinforce and layback the slopes, planting of vegetation to dissipate energy and consolidate the soil structure, use of plastic geogrid or natural fiber geotextile fabric, and placement of RSP to protect the soil surface. These options may be used in combination, such as geotextile fabric planted with wild rose. Engineering design of this component is not complete; however, for the purposes of this analysis, RSP reinforcement is assumed to provide the most conservative approach in terms of environmental impact and least habitat benefit. Therefore, it should be assumed that RSP would be placed from the toe of slope up to the crown, ranging in size from 12 to 24 inches at an average depth of 18 inches.

Operations and Maintenance

Detention basin slopes would be monitored for erosion. Soil and RSP may be placed to address any areas of evident erosion.

Degrade Existing Staten Island North Levee

Objective

Flows would be conveyed from McCormack-Williamson Tract to Staten Island by degrading the northern levee on Staten Island from an existing elevation of 15 feet to a lower elevation (to be determined in Project design through hydraulic modeling).

Location

This action would affect the north levee of Staten Island in the segment bounded by Walnut Grove–Thornton Road (see Figure 2-22).

Design and Construction

The levee would be degraded primarily with scrapers. Dozers would be used to reshape the levee to final grade, followed by an imprinter to compact the soil. The area between the degraded levee and the detention levee would be left to reform and revegetate by natural processes. The removed levee material would be used to construct other Project features.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically. Soil periodically may be replaced and regraded to maintain the levee cross section. RSP may be placed on the levee slope to control erosion.

Relocate Existing Structures

Objective

Opening up the northern part of Staten Island to detain flows in high-stage events would affect a number of important structures. These structures would be removed and relocated to maintain their use.

Location

The affected structures include a grain dryer facility, a residential complex, and other residential structures accessed via Staten Island Road on the northern part of the island (south of Walnut Grove–Thornton Road).

Design and Construction

Complete demolition of the grain dryer, a predominantly concrete and steel facility, is likely too costly; it may be selectively deconstructed and salvaged to minimize flood damage and safety concerns. A new grain dryer would be constructed on Staten Island, outside of the proposed detention area. Residential structures and associated buildings would be completely demolished. Their function would be replaced with new structures built on Staten Island near the headquarters complex on the west side of the island, outside of the proposed detention area. The affected structures and relocation area are shown on Figure 2-22.

Operations and Maintenance

These facilities would be operated and maintained consistent with current practices, although it is anticipated that the grain dryer would be of a different, more contemporary type and would be operated accordingly.

Modify Walnut Grove–Thornton Road and Staten Island Road

Objective

Under Alternative 2-A, Walnut Grove–Thornton Road would be realigned and elevated atop the new weir. Staten Island Road would be partially elevated on an earthen ramp to provide an at-grade intersection with the elevated Walnut Grove–Thornton Road. Realignment of Staten Island Road to the Staten Island west levee is also under consideration, but is not included in the scope of this environmental analysis as a permanent action. It is anticipated that the existing roadways and access connections would be maintained during construction to the greatest extent feasible.

Location

Walnut Grove–Thornton Road (also known as San Joaquin County Road J-11) crosses Staten Island at the extreme northern end. Staten Island Road begins at a "T"-intersection with Walnut Grove–Thornton Road and proceeds southward, bisecting the island into east and west halves (see Figure 2-22).

Design and Construction

As described under the inlet weir component, Walnut Grove–Thornton Road would be permanently realigned atop the new weir, adjacent to its existing alignment. The existing Walnut Grove–Thornton Road is expected to remain open for use during construction; therefore, there should be no disruption or minimal disruption in traffic patterns.

Staten Island Road would require a new earthen ramp to intersect Walnut Grove–Thornton Road at grade. The ramp grade would be approximately 5% to maintain site distance and provide a gentle slope for truck operations. To construct the ramp on the current Staten Island Road alignment, traffic would need to be temporarily diverted. As most of the structures and circulation needs are concentrated in the northwest corner of the island, the west levee of Staten Island would be developed to provide a temporary access route. While temporary, this route may receive a considerable amount of traffic and therefore would be paved, striped, and signed. It is anticipated that the temporary access route may be in use for up to 45 days.

Operations and Maintenance

As Walnut Grove–Thornton Road would be integrated with the inlet weir as part of Alternative 2-A, the roadway would need to be closed to all traffic when the weir is in operation (as water would be spilling over the roadway). The roadway would be barricaded on the east side of the New Hope Bridge, so that westbound traffic could not cross the South Fork Mokelumne River from New Hope Tract. The roadway would be barricaded on the east side of the Millers Ferry Bridge, so that eastbound traffic could cross the North Fork Mokelumne River from Tyler Island to access Dead Horse Island and Staten Island. During detention basin operation only (which is designed to be less frequent than the 10-year event), the west levee of Staten Island, improved for temporary access during construction, would be used for temporary access during flood events. Through-traffic between SR 160 (via River Road) and Interstate 5 would likely be diverted northward to Twin Cities Road.

Maintenance after flood events would include inspection of pavement integrity and street sweeping. Ordinary maintenance during non-flooding periods would be consistent with existing practices.

Retrofit or Replace Millers Ferry Bridge (Optional)

Objective

Alteration or replacement of Millers Ferry Bridge may be necessary to allow for construction of a weir and to accommodate a potential realignment of Walnut Grove–Thornton Road. This bridge (along with the New Hope Bridge) historically has been a constriction point in the system during flood events. Bridge replacement should help provide relief at this point of constriction in future flood events.

Location

Millers Ferry Bridge is at the crossing of Walnut Grove–Thornton Road and the North Fork Mokelumne River (see Figure 2-22).

Design and Construction

Options for Millers Ferry Bridge are opening one or more new bays to extend the bridge along its length and widen the channel area, or completely replace of the bridge. Either option is likely to require closing Walnut Grove–Thornton Road on Staten Island and detouring traffic, mostly to Twin Cities Road to the north to maintain access for Walnut Grove, Locke, and surrounding residences and businesses between SR 160 (via River Road) and I-5. The road may be closed up to 60 days.

Either of these options is also likely to reuse the steel bridge structure and require temporary removal of the bridge. It is anticipated that the bridge would be lifted by crane to an adjacent staging area while the abutments and supporting structure are under construction, or the bridge could be relocated to new abutments and supporting structure built near the existing alignment. An anticipated maximum footprint of disturbance is shown on Figure 2-27. Because of the need for vegetation clearing to convey floodflows, this footprint is considered a permanent impact.

Operations and Maintenance

Operations and maintenance would include clearing vegetation in the channel under the bridge and at the bridge approaches as part of other floodway and levee management activities. Operations and maintenance of the bridge would be similar to the existing condition, including on-demand articulation of the bridge for boat passage and maintenance of the roadway and bridge structure (such as periodic painting to resist weathering).

Retrofit or Replace New Hope Bridge (Optional)

Objective

Alteration or replacement of New Hope Bridge may be necessary to allow for construction of a weir and to accommodate a potential realignment of Walnut Grove–Thornton Road. This bridge (along with Millers Ferry Bridge) historically has been a constriction point in the system during flood events. Bridge replacement should help provide relief at this point of constriction in future flood events.

Location

New Hope Bridge is at the crossing of Walnut Grove–Thornton Road and the South Fork Mokelumne River (see Figure 2-22).

Design and Construction

Options for New Hope Bridge are opening one or more new bays to extend the bridge along its length and widen the channel area, or completely replacing the bridge. Either option is likely to require closing Walnut Grove–Thornton Road on Staten Island and detouring traffic, mostly to Twin Cities Road to the north to maintain access for Walnut Grove, Locke, and surrounding residences and businesses between SR 160 (via River Road) and I-5. The road may be closed up to 60 days. An anticipated maximum footprint of disturbance is shown on Figure 2-28. Because of the need for vegetation clearing to convey floodflows, this footprint is considered a permanent impact.

Operations and Maintenance

Operations and maintenance would include clearing vegetation in the channel under the bridge and at the bridge approaches as part of other floodway and levee management activities. Operations and maintenance of the bridge would be similar to the existing condition, including maintenance of the roadway and bridge structure (such as periodic painting to resist weathering).

Construct Wildlife Viewing Area

Objective

The objective of this optional component would be to enhance recreation opportunities in the North Delta, specifically focused on public facilities for viewing sandhill cranes.

Location

Access to the new wildlife viewing area would be via Staten Island Road, with a new parking facility and restroom located to the east of the road just south of the new detention levee (see Figure 2-22).

Design and Construction

Enhancements would be achieved through construction of a wildlife viewing area on the new detention levee with supporting infrastructure located near the base of the levee (parking lot and restrooms). An all –weather–surfaced ramp would be constructed along the levee to allow circulation between the parking area and the viewing area, meeting state and federal accessibility requirements. The viewing area would include an open blind-type structure, designed with a low profile and low visibility to blend in with the levee. The blind may include interpretive signage, benches, and permanently mounted spotting scopes. These enhancements would be constructed concurrently with the flood control improvements on Staten Island.

Supporting infrastructure would include an allweather–surfaced parking area, picnic benches, self-contained vault-type restrooms, and an interpretive trail loop.

Operations and Maintenance

Coordination with TNC's wildlife-friendly farming operation would occur so that recreation would not interfere with farming operations. No public access would be permitted to the viewing area during times when the detention basin is inundated. The restroom would require periodic inspection and maintenance.

Excavate Dixon and New Hope Borrow Sites

The inlet weir, roadway ramps, and new detention levee require select fill material, assumed to be available from the Dixon and New Hope borrow sites. This component would be the same as described under Alternative 1-A.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee

- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Table 2-8e summarizes the construction operations anticipated to implement Alternative 2-B, including work sequence and schedule, equipment, material volume, and duration.

Construct West Staten Inlet Weir

Objective

To convey high river stages into the detention basin on the western side of Staten Island, the degraded levee would be reinforced as a hardened weir to direct flow and minimize erosion.

Location

A weir would be constructed to direct flows on the North Fork Mokelumne River into the Staten Island detention basin, across the river from Tyler Island (see Figure 2-29). The resulting weir would be approximately 3,000 feet long.

Design and Construction

The weir would have a crest elevation set to 9 feet NGVD, approximately 16 feet above the surrounding land base (see Figure 2-30). The crest would be approximately 44 feet wide, and the slopes of the weir would be 3:1 on either side. RSP on the northern side of the weir would extend 10 feet down the weir face flush to grade to protect against turbulence in the approaching flow. The protection would continue across the crest and down the southern face of the structure. At the southern toe, an end sill would be constructed to dissipate the energy of the overtopping flow. All RSP would consist of 24-inch angular rock (USACE 1991) placed to a depth of 30 inches. One or more filter layers would be placed under all RSP areas to prevent scour of the underlying soil. The approximate total width of the footprint would be 160 feet.

Operations and Maintenance

The weir itself has no operable devices. The weir would be maintained in a manner similar to current levee management practices in the area for vegetation control. As a component of the AMP, DWR will develop a Flood Recovery Plan to ensure the land in the detention basin is restored for farming as quickly as possible after flood events.

Construct West Staten Interior Detention Levee

This component would be the same as described under Alternative 2-A, except for the location (see Figure 2-29). The detention levee would key into the existing Staten Island west levee at the southern end of the detention basin near Station 1030+00, and into the new setback levee where it meets the new inlet weir near Station 1252+90. The resulting detention levee would be approximately 22,000 feet long.

Construct West Staten Outlet Weir

This component would be the same as described under Alternative 2-A, except for the location (see Figure 2-29). The outlet weir would be constructed on approximately 3,000 feet of the existing levee along the North Fork Mokelumne River near the drainage pump station.

Install Detention Basin Drainage Pump Station

This component would the same as described under Alternative 2-A, except for the location and pump specifications (see Figure 2-29). The drainage pump station would be located at the southwest end of the detention basin, on the North Fork Mokelumne River levee at approximately Station 1031+85. Under Alternative 2-B, the detention basin area would be approximately 1,600 acres and capacity would be approximately 35,600 af, requiring nine 30-inch-diameter pumps, each rated at 200 to 250 horsepower running continuously to drain the basin within 30 days. Each diesel-powered pump would consume 10 to 14 gallons of fuel per hour and would generate 95 to 105 decibels of sound.

Reinforce Existing Levee

This component would be the same as described under Alternative 2-A except for the location (see Figure 2-29). Alternative 2-B proposes using the existing levee along the North Fork Mokelumne River as the western wall of the detention basin. Approximately 19,000 feet of this levee would be reinforced to safely contain floodwaters in the detention basin.

Construct Staten Island West Setback Levee

Objective

As a companion action with a degraded levee (described below), additional channel capacity during flood events would be created by providing setback levees. The increased channel capacity afforded by a setback levee is important for function of the inlet weir of the new detention basin.

Location

This component would affect the west levee of Staten Island on the North Fork Mokelumne River, landside and paralleling the existing levee alignment (see Figure 2-29).

Design and Construction

The setback levee would be set between 125 and 500 feet back from the Mokelumne River. The setback distance would be refined through hydraulic modeling. As shown in Figure 2-31, the setback levee crown height would be approximately 15 feet, or the greater of the existing levee height or DWR's PL84-99 standard. The crown width would be 16 feet, and the side slopes would be 2.5:1 on the landside and 3:1 on the waterside. The levee section would also include a 20-foot-wide bench at about 4 feet NGVD on the riverside and earthwork to facilitate development of a floodplain meander channel and positive drainage returning to the main channel of the river. The channel will be of a sufficient elevation to drain at low tide to discourage nonnative invasive species from establishing themselves in the channel. Soil from the Dixon and New Hope borrow sites would provide the extra material needed to build the setback levee.

A levee patrol road would be reconstructed on the crown of the levee. The road surface, proposed to be compacted aggregate base, would provide all-weather access.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically. Soil periodically may be replaced and regraded to maintain the levee cross section. RSP may be placed on the levee slope to control erosion. The access road would be managed for vegetation, anticipated to be mowed or treated with herbicide at the shoulders and side-slopes. The aggregate base surface would be refreshed periodically with new material and graded to maintain a drivable surface.

Degrade Existing Staten Island West Levee

Objective

Historically, the Delta was characterized by meandering channels and complexes of wetland, shallow aquatic, and riparian habitat. The present-day Delta is characterized by rip-rapped channels with steepened banks. As a companion action with a setback levee (described above), additional channel capacity during flood events would be created by degrading the existing Staten Island west levee. This would also serve to increase habitat values in the area by expanding the floodplain and creating diverse geomorphic surfaces for various aquatic habitat types. The increased channel capacity afforded by the setback levee is also important for function of the inlet weir of the new detention basin.

Location

This component would affect the west levee of Staten Island on the North Fork Mokelumne River (see Figure 2-29).

Design and Construction

As shown in Figure 2-30, the Mokelumne River levee would be degraded to a height of 6 feet and function solely as habitat. Riparian and emergent vegetation would be planted or allowed to colonize the levee, depending on elevation. The levee crown would be approximately 16 feet wide, with a 5:1 slope on the landside. The waterside of the levee would not be reconfigured so as to minimize disturbance to any existing habitat.

Between the degraded existing levee and the new setback levee, a meander channel approximately 20 feet wide would be constructed at about 0 feet NGVD. Breaches in the existing levee would allow the Mokelumne River to flow through this area during low flow and high tide. In higher flows, the meander channel area would be more fully inundated. In very high floodflows, the Mokelumne River channel would expand to the setback levee, adding from 125 to 500 feet to the existing channel cross section.

Operations and Maintenance

Vegetation management (by herbicide application, mowing, or removal with hand tools) may be required periodically, targeted at controlling invasive exotic vegetation.

Relocate Existing Structures

This component would be the same as described under Alternative 2-A, except different structures would be affected and the relocation area is different. Opening up the western part of Staten Island to detain flows in high-stage events would affect the headquarters complex for operating the island, located just south of the proposed inlet weir. These structures would be removed and relocated. The affected structures and relocation area are shown on Figure 2-29.

Retrofit or Replace Millers Ferry Bridge

This component would be the same as described under Alternative 2-A. The distance by which the bridge would be lengthened would be consistent with the channel width created by the new setback levee (ranging from 125 to 500 feet). See Figure 2-29, depicting this component in the context of Alternative 2-B.

Retrofit or Replace New Hope Bridge (Optional)

This component would be the same as described under Alternative 2-A. The distance by which the bridge would be lengthened would be consistent with the channel width created by the new setback levee (ranging from 125 to 500 feet). See Figure 2-29, depicting this component in the context of Alternative 2-B.

Construct Wildlife Viewing Area

This component would be the same as described under Alternative 2-A, except that the facilities would be shifted slightly based on the different detention basin and levee alignment (see Figure 2-29).

Excavate Dixon and New Hope Borrow Sites

The new detention levee and setback levee require select fill material, assumed to be available from the Dixon and New Hope borrow sites. This component would be the same as described under Alternative 1-A.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Table 2-8f summarizes the construction operations anticipated to implement Alternative 2-C, including work sequence and schedule, equipment, material volume, and duration.

Construct East Staten Inlet Weir

This component would be the same as described under Alternative 2-B except for the location (see Figure 2-32). The weir would be constructed to direct flows on the South Fork Mokelumne River into the Staten Island detention basin, across the river from Canal Ranch and New Hope Tract. The resulting weir would be approximately 3,000 feet long.

Construct East Staten Interior Detention Levee

This component would be the same as described under Alternative 2-A except for the location (see Figure 2-32). The detention levee would key into the Staten Island east levee at the southern end of the detention basin near Station 304+10, and into the new setback levee where it meets the new South Fork Weir. The resulting detention levee would be approximately 17,000 feet long.

Construct East Staten Outlet Weir

This component would be the same as described under Alternative 2-A except for the location (see Figure 2-32). The outlet weir would be constructed on approximately 3,000 feet of the existing levee along the South Fork Mokelumne River near the drainage pump station.

Install Detention Basin Drainage Pump Station

This component would be the same as described under Alternative 2-A except for the location and specifications (see Figure 2-32). The drainage pump station would be located at the southeast end of the detention basin, on the South Fork Mokelumne River levee at approximately Station 301+40. Under Alternative 2-C, the detention basin area would be approximately 1,600 acres, and the capacity would be approximately 32,400 af, requiring eight 30-inch-diameter pumps, each rated at 200 to 250 horsepower, running continuously to drain the basin within 30 days. Each diesel-powered pump would consume 10 to 14 gallons of fuel per hour and would generate 95 to 105 decibels of sound.

Reinforce Existing Levee

This component would be the same as described under Alternative 2-A except for the location. Alternative 2-C proposes using the existing levee on the eastern side of Staten Island along the South Fork Mokelumne River as the western wall of the detention basin. Approximately 16,000 feet of this levee would be reinforced to safely contain floodwaters in the detention basin.

Construct Staten Island East Setback Levee

This component would be the same as described under Alternative 2-B except for the location, which is the east levee of Staten Island on the South Fork Mokelumne River, landside and paralleling the existing levee alignment (see Figure 2-32).

Degrade Existing Staten Island East Levee

This component would be the same as described under Alternative 2-B except for the location, which is the east levee of Staten Island on the South Fork Mokelumne River (see Figure 2-32).

Relocate Existing Structures

This component would be the same as described under Alternative 2-A, except different structures would be affected. Opening up the eastern part of Staten Island to detain flows in high-stage events would affect the two residences along Staten Island Road near the new detention levee. These structures would be removed and relocated. The affected structures and relocation area are shown on Figure 2-32.

Retrofit or Replace New Hope Bridge

This component would be the same as described under Alternative 2-A. See Figure 2-32, depicting this component in the context of Alternative 2-C.

Retrofit or Replace Millers Ferry Bridge (Optional)

This component would be the same as described under Alternative 2-A. See Figure 2-32, depicting this component in the context of Alternative 2-C.

Construct Wildlife Viewing Area

This component would be the same as described under Alternative 2-A, except that the facilities would be shifted slightly based on the different detention basin and levee alignment (see Figure 2-32).

Excavate Dixon and New Hope Borrow Sites

The new detention levee and setback levee require select fill material, assumed to be available from the Dixon and New Hope borrow sites. This component would be the same as described under Alternative 1-A.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)

- Retrofit or Replace New Hope Bridge (*optional*)

Table 2-8g summarizes the construction operations anticipated to implement Alternative 2-D, including work sequence and schedule, equipment, material volume, and duration.

Dredge South Fork Mokelumne River

This component would be similar to the component described under Alternative 1-A. Although occurring within the same geographic limits and using the same methods as described under Alternative 1-A, this component is distinguished from that alternative in that the volume removed is not constrained by the objective to result in no effect on downstream conveyance capacity. In other words, downstream levees would be modified in combination with increased dredging to remove a larger volume of in-channel sediments to provide greater channel conveyance capacity within and downstream of the dredging area. The cross-sectional limits would be determined during detailed engineering to minimize effects on shallow aquatic habitat.

Unlike the similar optional component under Group I, this component under Alternative 2-D would include removal of accumulated sediments and associated vegetation from around the New Hope Bridge. The sediment is presently creating a constriction at the bridge by reducing the cross-sectional area of the channel at the bridge and its approaches.

Modify Levees to Increase Channel Capacity

Objective

Substantially increasing conveyance capacity of the South Fork Mokelumne River involves channel dredging in combination with modification of the levee system. Further, higher degrees of dredging necessitate raising the profile of downstream levees to accommodate the resulting greater flows, as demonstrated through hydraulic modeling.

The premise of a modified setback levee is that the levee slopes are laid back, such that the channel cross section is progressively wider and channel capacity is considerably increased, corresponding with higher water surface elevation. A modified setback levee approach has been implemented on the east side of Tyler Island, across the North Fork Mokelumne River from Staten Island, and is proposed to be further expanded upstream (under a separate project). This component proposes to adopt a similar approach on the South Fork Mokelumne River to increase channel capacity when needed at higher flows.

Location

This component would potentially be applied to the same geographic limits as the dredging component (see Figure 2-33). These activities are linked in part because dredge spoils would provide some of the material needed to construct the levee modifications. Both sides of the channel are proposed to be modified, except where structures or other infrastructure that cannot be easily relocated would preclude implementation.

Design and Construction

The modified setback levee entails laying back the waterside slope from the toe of the levee at a 5:1 (horizontal to vertical) angle, providing a 16-foot wide patrol road on the levee crown, and a 3:1 landside slope down to the land surface (see Figure 2-34). A key feature of the modified setback is a splash berm at the waterside hinge point of the levee, projecting 1 foot above the crown and 2 feet wide at the top to provide additional wave and wake protection at high flows. The waterside slope would be treated with RSP and planted with riparian vegetation along the slope face and emergent vegetation at the toe. The patrol road would be treated with compacted aggregate base.

Operations and Maintenance

Levees would be operated and maintained consistent with current practices; however, vegetation would be selectively permitted to grow on the waterside slope to dissipate wind and wave energy and protect the levee embankment.

Raise Downstream Levees to Accommodate Increased Flows

Objective

To address the hydraulic effects of increasing conveyance capacity on the South Fork Mokelumne River (through dredging and levee modifications), downstream levees would be raised as needed to maintain freeboard.

Location

Levees are proposed to be raised as needed along portions of the South Fork Mokelumne River, North Fork Mokelumne River, Sycamore Slough, Georgiana Slough, and the mainstem Mokelumne River (see Figure 2-33). Levees on opposite sides of the waterways are proposed to be raised in parallel (i.e., matching in profile).

Design and Construction

Hydraulic modeling results indicate that the implementation of dredging and levee modifications under Alternative 2-D would require levee raises along portions of the aforementioned waterways of approximately 1.2 inches (0.1 foot) (see Appendix E for more information on hydraulic modeling for the Project). These levee raises would require adding stabilized and compacted aggregate base to the levee crown and landside surface of the levee in order to maintain levee crown width and landside levee slope.

Operations and Maintenance

The levees affected by this component would continue to be managed as they are under existing conditions. These activities include vegetation management (by herbicide application, mowing, or removal with hand tools), placement of RSP to address waterside erosion, and restoration of the aggregate base patrol road with new material placed and graded to maintain a drivable surface.

Retrofit or Replace New Hope Bridge (Optional)

This component would be the same as described under Alternative 2-A. See Figure 2-32, depicting this component in the context of Alternative 2-D.

Retrofit or Replace Millers Ferry Bridge (Optional)

This component would be the same as described under Alternative 2-A. See Figure 2-32, depicting this component in the context of Alternative 2-D.

Scheduling and Phasing

Specific construction scheduling will be guided by environmental regulatory considerations, weather, soil moisture content, levee construction standards, and established work windows where applicable for Project components. A detailed construction schedule has not yet been developed based on these constraints, but the construction season is anticipated to likely occur between May 1 and October 15. Construction is likely to be completed over two to three construction seasons, with the first possible season in 2008.

Most construction would be conducted during weekdays between the hours of 7 a.m. and 6 p.m.; however, work on key public infrastructure (such as roadways) and other schedule-sensitive elements may necessitate extended working hours and work on weekends.

A likely general work sequence and schedule is presented in Table 2-7a, Table 2-7b, and Table 2-7c. The tables focus on construction-intensive items and do not include planning, operations, or maintenance activities. The following work-sequencing assumptions may be applied generally:

- flood control and ecosystem restoration components would be implemented in a way that maintains hydraulic neutrality;
- protective levees and other infrastructure modifications (such as relocation, demolition, or decommissioning) would be implemented prior to breaching or degrading levees, which may necessitate scheduling construction over successive seasons;
- new bridges and roadways would be constructed before existing features are deactivated;
- fill on top of or with peat soils would likely require placement in lifts over successive seasons to allow for settlement and compaction;
- dredging and soil importation actions are not anticipated to be single-time events and would recur over multiple years; and
- Group I would likely be implemented before Group II (as indicated in the titles of each table).

Table 2-7a. Construction Sequence for Group I Components (Year 1)

Component	May	Jun	Jul	Aug	Sep	Oct
Demolish Farm Residence and Infrastructure	X					
Modify Pump and Siphon Operations	X					
Reinforce Dead Horse Island East Levee	X	X				
Modify Downstream Levees to Accommodate Potentially Increased Flows	X	X				
Excavate and Restore Grizzly Slough Property	X	X	X	X	X	X
Excavate Dixon and New Hope Borrow Sites		X	X	X		
Construct Transmission Tower Protective Levee and Access Road	X	X	X	X	X	X
Enhance Landside Levee Slope and Habitat		X	X	X	X	X
Modify Landform and Restore Agricultural Land to Habitat			X	X	X	X
Construct Box Culvert Drains and Self-Regulating Tide Gates					X	
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area				X	X	
Degrade McCormack-Williamson Tract East Levee to Function as a Weir					X	X
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir					X	X
Breach Mokelumne River Levee				X	X	X
Dredge South Fork Mokelumne River			X	X	X	
Import Soil for Subsidence Reversal			X	X	X	

Table 2-7b. Construction Sequence for Group II Components (Year 2-Alternatives 2-A, 2-B, and 2-C)

Component	May	Jun	Jul	Aug	Sep	Oct
Relocate Existing Structures	X	X	X	X	X	X
Excavate Dixon and New Hope Borrow Sites	X	X	X			
Construct Setback Levee	X	X	X	X	X	X
Degrade Existing Levee				X	X	X
Construct Landside Detention Levee	X	X	X	X	X	X
Reinforce Existing Levees			X	X	X	X
Construct Outlet Weir				X	X	X
Install Detention Basin Drainage Pump Station				X	X	X
Retrofit or Replace Millers Ferry Bridge	X	X	X	X	X	X
Retrofit or Replace New Hope Bridge	X	X	X	X	X	X
Construct Inlet Weir				X	X	X
Modify Walnut-Grove Thornton Road and Staten Island Road			X	X	X	
Construct Wildlife Viewing Area				X	X	X

Table 2-7c. Construction Sequence for Group II Components (Year 2-Alternative 2-D)

Component	May	Jun	Jul	Aug	Sep	Oct
Dredge South Fork Mokelumne River		X	X	X	X	
Modify Levees to Increase Channel Capacity	X	X	X	X	X	X
Retrofit or Replace Millers Ferry Bridge	X	X	X	X	X	X
Retrofit or Replace New Hope Bridge	X	X	X	X	X	X

Summary of Equipment Operations

Implementation of the Project would require use of a number of pieces of motorized equipment. Equipment operations anticipated to implement the Project components are summarized for each alternative in Table 2-8a through Table 2-8g, describing the operation, equipment used, material volume, and duration of the operation.

1 **Table 2-8a.** Equipment Operations for Alternative 1-A

Component	Operation and Equipment	Material Volume
Demolish Farm Residence and Infrastructure	Demolish structures with dozer, load debris into truck with excavator, and haul off site with truck	484 tons of debris (exported)
Modify Pump and Siphon Operations	Dismantle pumps and piping by filling pipes with concrete or installing welded caps, and haul off site with truck	24 cubic yards of concrete (imported)
Reinforce Dead Horse Island East Levee	Import rock with barge and tugboat and place with dragline crane	34,000 tons of rock (imported)
Modify Downstream Levees to Accommodate Potentially Increased Flows	Import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	18,203 cubic yards of aggregate base (imported)
Excavate and Restore Grizzly Slough Property	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, degrade existing levee/grade and toe outlet, load levee material into truck, load borrow material into truck with excavator, haul borrow material to McCormack-Williamson Tract, replace topsoil and reshape land surface with dozer, wet surface with water truck for dust control, and imprint surface with compactor	830,000 cubic yards of levee and borrow material (exported)
Construct Transmission Tower Protective Levee and Access Road	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	91,424 cubic yards of levee material (imported) and 1,185 cubic yards of aggregate base (imported)
Enhance Landside Levee Slope and Habitat	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, place soil with dozer, wet surface with water truck for dust control, and imprint surface with compactor	552,500 cubic yards of levee material (imported)
Modify Landform and Restore Agricultural Land to Habitat	Reshape land surface with dozer and grader, dig channels with excavator, wet surface with water truck for dust control, transport material with truck for constructing features on the interior of the tract, and imprint surface with compactor	35,556 cubic yards of material (exported)
Degrade McCormack-Williamson Tract East Levee to Function as a Weir	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the tract, wet surface with water truck for dust control, imprint surface with compactor, import rock with truck, and place rock with excavator	58,667 cubic yards of levee material (transported on site) and 45,000 tons of rock (imported)
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the tract, wet surface with water truck for dust control, complete underwater excavation with dragline crane mounted on barge and moved by tugboat, and import rock with barge and tugboat and place with dragline crane	122,212 cubic yards of levee material (transported on site) and 2,627 tons of rock (imported)

Component	Operation and Equipment	Material Volume
Breach Mokelumne River Levee	Clear and grub levee surface with dozer, load material into truck with excavator, transport material with truck for constructing features on the interior of the tract, complete underwater excavation with dragline crane mounted on barge and moved by tugboat, and import rock with barge and tugboat and place with dragline crane	47,726 cubic yards of levee material (transported on site) and 1,387 tons of rock (imported)
Dredge South Fork Mokelumne River	Construct landside drying basins with dozer, remove material from channel bottom and place on landside of levee with dredge, load material into truck with excavator, transport material with truck for constructing features on McCormack-Williamson Tract, import rock with truck, and place rock with excavator	1,350,000 cubic yards of channel sediment (transported on site)
Enhance Delta Meadows Property	Upgrade boat launch with imported concrete, and clear and grub parking area with dozer	18 cubic yards of concrete (imported)

Table 2-8b. Equipment Operations for Alternative 1-B

Component	Operation and Equipment	Material Volume
Demolish Farm Residence and Infrastructure	Demolish structures with dozer, load debris into truck with excavator, and haul off site with truck	484 tons of debris (exported)
Modify Pump and Siphon Operations	Dismantle pumps and piping by filling pipes with concrete or installing welded caps, and haul off site with truck	16 cubic yards of concrete (imported)
Reinforce Dead Horse Island East Levee	Import rock with barge and tugboat and place with dragline crane	34,000 tons of rock (imported)
Modify Downstream Levees to Accommodate Potentially Increased Flows	Import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	18,203 cubic yards of aggregate base (imported)
Excavate and Restore Grizzly Slough Property	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, degrade existing levee/grade and toe outlet, load levee material into truck, load borrow material into truck with excavator, haul borrow material to McCormack-Williamson Tract, replace topsoil and reshape land surface with dozer, wet surface with water truck for dust control, and imprint surface with compactor	830,000 cubic yards of levee and borrow material (exported)
Construct Transmission Tower Protective Levee and Access Road	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	91,424 cubic yards of levee material (imported) and 1,185 cubic yards of aggregate base (imported)

Component	Operation and Equipment	Material Volume
Enhance Landside Levee Slope and Habitat	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, place soil with dozer, wet surface with water truck for dust control, and imprint surface with compactor	552,500 cubic yards of levee material (imported)
Modify Landform and Restore Agricultural Land to Habitat	Reshape land surface with dozer and grader, wet surface with water truck for dust control, and imprint surface with compactor	No materials would be exported or imported.
Construct Box Culvert Drains and Self-Regulating Tide Gates	Import materials with truck, prepare bedding with excavator, import rock with barge, install materials with crane	797 tons of rock (imported)
Degrade McCormack-Williamson Tract East Levee to Function as a Weir	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the tract, wet surface with water truck for dust control, imprint surface with compactor, import rock with truck, and place rock with excavator	58,667 cubic yards of levee material (transported on site) and 45,000 tons of rock (imported)
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the tract, wet surface with water truck for dust control, imprint surface with compactor, import rock with truck, and place rock with excavator	70,500 cubic yards of levee material (transported on site) and 81,600 tons of rock (imported)
Dredge South Fork Mokelumne River	Construct landside drying basins with dozer, remove material from channel bottom and place on landside of levee with dredge, load material into truck with excavator, transport material with truck for constructing features on McCormack-Williamson Tract	1,350,000 cubic yards of channel sediment (transported on site)
Enhance Delta Meadows Property	Upgrade boat launch with imported concrete, and clear and grub parking area with dozer	18 cubic yards of concrete (imported)

Table 2-8c. Equipment Operations for Alternative 1-C

Component	Operation and Equipment	Material Volume
Demolish Farm Residence and Infrastructure	Demolish structures with dozer, load debris into truck with excavator, and haul off site with truck	484 tons of debris (exported)
Modify Pump and Siphon Operations	Dismantle pumps and piping by filling pipes with concrete or installing welded caps, and haul off site with truck	16 cubic yards of concrete (imported)
Reinforce Dead Horse Island East Levee	Import rock with barge and tugboat and place with dragline crane	34,000 tons of rock (imported)
Modify Downstream Levees to Accommodate Potentially Increased Flows	Import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	18,203 cubic yards of aggregate base (imported)

Component	Operation and Equipment	Material Volume
Excavate and Restore Grizzly Slough Property	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, degrade existing levee/grade and toe outlet, load levee material into truck, load borrow material into truck with excavator, haul borrow material to McCormack-Williamson Tract, replace topsoil and reshape land surface with dozer, wet surface with water truck for dust control, and imprint surface with compactor	830,000 cubic yards of levee and borrow material (exported)
Construct Transmission Tower Protective Levee and Access Road	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	91,424 cubic yards of levee material (imported) and 1,185 cubic yards of aggregate base (imported)
Enhance Landside Levee Slope and Habitat	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, place soil with dozer, wet surface with water truck for dust control, and imprint surface with compactor	552,500 cubic yards of levee material (imported)
Modify Landform and Restore Agricultural Land to Habitat	Reshape land surface with dozer and grader, wet surface with water truck for dust control, and imprint surface with compactor	–
Construct Box Culvert Drains and Self-Regulating Tide Gates	Import materials with truck, prepare bedding with excavator, import rock with barge, install materials with crane	1,025 tons of rock (imported)
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area	Place soil with dozer, wet surface with water truck for dust control, import rock with barge, place rock with excavator, and imprint surface with compactor	20,279 cubic yards of levee material (transported on site) and 31,403 tons of rock (imported)
Degrade McCormack-Williamson Tract East Levee to Function as a Weir	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the tract, wet surface with water truck for dust control, imprint surface with compactor, import rock with barge, and place rock with excavator	58,667 cubic yards of levee material (transported on site) and 45,000 tons of rock (imported)
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the tract, wet surface with water truck for dust control, imprint surface with compactor, import rock with barge, and place rock with excavator	70,500 cubic yards of levee material (transported on site) and 81,600 tons of rock (imported)
Dredge South Fork Mokelumne River	Construct landside drying basins with dozer, remove material from channel bottom and place on landside of levee with dredge, load material into truck with excavator, transport material with truck for constructing features on McCormack-Williamson Tract	1,350,000 cubic yards of channel sediment (transported on site)
Enhance Delta Meadows Property	Upgrade boat launch with imported concrete, and clear and grub parking area with dozer	18 cubic yards of concrete (imported)
Import Soil for Subsidence Reversal	Place material and shape with dozer	160,000 cubic yards of soil fill (transported on site)

1 **Table 2-8d.** Equipment Operations for Alternative 2-A

Component	Operation and Equipment	Material Volume
Relocate Existing Structures	Demolish structures with dozer, load debris into truck with excavator, haul debris off site with truck, clear and grub land surface with dozer, prepare subgrade with compactor, import building materials with truck, and install material with crane	1,306 tons of debris (exported)
Excavate Dixon and New Hope Borrow Sites	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, load borrow material into truck with excavator, haul borrow material to Staten Island, replace topsoil and reshape land surface with dozer, wet surface with water truck for dust control, and imprint surface with compactor	613,066 cubic yards of levee material (exported) and 177,467 cubic yards of levee material (transported on site)
Degrade Existing Levee	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the island, wet surface with water truck for dust control, and imprint surface with compactor	81,000 cubic yards of levee material (transported on site)
Construct Interior Detention Levee	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, place levee material with dozer, import bentonite with truck, install plastic geogrids within core of levee, dig trench for cut-off wall with excavator, haul and place fill material with truck, import rock with barge and place with excavator, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, roll surface with compactor	2,300,000 cubic yards of levee material (imported), 3,951 cubic yards of aggregate base (imported), and 458,667 tons of rock (imported)
Reinforce Existing Levees	Import rock with barge and place rock with excavator	278,300 tons of rock (imported)
Construct Outlet Weir	Strip and stockpile aggregate base patrol road with scraper, strip and transport levee material with scraper for constructing features on the interior of the island, wet surface with water truck for compaction and dust control, roll surface with compactor, replace and smooth aggregate base with grader, and import and place concrete with truck	1,956 cubic yards of levee material (transported on site)
Install Detention Basin Drainage Pump Station	Import materials with truck and install with crane, dig slot channel with excavator, export channel materials with truck	18,056 cubic yards of channel materials (exported)
Retrofit or Replace Millers Ferry Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Retrofit or Replace New Hope Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Construct Inlet Weir	Strip and stockpile aggregate base patrol road with scraper, strip and transport levee material with scraper for constructing features on the interior of the island, wet surface with water truck for compaction and dust control, imprint surface with compactor, import rock with barge, and place rock with excavator	225,000 cubic yards of levee material (transported on site) and 112,520 tons of rock (imported)

Component	Operation and Equipment	Material Volume
Modify Walnut-Grove Thornton Road and Staten Island Road	Strip and stockpile asphalt and aggregate base patrol road with scraper, place material with dozer, wet surface with water truck for compaction and dust control, roll surface with compactor, import asphalt with truck, import rock with barge and place with excavator, place asphalt with paver, and stripe with truck	–2,912 cubic yards of fill material (imported) and 1,506 tons of rock (imported)
Import Off-Site Fill Materials	Transport additional fill materials with truck and place with dozer	2,245,934 cubic yards of fill material (imported)
Construct Wildlife Viewing Area	Grade ramp and parking area with dozer, prepare subgrade with compactor, import asphalt with truck, place with paver, and stripe with truck	824 cubic yards of soil and 2,372 square yards of pavement

Table 2-8e. Equipment Operations for Alternative 2-B

Component	Operation and Equipment	Material Volume
Relocate Existing Structures	Demolish structures with dozer, load debris into truck with excavator, and haul off site with truck	2,591 tons of debris (exported)
Excavate Dixon and New Hope Borrow Sites	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, load borrow material into truck with excavator, haul borrow material to Staten Island, replace topsoil and reshape land surface with dozer, wet surface with water truck for dust control, and imprint surface with compactor	613,066 cubic yards of levee material (exported) and 177,467 cubic yards of levee material (transported on site)
Construct Setback Levee	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	1,057,037 cubic yards of levee material (imported) and 2,099 cubic yards of aggregate base (imported)
Degrade Existing Levee	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the island, wet surface with water truck for dust control, and imprint surface with compactor	348,889 cubic yards of levee material (transported on site)
Construct Interior Detention Levee	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, install plastic geogrids within core of levee, place levee material with dozer, import bentonite with truck, dig trench for cut-off wall with excavator, haul and place fill material with truck, import rock with barge and place with excavator, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, roll surface with compactor	3,380,000 cubic yards of levee material (imported) 5,432 cubic yards of aggregate base (imported) and 630,066 tons of rock (imported)
Reinforce Existing Levees	Import rock with barge and place rock with excavator	187,500 tons of rock (imported)

Component	Operation and Equipment	Material Volume
Construct Outlet Weir	Strip and stockpile aggregate base patrol road with scraper, strip and transport levee material with scraper for constructing features on the interior of the island, wet surface with water truck for compaction and dust control, roll surface with compactor, replace and smooth aggregate base with grader, and import and place concrete with truck	1,956 cubic yards of levee material (transported on site)
Install Detention Basin Drainage Pump Station	Import materials with truck and install with crane	–
Retrofit or Replace Millers Ferry Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Retrofit or Replace New Hope Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Construct Inlet Weir	Strip and stockpile aggregate base patrol road with scraper, strip and transport levee material with scraper for constructing features on the interior of the island, wet surface with water truck for compaction and dust control, imprint surface with compactor, import rock with barge, and place rock with excavator	44,000 cubic yards of levee material (transported on site), 741 cubic yards of aggregate (imported), and 65,750 tons of rock (imported)
Import Off-Site Fill Materials	Transport additional fill materials with truck and place with dozer	4,817,934 cubic yards of fill material (imported)
Construct Wildlife Viewing Area	Grade ramp and parking area with dozer, prepare subgrade with compactor, import asphalt with truck, place with paver, and stripe with truck	824 cubic yards of soil and 2,372 square yards of pavement

Table 2-8f. Equipment Operations for Alternative 2-C

Component	Operation and Equipment	Material Volume
Relocate Existing Structures	Demolish structures with dozer, load debris into truck with excavator, and haul off site with truck	665 tons of debris (exported)
Excavate Dixon and New Hope Borrow Sites	Clear and grub land surface with dozer, strip and stockpile topsoil with scraper, load borrow material into truck with excavator, haul borrow material to Staten Island, replace topsoil and reshape land surface with dozer, wet surface with water truck for dust control, and imprint surface with compactor	613,066 cubic yards of levee material (exported) and 177,467 cubic yards of levee material (transported on site)
Construct Setback Levee	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, and roll surface with compactor	1,057,037 cubic yards of levee material (imported) and 3,086 cubic yards of aggregate (imported)

Degrade Existing Levee	Clear and grub levee surface with dozer, strip and transport material with scraper for constructing features on the interior of the island, wet surface with water truck for dust control, and imprint surface with compactor	254,000 cubic yards of levee material (transported on site)
Construct Interior Detention Levee	Clear and grub levee footprint with dozer, prepare subgrade with compactor, place soil with dozer, wet surface with water truck for compaction and dust control, install plastic geogrids within core of levee, place levee material with dozer, import bentonite with truck, dig trench for cut-off wall with excavator, haul and place fill material with truck, import rock with barge, import aggregate base and liquid stabilizer with truck, place and smooth material with grader, roll surface with compactor	2,440,000 cubic yards of levee material (imported) 4,198 cubic yards of aggregate base (imported), and 487,333 tons of rock (imported)
Reinforce Existing Levees	Import rock with barge and place rock with excavator	129,900 tons of rock (imported)
Construct Outlet Weir	Strip and stockpile aggregate base patrol road with scraper, strip and transport levee material with scraper for constructing features on the interior of the island, wet surface with water truck for compaction and dust control, roll surface with compactor, replace and smooth aggregate base with grader, and import and place concrete with truck	0 cubic yards of levee material (transported on site)
Install Detention Basin Drainage Pump Station	Import materials with truck and install with crane, dig channel slot with excavator	13,889 cubic yards of channel materials (exported)
Retrofit or Replace Millers Ferry Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Retrofit or Replace New Hope Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Construct Inlet Weir	Strip and stockpile aggregate base patrol road with scraper, strip and transport levee material with scraper for constructing features on the interior of the island, wet surface with water truck for compaction and dust control, imprint surface with compactor, import rock with barge, and place rock with excavator	71,444 cubic yards of levee material (transported on site), 741 cubic yards of aggregate (imported), and 65,750 tons of rock (imported)
Import Off-Site Fill Materials	Transport additional fill materials with truck and place with dozer	3,477,934 cubic yards of fill material (imported)
Construct Wildlife Viewing Area	Grade ramp and parking area with dozer, prepare subgrade with compactor, import asphalt with truck, place with paver, and stripe with truck	824 cubic yards of soil and 2,372 square yards of pavement

Table 2-8g. Equipment Operations for Alternative 2-D

Component	Operation and Equipment	Material Volume
Dredge South Fork Mokelumne River	Construct landside drying basins with dozer, remove material from channel bottom and place on landside of levee with dredge	2,700,000 cubic yards of channel sediment (transported on site)
Modify Levees to Increase Channel Capacity	Strip and stockpile aggregate base patrol road with scraper, clear and grub levee surface with dozer, shape levee material with dozer, wet surface with water truck for compaction and dust control, imprint and roll surface with compactor, replace and smooth aggregate base with grader, import rock with barge, import liquid stabilizer with truck, and place rock with dragline crane	786,483 cubic yards of levee material (transported on site), 1,002,573 tons of rock (imported), and 34,955 cubic yards of aggregate base (imported)
Retrofit or Replace Millers Ferry Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined
Raise Downstream Levees to Accommodate Increased Flows	Import aggregate with truck and place with dozer	48,282 cubic yards of aggregate (imported)
Retrofit or Replace New Hope Bridge	Clear and grub levee abutment footprint with dozer and excavator, import concrete and bridge materials with truck, place bridge materials with crane	To be determined

Environmental Commitments

As part of the Project planning process, DWR will incorporate certain environmental commitments and best management practices (BMPs) into the Project alternatives to avoid or minimize potential impacts. DWR and the appropriate county agencies will also coordinate planning, engineering, and implementation of the Project. Because the environmental commitments have been incorporated into the Project by DWR, they will not be restated in the impact analysis sections but instead will be incorporated by reference.

Uniform Building Code Requirements

DWR and their contractors will be responsible for ensuring that standard Uniform Building Code (Seismic Zone 3), California Building Standards Commission, and county general plan construction standards are incorporated into the Project design for applicable features. These standards are intended to minimize the potential fault rupture, liquefaction, and expansive soil hazards on associated Project features.

Access Point/Staging Areas

DWR will establish staging areas for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with the resource agencies. Practices and procedures for construction activities along city and county streets will be consistent with the policies of the affected local jurisdiction.

Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water. If an off-road site is chosen, qualified biological and cultural resources personnel will survey the selected site to verify that no sensitive resources would be disturbed by staging activities. If sensitive resources are found, an appropriate buffer zone will be staked and flagged to avoid impacts. If impacts on sensitive resources cannot be avoided, the site will not be used. Where possible, no equipment refueling or fuel storage will take place within 100 feet of a body of water. However, dredging equipment, specifically equipment on the barge, would be refueled in the channel and would abide by the measures set forth in a stormwater pollution prevention plan (SWPPP) (as described below).

For areas where construction activities take place outside of the road right-of-way, the biological and cultural resources personnel will determine whether the selected staging area meets the criteria identified above and whether additional environmental clearance is required for the site. If sensitive resources are identified on the site that cannot be protected by environmental commitments for similar resources, an alternate site will be selected.

Erosion and Sediment Control Plan

DWR will prepare and implement an erosion and sediment control plan to control short-term and long-term erosion and sedimentation effects and to restore soils and vegetation in areas affected by construction activities. The plan will include all the necessary local jurisdiction requirements regarding erosion control and will implement BMPs for erosion and sediment control as required.

Stormwater Pollution Prevention Plan

In areas where soils disturbance exceeds 1 acre, a SWPPP will be developed by a qualified engineer or erosion control specialist and implemented prior to construction. The objectives of the SWPPP would be to (1) identify pollutant sources associated with construction activity and project operations that may affect the quality of stormwater, and (2) identify, construct, and implement stormwater pollution prevention measures to reduce pollutants in stormwater discharges during and after construction. DWR and/or their contractor(s) will develop and implement a spill prevention and control plan as part of the SWPPP to minimize effects from spills of hazardous, toxic, or petroleum substances during construction of the Project. The program will be a component of the SWPPP, which will be completed before any construction activities begin. Implementation of this measure would comply with state and federal water quality regulations. The SWPPP will be kept on site during construction activity and during operation of the Project and will be made available upon request to representatives of the RWQCB. The SWPPP will include, but is not limited to the following items:

- a description of potential pollutants to stormwater from erosion,
- management of dredged sediments and hazardous materials present on site during construction (including vehicle and equipment fuels),
- details of how the sediment and erosion control practices comply with state and federal water quality regulations, and
- a description of potential pollutants to stormwater resulting from operation of the Project.

In areas where soils disturbance is less than 1 acre, the appropriate county grading ordinance will be followed and the erosion and sediment control plan described above will be implemented.

Spoils Disposal Plan

Subsurface conditions in dredge spoil areas will be investigated prior to disposal activities and documented in the form of a soil suitability analysis or geotechnical report. Soil borings will be drilled throughout the potential dredged material disposal area to determine stratigraphic conditions beneath the settling pond area and the depth and thickness of peat units present. Samples of the peaty soils will be collected from each boring and will be submitted to a geotechnical laboratory; the density of each sample will be measured according to American Society for Testing and Material (ASTM) standards. These data would be used in conjunction with the stratigraphic information to determine the maximum amount of compaction that could occur beneath the site. The disposal method would be designed to account for the type and depth of materials present below the disposal sites. The sediment and water depth would be kept at a minimum to reduce the risk of settlement of the underlying soils. Additionally, the amount of dredged material to be placed could offset the amount of land subsidence if it raises the ground surface to a height greater than or equal to the depth of anticipated land subsidence.

Dredging Sampling and Analysis Plan, and Spoils Disposal

To ensure that potentially contaminated dredged materials do not affect surface water or groundwater resources, a sampling and analysis plan for proposed dredging areas will be prepared no more than 1 year before proposed dredging activities. The plan would be consistent with both EPA and RWQCB standards.

Channel core samples equivalent to approximately one core for every 5,000 cubic yards (cy) of dredged material will be collected. Sediment cores will be taken to Project depth plus 1-foot overdredge allowance in areas where dredging is proposed. These cores will be combined into samples for testing, with samples of the individual original cores archived for future reference if necessary.

Both the dredged and disposal site material composite samples will be subjected to chemical analysis for the required list of analytes as requested in the waste discharge requirements (WDRs) General Order 5-00-183 (11 August 2000) and as recommended in the Delta Dredging and Reuse Strategy (CVRWQCB, Central Valley Region June 2002).

Standard elutriate tests (SET) will be conducted to simulate the action of the clamshell dredge, which might cause mobilization of soluble metals during the dredging process. DI-WET tests will also be done on these sediment composite samples to evaluate the potential for subsequent freshwater leaching of these sediments on the disposal site. The analysis for acid-generating and -neutralizing potential of the dredged sediment will be carried out to aid the evaluation of potential future impacts of leachate on surface and groundwater quality.

In addition, acute toxicity tests using *Pimephales promelas* (fathead minnow) will be carried out on each composite sample and on both background water samples. The toxicity test data from the dredge sites will be compared statistically to the toxicity data from tests carried out on the background waters. As the dredged sediments are proposed for upland disposal and will not offer an exposure pathway to benthic organisms, benthic toxicity tests are not appropriate for this program.

If the testing indicates any layer of toxic materials above applicable standards, contractors will dredge so that either that layer is not disturbed or the entire layer is removed. This would effectively eliminate the potential for exposure of the benthic environment to toxic layers.

If the testing concludes that dredged material is found to possess contaminants, its disposal may lead to significant impacts on groundwater quality by leaching contaminants into the underlying soil. The testing would be followed by a suitability analysis in which a suitable environment for the disposal of contaminated soils would be chosen.

Once testing of spoils is completed and the results analyzed, the dredged material would either be placed on site or transported to an approved off-site disposal site. One or more of three methods would be used to dispose of the spoils:

- **Untreated Reuse.** Dredged material will be placed on the Project site if testing indicates that the material is consistent with the composition and chemical properties of the soils in the Project site and would not affect the productivity of the Project site.

- **Treated On-Site Reuse.** If the results of spoils tests indicate that the dredged material is incompatible with the composition and chemical properties of the on-site soils and could result in a change in the on-site soils' suitability for proposed uses but does not contain hazardous levels of chemicals or elements considered toxic, such material may be used on site with the use of amendments. These amendments would serve to adjust the composition and chemical properties of the spoils to allow integration with existing soils.
- **Off-Site Disposal.** If the results of the spoils testing indicate that all or part of the spoils tested contain hazardous levels of any chemical or element considered toxic, such materials will be handled, transported, and disposed of in accordance with all appropriate health and safety regulations and the Project's hazardous materials management plan

Dust Control Plan

To control the generation of construction-related emissions of particulates 10 microns or less in size (PM10), the Project applicant will require construction contractors to prepare and submit a dust control plan at least 48 hours before any earthmoving or construction activities.

Minimize Construction-Related Effects on Recreational Boating

DWR will implement the following measures to ensure that construction-related effects on recreational boating are minimized:

- levee degradation will occur in a manner that allows boating access through half the channel cross section at all times;
- construction will not occur during major summer holiday periods;
- warning signs and buoys will be posted at, upstream of, and downstream of all construction equipment, sites, and activities;
- adequate warning will be provided regarding activities and equipment in construction sites; and
- signs describing alternate boating routes will be posted in convenient locations when boating access is restricted.

Traffic and Control Plan and Emergency Access Plan

DWR, in coordination with affected jurisdictions, will develop and implement a traffic and navigation control plan, which will include an emergency access plan, to reduce construction-related effects on the local roadways and to avoid hazardous traffic and circulation patterns during the construction period. All construction activities will follow the standard construction specifications and procedures of the appropriate jurisdictions.

The traffic and control plan will include an emergency access plan that provides for access into and adjacent to the construction zone for emergency vehicles. The emergency access plan, which requires coordination with emergency service providers before construction, would require effective traffic direction, substantially reducing the potential for disruptions to response routes.

The traffic control plan will include, but not be limited to, the following actions:

- coordinating with the affected jurisdictions on construction hours of operation;
- following guidelines of the local jurisdiction for road closures caused by construction activities;
- installing traffic control devices as specified in the California Department of Transportation's (Caltrans') *Manual of Traffic Controls for Construction and Maintenance Works Zones*;
- notification to the public of road closures in the immediate vicinity of the open trenches in the construction zone;
- posting signs that conform to the California Uniform State Waterway Marking System upstream and downstream of the dredge areas to warn boaters of work;
- providing access to driveways and private roads outside the immediate construction zone;
- coordinating with Sacramento and San Joaquin County Department of Transportation Right of Way divisions to ensure that levee roads and any other roads damaged during construction are monitored and repaired when necessary; and
- coordinating with emergency service providers before construction to develop an emergency access plan for emergency vehicles' access into and adjacent to the construction zone; the emergency access plan would require effective traffic direction, substantially reducing the potential for disruptions to response routes.

Integrated Mosquito Management

Mosquito control in the Project site will be challenging because of the significant number of species inhabiting the Delta's wetlands and the multitude of mosquito-friendly habitats. In the Sacramento-Yolo region alone there are 25 mosquito species, each with a distinct life history. This complicates pest management decisions because strategies that may be effective against one species may not be useful against another. For example, *Culex erythrothorax* is a standing-water mosquito that prefers to lay eggs in thick aquatic vegetation. As a result, larvicides tend to be less effective and visual predators such as mosquitofish (*Gambusia affinis)* have difficulty finding the larvae among the thick vegetation (Kwasny 2004). Even if pest management measures are successfully implemented locally, this may not prevent the migration of adult mosquitoes from other wetland areas in the Delta to the Project site (some species of mosquito can fly more than 20 miles) (SLAFC 2002). Finally, the creation of new aquatic habitat conducive to mosquito reproduction may result with the implementation of any of the proposed alternatives in the Project site. It is therefore essential to implement an integrated mosquito management program (IMM) and to provide the necessary long-term funding for monitoring mosquito populations and maintaining BMPs.

Integrated Pest Management (IPM) or IMM involves integrating different strategies (cultural practices, biological control, and chemical control) to achieve effective control of a pest species. BMPs are one IMM tool that tends to be more ecologically friendly than other approaches such as chemical control. In the case of wetlands, BMPs for mosquito control will vary depending on whether the site is actively or passively managed. Managed wetlands hydrology is controlled by the wetland manager, who can alter the timing and speed of the flooding and drawdown to reduce mosquito populations (Kwasny 2004). In contrast, the Project site will be passively managed in the sense that flooding will occur as a result of rainfall accumulation. The active component of the Project (depending on the alternative) will involve pumping water out of the McCormack Williamson Tract and into the Mokelumne River. The BMPs for the Project site must therefore be more preventive in nature through either engineering or preconstruction planning to discourage mosquito breeding sites. This, in turn, should reduce the reliance on insecticides to control mosquito larvae (Metzger 2004).

The Sacramento-Yolo Mosquito and Vector Control District has developed the following IMM guidelines for mosquito management in wetland habitat that may be incorporated into Project construction and maintenance plans, depending on which of the alternatives is finally selected.

Wetland Configuration

- Shorelines may be vacillating, but must not isolate sections from the main body of water that create pockets where mosquitoes would be free of competition and predation.
- Basins should have a high slope index, variable depths, and shallow and deep regions that provide open water zones adjacent to shallow vegetated zones.
- Sufficiently deep areas (2–3 feet) to provide water circulation, generate wave action, and give long-term refuge to mosquitofish and predatory insects when the shallow areas are dry.

Water Quality

- Avoid systems that will result in organic loading. Larger wetland ecosystems that use the above-described configuration are buffered by virtue of their volume from periodic seasonal perturbations such as organic loading.
- Avoid “pulses” of increased organic load to inhibit episodic fluctuation in mosquito population numbers during the months of April–October.
- Avoid the combination of low–dissolved oxygen levels and high organic content. Many mosquito species are particularly adapted to the low oxygen and high organic content of eutrophic wetlands.

Vegetation Management

- Avoid continuous stands of emergent vegetation. These stands generate microhabitats that support mosquito productivity by providing refuge from predation, accumulation and concentration of organic foods, and interference with water circulation and wave action.
- Aquatic vegetation may be maintained in islands surrounded by deeper water. This breaks-up the uniform microhabitat and provides variable physical and biological constraints on the mosquito population.
- Avoid plants that tend to mat the water surface. Promote plants in islands such as bulrush and cattails, which function as substrate for mosquito predators. Plants such as sago pondweed for example, are completely submergent and contribute little to mosquito refuge while providing good predator refuge and even waterfowl food.

Biological Control

- Suppression of mosquitoes in the wetland ecosystem is partially dependent on predation. A diverse habitat may support populations of various predator and parasitic species to help control mosquito populations.
- Moreover, the presence of chemicals associated with predators and parasites within the water column will reduce the attractiveness of the site for mosquito egg laying.
- Predators and parasites can take sizable numbers of mosquitoes, but if conditions support rapid development of mosquitoes, they alone do not have the ability to regulate mosquito productivity.
- Natural predation can be augmented by the addition of predaceous fish such as the mosquitofish.

Aside from the exotic mosquitofish, there are few other known fish species available for mosquito population control. Recent laboratory studies, however, have identified the Sacramento perch (*Archoplites interruptus*) as a more effective predator of mosquito larvae than the mosquitofish (Miller 2005). The Sacramento perch is a native centrarchid that has been extirpated from virtually all of its former habitats in the Sacramento–San Joaquin watershed (Tharratt and McKechnie 1966; Aceituno 1976; Leidy 1984; Gobalet 1995; Moyle 2002). Three hypotheses have been proposed to explain the Sacramento perch decline: habitat destruction, embryo predation, and interspecific competition with exotic centrarchids (Moyle 2002). There has been renewed interest in restocking sites previously inhabited by the Sacramento perch in a several locations in Contra Costa County. Reintroduction of this fish species to the Delta should also be considered, should the stocking prove successful in Contra Costa County. This would suppress mosquitoes as well as contribute to recovery of this important native species.

Mosquito Productivity

- It is critically important to have control of wet times versus dry times in the management of ephemeral wetlands for mosquito suppression. Such wetlands are characteristically unstable and highly productive for a few opportunistic waterfowl game species with the capacity to produce an enormous abundance of mosquitoes.
- Confine flooding to the cooler months of the year. During the late fall and winter months mosquito oviposition (egg laying) is dramatically reduced. For example, *Aedes melanimon*, a common duck club mosquito, does not tolerate water temperatures below 50ºF (Kliewer et al. 1966). Ideal flooding times are between the months of November and April. Irrigation during months outside this time frame must be done in accordance with district guidelines.
- Use colder water sources to dramatically reduce mosquito productivity.

Wetlands Maintenance

- A continual maintenance program must be developed.
- Periodic vegetation management, through harvesting, thinning, discing, or burning, must be performed to maintained open areas.
- Periodic silt and detritus should be removed to maintain a regular depth. The wetlands should have the ability to be filled quickly (3 days) and the shallow areas drained efficiently when necessary.

Chemical Control

- Provisions should be made for the application of *Bacillus thuringiensis* var. *israelensis*, *Bacillus sphaericus*, methoprene, or other EPA-approved pesticides as needed. In an emergency or when adult populations are intolerable, killing adults with EPA-approved insecticides may be required.

Construction-Area Fish Management Program

As part of implementing Project actions, DWR commits to implementing a construction-area fish management program, including environmental training, construction period limits, fish rescue and relocation, and practicable BMPs.

A guidance document, developed in cooperation with DFG, NMFS, and USFWS, will be followed to ensure compliance with Project permits and authorizations, including implementation of BMPs. DWR will implement a clear protocol to identify the responsible Project Environmental Coordinator or Biologist and will develop, in cooperation with fishery resource agencies, a reporting protocol to confirm compliance with practicable BMPs. DWR will designate a biological monitor to monitor on-site compliance with all Project BMPs and unanticipated effects on listed species.

Non-compliance with BMPs will be reported to the Resident Engineer immediately. When non-compliance is reported, the Resident Engineer will implement corrective actions immediately to meet all BMPs; where unanticipated effects on listed species cannot be immediately resolved, the Resident Engineer will stop work that is causing the effect.

Environmental Training

At preconstruction meetings, DWR through its Environmental Coordinator or Biologist will inform field management and construction personnel of the need to avoid and protect resources so that they are aware of their responsibilities and the importance of compliance.

Construction personnel will be educated on the types of sensitive resources located in the Project area and the measures required to avoid these resources. They will attend an environmental training program before groundbreaking activities associated with the Project begin. Material covered in the training program will include environmental rules and regulations for the Project and requirements for limiting activities to the construction right-of-way and avoiding demarcated sensitive resource areas.

Training seminars will be held to educate construction supervisors and managers on:

- the need for resource avoidance and protection,
- construction drawing format and interpretation,
- staking methods to protect resources,
- the construction process,
- roles and responsibilities,
- Project management structure and contacts,

- environmental commitments, and
- emergency procedures.

Construction Period Limits

To reduce the likelihood of adverse effects on migration, spawning and egg incubation, and rearing of resident native, anadromous, and sensitive fish species, in-channel construction, including riverbank and levee construction below the ordinary high water mark (OHWM), would be limited to approved in-water work windows. DWR will coordinate between DFG, EBMUD, NMFS, USFWS, CVRWQCB, and the USACE to determine a mutually approved in-water work window. It is expected that in-water work will be limited to periods when native fish species abundances are low and the potential for environmental effects on sensitive life stages and rare, threatened, or endangered species are minimized (e.g., summer). Any necessary in-water construction outside approved in-water work windows would require previous approval from these agencies.

Fish Stranding Management Plan

Project operation includes the inundation of floodplain habitat and/or the filling of an off-channel detention basin for ecosystem restoration and flood control benefits. Although minor grading of newly created floodplain areas is proposed to ensure positive drainage and minimization of fish stranding, the potential remains for scour holes and other areas to form that could result in the potential for delayed migration or entrapment of fish.

To reduce the likelihood of fish stranding on newly constructed floodplain habitats on McCormack-Williamson Tract and the Grizzly Slough property, and in the proposed Staten Island off-channel detention basin, DWR will submit a fish stranding management plan. This plan, developed prior to Project implementation and in consultation with DFG, EBMUD, NMFS, and USFWS, will include protocols for:

- quantifying the amount of potential stranding area;
- conducting fish stranding surveys to quantify any fish stranding that occurs following receding flood events;
- capturing, handling, transporting, and releasing stranded fish;
- identifying preventive measures and enhancements to eliminate areas that cause substantial fish stranding; and
- reporting results of fish stranding monitoring surveys and remedial actions.

Construction Site Best Management Practices for Fish

The following measures will be implemented to avoid and minimize effects of Project actions on fisheries resources, including listed species and critical habitat:

- limit the duration and extent of in-water work to the minimum necessary to complete the work;
- isolate in-water construction activities using silt curtains or floating booms to minimize the mobilization of suspended sediment and turbidity;
- revegetate areas where removal of vegetation is necessary for temporary access;
- remove cofferdams and other in-channel structures in a manner that minimizes disturbance to downstream flows and water quality;
- contain and decontaminate water behind cofferdams before removing cofferdams;
- discharge water (pumped from an isolated construction area) to an upland area providing overland flow and infiltration before returning to the stream (e.g., sediment basin, dry gravel/sand bar);
- limit the extent of bank and levee armoring to the minimum necessary to protect essential infrastructure;
- preserve large riparian trees and instream large woody material;
- avoid disturbance and removal of aquatic vegetation;
- install RSP and other bank protection features from the banks or from outside the wetted channel to the maximum extent practicable;
- pre-wash RSP and other erosion control and fill materials to remove sediment and other contaminants prior to placement;
- incorporate soil, native vegetation, and large woody material into RSP to the extent practicable; and
- apply bioengineering bank protection techniques whenever feasible and consistent with the specific engineering requirements.

Aviod Disruption of Public Utilities

Prior to dredging, existing above- and belowground utilities crossing the Mokelumne and South Fork Mokelumne Rivers will be identified. Utility lines will be avoided during dredging activities or relocated in coordination with the utility company or service provider. Work will be stopped immediately if an unanticipated conflict with a utility facility were to occur. The affected utility would be contacted immediately to (1) notify it of the conflict, (2) aid in coordinating repairs to the utility, and (3) coordinate to avoid further conflicts in the field.

Chapter 3
Physical Environment

This chapter provides environmental analyses relative to physical parameters of the Project area. Components of this study include a setting discussion, impact analysis criteria, project effects and significance, and applicable mitigation measures. This chapter is organized as follows:

- Section 3.1, Hydrology and Hydraulics;
- Section 3.2, Flood Control and Levee Stability;
- Section 3.3, Geomorphology and Sediment Transport;
- Section 3.4, Water Quality;
- Section 3.5, Water Supply and Management;
- Section 3.6, Groundwater;
- Section 3.7, Geology, Seismicity, Soils, and Mineral Resources;
- Section 3.8, Transportation and Navigation;
- Section 3.9, Air Quality; and
- Section 3.10, Noise.

3.1 Hydrology and Hydraulics

Analysis Summary and Introduction

This section addresses hydrology and hydraulics in the Project area, assessment methods, and potential Project-induced changes in hydraulic parameters, such as flow, velocity, stage, and related variables. The significance and environmental implications of these changes are not discussed in this section, but are addressed in other sections of this report in the context of the resources affected by the changes, most notably Sections 3.2, Flood Control and Levee Stability; 3.3, Geomorphology and Sediment Transport; 3.4, Water Quality; 3.5, Water Supply and Management; 4.1, Vegetation and Wetlands; and 4.2, Fish and Aquatic Ecosystems.

Sources of Information

The following key sources of information were used in the preparation of this section:

- *Advisory Committee Review Draft of The California Water Plan Volume 4—Reference guide*, Climate Change and California Water Resources: A Survey and Summary of the Literature.
- *Analysis of Opportunities for Restoring a Natural Flood Regime on the Cosumnes River Floodplain*, Prepared for The Nature Conservancy by Philip Williams & Associates, May 7, 1997.
- Blake S.H. *An Unsteady Hydraulic Surface Water Model of the Lower Cosumnes River, California, for the Investigation of Floodplain Dynamics*. MS thesis, University of California, Davis, 2001.
- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.
- *Cosumnes Research Group: Final Report, The Influence of Flood Regimes, Vegetative and Geomorphic Structures on the Links between Aquatic and Terrestrial Systems: Applications to CALFED Restoration and Watershed Monitoring Strategies*, California Bay-Delta Authority Ecosystem Restoration Program and National Fish and Wildlife Foundation, 2006.
- *Cosumnes River Task Force Plan*, State Water Resources Control Board, Sloughhouse Resource Conservation District, Natural Resource Conservation Service, June 2002.
- *Draft Environmental Impact Report/Environmental Impact Statement, Freeport Regional Water Project*, U.S. Department of the Interior, Bureau of Reclamation, July 2003.

- *Final Report—Cosumnes River Watershed Inventory and Assessment: Phase II*, Jones & Stokes, September 2003.
- Florsheim J.L. and Mount J. *Changes in lowland floodplain sedimentation processes: pre-disturbance to post-rehabilitation, Cosumnes River, California*. 2003.
- Hammersmark C. T. *Hydrodynamic Modeling and GIS Analysis of the Habitat Potential and Flood Control Benefits of the Restoration of a Leveed Delta Island*. MS thesis, University of California, Davis, 2002.
- *Hydrology Report (2) Low-Frequency Floods in North Delta Region*, California Department of Water Resources, March 1995.
- *Levee System Integrity Program Plan* (Technical Appendix to Final CALFED Programmatic EIR/EIS), CALFED Bay-Delta Program, July 2000.
- *Mokelumne River and Tributaries, California, Reconnaissance Report*, U.S. Army Corps of Engineers, June 1991.
- *Mokelumne River, California 1% Flood at Franklin 1990*, U.S. Army Corps of Engineers, May 1990.
- *North Delta HEC-RAS Model Report*, Prepared for the California Department of Water Resources by MBK Engineers, May 8, 2003.
- *North Delta Sedimentation Study Report*, Prepared for the California Department of Water Resources by Northwest Hydraulic Consultants, March, 2006.
- *Preparing for a Changing Climate*, *The Potential Consequences of Climate Variability and Change, The California Regional Assessment*. Sponsored by the National Science Foundation. Lead Author: Robert Wilkinson Coordinator, California Regional Climate Impacts Assessment, University of California, Santa Barbara, September 2002.
- *Sacramento–San Joaquin Delta California Special Study Hydrology*, U.S. Army Corps of Engineers, February 1992.
- *South Sacramento Streams, Morrison Creek Stream Group, California, Feasibility-Level Hydrology*, U.S. Army Corps of Engineers, July 1996.
- Technical Memorandum: *The Geomorphic Setting, History and Process of the Grizzly Slough Restoration Project Site*. Prepared for the California Department of Water Resource by Philip Williams & Associates, December 1, 2004.
- Technical Memorandum: *Grizzly Slough Hydrology Summary*. Prepared for the California Department of Water Resources by Philip Williams & Associates, September 7, 2004.
- Technical Memorandum—*Cosumnes and Mokelumne Watersheds Design Storm Runoff Analysis*, Prepared for Sacramento County Department of Water Resources by David Ford Consulting, January 2004.

- Technical Memorandum Report: *Progress on Incorporating Climate Change into Planning and Management of California's Water Resources*, Department of Water Resources, July 2006.
- *White Paper on North Delta Improvements*, CALFED Bay-Delta Program, July 2000.

Physical Setting/Affected Environment

Hydrology

Climate

Flows in the North Delta originate from four drainage basins: the Mokelumne River, Cosumnes River, Dry Creek, and Morrison Creek (illustrated in Figure 3.1-1). In general, these basins have a Mediterranean climate, characterized by hot, dry summers and cool, wet winters. Temperatures vary from freezing to over 100ºF. Almost all precipitation falls between October and May; little or no precipitation falls during the summer and early fall.

The Mokelumne River watershed has an average annual rainfall of 15 inches at lower elevations and 60 inches at higher elevations (Bureau of Reclamation 2003). The mean annual rainfall is 44 inches. Roughly 50% of the Mokelumne River basin lies above the snow level (5,000 feet), so snowmelt is a significant contributor. Snow depths range up to 100 inches or more, and densities vary from 35 to 50% (U.S. Army Corps of Engineers 1991).

The Cosumnes River watershed average annual precipitation ranges from 15 inches near the mouth of the river to 50–60 inches in the upper watershed (Jones & Stokes 2003). The mean annual rainfall is 40 inches. Significant snow cover generally only occurs above 5000 feet. As only approximately 16% of the Cosumnes basin is higher than 5000 feet, snowmelt does not contribute significantly to either seasonal runoff or floods (U.S. Army Corps of Engineers 1991).

The Dry Creek watershed mean annual rainfall is 28 inches. Dry Creek basin lies almost entirely below the snow line, so snowmelt does not contribute significantly to either seasonal runoff or floods (U.S. Army Corps of Engineers 1991).

Morrison Creek basin normal annual precipitation ranges from 15.5 inches in the lower Stones Lakes area to 20 inches in the Morrison Creek headwaters (U.S. Army Corps of Engineers 1996). Morrison Creek basin lies almost entirely below the snow line, so snowmelt does not contribute significantly to either seasonal runoff or floods (U.S. Army Corps of Engineers 1991).

Watershed Characteristics

Streams from the contributing basins shown in Figure 3.1-1 originate in the central Sierra Nevada with a total drainage area of approximately 2,000 square miles.

The Mokelumne River watershed drains a total area of 670 square miles. The Mokelumne River has 11 reservoirs with individual capacities exceeding 1,000 acre-feet. Camanche Reservoir is the most important, with a total storage capacity of 431,000 acre-feet and a maximum flood control reservation of 200,000 acre-feet (California Department of Water Resources 1995). The Mokelumne River is the least flashy of the area watersheds, with winter peak flows almost entirely attenuated by large dams. While historically the influence of the Mokelumne River on floodplain processes was probably considerable, its influence is now considered negligible (Philip Williams & Associates 2004b).

Channel conveyance area varies along the Mokelumne River. Near New Hope Landing, the river cross section is approximately 3,000 sf along the North Fork Mokelumne River; the cross section at Millers Ferry Bridge is restricted by levees and the bridge abutments to about 5,800 sf. The North Fork channel is generally restricted by levees to approximately 6,000 sf. Channels along the South Fork Mokelumne River are generally smaller than those along the North Fork. The channel at New Hope Bridge is 6,000 sf in area. For 5 miles or so downstream of the New Hope Landing Bridge, channel areas generally range from 4,000 to 6,000 sf. The channel areas between the North and South Fork (south of Walnut Grove Road) differ in their most restricted area by about 20% (CALFED Bay-Delta Program 2000e).

The Cosumnes River watershed drains a total of 936 square miles (State Water Resources Control Board 2002). Most of the flow in the Cosumnes River and its tributaries results from winter rain, and the annual hydrograph closely follows the pattern of precipitation. Extreme low flows (including dry bed) occur in the lower Cosumnes River in the late summer after long periods without precipitation. There are no significant flood control reservoirs on the Cosumnes River (Jones & Stokes 2003).

The Cosumnes River is a relatively flashy channel with floodflows peaking over a few hours and lasting a few days (Philip Williams & Associates 2004a). The capacity of the main channel of the Cosumnes ranges from 300 to 1,500 cfs from SR 99 to the Mokelumne River confluence. Flows that overtop the main channel banks downstream of SR 99 typically do not return to the river but instead flow toward Franklin Pond, a low area of land between SR 99 and I-5 north and west of the Cosumnes River. In this reach, sand is the dominant bed material, and moderate to dense riparian vegetation consistently covers channel banks (Jones & Stokes 2003).

The Dry Creek watershed drains a total of 320 square miles (California Department of Water Resources 1995). There are no significant flood control reservoirs on Dry Creek. The mainstem Dry Creek channel is wide and shallow; bed and bank materials are composed of silt and clay, with sand being the predominant material at the Cosumnes River confluence. Flood pulses in Dry Creek are slightly flashier than the Cosumnes River. The watershed is smaller, lower in elevation, and steeper in gradient resulting in a faster concentration time for peak flows (Philip Williams & Associates 2004b). Dry Creek is a significant contributor to peak flows on the Cosumnes, generating up to 40% of the magnitude of the Cosumnes River peak flows (Blake 2001).

The Morrison Creek basin drains a total area of about 180 square miles and includes Morrison Creek and its three principal tributaries—Elder, Unionhouse, and Laguna Creeks. The Morrison Creek basin streams are located in Sacramento County southeast of the City of Sacramento and northeast of the Project area and flow generally westward (U.S. Army Corps of Engineers 1996). There are no significant flood control reservoirs on Morrison Creek.

Hydraulics

North Delta area hydraulics is driven by a combination of tidal processes, discharge from the watersheds described above, and several water control structures. Discharge from the Cosumnes River watershed and to a lesser degree the Dry Creek watershed dominate inflow to the study area in the winter and early spring, while the Mokelumne River and Morrison Creek discharge play a larger role in the late spring and summer months (Hammersmark 2002).

Flow and Stage Information

Flows from the Cosumnes River, Dry Creek, and Mokelumne River basins converge just upstream of McCormack-Williamson Tract roughly at Benson’s Ferry and flow around McCormack-Williamson Tract via Lost Slough, Middle Slough, Snodgrass Slough, and the mainstem Mokelumne River. Morrison Creek basin flows converge in the vicinity of Beach-Stone Lakes (North of McCormack-Williamson Tract), flow south through the Beach-Stone Lakes area, and discharge into Snodgrass Slough at Lambert Road. These flows then typically head south through Snodgrass Slough and into the Mokelumne River system near western McCormack-Williamson Tract and Dead Horse Island. Sacramento River flows enter the system through the DCC west of McCormack-Williamson Tract when the DCC gates are open (Operation of the DCC and resultant flow consequences is covered in detail later in this section).

The mainstem Mokelumne River splits into the North and South Forks Mokelumne River at the southernmost tip of McCormack-Williamson Tract near New Hope landing. The North and South Forks Mokelumne River flow south around, and converge at the southwest tip of, Staten Island. There are several backwater sloughs (Beaver, Hog, and Sycamore) connected to the South Fork Mokelumne River. Georgiana Slough flows into the Mokelumne River just south of the North Fork/South Fork confluence. The Mokelumne River terminates in the San Joaquin River south of Bouldin Island.

The Michigan Bar gage is the only long-term reliable flow-gage on the Mokelumne/Cosumnes system below Camanche. Therefore, flow data for the Mokelumne River system are limited, and are available only for Michigan Bar.

Cosumnes River flows at the Michigan Bar gage were reported as high as 45,000 cfs during the February 1986 flood (Philip Williams & Associates 1997). The peak daily flow for the 1997 flood event was 46,958 cfs (Blake 2001). A detailed discussion of floodflow dynamics is included under Hydraulics in Flood Events.

Recent studies conclude that flows among the contributing watersheds are highly correlated. High flows on the Mokelumne River occur coincidently with those of Dry Creek and the Cosumnes River. In turn, all of these flows are also highly correlated with flows from the Sacramento and San Joaquin Rivers (David Ford Consulting 2004).

Figure 3.1-2 shows a key statistical stage-frequency analysis performed for the New Hope gage by the USACE (U.S. Army Corps of Engineers 1992). It is important to note that stage data for this statistical analysis were recorded in part before the Camanche Dam was constructed in 1963. Because Mokelumne River flows contributed significantly to floodflows before the construction of Camanche, the figures in this statistical analysis are very conservative.

Tidal Effects

As mentioned above, tidal conditions play a significant role in North Delta area hydrodynamics. The lowest reach of the Cosumnes River, up to Twin Cities Road, is subject to tidal inundation (Philip Williams & Associates 2004b).

At New Hope, a tidal signal is present in most flow conditions; in large flood events, as in 1997 and 1998, however, the tidal signal is overwhelmed by river discharge. Tidal range in the Mokelumne River is generally about 3 feet. Tidal characteristic indices MHHW, mean high water [MHW], mean tide level [MTL], mean low water [MLW], MLLW reflect the range of expected tidal conditions at a location based upon the period of data the statistics are derived from. These values are calculated from a time series of gage data, and reflect the effect of hydrologic conditions and facility operations. Table 3.1-1 shows published tidal characteristic values calculated by the National Oceanic Service (NOS) of the NOAA from the New Hope gage data for the period of November 1978 to October 1979. The values are shown relative to two different data, MLLW and NGVD 29.

Table 3.1-1. Published Tidal Characteristic Values at New Hope Gage

	Gage (feet) at New Hope, Relative to Datum	
Tidal Index	Mean Lower Low Water	NGVD 29
Mean higher high water	3.08	3.31
Mean high water	2.69	2.92
Mean tide level	1.54	1.77
Mean low water	0.36	0.59
Mean lower low water	0.00	0.23

Water Control Structures

Notable area water control structures include Mokelumne River reservoirs, the DCC, and the Lambert Road structure.

Reservoirs

As discussed under Watershed Characteristics, there are no significant flood control reservoirs on the Morrison Creek, Cosumnes River, or Dry Creek. The upper Mokelumne River has 11 reservoirs with capacities exceeding 1,000 acre-feet. Camanche Reservoir is the most important, with a total storage capacity of 431,000 acre-feet and a maximum flood control reservation of 200,000 acre-feet. The upper Mokelumne River reservoirs operate such that they generally limit outflow from Camanche to a maximum of 5,000 cfs for as long as possible once reservoir inflow at Camanche is more than 5,000 cfs. During the extreme flood event of February 1986, average daily releases from Camanche did not exceed 5,750 cfs. It is estimated that without the flow regulation provided by Camanche and the upstream reservoirs on the Mokelumne River, the recorded peak discharge of 6,060 cfs at Camanche's outlet would have been about 44,000 cfs (California Department of Water Resources 1995)

Delta Cross Channel

The DCC is a federal facility that was constructed in 1951 to improve water conveyance through the Delta. Operation of the structure was later adapted to function for both fisheries and water conveyance concerns. The DCC, about 30 miles south of Sacramento, diverts water from the Sacramento River into eastern Delta channels at Snodgrass Slough when the structure is open. The structure is closed periodically for fisheries concerns. The DCC operates through a schedule mandated by the State Water Board as follows:

- February 1–May 20: Gates are closed.
- May 21–June 15: Gates must be closed for 14 days.
- June 16–October 31: Gates are generally open.
- November 1–January 31: Gates are closed for up to 45 days.

Sacramento River flows do not typically flow through the DCC into the Mokelumne River system in flood events because the DCC is closed once the Sacramento River flows reach 25,000 cfs.

Lambert Road Structure

The Lambert Road structure consists of a bridge and one-way flap gates on Lambert Road, which runs east-west about 9 miles south of Freeport. The Lambert Road structure was built in 1921 for bridge passage and to prevent floodwaters from flowing north into the Stone Lakes area. The elevation of the bridge deck and the approach road on either end of the bridge is about 11 feet (NGVD 29). The one-way flap gates in the bridge structure allow flows to drain from the area north of Lambert Road but prevent backflow into the area. High stages south of the structure can cause floodflows to overtop the structure and flow northward. Overtopping of the Lambert Road structure is discussed further below (California Department of Water Resources 1995).

Hydraulics in Flood Events

North Delta area flood hydraulics is very complex. The varied timing and magnitude of flows from contributing watersheds, along with the complex network of channels, complicate flow patterns, which may change over the course of a single flood event. Factors such as constrictions caused by debris, boats, and levee breaches come into play during flood events. Figure 3.1-3 presents an aerial photograph of the North Delta area taken during the 1986 flood event. The photo shows the flooding of I-5, McCormack-Williamson Tract, Dead Horse Island, Tyler Island, New Hope Tract, Canal Ranch, and Glanville Tract. Also visible is a portion of the Franklin Pond starting east of I-5. Common area flood dynamics are described below followed by a description of the 1986 and 1997 historical flood events.

The Surge Effect

One key area dynamic that contributes significantly to flood damages is the way in which the McCormack-Williamson Tract levee breaches greatly affect other area levees and structures, or what local stakeholders have called the *surge effect*. Floodwaters from the Cosumnes, Dry Creek, and Mokelumne watersheds converge near Benson's Ferry and flow west towards McCormack-Williamson Tract. Restricted channel capacities in this area cause waters to back up adjacent to the east levee of McCormack-Williamson Tract, which acts as a significant control point for floodflows. McCormack-Williamson Tract levees are restricted in elevation by legal agreement, so the eastern levee of McCormack-Williamson Tract historically overtops and the tract fills with water. This causes the downstream levee in southwest McCormack-Williamson Tract to eventually breach, which sends a surge of floodwater down the North and South Forks Mokelumne River. The momentum of this surge, in combination with high flood stages during large events, has caused additional levees failures to occur on Dead Horse Island, New Hope Tract, and Tyler Island. Additionally, the surge knocks boats loose from the local marinas. The boats historically have been reduced to debris and become lodged against the New Hope or Miller Ferry Bridge, further constricting the area. Figures 3.1-4 and 3.1-5 show boats lodged at the New Hope and Miller Ferry Bridges, respectively, during the 1986 flood event. It is believed that metering flows more evenly through McCormack-Williamson Tract in flood events will significantly reduce failures caused in part by this surge effect.

Flow Reversals

Changes in stages and flow magnitudes within the complex network of North Delta area channels cause flow reversals in high events. For instance, Morrison Creek basin flows are contributed from north to south across Lambert Road and down Snodgrass Slough typically early in a flood event; however, as Cosumnes and Mokelumne River flows rise, a backwater effect may overtop the Lambert Road structure and flow may reverse direction from south to north toward Stone Lakes. The time series Figures 3.1-6 through 3.1-9 (data from NETWORK model simulations performed for the 1990 Draft EIR/EIS for the North Delta Program) illustrate this dynamic for the 1986 storm event. This flow reversal dynamic is of particular concern to stakeholders upstream of the Lambert Road structure as backflows over the Lambert Road structure can contribute to flood problems north of Lambert Road. Therefore, this dynamic must be considered carefully in any area flood control solution.

Although infrequent, a backwater effect may also cause flows to reverse over the closed DCC gates into the Sacramento River, as occurred in 1997. In addition, contribution of high flows in Georgiana Slough, a distributary of the Sacramento River that joins the Mokelumne River downstream of Staten Island, may raise stages downstream of Staten Island and cause a substantial backwater effect in the North and South Forks Mokelumne River.

Overflow Areas

There are several significant overflow areas in the North Delta vicinity. Beach Lake and Stone Lakes were originally overflow areas of the Sacramento River. (California Department of Water Resources 1995:p11). Now, the Stone Lakes area north of Lambert Road, along with the adjacent Point Pleasant area, provides about 74,000 acre-feet of overflow storage for Morrison Creek floodflows when water surface elevation reaches 11 feet NGVD 29 at Lambert Road. This is in part attributable to the backflow over Lambert Road described in the previous section. The discharge from the Morrison Creek basin (except that pumped into the Sacramento River) drains from the Beach Lake and North Stone Lake area to south Stone Lakes. This flow is hydraulically controlled by two sets of culverts located south of Hood-Franklin Road during smaller flood events of up to approximately 10 year–period return; but in higher flows, such as the February 1986 flood, the effect of these culverts is diminished by the great volume of water that spreads throughout the system. The Beach-Stone Lakes and Point Pleasant areas also receive floodwaters from the Franklin Pond area farther eastward (described below) when Franklin Pond stages become high enough to drive floodflows north and west through area culverts or when breaches occur.

Franklin Pond includes the area east of Franklin Boulevard, where the Cosumnes River, Dry Creek, and the Mokelumne River converge. This area historically has served as a flood detention area because of coincident high flow levels on the rivers, constricted channels of the lower river, and the effects of tidal conditions in the Delta (Philip Williams & Associates 2004b). Discharge from this area moves with relatively little head loss through the Western Pacific Railroad trestles and under the bridges of Franklin Road and I-5, meeting negligible resistance until it reaches the eastern end of McCormack-Williamson Tract. At this point, because of the limited conveyance capacity of Lost and Middle Sloughs and the Mokelumne River, water is backed up, creating a pond in the broad flood plain north of New Hope Tract. In very large flood events, such as the 1997 event, Franklin Pond backs up water from areas downstream of the Mokelumne-Cosumnes confluence (near McCormack-Williamson Tract) to approximately the 20-ft elevation contour line (NGVD 29) (Philip Williams & Associates 2004a).

Interstate-5 Flooding

Portions of I-5 (including on and off ramps) were inundated during the floods of 1986, 1997, and 1998. Any flooding of I-5 typically coincides with flooding of the Point Pleasant area further north. As shown in Figure 3.1-10, the Western Pacific Railroad embankment (at approximately 18 feet [NGVD 29]) and the

Glanville Tract southeast levee impound Franklin Pond flood waters until the railroad grade or levee is breached or overtopped. Floodwaters can also flow through culverts in the north, but typically these flows do not develop significantly before the railroad or levee is breached or overtopped, contributing much more significant floodflows to the area. The Benson's Ferry gage is located in the lower right section of Figure 3.1-10. Because the hydraulic profile is flat between the railroad grade and Benson's Ferry, stages at Benson's Ferry are a good indicator of whether the railroad grade will be overtopped. Consequently, any stage decreases at Benson's Ferry correspond to reducing the potential of flooding I-5 and adjacent areas such as Point Pleasant.

Description of the 1986 and 1997 Flood Events

1986 Flood Event

This flood event occurred in February of 1986 and is generally acknowledged as the most damaging flood event that occurred in the North Delta area in recent history. Peak flows at Michigan Bar on the Cosumnes reached 41,290 cfs. The hydrograph for the 1986 event at Michigan Bar on the Cosumnes River is shown in Figure 3.1-11. The Cosumnes River is the most significant contributor to flood event flows in the North Delta area because Mokelumne River flows are controlled by upstream reservoirs, the most important being Camanche Reservoir. During the flood of February 1986, average daily releases from Camanche did not exceed 5,750 cfs.

Numerous levee breaches occurred because of the 1986 flood event. According to accounts by local residents reported in the 1995 Hydrology Report on Low Frequency Floods in the North Delta Region, (California Department of Water Resources 1995) the McCormack-Williamson Tract east levee failed at 1:00 PM on February 18, 1986 and McCormack-Williamson Tract filled within 7 hours. It is estimated that the western levee of McCormack-Williamson Tract overtopped pouring flows into Snodgrass Slough at 8:00 PM on February 18, 1986. According to other personal accounts, floodwaters overtopped the Dead Horse Island levee around 8:00 PM on February 18, 1986 and filled Dead Horse Island in less than an hour. In addition, it is estimated that the eastern Tyler Island levee was overtopped after midnight on February 18 and caused a deep breach around 2:00 AM on February 19, 1986. It is estimated that the Western Pacific Railroad embankment adjacent to Glanville Tract failed on February 18 at 1:00 PM. A 1988 Report from USACE indicated that the New Hope Tract levee failed on February 20, 1986 at 7:00 AM resulting in flooding at the town of Thornton.

Islands or Tracts that flooded in the 1986 event include: Glanville Tract, McCormack-Williamson Tract, Dead Horse Island, New Hope Tract (including the town of Thornton), and Tyler Island. Although the 1986 flood event was catastrophic to the Project area, the statistical return interval was not great; the maximum 1986 storm event discharge of 41,290 cfs at Michigan Bar on the Cosumnes corresponds roughly to a 25-year storm. However, as can be seen from the shape of the hydrograph in Figure 3.1-11, the event consisted of two back-to-back high flow periods, and prolonged periods of high stages can contribute greatly to damages. In addition, improvements to area levees following the 1986 event may have prevented damages during the more statistically rare event that occurred in 1997 described below.

1997 Flood Event

This storm event occurred in January of 1997. Peak flows on the Cosumnes River at Michigan Bar reached 92,930 cfs. Figure 3.1-12 shows the flow hydrograph for the event at Michigan Bar on the Cosumnes. The Cosumnes River is the most significant contributor to flood event flows in the North Delta area because Mokelumne River flows are controlled by upstream reservoirs, the most important being Camanche Reservoir. During the flood of January 1997, average daily releases from Camanche were approximately 5,000 cfs.

Several levee breaches occurred because of the 1997 flood event. Information obtained from DWR aerials and conversations with local residents indicates that the McCormack-Williamson Tract East levee overtopped around 2:00 AM on January 3, 1997 and multiple breaches occurred along the southeast levee adjacent to the Mokelumne River around 10:00–10:30 AM on January 3, 1997. Dead Horse Island's east levee breached at 10:30 AM on January 3, 1997. A breach on the Snodgrass Slough side of Dead Horse Island occurred around 7:00 PM on January 3, 1997 and an additional breach along the North Fork Mokelumne River on Dead Horse Island occurred around 8:00 PM on January 3, 1997. The Union Pacific Railroad embankment adjacent to Glanville Tract failed around 2:00–3:00 AM on January 3, 1997 (MBK Engineers 2003).

Islands or Tracts that flooded include Glanville Tract, McCormack-Williamson Tract, and Dead Horse Island. The 1997 storm event in the North Delta is defined as a greater than 200-year storm event on the Cosumnes River at Michigan Bar based on statistical analysis of peak discharge.

Climate Change

Climate change may have a significant effect on the future performance of Project alternatives. Climate is the average state of the atmosphere and the underlying land or water, on time scales of seasons and longer. Literature suggests that climate change is likely to have significant impacts on the hydrological cycle, which in turn will affect many aspects of the California water system. Warmer conditions caused by global warming may influence climate patterns in ways that accentuate the extremes in these naturally occurring phenomena that cause flood and droughts, strong storm events, higher tides, and other impacts.

The average annual U.S. temperature has risen by almost 1ºF (0.6ºC) and precipitation has increased nationally by 5 to 10%. During the last 100 years, sea level has risen at a rate of approximately 1 to 2 mm per year, according to most estimates. Statewide trends in sea level rise are consistent with global trends, in that California over the past century has experienced rises of about 0.5 inch per decade. Mary Roos, former Chief Hydrologist for DWR, notes that "this is consistent with the historical trend reported at the Golden Gate tide station, although it is possible that tectonic movement or settlement has influenced the stages there." These trends are most apparent over the past few decades.

Scientific research predicts that the warming in the twenty-first century will be significantly greater than the twentieth century. Rainfall rates and the frequency of heavy precipitation events are predicted to increase, particularly over the higher latitudes. The Intergovernmental Panel on Climate Change assessment indicates that for the period of 1990 to 2100 surface temperatures (averaged globally) will increase by 1.4 to 5.8ºC relative to 1990, and sea level is projected to rise by 0.09 to 0.88 meters (Intergovernmental Panel on Climate Change 2001). This rise is very likely to be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Additional snow accumulation and melt attributable to climate change are not considered to be an issue as this is a minor contribution to annual runoff within the Project area.

Climate projections provided above are made using general circulation models (GCMs). Studies using models or statistical techniques to achieve higher spatial resolution show that climate change is likely to be highly variable across California, and that local impacts may be much greater than statewide averages would indicate.

The most widely forecasted effects of future sea level rise are inundation, erosion, increased flooding, and saltwater intrusion. Flooding would increase because storm surges would have higher bases to build upon and because rainwater would drain more slowly. Future flood damages will depend on many factors. Among the most important are the rate and style of development on the floodplains, the level and type of flood protection, and the nature of climate-induced changes in hydrological conditions, sea levels, and storm surges.

The changes in the timing or amount of precipitation over the next century are likely to have a greater impact on the ecosystem than changes in temperature because of the projected decrease in summer streamflows and intensified competition for the water supply.

In the North Delta area, the Cosumnes River is the largest contributor to floodflows. The headwaters of the Cosumnes River originate at a relatively low elevation of 7,600 feet in the Sierra Nevada. As a result, rainfall is the primary contributor to the 389 total acre-feet of annual river runoff (California Department of Water Resources 2006) and snowmelt produces approximately 16% of the total runoff. This runoff distribution explains the timing and magnitude of the two distinct flood events commonly observed in the Cosumnes watershed. The first period occurs anywhere from November to February and tends to have larger peak flows. The second period generally occurs from March to May and contains smaller peak flows resulting from snowmelt and groundwater discharges (University of California, Davis 2006).

Potential changes in climate will affect these two distinct flow events especially if temperature increases reach or exceed the 2ºC threshold. According to the DWR document Progress on Incorporating Climate Change into Management of California's Water Resources, "Lower elevation basins such as the Cosumnes may lose their snowpack entirely in drier years." As a result, the two distinct periods of flooding may instead combine into one larger flood event with higher peak flows during the November to February time period. This change in hydrology may also reduce the rate of groundwater recharge, especially at the higher elevations of the watershed.

Currently, the geographic location of the project site moderates the tidal effect evident in the more southwestern reaches of the Delta. However, future sea level rise associated with climate change may slightly increase (1) the tidal effect, (2) the extent of salinity intrusion, and (3) the magnitude of flood events on the Cosumnes river watershed.

Although there is much uncertainty as to the quantitative impacts of climate change, modeling results for the 1997 flood event are taken to reflect extreme event conditions (such as would exist in very conservative climate change impact estimates). The 1997 storm event in the North Delta is defined as a greater than 200-year storm event on the Cosumnes River at Michigan Bar based on statistical analysis of peak discharge.

Assessment Methods

Quantitative assessment of the North Delta Flood Control and Ecosystem Restoration Project alternatives for impact analysis was done using the MIKE 11 hydraulic modeling tool. Although this section provides a brief overview of the approach and results, the modeling effort was extensive and includes much detailed information. Appendix E documents the intricacies of the model engine, model development, calibration, and comparative analysis of simulation results.

Boundary condition data for the Mike11 model was gathered from a number of gages in the North Delta Project area and has been provided by a number of agencies including U.S. Geological Survey (USGS), DWR, EBMUD, and SAFCA. The availability of hydraulic gage data somewhat dictates the boundaries of the North Delta MIKE 11 model domain. As shown in Figure 3.1-13, the model extends upstream to hydraulic gages located at Michigan Bar on the Cosumnes River, Wilton Road on Deer Creek, above Galt on Dry Creek, Woodbridge on the Mokelumne River, and to Lambert Road at the Stone Lakes outfall. To the west, the model includes a short portion of the Sacramento River extending from above the Delta Cross Channel to below the divergence of Georgiana Slough. Downstream boundary conditions include the Mokelumne River at Georgiana Slough, Little Potato Slough downstream of Terminous Tract and the San Joaquin River. A more detailed description of the data types for each gage is provided in Table A-1 in Appendix E.

The Mike 11 model has been calibrated for a range of hydrologic events from large storm events to intermediate and low river flows. This includes simulation of the 1997 and 1986 flood events, and the 1998, 1999, and 2000 intermediate and low flows. Calibrating the Mike11 to a wide range of flows has ensured a robust model and has provided a tool that can easily determine comparative benefits and impacts of the integrated flood control and ecosystem restoration options. In general, high flow–event modeling has been used to evaluate the flood control performance of the integrated flood control and ecosystem restoration options, and low and intermediate flow–event modeling (in addition to high flow–event modeling) has been used to evaluate ecosystem restoration performance of the options.

Project flood control goals, formulated with broad stakeholder input, include that the Project reduce the risk of catastrophic flooding based on the 1997 flood event for stage and the 1986 event for volume. Therefore, Project alternatives were modeled with these historical events. Although Project goals are not tied specifically to the 100-year hydrology, Project alternatives were modeled with the 100-year hydrology for impact analysis.

Stages have been used as the main comparative analysis tool for hydraulics among alternatives for several reasons: 1) Project flood control goals, where quantified, are expressed in terms of stage goals, 2) because the system is tidally influenced, flow values do not correlate well to stage values and therefore stage is a better indicator of whether flooding will occur in this area, 3) there is very little historical flow data available within the Project area to effectively interpret comparative flow results. Maximum stages are reported at the following index points within the model network, which are shown in Figure 3.1-14.

- Benson's Ferry gage on the mainstem Mokelumne River (BF-1)
- Mainstem of the Mokelumne River adjacent to McCormack-Williamson Tract (MR-2)
- Snodgrass Slough at the junction of Middle Slough (SG-3)
- Northern tip of the South Fork Mokelumne River at New Hope Landing (NH-4)
- South Fork Mokelumne River at Beaver Slough (SF-5)
- South Fork Mokelumne River at Hog Slough (SF-6)
- South Fork Mokelumne River at Sycamore Slough (SF-7)
- Miller's Ferry on the North Fork Mokelumne River (NF-8)
- North Fork Mokelumne River (NF-9)
- North Fork Mokelumne River (NF-10)
- Cosumnes River west of Hwy 99 at the McConnell gage location (MC-11)
- Upstream of Twin Cities on the Cosumnes River (TC-12)
- Lambert Road (LR-13)
- Town of Point Pleasant (PP-14)
- South Fork Mokelumne River at Terminous Tract (TT-15)
- Confluence of the North and South Fork Mokelumne Rivers (NS-16)

In addition to analyzing peak stages at the above index points, maximum flow velocities at six key points for each alternative were investigated for the 1986 and 1997 floods. Velocity investigation was done to assess potential flow-related impacts to areas such as channel scour and sedimentation dynamics and fisheries concerns. For the same reason, flow splits were compared between the North and South Forks Mokelumne River for each alternative for the 1986 and 1997 events.

To determine whether flood control options would cause levee failures, river stage criteria were incorporated into the model to simulate a levee failure. Levee failure criteria and application are discussed in more detail in Technical Appendix E. No levee failures occurred during the simulation of alternatives.

In addition to the high flow events described, model runs were performed for 1998-, 1999-, and 2000-year spring hydrologic events. The 1998-, 1999-, and 2000-year events corresponded to roughly a 10-year, 5-year, and 2.5-year return interval, respectively, based on statistical flow analysis at the Michigan Bar gage on the Cosumnes River.

Regulatory Setting and Significance Criteria

Although Project-induced changes in hydraulic parameters, such as flow, velocity, stage, and related variables, are described in this section, their significance and the environmental implications of these changes are not discussed in this section. The regulatory setting and significance of these changes is addressed in other sections of this report in the context of each of the resources affected by the changes.

Project Effects

This section presents baseline and potential Project-induced changes in hydraulic parameters, such as flow, velocity, stage, and related variables. These values are generated from Mike11 modeling. The significance and environmental implications of these changes are not discussed in this section, but are addressed in other sections of this report in the context of the resources affected by the changes, most notably Sections 3.2, Flood Control and Levee Stability, 3.3, Geomorphology and Sediment Transport, 3.4, Water Quality, 3.5, Water Supply and Management, 4.1, Vegetation and Wetlands, and 4.2, Fish and Aquatic Ecosystems.

High-Flow Event Modeling Results

It is important to clarify a simplifying assumption that was made to model high flow events, including the 1986, 1997, and 100-year flood events: Early modeling runs established that there are no appreciable differences between the Group 1 alternatives, 1-A through 1-C, (described in detail in Chapter 2, “Project Description”) with regard to system-wide flood performance. This is because all of the Group 1 alternatives include lowering the east levee on McCormack-Williamson Tract, which is the greatest significant flood performance control in the area, to 8.5 feet (NGVD 29). Therefore, all Group 2 alternatives, 2-A through 2-D, (described in detail in Chapter 2, “Project Description”) were run with Alternative 1-B only and these results were taken as representative of performance of any of the Group 1 alternatives in combination with the modeled

Group 2 alternatives. For example, model results for the 1997 event for Alternative 1-B with Group 2 Alternative 2-A are also taken to be representative of the performance of either 1-A or 1-C coupled with Alternative 2-A for the 1997 event.

Tables 3.1-2, 3.1-3, and 3.1-4 present high flow peak stages at the index points (as shown in Figure 3.1-14) for each combination of the Project alternatives. The numbers shown in parentheses next to the stage values indicate the stage drop for the modeled alternative versus the baseline condition. Tables 3.1-2, 3.1-3, and 3.1-4 present results for the 1986, 1997, and 100-year flood events respectively. In addition to the maximum stages, stage-duration curves for key representative points have been provided for each alternative in Figures 3.1-15 through Figure 3.1-34 for the 1997 event.

Stage changes for Project alternatives are most accurately analyzed comparatively in reference to the “no failures” base case scenarios provided in the tables. In general, Alternative 1-B (which is also representative of 1-A and 1-C) produces stage decreases at Benson’s Ferry for all of the high flow events about 2.5–2.6 feet. Stage results for Alternative 1-B at New Hope remain the same for the 1986 event, decrease by 0.2 feet for the 1997 event, and decrease by 0.1 feet for the 100-year event. Downstream stages generally remain constant or show slight decreases for all high flow events; however, there are slight stage increases at locations on the North Fork Mokelumne River for the 1986 and 1997 events and on the South Fork Mokelumne for the 1986 event only. Stage results for Alternative 1-B at Snodgrass Slough and Lambert Road show stage decreases for all high flow events. The significance of these changes will be discussed in the appropriate resource chapters.

Model results for Group 2 alternatives 2-A through 2-D in combination with Alternative 1-B show stage decreases at Benson’s Ferry in the amount of 3–3.3 feet for the 1986 event, 2.7–3.3 feet for the 1997 event, and 2.7–2.8 feet for the 100-year event. Alternative 2-D/1-B (Group 1 actions with dredging) achieves the greatest stage reduction at Benson’s Ferry for all high flow events.

Model results for Group 2 alternatives 2-A through 2-D in combination with Alternative 1-B show stage decreases at New Hope in the amount of 1.1–2.3 feet for the 1986 event, 1.4–3.1 feet for the 1997 event, and 0.6–1.4 feet for the 100-year event. Alternative 2-A/1-B (Group 1 actions with North Staten detention) achieves the greatest stage reduction at New Hope for all high flow events. Stages at all other index points generally remain constant or decrease for all high flow events, with the exception of slight stage increases that are indicated on the South Fork Mokelumne River for Alternative 2-D/1-B (Group 1 actions with dredging) only. The significance of these changes will be discussed in the appropriate resource chapters.

Table 3.1-5 presents maximum flow velocities at key points for the 1986 and 1997 floods for each combination of alternatives. These results help to assess potential flow-related impacts on areas such as channel scour, sedimentation dynamics, and fisheries concerns. In addition, comparative flow splits between the North and South Forks of the Mokelumne River for each alternative for the

Table 3.1-2. 1986 Hydrology Results

		Peak Stage (ft NGVD 29)						
					Alternative 1-B with Group 2 Alternatives			
Index Point	Location	1986 Flood	1986 No Failures	Alternative 1-B (Base Case)	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	Benson's Ferry	17.8	18.8	16.3 (2.5)1	15.6 (3.2)	15.8 (3.0)	15.8 (3.0)	15.5 (3.3)
MR-2	Mokelumne River	14.4	15.6	13.6 (2.0)	11.6 (4.0)	12.5 (3.1)	12.6 (3.0)	12.1 (3.5)
SG-3	Snodgrass Slough	12.9	15.0	14.3 (0.7)	12.7 (2.3)	13.4 (1.6)	13.5 (1.5)	13.0 (2.0)
NH-4	New Hope	12.5	13.3	13.3 (0)	11.0 (2.3)	12.1 (1.2)	12.2 (1.1)	12.0 (1.3)
SF-5	SF[2] Mokelumne	8.7	9.4	9.3 (0.1)	8.2 (1.2)	8.7 (0.7)	8.3 (1.1)	9.1 (0.3)
SF-6	SF Mokelumne	7.2	7.6	7.6 (0)	7.2 (0.4)	7.3 (0.3)	7.2 (0.4)	7.9 (-0.3)
SF-7	SF Mokelumne	6.9	7.3	7.3 (0)	7.0 (0.3)	7.1 (0.2)	7.0 (0.3)	7.4 (-0.1)
NF-8	NF Mokelumne	11.3	12.5	12.7 (-0.2)	10.8 (1.7)	11.2 (1.3)	11.7 (0.8)	11.5 (1.0)
NF-9	NF Mokelumne	8.4	9.6	9.7 (-0.1)	8.6 (1.0)	8.8 (0.8)	9.1 (0.5)	9.0 (0.6)
NF-10	NF Mokelumne	6.9	7.9	7.9 (0)	7.4 (0.5)	7.5 (0.4)	7.6 (0.3)	7.7 (0.2)
MC-11	McConnell	46.3	46.3	46.3 (0)	46.2 (0.1)	46.2 (0.1)	46.2 (0.1)	46.3 (0)
TC-12	Twin Cities Road	24.9	24.9	24.7 (0.2)	24.6 (0.3)	24.6 (0.3)	24.6 (0.3)	24.7 (0.2)

		Peak Stage (ft NGVD 29)						
					Alternative 1-B with Group 2 Alternatives			
Index Point	Location	1986 Flood	1986 No Failures	Alternative 1-B (Base Case)	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
LR-13	Lambert Road	12.9	15.0	14.3 (0.7)[1]	12.7 (2.3)	13.4 (1.6)	13.5 (1.5)	13.0 (2.0)
PP-14	Point Pleasant	13.5	13.9	13.5 (0.4)	11.2 (2.7)	13.4 (0.5)	13.4 (0.5)	13.4 (0.5)
TT-15	Terminous Tract	6.8	7.1	7.2 (-0.1)	6.9 (0.2)	7.0 (0.1)	7.0 (0.1)	7.2 (-0.1)
NS-16	Confluence of NF and SF	6.8	7.2	7.2 (0)	7.0 (0.2)	7.0 (0.2)	7.0 (0.2)	7.2 (0)
Detention basin volume (ac-ft)					48,300[2]	35,600[3]	32,400[3]	N/A

SF = South Fork Mokelumne River.

NF = North Fork Mokelumne River.

[1] Value in parentheses denotes: stage difference (ft) = Stage for “No Failure” – Stage for “Alternative”; positive value means stage drop.

[2] 10-ft weir height.

[3] 9-ft weir height.

Table 3.1-3. 1997 Flood Hydrology Results

		Peak Stage (ft NGVD 29)						
					Alternative 1-B with Group 2 Alternatives			
Index Point	Location	1997 Flood	1997 No Failures	Alternative 1-B (Base Case)	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	Benson's Ferry	19.2	19.9	17.4 (2.5)[1]	16.8 (3.1)	17.2 (2.7)	17.1 (2.8)	16.6 (3.3)
MR-2	Mokelumne River	16.1	16.9	14.6 (2.3)	12.1 (4.8)	13.3 (3.6)	13.6 (3.3)	12.9 (4.0)
SG-3	Snodgrass Slough	15.0	16.3	15.4 (0.9)	13.9 (2.4)	14.4 (1.9)	14.7 (1.6)	13.8 (2.5)
NH-4	New Hope	14.3	14.5	14.3 (0.2)	11.4 (3.1)	12.7 (1.8)	13.1 (1.4)	12.8 (1.7)
SF-5	SF Mokelumne	9.6	9.7	9.7 (0)	7.9 (1.8)	8.7 (1.0)	8.2 (1.5)	9.3 (0.4)
SF-6	SF Mokelumne	7.2	8.3	7.2 (1.1)	6.4 (1.9)	6.7 (1.6)	6.6 (1.7)	7.6 (0.7)
SF-7	SF Mokelumne	6.7	6.8	6.7 (0.1)	6.2 (0.6)	6.4 (0.4)	6.3 (0.5)	6.9 (-0.1)
NF-8	NF Mokelumne	13.4	13.6	13.6 (0)	11.1 (2.5)	11.5 (2.1)	12.7 (0.9)	12.2 (1.4)
NF-9	NF Mokelumne	9.9	10.0	10.1 (-0.1)	8.4 (1.6)	8.8 (1.2)	9.4 (0.6)	9.2 (0.8)
NF-10	NF Mokelumne	7.7	7.8	7.8 (0)	6.9 (0.9)	7.1 (0.7)	7.4 (0.4)	7.4 (0.4)
MC-11	McConnell	49.8	49.8	49.8 (0)	49.7 (0.1)	49.7 (0.1)	49.7 (0.1)	49.8 (0)
TC-12	Twin Cities Road	25.8	25.8	25.6 (0.2)	25.6 (0.2)	25.6 (0.2)	25.6 (0.2)	25.6 (0.2)
LR-13	Lambert Road	15.0	16.3	15.4 (0.9)	13.9 (2.4)	14.4 (1.9)	14.7 (1.6)	13.8 (2.5)

Table 3.1-3. Continued

Index Point	Location	Peak Stage (ft NGVD 29): 1997 Flood	1997 No Failures	Alternative 1-B (Base Case)	Alternative 1-B with Group 2 Alternatives: Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
PP-14	Point Pleasant	12.5	12.7	12.5 (0.2)	12.3 (0.4)	12.4 (0.3)	12.5 (0.2)	12.5 (0.2)
TT-15	Terminous Tract	6.5	6.5	6.5 (0)	6.0 (0.5)	6.2 (0.3)	6.2 (0.3)	6.6 (-0.1)
NS-16	Confluence of NF and SF	6.7	6.7	6.7 (0)	6.3 (0.4)	6.4 (0.3)	6.5 (0.2)	6.6 (0.1)
Detention basin volume (ac-ft)					36,900[2]	24,800[3]	21,200[3]	N/A

SF = South Fork Mokelumne River.

NF = North Fork Mokelumne River.

[1] Value in parentheses denotes: stage difference (ft) = Stage for "No Failure" – Stage for "Alternative"; positive value means stage drop.

[2] 10-ft weir height.

[3] 9-ft weir height.

Table 3.1-4. 100-year Flood Hydrology Results

Index Point	Location	Peak Stage (ft NGVD 29)					
				Alternative 1-B with Group 2 Alternatives			
		100-year No Failures	Alternative 1-B (Base Case)	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	Benson's Ferry	18.7	16.1 (2.6)[1]	15.9 (2.8)	16.0 (2.7)	16.0 (2.7)	15.7 (3.0)
MR-2	Mokelumne River	15.3	13.0 (2.3)	12.0 (3.3)	12.5 (2.8)	12.6 (2.7)	11.8 (3.5)
SG-3	Snodgrass Slough	14.6	13.8 (0.8)	11.5 (3.1)	13.4 (1.2)	13.5 (1.1)	12.2 (2.4)
NH-4	New Hope	12.9	12.8 (0.1)	11.5 (1.4)	12.2 (0.7)	12.3 (0.6)	11.7 (1.2)
SF-5	SF Mokelumne	8.7	8.5 (0.2)	7.9 (0.8)	8.2 (0.5)	8.1 (0.6)	8.5 (0.2)
SF-6	SF Mokelumne	6.9	6.9 (0)	6.7 (0.2)	6.8 (0.1)	6.8 (0.1)	7.2 (-0.3)
SF-7	SF Mokelumne	6.7	6.7 (0)	6.5 (0.2)	6.6 (0.1)	6.6 (0.1)	6.8 (-0.1)
NF-8	NF Mokelumne	12.1	12.1 (0)	11.2 (0.9)	11.2 (0.9)	11.7 (0.4)	11.2 (0.9)
NF-9	NF Mokelumne	8.9	8.8 (0.1)	8.4 (0.5)	8.5 (0.4)	8.6 (0.3)	8.4 (0.5)
NF-10	NF Mokelumne	7.3	7.3 (0)	7.2 (0.1)	7.3 (0)	7.3 (0)	7.1 (0.2)
MC-11	McConnell	48.0	48.0 (0)	48.0 (0)	48.0 (0)	48.0 (0)	48.0 (0)
TC-12	Twin Cities Road	25.5	25.4 (0.1)	25.4 (0.1)	25.4 (0.1)	25.4 (0.1)	25.4 (0.1)
LR-13	Lambert Road	14.6	13.8 (0.8)	13.1 (1.5)	13.4 (1.2)	13.5 (1.1)	12.5 (2.1)
PP-14	Point Pleasant	11.9	11.8 (0.1)	11.8 (0.1)	11.8 (0.1)	11.8 (0.1)	11.7 (0.2)
TT-15	Terminous Tract	6.5	6.5 (0)	6.4 (0.1)	6.5 (0)	6.5 (0)	6.6 (-0.1)
NS-16	Confluence of NF and SF	6.8	6.8 (0)	6.7 (0.1)	6.7 (0.1)	6.7 (0.1)	6.7 (0.1)
Detention basin volume (ac-ft)				23,400[2]	16,000[3]	16,100[3]	N/A

SF = South Fork Mokelumne River.

NF = North Fork Mokelumne River.

[1] Value in parentheses denotes: stage difference (ft) = Stage for “No Failure” – Stage for “Alternative”; positive value means stage drop.

[2] 10-ft weir height.

[3] 9-ft weir height.

Table 3.1-5 Maximum Velocities (ft/sec) at Key Points for 1986 and 1997 Floods

	1986 Flood						1997 Flood					
			Alternative 1-B with Group 2 Alternatives						Alternative 1-B with Group 2 Alternatives			
Index Point[1]	Actual Flood	No Levee Failure	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D	Actual Flood	No Levee Failure	Alternative 2-A	Alternative 2-B	Alternative 2-C	Alternative 2-D
BF-1	3.20	2.99	3.63	3.61	3.62	3.86	3.02	3.19	3.57	3.40	4.45	3.67
MR-2	4.49	4.61	3.66	3.66	3.65	3.92	5.10	5.10	3.13	3.26	3.12	3.51
NH-4	2.93	2.61	2.61	2.62	2.60	2.24	3.09	2.81	2.81	2.81	2.81	1.91
SF-5	3.91	4.08	3.65	3.94	3.96	4.23	4.82	4.70	4.13	4.47	4.36	4.71
NF-8	5.16	4.86	4.57	5.35	4.83	4.52	5.34	5.37	4.96	5.94	5.24	4.87
NF-9	4.45	4.86	4.57	5.35	4.83	4.52	4.21	4.42	4.06	4.27	4.30	3.95

[1] For Index Point locations, see Figure 3.1-14.

1986 and 1997 events are shown in Figures 3.1-35 and 3.1-36. The significance of the reported velocity and flow split changes will be discussed in the appropriate resource chapters.

Low- and Intermediate-Flow Event Modeling Results

Model runs were performed for year 1998, 1999, and 2000 hydrologic events. The 1998, 1999, and 2000 events corresponded to roughly a 10-year, 5-year, and 2.5-year return interval, respectively, based on statistical flow analysis at the Michigan Bar gage on the Cosumnes River. The results of the low and intermediate flow modeling are presented in a table format similar to the high flow runs. However, because weir elevations on the detention basin elements in Alternatives 2-A through 2-C are set to overtop only in flow events greater than the 1-in-10 year event, only the Group 1 actions and Alternative 2-D have been modeled for the low flow events. In addition, for low and intermediate flow modeling, it cannot be assumed that the Group 1 alternatives are hydraulically neutral, so each of the Group 1 alternatives 1-A, 1-B, and 1-C have been modeled individually. Group 1 alternatives are described in detail in the Project description chapter.

Tables 3.1-6, 3.1-7, and 3.1-8 present peak stages at each of the model index points for each Group 1 Project alternative for the 1998-, 1999-, and 2000-year events, respectively. All Group 1 alternatives produce stage decreases at Benson's Ferry in the amount of 1.2–1.4 feet for the 1998-year event, 1.0–1.2 feet for the 1999-year event, and 0.9 feet for the 2000-year event. Alternative 1-A (Fluvial Process Optimization) achieves the greatest stage reduction at Benson's Ferry for the 1998- and 1999-year events. All Group 1 alternatives achieve the same stage reduction for the 2000-year event.

All Group 1 alternatives achieve a stage reduction of 0.1 feet at New Hope for the 1998-year event. Alternative 1-A (Fluvial Process Optimization) achieves a 0.1 feet stage reduction at New Hope for the 1999-year event, while stage at New Hope remains the same for Alternatives 1-B and 1-C. All Group 1 alternatives achieve a stage reduction of 0.3 feet at New Hope for the 2000-year event.

Stages at all other index points for the 1998-, 1999-, and 2000-year events generally remain constant or show slight decreases for each Group 1 alternative, with the exception of slight stage increases shown on the North Fork Mokelumne River for the 2000-year event for all alternatives. The significance of these changes will be discussed in the appropriate resource chapter.

In addition to the maximum stages, stage-duration curves for key representative points are provided for each alternative in Figures 3.1-37 through Figure 3.1-48 for the 1999-year event. These plots provide a comparison of stage duration with and without the modeled Project alternative. A set of stage hydrographs at each modeled index point for each modeled hydrology can be made available on CD by request. The significance of these changes will be discussed in the appropriate resource chapter.

Table 3.1-6. 1998 Hydrology Results

Index Point	Location	Peak Stage (ft NGVD 29)			
		1998 Flood	Group 1 Alternatives		
			1-A	1-B	1-C
BF-1	Benson's Ferry	15.2	13.8	14.0	14.0
MR-2	Mokelumne River	10.9	8.8	9.2	9.2
SG-3	Snodgrass Slough	10.0	9.8	9.8	9.8
NH-4	New Hope	8.5	8.4	8.4	8.4
SF-5	SF Mokelumne	7.5	7.4	7.4	7.4
SF-6	SF Mokelumne	7.3	7.3	7.3	7.3
SF-7	SF Mokelumne	7.3	7.2	7.2	7.2
NF-8	NF Mokelumne	8.2	8.2	8.1	8.2
NF-9	NF Mokelumne	7.4	7.3	7.3	7.3
NF-10	NF Mokelumne	7.2	7.2	7.2	7.2
MC-11	McConnell	47.3	47.3	47.3	47.3
TC-12	Twin Cities Road	28.3	28.3	28.3	28.3
LR-13	Lambert Road	10.9	10.9	10.9	10.9
PP-14	Point Pleasant	N/A	N/A	N/A	N/A
TT-15	Terminous Tract	7.2	7.2	7.2	7.2
NS-16	Confluence of NF and SF	7.1	7.1	7.1	7.1

SF = South Fork Mokelumne River.
NF = North Fork Mokelumne River.

Table 3.1-7. 1999 Hydrology Results

Index Point	Location	Peak Stage (ft NGVD 29)			
		1999 Flood	Group 1 Alternatives		
			1-A	1-B	1-C
BF-1	Benson's Ferry	14.2	13.0	13.2	13.2
MR-2	Mokelumne River	9.4	6.9	8.0	8.0
SG-3	Snodgrass Slough	7.0	6.9	6.9	6.9
NH-4	New Hope	5.9	5.8	5.9	5.9
SF-5	SF Mokelumne	4.7	4.6	4.7	4.7
SF-6	SF Mokelumne	4.5	4.5	4.5	4.5
SF-7	SF Mokelumne	4.6	4.6	4.6	4.6
NF-8	NF Mokelumne	5.6	5.6	5.6	5.6
NF-9	NF Mokelumne	4.9	4.8	4.9	4.9
NF-10	NF Mokelumne	4.8	4.7	4.8	4.8
MC-11	McConnell	43.1	43.1	43.1	43.1
TC-12	Twin Cities Road	25.8	25.8	25.8	25.8
LR-13	Lambert Road	7.4	7.4	7.4	7.4
PP-14	Point Pleasant	N/A	N/A	N/A	N/A
TT-15	Terminous Tract	4.4	4.4	4.4	4.4
NS-16	Confluence of NF and SF	4.7	4.7	4.7	4.7

SF = South Fork Mokelumne River.
NF = North Fork Mokelumne River.

Table 3.1-8. 2000 Hydrology Results

Index Point	Location	Peak Stage (ft NGVD 29) 2000 Flood	Group 1 Alternatives 1-A	1-B	1-C
BF-1	Benson's Ferry	12.8	11.9	11.9	11.9
MR-2	Mokelumne River	8.9	7.1	8.0	7.9
SG-3	Snodgrass Slough	7.4	7.2	7.2	7.1
NH-4	New Hope	6.5	6.2	6.2	6.2
SF-5	SF Mokelumne	5.9	5.7	5.8	5.8
SF-6	SF Mokelumne	5.7	5.6	5.7	5.7
SF-7	SF Mokelumne	5.6	5.6	5.6	5.6
NF-8	NF Mokelumne	6.2	6.0	6.1	6.0
NF-9	NF Mokelumne	5.8	5.6	5.8	5.7
NF-10	NF Mokelumne	5.5	5.6	5.6	5.6
MC-11	McConnell	41.9	41.9	41.9	41.9
TC-12	Twin Cities Road	24.8	24.8	24.8	24.8
LR-13	Lambert Road	7.9	7.9	7.9	7.9
PP-14	Point Pleasant	N/A	N/A	N/A	N/A
TT-15	Terminous Tract	5.6	5.6	5.6	5.6
NS-16	Confluence of NF and SF	5.5	5.5	5.5	5.5

SF = South Fork Mokelumne River.

NF = North Fork Mokelumne River.

3.2 Flood Control and Levee Stability

Analysis Summary

This chapter summarizes the existing conditions in the Project area relating to flood control and levee stability. Sources consulted are described, and the section assesses the environmental impacts that may result from implementation of each Project alternative.

Implementation of the alternatives results in only one significant flood control and levee stability impact—all alternatives except for Alternative 2-D may result in an increase in seepage potential because of designed increases in flooding frequency on the interior of islands. A monitoring program, which may result in the implementation of relief wells to reduce seepage pressure, is recommended as mitigation to reduce this impact to a less than significant level. All impacts are discussed in detail under Impacts and Mitigation of the Project Alternatives.

Introduction

This section presents the results and the evaluation of the impacts of the alternatives on flood control and levee stability. The section:

- provides a description of existing Project area flood control facilities, including levees and levee maintenance issues;
- evaluates and discusses impacts associated with the proposed Project groups in the Project area; and
- recommends measures to mitigate significant impacts in the Project area.

Sources of Information

The following key sources of information were used in the preparation of this section:

- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.
- Draft EIR/EIS North Delta Program, November 1990 (CALFED Bay-Delta Program 1990).
- Levee System Integrity Program Plan, CALFED Final Programmatic EIS/EIR Technical Appendix, July 2000.
- Sacramento–San Joaquin Delta, California Special Study, Office Report, Basis of Design and Cost Estimates, Department of the Army, U.S. Army Corps of Engineers, November 1992.

Assessment Methods

The methods and assessment approach used to evaluate impacts on flood control and levee stability included the application of quantitative modeling results and qualitative assessments. The assessment methods include:

- comparative-quantitative modeling performed using the Mike11 model; this model has been used to forecast stages and channel velocities for the Project alternatives;
- qualitative levee assessment as described in the Final Programmatic EIS/EIR Technical Appendix (CALFED Bay-Delta Program 2000); and
- assessment of the degree of scour and sedimentation related to flood control and levee stability as described in Section 3.3.

Physical Setting/Affected Environment

Overview of Flood Control

Before reclamation began in the 1850s, the Delta was mostly a large tidal marsh, part of an estuary system that included the San Francisco Bay and Suisun Marsh. During the flood season, the Delta became a great inland lake, and when the floodwaters receded, the network of sloughs and channels reappeared throughout the marsh. Early settlers avoided the Delta because of the high costs of levee construction and laws that forbade ownership of wetlands and seasonally inundated flood lands. The discovery of gold at Sutter's Mill in the foothills of the Sierra Nevada resulted in a large inflow of people. The growing population increased the demand for food. Congress passed the Arkansas Act in 1850, which warranted title of wetlands and flooded lands to private ownership. The higher demand for food and clear ownership laws accelerated land reclamation in the Delta.

In 1861, the State Legislature created the Board of Swamp and Overflowed Land Commissioners to manage reclamation projects. In 1866, the board's authority was transferred to county boards of supervisors. The first reclamation projects began in 1869, when developers constructed 4-foot-high by 12-foot-wide levees on Sherman and Twitchell Islands using the peat soils of the Delta. Since then, levee construction has improved and expanded to 1,100 miles throughout the Delta to protect agricultural and urban lands against flooding.

In the late 1870s, the developers had begun to realize that hand- and horse-powered labor could not maintain the reclaimed Delta islands. Steam-powered dredges began to be used to move the large volume of alluvial soils from the river channels to construct the large levees. These dredges were capable of moving material at about half the cost of hand labor.

The peak of Delta land reclamation was reached with the clamshell-type dredge, still commonly used. Advantages of this machine over its predecessors were versatility, ease of operation, and modest capital and operating costs.

After World War I, the number of operating dredges decreased greatly, as nearly all Delta marshland had been reclaimed. By this time, the Delta had been transformed from a large tidal marsh to the series of improved channels and leveed islands we know today. Approximately 1,100 miles of levee throughout the Delta protect agricultural and urban lands from flooding.

The major factors influencing water stage in the Delta are high flows, high tides, and wind. The highest water stages historically have occurred between the months of December and February. During this period, high runoff combines with high tides and wind-generated waves.

The North Delta study area is highly susceptible to the threat of repeated flooding. High flows from the Mokelumne River, Deer Creek, the Cosumnes River, and the Dry Creek watersheds enter the channels of the North and South Forks Mokelumne River. The restricted channel capacities, high flows, and deteriorating levee system magnify the flooding problem.

Since reclamation, each of the major islands or tracts has flooded at least once. About 100 failures have occurred since the early 1900s. Except for Big Break, Little Franks, and Little Holland Tracts and Little Mandeville, Lower Sherman, and Mildred Islands, flooded islands historically have been restored even when the cost of repairs exceeded the appraised value of the land.

Table 3.2-1 Historical Flooding in the North Delta Study Area since 1900

Flooded Islands	Years Flooded
Andrus Island	1902, 1907, 1909, 1972
Brannan Island	1902, 1904, 1907, 1909, 1972
Canal Ranch Tract	1958
Dead Horse Island	1950, 1955, 1958, 1980, 1986, 1997
Glanville Tract	1986, 1997
McCormack-Williamson Tract	1938, 1950, 1955, 1958, 1964, 1986, 1997
New Hope Tract	1900, 1904, 1907, 1928, 1950, 1955, 1986
Staten Island	1904, 1907
Terminous Tract	1907, 1958
Tyler Island	1904, 1907, 1986
Total Times Flooded (since 1900)	39

Flood Control Facilities

The following flood control elements currently protect the North Delta region:

- Delta levees,
- DCC control gates, and
- Mokelumne reservoirs.

Once the islands were reclaimed and farming operations began, the issue of subsidence quickly became apparent. Land subsidence is defined as a decrease in land-surface elevation. The primary cause of subsidence in the Delta is the aerobic decomposition (oxidation) of peat soils. Other sources of subsidence are wind, compaction, and combustion. As an island subsides, the head difference against the levee increases. This rise in pressure, coupled with the fact that many levees were poorly constructed, increases the probability of levee seepage and failure. Subsidence of the levee occurs as a result of compression of the peat from the load of the levee. The reduced heights of subsided levees lessen flood protection.

Since reclamation, average elevations of Delta islands have gradually lowered, and in some cases, the land surface has subsided by as much as 21 feet. Currently most island elevations in the Delta are below sea level. Much of the North Delta area is below sea level, and portions of Staten Island are subsided to as low as 25 feet below sea level. Figure 3.2-1 shows a schematic of qualitative subsidence in the Delta before the reclamation started and the present condition. More than 1,100 miles of levees in the Delta provide flood protection to the 60 islands and tracts located there.

Delta levees fall into two main categories: project levees and non-project levees. Project levees are part of the Federal Flood Control Project, and are located primarily along the Sacramento River, adjacent sloughs, and the San Joaquin River in the southeast portion of the Delta. These levees, which constitute about 35% of all Delta levees, generally provide higher levels of flood protection. Non-project levees constitute the remaining 65% and are maintained by island landowners or local levee and reclamation districts to varying and generally less stringent standards than project levees. Non-project levees generally have less freeboard, and therefore less protection, against overtopping and are typically less stable. As shown in Figure 3.2-2, the only project levees found in the study area are located along Georgiana Slough.

Although levees are the main means of flood protection in the region, the DCC and the Mokelumne reservoirs can greatly relieve floodflows. The DCC was constructed in 1951, and its operation rules are discussed in the Hydrology and Hydrodynamics section of this document. When Sacramento River flows exceed 25,000 cfs, the DCC gates are closed so as not to allow high Sacramento River flows from entering the North Delta. If high flows are occurring on the Mokelumne River, and river stage is less on the Sacramento River, the gates can be opened to reduce the stages downstream in the North and South Forks of the Mokelumne. This transfers floodwater from the non-project levees of the

Mokelumne River to the Sacramento River, which is protected with project levees. However, per the typical area storm pattern, high flows on the Sacramento River usually coincide with high flows on the Mokelumne and Cosumnes Rivers. Therefore, opportunities to provide relief through the DCC during high storm events are limited. The Sacramento River Flood Control Project (SRFCP) keeps the Sacramento River from flooding the Delta.

The area upstream of the North Delta study area has 11 reservoirs along the Mokelumne River basin with individual capacities exceeding 1,000 acre-feet. While the main purpose of most of these reservoirs is to supply power and water, the Camanche, Salt Springs, and Pardee Reservoirs also provide some flood storage (with more than 200,000 acre-feet of flood control storage).

Although both the DCC and upstream reservoirs provide an active means to reduce floodflows, the majority of the flood protection is still provided by Delta levees. Flows from the Dry Creek, Cosumnes River, and Morrison Creek basins still pass uncontrolled to the North Delta. To maximize the protection provided by the levee system, maintenance, monitoring, and improvement are constantly required, particularly during floods.

Levee Stability

Flooding is the greatest threat to the integrity of the Delta levee system. Levees are threatened by high water stages, seepage, subsidence, and potentially liquefaction (caused by earthquake). In addition, the levees are eroded by floodflows, tidal flows, and wave wash from wind and boat wakes. Most of the levees lack sufficient freeboard during high-water periods. When an island is flooded and its levee degrades, the levees of adjacent islands become more vulnerable to wind-wave erosion created by an increase in fetch.

Levees generally fail by three interrelated mechanisms: overtopping, seepage, and instability. Several other factors can damage levees and eventually contribute to levee failure. These include erosion, seismic movements, burrowing from small mammals, wind and wave action, and dead or decaying roots from levee vegetation.

Levee overtopping (Figure 3.2-3) occurs as the river stage exceeds the minimum levee crest elevation. Reduction in levee heights as a result of subsidence contributes to the possibility of overtopping. Because the landside portions of the levee are typically unprotected, the overflowing water usually erodes the levee, causing a breach. Historically, Delta levees failed mainly because of overtopping. The initial levees built in the Delta stood 4 feet above the ground level. After constant overtopping, it was quickly apparent that the levees would have to be substantially larger in order to impede floodflows. Currently, most levees in the Delta maintain the FEMA Hazard Mitigation Plan (HMP) standard, which calls for 1 foot of freeboard above the known 100-year flood elevation. At present, ground elevations range from –2 feet to 5 feet with levee crest elevations ranging from 15 feet to 18 feet, respectively, on the McCormack-Williamson Tract; and on Staten Island, ground elevations range from –19 feet to –8 feet with levee crest elevations ranging from 8 feet to 14 feet, respectively. Both islands currently meet HMP standard.

Most of the levees throughout the Delta are made up of permeable soils, mainly sand and peat. Whereas earthen dams usually have an impermeable core of clay or concrete to decrease the permeability of the structure, the levees in the Delta have no such core. Water from the river channel is constantly flowing through the levees and into drainage ditches where it is then pumped back into the channel. Because seepage is unavoidable for earthen levees, reduction of seepage and controlling the seepage path are the goals of levee design. The water flowing through a levee, in the form of seepage, can reduce the levee stability if the exit velocity exceeds the soil's resistance to erosion. Internal erosion (piping) is initiated by seepage exiting on the landside of the levee. The erosion progresses back from the landside exit point until a void (pipe) forms in the levee. Presence of animal burrows or channels formed by tree roots expedite the process of piping.

Underseepage occurs when water flows through a loose layer of sand beneath the levee and weakens the levee's foundation. Boils occur when underground water (coming from underseepage) forces its way to the surface to create a bubbling fountain of water and sand.

In addition to the water forces, the stability of a levee depends on its geometry, the strength of its foundation materials, and its internal strength. If used in the proper proportions and engineered correctly, sands, silts, and clays can be used to build stable levees. High percentages of sands or peat within or beneath a levee, however, can weaken its stability. Approximately 380,000 acres, or roughly 50% of Delta lands, consist primarily of peat soils. The high concentration of peat soils in the Delta means that most levees are built on top of a weak foundation. In addition to a weak foundation, the subsidence of peat soils around a levee greatly jeopardizes its stability as discussed previously.

Although no levees in the Delta have been known to fail because of seismic activity, the possibility of that happening is high and of great concern. Because the foundations of Delta levees are largely made up of sand and peat soils, even small amounts of shaking could induce liquefaction and cause levees to fail. The San Andreas Fault system has the greatest potential to affect Delta seismicity. Several other fault systems have the potential to induce liquefaction in the Delta, including: Hayward Fault, Healdsburg-Rogers Creek Fault, Maacama Fault, Coast Range Sierra Nevada Boundary Zone, and Green Valley–Cordelia and Concord Faults. Besides these faults, the region has so-called hidden (or buried) thrust faults, referred to as the Great Valley Faults. Hidden faults do not intersect the earth surface; hence, no rupture is visible; and for that reason, they are not listed in the Alquist-Priolo Earthquake Fault Zone. These faults are capable of generating significant earthquakes. In the past, these faults have generated earthquakes up to a magnitude of 6.6.

Levee Maintenance

While the USACE maintains most of the Delta project levees, the state, local agencies, or landowners must maintain the non-project levees. Currently, two state-funded programs are being implemented to maintain non-project Delta levees—the Delta Levees Subventions program and the Delta Levees Special Projects program.

The Delta Levees Subventions program provides financial assistance to local agencies for the maintenance and rehabilitation of Delta levees. The state reimburses local agencies part of the costs to maintain and improve eligible non-project and project levees. The Delta Levees Special Projects program provides funds to designated local agencies in the Delta for flood control projects and for related habitat mitigation and net long-term habitat improvement projects. Flood control projects consist mainly of levee rehabilitation and repair efforts.

Costs of maintaining and repairing the levee system in the Delta are substantial. Between 1987 and 2001, the average annual cost of levee maintenance for non-project levees in the Delta ranged from $1,000 to $540,000 per levee mile, depending on their conditions (approximate average cost was $21,000). A total of $123 million was spent on levee maintenance throughout this period.

Although the costs to maintain the levees in the Delta are extreme, they are still insufficient. In February of 1986, $17 million in damages was reported on McCormack-Williamson Tract, Dead Horse Island, New Hope Tract, and Tyler Island alone from levee failures. According to DWR estimates, the total emergency cost resulting from levee failures Delta-wide was $97 million between 1980 and 1986.

Regulatory Setting

The following federal, state, and local regulations, laws, and policies are pertinent to flood control and levee stability in the Delta.

Delta Protection Act of 1992

This act declares that the basic goals of the state for the Delta are, among other findings, to improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety.

Safe, Clean, Reliable Water Supply Act

This act declares that the basic goals of the state for the Delta are, among other findings, to protect the integrity of the state's water supply system from catastrophic failure attributable to earthquakes and flooding.

Public Law 84-99 Delta Specific Standard

This federal law specifies, among other findings, minimum standards to which the rehabilitation and construction of levees in the Delta should be constructed.

Section 401 of the Clean Water Act and State Regulations in Title 23 California Code of Regulations

This regulation establishes requirements for all dredging activities for navigable waters of the State of California.

Significance Criteria

The criteria used for determining the significance of an impact on flood control and levee stability are based on the State CEQA Guidelines and professional standards and practices. Impacts on flood control may be considered significant if implementation of an alternative would:

- significantly raise flood stage elevations;
- increase the frequency and duration of inundation of lands; or
- expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee

An impact on the levee system is considered significant if an alternative would substantially increase any of the following:

- seepage,
- levee settlement,
- wind erosion,
- scour,
- sediment deposition, or
- subsidence of land adjacent to levees.

In addition, an impact on the levee system is considered significant if an alternative would substantially decrease any of the following:

- levee stability;
- inspection, maintenance, or repair capabilities;
- current level of levee slope protection;
- emergency response capabilities;
- channel conveyance capacity; or
- the ability of the levees to withstand seismic loading.

Impacts and Mitigation of the Project Alternatives

Potential impacts and recommended mitigation measures are presented for each of the Project alternatives. The Project alternatives and their components are described in detail in Chapter 2.

One of the following CEQA conclusions is stated for each identified impact:

- less than significant;
- significant; less than significant with mitigation incorporated;
- significant and unavoidable; or
- beneficial.

Where possible, the mitigation strategies identified in the August 2000 CALFED Programmatic ROD will be used. CALFED Programmatic Mitigation Strategies are discussed below.

CALFED Programmatic Mitigation Strategies

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of Project-specific actions. The mitigation measures address the short-term, long-term and cumulative effects of the CALFED Program. As indicated in the Summary of Significant Impacts section of the ROD, no significant impact on flood control and levee stability was identified. However, the CALFED programmatic mitigation applicable to flood control was considered during this Project development. These programmatic mitigation measures are numbered as they appear in the ROD. A full listing of CALFED Programmatic Mitigation Measures is included in Appendix E, "Mitigation Measures Adopted in the Record of Decision."

Flood Control and Levee Stability Mitigation

- Improve levees to withstand expected hydraulic forces and seepage.
- Use riprap or another suitable means of slope protection to dissipate wave force.
- Design structures to minimize the loss of channel conveyance at gate structures located in channels.
- Implement flood management measures including dredging, levee maintenance, and snag removal.

Alternative NP: No Project

Under the No Project Alternative, the North Delta Flood Control and Ecosystem Restoration Project would not be implemented and the area would maintain the current level of flood protection. It is highly likely that catastrophic flooding would occur within the 20-year planning horizon that expires in 2025.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

The degradation of the McCormack-Williamson Tract east and southwest levees to function as weirs would increase the frequency of flooding within McCormack-Williamson Tract consistent with the goal of creating quality ecosystem habitat and minimizing the surge of floodwaters through McCormack-Williamson in future flood events. Because the alternative design incorporates protective levees for interior features that would be harmed from more frequent flooding, the alternative would not cause impacts from increasing the frequency of flooding within McCormack-Williamson Tract.

The opening of McCormack-Williamson Tract would provide overall flood control benefits to the area by minimizing the surge of flood waters through the Tract and decreasing stages at Benson's Ferry; however, hydraulic modeling shows that this diversion of flows through McCormack-Williamson Tract can cause slight stage increases (on the order of 0.1 foot) on levees downstream of the tract on the North Fork Mokelumne River. Therefore, this alternative includes downstream levee modification to accommodate increased stages.

Any potential impacts from increased flood stage and frequency are less than significant because the alternative includes features such as habitat-friendly levees and armoring of Dead Horse Island's existing levees in the design.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-2: Increase the Degree or Quantity of Seepage.

Levees in the North Delta area currently have some seepage problems. Opening up McCormack-Williamson Tract to more frequent flooding potentially could cause more seepage in adjacent levees. Frequent inundation would raise the groundwater level beneath the island, which would create a flow gradient toward the adjacent islands/tracts, causing more seepage there. Because the quantity of seepage is uncertain, this impact is considered significant.

Determination of Significance: Significant.

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program. A seepage-monitoring program will be implemented to establish a baseline, provide early detection of seepage problems caused by the Project, and quantify and document seepage impacts as the basis for appropriate mitigation and compensation measures. To the extent that the seepage monitoring indicates impacts attributable to the Project, relief wells will be installed to mitigate such impacts.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

The discussion and evaluation of potential levee settlement impacts are presented below and again in Section 3.7, Seismicity, Soils, and Mineral Resources.

Placement of degraded levee material and/or imported soil for levee construction, reinforcement, or modification in areas with peat soils could result in consolidation of the underlying materials and potentially land subsidence. Fill placed on a peat foundation is known to cause consolidation, and primary consolidation occurs in a short period (a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely; the rate of consolidation decreases with time. Because peat soils are known to underlie the McCormack-Williamson Tract, some subsidence from this alternative is possible.

A reduction in the elevation of the land surface in areas where degraded levee material and/or imported soil would be placed for levee construction, reinforcement, or modification could result in a number of effects, including the potential for increased seepage problems near the levee construction, reinforcement, or modification. Additionally, if the newly constructed, reinforced, or modified levees decrease in elevation because of subsidence, their purpose would be nullified.

The Project design and construction measures take into consideration the land subsidence potential. Subsurface conditions in levee construction, reinforcement, or modification areas would be investigated prior to any disposal activities.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

Opening McCormack-Williamson Tract to increased inundation would increase exposure of interior levees to wind-related wave erosion. The open expanse of water in the interior of McCormack-Williamson Tract would provide a large fetch distance for waves to develop and threaten interior levee slopes with erosion. *Fetch distance* is defined as the effective distance of water over which wind travels without changing direction before it breaks. Therefore, this alternative includes modification of interior levee slopes to address wind-related erosion. Modifications include providing shallow levee slopes and planting appropriate vegetation to aid erosion protection on the levee slopes.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

The discussion and evaluation of potential scour impacts are presented again in Section 3.3, Geomorphology.

Some scouring of the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee may occur. However, the riverside levee slope on the degraded McCormack-Williamson Tract east levee would be overexcavated an additional 30 inches from the crest to 10 feet down the slope, in which RSP would be placed to protect against erosion caused by turbulence in the approaching flow. As such, significant scouring is not anticipated on the degraded McCormack-Williamson Tract east levee. The breach on the Mokelumne River levee would be broken down into two side tiers at elevation 3.5 feet and one central tier at 0 feet NGVD. The lower tier would remain unprotected so that it can scour and eventually form into a natural channel inlet. The side tiers would be planted to protect against erosion and to precipitate colonization of the area by appropriate species. To protect the interface between the breach and the existing levee, 24-inch RSP would be placed to a depth of 30 inches along the exposed 3:1 slope that matches the different grades. A 60-inch launchable RSP toe would be placed in the river channel to prevent undercutting of the RSP. One or more filter layers would be placed under all RSP to prevent scour of the underlying soil. As such, desired and beneficial scouring effects would be achieved through Project design on the breached Mokelumne River levee.

Sediment transport under most flows is expected to be restored when levee degradation, reinforcement, and/or modification is complete. When floodwaters reach the level where they overtop the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee, the energy of the water in the Mokelumne River would decrease slightly as a result, and some minor localized aggradations in the channel of the Mokelumne River downstream of both of these levees could occur. As such, scouring in excess of the current conditions is not anticipated in the channel of the Mokelumne River.

Other than minor scouring of the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee during higher flows, scouring in the channel of the Mokelumne River and elsewhere in the study area is expected to be similar to existing conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

The discussion and evaluation of potential levee settlement impacts are presented again in Section 3.7, Geology, Seismicity, Soils, and Mineral Resources.

Placement of degraded levee material and/or imported soil for levee construction, reinforcement, or modification in areas with peat soils could result in consolidation of the underlying materials and potentially land subsidence. Fill placed on a peat foundation is known to cause consolidation, and primary consolidation occurs in a short period (a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely; the rate of consolidation decreases with time. Because peat soils are known to underlie the McCormack-Williamson Tract, some subsidence from this alternative is possible.

The design and construction measures take into consideration the land subsidence potential. Subsurface conditions in levee construction, reinforcement, or modification areas would be investigated prior to any disposal activities.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-7: Decrease Levee Inspection and Maintenance.

Enhancement of interior levee slopes would include planting with vegetation, which has the potential to decrease inspection capabilities. However, because the enhanced levee slopes include additional cross-section material and would provide better erosion protection through more gradual slopes and erosion-resistant plantings. Overall effect of the alternative is a net benefit with regard to levee maintenance.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

Levees in the Project area are prone to structural failures associated with liquefaction, slumping, and differential settlement. Contributing factors include poor construction, materials, erosion by current and wave action, seepage through or under the levee, rodent burrows, and improper levee repairs. There is a need to ensure the protection of the adjacent levees near the proposed degradation, reinforcement, modification, construction, and breach locations. These provisions have been addressed in Project design by incorporating RSP on existing levees where needed and providing appropriate design specifications for the proposed new levee sections.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-9: Decrease in Levee Stability from Non-Motorized Boating Activities.

Non-motorized boating activities would make portions of the levees more accessible to foot traffic than previously. This could cause direct trampling on the levees and possible dislodging of RSP or other protection, potentially compromising levee integrity. Signage would be enhanced to discourage trespassing on the levee slopes.

Determination of Significance: Less than significant.

Mitigation: None required.

Excavate and Restore Grizzly Slough Property (Optional)

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

The breaching and/or degradation of Grizzly Slough property levees would increase the frequency of flooding in the property from approximately a 2- to 3-year frequency to a 1.5-year frequency consistent with enhancing ecosystem habitat in the property and providing borrow material for other Project components. Because this slightly more frequent interior flooding of the Grizzly Slough property is consistent with Project ecosystem restoration goals, and because the alternative design would incorporate protective berms for interior features as needed, the alternative would not cause impacts from raising flood elevations and increasing the frequency of flooding within Grizzly Slough.

On properties adjacent to Grizzly Slough, water surface elevation changes would be insignificant for any hydrology less frequent than the 2- to 3-year event as the Grizzly Slough property currently inundates at this frequency.

Determination of Significance: Less than significant.

Mitigation: None required as long as the alternative retains the features that minimizes impacts through implementation.

Impact FC-2: Increase the Degree or Quantity of Seepage.

Levees in the Grizzly Slough area currently have some seepage problems. Opening up Grizzly Slough land to more frequent inundation would raise the groundwater level. This would create a flow gradient toward the adjacent islands/tracts, causing more seepage there. Because the quantity of seepage is uncertain, this impact is considered significant.

Determination of Significance: Significant.

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

The discussion and evaluation of potential levee settlement impacts are presented again in Section 3.7, Seismicity, Soils, and Mineral Resources.

This impact is similar to Impact FC-3 under Alternative 1-A. However, the Grizzly Slough Property is above sea level and its soil characteristics prevent significant land subsidence. Furthermore, most of the soil collected from levee breaching and degrading would be relocated to other locations in the Project area. Nonetheless, if collected soil is temporarily placed and stored on the Grizzly Slough Property, subsurface conditions in those areas would be investigated before any storage activities (i.e., a suitability analysis would be performed).

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

Opening the Grizzly Slough property to increased inundation would increase exposure of interior levees to wind-related wave erosion. The open expanse of water in the interior of Grizzly Slough would provide a large fetch distance, the effective distance of water over which wind travels without changing direction before it breaks, for waves to develop and threaten interior levee slopes with erosion. The alternative design includes enhancement/modifications of interior levee slopes where applicable to address wind-related erosion.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

The discussion and evaluation of potential scour impacts are presented again in Section 3.3, Geomorphology.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

The discussion and evaluation of potential impacts of subsidence adjacent to levees are presented again in Section 3.7, Seismicity, Soils, and Mineral Resources. Impacts from the implementation of this alternative would be identical to those under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

Impacts from the implementation of this alternative would be identical to those under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Mokelumne River Dredging (Optional)

Impact FC-10: Temporary Decrease in Flood Control or Levee Stability during Channel Dredging.

This measure involves dredging by hydraulic, clamshell, or dragline technique. Dredging activities could potentially result in effects on levee stability in areas where dredging could encroach on the toe of adjacent levees. If sediment were removed at the base of the levee banks, portions of levees could fail. However, this Project would incorporate a number of design features to protect levees adjacent to dredging activities. First, dredging operations would be limited primarily to locations nearest to the center of the channel so as not to adversely affect the waterside stability of levees. As well, rock slope protection would be enhanced on levees that are especially vulnerable as determined in detailed design plans. Additionally, it is anticipated that dredge spoils would be used in a number of ways, such as providing material for toe berms and other levee reinforcements that will improve levee stability in general. Dredging is expected to be repeated on a roughly 15-year interval.

Any dredging to be performed for this alternative would be restricted to work windows that minimize impacts on fish. Because the applicable dredging work windows coincide with times of the year when lower river flow occurs, there would be no impacts on flood control.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

Implementation of this alternative is similar to Alternative 1-A, but the elevation of the southwest McCormack-Williamson Tract levee would be maintained at an elevation to exclude tidal flows from the Tract. Any tidal action necessary to support ecosystem restoration goals would be provided through use of self-regulating tide-gates. Any potential impacts from increased flood stage and frequency would be less than significant because the alternative has components that would act as mitigating features. No mitigation is required for the alternative as long as the alternative retains the features that minimize impacts through implementation.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-2: Increase the Degree or Quantity of Seepage.

Impacts from the implementation of this alternative would be similar to those under Alternative 1-A. Because Alternative 1-B does not have McCormack-Williamson open to tidal flow as extensively as Alternative 1-A, the potential of seepage impacts is less for Alternative 1-B.

Determination of Significance: Significant.

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

Impacts from the implementation of this alternative would be similar to those under Alternative 1-A. Because Alternative 1-B does not have McCormack-Williamson open to tidal flow as extensively as Alternative 1-A, the potential of wind-related erosion impacts is even less for Alternative 1-B.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

Impacts from the implementation of this alternative would be similar to those under Alternative 1-A. Because Alternative 1-B does not have McCormack-Williamson open to tidal flow as extensively as Alternative 1-A, the potential of scour impacts is even less for Alternative 1-B.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-7: Decrease Levee Inspection and Maintenance.

This impact is the same as described under Alternative 1-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Excavate and Restore Grizzly Slough Property (Optional)

This impact is the same as described under Alternative 1-A.

Mokelumne River Dredging (Optional)

This impact is the same as described under Alternative 1-A.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

Implementation of this alternative is similar to implementation under Alternative 1-B, but this alternative includes construction of a cross-levee in the southwestern interior of McCormack-Williamson Tract to create a subsidence reversal area. Any potential impacts from increased flood stage and frequency would be less than significant because the alternative design includes mitigating features. No mitigation is required for the alternative as long as the alternative retains the features that minimize impacts through implementation.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-2: Increase the Degree or Quantity of Seepage.

Impacts from the implementation of this alternative would be similar to those under Alternative 1-A. Because Alternative 1-C does not have McCormack-Williamson Tract open to tidal flow as extensively as Alternative 1-A, the potential of seepage impacts is less for Alternative 1-C.

Determination of Significance: Significant.

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

Impacts from the implementation of this alternative would be similar to those under Alternative 1-A. Because Alternative 1-C does not have McCormack-Williamson open to tidal flow as extensively as Alternative 1-A, the potential of wind-related erosion impacts is even less for Alternative 1-C.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

Impacts from the implementation of this alternative would be similar to those under Alternative 1-A. Because Alternative 1-C does not have McCormack-Williamson open to tidal flow as extensively as Alternative 1-A, the potential of scour impacts is even less for Alternative 1-C.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-7: Decrease Levee Inspection and Maintenance.

This impact is the same as described under Alternative 1-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Excavate and Restore Grizzly Slough Property (Optional)

This impact is the same as described under Alternative 1-A.

Mokelumne River Dredging (Optional)

This impact is the same as described under Alternative 1-A.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

The detention basin constructed as part of this alternative would provide area flood control benefits by reducing the peak flow events that exceed the 10-year recurrence interval. Because the more frequent flooding of the acreage contained within the footprint of the detention basin is consistent with Project flood control goals, and because the alternative design avoids or incorporates protective levees for interior features that would be harmed from more frequent flooding, the alternative does not cause impacts from flooding in Staten Island.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-2: Increase the Degree or Quantity of Seepage.

Levees in the North Delta area currently have some seepage problems. Detaining floodflows within the proposed Staten Island detention basin could potentially cause more seepage to adjacent levees. For an explanation of increase in seepage, refer to Alternative 1-A.

Determination of Significance: Significant**.**

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

The discussion and evaluation of potential levee settlement impacts are presented again in Section 3.7, Seismicity, Soils, and Mineral Resources.

Placement of degraded levee material and/or imported soil for levee construction and reinforcement in areas with peat soils could result in consolidation of the underlying materials and potentially land subsidence. Fill placed on a peat foundation is known to cause consolidation, and primary consolidation occurs in a short period (a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely; the rate of consolidation decreases with time. This consolidation is a function of the height of fill, the thickness of the peat, and elapsed time. Because peat soils are known to underlie Staten Island, some subsidence from this alternative is possible.

A reduction in the elevation of the land surface in areas where degraded levee material and/or imported soil would be placed for levee construction, reinforcement, or modification could result in a number of effects, including the potential for increased seepage problems near the levee construction, reinforcement, or modification. Additionally, if the newly constructed, reinforced, or modified levees decrease in elevation because of subsidence, their purpose would be nullified.

The Project design and construction measures take into consideration the land subsidence potential. Subsurface conditions in levee construction and reinforcement areas would be investigated before any disposal activities (i.e., a Suitability Analysis would be performed).

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

Detaining a portion of the floodflows in the proposed Staten detention basin would increase exposure of interior levees to wind-related wave erosion. The open expanse of water in the interior of the Staten detention basin would provide a large fetch distance, the effective distance of water over which wind travels without changing direction before it breaks, for waves to develop and threaten interior levee slopes with erosion. Therefore, the alternative design includes enhancement of interior levee slopes to address wind-related wave erosion. Enhancements include placement of additional material to reinforce and layback the slopes, planting of vegetation to dissipate energy and consolidate the soil structure, use of plastic geogrid or natural fiber geotextile fabric, and placement of RSP to protect the soil surface.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

The discussion and evaluation of potential scour impacts are presented again in Section 3.3, Geomorphology.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

The discussion and evaluation of potential levee settlement impacts are presented again in Section 3.7, Seismicity, Soils, and Mineral Resources.

Placement of degraded levee material and/or imported soil for levee construction, reinforcement, or modification in areas with peat soils could result in consolidation of the underlying materials and potentially land subsidence. Fill placed on a peat foundation is known to cause consolidation, and primary consolidation occurs in a short period (a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely; the rate of consolidation decreases with time. Because peat soils are known to underlie Staten Island, some subsidence from this alternative is possible.

The design and construction measures take into consideration the land subsidence potential. Subsurface conditions in levee construction, reinforcement, or modification areas would be investigated prior to any disposal activities.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-7: Decrease Levee Inspection and Maintenance.

This impact is the same as described under Alternative 1-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

Levees in the Project area are prone to structural failures associated with liquefaction, slumping, and differential settlement. Contributing factors include poor construction, materials, erosion by current and wave action, seepage through or under the levee, rodent burrows, and improper levee repairs. The adjacent levees near the proposed degradation, reinforcement, modification, construction, and breach locations need to be protected. These provisions have been addressed in Project design by incorporating RSP on existing levees where needed and providing appropriate design specifications for the proposed new levee sections.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

This impact is the same as described under Alternative 2-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-2: Increase the Degree or Quantity of Seepage.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant**.**

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-7: Decrease Levee Inspection and Maintenance.

This impact is the same as described under Alternative 2-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact FC-1: Raise Flood Elevations and Increase the Frequency of Flooding.

This impact is the same as described under Alternative 2-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-2: Increase the Degree or Quantity of Seepage.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant**.**

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-4: Increase the Degree or Quantity of Wind Erosion.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-5: Increase the Degree or Quantity of Scour.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-7: Decrease Levee Inspection and Maintenance.

This impact is the same as described under Alternative 2-A.

Determination of Significance: No impact.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact FC-2: Increase the Degree or Quantity of Seepage.

Levees in the North Delta area currently experience some seepage problems. When existing riverbed material is removed by dredging, the amount of seepage flow from the river to the island/tract would increase. However, dredging operations could potentially cause more seepage to adjacent levees by exposing highly permeable sand lenses. Therefore, the maximum depth of channel dredging has been set to -20 feet (NGVD 29) to avoid exposing sand lenses.

Determination of Significance: Significant.

Mitigation Measure FC-1: Develop a Seepage-Monitoring Program.

Significance after Mitigation: Less than significant.

Impact FC-3: Increase the Degree or Quantity of Levee Settlement.

Impacts from the implementation of this alternative would be similar to those under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-6: Increase the Degree or Quantity of Subsidence Adjacent to Levees.

Impacts from the implementation of this alternative would be similar to those under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-8: Decrease in Levee Stability from Proposed Construction Activities.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact FC-10: Temporary Decrease in Flood Control or Levee Stability during Channel Dredging.

This alternative involves dredging by hydraulic, clamshell, or dragline technique. Dredging activities could potentially result in effects on levee stability in areas where dredging could encroach on the toe of adjacent levees. If sediment were removed at the base of the levee banks, portions of levees could fail. However, this Project would incorporate a number of design features to protect levees adjacent to dredging activities. First, dredging operations would be limited primarily to locations nearest to the center of the channel so as not to adversely affect the waterside stability of levees. As well, rock slope protection would be enhanced on levees that are especially vulnerable as determined in detailed design plans. Additionally, it is anticipated that dredge spoils would be used in a number of ways, such as providing material for toe berms and other levee reinforcements, that would improve levee stability in general. Dredging is expected to be repeated on a roughly 15-year interval.

Any dredging to be performed for this alternative would be restricted to work windows that minimize impacts on fish. Because the applicable dredging work windows coincide with times of the year when lower river flow occurs, there would be no impacts on flood control.

Determination of Significance: Less than significant.

Mitigation: None required.

3.3 Geomorphology and Sediment Transport

Analysis Summary

This chapter summarizes the existing conditions in the Project area, including summaries of geomorphology and sediment transport. Sources consulted are described, and the section assesses the environmental impacts that may result from implementation of each Project alternative.

Implementation of the alternatives results in only one significant sedimentation or scouring impact—Alternatives 2-A, 2-B, and 2-C may result in an increase in debris accumulation resulting in an increase in sediment accumulation and scouring. All impacts are discussed in detail under Impacts and Mitigation of the Project Alternatives.

Introduction

This section describes the existing environmental conditions and the impacts of the Project on sedimentation and scouring in the Project vicinity. Specifically, it evaluates and discusses the impacts associated with the Project. Significance of impacts is partially determined by using significance criteria set forth in the State CEQA Guidelines. The results of the sediment transport simulations, and consequently most of the geomorphic impacts associated with the Project, are analyzed at a reach-wide level.

Sources of Information

The following key sources of information were used in the preparation of this section:

- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.
- *Historic Sediment Loads in the Sacramento–San Joaquin Delta, California,* Department of Water Resources, October 1994.
- *North Delta Scour Monitoring Program: 1998–2000,* California Department of Water Resources, 2000.
- *Southern Delta Scour Monitoring Program: 1991 and 1992,* California Department of Water Resources, 1993.
- *North Delta Sedimentation Study*, Northwest Hydraulic Consultants, prepared for California Department of Water Resources, March 2006.

- *Tidal and Flood Hydraulic Modeling* (Appendix E), California Department of Water Resources, 2006.
- *Grizzly Slough Restoration Project, Phase 1, A Collection of Memoranda Submitted as Deliverables*, Philip William & Associates, prepared for: California Department of Water Resources and California Bay-Delta Authority, November 11, 2005.

Assessment Methods

Assessment of environmental impacts associated with sedimentation and scour has been accomplished through application of quantitative modeling and pre-Project quantitative and semi-quantitative studies.

The methods and approach used were:

- Quantitative modeling performed using a MIKE11 hydrodynamic model of the North Delta. The model was developed at UCD to evaluate flooding scenarios in the Project area and to assist in the design of flood control and ecological restoration alternatives.
- Quantitative calculations performed using available sediment data, rating curves, and established sediment transport equations. These data were used to estimate a preliminary sediment budget for the Delta. Annual bed loads were established indirectly using the Levi sediment transport equation.
- Quantitative modeling performed using HEC-RAS. This model has been used in estimation of sediment transport capacities of the channels in the Project area under a range of flow conditions, particularly the floods of 1995 and 1997.
- Quantitative modeling performed using an enhanced MIKE11 model originally developed by researchers at the University of California, Davis. The sediment transport modeling capability was added to the MIKE11 model using DHI's ST module. A sediment transport model that extended from upper McCormack-Williamson Tract to the San Joaquin River that could identify and quantify sedimentation rates as well as changes to those rates attributable to proposed flood control and restoration alternatives for the region was developed.
- Semi-quantitative assessment of sedimentation/scour potential based on existing federal and state channel hydraulic design standards and guidelines.

The results of the sediment transport simulations, and consequently most of the geomorphic impacts associated with the Project, are analyzed at a reach-wide level.

Physical Setting/Affected Environment

Geomorphology

This section addresses the geomorphic setting, the geomorphological alterations, the geomorphic history, and the geomorphic Project area of the north Delta region. The Grizzly Slough property is discussed separately at the end of the Physical Setting/Affected Environment section; however, the following discussion is pertinent to the Grizzly Slough property as well.

Geomorphic Setting of the Delta

The Delta covers approximately 738,000 acres (1,153 mi^2) of land area and forms a roughly triangular shape that broadens with distance inland. Most of the Delta is occupied by about 60 large islands or tracts separated by waterways (California Department of Water Resources 1995). Almost all of these areas have been reclaimed for agricultural purposes and lie at or below sea level. Islands and tracts are kept dry by approximately 1,100 miles of levees, and lift pumps are commonly used to lower the local groundwater table to levels acceptable for farming. An overview of Delta geography is provided in the Sacramento-San Joaquin Delta Atlas (California Department of Water Resources 1995).

Water and sediment movement in the Delta involves a complex interaction among tidal fluctuations, inflowing river discharges, and topography. The Delta exhibits mixed semidiurnal tides with two high and two low tides each day. Tidal fluctuations result in changes in water surface elevation and the direction and volume of water and sediment flow in the Delta (Northwest Hydraulic Consultants 2003). Tidal effects are most significant in low freshwater flow conditions, whereas during floods, tidal fluctuations are largely washed out by inflowing freshwater discharges. Rivers flowing into the Delta exhibit a decline in stream power (the amount of geomorphic work a stream can perform) because of the combination of decreasing channel slope and tidal effects.

Geomorphological Alterations of the Delta

Prior to the mid-1800s, the Delta islands consisted of flood basins filled with tules and other marshland vegetation. The islands were separated by channels that were contained by natural levees of low relief that were easily overtopped by flooding episodes. This resulted in sediment deposition and general aggradation of the Delta surface over time. Flooding was essential to the formation of peat soils as the tules died when covered by water, and new growth appeared as the islands drained (Shlemon and Begg 1975). The presence of erosion-resistant clays in the banktoe of the natural levees contributed to the stability and lack of migration of the channels. In some cases, however, flows would concentrate through natural levee breaks and scour new channels through the tidal marsh. This led to a cycle of ongoing change in the alignment and location of channel bifurcations in the Delta. The natural flood basins along the Sacramento and San

Joaquin Rivers provided storage and conveyance during flooding episodes, gradually releasing flows downstream, so that the channels in the Delta region were only moderately taxed by floods (Gilbert 1917).

The present geomorphic state of the north Delta is a function of the intensity of water management in each of the tributary rivers, local farming practices, intra- and inter-Delta water transfers, and an extensive human-made levee system. Today, channel alignments are largely fixed by artificial levees and erosion control measures. Flooding, except when artificial levees break, no longer occurs on most islands and tracts. Instead, flow and sediment remain confined to the existing channel network. Upstream water diversions for municipalities and agriculture reduce the amount of flow entering the Delta and the amount of sediment transported to the Delta. In addition, conveyance of water within and out of the Delta alters flow directions and affects sedimentation and erosion rates and patterns. The levee system in the Delta restricts flow to a network of human-made and natural channels that reduce flood events and inhibit the formation of new soils on the Delta islands.

Historical Geomorphology

Historical changes in the north Delta that have affected channel morphology include land reclamation, levee construction, dredging, hydraulic mining, impoundment of water and sediment by upstream dams and other diversions, and the construction of water diversion facilities and consequent alteration of flow and sedimentation patterns in the Delta. The effects of these changes on channel morphology in the Project area are summarized below:

- Waterways in the Project area are largely confined by levees and able to convey significantly greater flow and sediment discharges than during historical times.
- Historical cross-section data indicate that the majority of waterways in the Project area have experienced some channel incision over the several decades and may be experiencing a net sediment loss over time.
- Water regulation, diversions, and the impoundment of water and sediment by dams has resulted in a decline in the total annual water and sediment outflows to the Delta from the Central Valley, a trend that is expected to continue into the future (Northwest Hydraulic Consultants 2003).
- The construction of large water diversion facilities such as the Delta-Mendota Canal and DCC in 1951 and California Aqueduct in 1973 have altered the traditional flow patterns in the Delta that affect sedimentation. Water and sediment exhibit a more southerly flow in the Delta, somewhat reducing deposition of sediment in the North and Central Delta and increasing deposition of sediment in the South Delta (Northwest Hydraulic Consultants 2003).
- The combination of overgrazing, deforestation, floodplain reclamation, river channelization, and most importantly, hydraulic mining for gold caused large increases in sediment loads in the Delta system. The historical trend

demonstrates a rapid decline of sediment loads in the Delta streams at the beginning of the twentieth century, followed by a gradual, steady increase of sediment loads over the last half a century (Northwest Hydraulic Consultants 2003).

- Historically, some deposition of the solids occurred at locations in the Delta channels where water velocities were low. During high-flow periods, a high percentage of these solids were resuspended and moved downstream toward San Francisco Bay.

For a complete review of the historical geomorphology of the Delta region, refer to Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F).

Project Area Geomorphology

Located in the North Delta, the Project area encompasses McCormack-Williamson Tract, Dead Horse Island, Staten Island, and adjacent waterways. Waterways include the DCC, Snodgrass Slough, and the Mokelumne River, which enters the Delta along the southern boundary of McCormack-Williamson Tract. The Mokelumne River bifurcates into a North and South Fork around Staten Island before rejoining again at the southern end of the island. Snodgrass Slough borders the western edge of McCormack-Williamson Tract and Dead Horse Island and is connected to the Sacramento River via the DCC. This connection to the Sacramento River is an important contributor of fresh water and sediment to the Mokelumne River. The DCC typically operates during low flow conditions in summer and diverts flow from the Sacramento River to the Mokelumne River.

The geomorphology of the North and South Forks of the Mokelumne River is characteristic of Delta waterways. Both channels are bordered by levees that protect agricultural land uses. Channel alignments are preserved by ongoing levee maintenance and instream dredging. The North Fork is generally deeper and has a higher flow capacity that the South Fork. Combined, the North and South Forks have a maximum flow capacity of approximately 40,000 cfs, whereas the 100-year flood requires a capacity of approximately 90,000 cfs (California Department of Water Resources 2005). As a result, islands and tracts in the region are susceptible to flooding during high flows.

Current Sedimentation Regime in the Delta Region

This section describes the river flow characteristics, sediment inputs, flood control and flow conveyance system, sediment budget, sediment assessment for the 1995 and 1997 floods, and long-term sediment transport modeling of the north Delta region.

River Flow Characteristics

Rivers flowing into the Delta convey approximately 50% of the state's annual runoff (California Department of Water Resources 1995). The main rivers are the Sacramento, San Joaquin, Mokelumne, Cosumnes, and Calaveras Rivers. All the major rivers are regulated by dams, except for the Cosumnes River. The Sacramento River is the dominant source of fresh water and sediment to the Delta, accounting for approximately 80% of annual freshwater inflows (Anderson 1994). The San Joaquin River is the second largest contributor, accounting for about 10% of annual freshwater inflows. Outflow from the Delta passes into the San Francisco Bay system and the Pacific Ocean through the Golden Gate.

Sediment Inputs

Most of the sediment supplied to the Delta (between 80% and 85% in an average year) is carried by the Sacramento River, whereas the San Joaquin River and the Mokelumne-Cosumnes River supply only about 10% and 4%, respectively (Northwest Hydraulic Consultants 2003). The remaining sediment enters the system from the Yolo Bypass and from several other smaller tributaries and sloughs.

The sediments transported into the Delta by rivers and the Yolo Bypass include fine sands, silts, and clays. Coarser materials are deposited at points upstream of the Project area. The sands typically are transported in the bed load (i.e., rolling and bouncing along the bottom of the channel bed), while the clays and silts move with the suspended load (materials entrained in the water column). A large proportion of the suspended sediments is transported through the Delta into San Francisco Bay.

Bed load movement of sediments is dependent on the velocity of the water flowing over the sediments; the first movements are rolling in nature. At higher velocities, the sediments may leave the bed for short durations, giving the appearance of jumping along the bottom, a process called saltation. If the velocities become high enough, it is possible for the sediments to be suspended and become part of the suspended load. The higher velocities of a river's flow usually occur farther upstream where bed slopes are steeper. When the river reaches flatter slopes, velocities decrease, causing deposition of some suspended sediments and larger sediments moving with the bed load. Therefore, the sediments are sorted to some extent, with deposited sediment size decreasing as the flow progresses downstream.

The suspended load is made up of generally finer materials moving downstream in the water column. The particles that make up the suspended load are kept from falling by the turbulent motions of the river. As turbulence is reduced, the suspended particles begin to fall out of suspension and are deposited on the bottom of the channel. The smaller particles take longer to fall as they have a lower fall velocity. Because of the slower descent to the bed, the smaller particles are carried farther downstream. In the case of the Delta, deposited sediments are fine sands, silts, and clays. The smaller suspended particles are carried out into the San Francisco Bay system.

Sediment loads entering the Delta are dependent on the spatial and temporal distribution of river inflow. Sediment loads in the San Joaquin River are highest in early to mid-spring during melting of the snowpack. Sediments reaching the Delta from the south are mostly fine sands. It is noteworthy that the sediment load of the San Joaquin River is much smaller than that of the Sacramento River.

Delta Flood Control and Flow Conveyance System

The flow system conveys released reservoir waters from various upstream sources and stormwater runoff through the Delta and into San Francisco Bay. These waters contain dissolved and undissolved solids, both of which are transported through the system. Undissolved solids consist primarily of clay-, silt-, and sand-sized particles. Before construction of the flood control and conveyance system, the natural flow of freshwater runoff from the upstream mountainous regions transported significant quantities of silt and clay particles. Because of the wide expanse and flat terrain of the Delta, these particles would settle and form the sediments of the Delta alluvial plain. During the wet season when the volume of runoff water was much larger, the quantity of suspended and unsuspended solids was significant and included sands and, in some cases, gravels.

The natural processes described above continue today but in a modified manner. Much of the naturally eroded and transported solid particles now settle out in instream water storage reservoirs. A percentage of the fine solids, like silts and clays, still are transported during water releases that enter the system from waterways downstream of the reservoirs. These solids enter the Delta channels, and rather than settling out in the alluvial plain (as occurred before the channels were constructed), they now remain within the leveed channels.

Sediment Budget of the Delta

A preliminary sediment budget for the Delta was estimated by Northwest Hydraulic Consultants (2006) using available sediment data, rating curves, and established sediment transport equations. Annual suspended sediment loads were determined using USGS suspended sediment data collected in 1998 (high-flow year) and 1999 (average-flow year) from the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers, and from the Yolo Bypass, Delta-Mendota Canal, and Suisun Bay. Annual bed loads were established indirectly using the Levi sediment transport equation.

For a complete review of the sediment budget of the Delta region, refer to Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F).

The annual suspended sediment Suspended Sediment

contribution of the Sacramento River was calculated using daily time series data collected at the Freeport sediment gage. Annual suspended sediment yields in the San Joaquin River were calculated using daily data available from the Vernalis gage. Suspended loads passing through the Sacramento Weir to the Yolo Bypass were calculated using daily flow data for the weir and daily suspended sediment concentrations from the Sacramento and Freeport gages. Suspended sediment concentration at the weir was assumed to be 0.78 of the concentrations at Sacramento and Freeport (Porterfield 1980).

Annual suspended loads in Yolo Bypass near Woodland, Cosumnes River at Michigan Bar, Mokelumne River at Woodbridge, and Delta-Mendota Canal near Tracy were estimated using daily flow time series data and sediment rating curves developed from episodic measurements of suspended load. Suspended sediment outflow from the Delta to the Clifton Court Forebay and farther to the California Aqueduct was estimated using daily flow data for the Banks Delta Pumping Plant and a suspended load rating curve obtained for the Delta-Mendota Canal. It was assumed that the suspended sediment concentration at the water intakes was the same for both water export facilities.

Bed Load

The bed load data collected by the USGS in the Sacramento River and in Threemile Slough (Dinehart 2000) are limited in volume and range, which prevents accurate estimation of the bed load yield using the measured data alone. However, these data provide a useful basis for selection of a bed load transport formula most appropriate for the conditions of Delta streams. Because hydraulic data from Delta streams generally, but not always, contain both flow and stage information at a station, and because of the complex and highly sensitive flow behaviors exhibited in the tidally influenced Delta, six bed load transport formulas based on the flow- velocity concept were considered. Of the six, the Levi (1957) formula proved to be most accurate at predicting the bed load of the Sacramento River at Freeport.

The Levi formula was used together with flow and stage data downloaded from the USGS and DWR databases, and bathymetry data from NOAA, USACE, USGS, and DWR. Discrete bed load volumes were calculated at 15-minute to 24-hour intervals, depending on the resolution of the available flow and stage data, and then summed to obtain annual yields.

Annual Sediment Budget Estimate

The Sacramento River system including the Yolo bypass is the primary supplier of sediment to the Delta. The average annual sediment inflow from the Sacramento River system is about 3,530,000 tons. The San Joaquin River system supplies about 400,000 tons of sediment, and the Mokelumne River system supplies 180,000 tons of sediment. Bed load supply is 151,000 tons for the Sacramento River, 79,000 tons for the San Joaquin River, and about 8,000 tons for the Mokelumne River. For these calculations, bed load outflow through the Delta-Mendota Canal and California Aqueduct was ignored.

Although bed load constitutes only 4% to 20% of the total sediment load in the Sacramento, San Joaquin, Mokelumne, and Cosumnes Rivers, bed load transport is believed to be the main factor determining channel evolution (fill and scour of the channel bed) in the Delta (Northwest Hydraulic Consultants 2006). The Sacramento River system is clearly the primary supplier of sediment to the Delta.

On average, an estimated 2,290,000 tons (54%) of the average annual sediment supply to the Delta is transported to Suisun Bay and 730,000 tons (18%) is exported through water export facilities to Delta-Mendota Canal and California Aqueduct. An estimated 1,180,000 tons (28%) of the sediment supplied is deposited in the Delta each year. About 910,000 tons (22%) is dredged for navigation and levee maintenance purposes.

Using the estimates above, a remainder of approximately 270,000 tons (6%) of sediment per year on average would be deposited in the Delta. Based on analyses of cross sections and data published in DWR's Scour Monitoring Programs (California Department of Water Resources 2000, 1993), it appears that the majority of this deposition is occurring in the south Delta rather than in the north. However, additional analysis and data collection are necessary to confirm this apparent trend.

Sedimentation and Scour Assessment for 1995 and 1997 Floods

Sediment transport was calculated for two significant flood events that occurred between 8 March 1995 and 17 March 1995 and between 29 December 1996 and 9 January 1997. Calculations were performed for selected representative cross sections of the streams in the study area, including the Mokelumne River, North Fork Mokelumne River, South Fork Mokelumne River, Dead Horse Cut, Snodgrass Slough, Lost Slough, and Georgiana Slough. The cross sections at which sediment transport was calculated were selected on straight river reaches in the vicinity of the main stream junctions. A few additional cross sections were selected on the streams upstream and downstream of the study area to estimate sediment transport variability along the streams. Cross-section geometry and flow hydraulic data were obtained from the HEC-RAS model.

According to the calculations, net sediment transport capacities in the tidally affected North Delta channels varied from practically zero (Dead Horse Cut) to 25,000 metric tons (Georgiana Slough) during the 1995 flood and up to 56,000 metric tons (North Fork Mokelumne River) during the 1997 flood. Transport capacities vary significantly along the streams, depending on local channel conditions and tributaries supplying or diverting water and sediment. In the Mokelumne River, sediment transport capacity generally increases in the downstream direction. In the North Fork Mokelumne River, transport capacity increases abruptly below Snodgrass Slough. Fairly uniform longitudinal distribution of transport capacity is obtained for the South Fork Mokelumne River and Georgiana Slough. Although some sediment can be transported by tidal flows up and down Dead Horse Cut, net sediment transport here is practically zero. In Snodgrass Slough, transport capacity reduces in the vicinity of Dead Horse Cut and increased at North Fork Mokelumne River. Variable capacity is obtained along Lost Slough.

In most of the channels higher transport capacities are obtained for the extremely high 1997 flood. During this flood, levees were overtopped in some reaches, which resulted in significant volumes of water entering inside areas of islands and tracts. Filling and draining of the floodplain storage areas resulted in complex, atypical streamflow and sediment transport conditions through the North Delta channel network during the 1997 flood event. Therefore, the 1997 flood data are not suitable for sediment budget assessment in some of the North Delta channels. The sediment transport data calculated for the 1995 flood, which was conveyed within the channel boundaries, were used here primarily to identify reaches where significant scour or deposition during high flow events is likely.

Potentially depositional/scour reaches of the North Delta are shown in Figure 19 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F). Based on the sedimentation model, streambed scour is calculated in the following locations:

- Lower Mokelumne River at New Hope Landing,
- Snodgrass Slough between DCC and Dead Horse Cut,
- narrow channel of Snodgrass Slough at North Fork Mokelumne River, and
- at confluence of Snodgrass Slough and North Fork Mokelumne River.

Potential sediment deposition is calculated in the following locations:

- Snodgrass Slough above Delta Cross Channel,
- North Fork Mokelumne River between Dead Horse Cut and the confluence with Snodgrass Slough, and
- North Fork Mokelumne River below Snodgrass Slough.

For a complete review of the sediment budget of the Delta region, refer to Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F).

Long-Term Sediment Transport Modeling

Sedimentation in the streams and channels of the North Delta is controlled by a complex sequence of events and physical processes that occur over vast distances and on a wide range of time scales. Modeling such a system over the long term, in a deterministic sense with confidence, is simply not possible. However, it is possible to develop a simplified model of sediment transport in the Delta by identifying and quantifying some of the significant variables affecting sedimentation, so that trends can be revealed and ultimately predicted.

Northwest Hydraulic Consultants (2006) investigated the long-term sediment dynamics of the study area associated with the Project to better understand the existing system conditions and to evaluate the effects of proposed flood control and restoration alternatives. The analyses were performed using an enhanced MIKE11 model originally developed by researchers at the University of California, Davis. The sediment transport modeling capability was added to the MIKE11 model using the Danish Hydraulic Institute's (DHI) ST module. The goal of the investigation was to develop a sediment transport model that extended from upper McCormack-Williamson Tract to the San Joaquin River that could identify and quantify sedimentation rates as well as changes to those rates attributable to proposed flood control and restoration alternatives for the region.

For a complete review of long-term sediment transport modeling in the Project area, refer to Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F).

Baseline Model and Initial Results

A baseline sediment transport model was originally developed to test the sensitivity of the model setup and to verify the model's results against observed data. A 10-year time interval was chosen as a simulation period for the baseline model so that the length of its results would be of the same order of magnitude as the 7 years of cross-section scour data available through DWR. Because the period of record for the DWR scour data is short, it cannot be used to define long-term erosion or accurately describe depositional trends in the system. However, a reasonable qualitative assessment of the model's performance was completed by comparing modeled predictions to the observed data set.

Figures 24a and 24b of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F) present the mean elevations of specific scour cross sections surveyed by DWR from 1994 to 2001 combined with the mean channel elevations predicted by the model for 2002 to 2012. The location of each cross section in the North Delta study area can be found in Figure 4 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F) (Section 3). The figures demonstrate the reasonable agreement that exists between the observed data and elevations predicted by MIKE11 for channel reaches to the west of I-5.

Examination of Figures 24a and 24b of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F) reveals a rapid initial change in bed elevation in some cross sections at the beginning of the simulation. This is mainly because of start up instabilities in the sedimentation routine as the model establishes an equilibrium state. Near junctions, these exaggerations can be profound, sometimes resulting in large sediment deposits or deep scour holes. However, over time, these initial shocks generally subside. Table 3.3-1, taken from the results of Northwest Hydraulic Consultants' 2004 *North Delta Sedimentation Study Draft Report*, summarizes some of these trends in the Mid-Mokelumne (Mokelumne River along the eastern edge of the McCormack-Williamson Tract), Snodgrass Slough, and the North and South Forks of the Mokelumne.

Table 3.3-1. Summary of Sedimentation Trends in the Project Area

Channel	General trends	Comments
Mid-Mokelumne	Scour at the north end but generally stable.	Upstream scour is likely from lack of sediment in water near I-5, as transport has been essentially turned off in the channels east of the highway. Very little scour occurring at downstream end.
North Fork Mokelumne	Combination of deposition and scour throughout reach. Deposition of 1 to 2 feet in the north and around a foot in the south.	Scour in the upstream reaches has changed into slow deposition by increasing the average sediment grain size of the first 2 miles of the reach. Reach shows signs of both deposition and scour, usually of less than 2 feet.
South Fork Mokelumne	2 feet of scour north of Beaver Slough; 1 to 5 feet of deposition down to Sycamore Slough; then stable.	The model predicts 2 to 3 feet of deposition at the upstream end of the reach. Additional deposition of 1 foot upstream of Hog Slough. Slight scour downstream of Beaver Slough. Downstream end remains unchanged.
Snodgrass Slough	Generally stable with some deposition upstream of the DCC.	As the DCC gates are typically closed during high flow events, Snodgrass gets little sediment input. Model shows some scour just above confluence with North Fork Mokelumne.

Note: Based on Table 6 of Northwest Hydraulic Consultants' 2004 *North Delta Sedimentation Study Draft Report*.

Sensitivity Runs

To evaluate the sensitivity of the baseline model to various parameters, additional model runs were conducted. These included runs designed to determine the model's sensitivity to particle size per reach, the use of multiple grain sizes, and the application of different transport equations. Additional runs were also conducted using the highest 5% and 20% of the representative flood duration curve hydrographs to confirm that sediment transport in the MIKE11 model occurred only within the upper 10% of flows recorded in the historical record. Table 5 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F) lists some of the sensitivity runs performed and comments on the differences noted when comparing the results to the baseline model.

2006 Sediment Transport Modeling of North Delta Project Alternatives

Sediment transport models were developed for five different flood control and ecosystem restoration alternatives proposed by DWR for the North Delta. Each model was created by altering the geometry of an established baseline model to reflect changes associated with a particular Project option. The goal of the modeling was to identify large-scale and long-term sedimentation trends in the study area under existing conditions and to note significant changes in these trends attributable to implementation of each proposed alternative.

Specifically, the Project alternatives that were modeled were Alternative 1-A: Fluvial Process Optimization; Alternative 1-B: Seasonal Floodplain Optimization; Alternative 2-B: West Staten Detention; Alternative 2-C: East Staten Detention; and Alternative 2-D: Dredging and Levee Modifications.

The results of the sediment transport simulations were analyzed at a reach-wide level by defining 11 study reaches (Figure 25 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* [Appendix F]) near McCormack-Williamson Tract, Dead Horse Island, and Staten Island. The sediment volume captured in a study reach was calculated by subtracting the volume of sediment leaving a reach during the simulation from the total volume entering. A positive result indicated a net increase in sediment volume (deposition) in the reach, and a negative result indicated a net export of sediment volume (scour). This approach is useful for assessing sedimentation impacts of Project alternatives and provides a measure of quantifying the change in sedimentation patterns and the potential requirements for dredging and/or scour protection measures. The reach-averaged analysis is also preferred over the analysis of bed level changes at individual cross sections because sedimentation trends in the sub-reaches are more likely to stand out and are less likely to be affected by local instabilities and minor disturbances that may occur at individual cross sections in a sedimentation model (Northwest Hydraulic Consultants 2006).

Analysis of Simulation Results

The following subsections discuss the results of the simulations and describe observed sediment transport trends associated with each Project alternative.

Baseline Condition

The results of the baseline model predict a general trend of sediment deposition near Staten Island, especially in the upper reaches of the North and South Forks of the Mokelumne. Deposition is also predicted in upper Snodgrass Slough and in Dead Horse Cut. The model shows general scour in the Mid-Mokelumne reach adjacent to the McCormack-Williamson Tract and in lower Snodgrass Slough around Dead Horse Island. These sedimentation trends seem reasonable, with erosion occurring in the Mid-Mokelumne reach until the channel trifurcates, increasing the conveyance and encouraging deposition mainly in the South Fork Mokelumne. Farther downstream, in South Fork Mokelumne 4 and 5, sediment transport is very small, and net sediment storage is minor (Figure 25 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* [Appendix F]).

Alternative 1-A: Fluvial Process Optimization

Alternative 1-A includes substantial modifications to the flood control system around McCormack-Williamson Tract. The lowering of the northeastern levee allows floodflows to spill onto the tract and reduces the peak flow in Lost Slough and Snodgrass Slough by one half. The reduction of flow in Lost Slough causes most sediment to drop out early and reduces the deposition predicted to occur in Snodgrass Slough. The levee cut at the upstream end of the Mid-Mokelumne also encourages a substantial amount of flow to leave the channel and enter the tract. The resulting reduction in velocity in the Mid-Mokelumne causes most of the sediment load to drop out in the channel before it reaches the trifurcation. Flow exits the McCormack-Williamson Tract through Dead Horse Cut, which experiences a great increase in scour. The upper sections of both the North Fork and South Forks of the Mokelumne also show increased scour as sediment-starved water from the island reenters the channel system and velocities increase. In the case of the South Fork Mokelumne, the increase in scour continues south through Canal Ranch. Some of this additional sediment load is then deposited in the Brack Tract reach of the Mokelumne. Figure 26 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F) presents a schematic representation of the changes in sedimentation trends as a result of implementation of Alternative 1-A. Sediment transport onto McCormack-Williamson Tract was not evaluated in this study because sedimentation there would be very small and consist of wash load deposits and some suspended sediments rather than bed load (Northwest Hydraulic Consultants 2006).

Alternative 1-B: Seasonal Floodplain Optimization

The sedimentation trends associated with Alternative 1-B were fairly similar to those observed in the baseline model. Because this option would merely capture a portion of the hydrograph peak during very large flood events, the hydraulics of the system would not be significantly altered. The notable exception is the reduction of sediment deposition observed in upper Snodgrass Slough (Figure 26 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* [Appendix F]). This is because of increased sediment capture in Lost Slough upstream of Snodgrass Slough as a portion of the peak discharges are routed through McCormack-Williamson Tract and slough velocities are reduced.

Alternative 2-B: West Staten Detention

Proposed levee setbacks in Alternative 2-B would increase floodflows in the North Fork Mokelumne by widening the upstream section of the channel. The model predicts that, in general, the North Fork Mokelumne would experience additional scour from this increased in flow (Figure 27 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* [Appendix F]). Conversely, the reduction of flow into the South Fork Mokelumne would encourage additional deposition in its upper reaches. Water levels in the North Fork Mokelumne did not reach the elevation of the inlet weir of the flood detention pond, so its effects on sedimentation were not evaluated.

Alternative 2-C: East Staten Detention

In Alternative 2-C, levee setbacks proposed on Staten Island across from New Hope Tract would encourage additional flow to pass through the South Fork Mokelumne. The levee setbacks would decrease local channel velocities near New Hope enough to increase deposition in the upper reach (Figure 27 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study*

[Appendix F]). However, downstream of the setbacks, the increased flows and sediment-starved water would encourage scour of the Canal Ranch reach. The additional sediment load picked up along Canal Ranch would then be deposited near Brack Tract as the river velocities decreased with increasing channel area. Similar to Alternative 2-B, Alternative 2-C simulation did not predict significant flooding of the flood detention pond, and its effects on sedimentation were not evaluated.

Alternative 2-D: Dredging and Levee Modifications

In Alternative 2-D, dredging is proposed for lower Snodgrass Slough, Dead Horse Cut, Mid-Mokelumne, the upper reach of the North Fork Mokelumne near Dead Horse Island, and the upper and mid reaches of the South Fork Mokelumne. It is expected, therefore, that the general trend in these areas would be an increase in deposition or a decrease in scour attributable to lower velocities. This is exactly what the model predicted (Figure 27 of Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* [Appendix F]). Lower Snodgrass and the Mid-Mokelumne reaches show significant reductions in scour over the baseline model. An increase in deposition follows downstream in the upstream reaches of the North and South Forks of the Mokelumne. However, the downstream reach of the South Fork Mokelumne along Canal Ranch shows a significant increase in scour. This is mainly a result of the depositional trend observed upstream, which is responsible for sediment-starved water entering the reach and picking up material. The sediment load collected near Canal Ranch is then deposited just downstream near Brack Tract.

Geomorphology of the Grizzly Slough Property

The Grizzly Slough property is located where the Cosumnes River, Dry Creek and the Mokelumne River converge, and all three watersheds play a role in explaining the historical and current physical processes of the site. The Grizzly Slough property is bounded by Grizzly Slough to the west and northwest; Bear Slough to the northeast and east; and Dry Creek to the South. Grizzly and Bear Sloughs converge at their connection with the Cosumnes River.

Similar to the other portions of the Project area, the Grizzly Slough property has experienced significant geomorphic change in the last 150 years of site history. The Grizzly Slough property formed as a swampy overflow area created primarily by overflow from the Cosumnes River and secondarily by the presence of several small distributary sloughs from Dry Creek. Sediment delivery of mostly fine sediment was frequent. Presently, the Grizzly Slough property is a relatively disconnected abandoned floodplain. Many of the distributary channels have been either obliterated or enlarged and leveed. The contributing watersheds have changed from natural anabranching rivers with wide, dense riparian corridors to deeper, narrower, more single-thread, leveed systems. They deliver coarser sediment at less frequent intervals than the original system.

For a complete description of the geomorphic history and floodplain geomorphology and ecology of the Grizzly Slough property, please refer to

Grizzly Slough Restoration Project, Phase 1, A Collection of Memoranda Submitted as Deliverables (Philip William & Associates 2005).

Regulatory Setting and Significance Criteria

Regulatory Setting

This section describes the federal, state, and local regulations, laws, and policies that pertain to sedimentation and scour in the Delta.

Delta Protection Act of 1992

This act declares that the basic goals of the state for the Delta are, among other findings, to improve flood protection, and therefore to ensure an increased level of public health and safety, by structural and nonstructural means.

Section 401 of the Clean Water Act and State Regulations in Title 23 California Code of Regulations

This regulation establishes requirements for all dredging activities for navigable waters of the State of California.

Code of Federal Regulations, Title 40, Part 131, Water Quality Standards

This regulation establishes requirements for water quality, including activities related to in-channel construction, dredging, and long-term effects resulting in sediment transport and scouring

Significance Criteria

The criteria used for determining the significance of an impact on sedimentation and scour are based on Appendix G of the State CEQA Guidelines (Environmental Checklist) and professional standards and practices. Impacts on sedimentation and scour may be considered significant if implementation of an alternative would:

- substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on or off site; or
- substantially alter the existing drainage pattern of the site or area, including the alteration of the course of a stream or river, or substantially increase the

rate or amount of surface runoff in a manner that would result in flooding on or off site.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of Project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of the CALFED Program.

Applicable CALFED mitigation measures have been incorporated into the Project and are therefore not used to mitigate impacts. A list of those programmatic mitigation measures that were used in the development of the Project follows. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to sedimentation and scour are listed. Because of the inter-relatedness of sedimentation and scouring to physical resources, the mitigation measures are presented based on the relevant primary objective of water quality.

Sedimentation and Scour Mitigation

Water Quality

- Use best construction and drainage management practices to avoid transport of soils and sediments into waterways.
- Use cofferdams to construct levees and channel modifications in isolation from existing waterways.
- Use sediment curtains to contain turbidity plumes during dredging.

Impacts and Mitigation of the Project Alternatives

As mentioned under Assessment Methods, the results of the sediment transport simulations, and consequently most of the geomorphic impacts below, are analyzed at a reach-wide level.

Alternative NP: No Project

The No Project Alternative would not result in any construction-related or operations-related sedimentation or scour impacts associated with Project activities.

Under the No Project Alternative, the Project components described below would not be implemented; changes to the hydrologic regime of the four islands and tracts would not occur, and effects on sedimentation and scour would be similar to those described above under existing conditions. Geomorphic processes would continue as described in the existing conditions analysis, requiring ongoing dredging and erosion control practices to maintain the current levee system, islands, and infrastructure in the Project area. This No Project effect is the same as under existing conditions; therefore, no impact would result.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications.

Construction, degradation, reinforcement, and/or modification of levees would result in local accumulation of sediments during certain construction phases. This impact is considered less than significant because potential effects associated with sediment accumulation and scouring would be avoided by implementing the following CALFED Water Quality mitigation measures:

- use of cofferdams, siltation screens, and turbidity monitoring during construction, reinforcement, and/or modification operations to support operation adjustments, or other methods to reduce the transport of sediments, depending on the method of construction, reinforcement, and/or modification; and
- provisions for passing a 100-year storm flow during construction and protection of levee banks including cofferdam design to allow overtopping, removal of in-channel construction equipment and materials, and temporary placement of erosion control materials, depending on method of construction, reinforcement, and/or modification.

No **further** mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications.

In the channels of the Project area, the degradation, reinforcement, and/or modification of levees is expected to have a minor effect on the patterns of local accumulation of sediments. When floodwaters reach the level where they overtop the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee, however, the velocity and energy of the water in the Mokelumne River would decrease as a result, and localized aggradation in the channel of the Mid-Mokelumne River downstream of both of these areas would occur. Furthermore, some deposition is expected to occur in the Brack Tract reach of the South Fork Mokelumne River.

However, Alternative 1-A is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area.

Furthermore, as described in Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F), the Mokelumne River in the vicinity of the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee currently experiences scour under high flows (as modeled during the 1995 and 1997 flood events and modeled baseline conditions). Localized aggradation in the channel of the Mokelumne River downstream of both the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee as a result of Alternative 1-A would not significantly affect the patterns of local accumulation of sediments because flows lower than the breach elevations would continue to scour away any deposited sediment. Finally, it is unlikely that significant sediment accumulation would occur elsewhere in the Project area: sedimentation in the channel of the Mokelumne River and elsewhere in the Project area is expected to be similar to existing conditions. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Levee Modifications.

On land, very minor sedimentation is expected to occur downstream of the degraded McCormack-Williamson Tract east levee and downstream of the breached Mokelumne River levee (i.e., in a majority of the northern portion of McCormack-Williamson Tract). Degradation and breaching would allow high flows carrying suspended sediment to enter the McCormack-Williamson Tract. Depending on the amount of water that is carried over the degraded levee and the breached levee, the entire McCormack-Williamson Tract has the potential to be temporarily inundated and act as a sediment trap. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited on the McCormack-Williamson Tract. Most of this sediment likely would be deposited in the northern portion of the McCormack-Williamson Tract; however, the extent of sedimentation would depend on the magnitude of the floodwaters. Sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits.

On the lower portion of the McCormack-Williamson Tract, degradation of the McCormack-Williamson Tract southwest levee is expected to create a freshwater tidal marsh environment. With such a low land surface gradient, accumulation of sediment and bioaccretion is expected to occur throughout a significant portion of the lower part of the McCormack-Williamson Tract.

Bioaccretion and sedimentation through flooding, riverine, and tidal processes on the McCormack-Williamson Tract, which rarely experiences these processes, would be beneficial for establishing new vegetation and creating floodplain habitat complexity and diversity. Furthermore, a renewed hydraulic connection to the floodplain of the Mokelumne River would benefit aquatic organisms and help to promote geomorphic diversity on the floodplain. Therefore, this impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications.

In the channels of the Project area, the degradation, reinforcement, and/or modification of levees is expected to have a minor effect on the patterns of local scouring of sediments. Based on general federal channel design standards (U.S. Army Corps of Engineers 2000), impacts on the levees and the channels could occur if channel flow velocities exceed threshold levels of 2 to 6 feet per second (ft/s). This velocity range is generally considered a minimum velocity at which potential scour could occur in various channels, depending on construction type.

Based on information from the *Tidal and Flood Hydraulic Modeling* appendix (Appendix E), maximum velocities for the 1986 flood (actual flood) at the two index points closest to the McCormack-Williamson Tract east levee range from 3.20 to 4.49 ft/s; maximum velocities for the 1986 flood (no levee failure scenario) range from 2.99 to 4.61 ft/s. Maximum velocities for the 1997 flood (actual flood) range from 3.02 to 5.10 ft/s; maximum velocities for the 1997 flood (no levee failure scenario) range from 3.19 to 5.10 ft/s.

Some scouring of the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee may occur. However, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe would protect against potential scour, acting as sacrificial material to extend the levee slope protection. As such, significant scouring is not anticipated on the degraded McCormack-Williamson Tract east levee.

The breach on the Mokelumne River levee would be broken down into two side tiers at elevation 3.5 feet and one central tier at 0 feet NGVD 29. The lower tier would remain unprotected so that it can scour and eventually form into a natural channel inlet. The side tiers would be planted to protect against erosion and to precipitate colonization of the area by appropriate species. To protect the interface between the breach and the existing levee, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe is provided to protect against potential scour, acting as sacrificial material to extend the levee slope protection. A filter layers will be placed under all RSP to prevent scour of the underlying soil. As such, desired and beneficial scouring effects would be achieved through Project design on the breached Mokelumne River levee.

Scouring in channels is expected to cause slightly more significant effects. The resulting reduction in velocity in the Mid-Mokelumne causes most of the sediment load to drop out in the channel before it reaches the trifurcation. According to modeling results (Northwest Hydraulic Consultants 2006), flow exits the McCormack-Williamson Tract through Dead Horse Cut, which experiences a great increase in scour. The upper sections of both the North Fork and South Fork Mokelumne also show increased scour as sediment-starved water from the island reenters the channel system and velocities increase. In the case of the South Fork Mokelumne River, the increase in scour continues south through Canal Ranch.

Other than the scouring described above, scouring in the Project area is expected to be similar to existing conditions. Alternative 1-A is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5a: Increase in Scouring on Land as a Result of Levee Modifications (McCormack-Williamson Tract East Levee).

As described under Impact GEOMORPH-3 under Alternative 1-A, on land, sedimentation is expected to occur downstream of the degraded McCormack-Williamson Tract east levee, and downstream of the breached Mokelumne River levee (i.e., in a majority of the northern portion of McCormack-Williamson Tract) because degradation and breaching would allow high flows carrying suspended sediment to enter the McCormack-Williamson Tract. One area of scouring concern on land is where the degraded McCormack-Williamson Tract east levee initially encounters the land surface on the McCormack-Williamson Tract.

On the landside toe of the degraded McCormack-Williamson Tract east levee, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe is provided to protect against potential scour, acting as sacrificial material to extend the levee slope protection. As such, significant scouring is not anticipated on the landside of the degraded McCormack-Williamson Tract east levee. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5b: Increase in Scouring on Land as a Result of Levee Modifications (Mokelumne River Levee).

Another area of scouring concern on land is where the breached Mokelumne River levee interacts with the land surface of the McCormack-Williamson Tract.

The breach in the Mokelumne River levee is designed so that it can scour and eventually form into a natural channel inlet. The side tiers of the levee will be planted to protect against erosion and to precipitate colonization of the area by appropriate species. Furthermore, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe is provided to protect against potential scour, acting as sacrificial material to extend the levee slope protection. If the elevation of McCormack-Williamson Tract at the breach location is higher than local tide levels, a starter channel would be excavated on the floor of the island for approximately 3,000 linear feet for the degraded section to function as an inlet. These actions would induce localized scour to create a hydraulic connection to the floodplain. This natural channel inlet would be a stable geomorphic feature and be beneficial for reasons described under Impact GEOMORPH-3 under Alternative 1-A. This impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-5c: Increase in Scouring on Land as a Result of Levee Modifications (Dead Horse Island).

Scouring of Dead Horse Island is not a concern because reinforcement of the Dead Horse Island east levee would alleviate any potential for scouring on the island.

This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring.

The presence of constructed, reinforced, and/or modified levees would increase the potential for waterborne debris to accumulate on the upstream side of the levees. Degradation and breaching would allow high flows carrying suspended sediment and possibly debris to enter the McCormack-Williamson Tract. Depending on the amount of water that is carried over the degraded levee and the breached levee, the entire McCormack-Williamson Tract has the potential to be temporarily inundated and act as a sediment and debris trap. Once floodwaters recede, suspended sediment and debris would settle out of the water column and be deposited on the McCormack-Williamson Tract. The extent of sedimentation and debris accumulation would depend on the magnitude of the high flows.

Any debris that passed through or over the levees would be considered beneficial as it would induce localized bioaccretion, sedimentation, and some local scouring, thereby promoting floodplain habitat diversity. This impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-7: Scour and Deposition Associated with Excavation and Restoration of the Grizzly Slough Property.

Presently, the Grizzly Slough property is a relatively disconnected abandoned floodplain. Breaching or degrading portions of levees along the Grizzly Slough property adjacent to Bear and Grizzly Sloughs would increase flood frequency and provide annual connection to the adjacent sloughs. These actions would act to maximize floodplain habitat to benefit fish species that spawn on the floodplain and to reestablish natural floodplain processes, such as scour and deposition. Potential additional work to encourage floodplain processes and maximize floodplain habitat includes excavation and regrading of the floodplain terrace in Grizzly Slough to encourage formation of a secondary channel system.

The levee breach or degradation portions would be performed on the DWR-owned Grizzly Slough property along the northeast and northwest levees adjacent to Bear and Grizzly Sloughs, respectively. The Grizzly Slough breach would be in the vicinity of the DFG mitigation wetlands near the northernmost tip of the Grizzly Slough property. The Bear Slough breach would be located on the western bank of the Bear Slough levee just north of the New Hope Bridge on the eastern edge of the property. Excavation and regrading would occur on the interior of the Grizzly Slough property.

Effects would be similar to those under Impacts GEOMORPH-1 through GEOMORPH-6:

- Construction, degradation, reinforcement, and/or modification of levees would result in local accumulation of sediments during certain construction phases. However, this is considered less than significant because potential effects associated with sediment accumulation and scouring would be avoided by implementing the same precautions as described under Impact GEOMORPH-1.
- When floodwaters reach the level where they overtop the degraded and breached levees, the velocity and energy of the water in the adjacent channels would decrease as a result and localized aggradation would occur. However, Alternative 1-A is not projected to drastically change the sediment characteristics of the Grizzly Slough property to the point that management activities beyond those already implemented in the region would require significant modification.

- On land, very minor sedimentation is expected to occur. Degradation and breaching would allow high flows carrying suspended sediment to enter the Grizzly Slough property. Depending on the amount of water that is carried over the degraded and breached levees, a significant portion of the Grizzly Slough property has the potential to be temporarily inundated and act as a sediment trap. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited. Most of this sediment likely would be deposited in the area near the degraded and breached levees; however, the extent of sedimentation would depend on the magnitude of the floodwaters. Sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits. Bioaccretion and sedimentation through flooding, riverine and tidal processes on the Grizzly Slough property, which rarely experiences these processes, would be beneficial for establishing new vegetation and creating floodplain habitat complexity and diversity. Furthermore, a renewed hydraulic connection to the floodplain would benefit aquatic organisms and help to promote geomorphic diversity on the floodplain. Therefore, this is considered beneficial.

- Some scouring of the degraded and breached levees and on portions of the Grizzly Slough property may occur. However, Alternative 1-A is not projected to drastically change the sediment characteristics of the area to the point that management activities beyond those already implemented in the region would require significant modification. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour.

- The presence of constructed, reinforced, and/or modified levees would increase the potential for waterborne debris to accumulate on the upstream side of the levees. Degradation and breaching would allow high flows carrying suspended sediment and possibly debris to enter the Grizzly Slough property. Depending on the amount of water that is carried over degraded and breached levees, the Grizzly Slough property has the potential to be temporarily inundated and act as a sediment and debris trap. Once floodwaters recede, suspended sediment and debris would settle out of the water column and be deposited on the Grizzly Slough property. The extent of sedimentation and debris accumulation would depend on the magnitude of the high flows. Any debris that passed through or over the levees would be considered beneficial as it would induce localized bioaccretion, sedimentation, and some local scouring, thereby promoting floodplain habitat diversity. This is considered beneficial.

Overall, this impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-8: Increase in Scouring on South Fork Mokelumne River and Associated Increase in Deposition Downstream.

Dredging is proposed in lower Snodgrass Slough, Dead Horse Cut, Mid-Mokelumne River, the upper reach of the North Fork Mokelumne near Dead Horse Island, and the upper and mid reaches of the South Fork Mokelumne River. As such, Snodgrass Slough and the Mid-Mokelumne River reaches likely would experience significant reductions in scour over the baseline model. An increase in deposition likely would occur downstream in the upstream reaches of the North and South Forks of the Mokelumne. However, the downstream reach of the South Fork along Canal Ranch likely would experience a significant increase in scour. This is mainly attributable to the depositional trend observed upstream, which is responsible for sediment-starved water entering the reach and picking up material. The sediment load collected near Canal Ranch would then likely be deposited just downstream near Brack Tract.

Alternative 1-A is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road

- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications.

This impact is similar to Impact GEOMORPH-1 under Alternative 1-A. However, unlike Alternative 1-A, there is no breached Mokelumne River levee as part of this alternative. Accordingly, this impact would involve less of a temporary increase in sediment accumulation and scouring during levee modifications.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications.

This impact is similar, but not as significant in magnitude, to Impact GEOMORPH-2 under Alternative 1-A. When floodwaters reach the level where they overtop the degraded McCormack-Williamson Tract east levee, the velocity and energy of the water in the Mokelumne River would decrease as a result, and localized aggradation in the channel of the Mid-Mokelumne River downstream of this area would occur. Unlike Alternative 1, there is no breached Mokelumne River levee. As such, the predicted deposition in the Mid-Mokelumne River under Alternative 1-B would be smaller in magnitude than under Alternative 1-A.

Alternatives 1-B and 1-C have the least impact on changes to the sediment regime of any of the Project alternatives. These alternatives have the least impact on the hydrodynamics of flood conditions, and hence the least impact on the resultant sedimentation dynamics and are not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would be needed. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area.

Furthermore, as described in Northwest Hydraulic Consultants' 2006 *North Delta Sedimentation Study* (Appendix F), the Mokelumne River in the vicinity of the degraded McCormack-Williamson Tract east levee and the breached Mokelumne River levee currently experiences scour under high flows (as modeled during the 1995 and 1997 flood events and modeled baseline conditions). Localized aggradation in Mid-Mokelumne River downstream of the degraded McCormack-Williamson Tract east levee as a result of Alternative 1-B would not significantly affect the patterns of local accumulation of sediments because flows lower than the breach elevation would continue to scour away any deposited sediment. Finally, it is unlikely that significant sediment accumulation would occur elsewhere in the Project area: sedimentation in the channel of the Mokelumne River and elsewhere in the Project area is expected to be similar to existing conditions. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Levee Modifications.

This impact is similar, but not as significant in magnitude, to Impact GEOMORPH-3 under Alternative 1-A. On land, very minor sedimentation is expected to occur downstream of the degraded McCormack-Williamson Tract east levee (i.e., in the northern portion of McCormack-Williamson Tract). Degradation would allow high flows carrying suspended sediment to enter the McCormack-Williamson Tract. Depending on the amount of water that is carried over the degraded levee and the breached levee, the entire McCormack-Williamson Tract has the potential to be temporarily inundated and act as a sediment trap. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited on the McCormack-Williamson Tract. Most of this sediment likely would be deposited in the northern portion of the McCormack-Williamson Tract; however, the extent of sedimentation would depend on the magnitude of the floodwaters. Sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits.

On the lower portion of the McCormack-Williamson Tract, degradation of the McCormack-Williamson Tract southwest levee is expected to promote accumulation of sediment and bioaccretion. The magnitude of these processes is expected to be smaller than that of Alternative 1-A, as the elevation of the McCormack-Williamson Tract southwest levee would be higher (5.5 feet NGVD 29).

Bioaccretion and sedimentation through flooding, riverine, and tidal processes on the McCormack-Williamson Tract, which rarely experiences these processes, would be beneficial for establishing new vegetation and creating floodplain habitat complexity and diversity. Furthermore, a renewed hydraulic connection to the floodplain of the Mokelumne River would benefit aquatic organisms and help to promote geomorphic diversity on the floodplain. Therefore, this impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications.

In the channels of the Project area, the degradation, reinforcement, and/or modification of levees is expected to have a minor effect on the patterns of local scouring of sediments. Based on general federal channel design standards (U.S. Army Corps of Engineers 2000), impacts on the levees and the channels could occur if channel flow velocities exceed threshold levels of 2 to 6 ft/s. This velocity range is generally considered a minimum velocity at which potential scour could occur in various channels, depending on construction type.

Based on information from the *Tidal and Flood Hydraulic Modeling* appendix (Appendix E), maximum velocities for the 1986 flood (actual flood) at the two index points closest to the McCormack-Williamson Tract east levee range from 3.20 to 4.49 ft/s; maximum velocities for the 1986 flood (no levee failure scenario) range from 2.99 to 4.61 ft/s. Maximum velocities for the 1997 flood (actual flood) range from 3.02 to 5.10 ft/s; maximum velocities for the 1997 flood (no levee failure scenario) range from 3.19 to 5.10 ft/s.

Some scouring of the degraded McCormack-Williamson Tract east levee may occur. However, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe is provided to protect against potential scour, acting as sacrificial material to extend the levee slope protection. As such, significant scouring is not anticipated on the degraded McCormack-Williamson Tract east levee.

Scouring in channels is also expected to be minimal. The notable exception is the reduction of sediment deposition observed in upper Snodgrass Slough (Northwest Hydraulic Consultants 2006). This is attributable to increased sediment capture in Lost Slough upstream of Snodgrass Slough as a portion of the peak discharges are routed through McCormack-Williamson Tract and slough velocities are reduced.

Other than the scouring and decrease in deposition described above, scouring in the Project area is expected to be similar to existing conditions. Alternatives 1-B and 1-C have the least impact on changes to the sediment regime of any of the Project alternatives. These alternatives have the least impact on the hydrodynamics of flood conditions, and hence the least impact on the resultant sedimentation dynamics and are not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would be needed. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5a: Increase in Scouring on Land as a Result of Levee Modifications (McCormack-Williamson Tract East Levee).

As described under Impact GEOMORPH-3 under Alternative 1-B, on land, sedimentation is expected to occur downstream of the degraded McCormack-Williamson Tract east levee because degradation would allow high flows carrying suspended sediment to enter the McCormack-Williamson Tract. One area of scouring concern on land is where the degraded McCormack-Williamson Tract east levee initially encounters the land surface on the McCormack-Williamson Tract.

On the landside toe of the degraded McCormack-Williamson Tract east levee, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe is provided to protect against potential scour, acting as sacrificial material to extend the levee slope protection. As such, significant scouring is not anticipated on the landside of the degraded McCormack-Williamson Tract east levee. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5c: Increase in Scouring on Land as a Result of Levee Modifications (Dead Horse Island).

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring.

The presence of constructed, reinforced, and/or modified levees would increase the potential for waterborne debris to accumulate on the upstream side of the levees. Degradation would allow high flows carrying suspended sediment and possibly debris to enter the McCormack-Williamson Tract. Depending on the amount of water that is carried over the degraded levee, the entire McCormack-Williamson Tract has the potential to be temporarily inundated and act as a sediment and debris trap. Once floodwaters recede, suspended sediment and debris would settle out of the water column and be deposited on the McCormack-Williamson Tract. The extent of sedimentation and debris accumulation would depend on the magnitude of the high flows.

Any debris that passed through or over the levees would be considered beneficial as it would induce localized bioaccretion, sedimentation, and some local scouring, thereby promoting floodplain habitat diversity. This impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-7: Scour and Deposition Associated with Excavation and Restoration of the Grizzly Slough Property.

This impact is identical to Impact GEOMORPH-7 under Alternative 1-A.

Impact GEOMORPH-8: Increase in Scouring on South Fork Mokelumne River and Associated Increase in Deposition Downstream.

This impact is identical to Impact GEOMORPH-8 under Alternative 1-A.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications.

This impact is identical to Impact GEOMORPH-1 under Alternative 1-B.

Impact GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications.

This impact is identical to Impact GEOMORPH-2 under Alternative 1-B.

Impact GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Levee Modifications.

This impact is similar, but not as significant in magnitude, to Impact GEOMORPH-3 under Alternative 1-B. On land, very minor sedimentation is expected to occur downstream of the degraded McCormack-Williamson Tract east levee (i.e., in the northern portion of McCormack-Williamson Tract). Degradation would allow high flows carrying suspended sediment to enter the McCormack-Williamson Tract. Depending on the amount of water that is carried over the degraded levee and the breached levee, the entire upper half of the McCormack-Williamson Tract has the potential to be temporarily inundated and act as a sediment trap. However, the presence of the cross-levee to create the subsidence-reversal demonstration area would impede any sediment deposition associated with the degraded McCormack-Williamson Tract east levee to continue any farther southward along the tract. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited on the upper portion of the McCormack-Williamson Tract. As with Alternatives 1-A and 1-B, sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits.

On the lower portion of the McCormack-Williamson Tract, degradation of the McCormack-Williamson Tract southwest levee is expected to promote accumulation of sediment and bioaccretion. The magnitude of these processes is expected to be similar to that of Alternative 1-B, where the elevation of the McCormack-Williamson Tract southwest levee would be 5.5 feet NGVD 29.

Bioaccretion and sedimentation through flooding, riverine, and tidal processes on the McCormack-Williamson Tract, which rarely experiences these processes, would be beneficial for establishing new vegetation and creating floodplain habitat complexity and diversity. Furthermore, a renewed hydraulic connection to the floodplain of the Mokelumne River would benefit aquatic organisms and help to promote geomorphic diversity on the floodplain. Therefore, this impact is considered beneficial. No mitigation is required.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications.

This impact is identical to Impact GEOMORPH-4 under Alternative 1-B.

Impact GEOMORPH-5a: Increase in Scouring on Land as a Result of Levee Modifications (McCormack-Williamson Tract East Levee).

This impact is identical to Impact GEOMORPH-5a under Alternative 1-B.

Impact GEOMORPH-5c: Increase in Scouring on Land as a Result of Levee Modifications (Dead Horse Island).

This impact is identical to Impact GEOMORPH-5b under Alternative 1-B.

Impact GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring.

This impact is identical to Impact GEOMORPH-6 under Alternative 1-B.

Impact GEOMORPH-7: Scour and Deposition Associated with Excavation and Restoration of the Grizzly Slough Property.

This impact is identical to Impact GEOMORPH-7 under Alternative 1-A.

Impact GEOMORPH-8: Increase in Scouring on South Fork Mokelumne River and Associated Increase in Deposition Downstream.

This impact is identical to Impact GEOMORPH-8 under Alternative 1-A.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir

- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications.

In the channels of the Project area, the proposed degradation of the Staten Island north levee is expected to have a minor effect on the patterns of local accumulation of sediments. The North Fork Mokelumne River along the northern portion of Staten Island may experience a slight increase in deposition from decreased local channel velocities associated with the degradation of the Staten Island north levee. However, this would occur only when flows overtop the degraded levee. Downstream of this area, the sediment-starved water likely would encourage some scour in both the upstream reaches of the North and South Forks of the Mokelumne River. The additional sediment load picked up in these areas would then be deposited farther downstream.

However, Alternative 2-A is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would be needed. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area.

Localized aggradation in the North Fork Mokelumne River along the northern portion of Staten Island as a result of Alternative 2-A would not significantly affect the patterns of local accumulation of sediments because flows lower than the breach elevation would continue to scour away any deposited sediment. Furthermore, it is unlikely that significant sediment accumulation would occur elsewhere in the Project area: sedimentation in North Fork Mokelumne River and elsewhere in the Project area is expected to be similar to existing conditions. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Detention Basin Construction.

On land, very minor sedimentation is expected to occur in the detention basin downstream of the north Staten Island inlet weir. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. During these events, high flows would enter the north Staten Island inlet weir carrying suspended sediment. Depending on the amount of water that is carried over the north Staten Island inlet weir, the entire Staten Island north detention basin has the potential to be temporarily inundated and act as a sediment trap. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited in the Staten Island north detention basin. Most of this sediment likely would be deposited in the extreme northern portion of the Staten Island north detention basin; however, the extent of sedimentation would depend on the magnitude of the floodwaters.

Sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits. Accordingly, this impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications.

In the channels of the Project area, the degradation, reinforcement, and/or modification of levees is expected to have an effect on the patterns of local scouring of sediments. Based on general federal channel design standards (U.S. Army Corps of Engineers 2000), impacts on the levees and the channels could occur if channel flow velocities exceed threshold levels of 2 to 6 ft/s. This velocity range is generally considered a minimum velocity at which potential scour could occur in various channels, depending on construction type.

Based on information from the *Tidal and Flood Hydraulic Modeling* appendix (Appendix E), maximum velocities for the 1986 flood (actual flood) at the index points closest to the northern edge of Staten Island in the vicinity of the proposed north Staten Island inlet weir range from 2.93 to 5.16 ft/s; maximum velocities for the 1986 flood (no levee failure scenario) range from 2.61 to 4.86 ft/s. The maximum velocities for the 1997 flood (actual flood) range from 3.09 to 5.34 ft/s; maximum velocities for the 1997 flood (no levee failure scenario) range from 2.81 to 5.37 ft/s.

Some scouring of the north Staten Island inlet weir and the existing Staten Island north levee may occur. However, for the north Staten Island inlet weir, RSP will be sized to provide necessary erosion protection and placed on the slope of the levee to match the existing grade. In addition, the toe of the levee slope will be reinforced by placing an RSP launchable toe. The launchable toe is provided to protect against potential scour, acting as sacrificial material to extend the levee slope protection. As such, significant scouring is not anticipated on the east Staten Island inlet weir. The Staten Island north levee would be reinforced as well.

Scouring in channels is expected to cause slightly more significant scour effects. The North Fork Mokelumne River along the northern portion of Staten Island may experience a slight increase in deposition from decreased local channel velocities associated with the degradation of the Staten Island north levee. However, this would occur only when flows overtop the degraded levee. Downstream of this area, the sediment-starved water likely would encourage some scour in both upstream reaches of the North and South Forks of the Mokelumne River. The additional sediment load picked up in these areas would then be deposited further downstream.

Other than the scouring described above, scouring in the Project area is expected to be similar to existing conditions. Alternative 2-A is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would be needed. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5d: Increase in Scouring on Land as a Result of Detention Basin Construction (North Staten Island Inlet Weir).

As described under Impact GEOMORPH-3 under Alternative 2-A, on land, sedimentation is expected to occur downstream of the north Staten Island inlet weir. One area of scouring concern on land is where the north Staten Island inlet weir initially encounters the land surface on Staten Island. However, significant scouring is not anticipated on the landside of the north Staten Island inlet weir because Project design elements described under Impact GEOMORPH-4 under Alternative 2-A are expected to provide stability in this area and prevent significant scouring and destabilization. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5e: Increase in Scouring on Land as a Result of Detention Basin Construction (North Staten Island Interior Detention Levee).

Another area of scouring concern on land is where water interacts with the north Staten Island interior detention levee. Interior slopes surrounding detention areas are vulnerable to erosion from drawdown of the detained waters, especially where steepened slopes are susceptible to vertical sloughing. Wind and wave wash are an additional threat to these slopes. However, significant scouring is not expected because either chosen profile (i.e., Profile 1 or 2) would be protected against erosion. Designs under consideration for the Project include placement of additional material to reinforce and lay back the slopes, planting of vegetation to dissipate energy and consolidate the soil structure, use of plastic geogrid or natural fiber geotextile fabric, and placement of RSP to protect the soil surface. These options may be used in combination, such as geotextile fabric planted with wild rose. The detention basin side of the detention levee would be protected from erosion by placement of conventional RSP or by placement of soil treated with cement or lime as facing material. The dry side of the detention levee would be covered with vegetation to provide erosion protection and allow ready examination of the slope. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring.

The presence of constructed, reinforced, and/or modified levees would increase the potential for waterborne debris to accumulate on the upstream side of the levees and weirs. The north Staten Island inlet weir and the degraded Staten Island north levee would allow high flows carrying suspended sediment and possibly debris to overtop them. Depending on the amount of water that is carried over the north Staten Island inlet weir and the degraded Staten Island north levee, the areas on the other side of these features have the potential to be temporarily inundated and act as sediment and debris traps. Once floodwaters recede, suspended sediment and debris would settle out of the water column and be deposited. The extent of sedimentation and debris accumulation would depend on the magnitude of the high flows.

Any debris that passed through or over these features would probably be minimal; nonetheless, it would require removal before farming activities begin. Accordingly, this impact is considered significant and unavoidable. No mitigation is available.

Determination of Significance: Significant and unavoidable.

Mitigation: None available.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee

- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications.

This impact is identical to Impact GEOMORPH-1 under Alternative 1-A.

Impact GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications.

In the channels of the Project area, the proposed construction of the Staten Island west setback levee is expected to have a minor effect on the patterns of local accumulation of sediments. The North Fork Mokelumne River likely would experience additional scour from increased flow associated with the Staten Island west setback levee. The corresponding reduction of flow into the South Fork Mokelumne River likely would encourage deposition in its upper reaches.

However, Alternative 2-B is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would be needed. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area.

It is unlikely that significant sediment accumulation would occur elsewhere in the Project area: sedimentation elsewhere in the Project area is expected to be similar to existing conditions. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Detention Basin Construction.

On land, very minor sedimentation is expected to occur in the detention basin downstream of the west Staten Island inlet weir. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. During these events, high flows would enter the west Staten Island inlet weir carrying suspended sediment. Depending on the amount of water that is carried over the west Staten Island inlet weir, the entire Staten Island west detention basin has the potential to be temporarily inundated and act as a sediment trap. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited in the Staten Island west detention basin. Most of this sediment likely would be deposited in the extreme western portion of the Staten Island west detention basin; however, the extent of sedimentation would depend on the magnitude of the floodwaters.

Sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits. Accordingly, this impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications.

In the channels of the Project area, the degradation, reinforcement, and/or modification of levees is expected to have an effect on the patterns of local scouring of sediments. Based on general federal channel design standards (U.S. Army Corps of Engineers 2000), impacts on the levees and the channels could occur if channel flow velocities exceed threshold levels of 2 to 6 ft/s. This velocity range is generally considered a minimum velocity at which potential scour could occur in various channels, depending on construction type.

Based on information from the *Tidal and Flood Hydraulic Modeling* appendix (Appendix E), maximum velocities for the 1986 flood (actual flood) at the two index points closest to the western edge of Staten Island in the vicinity of the proposed west Staten Island inlet weir and the Staten Island west setback levee range from 5.16 to 4.45 ft/s; the maximum velocity for the 1986 flood (no levee failure scenario) is 4.86 ft/s. Maximum velocities for the 1997 flood (actual flood) range from 5.34 to 4.21 ft/s; maximum velocities for the 1997 flood (no levee failure scenario) range from 5.37 to 4.42 ft/s.

Some scouring of the west Staten Island inlet weir and the Staten Island west setback levee may occur. However, for the west Staten Island inlet weir, the elements would be same as described under Alternative 2-A, except for its location. As such, significant scouring is not anticipated on the west Staten Island inlet weir.

The side slopes of the Staten Island west setback levee would be 2.5:1 on the landside and 3:1 on the waterside. The levee section would also include a 20-

foot-wide bench at about 4 feet NGVD 29 on the riverside and earthwork to facilitate development of a floodplain meander channel and positive drainage returning to the main channel of the river. Coupled with the degradation of the existing Staten Island west levee, desired and beneficial scouring effects would be achieved through Project design on the Staten Island west setback levee.

Scouring in channels is expected to cause slightly more significant scour effects. As stated above under Impact GEOMORPH-2 under Alternative 2-B, the North Fork Mokelumne River likely would experience additional scour from increased flow associated with the Staten Island west setback levee. Other than the scouring described above, scouring in the Project area is expected to be similar to existing conditions. Alternative 2-B is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5f: Increase in Scouring on Land as a Result of Detention Basin Construction (West Staten Island Inlet Weir).

As described under Impact GEOMORPH-3 under Alternative 2-B, on land, sedimentation is expected to occur downstream of the west Staten Island inlet weir. One area of scouring concern on land is where the west Staten Island inlet weir initially encounters the land surface on Staten Island. However, significant scouring is not anticipated on the landside of the west Staten Island inlet weir because Project design elements described under Impact GEOMORPH-4 under Alternative 2-B are expected to provide stability in this area and prevent significant scouring and destabilization. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5g: Increase in Scouring on Land as a Result of Detention Basin Construction (West Staten Island Interior Detention Levee).

Another area of scouring concern on land is where water interacts with the west Staten Island interior detention levee. Interior slopes surrounding detention areas are vulnerable to erosion from drawdown of the detained waters, especially where steepened slopes are susceptible to vertical sloughing. Wind and wave wash are an additional threat to these slopes. However, significant scouring is not expected because either chosen profile (i.e., Profile 1 or 2) would be protected against erosion. Designs under consideration for the Project include placement of additional material to reinforce and lay back the slopes, planting of vegetation to dissipate energy and consolidate the soil structure, use of plastic geogrid or natural fiber geotextile fabric, and placement of RSP to protect the soil surface. These options may be used in combination, such as geotextile fabric planted with wild rose. The detention basin side of the detention levee would be protected from erosion by placement of conventional RSP or by placement of soil treated with cement or lime as facing material. The dry side of the detention levee would be covered with vegetation to provide erosion protection and allow ready examination of the slope. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring.

The presence of constructed, reinforced, and/or modified levees would increase the potential for waterborne debris to accumulate on the upstream side of the levees and weirs. The west Staten Island inlet weir and the Staten Island west setback levee would allow high flows carrying suspended sediment and possibly debris to overtop them. Depending on the amount of water that is carried over the west Staten Island inlet weir and the Staten Island west setback levee, the areas on the other side of these features have the potential to be temporarily inundated and act as sediment and debris traps. Once floodwaters recede, suspended sediment and debris would settle out of the water column and be deposited. The extent of sedimentation and debris accumulation would depend on the magnitude of the high flows.

Any debris that passed through or over these features would probably be minimal; nonetheless, it would require removal before farming activities begin. Accordingly, this impact is considered significant and unavoidable. No mitigation is available.

Determination of Significance: Significant and unavoidable.

Mitigation: None available.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GEOMORPH-1: Temporary Increase in Sediment Accumulation and Scouring during Levee Modifications.

This impact is identical to Impact GEOMORPH-1 under Alternative 1-A.

Impact GEOMORPH-2: Increase in Sediment Accumulation in Channels as a Result of Levee Modifications.

In the channels of the Project area, the proposed construction of the Staten Island east setback levee is expected to have a minor effect on the patterns of local accumulation of sediments. The South Fork Mokelumne River near the New Hope Tract would likely experience increased deposition from decreased local channel velocities associated with the Staten Island east setback levee. However, downstream of the setbacks, the increased flows and sediment-starved water would encourage scour of the Canal Ranch reach. The additional sediment load picked up along Canal Ranch would then be deposited near Brack Tract as the river velocities decreased with increasing channel area.

However, Alternative 2-C is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area.

It is unlikely that significant sediment accumulation would occur elsewhere in the Project area: sedimentation elsewhere in the Project area is expected to be similar to existing conditions. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-3: Increase in Sediment Accumulation on Land as a Result of Detention Basin Construction.

On land, very minor sedimentation is expected to occur in the detention basin downstream of the east Staten Island inlet weir. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. During these events, high flows carrying suspended sediment would enter the east Staten Island inlet weir. Depending on the amount of water that is carried over the east Staten Island inlet weir, the entire Staten Island east detention basin has the potential to be temporarily inundated and act as a sediment trap. Once floodwaters recede, suspended sediment would settle out of the water column and be deposited in the Staten Island east detention basin. Most of this sediment likely would be deposited in the extreme eastern portion of the Staten Island east detention basin; however, the extent of sedimentation would depend on the magnitude of the floodwaters.

Sedimentation is expected to be minimal and consist of wash load deposits and some suspended sediments rather than bed load deposits. Accordingly, this impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-4: Increase in Scouring on Levees and in Channels as a Result of Levee Modifications.

In the channels of the Project area, the degradation, reinforcement, and/or modification of levees is expected to have an effect on the patterns of local scouring of sediments. Based on general federal channel design standards (U.S. Army Corps of Engineers 2000), impacts on the levees and the channels could occur if channel flow velocities exceed threshold levels of 2 to 6 ft/s. This velocity range is generally considered a minimum velocity at which potential scour could occur in various channels, depending on construction type.

Based on information from the *Tidal and Flood Hydraulic Modeling* appendix (Appendix E), the maximum velocity for the 1986 flood (actual flood) at the index point closest to the eastern edge of Staten Island in the vicinity of the proposed east Staten Island inlet weir and the Staten Island east setback levee is 3.91 ft/s; the maximum velocity for the 1986 flood (no levee failure scenario) is 4.08 ft/s. The maximum velocity for the 1997 flood (actual flood) is 4.82 ft/s; the maximum velocity for the 1997 flood (no levee failure scenario) is 4.70 ft/s.

Some scouring of the east Staten Island inlet weir and the Staten Island east setback levee may occur. However, for the east Staten Island inlet weir, the elements would be same as described under Alternative 2-A, except for its location. As such, significant scouring is not anticipated on the east Staten Island inlet weir.

The elements of the Staten Island east setback levee would also be similar to those described under Alternative 2-B, except for its location. The side slopes of the Staten Island east setback levee would be 2.5:1 on the landside and 3:1 on the waterside. The levee section would also include a 20-foot-wide bench at about 4 feet NGVD 29 on the riverside and earthwork to facilitate development of a floodplain meander channel and positive drainage returning to the main channel of the river. Coupled with the degradation of the Staten Island east levee, desired and beneficial scouring effects would be achieved through Project design on the Staten Island east setback levee.

Scouring in channels is expected to cause slightly more significant scour effects. As stated above under Impact GEOMORPH-2 under Alternative 2-C, the South Fork Mokelumne River near the New Hope Tract likely would experience increased deposition from decreased local channel velocities associated with the Staten Island east setback levee. However, downstream of the setbacks, the increased flows and sediment-starved water would encourage scour of the Canal Ranch reach. The additional sediment load picked up along Canal Ranch would then be deposited near Brack Tract as the river velocities decreased with increasing channel area.

Other than the scouring described above, scouring in the Project area is expected to be similar to existing conditions. Alternative 2-C is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would be needed. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5h: Increase in Scouring on Land as a Result of Detention Basin Construction (East Staten Island Inlet Weir).

As described under Impact GEOMORPH-3 under Alternative 2-C, on land, sedimentation is expected to occur downstream of the east Staten Island inlet weir. One area of scouring concern on land is where the east Staten Island inlet weir initially encounters the land surface on Staten Island. However, significant scouring is not anticipated on the landside of the east Staten Island inlet weir because Project design elements described under Impact GEOMORPH-4 under Alternative 2-C are expected to provide stability in this area and prevent significant scouring and destabilization. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-5i: Increase in Scouring on Land as a Result of Detention Basin Construction (East Staten Island Interior Detention Levee).

Another area of scouring concern on land is where water interacts with the east Staten Island interior detention levee. Interior slopes surrounding detention areas are vulnerable to erosion from drawdown of the detained waters, especially where steepened slopes are susceptible to vertical sloughing. Wind and wave wash are an additional threat to these slopes. However, significant scouring is not expected because either chosen profile (i.e., Profile 1 or 2) would be protected against erosion. Designs under consideration for the Project include placement of additional material to reinforce and lay back the slopes, planting of vegetation to dissipate energy and consolidate the soil structure, use of plastic geogrid or natural fiber geotextile fabric, and placement of RSP to protect the soil surface. These options may be used in combination, such as geotextile fabric planted with wild rose. The detention basin side of the detention levee would be protected from erosion by placement of conventional RSP or by placement of soil treated with cement or lime as facing material. The dry side of the detention levee would be covered with vegetation to provide erosion protection and allow ready examination of the slope. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEOMORPH-6: Increase in Debris Accumulation Resulting in an Increase in Sediment Accumulation and Scouring.

The presence of constructed, reinforced, and/or modified levees would increase the potential for waterborne debris to accumulate on the upstream side of the levees and weirs. The east Staten Island inlet weir and the Staten Island east setback levee would allow high flows carrying suspended sediment and possibly debris to overtop them. Depending on the amount of water that is carried over the east Staten Island inlet weir and the Staten Island east setback levee, the areas on the other side of these features have the potential to be temporarily inundated and act as sediment and debris traps. Once floodwaters recede, suspended sediment and debris would settle out of the water column and be deposited. The extent of sedimentation and debris accumulation would depend on the magnitude of the high flows.

Any debris that passed through or over the weir and levee would probably be minimal; nonetheless, it would require removal before farming activities begin. Accordingly, this impact is considered significant and unavoidable. No mitigation is available.

Determination of Significance: Significant and unavoidable.

Mitigation: None available.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

Impact GEOMORPH-8: Increase in Scouring on South Fork Mokelumne River and Associated Increase in Deposition Downstream.

Dredging is proposed in lower Snodgrass Slough, Dead Horse Cut, Mid-Mokelumne River, the upper reach of the North Fork Mokelumne near Dead Horse Island, and the upper and mid reaches of the South Fork Mokelumne River. As such, Snodgrass Slough and the Mid-Mokelumne River reaches likely would experience significant reductions in scour over the baseline model. An increase in deposition likely would occur downstream in the upstream reaches of the North and South Forks of the Mokelumne. However, the downstream reach of the South Fork along Canal Ranch likely would experience a significant increase in scour. This is mainly attributable to the depositional trend observed upstream, which is responsible for sediment-starved water entering the reach and picking up material. The sediment load collected near Canal Ranch would then likely be deposited just downstream near Brack Tract.

Alternative 2-D is not projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Site-specific bank erosion control activities likely would be required in the future in response to continuing bank and bed scour. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area. This impact is considered less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

3.4 Water Quality

Analysis Summary

The Project could have some effects on key water quality constituents of concern during construction and operation. Construction, especially dredging, could mobilize sediments and potentially release pollutants into the environment. However, the extent of chemical mobilization during dredging operations is generally found to be quite low, and these chemicals may already be in the water column. Normal sediment control measures and practices during dredging and construction would provide effective minimization of this impact and no additional mitigation would be required.

Because the only potential changes in salinity from the Project would be beneficial, and cause a slight reduction in salinity within the Mokelumne River and Delta channels, salinity is not considered to be a water quality impact variable.

Because of the infrequent occurrence of flood events, water quality during floods is not of concern. Some Project elements, however, would alter local hydrodynamic conditions during normal conditions, especially at McCormack-Williamson Tract.

Because conversion of the land use on McCormack-Williamson Tract and Grizzly Slough would increase the area of wetlands and freshwater tidal water, there is a potential for changes in the source of total organic carbon (TOC) and production of methylmercury from the inundated sediments. However, the production of TOC from agricultural lands on peat soils may be similar to that of wetland vegetation. No significant impact on TOC is likely. In contrast, any increase in methylmercury would be a significant impact, because the RWQCB has “listed” the Delta as out of compliance with regard to methylmercury. There are no recommended mitigation measures beyond research monitoring and a possible “mercury load trading” program.

Introduction

For the purposes of this water quality analysis, the constituents of primary concern are TOC and methylmercury. This section evaluates the potential for the Project to affect these constituents during construction and operation.

Sources of Information

The following key sources of information were used in the preparation of this section.

- CALFED Bay-Delta Program Draft Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000.
- Reports from DWR's Municipal Water Quality Investigations Program addressing the release of organic carbon from Delta islands.
- Information from the CALFED Science Panel addressing the presence of mercury in the Delta and potential for mercury to be methylated in wetlands.
- Recent staff reports and other information from the Central Valley RWQCB summarizing the nature and extent of methylmercury pollution and anticipated programs to reduce pollutant loading in the Delta.

Assessment Methods

Salinity is a general water quality parameter that is of concern in the Delta because salinity intrusion may reduce the value of agricultural and drinking water supplies and impair the beneficial use of the water. There are no established quantitative methods for estimating the source of either TOC or methylmercury. The assessment is qualitative, and any increase in TOC or methylmercury is considered significant.

Impact Mechanisms

Salinity could be affected in two ways by the Project. The use of irrigation water from the Mokelumne River channels would be slightly reduced on McCormack-Williamson Tract. This would provide slightly greater Delta outflow throughout the summer irrigation season, which would slightly reduce the salinity intrusion and result in a beneficial effect on salinity. The irrigation drainage, which releases all the applied salt back to the channels, also would be reduced on McCormack-Williamson Tract. Although this salinity is released predominantly during the rainfall season, the effects on salinity would be beneficial. Because neither of these potential changes from the Project would cause any increase in salinity, salinity is not considered as an impact variable for the Project.

TOC is the refractory (hard to decay) dissolved organic molecules produced by the biochemical degradation (bacterial decay) of organic carbon originally produced through photosynthesis. Production of biomass from both wetlands and agriculture results in the release of some TOC. Although most of the organic carbon produced by agricultural crops or wetlands is decomposed to produce CO_2, a small residual (1–5%) is released as complex organic molecules that are resistant to further decomposition. The aerobic decomposition of peat soils in the Delta also releases a relatively large load of TOC. Therefore, the difference between agricultural production on McCormack-Williamson Tract or Grizzly Slough and the production of TOC from wetlands (which maintain moist soils) cannot be accurately determined. There is therefore, no likely significant effect from TOC.

Methylmercury (MeHg) is produced by sulfate-reducing bacteria that live in anoxic (low dissolved oxygen) environments, such as wetland-, river-, and lake-bottom sediments. The activity of these bacteria and the availability of reactive inorganic mercury (Hg) are the two primary factors affecting MeHg production (Marvin-DiPasquale et al. 2005; Yee et al. 2005). Organic-rich, vegetated wetland tracts exhibit 2–30 times greater production of MeHg than sediments of adjacent aquatic habitats (Slotton et al. 2002). However, studies show there is no localized increase in biotic MeHg concentrations (in fish) in wetland tracts than in adjacent aquatic habitats (Yee et al. 2005; Slotton et al. 2002). Nevertheless, regulatory limits developed by the RWQCB assume that any production of MeHg in the Delta would be a significant impact.

Physical Setting/Affected Environment

Overview of Water Quality in the Delta

The maintenance of beneficial water uses in the Delta depends on several key water quality variables. Beneficial uses include agriculture, municipal and industrial water supply, fish and wildlife, and recreation (State Water Board 1995). Water quality in the Delta is highly variable because of variable hydrologic conditions and water management operations that regulate Delta outflow to control salinity intrusion. Significant water quality issues that characterize the Delta are:

- Agricultural drainage from Delta islands contains elevated concentrations of TOC. High concentrations of organic carbon is considered a contaminant in drinking water supplies because it contributes to the formation of disinfection byproducts (DBPs).
- Synthetic chemicals (such as pesticides and herbicides) and natural contaminants such as heavy metals (e.g., mercury) have bioaccumulated in Delta fish and other aquatic organisms in quantities occasionally exceeding acceptable standards for food consumption. These chemicals may have accumulated in sediments in the Delta. Restoration of wetlands and disturbance of contaminated sediments may potentially release more of these constituents into the water column.
- High salinity water from Suisun and San Francisco Bays intrudes into the Delta during periods of low Delta outflow, adversely affecting beneficial uses. High bromide can lead to the formation of brominated DBPs.

Summary of Key Water Quality Constituents

Delta water quality constituents include dissolved organic carbon, dissolved minerals (including bromide), heavy metals, suspended sediments, and dissolved oxygen. The main constituents of concern associated with the Project are organic carbon, and the methylation of mercury in Delta sediments and bioaccumulation of MeHg in Delta aquatic organisms. The following sections describe the importance of these constituents.

Organic Carbon

A considerable portion of TOC (20–50%) in Delta waters originates from drainage water from peat soils on Delta islands (Chow et al. 2006, Fujii et al. 1998). The concentration and character (i.e., nature of biochemical molecules) of organic carbon in drainage water depends on many factors, including frequency of flooding and the presence of oxygen. Mineral soils contribute less organic carbon than peat soils (Chow et al. 2005). McCormack-Williamson Tract soils are intermediate between the peaty soils of the central Delta islands and more mineral soils upstream of the Delta.

Dissolved organic carbon is one of the primary variables that influence the formation of DBPs (Chow et al. 2006; Fujii et al. 1998). Little is known about the amount or quality of organic material released from different types of wetlands and agricultural operations. The suspected risk to humans from DBPs containing carcinogens has led some communities to revise their methods of disinfecting drinking water. DBP levels in drinking water can be reduced through the use of alternatives to chlorination in treating water for human consumption (i.e., ozonation or chloromines), although other potentially harmful DBP compounds may be formed during these other disinfection processes. Reducing organic carbon concentrations in raw water before chlorination, with flocculation or granular activated carbon adsorption, can reduce all DBP levels but may be quite expensive.

Mercury

Mercury contamination from mining activities is extensive on both sides of the Central Valley, primarily from widely scattered hydraulic mining debris on the east side and active abandoned mines and associated debris piles on the west side. These sources continue to deposit significant amounts of mercury into the Bay-Delta system. The Cosumnes River, Yolo Bypass, and Sacramento River are the primary ongoing sources of mercury contamination in the Bay-Delta. Natural mercury contamination can originate from volcanoes, forest fires, and oceanic releases; however, it is difficult to determine what proportion of mercury is from natural sources because of the variation in natural deposition.

Mercury occurs in several forms, including pure elemental Hg and toxic MeHg. Mercury is mobile in aquatic systems as aqueous mercury or when attached to suspended particulate matter. MeHg is a significant water quality concern because small amounts of it can bioaccumulate in fish to levels that are toxic to humans and wildlife. There are currently health advisories for consumption of fish in 13 water bodies in northern California, including the Bay-Delta. The concentrations of Hg in Delta fish are frequently above the EPA screening level of 0.5 ppm.

The effect of mercury loading in the Bay-Delta is dependent on how much Hg is converted to MeHg. MeHg is produced by sulfate-reducing bacteria that live in anoxic (low dissolved oxygen) environments, such as wetland-, river-, and lake-bottom sediments. The activity of these bacteria and the availability of reactive inorganic Hg are the two primary factors affecting MeHg production (Marvin-DiPasquale et al. 2005; Yee et al. 2005). Because wetland sediments contain inorganic Hg and sulfate-reducing bacteria thrive in wetland conditions, wetlands are assumed sites of enhanced Hg methylation. Organic-rich, vegetated wetland tracts exhibit 2–30 times greater production of MeHg than sediments of adjacent aquatic habitats (Slotton et al. 2002).

However, studies show no localized increase in biotic MeHg concentrations in wetland tracts versus adjacent aquatic habitats (Yee et al. 2005; Slotton et al. 2002). Thus, although flooded wetland tracts may be the primary source of MeHg production in the overall Bay-Delta system, the MeHg may not be available for bioaccumulation.

Numerous studies have evaluated concentrations of mercury in Delta sediments and biota. Sediment mercury concentrations represent the amount of mercury organisms are exposed to, and biotic mercury concentrations represent the amount of mercury bioaccumulated in organisms. Slotton (2000) found dry-weight, whole-sediment total Hg concentrations ranged from 0.01 to 0.3 ppm throughout the Delta. Suchanek and others (1999) found mercury concentrations in crayfish from the Bay-Delta as high as 2 ppm dry-weight. Slotton (1991) reported a range of mercury concentrations in zooplankton from 2 to 5 ppm dry-weight and in bluegill, Sacramento sucker, and largemouth bass, mercury concentrations were two to six times the health standard of 0.5 ppm for edible fish.

Regulatory Setting and Significance Criteria

Regulatory Setting

The section describes the state and federal regulatory framework for water quality.

Federal Requirements

Clean Water Act, Section 404

Actions typically subject to Section 404 of the Clean Water Act (CWA) requirements are those that would take place in wetlands or stream channels. Section 404 of the CWA requires that a permit be obtained from the USACE for the discharge of dredged or fill materials into waters of the United States. Waters of the United States include wetlands, lakes, streams, and their tributaries. Wetlands are defined for regulatory purposes at 33CFR 328.3.

Clean Water Act, Section 401

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification. Certification is obtained from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality must comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Resources Control Board (State Water Board), and applications for water quality certification under CWA Section 401 typically are processed by the applicable RWQCB. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States.

Clean Water Act, Section 303(d)

Under CWA Section 303(d), the RWQCBs and the State Water Board list water bodies as impaired when not in compliance with designated water quality objectives and standards. A total maximum daily load (TMDL) program must be prepared for waters identified by the state as impaired. A TMDL is a quantitative assessment of a problem that affects water quality. The problem can include the presence of a pollutant, such as heavy metal or a pesticide, or a change in the physical property of the water, such as dissolved oxygen or temperature. A TMDL specifies the allowable load of pollutants from individual sources to ensure compliance with water quality standards. Once the allowable load and existing source loads have been determined, reductions in allowable loads are allocated to individual pollutant sources.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) became law in 1974 and was reauthorized in 1986 and again in August 1996. Through the SDWA, Congress gave EPA the authority to set standards for contaminants in drinking water supplies. Under the SDWA provisions, the California Department of Health Services (DHS) has the primary enforcement responsibility. The California Health and Safety Code establishes DHS authority and mandates drinking water quality and monitoring standards.

State Requirements

Porter-Cologne Water Quality Control Act of 1969

In 1967, the Porter-Cologne Act established the State Water Board and nine RWQCBs as the primary state agencies with regulatory authority over California water quality and appropriative surface water rights allocations. Under this act (and the CWA), the state is required to adopt a water quality control policy to be implemented by the State Water Board and the nine RWQCBs. The State Water Board also establishes water quality control plans (WQCPs) and statewide plans. The RWQCBs carry out State Water Board policies and procedures throughout the state.

WQCPs, also known as basin plans, designate beneficial uses for specific surface water and groundwater resources and establish water quality objectives to protect those uses. WQCPs and water resource management plans relevant to the Project include the 1995 Bay-Delta WQCP and the 1975 WQCB for the Sacramento River and San Joaquin River Basins. The Bay-Delta WQCP defines narrative and numeric surface water quality objectives for several parameters, including suspended material, turbidity, pH, dissolved oxygen, bacteria, temperature, salinity, toxicity, ammonia, and sulfides. In addition, the overall basin plan establishes similar standards throughout the Central Valley.

State Water Resources Control Board and Central Valley Regional Water Quality Control Board—Construction Stormwater National Pollutant Discharge Elimination System Permit

The federal Clean Water Act effectively prohibits discharges of stormwater from construction sites unless the discharge is in compliance with a National Pollutant Discharge Elimination (NPDES) permit. The State Water Board is the permitting authority in California and has adopted a statewide General Permit for Stormwater Discharges Associated with Construction Activity (General Construction Permit) (State Water Board 1999) that applies to projects resulting in 1 or more acres of soil disturbance. The Project would result in disturbance of more than 1 acre of soil. Therefore, the Project will require the preparation of a SWPPP that would specify site management activities to be implemented during site development. These management activities will include construction stormwater BMPs, dewatering runoff controls, and construction equipment decontamination.

Significance Criteria

An alternative would result in a significant impact on water quality if it would:

- result in a discernable change in TOC at a drinking water intake,
- result in an increase in methylmercury loading into the Delta because of the increased risk of biotic exposure and uptake of methylmercury, or
- result in a substantial increase of pollutants into the environment during construction.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

There are no construction activities under Alternative NP. There are no impacts from construction or dredging. Current land practices, including farming on McCormack-Williamson Tract and on Staten Island, would continue. No changes in the release of TOC in the drainage water or floodwater would occur. Available methylmercury data are limited for methylmercury in agricultural return flows. It is assumed that Delta agriculture is a source of methylmercury and may contribute about 2.5% of the annual Delta load (Central Valley RWQCB 2005). No changes in the release of MeHg in the drainage or floodwater would occur.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 1-A include degrading the east and southwest levees of McCormack-Williamson Tract, strengthening downstream levees (including Dead Horse Island east levee), excavating materials from the borrow sites, constructing the transmission tower protective levee, creating wildlife-friendly interior levee slopes, and excavating starter channels on McCormack-Williamson Tract and the Grizzly Slough property. Alternative 1-A includes an optional dredging element that would result in the removal of large quantities of sediment from the South Fork Mokelumne River and other local waterways (Snodgrass Slough and Dead Horse Cut). These activities could result in numerous disturbances to the soil and sediment that could cause the release of pollutants into the surrounding waterways.

To ensure that potentially contaminated dredged materials do not affect surface water or groundwater resources, a sampling and analysis plan for proposed dredging areas will be prepared and implemented no more than 1 year before proposed dredging activities. If sampling indicates any layer of toxic materials above applicable standards, contractors will dredge so that either that layer is not disturbed or the entire layer is removed. If the sampling analysis concludes that dredged material possesses contaminants, a suitability analysis will be conducted to determine a suitable environment for the disposal of the contaminated soils.

The Department will use BMPs for sediment control during construction and will prepare a SWPPP, as required by the State Water Board. The SWPPP will contain a description of appropriate BMPs to ensure that erosion, fuel spills, and other forms of pollution are minimized during construction in accordance with the statewide General Permit for Stormwater Discharges Associated with Construction Activity. Because the pre-dredging sampling and SWPPP will be part of the Project activities, there are assumed to be no significant impacts from the release of pollutants during construction or dredging.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WQ-2: Release of Organic Carbon.

Under Alternative 1-A, land practices would be substantially changed on approximately one-half of McCormack-Williamson Tract. The southernmost portion of the tract would be converted to open-water, subtidal habitat, and an adjacent portion of the tract would be converted to intertidal marsh. Alternative 1-A also includes the restoration of Grizzly Slough, which is located approximately 5 miles upstream of McCormack-Williamson Tract and outside of the area of peaty Delta soils. Restoration of Grizzly Slough natural fluvial processes may increase organic carbon release. These tidal and vegetated areas would produce organic material through primary production of living matter (e.g., phytoplankton), decay of dead organic matter, and leaching from and microbial decay of soil (both peat and non-peat soils). However, there is scientific uncertainty regarding the level of organic carbon generated by wetlands compared to typical agricultural use. It is assumed that Alternative 1-A would not produce a significant increase in the release of TOC relative to the No Project Alternative.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WQ-3: Release of Methylmercury.

Under Alternative 1-A, land practices would be substantially changed on approximately one-half of McCormack-Williamson Tract. The southernmost portion of the tract would be converted to open-water, subtidal habitat, and an adjacent portion of the tract would be converted to intertidal marsh. Alternative 1-A also includes the restoration of Grizzly Slough. The tidal wetlands on McCormack-Williamson Tract and the enhanced fluvial processes on Grizzly Slough would produce environments that may increase the release of methylmercury. Little methylmercury production information is available for Delta wetlands; however, estimates from small experimental marshes on Twitchell Island suggest that increasing wetland acreage may increase methylmercury concentrations in water and biota (Central Valley RWQCB 2005).

There is scientific uncertainty regarding the relative production of methylmercury from wetlands versus agricultural lands. It is assumed, however, that Alternative 1-A would increase the release of methylmercury relative to the No Project Alternative.

Determination of Significance: Significant.

Mitigation Measure WQ-1: Participate in an Offset Program to Ensure No Net Increase in Methylmercury Loading.
There are no known mitigation measures to reduce the production of MeHg. Mitigation measures may be developed in the RWQCB implementation plan for the Sacramento–San Joaquin Delta Estuary TMDL for Methyl and Total Mercury. If no feasible BMPs are identified in the TMDL implementation plan, DWR will participate in an offset program to ensure no net increase in methylmercury loading into the Delta as a result of Project implementation. This would require quantification of the increase in MeHg from the land conversion of Alternative 1-A, and could include participating in funding improvements to the Cache Creek Settling Basin, other projects as recommended by the Central Valley RWQCB, or purchasing credits in an existing, approved offset program.

Significance after Mitigation: Less than significant.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir

- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 1-B would be similar to those under Alternative 1-A. The impacts therefore would be similar and the same monitoring and BMPs would be used. Because the pre-dredging sampling and SWPPP will be part of the Project activities, there are assumed to be no significant impacts from the release of pollutants during construction or dredging.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WQ-2: Release of Organic Carbon

Under Alternative 1-B, land practices on McCormack-Williamson Tract would change from agricultural production to natural habitat. Alternative 1-B also includes the restoration of Grizzly Slough, which is located approximately 5 miles upstream of McCormack-Williamson Tract and outside of the area of peaty Delta soils. Restoration of Grizzly Slough natural fluvial processes may increase organic carbon release. These tidal and vegetated areas would produce organic material through primary production of living matter (e.g., phytoplankton), decay of dead organic matter, and leaching from and microbial decay of soil (both peat and non-peat soils). However, there is scientific uncertainty regarding the level of organic carbon generated by wetlands compared to typical agricultural use. It is assumed that Alternative 1-B would not produce a significant increase in the release of TOC relative to the No Project Alternative.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WQ-3: Release of Methylmercury.

Under Alternative 1-B, land practices on McCormack-Williamson Tract would change from agricultural production to natural habitat. Alternative 1-B also includes the restoration of Grizzly Slough. The tidal wetlands on McCormack-Williamson Tract and the enhanced fluvial processes on Grizzly Slough would produce environments that may increase the release of methylmercury. There is scientific uncertainty in the relative production of methylmercury from wetlands versus agricultural lands. It is assumed, however, that Alternative 1-A would increase the release of methylmercury relative to the No Project Alternative.

Determination of Significance: Significant.

Mitigation Measure WQ-1: Participate in an Offset Program to Ensure No Net Increase in Methylmercury Loading.

Significance after Mitigation: Less than significant.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure

- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 1-C would be similar to those under Alternative 1-A. The impacts would therefore be similar to Alternative 1-A and the same monitoring and BMPs would be used. Because the pre-dredging sampling and SWPPP will be part of the Project activities, there are assumed to be no significant impacts from the release of pollutants during construction or dredging.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WQ-2: Release of Organic Carbon.

Under Alternative 1-C, land practices would be changed on McCormack-Williamson Tract in a manner similar to Alternative 1-A. The southernmost portion of the tract would be converted to intertidal wetland for the purpose of subsidence reversal. Riparian plantings would occur along the landside of all McCormack-Williamson Tract levees. These tidal and vegetated areas would produce organic material through primary production of living matter (e.g., phytoplankton), decay of dead organic matter, and leaching from and microbial decay of soil (both peat and non-peat soils). However, there is scientific uncertainty regarding the level of organic carbon generated by wetlands compared to typical agricultural use. It is assumed that Alternative 1-C would not produce a significant increase in the release of TOC relative to the No Project Alternative.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WQ-3: Release of Methylmercury.

Under Alternative 1-C, land practices would be changed on McCormack-Williamson Tract in a manner similar to Alternative 1-A. The southernmost portion of the tract would be converted to intertidal wetland for the purpose of subsidence reversal. In addition, riparian plantings would occur along the landside of all McCormack-Williamson Tract levees. The tidal wetlands on McCormack-Williamson Tract and the enhanced fluvial processes on Grizzly Slough would produce environments that may increase the release of methylmercury. There is scientific uncertainty in the relative production of methylmercury from wetlands versus agricultural lands. It is assumed, however, that Alternative 1-A would increase the release of methylmercury relative to the No Project Alternative.

Determination of Significance: Significant.

Mitigation Measure WQ-1: Participate in an Offset Program to Ensure No Net Increase in Methylmercury Loading.

Significance after Mitigation: Less than significant.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road

- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 2-A include degrading the north Staten Island levees to create a weir, creating the North Staten Island detention basin, and conducting roadway and optional bridge improvements. These activities could result in numerous disturbances to water quality, including erosion of exposed soils and subsequent release of sediment into waterways and accidental release of hazardous substances such as diesel fuel into the environment. Because a SWPPP will be prepared as an environmental commitment of the Project, this impact is considered less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures

- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 2-B include degrading the west Staten Island levees to create a weir, creating the West Staten Island detention basin, and conducting roadway and optional bridge improvements. These activities could result in numerous disturbances to water quality, including erosion of exposed soils and subsequent release of sediment into waterways and accidental release of hazardous substances such as diesel fuel into the environment. Because a SWPPP will be prepared as an environmental commitment of the Project, this impact is considered less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures

- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 2-B include degrading the east Staten Island levees to create a weir, creating the East Staten Island detention basin, and conducting roadway and optional bridge improvements. These activities could result in numerous disturbances to water quality, including erosion of exposed soils and subsequent release of sediment into waterways and accidental release of hazardous substances such as diesel fuel into the environment. Because a SWPPP will be prepared as an environmental commitment of the Project, this impact is considered less than significant

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact WQ-1: Release of Pollutants during Construction and Dredging.

Construction activities under Alternative 2-D include dredging and levee improvement, and conducting optional roadway and bridge improvements s. These activities could result in numerous disturbances to water quality, including erosion of exposed soils and subsequent release of sediment into waterways and accidental release of hazardous substances such as diesel fuel into the environment. Because a SWPPP will be prepared as an environmental commitment of the Project, this impact is considered less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Cumulative Impacts

Because the Project has no significant impacts, the Project does not contribute significantly to any cumulative impacts. Other actions that might affect Delta water quality include: management and regulation of flows into the Delta; export of water from the Delta by the CVP, SWP, CCWD, and other municipal diverters; agricultural practices, including management of diversions and return flows; discharges from wastewater treatment plants; upstream land use practices that affect stormwater runoff; and many other factors. From a water quality perspective, all of these actions must be consistent with the 1995 Bay-Delta WQCP. The narrative and numeric standards in the Bay-Delta Plan will continue to be studied and updated as appropriate. Implementation of the Bay-Delta Plan, as may be amended from time to time, provides effective mitigation for these cumulative water quality impacts.

The extensive wetland restoration efforts planned under the CALFED Bay-Delta Program have the potential to increase methylmercury exposure of aquatic organisms. Implementation of a TMDL Mercury Load Reduction Program is expected to reduce the overall methylmercury concentrations in the Delta.

3.5 Water Supply and Management

Analysis Summary

The Project would not substantially change water supply or water quality in the lower Mokelumne River channels or in the Delta as a whole. Proposed land use changes on McCormack-Williamson Tract and Grizzly Slough would reduce agricultural water use. Water use on Staten Island would not change. There likely would be no effect on overall Central Valley Project (CVP) and SWP operations. There would be no effects on EBMUD management of the Mokelumne River reservoirs or diversions and no changes in water management by the Woodbridge Irrigation District (WID).

Introduction

Water is currently used on McCormack-Williamson Tract, Staten Island, and Grizzly Slough for agricultural land uses. The Project would alter agricultural water uses in these areas. Water quality would be indirectly affected by the conversion of some of the land area to wetlands and natural vegetation (non-irrigated).

Sources of Information

The following key source of information was used in the preparation of this section:

- *CALFED Bay-Delta Program Draft Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.

Assessment Methods

Changes in water uses are not considered to be a direct physical environmental impact. A water supply impact would result from any interference with an existing water right holder or the needs for environmental water (i.e., instream flows). Changes in irrigation may produce a change in vegetation and associated habitat conditions. Changes in irrigation may reduce agricultural return flows (drainage), and improve water quality in the surrounding channels.

Physical Setting/Affected Environment

Water use in the project area is primarily for agricultural purposes, including the diversion of water from the Mokelumne River and other waterways into interior farms and internal distribution of water within these farms. Following irrigation use, drainage water is returned to the Delta waterways.

EBMUD operates two large upstream reservoirs on the Mokelumne River. Pardee Reservoir is operated to divert water supply for EBMUD. Camanche Reservoir is operated to provide seasonal storage and flood control storage space. Flows are released from Camanche to supply the WID diversions at the Woodbridge Dam and to satisfy minimum flows below Woodbridge Dam for the lower Mokelumne River Management Plan. These flows enter the Delta in the vicinity of the Project area.

A large quantity of water is diverted from the Delta for agricultural and municipal uses. The State Water Project (SWP) operated by DWR and the CVP operated by the US Bureau of Reclamation maintain pumping plants in the southern Delta that pump water into the California Aqueduct and Delta-Mendota Canal. These facilities and associated facilities deliver water to many areas south of the Delta, including farmlands in the San Joaquin Valley and Tulare Basin, farmlands and cities in the Santa Clara Valley and nearby coastal areas, and cities in metropolitan Southern California.

Regulatory Setting and Significance Criteria

Regulatory Setting

Water use on McCormack-Williamson Tract, Staten Island, and Grizzly Slough is based on riparian rights. Riparian water rights are entitlements to water that are held by owners of land bordering natural flows of water. A landowner has the right to divert a portion of the natural flow for reasonable and beneficial uses. McCormack-Williamson Tract and Staten Island are within the North Delta Water Agency area, but the North Delta Water Agency does not provide wholesale or retail water service to these areas.

The management of the SWP and CVP diversions in the southern Delta are controlled by State Water Board water rights Decision D-1641, which specifies several Delta outflow and pumping criteria, dependent on water year type and monthly runoff values.

Significance Criteria

An alternative would result in a significant impact on water supply only if it would increase conflicts between water users and environmental needs or reduce access to economically efficient water supplies for other water users.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Existing water use in the project area is primarily for farming. If the No Project Alternative is implemented, this use is expected to remain similar to existing conditions. Operation of the SWP, CVP, and other Delta diversions would continue in the same manner as current conditions under the same regulatory standards. No changes in water uses would occur.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact WSM-1: Changes in Water Uses as a Result of the Project.

Under Alternative 1-A, land practices would be changed on approximately one-half of McCormack-Williamson Tract. The southernmost portion of the tract would be converted to open-water, subtidal habitat, and an adjacent portion of the tract would be converted to intertidal marsh. As shown in Table 2-4, water diversion pumps would generally continue to operate but overall use would decrease slightly and drainage pumps would be decommissioned.

There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*

- Enhance Delta Meadows Property *(optional)*

Impact WSM-1: Changes in Water Uses as a Result of the Project.

Under Alternative 1-B, land practices on McCormack-Williamson Tract would change from agricultural production to natural habitat. In contrast to Alternative 1-A, McCormack-Williamson Tract would not be subject to full tidal influences and restored floodplain habitat would be inundated only during large storm events when water overtops the degraded east levee. Flood waters would flow off McCormack-Williamson Tract through the tidal gates, or would be pumped off the tract. Water use would decrease compared to the No Project.

There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates

- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact WSM-1: Changes in Water Uses as a Result of the Project.

Under Alternative 1-C, the southernmost portion of McCormack-Williamson Tract would be converted to intertidal wetland for the purpose of subsidence reversal. The intertidal wetland would be inundated only as a result of seasonal flow through tide gates. The remainder of McCormack-Williamson Tract would be inundated during large storm events when water overtops the degraded east levee. Flood waters would flow off McCormack-Williamson Tract through operable tide gates (subsidence wetland area) or through self-regulating tide gates (remainder of the tract). Water use associated with Alternative 1-C would be less than for the No Project. There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station

- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact WSM-1: Changes in Water Uses as a Result of the Project.

With implementation of Alternative 2-A, there would be no change in water uses because Staten Island would continue to be farmed in a manner consistent with current practices. Very infrequently, a portion of Staten Island (North Detention Basin) would be flooded. By the start of the irrigation season, it is expected that the detention basin would have drained and could be farmed in the same manner as under the No Project Alternative. There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station

- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact WSM-1: Changes in Water Uses as a Result of the Project.

With implementation of Alternative 2-B, there would be no change in water uses because Staten Island would continue to be farmed in a manner consistent with current practices. Very infrequently, a portion of Staten Island (West Detention Basin) would be flooded. By the start of the irrigation season, it is expected that the detention basin would have drained and could be farmed in the same manner as under the No Project Alternative. There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station

- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact WSM-1: Changes in Water Uses as a Result of the Project.

With implementation of Alternative 2-C, there would be no change in water uses because Staten Island would continue to be farmed in a manner consistent with current practices. Very infrequently, a portion of Staten Island (East Detention Basin) would be flooded. By the start of the irrigation season, it is expected that the detention basin would have drained and could be farmed in the same manner as under the No Project Alternative. There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact WSM-1: Changes in Water Uses as a Result of the Project.

Construction activities under Alternative 2-D include a dredging element that would result in the removal of large quantities of sediment from the South Fork Mokelumne River and other waterways south of Staten Island. In addition, some amount of levee strengthening work would occur on southern Staten Island and on other nearby islands such as Bouldin Island and Terminous Tract. This alternative is not expected to alter any existing in-Delta water use on Staten Island or any nearby island. There would be no changes in SWP and CVP Delta operations, the EBMUD Mokelumne River operations, or the WID diversions.

Determination of Significance: Less than significant.

Mitigation: None required.

3.6 Groundwater

Analysis Summary

This section addresses groundwater resources in the Project area, the potentially significant impacts that may occur with the implementation of a project, and mitigation measures.

Introduction

This section documents the impact evaluation of flood control improvements and ecosystem restoration on groundwater and seepage in the Project area. The section presents the following topics:

- a description of regional and local groundwater basin and Project area groundwater resources,
- groundwater monitoring and sampling programs,
- regulatory setting and California's Groundwater Management Act, and
- impacts and mitigation of the Project components.

Sources of Information

The following key sources of information were used in the preparation of this section:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000.
- California's Groundwater—Bulletin 118—Update 2003
- Interim North Delta Program Seepage Monitoring Network
- Environmental Study for the Interim North Delta—Water, Sediment and Soil Quality
- Department of Water Resources Water Data Library (http://wdl.water.ca.gov)

Assessment Methods

Geotechnical Investigations and Seepage Monitoring

Geotechnical investigations have been performed in the North Delta area for the Interim North Delta Program and to evaluate obtaining borrow soils from the area north of New Hope Road. However, a more in-depth geotechnical evaluation of the area will need to be performed as part of the Project design. A seepage monitoring network was developed for the Interim North Delta Program in 1994. Geologic information and the geotechnical investigations described above were used to determine the best locations for the observation wells that make up the seepage monitoring network. Locations were then modified to prevent adverse environmental impact. Final locations were coordinated with farm landowners, farm lessees, and reclamation districts. Refer to Figure 3.6-1 for a location map of the seepage monitoring network.

The shallow wells are spaced about 2,000 to 4,000 feet apart along levees adjacent to channels. The locations were chosen to monitor reaches of similar levee foundation geology. The shallow observation wells were placed on or near levee toes so as not to interfere with farming. Some were placed on levee tops when levee toe access was not possible. The deep multi-completion observation wells were set back 500 to 1,000 feet from the levee toe so potential changes in groundwater gradient can be determined. Locations of shallow and deep observation wells were shifted as needed to ensure good access and not disturb farming operations.

Seepage monitoring was done by collecting data from the network of shallow and deep observation wells. This collecting was performed with the expectation that the data would provide a baseline so that potential changes in groundwater levels and groundwater gradients in lands adjacent to proposed North Delta implementation actions would be monitored. The shallow observation wells monitor seepage through the shallow deltaic sediments, and the deep observation wells monitor the deeper aquifers in the underlying basin and floodplain deposits (California Department of Water Resources 1994).

Groundwater Quantity Monitoring

The Division of Planning and Local Assistance and other organizations in DWR have an online Water Data Library (http://wdl.water.ca.gov/default.asp) where the DWR observation well information is available and updated when measurements are taken. The DWR observation well information provides groundwater levels and the ground surface elevation at locations depicted in Figure 3.6-2.

Groundwater quantity will be assessed and monitored with the DWR observation wells illustrated in Figure 3.6-2 and the seepage monitoring network shown in

Figure 3.6-1. Examination of pre-Project groundwater levels to estimate quantity will provide a baseline for post-Project monitoring when it is performed to determine changes in quantity.

Water Quality Sampling and Testing

An environmental study was conducted to help determine any impacts that would result from proposed dredging activities associated with the Interim North Delta Program. The dredging proposed in the Interim North Delta Program is similar to the dredging proposed for the Project. The results of the environmental study should be indicative of sampling and testing required during the permitting process.

The primary environmental concern with using dredged material for levee reinforcement is the release of contaminants from the dredged material and their possible introduction into the groundwater and/or aquatic system. The Interim North Delta Program Environmental Study (California Department of Water Resources 1995) stated that it is not likely that leachate produced from dredge spoils would affect groundwater.

Selected groundwater samples from the seepage monitoring network in the North Delta area were taken for each island/tract and tested for standard minerals to establish a water quality baseline. Results were generally good.

All water quality sampling and testing required to obtain the permits to dredge would be performed. Water quality monitoring using the seepage monitoring network would occur post-Project to determine any changes in the groundwater quality.

Physical Setting/Affected Environment

Regional Perspective

As described in the 2003 DWR publication, *California's Groundwater—Bulletin 118*. The Project area is included in the Central Valley regional aquifer system. As identified in this bulletin, the Central Valley regional aquifer system is divided into three hydrologic regions (HRs)—the Sacramento River, the San Joaquin River, and Tulare Lake. A hydrologic region is defined as a study area consisting of multiple planning subareas.

This section will be limited to the Sacramento Valley and San Joaquin Valley groundwater basins of the Sacramento River and San Joaquin River HRs because the Project area falls in these two basins.

Central Valley Regional Aquifer System

Extensive groundwater development has occurred in the Central Valley to meet agricultural demands. The Central Valley regional aquifer is a 400-mile-long asymmetric trough averaging 50 miles in width.

Before development of the CVP, groundwater overdraft conditions occurred in portions of the San Joaquin Valley as a result of extensive groundwater development and the reliance on groundwater during drought years. Long-term effects of continued groundwater use have resulted in regional land subsidence. The geographic extent of land subsidence generally coincides with areas where groundwater elevations have declined significantly as a result of historical overdraft conditions.

Sacramento Valley Groundwater Basin

The Sacramento Valley groundwater basin is one of 95 groundwater basins in the Sacramento River HR. The northern third of the Central Valley regional aquifer system is located in the Sacramento River HR and extends over 5,500 square miles. Two subbasins in the Sacramento Valley groundwater basin are in the Project area—the South American and Solano subbasins. Figure 3.6-3 illustrates the Project area and contributing groundwater basins and subbasins.

Groundwater elevations in the Sacramento Valley historically have declined moderately during extended drought periods, generally recovering to pre-drought levels as a result of subsequent wetter conditions. Depth to groundwater varies throughout the region, from as little as a few feet below ground surface to more than 100 feet.

Groundwater provides about 31% of the water supply for urban and agricultural uses in this region. Water quality is generally excellent in the Sacramento Valley groundwater basin, with the exception of a few local impairments that are not in the Project area.

The Sacramento River, which is the western boundary of the Project area, is one of the two most significant sources of groundwater recharge in the Sacramento River HR. Surface water and groundwater resources in this region are interdependent. The majority of streambeds in the Sacramento Valley are hydraulically connected with the underlying aquifer.

Surface water availability and natural recharge in the Sacramento Valley have generally compensated for groundwater pumping, resulting in minimal declines in groundwater elevations. Consequently, land subsidence in the Sacramento Valley has been minimal (California Department of Water Resources 2003).

San Joaquin Valley Groundwater Basin

The San Joaquin River HR is located in the central portion of the Central Valley regional aquifer system. One groundwater basin in the San Joaquin River HR is the San Joaquin Valley groundwater basin.

In general, groundwater quality throughout the region is suitable for most urban and agricultural uses with only local impairments. There are no known local impairments in the Project area.

Three of the nine subbasins in this groundwater basin are included in the Project area—the Eastern San Joaquin, Tracy, and Cosumnes subbasins. Figure 3.6-3 for illustrates the Project area and contributing groundwater basins and subbasins.

Generally the aquifers are thick in the San Joaquin Valley subbasins, with groundwater wells commonly extending to depths of up to 800 feet. Aquifers include unconsolidated alluvium and consolidated rocks with unconfined and confined groundwater conditions. Typical well yields in the San Joaquin Valley range from 300 to 2,000 gpm (California Department of Water Resources 2003).

North Delta Flood Control and Ecosystem Restoration Project Area Groundwater Resources

As stated above, the Project area is in the Sacramento and San Joaquin Valley groundwater basins. The Project area includes the South American, Solano, Eastern San Joaquin, Cosumnes, and Tracy subbasins. The northern and western portions of the Project area lie in the Sacramento Valley groundwater basin, and the southern and eastern regions lie in the San Joaquin River groundwater basin.

The South American subbasin includes McCormack-Williamson Tract, Walnut Grove, and Point Pleasant. Grizzly Slough is in the Cosumnes subbasin, and the Cosumnes River borders the South American and Cosumnes subbasins. Staten Island, New Hope Tract, Canal Ranch, Brack Tract, and Terminous Tract lie in the eastern San Joaquin subbasin. The Mokelumne River borders the Eastern San Joaquin and Cosumnes subbasins to a point, then borders the South American and Eastern San Joaquin subbasins near McCormack-Williamson Tract. The Solano subbasin includes Tyler Island and Dead Horse Island and Georgianna Slough. The stretch of the San Joaquin River in the Project area lies in the Tracy subbasin.

Geologic materials in the Project area are recent age deltaic deposits consisting primarily of organic soils, which are underlain by Pleistocene age basin and floodplain deposits. Younger age soils have lower consistencies, strengths, and compressibilities than geologically older Pleistocene soils. The deltaic deposits are composed of a heterogeneous mixture of organic and mineral components that have accumulated in the near–sea level tidal swamps of the Delta. This environment allowed a thick accumulation of tule and reed remains coincident with the slow inflow of fine-grained mineral sediments. The resulting soil deposits are highly lenticular and are composed of organic silts, organic clays, fibrous peat, and organic mineral soil.

Interlayered with the organic soils are lenses of fine-grained sand and silt that were deposited in ancestral distributary channels. Seepage from the channels to the islands occurs primarily throughout the sand lenses that locally underlie many of the delta levees. Seepage also occurs, but to a much lesser extent, throughout the more matted fibrous peat deposits.

The underlying basin and floodplain deposits are composed of fine-grained mineral soils. These deposits are primarily clay with lenticular interbeds of silts and sands. The potential for increased seepage from the channels to the islands through the basin or floodplain deposits probably is much less than through the deltaic deposits (California Department of Water Resources 1994).

Existing data suggest that the peat is relatively thin in the central and northern portion of Staten Island, whereas the peat in the southern portion extends 10 feet to 15 feet below the ground surface. Hydraulic conductivity of the peat is higher than clay, but sands found in the area have the highest hydraulic conductivity of the soils in the area. McCormack-Williamson Tract soils are of higher mineral content than Staten Island soils. Hydraulic conductivity is expected to be lower than that of Staten Island, as well as seepage rates. The top 12 feet of soil in the Grizzly Slough area are clayey with sands below the clay layer. The sands are estimated to have a relatively high hydraulic conductivity, and clays have a relatively low hydraulic conductivity.

Groundwater levels in the Project area are from approximately 2 feet to 8 feet below the ground surface. The groundwater levels in the levees vary with the tidal influence. The DWR observation well network includes wells in the vicinity of McCormack-Williamson Tract, I-5, New Hope Tract, Canal Ranch and Brack Tract, which are shown in Figure 3.6-2.

Groundwater was measured at other locations in the Project area when the North Delta Seepage Monitoring Network was developed (Refer to Figure 3.6-1). Additional information regarding groundwater levels and quantities can be determined from the North Delta Seepage Monitoring Network described in the next section.

There are no known groundwater quality impairments in the Project area. Bulletin 118 describes the portion of the subbasins named above in the Project area as having good to excellent water quality.

Regulatory Setting and Significance Criteria

Regulatory Setting

The Project may involve disposal of dredged spoils on North Delta islands/tracts. The disposal may have elements of both an upland site and a direct discharge to waters of the state.

Clean Water Act

CWA Section 404(b)(1) guidelines provide environmental criteria used in evaluating proposed discharges of dredged materials into waters of the United States. For proposed discharges of dredged material to comply with the guidelines, they must satisfy four requirements found in Section 230.10 and summarized in the Draft Inland Testing Manual, as follows. Section 230.10(a) addresses those impacts associated with the loss of aquatic site functions and values of the proposed discharge site by requiring that the discharge site represent the least environmentally damaging, practical alternative. Section 230.10(b) requires compliance with established legal standards (e.g., issuance or waiver of state water quality certification). Section 230.10(c) requires that discharge of dredged material not result in significant degradation of the aquatic ecosystem. Section 230.10(d) requires that all practicable means be used to minimize adverse environmental impacts.

Upland disposal of dredged sediment is regulated by California Water Code 23, Chapter 15. Waste discharges to land are classified according to Article 2 of Chapter 15, which in its introduction states,

> "…wastes which can be discharged directly or indirectly to waters of the state are regulated under waste discharge requirements which implement applicable water quality control plans."

This refers to the WDRs issued for compliance with the state Porter-Cologne Water Quality Control Act (Porter-Cologne) under Section 401 of the federal CWA, and NPDES permits authorized under the CWA Porter-Cologne define waters of the state as "any surface water or ground water, including saline waters, within the boundaries of the state."

Porter-Cologne is California's primary state law protecting California's waters. Porter-Cologne is codified in Title 23 of the California Water Code. Porter-Cologne gives the state and RWQCBs the authority to regulate discharges of waste, including dredged or fill material, to any waters of the state.

The upland disposal of spoil material and subsequent diffuse discharge of water that may affect groundwater quality require compliance with Subchapter 15 of Porter-Cologne. According to this subchapter, the local RWQCB shall regulate discharges of waste that could affect the quality of waters of the state, and discharges of waste into waters of the state through WDRs authorized under Porter-Cologne and through NPDES permits authorized under the CWA.

The RWQCBs issue WDRs to regulate activities of entities subject to the state's jurisdiction that would discharge waste that may affect groundwater quality or that may discharge waste in a diffused manner (e.g., through erosion from soil disturbance). The types of activities that fall under this requirement include dredging or filling operations, experimental or long-term work in sensitive environments, and the disposal of wastes on land. RWQCBs may determine that a general NPDES permit or general WDR may be more effective for a proposed discharge.

To obtain a WDR, the discharger must submit a report of waste discharge to the RWQCB and include details of the location and type of discharge and proposed method of disposal (often referred to as a *suitability analysis*).

This report should also include specific construction standards, programs for groundwater quality monitoring, a maintenance plan, contingency plan, and monitoring plan.

The dredged material may be classified as a *designated waste*. According to Subchapter 15, a designated waste is a:

> "...non-hazardous waste which consists of or contains pollutants which, under ambient environmental conditions at the waste management unit, could be released at concentrations in excess of applicable water quality objectives, or which could cause degradation of waters of the state."

The discharger may establish, to the satisfaction of the RWQCB, that the dredged material is not a designated waste by showing that a particular waste constituent or combination of constituents presents a lower risk of water quality degradation. A designated waste must be discharged to a Waste Management Unit (WMU) that is designed and constructed according Subchapter 15 specifications.

California's Groundwater Management Act (AB 3030)

California's Groundwater Management Act (Water Code Sections 10750–10756) gives local agencies expanded authority over the management of groundwater resources in basins recognized by DWR. Its intent is to promote the voluntary development of groundwater management plans in order to ensure stable groundwater supplies for the future.

The act identifies the required technical components of a groundwater management plan. It also stipulates procedures for adopting a groundwater management plan, including passage of a formal resolution of intent to adopt a plan and holding a public hearing on the proposed plan. The act also requires agencies to establish rules and regulations to implement an adopted plan and empowers agencies to raise funds to pay for the facilities needed to manage the basin, such as extraction wells, conveyance infrastructure, recharge facilities, and testing and treatment facilities.

Significance Criteria

The following significance criteria have been developed according to the Environmental Checklist Form contained in Appendix G of the State CEQA guidelines and the CALFED Programmatic EIS/EIR.

Table 3.6-1. Significance Criteria

Potential Impact	As Measured by	Significance Criteria	Justification
Will the Project affect groundwater quantity?	Reduction in groundwater recharge	Impact on local groundwater pumping	CEQA Guidelines, Appendix G; CALFED Programmatic EIS/EIR
Will the Project substantially degrade groundwater quality?	Land uses that could contribute to groundwater degradation	Regulatory compliance	Clean Water Act Section 401 and 404(b)(1)
Will the Project cause increased seepage?	Water levels of observation wells	Increased flooding of adjacent islands/tracts	CALFED Programmatic EIS/EIR
Will the Project further land subsidence?	Groundwater level declines	Decline in ground surface elevations from depletion of groundwater	CALFED Programmatic EIS/EIR

Impacts and Mitigation of the Project Alternatives

Impact analysis on groundwater resources has been performed and is presented for each Project alternative. The significance of the impact is stated and mitigation is defined when required.

Mitigation measures include monitoring and testing groundwater wells and aquifers, implementation of a seepage monitoring on non-flooded islands/tracts adjacent to a potential shallow-flooded portion of an island, and following established and proper procedures and regulations for identifying, removing and disposing of contaminated materials.

The mitigation measures identified in the 2000 CALFED ROD were considered in this analysis, consistent with CALFED guidance.

In this section impacts on groundwater and seepage and recommended mitigation measures are organized based on the Project alternatives. The Project alternatives and their components are described in detail in Chapter 2 of the EIR.

Alternative NP: No Project

Under the No Project Alternative, no improvements for flood control or ecosystem restoration would be implemented. Under Future No Project conditions (2025 conditions), no improvement would occur.

No change in groundwater use in the Delta is expected under the No Project Alternative. However, subsidence of Delta islands will continue as groundwater pumping for drainage of croplands continues. No other impacts are expected in the Delta region (CALFED 2000).

Changes in groundwater conditions in the Sacramento River HR are expected to occur in response to increased local demand for groundwater. However, this concern does not apply to the Project area. A reduction in groundwater recharge may result from reduced infiltration and storage in the upper watersheds if retention capacity in the watersheds continues to decrease. This would not affect groundwater levels in the Sacramento River HR but could result in significant local impacts in the upper watersheds.

Impacts on groundwater in the upper watershed areas of the San Joaquin River HR would be similar to those described for the Sacramento River HR.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program

- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GW-1. Potential Increase in Groundwater Levels as a Result of Conversion of Farmland to Ecosystem Restoration.

Degradation of Project area levees would result in permanent loss of 1,600 acres of farmable land. Conversion of agricultural lands to wetland or aquatic habitat is a component of the CALFED Ecosystem Restoration Program. In many areas of the Delta, groundwater is currently pumped to drain croplands or to grow crops. So, conversion of agricultural lands would potentially increase groundwater levels. The converted lands also would provide a benefit by increasing infiltration area, thereby improving groundwater recharge.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GW-2. Potential Groundwater Seepage to Adjacent Islands/Tracts as a Result of Frequent Inundation of McCormack-Williamson Tract.

Studies and observations confirm that seepage from flooded areas can significantly affect adjacent properties. If the southwest McCormack-Williamson Tract was degraded and armored at an elevation of -2.5 feet (NGVD 29), the tract would be inundated frequently, potentially increasing seepage to neighboring islands/tracts.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.
The seepage monitoring network developed by DWR should be enhanced to create a seepage monitoring program to verify that seepage rates will not increase significantly. The enhanced seepage monitoring network should be extensive enough to assess potential design options early in the design phase. The network needs to be upgraded through additional borings deep enough to be below the footing grades of any potential grout-seal walls. Also, geologic cross sections should be developed along each reach where additional flooding is planned. Additional monitoring wells should be equipped with data loggers capable of frequent monitoring of groundwater levels and temperature. With an upgraded monitoring capability, an increase in seepage rates will be adaptively managed,

and additional protection will be provided if implementation has larger impacts than estimated.

Additional geotechnical and groundwater data should be acquired and examined during the initial design to determine and provide direction on method(s) of seepage control most appropriate to protect the lands adjacent to McCormack-Williamson Tract and Staten Island, which potentially would be affected by frequent inundation of McCormack-Williamson Tract and infrequent inundation of a portion of Staten Island.

Common methods of seepage control are internal drainage, seepage berms, cutoff walls, passive relief wells, and active pumping wells. The first two methods, internal drainage and seepage berms, primarily affect seepage locally near the levee and may not be effective in controlling seepage migration away from the levee. Therefore, mitigation will consist of cutoff walls or passive relief and pumping wells, depending on final design determination.

For cutoff walls to be effective from practical and cost perspectives, there needs to be a low hydraulic conductivity layer beneath the seepage layers into which a cutoff wall can be extended. While cutoff walls have been extended to depths of more than 100 feet, more practical depths are less than about 60 feet.

Where low hydraulic conductivity soils are deeper than about 80 feet, deep pumping wells may be required to control seepage and maintain groundwater levels at pre-flooding levels on adjacent properties.

To minimize seepage impacts from the detention basins in the event that floodwaters are detained on Staten Island, half the detention basin volume would be pumped out within 30 days of the end of the flood. This action should minimize or prevent increased seepage to adjacent islands.

Significance after Mitigation: Less than significant.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows

- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GW-1. Potential Increase in Groundwater Levels as a Result of Conversion of Farmland to Ecosystem Restoration.

This impact is similar to that described under Alternative 1-A, but to a lesser degree.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GW-2. Potential Groundwater Seepage to Adjacent Islands/Tracts as a Result of Frequent Inundation of McCormack-Williamson Tract.

This impact is similar to that described under Alternative 1-A, but to a lesser degree.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.

Significance after Mitigation: Less than significant.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GW-1. Potential Increase in Groundwater Levels as a Result of Conversion of Farmland to Ecosystem Restoration.

This impact is the similar to that described under Alternative 1-A, but to a lesser degree.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GW-2. Potential Groundwater Seepage to Adjacent Islands/Tracts as a Result of Frequent Inundation of McCormack-Williamson Tract.

This impact is the similar to that described under Alternative 1-A, but to a lesser degree.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.

Significance after Mitigation: Less than significant.

Impact GW-3. Potentially Increased Groundwater Seepage to Adjacent Lands

Grizzly Slough has been analyzed by DFG and DWR to determine whether it is appropriate for the property to be excavated and graded to a lower elevation than current conditions for ecosystem restoration and for levee material. Preliminary geological reconnaissance conducted by DWR determined that the top 8 to 12 feet of soil is satisfactory for impervious levee material. Studies and observations confirm that seepage from flooded areas can significantly affect adjacent properties.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.

Significance after Mitigation: Less than significant.

Impact GW-4. Potentially Increased Groundwater Recharge.

DWR conducted preliminary geological reconnaissance that determined that the top 8 to 12 feet of soil is satisfactory for impervious levee material. Removal of most of or the entire clay layer, exposing the sand layer, would increase infiltration and deep percolation to the aquifer. The CALFED Programmatic EIS/EIR views groundwater recharge as a beneficial impact.

Determination of Significance: Beneficial.

Mitigation: None required.

Mokelumne River Dredging (Optional)

This alternative is optional within Group 1 and provides additional channel capacity through dredging of the river bottom. The Mokelumne River Dredging Alternative has the following components:

- Dredge Channel Bottom
- Transport and Place Dredged Material

Impact GW-5. Potential Increased Groundwater Seepage from Exposing High Permeability Sand Lenses.

Given the nature of the soils in the Project area, there is potential for exposing sand lenses when removing sediment from channels. This potentially would increase interaction between the stream and groundwater but is not viewed as a significant issue. Channel dredging would be limited to a depth of 20 feet below sea level in part to avoid risk of exposing layers of high hydraulic conductivity, with potential seepage impacts on adjacent lands.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GW-6. Potential Groundwater Contamination from Dredge Spoils.

There is potential that the material that is proposed for dredging is contaminated. The Interim North Delta Program Environmental Study was conducted to help determine any impacts that would result from proposed dredging activities that included the effects of the physical and chemical components of the dredged material on the environment. Most of the water, sediment, and soil samples had constituent concentrations that were less than the applicable regulatory criteria. Conclusions stated that it is not likely that leachate from dredged material would affect groundwater (California Department of Water Resources 1995).

CWA Section 404(b)(1) guidelines would be followed. A Report of Waste Discharge would be submitted to the RWQCB and include details of the location and type of discharge and proposed method of disposal (often referred to as a *suitability analysis*). This report also would include specific construction standards, programs for groundwater quality monitoring, a maintenance plan, contingency plan, and monitoring plan.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GW-7. Potential Increase in Seepage of Groundwater to Adjacent Islands/Tracts from Flood Storage.

Although the detention area would be used infrequently, studies and observations confirm that seepage from flooded areas can significantly affect adjacent properties.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.

Significance after Mitigation: Less than significant.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GW-7. Potential Increase in Seepage of Groundwater to Adjacent Islands/Tracts from Flood Storage.

This impact is similar to that described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.

Significance after Mitigation: Less than significant.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GW-7. Potential Increase in Seepage of Groundwater to Adjacent Islands/Tracts from Flood Storage.

This impact is similar to that described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure GW-1: Control Seepage.

Significance after Mitigation: Less than significant.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact GW-5. Potential Increased Groundwater Seepage from Exposing High Permeability Sand Lenses.

Dredging under Alternative 2-D is likely to be of longer duration than dredging under Alternative 1-A; however, for the same reasons explained under Alternative 1-A, the impact on groundwater would be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GW-6. Potential Groundwater Contamination from Dredge Spoils.

Dredging under Alternative 2-D would be of longer duration than under Alternative 1-A. For reasons mentioned under Alternative 1-A, and because CWA Section 404(b)(1) guidelines would be followed and a Report of Waste Discharge submitted to the RWQCB, the impact on groundwater would remain less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

3.7 Geology, Seismicity, Soils, and Mineral Resources

Analysis Summary

This section summarizes the existing conditions in the Project area, including summaries of regional and local geology, seismicity, soils, and mineral resources. Sources consulted are described, and the environmental consequences that may result from implementation of each Project alternative are assessed. Levee stability is discussed separately in Section 3.2, Flood Control and Levee Stability. Potential effects of global warming are also discussed in Section 3.2, Flood Control and Levee Stability. Geomorphic conditions are discussed separately in Section 3.3, Geomorphology and Sediment Transport.

There are no significant impacts on geological resources or hazards to persons or property as a result of any Project alternative under Group 1. However, significant and unavoidable impacts on geological resources are associated with the alternatives in Group 2. Because no alternatives under Group 2 would include converting agricultural land to habitat, they would not decrease subsidence effects normally associated with farming. Impacts are discussed in detail in the Environmental Consequences section.

Introduction

This section describes the existing environmental conditions and the consequences of the proposed Project on geological resources, such as soils and mineral resources. It also addresses geologic hazards to persons or property. Specifically, it evaluates and discusses the consequences associated with the Project. Significance of impacts is determined using significance criteria set forth in the State CEQA Guidelines.

The primary concerns related to geological resources are accelerated runoff, erosion, and sedimentation caused by grading, excavation, and other construction activities and potential land subsidence caused by placement of material on peat soils.

Sources of Information

Jones & Stokes' description of existing conditions is based on scientific literature, such as regional geologic maps, seismic hazard maps, fault activity maps, soil survey reports, and other supporting documents with pertinent geologic information. The following key sources of information were used in the preparation of this section:

- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000
- Maps and reports by the U.S. Geological Survey (USGS)
- Map and reports by the California Geological Survey (CGS)
- Maps and reports by the Natural Resources Conservation Service (NRCS)
- Maps and reports by DWR
- Sacramento and San Joaquin Counties general plans

Assessment Methods

Evaluation of the impacts in this section is based on the results of technical reports prepared for the Project and on professional judgment. This impact analysis assumes that the Project applicant will conform to the latest Uniform Building Code (UBC) standards, California Building Standards Code (CBSC) standards, county general plan seismic safety standards, county grading ordinances, and NPDES requirements.

Physical Setting/Affected Environment

Unless otherwise noted, the following discussions apply to the entire Project area.

Geology

This section addresses the historical geology and geology of the north Delta region and the Project area. Quaternary sediments and geologic hazards pertaining to the Project area are emphasized.

Regional and Historical Geology

The Delta is located along the western margin of an immense sediment-filled structural trough that forms the Central Valley of California. In the vicinity of the Delta, discrete layers can be distinguished in these sedimentary deposits. Several miles beneath the Delta surface, basement rocks are composed of marine sedimentary rocks dating from the pre-Cretaceous Period (before 144 million years ago [mya]) to the early Tertiary Period (66.4 mya to about 40 mya) (U.S. Army Corps of Engineers 1974; California Department of Water Resources 1986). The basement rocks are overlain by 3–6 miles of sedimentary deposits, most of which accumulated in marine environments between 175 and 25 mya (Atwater 1982). These marine sediments are capped by late Tertiary (about 25–1.6 mya) and Quaternary (1.6 mya to present) nonmarine sediments, ranging from 2,360 to more than 2,950 feet thick (Burroughs 1967; California Department of Water Resources 1980a). Lastly, these nonmarine sediments are overlain by a layer of peat and peaty sediments between 0 and about 20 feet thick that are interbedded with fluvial and tidal deposits of marine clay, silt, and sand. These sediments form the modern Delta and decrease in thickness with distance toward the Delta margins.

The Delta evolved as a result of millions of years of gradual infilling of the Sacramento Sea, an inland sea that once occupied a large portion of central California during the Oligocene Epoch (about 39 mya). During this time, the Sierra Nevada was much lower than it is today, as was the ancestral Coast Range. Over the next 35 million years, an active subduction zone along the California coastline contributed to uplift of the Sierra Nevada and Coast Range and, as the mountains rose, eroded material gradually filled the Sacramento Sea. Prehistoric delta environments occupied large tracts of land along the vast inland shoreline that, as sedimentation progressed, migrated westward to converge in the vicinity of the modern Delta. By about 5–3 mya, the Sacramento Sea had largely filled in with sediment, forming the Central Valley (Hickman 1993).

The modern Delta is the most recent of several deltas that formed during a sequence of depositional and erosional cycles in the Quaternary Period (Shlemon 1971; Shlemon and Begg 1975). These cycles resulted from fluctuations in climate and sea level related to the advance and retreat of glacial ice. The most recent cycle is one of deposition, resulting from a rise in sea level initiated by deglaciation following the height of the last (Tioga) glaciation approximately 20,000 years ago, a time when sea level was approximately 390 feet lower than it is today (U.S. Army Corps of Engineers 1974; Hickman 1993). As glacial ice retreated, sea level rose more rapidly at first, then slowed to a rate of about 0.04–0.08 inch per year, a rate that has persisted from about 6,000 years ago to the present time (Atwater et al. 1977).

Unlike most deltas, the modern Delta formed in an inland direction as rising sea levels intruded upstream and flooded a pre-Holocene valley, creating a broad tidal marsh. Rising sea levels gradually submerged the marsh, creating anaerobic conditions that greatly reduced the rate of plant decomposition. As a result, the accumulation of decomposing plant material kept pace with rising sea levels over approximately 7,000 to 11,000 years, resulting in the formation of thick peat deposits (Prokopovich 1988; Shlemon and Begg 1975). These deposits are thickest in the west and central parts of the Delta and grade to thinner accumulations inland toward the Delta margins (California Department of Water Resources 1995).

Geology of the Project Area

The thick alluvial deposits of the Project area consist of Quaternary alluvial deposits, intertidal deposits, and the Modesto Formation. Most of this area consists of surface materials of intertidal deposits, which are soft mud and peaty mud in marshes, swamps, and waterways. The eastern portion of this area consists of the Modesto Formation, which is made up of arkosic alluvium. The northeastern portion of this area consists of natural levee and channel deposits and basin deposits, all of which are alluvial (Wagner et al. 1987).

Geologic formations are commonly separated by buried soil horizons, indicating that the formations were deposited in phases, separated by periods of subaerial weathering (Entrix 1996). These paleosols represent a complex intermingling of coarse sand and gravel bed load deposits, sand- and silt-sized overbank deposits, and silt- and clay-sized backswamp deposits. The recent alluvial sediments that overlie these formations are generally dark colored, are often highly organic, and have mixed lithologic composition and origin (Entrix 1996).

The Quaternary sediments along the eastern margin of the Delta are primarily derived from metamorphic rock sources in the Sierra Nevada foothills, and the sediments along the western margin of the Delta are derived from the uplifted Tertiary sedimentary rocks of the Coast Range. The interfingering of these lithologic types is common away from the Delta margins (Shlemon 1969).

McCormack-Williamson Tract, Dead Horse Island, and Staten Island

The outer edges of the McCormack-Williamson Tract are alluvial basin deposits, and the center of the tract is intertidal deposits. All of Dead Horse and Staten Islands are intertidal deposits (Wagner et al. 1987).

Grizzly Slough Property

The thick alluvial deposits of the Grizzly Slough Property consist of Quaternary alluvial deposits. Specifically, the northern portion of the Grizzly Slough Property consists of alluvial basin deposits, and the southern portion consists of natural levee and channel deposits (Wagner et al. 1987).

Land Subsidence

Land subsidence is a decrease in land-surface elevation. Land subsidence occurs in three ways in the Delta region: as a result of compaction and oxidation of peat soils, hydrocompaction, and groundwater overdraft. In the Project area, compaction and aerobic decomposition (oxidation) of peat soils is the most relevant.

Historically (i.e., in the past 200 years), land subsidence has been a significant problem in the southern half of the San Joaquin Valley and is a major concern in the south Delta. However, it is also a concern in the north Delta (Figure 3.7-1). Historical land subsidence in the vicinity of the Project area generally increases in a southwest direction. Thicknesses of organic soils are minor at McCormack-Williamson Tract, whereas organic soils are between 30 and 40 feet thick in the southwestern corner of Tyler Island (California Department of Water Resources 1995). For the most part, islands and tracts in the Project area have experienced approximately 10 feet of historical land subsidence, except Tyler Island, where land subsidence may exceed 20 feet (California Department of Water Resources 1980b).

Specifically, the McCormack-Williamson Tract has experienced land subsidence of up to 3 feet; the lower portion of Staten Island has experienced land subsidence of up to 25 feet. No detailed land subsidence information is available for Dead Horse Island; however, according to the DWR (1995), Dead Horse Island has possibly experienced up to approximately 10 feet of land subsidence (Figure 3.7-1). The Grizzly Slough Property is above sea level, and its soil characteristics prevent significant land subsidence.

As an island subsides, the head difference (i.e., pressure) against the levee increases. This increase in pressure, coupled with the poor construction of many levees, increases the probability of levee seepage and failure (California Department of Water Resources 1995). Subsidence may also decrease the levee height, which reduces the flood protection capability. Consequently, the levees are in need of continual maintenance.

Compaction and Oxidation of Peat Soils

Land subsidence can occur as a result of farming and cessation of flooding. Most of the north Delta islands and tracts are covered in thick layers of peat, a highly organic soil. Tillage of the peat soil, combined with removal of flooding from the islands and tracts and construction of drainage ditches, exposes the peat soils to oxygen. This creates a chemical reaction that causes the soil to oxidize and consolidate, lowering the land level. Wind erosion further exacerbates this condition.

Subsidence of this type is a major concern in the Project area (Figure 3.7-2).

Hydrocompaction

Hydrocompaction, as it relates to the Project area, is the loss of water between peat particles as a result of compaction from farming practices. The loss of water helps to lower the land level.

Subsidence of this type is not well documented in the Project area; however, because this process is closely related to compaction of peat soils and associated chemical reactions, it is assumed that it is a significant concern.

Groundwater Overdraft

Groundwater overdraft occurs when groundwater extraction results in so much compression of a clay bed in an aquifer that it no longer expands to its original thickness after groundwater recharge. Clay beds often compress when wells pump groundwater and expand after pumping stops. Clay beds contain individual clay particles and small pores that fill with groundwater in saturated conditions. Groundwater maintains the pore space, expands the clay particles, and helps the bed maintain its thickness. A clay bed will yield a certain volume of groundwater (i.e., safe yield) without losing storage capacity. If safe yield is not exceeded, the clay bed will compress and expand as the pores shrink and swell. This can lead to elastic land subsidence at the ground surface, where elevation decreases when water is extracted then increases when water is recharged. If the safe yield of a clay bed is exceeded, however, its pores collapse and the surrounding clay particles settle in their place. When the clay particles settle, the clay bed is effectively thinned, resulting in permanent land subsidence at the ground surface (California Department of Water Resources 2000).

Subsidence caused by groundwater pumping for agriculture is a common problem throughout the Delta region; however, it is more common upstream in the San Joaquin River hydrologic region and is not a major concern in the Project area (Figure 3.7-2).

Seismicity

Seismic hazards are earthquake fault ground rupture and ground shaking (primary hazards) and liquefaction and earthquake-induced slope failure (secondary hazards). Ground shaking, liquefaction, and related hazards (e.g., lateral spreading and differential settlement) are the most significant seismic hazards in the Project area.

Surface Rupture and Faulting

The purpose of the Alquist-Priolo Earthquake Fault Zoning Act (Alquist-Priolo Act) is to regulate development near active faults to mitigate the hazard of surface rupture. Faults in an Alquist-Priolo Earthquake Fault Zone are typically active faults. As defined under the Alquist-Priolo Act, an active fault is one that has had surface displacement within Holocene time (about the last 11,000 years). An early Quaternary fault (formerly known as a potentially active fault) is one that has had surface displacement during Quaternary time (last 1.6 million years). A pre-Quaternary fault is one that has had surface displacement before the Quaternary period.

The Project area is subject to seismic hazards because of its proximity to the San Andreas fault system. Faults in the San Andreas fault system are known to be historically active and are capable of generating earthquakes; however, the active and early Quaternary faults associated with the San Andreas fault system are not located within a 20-mile radius of the Project area. However, several early Quaternary and pre-Quaternary faults are present in an approximately 20-mile radius. These include (i.e., are not limited to) an unnamed pre-Quaternary fault, the Midland fault zone, and the Rio Vista, Montezuma Hills, Vaca, Kirby Hills, and Antioch faults (Jennings 1994). Of these, the unnamed pre-Quaternary fault is closest to the Project area, situated on Staten Island. None of these faults are in Alquist-Priolo Earthquake Fault Zones (Hart and Bryant 1997).

However, buried thrust faults are located near the North Delta. These faults are capable of generating significant earthquakes. Accordingly, the seismic hazards for the North Delta are affected by both the San Andreas fault system and these buried thrust faults. The buried thrust faults are not listed in Alquist-Priolo Earthquake Fault Zone because they do not have surface ruptures.

Nonetheless, based on existing data, the risk of surface rupture and faulting in the Project area is apparently small.

Ground Shaking Hazard

The Project area is located in UBC Seismic Hazard Zone 3. The Zone 3 designation indicates earthquakes in the region have the potential to make standing difficult and to cause stucco and some masonry walls to fall. Structures must be designed to meet the regulations and standards associated with Zone 3 hazards. However, the Project area is located in a region of California characterized by locally very low to moderate historical seismic activity. In addition, the UBC recognizes no active seismic sources in the Project vicinity (International Conference of Building Officials 1997).

As described above, the risk of surface rupture in the Project area is generally low because of its distance from active faults. However, earthquake-induced ground shaking poses a slightly more significant hazard. Most of the seismic activity in the vicinity of the Project area (and therefore most of the seismic ground shaking hazard) is associated with the historically active San Andreas fault zone and other nearby faults, fault zones, and fault complexes.

The Project area is located in a region of California characterized by a low to moderate ground shaking hazard. Based on a probabilistic seismic hazard map that depicts the peak horizontal ground acceleration values exceeded at a 10% probability in 50 years (California Geological Survey 2006; Cao et al. 2003), the probabilistic peak horizontal ground acceleration values in the Project area range from 0.2 to 0.3g, where one *g* equals the force of gravity. This range indicates that the ground shaking hazard in the Project area is generally low. However, probabilistic peak horizontal ground acceleration values are typically described for firm rocks. As such, ground shaking hazard is more likely to be higher (i.e., moderate) in the Project area because most of the soils are softer alluvium. Additionally, a California Division of Mines and Geology map included in the Safety Element of the County of Sacramento General Plan (1997) indicates the Project area has a moderate ground shaking hazard. Farther to the west and south, the ground shaking hazard increases, coinciding with the increase in abundance of associated faults and fault complexes (California Geological Survey 2006; Cao et al. 2003).

Liquefaction and Related Hazards

Liquefaction is a phenomenon in which the strength and stiffness of unconsolidated sediments are reduced by earthquake shaking or other rapid loading. Liquefaction is the most likely form of ground failure to occur in the Project area (Sacramento County 1997; San Joaquin County 1992a). Poorly consolidated, water-saturated fine sands and silts having low plasticity and located within 50 feet of the ground surface are typically considered to be the most susceptible to liquefaction. Soils and sediments that are not water saturated and that consist of coarser or finer materials are generally less susceptible to liquefaction (California Division of Mines and Geology 1997). Based on the clay/silt/sand composition of the soils and sediments and the shallow depth to groundwater, liquefaction hazard is expected to be moderate to high for the Project area.

Liquefaction of the levee fills is also a major concern for levee safety. Studies of the North Delta generally show that liquefaction of the fills is a greater hazard for levee safety than liquefaction of the natural foundation materials.

Two potential ground failure types associated with liquefaction in the north Delta are lateral spreading and differential settlement (Association of Bay Area Governments 2001). Lateral spreading involves a layer of ground at the surface being carried on an underlying layer of liquefied material over a gently sloping surface toward a river channel or other open face. Lateral spreading is common in the North Delta area and poses a moderate to significant hazard (Association of Bay Area Governments 2001).

Another common hazard in the North Delta area is differential settlement as soil compacts and consolidates after the ground shaking ceases. Differential settlement occurs when the layers that liquefy are not of uniform thickness, a common problem when the liquefaction occurs in artificial fills. Settlement can range from 1 to 5%, depending on the cohesiveness of the sediments (Tokimatsu and Seed 1984). In the Project area, where poorly consolidated, water-saturated fine sands and silts are common, differential settlement is expected to be a moderate to significant hazard.

Although the Delta has been subjected to moderate seismic shaking during historical earthquake events, there has been no recorded observation of levee failure directly caused by an earthquake (Kearney 1980; U.S. Army Corps of Engineers 1995). Nevertheless, the risk of liquefaction of protection levees is present, given the potential for strong ground shaking in the region and the poor geotechnical characteristics of the peat deposits on which most Delta levees are constructed.

Soils

The soils in the north Delta have been mapped by the U.S. Department of Agriculture, Soil Conservation Service (now called the Natural Resources Conservation Service) and are described in the soil surveys of Sacramento and San Joaquin Counties (McElhiney 1992; Tugel 1993). The following soil associations occur on the deltas, floodplains, and levees in the Project area (Table 3.7-1): the Clear Lake, Columbia-Cosumnes, Columbia-Vina-Coyote Creek, Dierssen, Egbert-Valpac, Gazwell-Rindge, Guard-Devries-Rio Blancho, Merritt-Grangeville-Columbia, Peltier-Egbert, Rindge-Kingile-Ryde, Sailboat-Scribner-Cosumnes, and San Joaquin-Bruella soil associations.

Table 3.7-1. Soil Characteristics of the North Delta Flood Control and Ecosystem Restoration Project Area

Soil Association	Soil Description
Clear Lake	Somewhat poorly drained soils that have a seasonal high water table, are protected by levees, and are very deep or deep over a cemented hardpan
Columbia-Cosumnes	Somewhat poorly drained soils that are subject to flooding or are protected by levees
Columbia-Vina-Coyote Creek	Somewhat poorly drained and well drained, moderately coarse textured and medium textured soils that are very deep and are subject to flooding or protected by levees; occur on floodplains
Dierssen	Somewhat poorly drained soils that have a perched water table, are protected by levees, and are moderately deep or deep over a cemented hardpan
Egbert-Valpac	Somewhat poorly drained and poorly drained soils that have a high water table throughout the year and are protected by levees
Gazwell-Rindge	Very poorly drained, highly organic mineral soils that have a high water table throughout the year and are protected by levees
Guard-Devries-Rio Blancho	Poorly drained and somewhat poorly drained, moderately coarse textured and moderately fine textured soils that are moderately deep to a cemented hardpan or are very deep and that have been drained in most areas; occur on basin rims
Merritt-Grangeville-Columbia	Poorly drained and somewhat poorly drained, moderately coarse textured and medium textured soils that are very deep and have been partially drained or drained; occur on floodplains
Peltier-Egbert	Poorly drained, highly organic moderately fine textured soils that are deep and have been partially drained; occur on deltas and floodplains
Rindge-Kingile-Ryde	Very poorly drained, organic soils and very poorly drained, highly organic, moderately fine textured, mineral soils that are very deep and have been partially drained; occur on deltas and floodplains
Sailboat-Scribner-Cosumnes	Somewhat poorly drained and poorly drained soils that have a seasonal high water table and are protected by levees
San Joaquin-Bruella	Moderately well drained and well drained, moderately coarse-textured and medium-textured soils that are moderately deep to a cemented hardpan or are very deep; occur on low terraces

Sources: McElhiney 1992 and Tugel 1993.

According to the soil surveys, soils in the North Delta predominantly comprise loams, clays, clay loams, silty clay loams, and mucks. In general, all of these soils are very deep and very poorly to poorly drained, depending partly on their respective textural characteristics. (McElhiney 1992; Tugel 1993.)

Table 3.7-2 summarizes soil characteristics for the four islands and tracts in the Project area. These soils generally have a slow runoff rate, a slight hazard of water erosion, and a slight to moderate hazard of wind erosion. Moderate to high shrink-swell potential (i.e., expansive soils) and subsidence (discussed above) are the most limiting factors.

Expansive soils, such as clay, swell when they absorb water and shrink as they dry. The North Delta is one of the areas with the greatest shrink-swell soil problems in Sacramento and San Joaquin counties (Sacramento County 1997; San Joaquin County 1992b).

It is important to recognize that the soil properties described above characterize the soils in their natural, unaltered condition. The presence of levees and conversion of wetlands into agricultural land have altered soil characteristics. Soils have been effectively drained by the presence of levees and by ditch construction. Additionally, some Project activities would occur in channels, where the soil survey mapping does not apply.

Mineral and Natural Gas Resources

In Sacramento and San Joaquin Counties, significant aggregate resources have been classified and mapped through the authority of the Surface Mining and Reclamation Act (SMARA). The primary extractive resources in each county are sand, gravel, and natural gas.

The San Joaquin County General Plan (1992b) identifies four areas in the county, referred to as sectors, containing regionally significant deposits of high-grade aggregate (sand and gravel). There are three major and several smaller areas of sand and gravel production in Sacramento County (County of Sacramento 1993). None of these identified areas are close to the Project area. As such, the following impact analysis does not discuss impacts associated with loss of mineral resources.

Sacramento and San Joaquin Counties have long been active areas for natural gas extraction, with the Delta serving as an important natural gas source and underground gas storage area. Most natural gas extraction activities in San Joaquin County take place in the vicinity of the south Delta. Lathrop, McDonald Island, and Union Island gas fields account for most of the natural gas extracted from San Joaquin County (San Joaquin County 1992b). Several gas fields are in present in the north Delta, including Rio Vista Field, one of California’s largest natural gas–producing areas (County of Sacramento 1993). The closest gas fields to the Project area are the West Thornton and Walnut Grove gas fields.

Natural gas is extracted through wells from subsurface fields, and disruption or interference with other surface land uses is minimal. The contribution of natural gas extraction to land subsidence is not known.

Regulatory Setting and Significance Criteria

Regulatory Setting

The following regulations, policies, and ordinances are in place to protect people and property from geologic hazards.

Federal

Clean Water Act, Section 402/National Pollutant Discharge Elimination System

The CWA is discussed in detail in Section 3.4, Water Quality. However, because CWA Section 402 is directly relevant to excavation and grading, additional information is provided here.

Amendments in 1987 to the CWA added Section 402p, which establishes a framework for regulating municipal and industrial stormwater discharges under the NPDES program. The EPA has delegated to the State Water Resources Control Board the authority for the NPDES program in California, which is implemented by the state’s nine regional water quality control boards. Under the NPDES Phase II Rule, construction activity disturbing 1 acre or more must obtain coverage under the state’s General Construction Permit. General Construction Permit applicants are required to prepare a Notice of Intent and a SWPPP and implement and maintain BMPs to avoid adverse effects on receiving water quality as a result of construction activities, including earthwork.

State

Alquist-Priolo Earthquake Fault Zoning Act

California’s Alquist-Priolo Act (PRC Sec. 2621 et seq.), originally enacted in 1972 as the Alquist-Priolo Special Studies Zones Act and renamed in 1994, is intended to reduce the risk to life and property from surface fault rupture during earthquakes. The Alquist-Priolo Act prohibits the location of most types of structures intended for human occupancy across the traces of active faults and strictly regulates construction in the corridors along active faults (Earthquake Fault Zones). It also defines criteria for identifying active faults, giving legal weight to terms such as *active* and establishes a process for reviewing building proposals in and adjacent to Earthquake Fault Zones.

Under the Alquist-Priolo Act, faults are zoned, and construction along or across them is strictly regulated if they are “sufficiently active” and “well-defined.” A

Table 3.7-2. Soil Characteristics of North Delta Flood Control and Ecosystem Restoration Project Area Islands and Tracts

Soil Map Unit	Shrink-Swell Potential	Water Erosion Hazard	Runoff Rate
McCormack-Williamson Tract			
Columbia sandy loam, partially drained, 0–2% slopes	Low	None to slight	Very slow to slow
Columbia sandy loam, clayey substratum, partially drained, 0–2% slopes	Low	None to slight	Very slow to slow
Cosumnes silt loam, partially drained, 0–2% slopes	High	Slight	Slow
Dierssen clay loam, deep, drained, 0–2% slopes	Moderate	None to slight	Very slow
Egbert clay, partially drained, 0–2% slopes	High	Slight	Very slow
Dead Horse Island			
Egbert clay, partially drained, 0–2% slopes	High	Slight	Very slow
Staten Island			
Fluvaquents, 0–2% slopes, frequently flooded	High	Slight	Very slow
Peltier mucky clay loam, partially drained, 0–2% slopes	Moderate	Slight	Very slow
Peltier mucky clay loam, organic substratum, partially drained, 0–2% slopes	Moderate	Slight	Very slow
Piper sandy loam, partially drained, 0–2% slopes	Low	Slight	Slow
Rindge mucky silt loam, partially drained, 0–2% slopes, overwashed	Low	Slight	Very slow

Soil Map Unit	Shrink-Swell Potential	Water Erosion Hazard	Runoff Rate
Rindge muck, partially drained, 0–2% slopes	Low	Slight	Very slow
Ryde clay loam, partially drained, 0–2% slopes	Moderate	Slight	Very slow
Ryde silty clay loam, organic substratum, partially drained, 0–2% slopes	Moderate	Slight	Very slow
Shima Muck, partially drained, 0–2% slopes	Low	Slight	Very slow
Valdez silt loam, organic substratum, partially drained, 0–2% slopes	Low	Slight	Very slow
Venice mucky silt loam, partially drained, 0–2% slopes, overwashed	Low	Slight	Very slow
Grizzly Slough Property			
Clear Lake clay, partially drained, 0–2% slopes, frequently flooded	High	Slight	Slow
Cosumnes silt loam, drained, 0–2% slopes	High	Slight	Slow
Cosumnes silt loam, drained, 0–2% slopes, occasionally flooded	High	Slight	Slow
Dierssen clay loam, deep, drained, 0–2% slopes	Moderate	None to slight	Very slow
San Joaquin–Durixeralfs complex, 0–1% slopes	High	None to slight	Very slow

Note: Soil characteristics are described for upper portion of soil profile only.

Sources: McElhiney 1992 and Tugel 1993.

fault is considered sufficiently active if one or more of its segments or strands shows evidence of surface displacement during Holocene time (defined for purposes of the act as within the last 11,000 years). A fault is considered well-defined if its trace can be clearly identified by a trained geologist at the ground surface or in the shallow subsurface, using standard professional techniques, criteria, and judgment (Hart and Bryant 1997).

Seismic Hazards Mapping Act

Like the Alquist-Priolo Act, the Seismic Hazards Mapping Act of 1990 (PRC Sec. 2690–2699.6) is intended to reduce damage resulting from earthquakes. While the Alquist-Priolo Act addresses surface fault rupture, the Seismic Hazards Mapping Act addresses other earthquake-related hazards, including strong ground shaking, liquefaction, and seismically induced landslides. Its provisions are similar in concept to those of the Alquist-Priolo Act: the state is charged with identifying and mapping areas at risk of strong ground shaking, liquefaction, landslides, and other corollary hazards, and cities and counties are required to regulate development within mapped Seismic Hazard Zones.

Under the Seismic Hazards Mapping Act, permit review is the primary mechanism for local regulation of development. Specifically, cities and counties are prohibited from issuing development permits for sites in Seismic Hazard Zones until appropriate site-specific geologic or geotechnical investigations have been carried out and measures to reduce potential damage have been incorporated into the development plans.

California Building Standards Code

The State of California’s minimum standards for structural design and construction are given in the CBSC (California Code of Regulations, Title 24). The CBSC is based on the UBC (International Code Council 1997), which is used widely throughout United States (generally adopted on a state-by-state or district-by-district basis), and has been modified for California conditions with numerous, more detailed, or more stringent regulations. The CBSC requires that “classification of the soil at each building site will be determined when required by the building official” and that “the classification will be based on observation and any necessary test of the materials disclosed by borings or excavations.” In addition, the CBSC states that “the soil classification and design-bearing capacity will be shown on the (building) plans, unless the foundation conforms to specified requirements.” The CBSC provides standards for various aspects of construction, including (i.e., not limited to) excavation, grading, and earthwork construction; fills and embankments; expansive soils; foundation investigations; and liquefaction potential and soil strength loss. In accordance with California law, certain aspects of the Project would be required to comply with all provisions of the CBSC.

Local

Geotechnical Investigations

Local jurisdictions typically regulate construction activities through a multistage permitting process that may require preparation of a site-specific geotechnical investigation. The purpose of a site-specific geotechnical investigation is to provide a geologic basis for the development of appropriate construction design. Geotechnical investigations typically assess bedrock and Quaternary geology, geologic structure, soils, and previous history of excavation and fill placement.

Local Grading and Erosion Control Ordinances

Many counties have grading and erosion control ordinances. These ordinances are intended to control erosion and sedimentation caused by construction activities. A grading permit is typically required for construction-related projects in the county. As part of the permit, the Project applicant usually must submit a grading and erosion control plan, vicinity and site maps, and other supplemental information. Standard conditions in the grading permit include a description of BMPs similar to those contained in a SWPPP.

Seismic Elements of the Sacramento County and San Joaquin County General Plans

The seismic elements of the Sacramento County and San Joaquin County General Plans contain goals, objectives, and policies aimed at reducing the seismic risk to people and property. Any substantial conflict between the Project and these goals, objectives, and policies would constitute a significant impact.

Significance Criteria

The standards of significance described in CEQA and seismic elements of the Sacramento County and San Joaquin County General Plans were used in this analysis, as described below.

Appendix G of the State CEQA Guidelines provides guidance for evaluation of project effects on geologic and mineral resources. Based on these guidelines, the Project is considered to have a significant impact on the geology, soils, or mineral resources if it would:

- expose people or structures to rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault;
- expose people or structures to strong seismic ground shaking;
- expose people or structures to seismic-related ground failure, including liquefaction;
- expose people or structures to landslides;
- result in substantial soil erosion or the loss of topsoil;
- be located on a geologic unit or soil that is unstable or that would become unstable as a result of the Project and potentially result in an on-site or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;

- be located on expansive soil, as defined in Table 18-1-B of the UBC (International Code Council 1997), creating substantial risks to life or property;
- result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state; or
- result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other lands use plan.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term and cumulative effects of the CALFED Program.

These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to the Project area are listed below. To see a full listing of CALFED programmatic mitigation measures, please refer to Appendix E, "CALFED Mitigation Measures."

Geology and Soils Mitigation Measures

1. Protect flooded Delta island inboard levee slopes against wind and wave erosion with vegetation, soil matting, or rock.
2. Protect exposed soils with mulches, geotextiles, and vegetative ground covers to the extent possible during and after project construction activities in order to minimize soil loss.
3. Implement erosion control measures and bank stabilization projects.
4. Reuse dredged materials to reduce or replace soil loss.
5. Prepare and implement best construction management plans.
6. Prepare and implement construction mitigation plans.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Under the No Project Alternative, the Project components described below would not be implemented; changes to the hydrologic regime of the four islands and tracts would not occur. There would be no impact on geologic resources, and existing conditions as described above would remain unchanged. Specifically, portions of the Project area would remain vulnerable to continued land subsidence.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture.

Based on available knowledge of fault locations and locations of earthquake epicenters, the risk of surface fault rupture in the Project area is generally low because of its distance from active faults. Therefore, this impact is considered less than significant. Furthermore, DWR has incorporated requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design for applicable features to minimize the potential fault rupture hazards on associated Project features. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

A large earthquake could cause low to moderate ground shaking in the Project area. Anticipated ground acceleration at the site is great enough to cause structural damage to newly degraded, reinforced, modified, constructed, or breached levees and injury to workers in the vicinity. Furthermore, an optional component of this alternative involves enhancement of a boat launch, and associated activities include construction of a dock, extension of a ramp, installation of a light to mark the location of the ramp for twilight returns to the ramp, widening of the existing boat ramp, and expansion of parking. Therefore, more structures would be constructed that could be potentially damaged by ground shaking if this component is approved.

Although the potential for low to moderate ground shaking exists in the vicinity, this impact is considered less than significant because DWR has incorporated requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design for applicable features to minimize the potential ground shaking hazards on associated Project features. Furthermore, there are no nearby active faults (and thus the likelihood of ground shaking is low). No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

A large earthquake could cause low to moderate ground shaking in the Project area, potentially resulting in liquefaction and associated ground failure, such as lateral spreading and differential settlement. Furthermore, the Project may increase the potential for liquefaction by detaining water onsite, contributing to saturated conditions. It is assumed that a geotechnical report will be prepared by a qualified engineer prior to the start of activities associated with levee construction, reinforcement, or modification; access road construction; or Delta Meadows Property enhancement. This report will include documentation of soils that may be subject to liquefaction hazard. If such soils are identified, this impact would be considered significant. The environmental commitment to incorporate requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design would include measures to minimize the potential liquefaction hazards on associated Project features, thus reducing this impact to less than significant. Please refer to Environmental Commitments in Chapter 2, “Project Description.”

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.

The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

The following activities could temporarily increase erosion and sedimentation in the construction areas: grading, excavation, removal of vegetation cover, and loading associated with levee degradation, reinforcement, modification, construction, or breaching; construction of an access road; demolition of the farm residence and infrastructure; excavation of the Dixon and New Hope Borrow Sites; and enhancement of the Delta Meadows Property. Although activities at these locations could result in soil compaction and wind erosion effects that could adversely affect soils and reduce the revegetation potential at the construction sites and staging areas, these impacts are considered less than significant because DWR will: a) implement a SWPPP if the area of disturbance is more than 1 acre, or b) follow the appropriate county grading ordinance if the area of disturbance is less than 1 acre. Furthermore, DWR will be required to follow CALFED Geology and Soils Mitigation Measures 1, 2, 3, 5, and 6. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, “Project Description.”

Because a fill deficit is anticipated for the McCormack-Williamson Tract actions, DWR expects to be able to use two other DWR-owned parcels in the Project area for borrow: the Dixon and New Hope borrow sites. Because borrow excavation at the Dixon and New Hope sites is not already permitted, erosion control plans similar to a SWPPP would be implemented for borrow activities. Following excavation, side slopes at the borrow sites would be graded to a maximum steepness of 3:1 (horizontal to vertical), and the stockpiled topsoil would be replaced to allow natural revegetation.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

Most soils with moderate to high shrink-swell potential on the McCormack-Williamson Tract and the Grizzly Slough Property may have been disturbed by prior levee construction and farming activities. These soils include the Cosumnes silt loam, Dierssen clay loam, and Egbert clay on the McCormack-Williamson Tract and the Clear Lake Clay, Cosumnes silt loam, Dierssen clay loam, and San Joaquin-Durixeralfs complex on the Grizzly Slough Property. If the following activities are located in areas that contain expansive soils, potential structural damage and injury from development on expansive soils could occur: proposed levee degradation, reinforcement, modification, construction, or breaching activities; access road construction; farm residence and infrastructure demolition; or Delta Meadows Property enhancement.

It is assumed that a geotechnical report will be prepared by a qualified engineer prior to the start of activities associated with levee construction, reinforcement, or modification; access road construction; or Delta Meadows Property enhancement. This report will include documentation of soils that may be subject to shrink-swell hazard. If such soils are identified, this impact would be considered significant. The environmental commitment to incorporate requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design would include measures to minimize the shrink-swell hazards on associated Project features, thus reducing this impact to less than significant.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

Impact GEO-6: Increase Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils.

Placement of material (from levee degradation or breaching or dredging) or imported soil for levee reinforcement, modification, or construction in areas with peat soils could result in consolidation of the peat soils and land subsidence. Fill placed on a peat foundation is known to cause consolidation, and primary consolidation occurs in a short period (i.e., a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely; the rate of consolidation decreases with time. This consolidation is a function of the height of fill, the thickness of the peat, and the elapsed time (U.S. Army Corps of Engineers 1982). Because peat soils are known to underlie the McCormack-Williamson Tract, subsidence could result from this alternative.

A reduction in the land surface elevation in areas where degraded levee material or imported soil would be placed for levee reinforcement, modification, or construction could result in a number of effects, including increased seepage problems. Additionally, if the levees decrease in elevation as a result of subsidence, the flood protection they provide would be reduced.

Project design and construction measures take into consideration the land subsidence potential. A certain amount of overburden material would be incorporated into the design of any levee modifications, so that settlement would be negligible. Furthermore, subsurface conditions in levee construction, reinforcement, or modification areas would be investigated prior to disposal activities (i.e., a suitability analysis would be performed), as described under Environmental Commitments in Chapter 2. Finally, levee standards included in Federal Flood Insurance Program Regulations, Mapping of Areas Protected by Levee Systems (44 CFR 65.10) (as described in Section 3.2, Flood Control and Levee Stability) require use of design criteria for freeboard, embankment protection, embankment and foundation stability, settlement, and other design features, and maintenance plans and criteria would be required for all levee modifications and would need to be approved by FEMA. The Project applicant or its engineers would follow these design criteria in consultation with local Reclamation District 2115 before levee modifications began.

This impact is considered less than significant. No further mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-7: Decrease Rate of Land Subsidence as a Result of Abandonment of Farming Activities.

Because this alternative would include converting agricultural land to habitat, it would decrease subsidence effects normally associated with farming. Project effects on subsidence, other than those in areas of levee construction, reinforcement, or modification, are considered beneficial.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource.

This alternative would not involve the loss of availability of a known mineral resource or of a locally important mineral resource. Therefore, there is no impact.

Determination of Significance: No impact.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property

- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture.

This impact would be similar to Impact GEO-1 under Alternative 1-A. However, because box culvert drains and self-regulating tide gates would also be constructed, there would be more structures that could be potentially damaged by fault rupture. Therefore, the potential for structural damage and injury from fault rupture would be slightly greater under Alternative 1-B than under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

This impact would be similar to Impact GEO-2 under Alternative 1-A. However, because construction of box culvert drains and self-regulating tide gates would also occur, there would be more structures that could be damaged by ground shaking. Therefore, the potential for structural damage and injury from ground shaking would be slightly greater under Alternative 1-B than under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

This impact would be similar to Impact GEO-3 under Alternative 1-A. However, because construction of box culvert drains and self-regulating tide gates would also occur, there would be more structures that could be damaged from development on materials subject to liquefaction. Therefore, the potential for structural damage and injury caused by development on materials subject to liquefaction would be slightly greater under Alternative 1-B than under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

This impact would be similar to Impact GEO-4 under Alternative 1-A. Construction of box culvert drains and self-regulating tide gates would not further significantly increase runoff, erosion, or sedimentation on the McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

This impact would be similar to Impact GEO-5 under Alternative 1-A. However, because construction of box culvert drains and self-regulating tide gates would also occur, there would be more structures that could be potentially damaged from development on expansive soils. Therefore, the potential for structural damage and injury caused by development on expansive soils would be slightly more under Alternative 1-B than under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists

or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

Impact GEO-6: Increase the Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils.

This impact would be the same as Impact GEO-6 under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-7: Decrease Rate of Land Subsidence as a Result of Abandonment of Farming Activities.

This impact would be the same as Impact GEO-7 under Alternative 1-A.

Determination of Significance: Beneficial

Mitigation: None required.

Impact GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource.

This impact would be the same as Impact GEO-8 under Alternative 1-A.

Determination of Significance: No impact.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture.

This impact would be the same as Impact GEO-1 under Alternative 1-B.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

This impact would be the same as Impact GEO-2 under Alternative 1-B.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

This impact would be the same as Impact GEO-3 under Alternative 1-B.

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.

The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

This impact would be similar to Impact GEO-4 under Alternative 1-B. Constructing a cross-levee in the middle of the McCormack-Williamson Tract would not further significantly increase runoff, erosion, or sedimentation on the McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

This impact would be the same as Impact GEO-5 under Alternative 1-B.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.

The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

Impact GEO-6: Increase the Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils.

This impact would be similar to Impact GEO-6 under Alternative 1-A. However, the potential land subsidence from placement of degraded levee material or additional soil for levee construction on peat soils would have a greater impact under Alternative 1-C than under Alternative 1-A because of the additional component of constructing a cross-levee in the middle of the McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-7: Decrease the Rate of Land Subsidence as a Result of Abandonment of Farming Activities.

This impact would be similar to Impact GEO-7 under Alternative 1-A. Because this alternative would include converting agricultural land to habitat and importing soil for subsidence reversal, it would both decrease subsidence effects normally associated with farming and increase the elevations where soil is imported. Project effects on subsidence, other than those in areas of levee construction, reinforcement, or modification, are considered beneficial.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource.

This impact would be the same as Impact GEO-8 under Alternative 1-A.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture.

Based on available knowledge of fault locations and locations of earthquake epicenters, the risk of surface fault rupture in the Project area is generally low because of its distance from active faults. Therefore, this impact is considered less than significant. Furthermore, DWR has incorporated requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design for applicable features to minimize the potential fault rupture hazards on associated Project features. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

A large earthquake could cause low to moderate ground shaking in the Project area. Anticipated ground acceleration at the site is great enough to cause injury to workers in the vicinity and structural damage to the newly retrofitted or replaced bridges; newly constructed pump station; residences that would be relocated; newly constructed, reinforced, or degraded levees; and wildlife viewing areas.

Although the potential for low to moderate ground shaking exists in the vicinity, this impact is considered less than significant because DWR has incorporated requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design for applicable features to minimize the potential ground shaking hazards on associated Project features. Furthermore, there are no nearby active faults (and thus the likelihood of ground shaking is low), and the Project does not increase the present potential for ground shaking. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

A large earthquake could cause low to moderate ground shaking in the Project area, potentially resulting in liquefaction and associated ground failure, such as lateral spreading and differential settlement. Furthermore, the Project may increase the potential for liquefaction by detaining water onsite, contributing to saturated conditions. It is assumed that a geotechnical report will be prepared by a qualified engineer prior to the start of Project activities such as retrofitting or replacement of bridges, construction of the pump station, relocation of residences, construction of the wildlife viewing area, modification of Walnut Grove-Thornton Road and Staten Island Road, and construction or reinforcement of levees. This report will include documentation of soils that may be subject to liquefaction hazard. If such soils are identified, this impact would be considered significant. The environmental commitment to incorporate requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design would include measures to minimize the potential liquefaction hazards on associated Project features, thus reducing this impact to less than significant. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

The following activities could temporarily increase erosion and sedimentation in the construction areas: grading, excavation, removal of vegetation cover, and loading associated with retrofitting or replacement of bridges, construction of the pump station, relocation of residences, construction of the wildlife viewing area, modification of Walnut Grove-Thornton Road and Staten Island Road, construction or reinforcement of levees, and excavation of the Dixon and New Hope borrow sites. Although these activities could result in soil compaction and wind erosion effects that could adversely affect soils and reduce the revegetation potential at the construction sites and staging areas, these impacts are considered less than significant because DWR will: a) implement a SWPPP if the area of disturbance is more than 1 acre, or b) follow the appropriate county grading ordinance if the area of disturbance is less than 1 acre. Furthermore, DWR will be required to follow CALFED Geology and Soils Mitigation Measures 1, 2, 3, 5, and 6. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Because a fill deficit is anticipated for the Staten Island actions, DWR expects to be able to use two other DWR-owned parcels in the Project area for borrow: the Dixon and New Hope borrow sites. Because borrow excavation at the Dixon and New Hope sites is not already permitted, erosion control plans similar to a SWPPP would be implemented for borrow activities. Following excavation, side slopes at the borrow sites would be graded to a maximum steepness of 3:1 (horizontal to vertical), and the stockpiled topsoil would be replaced to allow natural revegetation.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

Most soils with moderate to high shrink-swell potential on Staten Island may have been disturbed by prior levee construction and farming activities. These soils include Fluvaquents, the Peltier mucky clay loam, the Peltier mucky clay loam, the Ryde clay loam, and the Ryde silty clay loam. If the following activities are located in areas that contain expansive soils, potential structural damage and injury from development on expansive soils could occur: proposed retrofitting or replacement of bridges, construction of the pump station, relocation of residences, construction of the wildlife viewing area, modification of Walnut Grove-Thornton Road and Staten Island Road, or construction or reinforcement of levees.

It is assumed that a geotechnical report will be prepared by a qualified engineer prior to the start of Project activities such as retrofitting or replacement of bridges, construction of the pump station, residence relocation, construction of the wildlife viewing area, modification of Walnut Grove-Thornton Road and Staten Island Road, or construction or reinforcement levees. This report will include documentation of soils that may be subject to shrink-swell hazard. If such soils are identified, this impact would be considered significant. The environmental commitment to incorporate requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design would include measures to minimize the shrink-swell hazards on associated Project features, thus reducing this impact to less than significant.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not

affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

Impact GEO-6: Increase Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils.

Placement of degraded levee material or imported soil for levee construction and reinforcement in areas with peat soils could result in consolidation of the peat soils and land subsidence. Fill placed on a peat foundation is known to cause consolidation, and primary consolidation occurs in a short period (i.e., a few weeks to a few months) and can equal the height of the fill placed. Secondary consolidation continues indefinitely; the rate of consolidation decreases with time. This consolidation is a function of the height of fill, the thickness of the peat, and the elapsed time (U.S. Army Corps of Engineers 1982). Because peat soils are known to underlie Staten Island, subsidence could result from this alternative.

A reduction in the elevation of the land surface in areas where degraded levee material or imported soil would be placed for levee construction, reinforcement, or modification could result in a number of effects, including the potential for increased seepage problems near the levee construction, reinforcement, or modification areas. Additionally, if the newly constructed, reinforced, or modified levees decrease in elevation as a result of subsidence, the flood protection they provide would be reduced.

Project design and construction measures take into consideration the land subsidence potential. A certain amount of overburden material would be incorporated into the design of any levee modifications, so that settlement would be negligible. Furthermore, subsurface conditions in levee construction, reinforcement, or modification areas would be investigated prior to disposal activities (i.e., a suitability analysis would be performed), as described under Environmental Commitments in Chapter 2. Finally, levee standards included in Federal Flood Insurance Program Regulations, Mapping of Areas Protected by Levee Systems (44 CFR 65.10) (as described in Section 3.2, Flood Control and Levee Stability) require use of design criteria for freeboard, embankment protection, embankment and foundation stability, settlement, and other design features, and maintenance plans and criteria would be required for all levee modifications and would need to be approved by FEMA. The Project applicant or its engineers would follow these design criteria in consultation with local Reclamation District 2115 before levee modifications began.

This impact is considered less than significant. No further mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource.

This alternative would not involve the loss of availability of a known mineral resource or of a locally important mineral resource. Therefore, there is no impact.

Determination of Significance: No impact.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture.

This impact would be similar to Impact GEO-1 under Alternative 2-A. However, because more residences would possibly be relocated, there would be more structures that could be potentially damaged by fault rupture. Therefore, the potential for structural damage and injury from fault rupture would be slightly greater under Alternative 2-B than under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

This impact would be similar to Impact GEO-2 under Alternative 2-A. However, because there would possibly be more structures constructed that could be damaged by ground shaking, the potential for structural damage and injury from ground shaking would be slightly greater under Alternative 2-B than under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

This impact would be similar to Impact GEO-3 under Alternative 2-A. However, because more structures would possibly be constructed that could be damaged from development on materials subject to liquefaction, the potential for structural damage and injury from development on materials subject to liquefaction would be slightly greater under Alternative 2-B than under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction and Design Project to Accommodate Effects of Liquefaction.

The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

This impact would be similar to Impact GEO-4 under Alternative 2-A. However, because there would possibly be more construction associated with this alternative, the potential for increased runoff, erosion, and sedimentation would be slightly greater under Alternative 2-B than under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

This impact would be similar to Impact GEO-3 under Alternative 2-A. However, because more structures would possibly be constructed that could be damaged from development on expansive soils, the potential for structural damage and injury from development on expansive soils would be slightly more under Alternative 2-B than under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

Impact GEO-6: Increase the Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils.

This impact would be the same as Impact GEO-6 under Alternative 2-A.

Impact GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource.

This impact would be the same as Impact GEO-8 under Alternative 2-A.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact GEO-1: Increase the Potential for Structural Damage and Injury Caused by Fault Rupture.

This impact would be the same as Impact GEO-1 under Alternative 2-B.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

This impact would be the same as Impact GEO-2 under Alternative 2-B.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

This impact would be the same as Impact GEO-3 under Alternative 2-B.

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

This impact would be the same as Impact GEO-4 under Alternative 2-B.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

This impact would be the same as Impact GEO-5 under Alternative 2-B.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.

The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

Impact GEO-6: Increase the Potential for Land Subsidence as a Result of Placement of Degraded Levee Material or Additional Soil for Levee Construction on Peat Soils.

This impact would be the same as Impact GEO-6 under Alternative 2-A.

Impact GEO-8: Loss of Availability of a Known Mineral Resource or of a Locally Important Mineral Resource.

This impact would be the same as Impact GEO-8 under Alternative 2-A.

Determination of Significance: No impact.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact GEO-1: Increase the Potential for Land Subsidence as a Result of Placement of Dredged Levee Material on Peat Soils.

This impact would be the same as Impact GEO-6 under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-2: Increase the Potential for Structural Damage and Injury Caused by Ground Shaking.

A large earthquake could cause low to moderate ground shaking in the Project area. Anticipated ground acceleration at the site is great enough to cause injury to workers in the vicinity and structural damage to the newly retrofitted or replaced bridges.

Although the potential for low to moderate ground shaking exists in the vicinity, this impact is considered less than significant because DWR has incorporated requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design for applicable features to minimize the potential ground shaking hazards on associated Project features. Furthermore, there are no nearby active faults (and thus the likelihood of ground shaking is low), and the Project does not increase the present potential for ground shaking. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, “Project Description.”

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-3: Increase the Potential for Structural Damage and Injury as a Result of Development on Materials Subject to Liquefaction.

A large earthquake could cause low to moderate ground shaking in the Project area, potentially resulting in liquefaction and associated ground failure, such as lateral spreading and differential settlement. Furthermore, the Project may increase the potential for liquefaction by detaining water onsite, contributing to saturated conditions. It is assumed that a geotechnical report will be prepared by a qualified engineer prior to the start of Project activities such as retrofitting or replacement of bridges. This report will include documentation of soils that may be subject to liquefaction hazard. If such soils are identified, this impact would be considered significant. The environmental commitment to incorporate requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design would include measures to minimize the potential liquefaction hazards on associated Project features, thus reducing this impact to less than significant. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Significant.

Mitigation Measure GEO-1: Conduct Geotechnical Evaluation for Sediments Susceptible to Liquefaction, and Design Project to Accommodate Effects of Liquefaction.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation of unconsolidated sediments in the Project area to determine whether they are susceptible to liquefaction. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project to accommodate the effects of liquefaction. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. The effects of liquefaction may include lateral deformation or vertical settlement that can be accommodated within the design of the levee or other improvements.

Significance after Mitigation: Less than significant.

Impact GEO-4: Increase the Potential for Accelerated Runoff, Erosion, and Sedimentation as a Result of Grading, Excavation, and Levee Construction Activities.

Loading associated with retrofitting or replacement of bridges could temporarily increase erosion and sedimentation in the construction areas. Although these activities could result in soil compaction and wind erosion effects that could adversely affect soils and reduce the revegetation potential at the construction sites and staging areas, these impacts are considered less than significant because DWR will: a) implement a SWPPP if the area of disturbance is more than 1 acre, or b) follow the appropriate county grading ordinance if the area of disturbance is less than 1 acre. Furthermore, DWR will be required to follow CALFED

Geology and Soils Mitigation Measures 1, 2, 3, 5, and 6. No further mitigation is required. Please refer to Environmental Commitments in Chapter 2, "Project Description."

Determination of Significance: Less than significant.

Mitigation: None required.

Impact GEO-5: Increase the Potential for Structural Damage and Injury as a Result of Development on Expansive Soils.

Most soils with moderate to high shrink-swell potential on Staten Island may have been disturbed by prior levee construction and farming activities. These soils include Fluvaquents, the Peltier mucky clay loam, the Peltier mucky clay loam, the Ryde clay loam, and the Ryde silty clay loam. If the proposed retrofitting or replacement of bridges is located in areas that contain expansive soils, potential structural damage and injury from development on expansive soils could occur.

It is assumed that a geotechnical report will be prepared by a qualified engineer prior to the start of Project activities such as retrofitting or replacement of bridges. This report will include documentation of soils that may be subject to shrink-swell hazard. If such soils are identified, this impact would be considered significant. The environmental commitment to incorporate requirements for standard UBC Seismic Zone 3, CBSC, and county general plan construction standards into the Project design would include measures to minimize the shrink-swell hazards on associated Project features, thus reducing this impact to less than significant.

Determination of Significance: Significant.

Mitigation Measure GEO-2: Conduct Geotechnical Evaluation for Expansive Soils, and Design Project to Accommodate Effects of Expansive Soils.
The Project applicant, in conjunction with soil scientists or engineers, will be responsible for conducting a geotechnical evaluation for expansive soils. Based on subsurface conditions, the Project applicant, in conjunction with soil scientists or engineers, will design the Project structures to accommodate the effects of expansive soils. The presence of levees that can safely store water without modification of the substrate is considered an acceptable engineering approach. Expansive soils that are buried deep or below the groundwater level would not affect surface structures. Therefore, there is no impact, and no modification of soils would be necessary.

Significance after Mitigation: Less than significant.

3.8 Transportation and Navigation

Analysis Summary

Constructing the Project alternatives would result in changes to circulation patterns, increased roadway hazards, and damage to roadways. These impacts are considered less than significant for all alternatives because local roadways are not heavily traveled and because these impacts would occur only during the construction phase. Impacts on navigation would be greatest under Alternatives 2-A, 2-B, and 2-C because of the potential to restrict navigation during the period the New Hope Bridge and/or Millers Ferry Bridge is being improved or replaced. Impacts are not considered significant because environmental commitments would be implemented during the construction phase that address damage to roadways, traffic hazards, and circulation issues. Operation-related impacts on transportation would be avoided because alternative access routes would be provided.

Introduction

This section describes existing transportation and navigation conditions in the immediate Project area and discloses the potential effects of constructing and operating the Project alternatives on transportation and navigation. Transportation and navigation impacts are not expected to occur outside of the immediate Project area; therefore, regional transportation and navigation issues are not discussed.

For the transportation discussion, this section focuses on: (1) the existing condition of the roadways that make up the routes that are expected to be used during Project construction and the potential effects on those roadways from construction vehicles; (2) the potential effects on roadway capacity and circulation patterns.

A quantitative assessment of changes in vehicle/capacity ratios and levels of service (LOS) of affected roadways and potential impacts on LOS was not evaluated in this document because construction impacts would be minimal and short-term, and cover a wide geographical Project area; permanent impacts from roadway modifications and facility operations would also be minimal and cover a wide geographical Project area.

For the navigation discussion, the changes in access to Delta waterways by boats and other vessels during construction and operation of the Project alternatives, including changes in water levels/depths, are addressed. Because the use of waterways in the Project area is limited primarily to recreational boating and some emergency access use, permanent impacts on boat access and navigation use in the Delta waterways are discussed in Section 5.1, Land Use, Recreation, and Economics, and in Section 5.6, Public Health and Environmental Hazards.

Sources of Information

The following key sources of information were used in the preparation of this section:

- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000;
- *North Delta Program Draft Environmental Impact Report/Environmental Impact Statement*, November 1990; and
- California Department of Water Resources' *Sacramento–San Joaquin Delta Atlas*, 1995.

Assessment Methods

The significance of potential impacts on transportation and navigation in the Project area was determined by comparing the significance criteria described below to the anticipated impacts resulting from the Project components and alternatives.

Physical Setting/Affected Environment

Transportation

Roadways

The Project area is served by three main freeways—Interstate 5 (I-5), State Route (SR) 12, and SR 160—and local roads. I-5 runs north-south near the eastern edge of the Project area, and SR 12 is a two-lane road that runs east-west near the southern edge of the Project area. SR 160 runs north-south along the Sacramento River, which serves as the western boundary of the Project area.

Local roads in the Project area include Walnut Grove–Thornton Road also known as J11, Hood Franklin Road, New Hope Road, Twin Cities Road, Staten Island Centerline Road, and North Staten Island Road.

Bridges

Two bridges in the Project area may be affected by the proposed Project—Millers Ferry Bridge and New Hope Bridge. Millers Ferry Bridge is a manually operated drawbridge that spans the North Fork Mokelumne River. New Hope Bridge spans the South Fork Mokelumne River.

Ferries

Five ferries serve the Delta region and provide access to those islands that do not have bridge access. Three of those ferries are for private use, and the other two are public. The Real McCoy takes vehicles across Cache Slough to Ryer Island, and the J-Mack transports riders across Steamboat Slough. The private ferries access Jersey Island, Webb Tract, Bradford Island, Empire Tract, and Woodward Island (California Delta Chambers and Visitors Bureau 2004).

Railways

Several railways provide service to the Delta region. The northwest-southeast Union Pacific Railroad runs to the east and the south of the Project area and carries mostly freight. Santa Fe Railway provides passenger service between Stockton and Antioch and cities beyond and is located to the south of the Project area (California Department of Water Resources 1995). Amtrak and the ACE also use these rail lines. Amtrak provides service from Stockton to San Jose and ACE serves as a direct commuter rail service to Silicon Valley (with stops in Stockton, Lathrop, Manteca, and Tracy). There are no railways in the Project area.

Bikeways

Several trails serve as bike routes in the Delta. Brannan Island State Recreation Area and Delta Meadows State Park have designated bike paths (Delta Protection Commission 2004). Bicyclists also use many of the levee roads throughout the Delta.

Aviation Facilities

The closest airports to the Project area are Borges-Clarksburg Airport, Franklin Field, and Rio Vista Municipal Airport. The Clarksburg Airport is 2 miles northeast of the City of Clarksburg. This public airport averages approximately 57 operations per week (AirNav.com 2006). Franklin Field is located to the East of the Project area on Bruceville Road. This airport is public and is owned by the County of Sacramento. This uncontrolled airport handles approximately 36,000 operations a year including flight training (County of Sacramento 2004). Rio Vista Municipal Airport is also a public airport, and it serves and average of 96 operations per day. This airport is approximately 3 miles northwest of the City of Rio Vista (AirNav.com 2004).

Several private airstrips in the Delta are used for agricultural activities. One such airstrip on Bouldin Island is used for agricultural activities on Bouldin Island, Webb Tract, and Holland Tract (Jones & Stokes 1995).

Sacramento International airport is owned by the County of Sacramento is approximately 25 miles northeast of the Project area.

Navigation

Most of the waterways in the immediate Project vicinity are public waterways. Navigation in the Project area is limited to recreational watercraft because these channels are too small to easily accommodate large commercial vessels. Recreational navigation is discussed further in Section 5.1, Land Use, Recreation, and Economics. Marinas serving recreational watercraft in the Project area include: New Hope Landing, Wimpy's, and Walnut Grove Marina (California Department of Water Resources 1990).

Two deep-water ship channels in the Delta region are navigable by commercial vessels: the Stockton Deep Water Ship Channel and the Sacramento Deep Water Ship Channel. These two ship channels serve the Port of Stockton and the Port of Sacramento (California Department of Water Resources 1995), which combined handle approximately five million tons of cargo annually.

Significance Criteria

Significance Criteria

Significance criteria for potential traffic and transportation impacts are based on relevant thresholds of significance established by agencies with jurisdictional authority and/or applicable laws and regulations. According to the State CEQA Guidelines, the San Joaquin Council of Governments, the CALFED Bay-Delta Programmatic ROD, and professional standards, a Project may be considered to have a significant effect on the environment if it would result in:

1. substantial increase in the traffic delay experienced by drivers;
2. inadequate parking capacity;
3. safety conflicts because of operating large, slow-moving dredging equipment on Delta waterways;
4. impedance of navigational craft as a result of the construction activities at bridge locations;
5. substantial deterioration of the roadway surface as a result of construction activities;
6. conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks); or
7. substantial alteration to present patterns of circulation or movement.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Under the No Project Alternative, there would be no change in the characteristics of the regional transportation system, local roadways, or navigation through Delta channels. It is likely that the levee roads and other roads in the Project area would continue to be maintained by San Joaquin and Sacramento Counties. No road modifications, including raising and building new roads, would occur. Navigation would not change under the No Project Alternative. Water levels and flows are not expected to change, and channels that are currently accessible to watercraft will continue to be so. No impacts associated with the No Action Alternative have been identified. No mitigation is required.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

Alternative 1-A would result in a temporary increase in construction-related traffic on local roadways. This would include transporting levee and other construction materials. If materials from the degraded levees need to be disposed of off site, they would most likely be transported to the Foothill Landfill near the Stanislaus County line. This would result in increased truck traffic on Walnut Grove–Thornton Road, I-5, SR 4, and Stanislaus Street and Hazelton Avenue in Stockton during the period the levees are being degraded. If this material is suitable for construction of Project features, it would be transported to other locations in the Project area (e.g., transmission tower, South and North Forks Mokelumne River, Sycamore Slough).

In addition to construction equipment, construction workers would access the Project site over local roadways. The construction work force for the Project would most likely be drawn from the local labor pool in San Joaquin and Sacramento Counties. It is anticipated that workers would commute 20 miles or less one way.

Transporting materials may result in increased travel times on local roads but would not likely result in any substantial delays on major highways such as I-5 and SR 4. During construction, increases in roadway hazards and changes circulation patterns would occur. The capacity of the local roadway system is not expected to decrease substantially because these roads are used primarily by local residents and agricultural equipment.

As part of the Project's environmental commitments (see Chapter 2), a traffic control plan will be prepared and implemented to reduce construction-related effects on the capacity and circulation characteristics of local roadways and to reduce hazards resulting from construction-related traffic. Traffic delays, increased road hazards, and changes in circulation patterns would be temporary and would return to pre-Project conditions once construction is completed.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface.

Maintenance of San Joaquin and Sacramento County roads routes includes periodic inspection to assess structural integrity and need for repairs, followed by implementation of needed repairs. If construction trucks travel on roadways that are not covered by these maintenance programs, roadway damage such as potholes or minor fractures may occur that are not subject to inspection and repair. However, environmental commitments (Chapter 2) will ensure that DWR will coordinate with San Joaquin County and the Sacramento County Department of Transportation Right of Way Division to determine appropriate repairs to damaged roads. This commitment will ensure that roadways damaged during construction of the Project are repaired to pre-Project conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

Alternative 1-A could require the construction of new roads and would likely require improvements to existing roads to support heavy trucks and other construction equipment. Existing levee roads that would be used by trucks transporting materials to and from the Project site would need to be reinforced by widening the crowns and possibly surfacing with aggregate. This would result in beneficial effects on transportation as it would generally improve the condition of the roadways in the Project area.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact TN-4: Changes in Circulation and Access.

Lowering the height of levees, and subsequently the elevation of levee roads, would result in changes in circulation during times the flood control element of the Project is operating. During flow events high enough to overtop the lowered levees, the levee roads would not be passable. This would result in a change in circulation and access to McCormick-Williamson Tract. However, it is expected that flows high enough to overtop levees and roadways would be infrequent and would occur only during flood season, and would not be substantially different than access during flooding under existing conditions. During high-flow events, access to McCormick-Williamson Tract would be similar to existing conditions, based on the corresponding height of the weir relative to the existing access road.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-5: Changes in Navigation.

Alternative 1-A would result in levee modifications that, in turn, could affect the navigability of channels in the Project area. During construction, channel access may be restricted by the presence of equipment. All equipment would be removed from the channels once construction is completed and no permanent structures that would impede access would be constructed.

Alternative 1-A could affect the navigability of local channels when water spills into the McCormick-Williamson Tract detention basin. Because changes in channel hydraulics great enough to affect navigation in local channels would be infrequent and would occur only during flood season, Alternative 1-A would not result in a substantial change in the navigability of Delta waterways.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

Alternative 1-B would result in impacts on traffic, hazards, and circulation similar to those described for Alternative 1-A. Although the components of Alternative 1-B differ slightly from Alternative 1-A, the overall increases in traffic and road hazards, as well as changes in circulation patterns, would occur in the same general locations and be of the similar magnitude. As part of the Project's environmental commitments (see Chapter 2), a traffic control plan will be prepared and implemented to reduce construction-related effects on the capacity and circulation characteristics of local roadways and to reduce hazards resulting from construction-related traffic. Additionally, traffic delays, increased road hazards, and changes in circulation patterns would be temporary and would end once construction is completed.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface.

Implementing Alternative 1-B would result in impacts on roadway surfaces similar to those described for Alternative 1-A. However, environmental commitments (Chapter 2) include the commitment to coordinate with the Sacramento County Department of Transportation Right of Way Division to determine the appropriate repair to damaged roads. This commitment will ensure that roadways damaged during construction of the Project are repaired to pre-Project conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

Similar to Alternative 1-A, implementing Alternative 1-B could require the construction of new roads and the improvement of some existing roads to accommodate construction equipment. This would result in beneficial effects on transportation as it would generally improve the condition of the roadways in the Project area.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact TN-4: Changes in Circulation and Access.

Similar to Alternative 1-A, Alternative 1-B would result in changes in circulation patterns when water is spilling into McCormick-Williamson Tract. However, it is expected that flows high enough to overtop levees and roadways would be infrequent and would occur only during flood season. During high-flow events, access to McCormick-Williamson Tract would be similar to existing conditions, based on the corresponding height of the weir relative to the existing access road.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-5: Changes in Navigation.

Alternative 1-B would result in impacts on navigation similar to those described for Alternative 1-A. Alternative 1-B would not result in a substantial change to the navigability of Delta waterways.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat

- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

Implementing Alternative 1-C would result in similar impacts on traffic, hazards, and circulation to those described for Alternative 1-A. Although the components of Alternative 1-C differ slightly from Alternative 1-A, the overall increases in traffic and road hazards, as well as changes in circulation patterns, would occur in the same general locations and be of similar magnitude. As part of the Project's environmental commitments (see Chapter 2), a traffic control plan will be prepared and implemented to reduce construction-related effects on the capacity and circulation characteristics of local roadways and to reduce hazards resulting from construction-related traffic. Additionally, traffic delays, increased road hazards, and changes in circulation patterns would be temporary and would end once construction is completed.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface.

Implementing Alternative 1-C would result in similar impacts on roadway surfaces as described for Alternative 1-A. However, the Project includes an environmental commitment (Chapter 2) to coordinate with the Sacramento County Department of Transportation Right of Way Division to determine the appropriate repairs to damaged roads. This commitment will ensure that roadways damaged during construction of the Project are repaired to pre-Project conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

Similar to Alternative 1-A, implementing Alternative 1-C could require the construction of new roads and the improvement of some existing roads to accommodate construction equipment. This would result in beneficial effects on transportation, as it would generally improve the condition of the roadways in the Project area.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact TN-4: Changes in Circulation and Access.

Similar to Alternative 1-A, Alternative 1-C would result in changes in circulation patterns when water is spilling into McCormick-Williamson Tract. However, it is expected that flows high enough to overtop levees and roadways would be infrequent and would occur only during flood season. During high-flow events, access to McCormick-Williamson Tract would be similar to existing conditions, based on the corresponding height of the weir relative to the existing access road.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-5: Changes in Navigation.

Implementing Alternative 1-C would result in impacts on navigation similar to those described for Alternative 1-A. Alternative 1-C would not result in a substantial change to the navigability of Delta waterways.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

Alternative 2-A would result in a temporary increase in construction-related traffic on local roadways. Construction materials transported to the Project site include levee materials, RSP, and bridge components. Materials from the degraded levee would be hauled to sites in the Project area and used to construct Project components.

In addition to construction equipment, construction workers would access the site over local roadways. The construction work force for the Project would most likely be drawn from the local labor pool in San Joaquin and Sacramento Counties. It is anticipated that workers would commute 20 miles or less one way.

Transporting materials may result in increased travel times on local roads, but would not likely result in any substantial delays on major highways such as I-5 and SR 4. During construction, increases in roadway hazards and changes in circulation patterns would occur. The capacity of the local roadways is not expected to substantially decrease because these roads are used primarily by local residents and agricultural equipment.

Alternative 2-A includes raising Walnut Grove–Thornton Road and Staten Island Road. Additionally, options in this alternative include retrofitting or replacing the New Hope Bridge and/or the Millers Ferry Bridge. During raising, retrofit, and replacement activities, traffic patterns and circulation would be altered because of temporary disruption to existing roads and detours. During bridge construction activities, it is likely that Walnut Grove–Thornton Road on Staten Island would be closed and traffic detoured, mostly to Twin Cities Road to the north to maintain access for Walnut Grove, Locke, and surrounding residences and businesses between SR 160 (via River Road) and I-5. It is also likely that the retrofitting or replacement of Millers Ferry Bridge would require the temporary removal of the bridge. Closure may last up to 60 days. As part of the Project's environmental commitments (see Chapter 2), a traffic control plan will be prepared and implemented to reduce construction-related effects on the local roadways to avoid hazardous traffic and circulation patterns during the construction period. Any traffic delays, increased road hazards, and changes in circulation patterns resulting from construction activities would be temporary and would return to pre-Project conditions once construction is completed.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface.

Maintenance of San Joaquin and Sacramento county roads includes periodic inspection to assess structural integrity and need for repairs, followed by implementation of needed repairs. If construction trucks travel on roadways that are not covered by these maintenance programs, roadway damage such as potholes or minor fractures may occur that is not subject to inspection and repair. However, environmental commitments (Chapter 2) will ensure DWR will coordinate with the Sacramento County Department of Transportation Right of Way Division to determine the appropriate repair and maintenance for damaged roads. This commitment will ensure that roadways damaged during construction of the Project are repaired to pre-Project conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

Alternative 2-A includes constructing new roads and a bridge and would require the improvement and raising of Walnut Grove–Thornton Road and Staten Island Road. Additionally, other roads in the Project area may require improvements to support heavy trucks used for construction activities. Levee roads that would be used by construction equipment would need to be reinforced by widening the crown and surfacing with aggregate. Although construction of these components would temporarily disrupt traffic, this would result in permanent beneficial effects on transportation as the condition of local roadways would improve.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact TN-4: Changes in Circulation and Access.

Degrading portions of the northern Staten Island levee, and subsequently the levee road, would result in changes in circulation. Portions of the levees would be degraded to allow water to flow over the top into Staten Island during periods of high flow and vehicle access would be restricted. This would result in permanent changes in circulation. However, alternative routes would remain accessible for the relatively few vehicles that use these levee roads.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-5: Changes in Navigation.

Implementing Alternative 2-A would result in several levee modifications that, in turn, could change the hydrology and navigability of channels in the Project area. During construction, channel access may be restricted. Upon completion of construction activities associated with the levee modifications, there would be no substantial changes in navigation. As water enters the detention basin, it would relieve the channels of excess volume. Although this is a change from existing conditions, it would only result in the control of potential floodwaters and would not affect the capacity or navigability of the Mokelumne River.

Retrofitting or replacing Millers Ferry or New Hope Bridges would require at least the partial closure of the Mokelumne River for up to 60 days in the immediate vicinity of each bridge. This would result in decreased or prohibited access for all watercraft not related to construction. Alternative routes would be provided for watercraft at each bridge site. Because the adverse impacts on navigation would be temporary and conditions would generally be improved or unchanged upon completion of construction activities, this alternative would not result in substantial navigational changes.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

Implementing Alternative 2-B would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the west side of Staten Island instead of the north.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface.

Implementing Alternative 2-B would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the west side of Staten Island instead of the north.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

Implementing Alternative 2-B would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the west side of Staten Island instead of the north. Walnut-Grove Thornton Road would not be elevated under this alternative.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact TN-4: Changes in Circulation and Access.

Implementing Alternative 2-B would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the west side of Staten Island instead of the north.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-5: Changes in Navigation.

Implementing Alternative 2-B would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the west side of Staten Island instead of the north. Additionally, the setback levee on the North Mokelumne River could result in changes to navigation during high flows by providing additional area accessible to small watercraft.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

Implementing Alternative 2-C would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the east side of Staten Island instead of the north.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface

Implementing Alternative 2-C would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the east side of Staten Island instead of the north.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

Implementing Alternative 2-C would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the east side of Staten Island instead of the north. Walnut-Grove Thornton Road would not be elevated under this alternative.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact TN-4: Changes in Circulation and Access.

Implementing Alternative 2-C would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the east side of Staten Island instead of the north.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-5: Changes in Navigation.

Implementing Alternative 2-C would result in impacts similar to those described for Alternative 2-A. Slight differences would occur because construction activities would be located primarily on the east side of Staten Island instead of the north. Additionally, the setback levees that would be constructed may result in increased navigability of the South Fork Mokelumne River during high flows when there is greater accessibility for small watercraft.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modification

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact TN-1: Temporary Increase in Traffic Delays, Increase in Road Hazards, and Changes in Circulation Patterns.

The impacts of Alternative 2-D on traffic patterns would be the same as described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-2: Deterioration of the Roadway Surface.

This impact would be the same as described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact TN-3: Construction of New or Improvement of Existing Roads.

This impact would be the same as described for Alternative 1-A.

Impact TN-4: Changes in Circulation and Access.

This impact would be the same as described for Alternative 1-A.

Impact TN-5: Changes in Navigation.

Implementing Alternative 2-D would result in several levee modifications that, in turn, could change the hydrology and navigability of channels in the Project area. During construction, channel access may be restricted by the presence of barges and other dredge equipment. All equipment would be removed from the channels and no permanent structures would be constructed. Upon completion of levee modifications, changes in navigability could occur during high flows when the McCormick-Williamson Tract is used as a detention basin. Additionally, a portion of the tract could be made available to non-motorized watercraft. Upon completion of dredging, the channel would allow for greater volumes of water and would therefore improve navigability in this area.

Retrofitting or replacing Millers Ferry or New Hope Bridges would require at least the partial closure of the Mokelumne River for up to 60 days in the immediate vicinity of each bridge. This would result in decreased or prohibited access for all watercraft not related to construction. Alternative routes would be provided for watercraft at each bridge site. The adverse impacts on navigation would be temporary and conditions would generally be improved or unchanged upon completion of construction activities.

This alternative would not result in substantial navigational changes.

Determination of Significance: Less than significant.

Mitigation: None required.

3.9 Air Quality

Analysis Summary

Table 3.9-1 summarizes air quality impacts and mitigation measures associated with the Project.

Introduction

This section describes existing air quality in the Project area. It also presents the federal, state, and local policies and regulations that determine mitigation requirements; and identifies impacts associated with implementation of the Project.

Sources of Information

The following key sources of information were used in the preparation of this section:

- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.
- California Air Resources Board. 2003. Proposed Amendments to the Area Designation Criteria and Area Designations for State Ambient Air Quality Standards and Maps of Area Designations for State and National Ambient Air Quality Standards. December 5. Sacramento, CA
- California Air Resources Board. 2005. ARB Databases: Aerometric Data Analysis and Management System (ADAM). Last Revised: September 12, 2005. Available: <http://www.arb.ca.gov/html/databases.htm>. Accessed: January 9, 2006.
- Guerra, Hector, Senior Air Quality Planner, San Joaquin Valley Unified Air Pollution Control District. September 26, 2003 telephone conversation regarding health risk assessment procedures for Diesel exhaust from construction equipment in the San Joaquin Valley Air Basin.
- Sacramento Metropolitan Air Quality Management District. 2004. Guide for Air Quality Assessment in Sacramento County. July 10. Sacramento, CA.
- San Joaquin Valley Unified Air Pollution Control District. 2002. Guide for Assessing and Mitigating Air Quality Impacts. Mobile Source/CEQA Section of the Planning Division of the San Joaquin Valley Unified Air Pollution Control District. January 10. Fresno, CA.

- Stonefield, David H. Environmental Engineer. U.S. Environmental Protection Agency: Ozone Policy and Strategies Group, Research Triangle Park, NC. December 17, 2004 – email message
- U.S. Environmental Protection Agency. 2006. Air Data. Last Revised: January 3, 2006. Available: <http://www.epa.gov/air/data/reports.html>. Accessed: January 9, 2006.
- Energy and Environmental Analysis, Inc. 2000. Analysis of Commercial Marine Vessels Emissions and Fuel Consumption Data. EPA420-R-00-002. February. Prepared for U.S. Environmental Protection Agency, Office of Transportation and Air Quality.

Assessment Methods

Construction-Related Emissions

Construction of the Project would result in the temporary generation of emissions of carbon monoxide (CO), reactive organic gases (ROG), oxides of nitrogen (NO_x), and particulate matter 10 microns or less in diameter (PM10). Emissions would originate from mobile and stationary construction equipment exhaust, employee vehicle exhaust, dust from clearing the land, exposed soil eroded by wind, and ROGs from architectural coatings. Construction-related emissions would vary substantially depending on the level of activity, length of the construction period, specific construction operations, types of equipment, number of personnel, wind and precipitation conditions, and soil moisture content.

Construction-related emissions associated with construction equipment operation and earthmoving truck trips were estimated and analyzed using URBEMIS2002, which is a computer program used to estimate emissions from construction, vehicle trips, and fuel use resulting from land use development projects. To estimate construction emissions, URBEMIS2002 analyzes the type of construction equipment used and the duration of the construction period. Emissions associated with barge and dredging activities were estimated from emission factors provided by the EPA (Energy and Environmental Analysis 2000).

The Project proponent has provided a preliminary summary of equipment operations anticipated to implement the Project components, and Table 2-8a through Table 2-8g summarizes the operation, equipment used, material volume, and duration of the operation for each alternative. Because some of the information pertaining to equipment operations is preliminary and incomplete, many assumptions were used to complete the analysis. The information used in the assessment of air quality impacts is summarized in Table 3.9-2.

In addition to the preliminary summary of equipment operations, the Project proponent has also provided preliminary schedule and phasing information for the equipment operations. A detailed construction schedule has not yet been developed based on these constraints, but the construction season is anticipated to

Table 3.9-1. Summary of Air Quality Impacts and Mitigation Measures

	Alternative							
	NP	1-A	1-B	1-C	2-A	2-B	2-C	2-D
Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels								
Significance before mitigation	LTS	SU	SU	SU	SU	SU	SU	SU
Significance after mitigation	LTS	SU	SU	SU	SU	SU	SU	SU
Mitigation measures	NA	AIR-1 through AIR-6	AIR-1 through AIR-6	AIR-1 through AIR-6	AIR-1 through AIR-6	AIR-1 through AIR-6	AIR-1 through AIR-6	AIR-1 through AIR-6
Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk								
Significance before mitigation	LTS	LTS	LTS	LTS	LTS	LTS	LTS	LTS
Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels								
Significance before mitigation	LTS	SU	SU	SU	SU	SU	SU	SU
Significance after mitigation	LTS	SU	SU	SU	SU	SU	SU	SU
Mitigation measures	NA	AIR-7	AIR-7	AIR-7	AIR-7	AIR-7	AIR-7	AIR-7

NP = No Project.
LTS = Less than significant.
SU = Significant and unavoidable.
NA = Not applicable.

Table 3.9-2. Summary of Analysis Assumptions

Component	Equipment[a] Crane[b]	Excavator[c]	Grader[d]	Roller[e]	Bulldozer[f]	Scraper[g]	Paver[h]	Barge	Soil Moved Yards^3	Soil Moved Yards^3/Day[i]	Soil Moved Trips/Day[j,k]	Aggregate Yards^3	Aggregate Trips/Day[j,k]	Acres Dist. per Day	Barges per Day	New Roads Built?	Pumps?	Prescrib. Burning?	Mowing?	Levee Maintenance Soil	Levee Maintenance Grading	Road/Levee Maintenance Aggregate	Road/Levee Maintenance Grading	Total Demolish Build. Dimension	Max. Build. Demol/Day	Demolition Trips/Day[l]	Painting
Component 1-A																											
1		1		2	2	2			58,667	1,333.3409		15,000	17.0						X								
2		2		4	4	4			122,212	2,777.5455		30,000	34.1						X								
3	1							1				30,000		2.5					X								
4			2	2								30,000	34.1	2.5								X	X				
5			2	4	4				91,424	692.6061	46.0	30,000				X			X			X	X				
6		1			1																			100x100x24	30x30x24	10.0	
7			3	6	6	6			552,500	5,022.7273	251.1								X								
8			2	2	2									2.5				X	X								
9	1												5.0	1.0			X										
10		2		2	2				8,837	133.8934	6.7								X								
16a[m]		2		4	4	4			387,200	5,866.6667	293.3																
16b[n]		2		4	4	4			403,333	6,111.1060	305.6																
17		8		8	8	8			934,000	7,075.7576	353.8																
18	1[o]		2[p]					1[q]	1,350,000					5.0													
19																											
Component 1-B																											
2		1		2	2	2			70,500	1,602.2727		15,000	17.0						X								
8				2	2									2.5				X	X								
12	1	2												1.0													
Component 1-C																											
13				2	2				20,279	460.8864				2.5													
14					3									5.0													
Component 2-A																											
A		2		5		5			337,500	5,113.6363		60,000	45.0														
B		16	16	16	16				2,300,000	17,424.2424	909.1	100,000				X			X	X	X	X	X				
C			2	2		2			18,222	276.0909																	X
D	1	1												1.0													
E		2										60,000	34.1	1.0								X					

Table 3.9-2. Continued

Component	Equipment[a]								Soil Moved Yards^3	Soil Moved Yards^3/Day[i]	Soil Moved Trips/Day[j,k]	Aggregate Yards^3	Aggregate Trips/Day[j,k]	Acres Dist. per Day	Barges per Day	New Roads Built?	Pumps?	Prescrib. Burning?	Mowing?	Levee Maintenance		Road/Levee Maintenance		Total Demolish Build. Dimension	Max. Build. Demol/Day	Demolition Trips/Day[l]	Painting
	Crane[b]	Excavator[c]	Grader[d]	Roller[e]	Bulldozer[f]	Scraper[g]	Paver[h]	Barge												Soil	Grading	Aggregate	Grading				
G				4	4	4			81,000	1,227.2727									X	X		X					
H	1	2		2	4									1.0										200x200x100	50X50X50	57.9	
I				1	1	1	1									X											
J	1	1			1						5.7																X
K	1	1			1						5.7																X
L				1	1		1																				
Component 2-B																											
A		2		4		4			44,000	66.6667		15,000	11.4														
F			8	8	8				946,296	7,168.9091	358.4																
G				4	4	4			348,889	5,286.1970									X	X		X					
Component 2-D																											
N	1[o]		2[p]					1[q]	2,700,000					5.0													
O																											

Notes: Red Text = Assumed Data

a All construction equipment assumed to operate for 12 hours per day
b Crane = 190 horsepower (hp), 0.43 load factor
c Excavator = 180 hp, 0.58 load factor
d Grader = 174 hp, 0.575 load factor
e Roller = 114 hp, 0.43 load factor
f Dozer = 352 hp, 0.59 load factor
g Scraper = 313 hp, 0.66 load factor
h Paver = 132 hp, 0.59 load factor
I Based on total amount of earth and rock moved over entire component construction duration
j Calculated by URBEMIS2002
k Round trip haul route assumed at 20 miles
l Round trip haul route assumed at 30 miles
m New Hope--> McCormack
n Dixon--> McCormack
o Crane would be used under the dragline dredging option
p for construction of drying basins
q one barge and one tug would be used. See barge emissions spreadsheet for barge assumptions

likely occur between May 1 and October 15. Construction is likely to be completed over two to three construction seasons, with the first possible season in 2008. Most construction would be conducted during weekdays over a 12 hour work day between the hours of 7 a.m. and 6 p.m.; however, work on key public infrastructure (such as roadways) and other schedule-sensitive elements may necessitate extended working hours and work on weekends. A likely general work sequence and schedule provided by the Project proponent is presented in Table 2-7a, Table 2-7b, and Table 2-7c. Based on the assumptions from Table 3.9-2 and data provided in Table 2-7a Table 2-7b, and Table 2-7c, this analysis assumes that construction activities associated with each Project component would occur throughout the duration of the months scheduled, with all equipment pieces in operation for each appropriate component to represent a worst-case scenario.

Operation-Related Emissions

Project operations would primarily consist of maintenance activities, including prescribed burning, mowing of vegetation, operation of pumps, application of soil and grading of levees, application of aggregate and grading of levee and access roads, street sweeping, application of architectural coatings, and maintenance dredging of the south fork of the Mokelumne River. The Project proponent did not provide specific data regarding the extent and timing of, and equipment necessary to complete maintenance activities. Consequently, emissions associated with Project operations are addressed qualitatively in this analysis. In addition, it is anticipated that significant impacts will primarily result from construction, rather than operational, activities, because of the scale of construction activities associated with each of the Project components, relative to operational activities that are anticipated to occur. Pump and siphon operations associated with Alternatives 1-A through 1-C will involve the operation of gasoline, diesel, and propane powered pumps. However, operations under Alternatives 1-A through 1-C will either decommission these pumps or result in no net change in operations, relative to existing conditions, and would not result in increased emissions resulting from implementation of the Project.

Physical Setting/Affected Environment

This section discusses the existing conditions related to air quality in the Project area. Federal, state, and local regulations related to air quality that would apply to the proposed program are discussed in detail below.

The Project site is located within Sacramento and San Joaquin Counties. Sacramento County is located in the Sacramento Valley Air Basin (SVAB), while San Joaquin County is located within the San Joaquin Valley Air Basin (SJVAB). The SVAB is bound on the west by the Coast Ranges (averaging 3,000 feet in elevation), on the north by the Cascade Range (as high as 14,410 feet in elevation), and on the east by the Sierra Nevada (8,000–14,000 feet in elevation), and it includes Sacramento, Shasta, Tehama, Butte, Glenn, Colusa, Sutter, Yuba, Yolo, and parts of Solano and Placer Counties. The Sacramento Metropolitan Air Quality Management District (SMAQMD) has jurisdiction over air quality issues within Sacramento County portion of the SVAB.

The SJVAB is defined by the Sierra Nevada to the east, the Coast Ranges to the west, and the Tehachapi Mountains to the south (6,000–8,000 feet in elevation). The SJVAB includes a portion of Kern County and all of San Joaquin, Stanislaus, Merced, Madera, Fresno, Kings, and Tulare Counties. The San Joaquin Valley Air Pollution Control District (SJVAPCD) has jurisdiction over air quality issues throughout the eight-county SJVAB.

Regional Climate and Meteorology

The Project would be located in Sacramento and San Joaquin Counties. These counties are in the south end of the Sacramento Valley and the north end of the San Joaquin Valley, respectively. This area is about 50 miles east-northeast of the Carquinez Strait, a sea-level gap between the Coast Ranges and the Diablo Range. The prevailing winds are from the south and west, primarily because of marine breezes through the Carquinez Strait, although during winter the sea breezes diminish and winds from the north occur more frequently. This portion of the Project area has episodes of poor atmospheric mixing caused by inversion layers. Inversion layers form when temperature increases with elevation aboveground or when a mass of warm, dry air settles over a mass of cooler air near the ground. Surface inversions (0–500 feet) are most frequent in winter, and subsidence inversions (1,000—2,000 feet) are most frequent in summer. Inversion layers limit vertical mixing in the atmosphere, trapping pollutants near the surface.

Criteria Pollutants and Local Air Quality

Description of Pollutants

The federal and state governments have established ambient air quality standards for six criteria pollutants: ozone, CO, NO_2, SO_2, particulate matter, and lead. Ozone, NO_2, and particulate matter are generally considered to be "regional" pollutants, as these pollutants or their precursors affect air quality on a regional scale. Pollutants such as CO, SO_2, lead, and particulate matter are considered to be local pollutants that tend to accumulate in the air locally. Particulate matter is considered to be a localized pollutant as well as a regional pollutant. In the area where the Project is located, ozone, CO, and particulate matter are of particular concern. Brief descriptions of these pollutants are provided below.

Ozone

Ozone is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections and can cause substantial damage to vegetation and other materials. Ozone is a severe eye, nose, and throat irritant. Ozone also attacks synthetic rubber, textiles, plants, and other materials. Ozone causes extensive damage to plants by leaf discoloration and cell damage.

Ozone is not emitted directly into the air, but is formed by a photochemical reaction in the atmosphere. Ozone precursors, which include ROG and NO_x, react in the atmosphere in the presence of sunlight to form ozone. Because photochemical reaction rates depend on the intensity of ultraviolet light and air temperature, ozone is primarily a summer air pollution problem. The ozone precursors, ROG and NO_x, are emitted by mobile sources and by stationary combustion equipment.

State and federal standards for ozone have been set for an 8-hour averaging time. The state 8-hour standard is 0.070 parts per million (ppm), not to be exceeded, while the federal 8-hour standard is 0.08 ppm, not to be exceeded more than three times in any 3-year period. The state has established a 1-hour ozone standard of 0.09 ppm, not to be exceeded, while the federal 1-hour ozone standard of 0.12 ppm has recently been replaced by the 8-hour standard. State and federal standards are summarized in Table 3.9-3.

Carbon Monoxide

CO is essentially inert to plants and materials but can have significant effects on human health. CO is a public health concern because it combines readily with hemoglobin and thus reduces the amount of oxygen transported in the bloodstream. Effects on humans range from slight headaches to nausea to death.

Motor vehicles are the dominant source of CO emissions in most areas. High CO levels develop primarily during winter when periods of light winds combine with the formation of ground level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

State and federal CO standards have been set for both 1-hour and 8-hour averaging times. The state 1-hour standard is 20 parts by volume, and the federal 1-hour standard is 35 ppm. Both state and federal standards are 9 ppm for the 8-hour averaging period. State and federal standards are summarized in Table 3.9-3.

Inhalable Particulate Matter

Particulates can damage human health and retard plant growth. Health concerns associated with suspended particulate matter focus on those particles small enough to reach the lungs when inhaled. Particulates also reduce visibility and corrode materials.

The federal and state ambient air quality standard for particulate matter applies to two classes of particulates: PM10 and particulate matter 2.5 microns or less in diameter (PM2.5). The state PM10 standards are 50 micrograms per cubic meter (μ/m^3) as a 24-hour average and 20 μ/m^3 as an annual geometric mean. The federal PM10 standards are 150 μ/m^3 as a 24-hour average and 50 μ/m^3 as an annual arithmetic mean. The federal PM2.5 standards are 15 μ/m^3 for the annual average and 65 μ/m^3 for the 24-hour average. The state PM2.5 standard is 12 μ/m^3 as an annual geometric mean. State and federal standards are summarized in Table 3.9-3.

Toxic Air Contaminants

Toxic air contaminants (TACs) are pollutants that may be expected to result in an increase in mortality or serious illness or that may pose a present or potential hazard to human health. Health effects of TACs include cancer, birth defects, neurological damage, damage to the body's natural defense system, and diseases that lead to death. The California Air Resources Board (CARB) identified diesel exhaust particulate matter as a TAC in 2000.

Existing Air Quality Conditions

The existing air quality conditions in the proposed Project area can be characterized by monitoring data collected in the region. The closest monitoring station to the Project area within Sacramento County is the Bruceville Road monitoring station in Elk Grove, which monitors ozone. The closest monitoring station within Sacramento County that monitors all other pollutants is the T Street monitoring station in Sacramento. The closest monitoring station to the Project area in San Joaquin County is the Wagner-Holt School monitoring station in Stockton, which monitors PM10. The closest monitoring station within San Joaquin County that monitors all other pollutants is the Hazelton Street monitoring station in Stockton. Air quality monitoring data from these monitoring stations is summarized in Table 3.9-4. This data represents air quality monitoring data for the last three years (2003–2005) in which complete data is available. The monitoring data in Table 3.9-4 indicates that state and federal standards for ozone, PM10, and PM2.5 were occasionally exceeded during the last three years in which complete data is available.

If monitored pollutant concentrations meet state or federal standards over a designated period of time, the area is classified as being in attainment for that pollutant. If monitored pollutant concentrations violate the standards, the area is considered a nonattainment area for that pollutant. If data are insufficient to determine whether a pollutant is violating the standard, the area is designated unclassified.

The EPA has classified Sacramento County as a severe nonattainment area for the 1-hour ozone standard and a serious nonattainment area for the 8-hour ozone standard. For the CO standard, the EPA has classified Sacramento County as a moderate (≤ 12.7 ppm) maintenance area. The EPA has classified Sacramento County as a moderate nonattainment area for the PM10 standard, while Sacramento County as classified as an unclassified/attainment area for the PM2.5 standard. The CARB has classified Sacramento County as a serious nonattainment area for the 1-hour ozone standard. For the CO standard, the CARB has classified Sacramento County as an attainment area. The CARB has classified Sacramento County as a nonattainment area for the PM10 and PM2.5 standards. Sacramento County's attainment status for each of these pollutants

Table 3.9-3. Ambient Air Quality Standards Applicable in California

			Standard (parts per million)		Standard (micrograms per cubic meter)		Violation Criteria	
Pollutant	Symbol	Average Time	California	National	California	National	California	National
Ozone*	O_3	1 hour	0.09	NA	180	NA	If exceeded	NA
		8 hours	0.070	0.08	137	157	If exceeded	If fourth highest 8-hour concentration in a year, averaged over 3 years, is exceeded at each monitor within an area
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
		1 hour	20.0	35	23,000	40,000	If exceeded	If exceeded on more than 1 day per year
(Lake Tahoe only)		8 hours	6	NA	7,000	NA	If equaled or exceeded	NA
Nitrogen dioxide	NO_2	Annual average	NA	0.053	NA	100	NA	If exceeded on more than 1 day per year
		1 hour	0.25	NA	470	NA	If exceeded	NA
Sulfur dioxide	SO_2	Annual average	NA	0.03	NA	80	NA	If exceeded
		24 hours	0.04	0.14	105	365	If exceeded	If exceeded on more than 1 day per year
		1 hour	0.25	NA	655	NA	If exceeded	NA
Hydrogen sulfide	H_2S	1 hour	0.03	NA	42	NA	If equaled or exceeded	NA
Vinyl chloride	C_2H_3Cl	24 hours	0.01	NA	26	NA	If equaled or exceeded	NA
Inhalable particulate matter	PM10	Annual geometric mean	NA	NA	20	NA	If exceeded	NA
		Annual arithmetic mean	NA	NA	NA	50	NA	If exceeded at each monitor within area
		24 hours	NA	NA	50	150	If exceeded	If exceeded on more than 1 day per year
	PM2.5	Annual geometric mean	NA	NA	NA	NA	If exceeded	NA
		Annual arithmetic mean	NA	NA	12	15	NA	If 3-year average from single or multiple community-oriented monitors is exceeded
		24 hours	NA	NA	NA	65	NA	If 3-year average of 98th percentile at each population-oriented monitor within an area is exceeded
Sulfate particles	SO_4	24 hours	NA	NA	25	NA	If equaled or exceeded	NA
Lead particles	Pb	Calendar quarter	NA	NA	NA	1.5	NA	If exceeded no more than 1 day per year
		30-day average	NA	NA	1.5	NA	If equaled or exceeded	NA

Notes: All standards are based on measurements at 25ºC and 1 atmosphere pressure.
National standards shown are the primary (health effects) standards.
NA = not applicable.

* The U.S. Environmental Protection Agency (EPA) recently replaced the 1-hour ozone standard with an 8-hour standard of 0.08 part per million. EPA issued a final rule that revoked the 1-hour standard on June 15, 2005. However, the California 1-hour ozone standard will remain in effect.

Source: California Air Resources Board 2003.

Table 3.9-4. Ambient Air Quality Monitoring Data Measured at the Elk Grove Bruceville Road, Sacramento T Street, Stockton Wagner-Holt School, and Stockton Hazelton Monitoring Stations

Pollutant Standards	Elk Grove Bruceville Road			Sacramento T Street			Stockton Wagner-Holt			Stockton Hazelton		
	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004
Ozone (O_3)												
Maximum 1-hour concentration (ppm)	0.096	0.108	0.096	0.109	0.111	0.105	–	–	–	0.102	0.104	0.096
Maximum 8-hour concentration (ppm)	0.082	0.089	0.086	0.091	0.091	0.075	–	–	–	0.081	0.088	0.080
Number of days standard exceeded[a]												
NAAQS 1-hour (>0.12 ppm)	0	0	0	0	0	0	–	–	–	0	0	0
CAAQS 1-hour (>0.09 ppm)	1	10	1	6	4	1	–	–	–	2	3	1
NAAQS 8-hour (>0.08 ppm)	0	5	1	3	1	0	–	–	–	0	1	0
Carbon Monoxide (CO)												
Maximum 8-hour concentration (ppm)	–	–	–	4.31	3.40	2.96	–	–	–	3.21	3.14	2.51
Maximum 1-hour concentration (ppm)	–	–	–	5.6	5.8	3.5	–	–	–	6.0	5.8	3.7
Number of days standard exceeded[a]												
NAAQS 8-hour (≥9.0 ppm)	–	–	–	0	0	0	–	–	–	0	0	0
CAAQS 8-hour (≥9.0 ppm)	–	–	–	0	0	0	–	–	–	0	0	0
NAAQS 1-hour (≥35 ppm)	–	–	–	0	0	0	–	–	–	0	0	0
CAAQS 1-hour (≥20 ppm)	–	–	–	0	0	0	–	–	–	0	0	0
Particulate Matter (PM10)[b]												
National[c] maximum 24-hour concentration (μg/m^3)	–	–	–	77.0	65.0	58.0	80.0	52.0	48.0	87.0	88.0	60.0
National[c] second-highest 24-hour concentration (μg/m^3)	–	–	–	61.0	45.0	49.0	65.0	50.0	43.0	78.0	63.0	56.0
State[d] maximum 24-hour concentration (μg/m^3)	–	–	–	81.0	66.0	58.0	84.0	53.0	50.0	91.0	90.0	61.0
State[d] second-highest 24-hour concentration (μg/m^3)	–	–	–	63.0	46.0	50.0	70.0	52.0	46.0	82.0	64.0	57.0
National annual average concentration (μg/m^3)	–	–	–	26.7	22.5	–	29.6	22.1	21.7	35.5	28.1	28.6
State[e] annual average concentration (μg/m^3)	–	–	–	27.6	23.3	–	30.6	22.8	22.4	36.1	28.4	29.4
Number of days standard exceeded[a]												
NAAQS 24-hour (>150 μg/m^3)[f]	–	–	–	0	0	–	0	0	0	0	0	0
CAAQS 24-hour (>50 μg/m^3)[f]	–	–	–	18.4	6.1	–	39.0	20.2	0	58.4	17.3	18.0
Particulate Matter (PM2.5)												
National[c] maximum 24-hour concentration (μg/m^3)	–	–	–	73.0	49.0	46.0	–	–	–	64.0	45.0	41.0
National[c] second-highest 24-hour concentration (μg/m^3)	–	–	–	69.0	41.0	43.0	–	–	–	55.0	44.0	39.0

Pollutant Standards	Elk Grove Bruceville Road			Sacramento T Street			Stockton Wagner-Holt			Stockton Hazelton		
	2002	2003	2004	2002	2003	2004	2002	2003	2004	2002	2003	2004
State[d] maximum 24-hour concentration (μg/m^3)	–	–	–	73.0	49.0	52.5	–	–	–	64.0	45.0	41.0
State[d] second-highest 24-hour concentration (μg/m^3)	–	–	–	69.0	41.0	48.0	–	–	–	55.0	44.0	39.0
National[c] annual average concentration (μg/m^3)	–	–	–	14.3	–	–	–	–	–	16.7	13.6	13.2
State[d] annual average concentration (μg/m^3) [e]	–	–	–	–	–	–	–	–	–	16.7	13.6	13.2
Number of days standard exceeded[a]												
NAAQS 24-hour (>65 μg/m^3)	–	–	–	4	0	0	–	–	–	0	0	0

Notes: CAAQS = California ambient air quality standards.
NAAQS = national ambient air quality standards.
– = insufficient data available to determine the value.

[a] An exceedance is not necessarily a violation.

[b] Measurements usually are collected every 6 days.

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

[d] 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.

[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.

Sources: California Air Resources Board 2005; U.S. Environmental Protection Agency 2006.

California Air Resources Board. 2005. ARB Databases: Aerometric Data Analysis and Management System (ADAM). Last Revised: September 12, 2005. Available: <http://www.arb.ca.gov/html/databases.htm>. Accessed: January 9, 2006.

U.S. Environmental Protection Agency. 2006. Air Data. Last Revised: January 3, 2006. Available: <http://www.epa.gov/air/data/reports.html>. Accessed: January 9, 2006.

relative to the National Ambient Air Quality Standards (NAAQS) and California Ambient Air Quality Standards (CAAQS) is summarized in Table 3.9-5.

Table 3.9-5. 2005 Sacramento County Attainment Status for State and Federal Standards

Pollutant	State	Federal
1-hour O_3	Serious nonattainment	NA
8-hour O_3	NA	Serious nonattainment
CO	Attainment	Moderate (≤ 12.7 ppm) maintenance area
PM10	Nonattainment	Moderate nonattainment
PM2.5	Nonattainment	Unclassified/attainment

The EPA has classified San Joaquin County as an extreme nonattainment area for the 1-hour ozone standard and a serious nonattainment area for the 8-hour ozone standard. For the CO standard, the EPA has classified the Stockton Urbanized Area (5/16/84, 49 FR 20651) as a moderate (≤ 12.7 ppm) maintenance area, while the rest of San Joaquin County is classified as an unclassified/attainment area. The EPA has classified San Joaquin County as a serious nonattainment area for the PM10 standard, while San Joaquin County as classified as a nonattainment area for the PM2.5 standard. The CARB has classified San Joaquin County as a severe nonattainment area for the 1-hour ozone standard. For the CO standard, the CARB has classified San Joaquin County as an attainment area. The CARB has classified San Joaquin County as a nonattainment area for the PM10 and PM2.5 standards. San Joaquin County's attainment status for each of these pollutants relative to the NAAQS and CAAQS is summarized in Table 3.9-6.

Table 3.9-6. 2005 San Joaquin County Attainment Status for State and Federal Standards

Pollutant	State	Federal
1-hour O_3	Severe nonattainment	NA
8-hour O_3	NA	Serious nonattainment
CO	Attainment	Moderate (≤ 12.7 ppm) maintenance area for the Stockton Urbanized Area (5/16/84, 49 FR 20651), unclassified/attainment area for rest of the County
PM10	Nonattainment	Serious nonattainment for the San Joaquin Valley planning area
PM2.5	Nonattainment	Nonattainment

Sensitive Land Uses

The SJVAPCD generally defines a sensitive receptor as a facility that houses or attracts children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants, and there is reasonable expectation of continuous human exposure according to the averaging period for the AAQS (e.g., 24-hour, 8-hour, 1-hour). The SMAQMD generally defines a sensitive receptor as facilities that generally house or attract children, the elderly, people with illnesses, or others who are especially sensitive to the effects of air pollutants and may experience adverse effects from unhealthful concentrations of air pollutants. Hospitals, schools, convalescent facilities, and residential areas are examples of sensitive receptors.

Sensitive uses in the Project area include isolated single family residences surrounding the McCormack-Williamson Tract East and Southwest Levees and the east side of the Staten Island (Figure 3.9-1) and there are sensitive land uses located in the towns of Walnut Grove, Courtland, Hood, Clarksburg, Rio Vista, and Point Pleasant.

Regulatory Setting and Significance Criteria

Regulatory Setting

Federal and State Ambient Air Quality Standards

California and the federal government have established standards for several different pollutants. For some pollutants, separate standards have been set for different measurement 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 pollutants of greatest concern in the Project area are CO, ozone, and PM 2.5 and PM10, which are inhalable. Table 3.9-3 shows the state and federal standards for a variety of pollutants.

Federal Regulations

The federal Clean Air Act (CAA), promulgated in 1970 and amended twice thereafter (including the 1990 amendment), establishes the framework for modern air pollution control. This act directs the EPA to establish ambient air standards for six pollutants: ozone, CO, lead, nitrogen dioxide, particulate matter, and sulfur dioxide. The standards are divided into primary and secondary standards; the former are set to protect human health within an adequate margin of safety and the latter to protect environmental values, such as plant and animal life.

The primary legislation that governs federal air quality regulations is the Clean Air Act Amendments of 1990 (CAAA). The CAAA delegates primary responsibility for clean air to the EPA. The EPA develops rules and regulations to preserve and improve air quality, as well as delegating specific responsibilities to state and local agencies.

Federal Conformity Requirements

The CAAA of 1990 requires that all federally funded projects come from a plan or program that conforms to the appropriate State Implementation Plan (SIP). Federal actions are subject to either the Transportation Conformity Rule (*40 CFR 51[T]*), which applies to federal highway or transit projects, or the General Conformity Rule (*40 CFR 51[W]*), which applies to all other federal actions.

General Conformity Requirements

The purpose of the General Conformity Rule is to ensure that federal actions conform to applicable SIPs so that they do not interfere with strategies employed to attain the NAAQS. The rule applies to federal actions in areas designated as nonattainment areas for any of the six criteria pollutants and in some areas designated as maintenance areas. The rule applies to all federal actions except:

- programs specifically included in a transportation plan or program that is found to conform under the federal transportation conformity rule,
- projects with associated emissions below specified *de minimis* threshold levels, and
- certain other projects that are exempt or presumed to conform.

A general conformity determination would be required if a proposed action's total direct and indirect emissions fail to meet any of the following two conditions:

- emissions for each affected pollutant for which the region is classified as a maintenance or nonattainment area for the national standards are below the *de minimis* levels indicated in Tables 3.9-7 and 3.9-8, and
- emissions for each affected pollutant for which the region is classified as a maintenance or nonattainment area for the national standards are regionally insignificant (total emissions are less than 10% of the area's total emissions inventory for that pollutant).

If any of the two conditions above are not met, a general conformity determination must be performed to demonstrate that total direct and indirect emissions for each affected pollutant for which the region is classified as a maintenance or nonattainment area for the national standards would conform with the applicable SIP.

However, if the above two conditions are met, then the requirements for general conformity do not apply because the proposed action is presumed to conform with the applicable SIP for each affected pollutant. As a result, no further analysis or determination would be required.

Table 3.9-7. Federal *de Minimis* Threshold Levels for Criteria Pollutants in Nonattainment Areas

Pollutant	Emission Rate (Tons per Year)
Ozone (Volatile Organic Compounds [VOCs] 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	
VOC	50
NO_x	100
CO: All nonattainment areas	100
SO_2 or NO_2: All nonattainment areas	100
PM10	
Moderate nonattainment areas	**100**
Serious nonattainment areas	70
Pb: All nonattainment areas	25

Note: *de minimis* threshold levels for conformity applicability analysis.

Boldfaced text indicates pollutants for which the region is in non-attainment, and a conformity determination must be made.

Source: 40 CFR 51.853.

Table 3.9-8. Federal *de Minimis* Threshold Levels for Criteria Pollutants in Maintenance Areas

Pollutant	Emission Rate (Tons per Year)
Ozone (NO_x), SO_2 or NO_2	
All maintenance areas	100
Ozone (VOC)	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
CO: All maintenance areas	**100**
PM10: All maintenance areas	100
Pb: All maintenance areas	25

Note: *de minimis* threshold levels for conformity applicability analysis.

Boldfaced text indicates pollutants for which the region is a maintenance area, and a conformity determination must be made.

Source: 40 CFR 51.853.

Because the Project is not a federal highway or transit project, it is subject to the General Conformity Rule. As indicated in Tables 3.9-4 and 3.9-5, the Project area is classified federally as a serious nonattainment area for the 8-hour ozone standard, a serious nonattainment area for the PM10 standard, and a moderate maintenance area for CO. Consequently, to fulfill general conformity requirements, an analysis must be undertaken to identify whether the proposed action's total emissions of ozone, PM10, and CO

- are below the appropriate *de minimis* levels indicated in Tables 3.9-6 and 3.9-7, and
- are regionally insignificant (total emissions are less than 10% of the area's total emissions inventory for that pollutant)

It should be noted that after June 15, 2005, federal conformity for ozone is based on the 8-hour standard rather than the 1-hour standard (Stonefield pers. comm.). Furthermore, the Project area lies within Sacramento and San Joaquin Counties, which have differing attainment designations for the federal PM10 standard (moderate nonattainment for Sacramento County and serious nonattainment for San Joaquin County). To represent a worst-case scenario, the conformity determination in this analysis is based on the most stringent *de minimis* classification from Tables 3.9-7 and 3.9-8.

State Regulations

Responsibility for achieving California's standards, which are more stringent than federal standards, is placed on the CARB and local air districts and is to be achieved through district-level air quality management plans that will be incorporated into the SIP. In California, the EPA has delegated authority to prepare SIPs to the CARB, which, in turn, has delegated that authority to individual air districts

The CARB has traditionally established state air quality standards, maintaining oversight authority in air quality planning, developing programs for reducing emissions from motor vehicles, developing air emission inventories, collecting air quality and meteorological data, and approving state implementation plans.

Responsibilities of air districts include overseeing stationary source emissions, approving permits, maintaining emissions inventories, maintaining air quality stations, overseeing agricultural burning permits, and reviewing air quality–related sections of environmental documents required by CEQA.

The California Clean Air Act of 1988 (CCAA) substantially added to the authority and responsibilities of air districts. The CCAA designates air districts as lead air quality planning agencies, requires air districts to prepare air quality plans, and grants air districts authority to implement transportation control measures. The CCAA focuses on attainment of the state ambient air quality standards, which, for certain pollutants and averaging periods, are more stringent than the comparable federal standards.

The CCAA requires designation of attainment and nonattainment areas with respect to state ambient air quality standards. The CCAA also requires that local and regional air districts expeditiously adopt and prepare an air quality attainment plan if the district violates state air quality standards for CO, sulfur dioxide, nitrogen dioxide, or ozone. These Clean Air Plans are specifically designed to attain these standards and must be designed to achieve an annual five percent reduction in district-wide emissions of each nonattainment pollutant or its precursors. No locally prepared attainment plans are required for areas that violate the state PM10 standards.

The CCAA requires that the state air quality standards be met as expeditiously as practicable but, unlike the federal CAA, does not set precise attainment deadlines. Instead, the act established increasingly stringent requirements for areas that will require more time to achieve the standards.

Local Regulations

The air quality management agencies of direct importance in Sacramento and San Joaquin Counties include the EPA, CARB, SMAQMD, and SJVAPCD. The EPA has established federal standards for which the CARB, SMAQMD, and SJVAPCD have primary implementation responsibility. The CARB, SMAQMD, and SJVAPCD are responsible for ensuring that state standards are met. The SMAQMD and SJVAPCD are responsible for implementing strategies for air quality improvement and recommending mitigation measures for new growth and development. At the local level, air quality is managed through land use and development planning practices and is implemented in the counties through the general planning process. The SMAQMD and SJVAPCD are responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws. The Project may be subject to the following air quality management district rules. In addition, the program may be subject to additional rules.

Sacramento Metropolitan Air Quality Management District

Within Sacramento County, the SMAQMD is responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws. The proposed program may be subject to the following SMAQMD rules. In addition, the program may be subject to additional rules.

- **SMAQMD RULE 202 (New Source Review):** The purpose of this rule is to provide for the review of new and modified stationary air pollution sources and to provide mechanisms, including emission offsets, by which authorities to construct such sources may be granted without interfering with the attainment or maintenance of ambient air quality standards.
- **SMAQMD RULE 204 (Emission Reduction Credits):** The purpose of this rule is to provide an administrative mechanism for quantifying, adjusting and certifying surplus emission reductions for later use as offsets pursuant to SMAQMD**;** state; or federal rules or regulations, or transfer to other sources as offsets pursuant to Rule 202, New Source Review.
- **SMAQMD RULE 205 (Community Bank and Priority Reserve Bank):** The Community Bank and the Priority Reserve Bank are established within the emission reduction Register pursuant to Rule 204, Emission Reduction Credits. The Priority Reserve Bank is established for the purpose of providing loans of emission reduction credits for use as offsets for new or modified stationary sources that are essential public services, or use or reuse of a military base. The Priority Reserve Bank also may be used for the purpose of providing loans of emission reduction credits to comply with rules specified in Section 102.4, a conformity determination pursuant to SMAQMD Rule 104 (General Conformity) or mitigation under the CEQA. The Community Bank is established for the purpose of providing loans of emission reduction credits to comply with specified prohibitory rules, New Source Review, a conformity determination pursuant to SMAQMD Rule 104 (General Conformity) or for use as mitigation under either CEQA or a functionally equivalent program pursuant to Public Resources Code Section 21080.5.
- **SMAQMD RULE 207 (Federal Operating Permit Program):** The purpose of this rule is to establish an operating permitting system consistent with the requirements of 42 U.S.C. Section 7661 et seq. (Title V) and pursuant to *40 CFR Part 70.* Stationary sources subject to the requirements of this rule are also required to comply with any other applicable federal, state, or SMAQMD orders, rules and regulations, including requirements pertaining to prevention of significant deterioration pursuant to Rule 203, Prevention of Significant Deterioration, requirements to obtain an authority

to construct pursuant to Rule 201, General Permit Requirements, or applicable requirements under Rule 202, New Source Review.

- **SMAQMD RULE 209 (Limiting Potential to Emit):** The purpose of this rule is to eliminate the need for certain stationary sources to obtain a Title V operating permit pursuant to SMAQMD Rule 207, Title V: Federal Operating Permit Program. Stationary sources subject to this rule are those whose actual emissions are less than or equal to 50% of those of a major stationary source, but whose potential emissions are equal to or greater than the major stationary source thresholds. These stationary sources must comply with emissions limitations set in this rule.
- **SMAQMD RULE 301 (Stationary Source):** The purpose of this rule is to establish fees to be charged to (1) owners/operators of a stationary source required to obtain an Authority to Construct or a Permit to Operate by Rule 201, (2) owners/operators of a stationary source required to obtain a Title V operating permit by Rule 207, and (3) applicants requesting to deposit or withdraw emission reduction credits from the SMAQMD credit bank.
- **SMAQMD RULE 401 (Ringelmann Chart):** The purpose of this rule is to limit the discharge of air contaminants into the atmosphere through visible emissions and opacity.
- **SMAQMD RULE 402 (Nuisance):** The purpose of this rule is to protect the public's health and welfare from the emission of air contaminants that constitute a nuisance.
- **SMAQMD RULE 403 (Fugitive Dust):** The purpose of this rule is to reasonably regulate operations that periodically may cause fugitive dust emissions into the atmosphere.
- **SMAQMD RULE 404 (Particulate Matter):** The purpose of this rule is to limit the quantity of particulate matter in the atmosphere through establishment of an emission concentration limit.
- **SMAQMD RULE 405 (Dust and Condensed Fumes):** The purpose of this rule is to limit the discharge of dust and condensed fumes into the atmosphere by establishing emission rates based on process weight.
- **SMAQMD RULE 406 (Specific Contaminants):** The purpose of this rule is to limit the emission of sulfur compounds and combustion contaminants through establishment of emission concentrations.
- **SMAQMD RULE 407 (Open Burning):** The purpose of this rule is to reduce air pollution from non-agricultural open outdoor fires.
- **SMAQMD RULE 412 (Stationary Internal Combustion Engines Located at Major Stationary Sources of NO_x):** The purpose of this rule is to limit emissions of NO_x, CO, and non-methane hydrocarbons from the operation of stationary internal combustion engines, rated at more than 50 brake horsepower, located at a major stationary source of NO_x.
- **SMAQMD RULE 413 (Stationary Gas Turbines):** The purpose of this rule is to limit emissions of NO_x to the atmosphere from the operation of stationary gas turbines.

- **SMAQMD RULE 420 (Sulfur Content of Fuels):** The purpose of this rule is to limit the emission of compounds of sulfur from combustion of fuels.
- **SMAQMD RULE 442 (Architectural Coatings):** The purpose of this rule is to limit the quantity of volatile organic compounds (VOC) in architectural coatings supplied, sold, offered for sale, applied, solicited for application, or manufactured for use within the SMAQMD.
- **SMAQMD RULE 446 (Storage of Petroleum Products):** The purpose of this rule is to limit emissions from storage tanks for organic liquids with a vapor pressure greater than 1.5 psia (10.3 kPa) under actual storage conditions.
- **SMAQMD RULE 453 (Cutback and Emulsified Asphalt Paving Materials):** The purpose of this rule is to limit emissions of VOC from the use of cutback and emulsified asphalt in paving materials, paving, and maintenance operations.
- **SMAQMD RULE 501 (Agricultural Burning):** The purpose of this rule is to reduce air pollution through the regulation of agricultural burning.

Sacramento Metropolitan Air Quality Management District Thresholds of Significance

The SMAQMD has specified significance thresholds within its *Guide to Air Quality Assessment in Sacramento County* (2004) to determine whether mitigation is needed for project-related air quality impacts. The SMAQMD's thresholds of significance for construction- and operation-related emissions are presented below in Table 3.9-9.

Table 3.9-9. Sacramento Metropolitan Air Quality Management District Thresholds of Significance

	Ozone Precursor Emissions			
	ROG (lbs/day)	NO_x (lbs/day)	CO (lbs/day)	PM10 (lbs/day)
Construction (short-term)	None	85	CAAQS[a]	CAAQS[a]
Operational (long-term)	65	65	CAAQS[a]	CAAQS[a]

a. A project that may cause an exceedance of a state air quality standard or may make a substantial contribution to an existing exceedance of an air quality standard will have a significant adverse air quality impact. "Substantial" is defined as making measurably worse, which is 5% or more of an existing exceedance of a state ambient air quality standard.

Source: Sacramento Metropolitan Air Quality Management District 2004.

For the assessment of significant impacts from construction-related emissions of particulate matter, the SMAQMD has established screening levels based on a project's maximum actively disturbed area. Based on the maximum area disturbed, the SMAQMD recommends mitigation measures that would reduce particulate matter emissions to a less-than-significant level. Table 3.9-10 summarizes the mitigation measures the SMAQMD recommends for various project sizes.

Table 3.9-10. Sacramento Metropolitan Air Quality Management District Particulate Matter Screening Levels for Construction Projects

Screening Level	Mitigation
5 Acres and below	No mitigation required
5.1–8 Acres	Level One Mitigation Required: Water exposed soil twice daily. Maintain two feet of freeboard space on haul trucks
8.1–12 Acres	Level Two Mitigation Required: Water exposed soil three times daily. Water soil piles three times daily. Maintain two feet of freeboard space on haul trucks.
12.1–15 Acres	Level Three Mitigation Required: Keep soil moist at all times. Maintain two feet of freeboard space on haul trucks Use emulsified diesel or diesel catalysts on applicable heavy duty diesel construction equipment

Source: Sacramento Metropolitan Air Quality Management District 2004.

San Joaquin Valley Air Pollution Control District

At the local level, air quality is managed through land use and development planning practices. These practices are implemented in San Joaquin County through the general planning process. The SJVAPCD is responsible for establishing and enforcing local air quality rules and regulations that address the requirements of federal and state air quality laws. The proposed program may be subject to the following SJVAPCD rules. In addition, the program may be subject to additional rules.

- **SJVAPCD Rule 2201 (New and Modified Stationary Source Review Rule):** This rule applies to all new stationary sources and all modifications of existing stationary sources which are subject to SJVAPCD permit requirements and after construction emit or may emit one or more affected pollutant.
- **SJVAPCD Rule 2020 (Exemptions, Permits):** This rule exempts laboratory testing equipment used for chemical and physical analysis from permit requirements in the SJVAPCD provided that they emit no hazardous air pollutants and less than 2.0 pounds per day (75 pounds per year) of any other pollutant. This means that laboratories that emit even small quantities of hazardous air pollutants would be required to apply for and obtain permits from the SJVAPCD.
- **SJVAPCD Rule 3110 (Air Toxic Fees):** This is a program for facilities that emit toxic air contaminants. It is noted here that hospitals that do not use ethylene oxide for sterilizers are defined as *de minimis* facilities and are not subject to fee requirements.

- **SJVAPCD Rule 4002 (National Emission Standards for Hazardous Air Pollutants):** This rule applies to any portion of an existing building that will be renovated, partially demolished, or removed. Prior to any demolition activity, an asbestos survey of existing structures on the Project site may be required to identify the presence of any asbestos containing building material (ACBM). Any identified ACBM having the potential for disturbance must be removed by a certified asbestos-contractor in accordance with California Occupational Safety and Health Administration requirements.
- **SJVAPCD Rule 4101 (Visible Emissions):** This rule prohibits emissions of visible air contaminants to the atmosphere and applies to any source operation that emits or may emit air contaminants.
- **SJVAPCD Rule 4102 (Nuisance):** This rule applies to any source operation that emits or may emit air contaminants or other materials. In the event that the Project or construction of the Project creates a public nuisance, it could be in violation and be subject to SJVAPCD enforcement action.
- **SJVAPCD Rule 4103 (Open Burning):** This rule regulates the burning of agricultural material. Rule 4103 explicitly states that agricultural material shall not be burned when the land use is converted from agriculture to nonagricultural purposes.
- **SJVAPCD Rule 4641 (Cutback, Slow Cure, and Emulsified Asphalt, Paving, and Maintenance Operations):** If asphalt paving will be used, paving operations will be subject to this rule. This rule applies to the manufacture and use of cutback asphalt, slow cure asphalt, and emulsified asphalt for paving and maintenance operations.
- **SJVAPCD Rule 4701 (Internal Combustion Engines – Phase 1):** This rule limits the emissions of NO_x, CO, and VOC from internal combustion engines. These limits are not applicable to standby engines as long as they are used fewer than 200 hours per year (e.g., for testing during nonemergencies).
- **SJVAPCD Rule 4702 (Internal Combustion Engines – Phase 2):** This rule limits the emissions of NO_x, CO, and VOC from spark-ignited internal combustion engines.
- **SJVAPCD Rule 9510 (Indirect Source Review):** This rule fulfills the SJVAPCD's emission reduction commitments in the PM10 and Ozone Attainment Plans through emission reductions from the construction and use of development projects through design features and on-site measures. Rule 9510 applies to any applicant that seeks to gain a final discretionary approval for a development project, or any portion thereof, that upon full buildout will include any one of the following:
    - 50 residential units;
    - 2,000 square feet of commercial space;
    - 25,000 square feet of light industrial space;
    - 100,000 square feet of heavy industrial space;
    - 20,000 square feet of medical office space;

- 39,000 square feet of general office space;
- 9,000 square feet of educational space;
- 10,000 square feet of government space;
- 20,000 square feet of recreational space; or
- 9,000 square feet of space not identified above.

- **SJVAPCD Regulation VIII (Fugitive PM10 Prohibitions)** is a series of rules (Rules 8011–8081) designed to reduce PM10 emissions (predominantly dust/dirt) generated by human activity, including construction, road construction, bulk materials storage, landfill operations, etc. Specifically, the following rules comprise this regulation:
    - Rule 8011: General Requirements
    - Rule 8021: Construction, Demolition, Excavation, Extraction and Other Earthmoving Activities
    - Rule 8031: Bulk Materials
    - Rule 8041: Carryout and Trackout
    - Rule 8051: Open Areas
    - Rule 8061 Paved and Unpaved Roads
    - Rule 8071: Unpaved Vehicle/Equipment Traffic Areas
    - Rule 8081: Agricultural Sources

San Joaquin Valley Air Pollution Control District Thresholds of Significance

The SJVAPCD has specified significance thresholds within its *Guide for Assessing and Mitigating Air Quality Impacts* (San Joaquin Valley Air Pollution Control District 2002) to determine air quality impacts for projects located within the SJVAB. For construction activities, a review of the SJVAPCD's *Guide for Assessing and Mitigating Air Quality Impacts* (2002) indicates that the SJVAPCD considers PM10 to be the primary pollutant of concern from construction activities and that compliance with SJVAPCD Regulation VIII will constitute sufficient mitigation to reduce PM10 emissions to less-than-significant levels. For the CEQA analysis, construction emission estimates were not quantified as the SJVAPCD requires implementation of effective and comprehensive control measures rather than detailed quantification of emissions (San Joaquin Valley Air Pollution Control District 2002). The amount of PM10 emitted during construction activities varies greatly depending on the level of activity, the specific operations taking place, the equipment being operated, soil characteristics, and weather conditions. Despite this variability in emissions, experience has shown that several feasible control measures can be reasonably implemented to reduce PM10 emissions during construction.

The SJVAPCD has determined that compliance with its Regulation VIII Fugitive PM10 Prohibitions, including implementation of all feasible control measures specified in its *Guide for Assessing Air Quality Impacts* (San Joaquin Valley Air

Pollution Control District 2002), is sufficient mitigation to minimize adverse air quality effects from construction. All construction projects must abide by this regulation. Since the publication of the SJVAPCD's guidance manual, the SJVAPCD has revised some of the rules comprising Regulation VIII. Guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). This analysis assumes that the Project proponent would comply with Regulation VIII through implementation of a Dust Control Plan, which would be sufficient to eliminate any potentially substantial adverse air quality effects generated by construction activities and has been incorporated into the Project as an environmental commitment (see Chapter 2).

The SJVAPCD's operational thresholds of significance, as indicated in their *Guide for Assessing and Mitigating Air Quality Impacts* (2002), are summarized below:

- Expose sensitive receptors to substantial pollutant concentrations.
- Project operations would produce greater than 10 tons/year ROG.
- Project operations would produce greater than 10 tons/year $NO_{x.}$
- Project-related emissions of CO would exceed NAAQS or CAAQS (Table 3.9-3)
- Not comply with the San Joaquin Valley Air Pollution Control's Regulation VIII regarding particulate matter emissions from construction activities. Compliance with SJVAPCD Regulation VIII and the local zoning code will reduce particulate emission impacts to levels that are considered less-than-significant by the SJVAPCD.
- Result in more than 10 cases of cancer in one million.

Significance Criteria

CALFED Programmatic EIS/EIR

The CALFED Programmatic EIS/EIR contains applicable significance criteria identified by the 18 state and federal agencies with regulatory and management responsibilities in the San Francisco Bay/San Joaquin River Bay-Delta. These significance criteria are applicable to all projects located within the San Francisco Bay/San Joaquin River Bay-Delta program area or undertaken under the auspices of the CALFED Bay-Delta Program. Regarding air quality, potential impacts are considered potentially significant if the construction or operations of facilities would cause substantial adverse changes to the existing (ambient) air quality conditions in the affected area. The range of such changes includes producing emissions that would either on their own or when combined with existing emissions have the following effect(s):

- Violate federal or state ambient air quality standards.

- Cause a lowering of attainment status.
- Conflict with adopted air quality management plan policies or programs.

The criteria adopted in the CALFED Programmatic EIS/EIR are similar to those found in the State CEQA Guidelines. In addition, as previously indicated, the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make determinations with regard to the State CEQA Guidelines. Consequently, the significance criteria identified by the SMAQMD and SJVAPCD is assumed, by default, to address significance under the CALFED Bay-Delta Program.

National Environmental Policy Act

The Project would adversely affect air quality if combined Project emissions (i.e., construction and operational) of ozone precursors (ROG and NO_x) would exceed 50 tons per year and PM10 and CO emissions would exceed 100 tons per year.

California Environmental Quality Act

Based on the State CEQA Guidelines and standard professional practice, the Project would result in a significant impact on air quality if it would:

- conflict with or obstruct implementation of the applicable air quality management plan;
- violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors);
- expose sensitive receptors to substantial pollutant concentrations; or
- create objectionable odors affecting a substantial number of people.

The State CEQA Guidelines further state that the significance criteria established by the applicable air quality management or air pollution control district may be relied on to make the determinations above.

As previously indicated, the Project is located within Sacramento and San Joaquin Counties. Air quality within these counties is managed by the SMAQMD and SJVAPCD, respectively. Because the Project lies within the jurisdiction of two different air districts, the more stringent of the two differing thresholds of significance are used to assess the air quality impacts in this analysis. Consequently, construction impacts are assessed using the SMAQMD's thresholds of significance, while operational impacts are assessed using the SJVAPCD's thresholds of significance.

Impacts and Mitigation of the Project Alternatives

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of the CALFED program.

The discussion of significant impacts and mitigation measures in this section includes a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the Project. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to air quality in the Project resource area are listed below; therefore, numbering may appear out of sequence.

1. Setting traffic limits on construction vehicles.
2. Maintaining properly tuned equipment.
3. Limiting the hours of operation or amount of equipment.
5. Coordinating prescribed burning programs with relevant air quality management agencies to ensure that the programs are accounted for in state and federal air quality management plans..
6. Regular, periodic watering of construction sites to control levels of dust in the air.
7. Using soil stabilizers and dust suppressants on unpaved service roadways.
8. Daily contained sweeping of paved surfaces.
9. Limiting vehicle idling time.
10. Using alternatively fueled equipment.
11. Requiring selection of borrow sites that are closest to fill locations.
12. Implementing construction practices that reduce generation of particulate matter.
13. Hydroseeding and mulching exposed areas.

Alternative NP: No Project

Under the No Action Alternative, expected and potential sources of air pollutant emissions would continue as at present. Air pollution sources would include equipment used with agricultural operations and irrigation, drainage, and domestic well pumps. Because no new facilities would be constructed and modifications to existing facilities would not occur, there would be no increase in air pollutant emissions and thus no air quality-related impacts.

2025 Conditions

Under the future no action conditions (2025 conditions), the SDIP would not be implemented, and there would be no additional air pollutant emissions in the Project area as a result of construction or operation. It is expected that minimal development would occur in this area. Because of continuing improvements in engine and motor technology and the retirement of older, higher-emitting engines and motors, it is anticipated that 2025 air pollutant emissions would be lower than the existing conditions described above.

Alternative 1-A: Fluvial Process Optimization

Construction and operational activities associated with Project components for Alternative 1-A will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels.

As previously mentioned, construction activities are anticipated to be the primary source of emissions associated with Project components associated with Alternative 1-A. Consequently, construction emissions are addressed quantitatively, while operational emissions are addressed qualitatively.

Table 3.9-11 summarizes construction emissions by Project component for Alternative 1-A. As indicated in Table 3.9-11, construction emissions are anticipated to exceed the SMAQMD's thresholds of significance (Table 3.9-9). Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-1 through AIR-4 and AIR-6 will reduce construction emissions, but not to a less-than-significant level (Table 3.9-12). The SJVAPCD requires that all construction activities must comply with Regulation VIII. Further, guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). The requirement to implement a Dust Control Plan in accordance with SJVAPCD requirements has been incorporated into the Project as an environmental commitment (see Chapter 2). Although Mitigation Measures AIR-1 through AIR-4, AIR-6, and the dust control plan will reduce emissions, they will not reduce emissions below threshold levels. Consequently, this impact is considered **significant and unavoidable**.

Project operations would primarily consist of maintenance activities, including prescribed burning, mowing of vegetation, operation of pumps, application of soil and grading of levees, application of aggregate and grading of levee and access roads, street sweeping, application of architectural coatings, and maintenance dredging of the south fork of the Mokelumne River. It is anticipated that activities associated with maintenance dredging of the south fork of the Mokelumne River will be the primary source of emissions associated with Project operations. It is currently not known what type of dredging would occur (i.e., clamshell, hydraulic, or dragline), how much dredging will occur, when it will occur, and what equipment that will be used to dispose of dredged material. However, given the amount of activities associated with dredging operations, it is anticipated that dredging activities would exceed the SJVAPCD's thresholds of significance. Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-2, AIR-5, and AIR-6 will reduce this impact, but not to a less-than-significant level. Consequently, this impact is considered **significant and unavoidable**.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

The Project proponent will ensure that all applicable mitigation measures included in the 2002 CALFED Bay-Delta Program Final Programmatic EIS/EIR are implemented. These mitigation measures include CALFED Programmatic Mitigation Measures 1, 2, 3, 5, 6, 7, 8, 9, 10, 11, 12, and 13.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment. The Project proponent shall provide a plan, for approval by the lead agency and **SMAQMD**, demonstrating that the heavy-duty (> 50 horsepower) off-road vehicles to be used in the construction Project, including owned, leased, and subcontractor vehicles, will achieve a Project-wide fleet average of 20% NO_x reduction and 45% particulate reduction[1] compared to the most recent CARB fleet average at time of construction.

The Project representative shall submit to the lead agency and SMAQMD a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 horsepower, that will be used an aggregate of 40 or more hours during any portion of the construction Project. The inventory shall include the horsepower rating, engine production year, and projected hours of use or fuel throughput for each piece of equipment. The inventory shall be updated and submitted monthly throughout the duration of the Project, except that an inventory shall not be required for any 30-day period in which no construction activity occurs. At least 48 hours prior to the use of subject heavy-duty off-road equipment, the Project representative shall provide the SMAQMD with the anticipated construction timeline, including start date and name and phone number of the Project manager and on-site foreman.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel-Powered Equipment. The Project proponent shall ensure that emissions from all off-road diesel-powered equipment used on the Project site do not exceed 40% opacity for more than 3 minutes in any 1 hour. Any equipment found to exceed 40% opacity (or Ringelmann 2.0) shall be repaired immediately, and the lead agency and SMAQMD shall be notified within 48 hours of identification of noncompliant equipment. 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. The SMAQMD and/or other officials may conduct periodic site inspections to determine compliance. Nothing in this section shall supersede other SMAQMD or state rules or regulations.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee. The SMAQMD requires that all projects with construction emissions in excess of the their threshold of significance after application of the SMAQMD's standard construction mitigation measures (Mitigation Measures AIR-2 and AIR-3) pay an off-site mitigation fee to reduce construction-related emissions of NO_x to a less-than-significant level. As previously indicated, this analysis is based on

[1] Acceptable options for reducing emissions may include use of late model engines, low-emission diesel products, alternative fuels, use of electrically powered equipment, engine retrofit technology, after-treatment products, and/or other options as they become available.

Table 3.9-11. Alternative 1-A Emissions (Unmitigated)

Component	May				June				July				August				September				October			
	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 1-A	**2008**		**Pounds Per Day**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	27.8	186.4	222.3	597.7	27.8	186.4	222.3	597.7
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	55.7	372.9	456.6	604.8	55.7	372.9	456.6	604.8
Reinforce Dead Horse Island East Levee	2.2	12.8	18.8	25.4	2.2	12.8	18.8	25.4																
Modify Downstream Levees to Accommodate Potentially Increased Flows	8.8	60.4	72.4	27	8.8	60.4	72.4	27																
Construct Transmission Tower Protective Levee and Access Road	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4
Demolish Farm Residence and Infrastructure	7	60.9	49.9	11.3																				
Enhance Interior Levee Slope and Habitat					88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8
Modify Landform and Restore Agricultural Land to Habitat									19	126.8	155	30	19	126.8	155	30	19	126.8	155	30	19	126.8	155	30
Modify Pump and Siphon Operations	2.3	14.8	19.2	10.5																				
Breach Mokelumne River Levee													19.4	130.1	157.5	79.8	19.4	130.1	157.5	79.8	19.4	130.1	157.5	79.8
Construct Box Culvert Drains and Self-Regulating Tide Gates																	NA	NA	NA	NA				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					62	472	479.7	608	62	472	479.7	608	62	472	479.7	608								
Excavate Dixon and New Hope Borrow Sites (Dixon)					62.3	476.9	480.8	608.2	62.3	476.9	480.8	608.2	62.3	476.9	480.8	608.2								
Excavate and Restore Grizzly Slough Property	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4
Dredge South Fork Mokelumne River (Prepare Drying Basins)									5.32	31.9	45.8	51.1	5.32	31.9	45.8	51.1	5.32	31.9	45.8	51.1				
Dredge South Fork Mokelumne River (Dredging)									30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132				
TOTAL	**183.50**	**1,337.22**	**1,462.30**	**790.00**	**386.50**	**2,864.02**	**3,053.20**	**2,599.20**	**430.44**	**3,537.97**	**3,400.70**	**2,647.03**	**449.84**	**3,668.07**	**3,558.20**	**2,726.83**	**409.04**	**3,278.47**	**3,276.60**	**2,713.13**	**373.10**	**2,658.12**	**2,992.90**	**2,642.90**
Alternative 1-A	**2008**		**Tons per Year**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	0.61	4.09	5.02	6.65	0.61	4.09	5.02	6.65
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	1.23	8.17	10.03	6.81	1.23	8.17	10.03	6.81
Reinforce Dead Horse Island East Levee	0.05	0.28	0.41	0.56	0.05	0.28	0.41	0.56																
Modify Downstream Levees to Accommodate Potentially Increased Flows	0.19	1.32	1.59	0.59	0.19	1.32	1.59	0.59																
Construct Transmission Tower Protective Levee and Access Road	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03
Demolish Farm Residence and Infrastructure	0.08	0.67	0.55	0.13																				

Table 3.9-11. Continued

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Enhance Interior Levee Slope and Habitat					4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82
Modify Landform and Restore Agricultural Land to Habitat									0.84	5.58	6.81	1.32	0.84	5.58	6.81	1.32	0.84	5.58	6.81	1.32	0.84	5.58	6.81	1.32
Modify Pump and Siphon Operations	0.02	0.16	0.2	0.11																				
Breach Mokelumne River Levee													0.64	4.28	5.19	2.63	0.64	4.28	5.19	2.63	0.64	4.28	5.19	2.63
Construct Box Culvert Drains and Self-Regulating Tide Gates																	NA	NA	NA	NA				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					2.05	15.58	15.82	7.07	2.05	15.58	15.82	7.07	2.05	15.58	15.82	7.07								
Excavate Dixon and New Hope Borrow Sites (Dixon)					2.06	15.73	15.86	7.07	2.06	15.73	15.86	7.07	2.06	15.73	15.86	7.07								
Excavate and Restore Grizzly Slough Property	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72
Dredge South Fork Mokelumne River (Prepare Drying Basins)									0.06	0.35	0.5	0.56	0.06	0.35	0.5	0.56	0.06	0.35	0.5	0.56				
Dredge South Fork Mokelumne River (Dredging)									1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135				
TOTAL	**11.09**	**79.10**	**88.61**	**16.14**	**19.94**	**144.65**	**152.98**	**37.86**	**21.61**	**168.40**	**166.14**	**39.22**	**22.25**	**172.68**	**171.33**	**41.85**	**19.98**	**153.63**	**154.70**	**41.17**	**18.91**	**133.86**	**146.35**	**39.98**

Table 3.9-12. Alternative 1-A Emissions (Mitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 1-A (Mitigated)	**2008**		**Pounds Per Day**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	27.8	130.9	222.3	232.7	27.8	130.9	222.3	232.7
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	55.7	261.7	456.6	233.4	55.7	261.7	456.6	233.4
Reinforce Dead Horse Island East Levee	2.2	8.8	18.8	9.9	2.2	8.8	18.8	9.9																
Modify Downstream Levees to Accommodate Potentially Increased Flows	8.8	45.8	72.4	10.4	8.8	45.8	72.4	10.4																
Construct Transmission Tower Protective Levee and Access Road	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5
Demolish Farm Residence and Infrastructure	7	49.3	49.9	10.4																				
Enhance Interior Levee Slope and Habitat					88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7
Modify Landform and Restore Agricultural Land to Habitat									19	87.3	155	10.2	19	87.3	155	10.2	19	87.3	155	10.2	19	87.3	155	10.2
Modify Pump and Siphon Operations	2.3	10.8	19.2	4																				
Breach Mokelumne River Levee													19.4	90.6	157.5	30	19.4	90.6	157.5	30	19.4	90.6	157.5	30
Construct Box Culvert Drains and Self-Regulating Tide Gates																	NA	NA	NA	NA				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					62	360.9	479.7	236.6	62	360.9	479.7	236.6	62	360.9	479.7	236.6								
Excavate Dixon and New Hope Borrow Sites (Dixon)					62.3	365.7	480.8	236.8	62.3	365.7	480.8	236.8	62.3	365.7	480.8	236.8								
Excavate and Restore Grizzly Slough Property	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6
Dredge South Fork Mokelumne River (Prepare Drying Basins)									5.32	22	45.8	19.7	5.32	22	45.8	19.7	5.32	22	45.8	19.7				
Dredge South Fork Mokelumne River (Dredging)									30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132				
TOTAL	**183.50**	**991.80**	**1,462.30**	**306.80**	**386.50**	**2,145.30**	**3,053.20**	**1,002.50**	**430.44**	**2,788.45**	**3,400.70**	**1,031.23**	**449.84**	**2,879.05**	**3,558.20**	**1,061.23**	**409.04**	**2,545.05**	**3,276.60**	**1,053.93**	**373.10**	**1,934.60**	**2,992.90**	**1,015.10**
Alternative 1-A (Mitigated)	**2008**		**Tons per Year**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	0.61	2.87	5.02	2.56	0.61	2.87	5.02	2.56
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	1.23	5.72	10.03	2.58	1.23	5.72	10.03	2.58
Reinforce Dead Horse Island East Levee	0.05	0.19	0.41	0.22	0.05	0.19	0.41	0.22																
Modify Downstream Levees to Accommodate Potentially Increased Flows	0.19	1	1.59	0.23	0.19	1	1.59	0.23																
Construct Transmission Tower Protective Levee and Access Road	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2
Demolish Farm Residence and Infrastructure	0.08	0.54	0.55	0.12																				
Enhance Interior Levee Slope and Habitat					4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81

Table 3.9-12. Continued

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Modify Landform and Restore Agricultural Land to Habitat									0.84	3.84	6.81	0.45	0.84	3.84	6.81	0.45	0.84	3.84	6.81	0.45	0.84	3.84	6.81	0.45
Modify Pump and Siphon Operations	0.02	0.12	0.2	0.04																				
Breach Mokelumne River Levee													0.64	2.98	5.19	0.98	0.64	2.98	5.19	0.98	0.64	2.98	5.19	0.98
Construct Box Culvert Drains and Self-Regulating Tide Gates																	NA	NA	NA	NA				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					2.05	11.91	15.82	2.7	2.05	11.91	15.82	2.7	2.05	11.91	15.82	2.7								
Excavate Dixon and New Hope Borrow Sites (Dixon)					2.06	12.06	15.86	2.7	2.06	12.06	15.86	2.7	2.06	12.06	15.86	2.7								
Excavate and Restore Grizzly Slough Property	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98
Dredge South Fork Mokelumne River (Prepare Drying Basins)									0.06	0.24	0.5	0.22	0.06	0.24	0.5	0.22	0.06	0.24	0.5	0.22				
Dredge South Fork Mokelumne River (Dredging)									1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135				
TOTAL	**11.09**	**57.97**	**88.61**	**5.79**	**19.94**	**107.18**	**152.98**	**13.84**	**21.61**	**129.49**	**166.14**	**14.69**	**22.25**	**132.47**	**171.33**	**15.67**	**19.98**	**117.09**	**154.70**	**15.41**	**18.91**	**97.43**	**146.35**	**14.56**

incomplete, preliminary, and assumed data, with an assumption that construction activities associated with each Project component would occur throughout the duration of the months scheduled and that all equipment will be in operation for each appropriate component to represent a worst-case scenario. Because of this approach, Project emissions represent a worst-case scenario and are likely to be lower when Project-specific data (e.g., the exact phasing and scheduling of construction activities, the types and number of construction equipment pieces that will be used, etc.) are known. Consequently, this analysis does not quantify the Off-Site Mitigation Fee payable to the SMAQMD. Rather, once this Project-specific data is known, prior to the approval of improvement plans or the issuance of grading permits, the Project proponent will calculate Project-specific construction emissions associated with the Project and submit proof that the off-site air quality mitigation fee of has been paid to SMAQMD and that the construction air quality mitigation plan has been approved by SMAQMD and the lead agency.

The Off-Site Mitigation Fee is calculated by estimating the pounds of mitigated daily NO_x emissions over the SMAQMD's 85 pounds per day threshold, divided by 2000 pounds per ton, multiplied by the number of days of construction, and multiplied by the standard SMAQMD fee of $13,600/ton of NO_x.

Mitigation Measure AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions.

The Project proponent will consult with the SMAQMD and SJVAPCD to determine required measures to reduce the impacts to less-than-significant levels. The Project proponent shall either require the contractor to obtain an air quality permit from the SMAQMD and SJVAPCD or the Project proponent shall contract with the SMAQMD and SJVAPCD for emission reduction credits or funding for an emission reduction program. Emission Reduction Credits shall be provided by either leasing approved credits from the SMAQMD and SJVAPCD emissions reductions credit bank or by funding an emission reduction project that will provide equivalent emission reductions as approved by SMAQMD and SJVAPCD. The Project proponent will implement the SMAQMD- and SJVAPCD-approved emissions reduction programs or offsets to reduce emissions to a level considered less than significant by the SMAQMD and SJVAPCD.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

In the event that electric equipment is not available, the Project proponent shall require construction and dredging contractors to use equipment with a valid Statewide Portable Equipment Registration or obtain a permit from the SMAQMD and SJVAPCD for equipment to be used. In the event that the equipment is subject to the Portable Equipment Registration Program and has not previously operated in the SVAB and SJVAB and is not part of the planning inventory for the SVAB and SJVAB, then the Project proponent or the contractor shall provide emission reduction credits to reduce the Project impacts to a less-than-significant level in accordance with Mitigation Measure AIR-6.

Significance after Mitigation: Significant and unavoidable.

Impact AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk.

Construction, as well as dredging, activities will involve the operation of diesel-powered equipment. In October 2000, the CARB identified diesel exhaust as a TAC. Conversation with SJVAPCD indicates that the SJVAPCD does not consider construction equipment diesel-related cancer risks to be an issue because of the short-term nature of construction activities (Guerrera pers. comm.). As described above, construction activities would occur between May and October during two to three construction seasons. The assessment of cancer health risks associated with exposure to diesel exhaust is typically associated with chronic exposure in which a 70-year exposure period is often assumed. Although cancer can result from exposure periods of less than 70 years, acute exposure periods (i.e., exposure periods of two to three years) to diesel exhaust are not anticipated to result in an increased health risk because health risks associated with exposure to diesel exhaust are typically seen in exposures periods that are chronic in nature. Health impacts associated with exposure to diesel exhaust from Project activities are anticipated to be **less than significant** because construction activities will occur over a two- to three-year period and will not result in long-term emissions of diesel exhaust at the Project site. It is also anticipated that concentrations of diesel exhaust will attenuate to levels well below acceptable exposure limits because of the distances of sensitive receptors from Project activities. In addition, Mitigation Measure AIR-2 will further reduce emissions from Project activities.

Determination of Significance: Less than significant.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Significance after Mitigation: Less than significant.

Impact AIR-3: Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels.

Table 3.9-11 summarizes construction emissions by Project component for Alternative 1-A. As indicated in Table 3.9-11, construction emissions are anticipated to exceed the *de minimis* thresholds of significance (Tables 3.9-7 and 3.9-8). Consequently, this is considered to be an adverse impact and mitigation is required. Although Mitigation Measures AIR-1 through AIR-4, AIR-6, and the environmental commitments will reduce emissions, they will not reduce emissions below threshold levels. Because the total direct and indirect emissions associated with the Project exceed the *de minimis* thresholds indicated in Tables 3.9-7 and 3.9-8, a conformity determination must be made. Consequently, this impact is considered **adverse**, and Mitigation Measure AIR-7 is required.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NOX Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Mitigation Measure AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.
The Project proponent will consult with the SMAQMD and SJVAPCD to conduct a conformity determination to show how the proposed Project alternative would conform to the applicable SIP.

Significance after Mitigation: Significant and unavoidable.

Alternative 1-B: Seasonal Floodplain Optimization

Construction and operational activities associated with Project components for Alternative 1-B will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir

- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels.

As previously mentioned, construction activities are anticipated to be the primary source of emissions associated with Project components associated with Alternative 1-B. Consequently, construction emissions are addressed quantitatively, while operational emissions are addressed qualitatively.

Table 3.9-13 summarizes construction emissions by Project component for Alternative 1-B. As indicated in Table 3.9-13, construction emissions are anticipated to exceed the SMAQMD's thresholds of significance (Table 3.9-9). Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-1 through AIR-4 and AIR-6 will reduce construction emissions, but not to a less-than-significant level (Table 3.9-14). The SJVAPCD requires that all construction activities must comply with Regulation VIII. Further, guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). The requirement to implement a Dust Control Plan in accordance with SJVAPCD requirements has been incorporated into the Project as an environmental commitment (see Chapter 2). Although Mitigation Measures AIR-1 through AIR-4, AIR-6, and environmental commitments will reduce emissions, they will not reduce emissions below threshold levels. Consequently, this impact is considered **significant and unavoidable**.

Project operations would primarily consist of maintenance activities, including prescribed burning, mowing of vegetation, operation of pumps, application of

Table 3.9-13. Alternative 1-B Emissions (Unmitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 1-B	**2008**		**Pounds Per Day**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	27.8	186.4	222.3	597.7	27.8	186.4	222.3	597.7
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	27.8	186.4	222.3	597.7	27.8	186.4	222.3	597.7
Reinforce Dead Horse Island East Levee	2.2	12.8	18.8	25.4	2.2	12.8	18.8	25.4																
Modify Downstream Levees to Accommodate Potentially Increased Flows	8.8	60.4	72.4	27	8.8	60.4	72.4	27																
Construct Transmission Tower Protective Levee and Access Road	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4
Demolish Farm Residence and Infrastructure	7	60.9	49.9	11.3																				
Enhance Interior Levee Slope and Habitat					88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8
Modify Landform and Restore Agricultural Land to Habitat									13.7	94.9	108.6	28.8	13.7	94.9	108.6	28.8	13.7	94.9	108.6	28.8	13.7	94.9	108.6	28.8
Modify Pump and Siphon Operations	2.3	14.8	19.2	10.5																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	7.7	44.9	66.9	11.3				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					62	472	479.7	608	62	472	479.7	608	62	472	479.7	608								
Excavate Dixon and New Hope Borrow Sites (Dixon)					62.3	476.9	480.8	608.2	62.3	476.9	480.8	608.2	62.3	476.9	480.8	608.2								
Excavate and Restore Grizzly Slough Property	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4
Dredge South Fork Mokelumne River (Prepare Drying Basins)									5.32	31.9	45.8	51.1	5.32	31.9	45.8	51.1	5.32	31.9	45.8	51.1				
Dredge South Fork Mokelumne River (Dredging)									30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132				
TOTAL	**183.50**	**1,337.22**	**1,462.30**	**790.00**	**386.50**	**2,864.02**	**3,053.20**	**2,599.20**	**425.14**	**3,506.07**	**3,354.30**	**2,645.83**	**425.14**	**3,506.07**	**3,354.30**	**2,645.83**	**364.14**	**2,974.87**	**2,905.30**	**2,636.33**	**320.50**	**2,309.62**	**2,554.70**	**2,554.80**
Alternative 1-B	**2008**		**Tons per Year**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	0.61	4.09	5.02	6.65	0.61	4.09	5.02	6.65
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	0.61	4.09	5.02	6.65	0.61	4.09	5.02	6.65
Reinforce Dead Horse Island East Levee	0.05	0.28	0.41	0.56	0.05	0.28	0.41	0.56																
Modify Downstream Levees to Accommodate Potentially Increased Flows	0.19	1.32	1.59	0.59	0.19	1.32	1.59	0.59																
Construct Transmission Tower Protective Levee and Access Road	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03
Demolish Farm Residence and Infrastructure	0.08	0.67	0.55	0.13																				
Enhance Interior Levee Slope and Habitat					4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82

Table 3.9-13. Continued

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Modify Landform and Restore Agricultural Land to Habitat									0.6	4.18	4.17	1.27	0.6	4.18	4.17	1.27	0.6	4.18	4.17	1.27	0.6	4.18	4.17	1.27
Modify Pump and Siphon Operations	0.02	0.16	0.2	0.11																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	0.08	0.49	0.74	0.12				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					2.05	15.58	15.82	7.07	2.05	15.58	15.82	7.07	2.05	15.58	15.82	7.07								
Excavate Dixon and New Hope Borrow Sites (Dixon)					2.06	15.73	15.86	7.07	2.06	15.73	15.86	7.07	2.06	15.73	15.86	7.07								
Excavate and Restore Grizzly Slough Property	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72
Dredge South Fork Mokelumne River (Prepare Drying Basins)									0.06	0.35	0.5	0.56	0.06	0.35	0.5	0.56	0.06	0.35	0.5	0.56				
Dredge South Fork Mokelumne River (Dredging)									1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135				
TOTAL	**11.09**	**79.10**	**88.61**	**16.14**	**19.94**	**144.65**	**152.98**	**37.86**	**21.37**	**167.00**	**163.50**	**39.17**	**21.37**	**167.00**	**163.50**	**39.17**	**18.56**	**144.36**	**142.60**	**38.45**	**17.41**	**124.10**	**133.51**	**37.14**

Table 3.9-14. Alternative 1-B Emissions (Mitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 1-B (Mitigated)	**2008**		**Pounds Per Day**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	27.8	130.9	222.3	232.7	27.8	130.9	222.3	232.7
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	27.8	130.9	222.3	232.7	27.8	130.9	222.3	232.7
Reinforce Dead Horse Island East Levee	2.2	8.8	18.8	9.9	2.2	8.8	18.8	9.9																
Modify Downstream Levees to Accommodate Potentially Increased Flows	8.8	45.8	72.4	10.4	8.8	45.8	72.4	10.4																
Construct Transmission Tower Protective Levee and Access Road	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5
Demolish Farm Residence and Infrastructure	7	49.3	49.9	10.4																				
Enhance Interior Levee Slope and Habitat					88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7
Modify Landform and Restore Agricultural Land to Habitat									13.7	65.3	108.6	10.1	13.7	65.3	108.6	10.1	13.7	65.3	108.6	10.1	13.7	65.3	108.6	10.1
Modify Pump and Siphon Operations	2.3	10.8	19.2	4																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	7.7	30.9	66.9	4				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					62	360.9	479.7	236.6	62	360.9	479.7	236.6	62	360.9	479.7	236.6								
Excavate Dixon and New Hope Borrow Sites (Dixon)					62.3	365.7	480.8	236.8	62.3	365.7	480.8	236.8	62.3	365.7	480.8	236.8								
Excavate and Restore Grizzly Slough Property	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6
Dredge South Fork Mokelumne River (Prepare Drying Basins)									5.32	22	45.8	19.7	5.32	22	45.8	19.7	5.32	22	45.8	19.7				
Dredge South Fork Mokelumne River (Dredging)									30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132				
TOTAL	**183.50**	**991.80**	**1,462.30**	**306.80**	**386.50**	**2,145.30**	**3,053.20**	**1,002.50**	**425.14**	**2,766.45**	**3,354.30**	**1,031.13**	**425.14**	**2,766.45**	**3,354.30**	**1,031.13**	**364.14**	**2,332.55**	**2,905.30**	**1,027.13**	**320.50**	**1,691.20**	**2,554.70**	**984.30**
Alternative 1-B (Mitigated)	**2008**		**Tons per Year**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	0.61	2.87	5.02	2.56	0.61	2.87	5.02	2.56
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	0.61	2.87	5.02	2.56	0.61	2.87	5.02	2.56
Reinforce Dead Horse Island East Levee	0.05	0.19	0.41	0.22	0.05	0.19	0.41	0.22																
Modify Downstream Levees to Accommodate Potentially Increased Flows	0.19	1	1.59	0.23	0.19	1	1.59	0.23																
Construct Transmission Tower Protective Levee and Access Road	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2
Demolish Farm Residence and Infrastructure	0.08	0.54	0.55	0.12																				
Enhance Interior Levee Slope and Habitat					4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81

Table 3.9-14. Continued

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Modify Landform and Restore Agricultural Land to Habitat									0.6	2,88	4.17	0.44	0.6	2,88	4.17	0.44	0.6	2,88	4.17	0.44	0.6	2,88	4.17	0.44
Modify Pump and Siphon Operations	0.02	0.12	0.2	0.04																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	0.08	0.34	0.74	0.04				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													NA	NA	NA	NA	NA	NA	NA	NA				
Import Soil for Subsidence Reversal									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Excavate Dixon and New Hope Borrow Sites (New Hope)					2.05	11.91	15.82	2.7	2.05	11.91	15.82	2.7	2.05	11.91	15.82	2.7								
Excavate Dixon and New Hope Borrow Sites (Dixon)					2.06	12.06	15.86	2.7	2.06	12.06	15.86	2.7	2.06	12.06	15.86	2.7								
Excavate and Restore Grizzly Slough Property	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98
Dredge South Fork Mokelumne River (Prepare Drying Basins)									0.06	0.24	0.5	0.22	0.06	0.24	0.5	0.22	0.06	0.24	0.5	0.22				
Dredge South Fork Mokelumne River (Dredging)									1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135				
TOTAL	**11.09**	**57.97**	**88.61**	**5.79**	**19.94**	**107.18**	**152.98**	**13.84**	**21.37**	**125.65**	**163.50**	**14.68**	**21.37**	**125.65**	**163.50**	**14.68**	**18.56**	**107.76**	**142.60**	**14.44**	**17.41**	**87.76**	**133.51**	**13.55**

soil and grading of levees, application of aggregate and grading of levee and access roads, street sweeping, application of architectural coatings, and maintenance dredging of the south fork of the Mokelumne River. It is anticipated that activities associated with maintenance dredging of the south fork of the Mokelumne River will be the primary source of emissions associated with Project operations. It is currently not known what type of dredging would occur (i.e., clamshell, hydraulic, or dragline), how much dredging will occur, when it will occur, and what equipment that will be used to dispose of dredged material. However, given the amount of activities associated with dredging operations, it is anticipated that dredging activities would exceed the SJVAPCD's thresholds of significance. Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-2, AIR-5, and AIR-6 will reduce this impact, but not to a less-than-significant level. Consequently, this impact is considered **significant and unavoidable**.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Significance after Mitigation: Significant and unavoidable.

Impact AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk.

Impacts under Alternative 1-B would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Significance after Mitigation: Less than significant.

Impact AIR-3: Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels.

Impacts under Alternative 1-B would be the same as described under Alternative 1-A.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NOX Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Mitigation Measure AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.

Significance after Mitigation: Significant and unavoidable.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

Construction and operational activities associated with Project components for Alternative 1-C will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels.

As previously mentioned, construction activities are anticipated to be the primary source of emissions associated with Project components associated with Alternative 1-C. Consequently, construction emissions are addressed quantitatively, while operational emissions are addressed qualitatively.

Table 3.9-15 summarizes construction emissions by Project component for Alternative 1-B. As indicated in Table 3.9-15, construction emissions are anticipated to exceed the SMAQMD's thresholds of significance (Table 3.9-9). Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-1 through AIR-4 and AIR-6 will reduce construction emissions, but not to a less-than-significant level (Table 3.9-16). The SJVAPCD requires that all construction activities must comply with Regulation VIII. Further, guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). The requirement to implement a Dust Control Plan in accordance with SJVAPCD requirements has been incorporated into the Project as an environmental commitment (see Chapter 2). Although Mitigation Measures AIR-1 through AIR-4, AIR-6, and environmental commitments will reduce emissions, they will not reduce emissions below threshold levels. Consequently, this impact is considered **significant and unavoidable**.

Project operations would primarily consist of maintenance activities, including prescribed burning, mowing of vegetation, operation of pumps, application of soil and grading of levees, application of aggregate and grading of levee and access roads, street sweeping, application of architectural coatings, and maintenance dredging of the south fork of the Mokelumne River. It is anticipated that activities associated with maintenance dredging of the south fork of the Mokelumne River will be the primary source of emissions associated with Project operations. It is currently not known what type of dredging would occur (i.e., clamshell, hydraulic, or dragline), how much dredging will occur, when it will occur, and what equipment will be used to dispose of dredged material. However, given the amount of activities associated with dredging operations, it is anticipated that dredging activities would exceed the SJVAPCD's thresholds of significance. Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-2, AIR-5, and AIR-6 will reduce this impact, but not to a less-than-significant level. Consequently, this impact is considered **significant and unavoidable**.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable

Table 3.9-15. Alternative 1-C Emissions (Unmitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 1-C	**2008**		**Pounds Per Day**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	27.8	186.4	222.3	597.7	27.8	186.4	222.3	597.7
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	27.8	186.4	222.3	597.7	27.8	186.4	222.3	597.7
Reinforce Dead Horse Island East Levee	2.2	12.8	18.8	25.4	2.2	12.8	18.8	25.4																
Modify Downstream Levees to Accommodate Potentially Increased Flows	8.8	60.4	72.4	27	8.8	60.4	72.4	27																
Construct Transmission Tower Protective Levee and Access Road	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4	33.8	243.4	267.3	91.4
Demolish Farm Residence and Infrastructure	7	60.9	49.9	11.3																				
Enhance Interior Levee Slope and Habitat					88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8	88	653.6	699.5	614.8
Modify Landform and Restore Agricultural Land to Habitat									13.7	94.9	108.6	28.8	13.7	94.9	108.6	28.8	13.7	94.9	108.6	28.8	13.7	94.9	108.6	28.8
Modify Pump and Siphon Operations	2.3	14.8	19.2	10.5																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	7.7	44.9	66.9	11.3				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													13.7	94.9	108.5	28.8	13.7	94.9	108.5	28.8				
Import Soil for Subsidence Reversal									See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18				
Excavate Dixon and New Hope Borrow Sites (New Hope)					62	472	479.7	608	62	472	479.7	608	62	472	479.7	608								
Excavate Dixon and New Hope Borrow Sites (Dixon)					62.3	476.9	480.8	608.2	62.3	476.9	480.8	608.2	62.3	476.9	480.8	608.2								
Excavate and Restore Grizzly Slough Property	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4	129.4	944.92	1034.7	624.4
Dredge South Fork Mokelumne River (Prepare Drying Basins)									5.32	31.9	45.8	51.1	5.32	31.9	45.8	51.1	5.32	31.9	45.8	51.1				
Dredge South Fork Mokelumne River (Dredging)									30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132				
TOTAL	**183.50**	**1,337.22**	**1,462.30**	**790.00**	**386.50**	**2,864.02**	**3,053.20**	**2,599.20**	**425.14**	**3,506.07**	**3,354.30**	**2,645.83**	**438.84**	**3,600.97**	**3,462.80**	**2,674.63**	**377.84**	**3,069.77**	**3,013.80**	**2,665.13**	**320.50**	**2,309.62**	**2,554.70**	**2,554.80**
Alternative 1-C	**2008**		**Tons per Year**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	0.61	4.09	5.02	6.65	0.61	4.09	5.02	6.65
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	0.61	4.09	5.02	6.65	0.61	4.09	5.02	6.65
Reinforce Dead Horse Island East Levee	0.05	0.28	0.41	0.56	0.05	0.28	0.41	0.56																
Modify Downstream Levees to Accommodate Potentially Increased Flows	0.19	1.32	1.59	0.59	0.19	1.32	1.59	0.59																
Construct Transmission Tower Protective Levee and Access Road	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03	2.22	15.86	17.62	6.03
Demolish Farm Residence and Infrastructure	0.08	0.67	0.55	0.13																				
Enhance Interior Levee Slope and Habitat					4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82	4.84	35.07	33.44	7.82

Table 3.9-15. Continued

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Modify Landform and Restore Agricultural Land to Habitat									0.6	4.18	4.17	1.27	0.6	4.18	4.17	1.27	0.6	4.18	4.17	1.27	0.6	4.18	4.17	1.27
Modify Pump and Siphon Operations	0.02	0.16	0.2	0.11																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	0.08	0.49	0.74	0.12				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													0.3	2.08	2.39	0.63	0.3	2.08	2.39	0.63				
Import Soil for Subsidence Reversal									See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18				
Excavate Dixon and New Hope Borrow Sites (New Hope)					2.05	15.58	15.82	7.07	2.05	15.58	15.82	7.07	2.05	15.58	15.82	7.07								
Excavate Dixon and New Hope Borrow Sites (Dixon)					2.06	15.73	15.86	7.07	2.06	15.73	15.86	7.07	2.06	15.73	15.86	7.07								
Excavate and Restore Grizzly Slough Property	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72	8.53	60.81	68.24	8.72
Dredge South Fork Mokelumne River (Prepare Drying Basins)									0.06	0.35	0.5	0.56	0.06	0.35	0.5	0.56	0.06	0.35	0.5	0.56				
Dredge South Fork Mokelumne River (Dredging)									1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135				
TOTAL	**11.09**	**79.10**	**88.61**	**16.14**	**19.94**	**144.65**	**152.98**	**37.86**	**21.37**	**167.00**	**163.50**	**39.17**	**21.67**	**169.08**	**165.89**	**39.80**	**18.86**	**146.44**	**144.99**	**39.08**	**17.41**	**124.10**	**133.51**	**37.14**

Table 3.9-16. Alternative 1-C Emissions (Mitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 1-C (Mitigated)	**2008**		**Pounds Per Day**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	27.8	130.9	222.3	232.7	27.8	130.9	222.3	232.7
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	27.8	130.9	222.3	232.7	27.8	130.9	222.3	232.7
Reinforce Dead Horse Island East Levee	2.2	8.8	18.8	9.9	2.2	8.8	18.8	9.9																
Modify Downstream Levees to Accommodate Potentially Increased Flows	8.8	45.8	72.4	10.4	8.8	45.8	72.4	10.4																
Construct Transmission Tower Protective Levee and Access Road	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5	33.8	174.4	267.3	33.5
Demolish Farm Residence and Infrastructure	7	49.3	49.9	10.4																				
Enhance Interior Levee Slope and Habitat					88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7	88	487	699.5	236.7
Modify Landform and Restore Agricultural Land to Habitat									13.7	65.3	108.6	10.1	13.7	65.3	108.6	10.1	13.7	65.3	108.6	10.1	13.7	65.3	108.6	10.1
Modify Pump and Siphon Operations	2.3	10.8	19.2	4																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	7.7	30.9	66.9	4				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													13.7	65.3	108.5	10.1	13.7	65.3	108.5	10.1				
Import Soil for Subsidence Reversal									See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18				
Excavate Dixon and New Hope Borrow Sites (New Hope)					62	360.9	479.7	236.6	62	360.9	479.7	236.6	62	360.9	479.7	236.6								
Excavate Dixon and New Hope Borrow Sites (Dixon)					62.3	365.7	480.8	236.8	62.3	365.7	480.8	236.8	62.3	365.7	480.8	236.8								
Excavate and Restore Grizzly Slough Property	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6	129.4	702.7	1034.7	238.6
Dredge South Fork Mokelumne River (Prepare Drying Basins)									5.32	22	45.8	19.7	5.32	22	45.8	19.7	5.32	22	45.8	19.7				
Dredge South Fork Mokelumne River (Dredging)									30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132	30.6194	588.449	237.895	19.132				
TOTAL	**183.50**	**991.80**	**1,462.30**	**306.80**	**386.50**	**2,145.30**	**3,053.20**	**1,002.50**	**425.14**	**2,766.45**	**3,354.30**	**1,031.13**	**438.84**	**2,831.75**	**3,462.80**	**1,041.23**	**377.84**	**2,397.85**	**3,013.80**	**1,037.23**	**320.50**	**1,691.20**	**2,554.70**	**984.30**
Alternative 1-C (Mitigated)	**2008**		**Tons per Year**																					
Degrade McCormack-Williamson Tract East Levee to Function as a Weir																	0.61	2.87	5.02	2.56	0.61	2.87	5.02	2.56
Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir																	0.61	2.87	5.02	2.56	0.61	2.87	5.02	2.56
Reinforce Dead Horse Island East Levee	0.05	0.19	0.41	0.22	0.05	0.19	0.41	0.22																
Modify Downstream Levees to Accommodate Potentially Increased Flows	0.19	1	1.59	0.23	0.19	1	1.59	0.23																
Construct Transmission Tower Protective Levee and Access Road	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2	2.22	11.3	17.62	2.2
Demolish Farm Residence and Infrastructure	0.08	0.54	0.55	0.12																				
Enhance Interior Levee Slope and Habitat					4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81	4.84	25.9	33.44	2.81

Table 3.9-16. Continued

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Modify Landform and Restore Agricultural Land to Habitat									0.6	2,88	4.17	0.44	0.6	2,88	4.17	0.44	0.6	2,88	4.17	0.44	0.6	2,88	4.17	0.44
Modify Pump and Siphon Operations	0.02	0.12	0.2	0.04																				
Breach Mokelumne River Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Box Culvert Drains and Self-Regulating Tide Gates																	0.08	0.34	0.74	0.04				
Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area													0.3	1.43	2.39	0.23	0.3	1.43	2.39	0.23				
Import Soil for Subsidence Reversal									See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18	See 18				
Excavate Dixon and New Hope Borrow Sites (New Hope)					2.05	11.91	15.82	2.7	2.05	11.91	15.82	2.7	2.05	11.91	15.82	2.7								
Excavate Dixon and New Hope Borrow Sites (Dixon)					2.06	12.06	15.86	2.7	2.06	12.06	15.86	2.7	2.06	12.06	15.86	2.7								
Excavate and Restore Grizzly Slough Property	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98	8.53	44.82	68.24	2.98
Dredge South Fork Mokelumne River (Prepare Drying Basins)									0.06	0.24	0.5	0.22	0.06	0.24	0.5	0.22	0.06	0.24	0.5	0.22				
Dredge South Fork Mokelumne River (Dredging)									1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135	1.01044	19.4188	7.85055	0.63135				
TOTAL	**11.09**	**57.97**	**88.61**	**5.79**	**19.94**	**107.18**	**152.98**	**13.84**	**21.37**	**125.65**	**163.50**	**14.68**	**21.67**	**127.08**	**165.89**	**14.91**	**18.86**	**109.19**	**144.99**	**14.67**	**17.41**	**87.76**	**133.51**	**13.55**

Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Significance after Mitigation: Significant and unavoidable.

Impact AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk.

Impacts under Alternative 1-C would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Significance after Mitigation: Less than significant.

Impact AIR-3: Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels.

Impacts under Alternative 1-C would be the same as described under Alternative 1-A.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NOX Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Mitigation Measure AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.

Significance after Mitigation: Significant and unavoidable.

Alternative 2-A: North Staten Detention

Construction and operational activities associated with Project components for Alternative 2-A will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels.

As previously mentioned, construction activities are anticipated to be the primary source of emissions associated with Project components associated with Alternative 1-B. Consequently, construction emissions are addressed quantitatively, while operational emissions are addressed qualitatively.

Table 3.9-17 summarizes construction emissions by Project component for Alternative 1-B. As indicated in Table 3.9-17, construction emissions are

Table 3.9-17. Alternative 2-A Emissions (Unmitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 2-A	**2009**		**Pounds per Day**																					
Construct Inlet Weir													40.6	255.5	344.3	599.1	40.6	255.5	344.3	599.1	40.6	255.5	344.3	599.1
Construct Interior Detention Levee	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5
Construct Outlet Weir													18.9	112.9	163.3	36.6	18.9	112.9	163.3	36.6	18.9	112.9	163.3	36.6
Install Detention Basin Drainage Pump Station													5.0	28.6	42.7	10.8	5.0	28.6	42.7	10.8	5.0	28.6	42.7	10.8
Reinforce Existing Levees									6.3	46.7	50.6	11.3	6.3	46.7	50.6	11.3	6.3	46.7	50.6	11.3	6.3	46.7	50.6	11.3
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													49.2	314.3	410.8	602.6	49.2	314.3	410.8	602.6	49.2	314.3	410.8	602.6
Relocate Existing Structures	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6
Modify Walnut Grove–Thornton Road and Staten Island Road									14.6	91.2	120.8	3.4	14.6	91.2	120.8	3.4	14.6	91.2	120.8	3.4				
Retrofit or Replace Millers Ferry Bridge	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5
Retrofit or Replace New Hope Bridge	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5
Construct Wildlife Viewing Area													9.0	57.5	73.9	2.2	9.0	57.5	73.9	2.2	9.0	57.5	73.9	2.2
Excavate Dixon and New Hope Borrow Sites (New Hope)	61.4	451.1	483.1	606.9	61.4	451.1	483.1	606.9	61.4	451.1	483.1	606.9												
Excavate Dixon and New Hope Borrow Sites (Dixon)	61.7	455.5	484.1	607.1	61.7	455.5	484.1	607.1	61.7	455.5	484.1	607.1												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**385.50**	**2,899.10**	**3,027.40**	**3,410.10**	**385.50**	**2,899.10**	**3,027.40**	**3,410.10**	**406.40**	**3,037.00**	**3,198.80**	**3,424.80**	**406.00**	**2,899.20**	**3,266.60**	**3,462.10**	**406.00**	**2,899.20**	**3,266.60**	**3,462.10**	**391.40**	**2,808.00**	**3,145.80**	**3,458.70**
Alternative 2-A	**2009**		**Tons per Year**																					
Construct Inlet Weir													1.3	8.4	11.3	6.8	1.3	8.4	11.3	6.8	1.3	8.4	11.3	6.8
Construct Interior Detention Levee	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3
Construct Outlet Weir													0.6	3.7	5.4	1.2	0.6	3.7	5.4	1.2	0.6	3.7	5.4	1.2
Install Detention Basin Drainage Pump Station													0.2	0.9	1.4	0.4	0.2	0.9	1.4	0.4	0.2	0.9	1.4	0.4
Reinforce Existing Levees									0.3	2.0	2.2	0.5	0.3	2.0	2.2	0.5	0.3	2.0	2.2	0.5	0.3	2.0	2.2	0.5
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													1.6	10.4	13.5	6.9	1.6	10.4	13.5	6.9	1.6	10.4	13.5	6.9
Relocate Existing Structures	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9
Modify Walnut Grove–Thornton Road and Staten Island Road									0.5	3.0	4.0	0.1	0.5	3.0	4.0	0.1	0.5	3.0	4.0	0.1				
Retrofit or Replace Millers Ferry Bridge	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8
Retrofit or Replace New Hope Bridge	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8
Construct Wildlife Viewing Area													0.3	1.9	2.4	0.1	0.3	1.9	2.4	0.1	0.3	1.9	2.4	0.1
Excavate Dixon and New Hope Borrow Sites (New Hope)	2.0	14.9	15.9	7.0	2.0	14.9	15.9	7.0	2.0	14.9	15.9	7.0												
Excavate Dixon and New Hope Borrow Sites (Dixon)	2.0	15.0	16.0	7.1	2.0	15.0	16.0	7.1	2.0	15.0	16.0	7.1												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**20.8**	**150.9**	**164.9**	**156.9**	**20.8**	**150.9**	**164.9**	**156.9**	**21.6**	**155.9**	**171.1**	**157.5**	**21.6**	**151.3**	**173.2**	**158.8**	**21.6**	**151.3**	**173.2**	**158.8**	**21.1**	**148.3**	**169.2**	**158.7**

anticipated to exceed the SMAQMD's thresholds of significance (Table 3.9-9). Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-1 through AIR-4 and AIR-6 will reduce construction emissions, but not to a less-than-significant level (Table 3.9-18). The SJVAPCD requires that all construction activities must comply with Regulation VIII. Further, guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). The requirement to implement a Dust Control Plan in accordance with SJVAPCD requirements has been incorporated into the Project as an environmental commitment (see Chapter 2). Although Mitigation Measures AIR-1 through AIR-4, AIR-6, and environmental commitments will reduce emissions, they will not reduce emissions below threshold levels. Consequently, this impact is considered **significant and unavoidable**.

Project operations would primarily consist of maintenance activities, including prescribed burning, mowing of vegetation, operation of pumps, application of soil and grading of levees, application of aggregate and grading of levee and access roads, street sweeping, and application of architectural coatings. It is currently not known what levels of maintenance activities would occur or how much soil/aggregate would be required for levee and road maintenance. However, it is anticipated that maintenance activities could exceed the SJVAPCD's thresholds of significance. Consequently, this impact is considered potentially significant and mitigation is required. Mitigation Measures AIR-2, AIR-5, and AIR-6 will reduce this impact, but not to a less-than-significant level. Consequently, this impact is considered **significant and unavoidable**.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Significance after Mitigation: Significant and unavoidable.

Impact AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk.

Impacts under Alternative 2-A would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Significance after Mitigation: Less than significant.

Impact AIR-3: Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels.

Impacts under Alternative 2-A would be the same as described under Alternative 1-A.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NOX Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Mitigation Measure AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.

Significance after Mitigation: Significant and unavoidable.

Table 3.9-18. Alternative 2-A Emissions (Mitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 2-A (Mitigated)	**2009**		**Pounds per Day**																					
Construct Inlet Weir													40.6	182.0	344.3	233.1	40.6	182.0	344.3	233.1	40.6	182.0	344.3	233.1
Construct Interior Detention Levee	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4
Construct Outlet Weir													18.9	77.7	163.3	13.2	18.9	77.7	163.3	13.2	18.9	77.7	163.3	13.2
Install Detention Basin Drainage Pump Station													5.0	19.7	42.7	4.0	5.0	19.7	42.7	4.0	5.0	19.7	42.7	4.0
Reinforce Existing Levees									6.3	36.7	50.6	4.4	6.3	36.7	50.6	4.4	6.3	36.7	50.6	4.4	6.3	36.7	50.6	4.4
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													49.2	216.4	410.8	232.9	49.2	216.4	410.8	232.9	49.2	216.4	410.8	232.9
Relocate Existing Structures	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8
Modify Walnut Grove–Thornton Road and Staten Island Road									14.6	63.0	120.8	0.3	14.6	63.0	120.8	0.3	14.6	63.0	120.8	0.3				
Retrofit or Replace Millers Ferry Bridge	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2
Retrofit or Replace New Hope Bridge	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2
Construct Wildlife Viewing Area													9.0	39.7	73.9	0.2	9.0	39.7	73.9	0.2	9.0	39.7	73.9	0.2
Excavate Dixon and New Hope Borrow Sites (New Hope)	61.4	343.2	483.1	236.3	61.4	343.2	483.1	236.3	61.4	343.2	483.1	236.3												
Excavate Dixon and New Hope Borrow Sites (Dixon)	61.7	347.6	484.1	236.5	61.7	347.6	484.1	236.5	61.7	347.6	484.1	236.5												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**385.50**	**2,224.50**	**3,027.40**	**1,359.40**	**385.50**	**2,224.50**	**3,027.40**	**1,359.40**	**406.40**	**2,324.20**	**3,198.80**	**1,364.10**	**406.00**	**2,168.90**	**3,266.60**	**1,374.70**	**406.00**	**2,168.90**	**3,266.60**	**1,374.70**	**391.40**	**2,105.90**	**3,145.80**	**1,374.40**
Alternative 2-A (Mitigated)	**2009**		**Tons per Year**																					
Construct Inlet Weir													1.3	5.9	11.3	2.6	1.3	5.9	11.3	2.6	1.3	5.9	11.3	2.6
Construct Interior Detention Levee	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2
Construct Outlet Weir													0.6	2.6	5.4	0.4	0.6	2.6	5.4	0.4	0.6	2.6	5.4	0.4
Install Detention Basin Drainage Pump Station													0.2	0.7	1.4	0.1	0.2	0.7	1.4	0.1	0.2	0.7	1.4	0.1
Reinforce Existing Levees									0.3	1.5	2.2	0.2	0.3	1.5	2.2	0.2	0.3	1.5	2.2	0.2	0.3	1.5	2.2	0.2
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													1.6	7.1	13.5	2.6	1.6	7.1	13.5	2.6	1.6	7.1	13.5	2.6
Relocate Existing Structures	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4
Modify Walnut Grove–Thornton Road and Staten Island Road									0.5	2.1	4.0	0.0	0.5	2.1	4.0	0.0	0.5	2.1	4.0	0.0				
Retrofit or Replace Millers Ferry Bridge	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3
Retrofit or Replace New Hope Bridge	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3
Construct Wildlife Viewing Area													0.3	1.3	2.4	0.0	0.3	1.3	2.4	0.0	0.3	1.3	2.4	0.0
Excavate Dixon and New Hope Borrow Sites (New Hope)	2.0	11.3	15.9	2.7	2.0	11.3	15.9	2.7	2.0	11.3	15.9	2.7												
Excavate Dixon and New Hope Borrow Sites (Dixon)	2.0	11.5	16.0	2.7	2.0	11.5	16.0	2.7	2.0	11.5	16.0	2.7												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**20.8**	**114.1**	**164.9**	**61.6**	**20.8**	**114.1**	**164.9**	**61.6**	**21.6**	**117.7**	**171.1**	**61.8**	**21.6**	**112.5**	**173.2**	**62.1**	**21.6**	**112.5**	**173.2**	**62.1**	**21.1**	**110.4**	**169.2**	**62.1**

Alternative 2-B: West Staten Detention

Construction and operational activities associated with Project components for Alternative 2-B will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels.

As previously mentioned, construction activities are anticipated to be the primary source of emissions associated with Project components associated with Alternative 1-B. Consequently, construction emissions are addressed quantitatively, while operational emissions are addressed qualitatively.

Table 3.9-19 summarizes construction emissions by Project component for Alternative 1-B. As indicated in Table 3.9-19, construction emissions are anticipated to exceed the SMAQMD's thresholds of significance (Table 3.9-9). Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-1 through AIR-4 and AIR-6 will reduce construction emissions, but not to a less-than-significant level (Table 3.9-20). The SJVAPCD requires that all construction activities must comply with Regulation VIII. Further, guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). The requirement to implement a Dust Control Plan in accordance with SJVAPCD requirements has been incorporated into the Project as an environmental commitment (see Chapter 2). Although Mitigation Measures AIR-1 through AIR-4, AIR-6, and environmental commitments will reduce emissions, they will not reduce emissions below threshold levels. Consequently, this impact is considered **significant and unavoidable**.

Project operations would primarily consist of maintenance activities, including prescribed burning, mowing of vegetation, operation of pumps, application of soil and grading of levees, application of aggregate and grading of levee and access roads, street sweeping, and application of architectural coatings. It is currently not known what levels of maintenance activities would occur or how much soil/aggregate would be required for levee and road maintenance. However, it is anticipated that maintenance activities could exceed the SJVAPCD's thresholds of significance. Consequently, this impact is considered potentially significant and mitigation is required. Mitigation Measures AIR-2, AIR-5, and AIR-6 will reduce this impact, but not to a less-than-significant level. Consequently, this impact is considered **significant and unavoidable**.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Significance after Mitigation: Significant and unavoidable.

Table 3.9-19. Alternative 2-B Emissions (Unmitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 2-B	**2009**		**Pounds per Day**																					
Construct Inlet Weir													33.0	200.0	282.8	597.3	33.0	200.0	282.8	597.3	33.0	200.0	282.8	597.3
Construct Interior Detention Levee	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5	216.8	1,623.2	1,719.6	2,110.5
Construct Outlet Weir													18.9	112.9	163.3	36.6	18.9	112.9	163.3	36.6	18.9	112.9	163.3	36.6
Install Detention Basin Drainage Pump Station													5.0	28.6	42.7	10.8	5.0	28.6	42.7	10.8	5.0	28.6	42.7	10.8
Reinforce Existing Levees									6.3	46.7	50.6	11.3	6.3	46.7	50.6	11.3	6.3	46.7	50.6	11.3	6.3	46.7	50.6	11.3
Construct Setback Levee	84.0	642.0	659.8	613.0	84.0	642.0	659.8	613.0	84.0	642.0	659.8	613.0	84.0	642.0	659.8	613.0	84.0	642.0	659.8	613.0	84.0	642.0	659.8	613.0
Degrade Existing Levee													49.2	314.3	410.8	602.6	49.2	314.3	410.8	602.6	49.2	314.3	410.8	602.6
Relocate Existing Structures	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6	24.4	231.7	165.2	60.6
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5
Retrofit or Replace New Hope Bridge	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5
Construct Wildlife Viewing Area													9.0	57.5	73.9	2.2	9.0	57.5	73.9	2.2	9.0	57.5	73.9	2.2
Excavate Dixon and New Hope Borrow Sites (New Hope)	61.4	451.1	483.1	606.9	61.4	451.1	483.1	606.9	61.4	451.1	483.1	606.9												
Excavate Dixon and New Hope Borrow Sites (Dixon)	61.7	455.5	484.1	607.1	61.7	455.5	484.1	607.1	61.7	455.5	484.1	607.1												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**469.50**	**3,541.10**	**3,687.20**	**4,023.10**	**469.50**	**3,541.10**	**3,687.20**	**4,023.10**	**475.80**	**3,587.80**	**3,737.80**	**4,034.40**	**467.80**	**3,394.50**	**3,744.10**	**4,069.90**	**467.80**	**3,394.50**	**3,744.10**	**4,069.90**	**467.80**	**3,394.50**	**3,744.10**	**4,069.90**
Alternative 2-B	**2009**		**Tons per Year**																					
Construct Inlet Weir													1.1	6.6	9.3	6.7	1.1	6.6	9.3	6.7	1.1	6.6	9.3	6.7
Construct Interior Detention Levee	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3	14.3	103.5	113.4	139.3
Construct Outlet Weir													0.6	3.7	5.4	1.2	0.6	3.7	5.4	1.2	0.6	3.7	5.4	1.2
Install Detention Basin Drainage Pump Station													0.2	0.9	1.4	0.4	0.2	0.9	1.4	0.4	0.2	0.9	1.4	0.4
Reinforce Existing Levees									0.3	2.0	2.2	0.5	0.3	2.0	2.2	0.5	0.3	2.0	2.2	0.5	0.3	2.0	2.2	0.5
Construct Setback Levee	5.5	40.9	43.5	8.0	5.5	40.9	43.5	8.0	5.5	40.9	43.5	8.0	5.5	40.9	43.5	8.0	5.5	40.9	43.5	8.0	5.5	40.9	43.5	8.0
Degrade Existing Levee													1.6	10.4	13.5	6.9	1.6	10.4	13.5	6.9	1.6	10.4	13.5	6.9
Relocate Existing Structures	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9	1.1	8.5	8.0	1.9
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8
Retrofit or Replace New Hope Bridge	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8
Construct Wildlife Viewing Area													0.3	1.9	2.4	0.1	0.3	1.9	2.4	0.1	0.3	1.9	2.4	0.1
Excavate Dixon and New Hope Borrow Sites (New Hope)	2.0	14.9	15.9	7.0	2.0	14.9	15.9	7.0	2.0	14.9	15.9	7.0												
Excavate Dixon and New Hope Borrow Sites (Dixon)	2.0	15.0	16.0	7.1	2.0	15.0	16.0	7.1	2.0	15.0	16.0	7.1												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**26.3**	**191.8**	**208.4**	**164.9**	**26.3**	**191.8**	**208.4**	**164.9**	**26.6**	**193.8**	**210.6**	**165.4**	**26.4**	**187.4**	**210.7**	**166.6**	**26.4**	**187.4**	**210.7**	**166.6**	**26.4**	**187.4**	**210.7**	**166.6**

Table 3.9-20. Alternative 2-B Emissions (Mitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 2-B (Mitigated)	**2009**		**Pounds per Day**																					
Construct Inlet Weir													33.0	139.2	282.8	232.6	33.0	139.2	282.8	232.6	33.0	139.2	282.8	232.6
Construct Interior Detention Levee	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4	216.8	1,239.2	1,719.6	821.4
Construct Outlet Weir													18.9	77.7	163.3	13.2	18.9	77.7	163.3	13.2	18.9	77.7	163.3	13.2
Install Detention Basin Drainage Pump Station													5.0	19.7	42.7	4.0	5.0	19.7	42.7	4.0	5.0	19.7	42.7	4.0
Reinforce Existing Levees									6.3	36.7	50.6	4.4	6.3	36.7	50.6	4.4	6.3	36.7	50.6	4.4	6.3	36.7	50.6	4.4
Construct Setback Levee	84.0	490.0	659.8	237.5	84.0	490.0	659.8	237.5	84.0	490.0	659.8	237.5	84.0	490.0	659.8	237.5	84.0	490.0	659.8	237.5	84.0	490.0	659.8	237.5
Degrade Existing Levee													49.2	216.4	410.8	232.9	49.2	216.4	410.8	232.9	49.2	216.4	410.8	232.9
Relocate Existing Structures	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8	24.4	198.1	165.2	56.8
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2
Retrofit or Replace New Hope Bridge	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2
Construct Wildlife Viewing Area													9.0	39.7	73.9	0.2	9.0	39.7	73.9	0.2	9.0	39.7	73.9	0.2
Excavate Dixon and New Hope Borrow Sites (New Hope)	61.4	343.2	483.1	236.3	61.4	343.2	483.1	236.3	61.4	343.2	483.1	236.3												
Excavate Dixon and New Hope Borrow Sites (Dixon)	61.7	347.6	484.1	236.5	61.7	347.6	484.1	236.5	61.7	347.6	484.1	236.5												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**469.50**	**2,714.50**	**3,687.20**	**1,596.90**	**469.50**	**2,714.50**	**3,687.20**	**1,596.90**	**475.80**	**2,751.20**	**3,737.80**	**1,601.30**	**467.80**	**2,553.10**	**3,744.10**	**1,611.40**	**467.80**	**2,553.10**	**3,744.10**	**1,611.40**	**467.80**	**2,553.10**	**3,744.10**	**1,611.40**
Alternative 2-B (Mitigated)	**2009**		**Tons per Year**																					
Construct Inlet Weir													1.1	4.6	9.3	6.7	1.1	4.6	9.3	6.7	1.1	4.6	9.3	6.7
Construct Interior Detention Levee	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2	14.3	78.2	113.4	54.2
Construct Outlet Weir													0.6	2.6	5.4	0.4	0.6	2.6	5.4	0.4	0.6	2.6	5.4	0.4
Install Detention Basin Drainage Pump Station													0.2	0.7	1.4	0.1	0.2	0.7	1.4	0.1	0.2	0.7	1.4	0.1
Reinforce Existing Levees									0.3	1.5	2.2	0.2	0.3	1.5	2.2	0.2	0.3	1.5	2.2	0.2	0.3	1.5	2.2	0.2
Construct Setback Levee	5.5	30.9	43.5	2.9	5.5	30.9	43.5	2.9	5.5	30.9	43.5	2.9	5.5	30.9	43.5	2.9	5.5	30.9	43.5	2.9	5.5	30.9	43.5	2.9
Degrade Existing Levee													1.6	7.1	13.5	2.6	1.6	7.1	13.5	2.6	1.6	7.1	13.5	2.6
Relocate Existing Structures	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4	1.1	6.7	8.0	1.4
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3
Retrofit or Replace New Hope Bridge	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3
Construct Wildlife Viewing Area													0.3	1.3	2.4	0.0	0.3	1.3	2.4	0.0	0.3	1.3	2.4	0.0
Excavate Dixon and New Hope Borrow Sites (New Hope)	2.0	11.3	15.9	2.7	2.0	11.3	15.9	2.7	2.0	11.3	15.9	2.7												
Excavate Dixon and New Hope Borrow Sites (Dixon)	2.0	11.5	16.0	2.7	2.0	11.5	16.0	2.7	2.0	11.5	16.0	2.7												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Dredge South Fork Mokelumne River (Dredging)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Modify Levees to Increase Channel Capacity	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	**26.3**	**145**	**208.4**	**64.5**	**26.3**	**145**	**208.4**	**64.5**	**26.6**	**146.5**	**210.6**	**64.7**	**26.4**	**140**	**210.7**	**69.1**	**26.4**	**140**	**210.7**	**69.1**	**26.4**	**140**	**210.7**	**69.1**

Impact AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk.

Impacts under Alternative 2-B would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Significance after Mitigation: Less than significant.

Impact AIR-3: Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels.

Impacts under Alternative 2-B would be the same as described under Alternative 1-A.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NOX Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Mitigation Measure AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.

Significance after Mitigation: Significant and unavoidable.

Alternative 2-C: East Staten Detention

Construction and operational activities associated with Project components for Alternative 2-C will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impacts under Alternative 2-C would be the same as described under Alternative 2-B.

Alternative 2-D: Dredging and Levee Modifications

Construction and operational activities associated with Project components for Alternative 2-C will result in air pollutant emissions of ozone precursors (ROG and NO_x), CO, and particulate matter (PM10).

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact AIR-1: Generation of Pollutant Emissions in Excess of SMAQMD and SJVAPCD Threshold Levels.

As previously mentioned, construction activities are anticipated to be the primary source of emissions associated with Project components associated with Alternative 2-D. Consequently, construction emissions are addressed quantitatively, while operational emissions are addressed qualitatively.

Table 3.9-21 summarizes construction emissions by Project component for Alternative 2-D. As indicated in Table 3.9-21, construction emissions are anticipated to exceed the SMAQMD's thresholds of significance (Table 3.9-9). Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-1 through AIR-4 and AIR-6 will reduce construction emissions, but not to a less-than-significant level (Table 3.9-22). The SJVAPCD requires that all construction activities must comply with Regulation VIII. Further, guidance from SJVAPCD staff indicates that implementation of a Dust Control Plan would satisfy all of the requirements of SJVAPCD Regulation VIII (Cadrett pers. comm.). The requirement to implement a Dust Control Plan in accordance with SJVAPCD requirements has been incorporated into the Project as an environmental commitment (see Chapter 2). While Mitigation Measures AIR-1 through AIR-4, AIR-6, and environmental commitments will reduce emissions, they will not reduce emissions below threshold levels. Consequently, this impact is considered **significant and unavoidable**.

Project operations would primarily consist of maintenance activities, including maintenance dredging of the south fork of the Mokelumne River. It is currently not known what type of dredging would occur (i.e., clamshell, hydraulic, or dragline), how much dredging will occur, when it will occur, and what equipment that will be used to dispose of dredged material. However, given the amount of activities associated with dredging operations, it is anticipated that dredging activities would exceed the SJVAPCD's thresholds of significance. Consequently, this impact is considered significant and mitigation is required. Mitigation Measures AIR-2, AIR-5, and AIR-6 will reduce this impact, but not to a less-than-significant level. Consequently, this impact is considered **significant and unavoidable**.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel-Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-5: Consult with SMAQMD and SJVAPCD and Implement Approved Emissions Reduction Programs or Offsets to Reduce Operational Emissions.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Significance after Mitigation: Significant and unavoidable.

Impact AIR-2: Exposure of Sensitive Receptors to Elevated Levels of Diesel Exhaust and an Increased Health Risk.

Impacts under Alternative 2-D would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NO_X Emissions from Off-Road Diesel-Powered Equipment.

Significance after Mitigation: Less than significant.

Impact AIR-3: Generation of Pollutant Emissions in Excess of *de Minimis* Threshold Levels.

Impacts under Alternative 2-D would be the same as described under Alternative 1-A.

Determination of Significance: Significant and unavoidable.

Mitigation Measure AIR-1: Implement all Mitigation Measures from the CALFED Bay-Delta Program Final Programmatic EIS/EIR.

Table 3.9-21. Alternative 2-D Emissions (Unmitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 2-D	**2009**		**Pounds per Day**																					
Construct Inlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Interior Detention Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Outlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Install Detention Basin Drainage Pump Station													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reinforce Existing Levees									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Relocate Existing Structures	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5
Retrofit or Replace New Hope Bridge	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5	10.6	68.8	87.7	12.5
Construct Wildlife Viewing Area													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Excavate Dixon and New Hope Borrow Sites (New Hope)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Excavate Dixon and New Hope Borrow Sites (Dixon)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					5.3	31.3	45.7	51.0	5.3	31.3	45.7	51.0	5.3	31.3	45.7	51.0	5.3	31.3	45.7	51.0				
Dredge South Fork Mokelumne River (Dredging)					46.1	910.2	281.3	27.2	46.1	910.2	281.3	27.2	46.1	910.2	281.3	27.2	46.1	910.2	281.3	27.2				
Modify Levees to Increase Channel Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**21.2**	**137.6**	**175.4**	**25.0**	**72.6**	**1079.1**	**502.4**	**103.2**	**72.6**	**1079.1**	**502.4**	**103.2**	**72.6**	**1079.1**	**502.4**	**103.2**	**72.6**	**1079.1**	**502.4**	**103.2**	**21.2**	**137.6**	**175.4**	**25.0**
Alternative 2-D	**2009**		**Tons per Year**																					
Construct Inlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Interior Detention Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Outlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Install Detention Basin Drainage Pump Station													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reinforce Existing Levees									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Relocate Existing Structures	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8
Retrofit or Replace New Hope Bridge	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8	0.7	4.5	5.8	0.8
Construct Wildlife Viewing Area													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Excavate Dixon and New Hope Borrow Sites (New Hope)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Excavate Dixon and New Hope Borrow Sites (Dixon)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					0.1	0.3	0.5	0.6	0.1	0.3	0.5	0.6	0.1	0.3	0.5	0.6	0.1	0.3	0.5	0.6				
Dredge South Fork Mokelumne River (Dredging)					1.5	30.0	9.3	0.9	1.5	30.0	9.3	0.9	1.5	30.0	9.3	0.9	1.5	30.0	9.3	0.9				
Modify Levees to Increase Channel Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1.4**	**9.0**	**11.6**	**1.6**	**3.0**	**39.3**	**21.4**	**3.1**	**3.0**	**39.3**	**21.4**	**3.1**	**3.0**	**39.3**	**21.4**	**3.1**	**3.0**	**39.3**	**21.4**	**3.1**	**1.4**	**9.0**	**11.6**	**1.6**

Table 3.9-22. Alternative 2-D Emissions (Mitigated)

	May				June				July				August				September				October			
Component	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10	ROG	NOx	CO	PM10
Alternative 2-D (Mitigated)	**2009**		**Pounds per Day**																					
Construct Inlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Interior Detention Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Outlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Install Detention Basin Drainage Pump Station													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reinforce Existing Levees									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Relocate Existing Structures	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2
Retrofit or Replace New Hope Bridge	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2	10.6	48.2	87.7	4.2
Construct Wildlife Viewing Area													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Excavate Dixon and New Hope Borrow Sites (New Hope)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Excavate Dixon and New Hope Borrow Sites (Dixon)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					5.3	21.6	45.7	19.7	5.3	21.6	45.7	19.7	5.3	21.6	45.7	19.7	5.3	21.6	45.7	19.7				
Dredge South Fork Mokelumne River (Dredging)					46.1	910.2	281.3	27.2	46.1	910.2	281.3	27.2	46.1	910.2	281.3	27.2	46.1	910.2	281.3	27.2				
Modify Levees to Increase Channel Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**21.2**	**96.4**	**175.4**	**8.4**	**72.6**	**1028.2**	**502.4**	**55.3**	**72.6**	**1028.2**	**502.4**	**55.3**	**72.6**	**1028.2**	**502.4**	**55.3**	**72.6**	**1028.2**	**502.4**	**55.3**	**21.2**	**96.4**	**175.4**	**8.4**
Alternative 2-D (Mitigated)	**2009**		**Tons per Year**																					
Construct Inlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Interior Detention Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Outlet Weir													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Install Detention Basin Drainage Pump Station													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Reinforce Existing Levees									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct Setback Levee	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Degrade Existing Levee													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Relocate Existing Structures	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Modify Walnut Grove–Thornton Road and Staten Island Road									NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
Retrofit or Replace Millers Ferry Bridge	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3
Retrofit or Replace New Hope Bridge	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3	0.7	3.2	5.8	0.3
Construct Wildlife Viewing Area													NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Excavate Dixon and New Hope Borrow Sites (New Hope)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Excavate Dixon and New Hope Borrow Sites (Dixon)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA												
Dredge South Fork Mokelumne River (Prepare Drying Basins)					0.1	0.2	0.5	0.6	0.1	0.2	0.5	0.6	0.1	0.2	0.5	0.6	0.1	0.2	0.5	0.6				
Dredge South Fork Mokelumne River (Dredging)					1.5	30.0	9.3	0.9	1.5	30.0	9.3	0.9	1.5	30.0	9.3	0.9	1.5	30.0	9.3	0.9				
Modify Levees to Increase Channel Capacity	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	**1.4**	**6.4**	**11.6**	**0.6**	**3.0**	**36.6**	**21.4**	**2.1**	**3.0**	**36.6**	**21.4**	**2.1**	**3.0**	**36.6**	**21.4**	**2.1**	**3.0**	**36.6**	**21.4**	**2.1**	**1.4**	**6.4**	**11.6**	**0.6**

Mitigation Measure AIR-2: Implement SMAQMD Requirement to Reduce NOX Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-3: Implement SMAQMD Requirement to Control Visible Emissions from Off-Road Diesel Powered Equipment.

Mitigation Measure AIR-4: Implement SMAQMD Requirement to Pay an Off-Site Mitigation Fee.

Mitigation Measure AIR-6: Require Construction and Dredging Contractors to Use Equipment with Valid Statewide Portable Equipment Registrations or to Obtain an Operating Permit from the SMAQMD and SJVAPCD.

Mitigation Measure AIR-7: Consult with the SMAQMD and SJVAPCD to Conduct a Conformity Determination.

Significance after Mitigation: Significant and unavoidable.

Attachment 3.9-1

San Joaquin Valley Air Pollution Control District Regulation VIII – Fugitive PM10 Prohibitions Dust Control Plan

San Joaquin Valley
Air Pollution Control District

San Joaquin Valley Air Pollution Control District
Regulation VIII – Fugitive PM10 Prohibitions
Dust Control Plan

Rule 8021 – *Construction, Demolition, Excavation, Extraction, and Other Earthmoving Activities* requires the owner or operator of a construction project to submit a Dust Control Plan to the District if at anytime the project involves:

- Residential developments of ten (10) or more acres of disturbed surface area,
- Non-residential developments of five (5) or more acres of disturbed surface area, or
- Relocation of more than 2,500 cubic yards per day of materials on at least three (3) days of the project.

A Dust Control Plan identifies the fugitive dust sources at the construction site and describes all of the fugitive dust control measures that will be implemented before, during, and after any dust generating activity for the duration of the project. One Dust Control Plan may cover a single project or multiple projects at different sites where construction will commence within the following 12 months.

The District will review and approve, conditionally approve, or disapprove the Dust Control Plan within 30 days of submittal. **Construction activities shall not commence until the Dust Control Plan has been approved or conditionally approved.** An owner or operator must also provide written notification to the District via fax or mail within 10 days prior to the commencement of earthmoving activities. A copy of the approved Dust Control Plan must be retained at the project site and made available upon request by a District inspector.

At least one key individual representing the owner or operator, or any person who prepares a Dust Control Plan must complete a Dust Control Training Course presented by the District. Please contact the District to find out when courses are being offered.

Regardless of whether a District-approved Dust Control Plan is in place or not, the owner or operator is required to comply with all requirements of the applicable rules under Regulation VIII and the District's Rules and Regulations at all times.

Submit the Dust Control Plan to the District's Compliance Division at the office listed below:

For San Joaquin, Stanislaus, and Merced Counties:	**Northern Region Office** 4230 Kiernan Avenue, Suite 130 Modesto, CA 95356 (209) 557-6400 FAX (209) 557-6475
For Madera, Fresno, and Kings Counties:	**Central Region Office** 1990 East Gettysburg Avenue Fresno, CA 93726 (559) 230-5950 FAX (559) 230-6062
For Tulare County and the valley portion of Kern County	**Southern Region Office** 2700 "M" Street, Suite 275 Bakersfield, CA 93301 (661) 326-6900 FAX (661) 326-6985

www.valleyair.org

Dust Control Plan
Section 1 – General Information – Page 1

1-A Project Name and Location

Project Name: ______________________

Project Address: ______________________

Major X-Streets: ______________________

City: ____________ County: ____________

Section(s): ____________ Township: ________ Range: ________

Expected Construction Start Date: ____________ End Date: ____________

1-B Contacts

Report the names, addresses, and phone numbers of persons and owners or operators responsible for the preparation, submittal, and implementation of the Dust Control Plan and responsible for the dust generating operation and dust control applications. (Rule 8021 Sec. 6.3.6.1)

Property Owner: ______________________

Address: ______________________

City / State / Zip: ______________________

Phone: ____________ Fax: ____________

Developer: ______________________

Address: ______________________

City / State / Zip: ______________________

Contact Person: ______________________

Phone: ____________ Fax: ____________

General Contractor: ______________________

Address: ______________________

City / State / Zip: ______________________

Contact Person: ______________________

Phone: ____________ Fax: ____________

This Dust Control Plan was prepared by:

Name: ______________________

Title: ______________________

Company Name: ______________________

Address: ______________________

City / State / Zip: ______________________

Phone: ____________ Fax: ____________

Date training completed: ____________ Training Location: ____________

Section 1 – General Information – Page 2

Project Name: ______________________________

1-C Contractors

Provide the names, addresses, and phone numbers of the contractors involved in dust generating activities **or** performing dust control as part of this project. (Rule 8021 Sec. 6.3.6.1)

1. ______________________________

____

2. ______________________________

____

3. ______________________________

____

4. ______________________________

____

5. ______________________________

____

1-D Who will have the primary responsibility for implementing this Dust Control Plan?

(Rule 8021 Sec 6.3.6.1)

☐ **Property Owner** ☐ **Developer** ☐ **General / Prime Contractor**

☐ **Sub-Contractor(s)** ☐ **Other:** ______________________________

Primary Project Contact: ______________________________

Title: ______________________________

Company Name: ______________________________

Address: ______________________________

City / State / Zip: ______________________________

On-Site Phone: ______________________________ Fax: ______________________________

Mobile Phone: ______________________________ Pager: ______________________________

1-E Provide a brief description of the Project's Operations.

____

____

____

____

____

Dust Control Plan
Section 2 – Plot Plan – Page 1

Project Name: ______________________________

2-A Plot Plan

A plot plan identifies the type and location of each project. Attach appropriately sized maps with the project boundaries outlined or use the space in sections 2-B or 2-C to draw a plot plan. Attached maps may include tract maps, site maps, and topographic maps. Use the checklist below to make sure all areas have been identified on the plot plan. (Rule 8021 Sec. 6.3.6.2 & 6.3.6.5)

Identify the relative locations of actual and potential sources of fugitive dust emissions.

- ☐ Bulk material handling and storage areas.
- ☐ Paved and unpaved access roads, haul roads, traffic areas, and equipment storage yards.
- ☐ Exit points where carryout and trackout onto paved public roads may occur.
- ☐ Water supply locations if water application will be used for controlling visible dust emissions.

Identify the relative locations of sensitive receptors within ¼ mile of the project. (Rule 4102 Sec. 4.1)

- ☐ No sensitive receptors within ¼ mile of the project.
- ☐ Residential areas, schools, day care, churches, hospitals, nursing facilities, commercial, retail, etc.
- ☐ Freeways, roads, or traffic areas that may be affected by the dust generating activities.
- ☐ Other: ______________________________

2-B Draw Plot Plan (if one is not attached)

May use the back of this form
Include a North Arrow

☐ Plot plan is attached (Skip to 3-A).

Section 2 – Plot Plan – Page 2

Project Name: ______________________________

2-C **Draw Plot Plan** (if one is not attached) Include a North Arrow

Dust Control Plan
Section 3 – Fugitive PM10 Sources – Page 1

Project Name: ______________________________

3-A Disturbed Surface Area

Report the total area of land surface to be disturbed, the daily throughput volume of earthmoving in cubic yards, and the total area in acres of the entire project site. (Rule 8021 Sec. 6.3.6.3)

Total area of land surface to be disturbed:	________	Acres
Daily maximum throughput volume of earthmoving:	________	Cubic Yards
Daily average throughput volume of earthmoving:	________	Cubic Yards
Total area of entire project site:	________	Acres
Total disturbed areas that will be left inactive for more than seven days:	________	Acres

3-B Dust Generating Activity Dates

The expected start and completion dates of **dust generating activities and soil disturbance activities** to be performed on site. For phased projects, it may be necessary to report expected start and completion dates separately. (Rule 8021 Sec. 6.3.6.4)

Expected start date:	________	**Completion Date**:	________
Phase Project Start – A:	________	Completion – A:	________
Phase Project Start – B:	________	Completion – B:	________
Phase Project Start – C:	________	Completion – C:	________

3-C Other Locations

Identify whether any other locations should be included with this plan that are involved with this project. An example may include listing any site where materials will be imported from or exported to. (Rule 8021 Sec. 6.3.2)

☐ No other locations are included with this project. (Skip to 3-D)

Location 1: ______________________________

☐ No Dust Control Plan Required ☐ Included with this plan ☐ Included with another plan

Location 2: ______________________________

☐ No Dust Control Plan Required ☐ Included with this plan ☐ Included with another plan

Location 3: ______________________________

☐ No Dust Control Plan Required ☐ Included with this plan ☐ Included with another plan

Section 3 – Fugitive PM10 Sources – Page 2

Project Name: ______________________________

3-D Sources of Fugitive Dust

This section describes the minimum requirements for limiting visible dust emissions from activities that cause fugitive dust emissions. (Rule 8021 Sec. 6.3.6.5) **Check at least one box under each category**.

Structural Demolition. (Rule 8021 Sec. 5.1, 6.3.3, & 6.3.6.5)

- ☐ No demolitions are planned for this project.
- ☐ Asbestos NESHAP notification and fees have been submitted to the District. (Rule 3050 and Rule 4002).
- ☐ Water will be applied to the following areas for the duration of the demolition activities:
  - Building exterior surfaces;
  - Unpaved surface areas where equipment will operate;
  - Razed building materials; and
  - Water or dust suppressants will be applied to unpaved surface areas within 100 feet of structure during demolition.

Pre-Activity. (Rule 8021 Sec. 5.2)

- ☐ Not applicable for this project (Please explain why in Section 3-F).
- ☐ The site will be pre-watered and work will be phased to reduce the amount of disturbed surface area at any one time (Complete Section 4-A).

Active Operations. (Rule 8021 Sec. 5.2)

- ☐ Water will be applied to dry areas during leveling, grading, trenching, and earthmoving activities (Complete Section 4-A).
- ☐ Wind barriers will be constructed and maintained, and water or dust suppressants will be applied to the disturbed surface areas (Complete Sections 4-A or 4-B, and 4-C).

Inactive Operations, including after work hours, weekends, and holidays. (Rule 8021 Sec. 5.2)

- ☐ Not applicable for this project (Please explain why in Section 3-F).
- ☐ Water or dust suppressants will be applied on disturbed surface areas to form a visible crust, and vehicle access will be restricted to maintain the visible crust. (Complete Section 4-A or 4-B, and 4-C)

Temporary stabilization of areas that remain unused for seven or more days. (Rule 8021 Sec. 5.2)

- ☐ Not applicable for this project (Please explain why in Section 3-F)
- ☐ Vehicular access will be restricted and water or dust suppressants will be applied and maintained at all un-vegetated areas (Complete Section 4-A or 4-B, and 4-C).
- ☐ Vegetation will be established on all previously disturbed areas (Complete Section 4-C).
- ☐ Gravel will be applied and maintained at all previously disturbed areas (Complete Section 4-C).
- ☐ Previously disturbed areas will be paved (Complete Section 4-C).

Unpaved Access and Haul Roads, Traffic and Equipment Storage Areas. (Rule 8021 Sec. 5.2 and 5.3)

- ☐ Not applicable for this project (Please explain why in Section 3-F)
- ☐ Apply water or dust suppressants to unpaved haul and access roads (Complete Section 4-A or 4-B)
- ☐ Post speed limit signs of not more than 15 miles per hour at each entrance, and again every 500 feet. (Complete Section 4-C)
- ☐ Water or dust suppressants will be applied to vehicle traffic and equipment storage areas (Complete Section 4-A or 4-B).

Wind Events. (Rule 8021 Sec. 5.4)

- ☐
  - Water application equipment will apply water to control fugitive dust during wind events, unless unsafe to do so.
  - Outdoor construction activities that disturb the soil will cease whenever visible dust emissions cannot be effectively controlled.

3-E Bulk Materials (Rule 8021 Sec. 6.3.6.6 and Rule 8031)

Outdoor Handling of Bulk Materials. (Rule 8031 Sec. 5.0 A)

- ☐ No bulk materials will be handled during this project.
- ☐ Water or dust suppressants will be applied when handling bulk materials.
- ☐ Wind barriers with less than 50 percent porosity will be installed and maintained, and water or dust suppressants will be applied.

Outdoor Storage of Bulk Materials. (Rule 8031 Sec. 5.0 B)

- ☐ No bulk materials will be stored during this project.
- ☐ Water or dust suppressants will be applied to storage piles.
- ☐ Storage piles will be covered with tarps, plastic, or other suitable material and anchored in such a manner that prevents the cover from being removed by wind action.
- ☐ Wind barriers with less than 50 percent porosity will be installed and maintained around the storage piles, and water or dust suppressants will be applied.
- ☐ A three-sided structure (< 50% porosity) will be used that is at least as high as the storage piles.

On-Site Transporting of Bulk Materials. (Rule 8031 Sec. 5.0 C)

- ☐ No bulk materials will be transported on the project site.
- ☐ Vehicle speed will be limited on the work site.
- ☐ All haul trucks will be loaded such that the freeboard is not less than six inches when transported across any paved public access road.
- ☐ A sufficient amount of water will be applied to the top of the load to limit visible dust emissions.
- ☐ Haul trucks will be covered with a tarp or other suitable cover.

Off-Site Transporting of Bulk Materials. (Rule 8031 Sec. 5.0 D)

- ☐ No bulk materials will be transported to or from the project site.
- ☐ The following practices will be performed: (complete Section 5-B)
  - The interior of emptied truck cargo compartments will be cleaned or covered before leaving the site.
  - Spillage or loss of bulk materials from holes or other openings in the cargo compartment's floor, sides, and tailgates will be prevented.
  - Haul trucks will be covered with a tarp or other suitable cover or will be loaded such that the freeboard is not less than six inches when transported on any paved public access road to or from the project site and a sufficient amount of water will be applied to the top of the load to limit visible dust emissions.

Outdoor Transport using a Chute or Conveyor. (Rule 8031 Sec. 5.0 E)

- ☐ No chutes or conveyors will be used.
- ☐ Chute or conveyor will be fully enclosed.
- ☐ Water spray equipment will be used to sufficiently wet the materials.
- ☐ Transported materials will be washed or screened to remove fines (PM10 or smaller).

3-F Comments

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Dust Control Plan
Section 4 – Dust Control Methods – Page 1

Project Name: ______________________________

4-A Water Application

Complete this section if water application will be used as a control method for limiting visible dust emissions and stabilizing surface areas. Check and answer everything that applies to this project.
(Rule 8021 Sec. 6.3.6.6)

Water Application Equipment:

☐ Sprinklers: Describe the activities that will utilize sprinklers:

____

Minimum treated area: ______________ ☐ Square Feet ☐ Acres

Maximum treated area: ______________ ☐ Square Feet ☐ Acres

Minimum water flow rate: Duration: ______________

☐ Water Truck, ☐ Water Trailer, ☐ Water Wagon, ☐ Other: ______________

Describe the activities that will utilize this equipment:

____

Number of application equipment available: ______________

Application equipment capacity: ______________

Application frequency: ______________

Application rate: __________ Gallons per acre per application

Hours of operation: ______________

Water application equipment is available to operate after normal working hours, on weekends, and holidays.

After-hours contact: ______________ Phone No.: ______________

After-hours contact: ______________ Phone No.: ______________

Water Supply: Include the relative locations of these sources on the plot plan in Section 2.

☐ Fire hydrants

Number of hydrants available On-Site: ________ Off-Site: ________

Approval granted by the owner or public agency to use their fire hydrants for this project.

Owner or Agency: ______________

Contact: ______________ Phone No.: ______________

☐ Storage tanks Number and capacity: ______________

☐ Wells Number and flow rate: ______________

☐ Canal, River, Pond, Lake, etc. Describe: ______________

Approval granted by the owner or public agency to use their water source for this project.

Owner or Agency: ______________

Contact: ______________ Phone No.: ______________

☐ Other: ______________

Section 4 – Dust Control Methods – Page 2

Project Name: ______________________________

4-B Dust Suppressant Products

Complete this section if a dust suppressant product will be used. These materials include, but are not limited to: hygroscopic suppressants (road salts), adhesives, petroleum emulsions, polymer emulsions, and bituminous materials (road oils). (Rule 8021 Sec. 6.3.6.6)

Copy this page if more than one dust suppressant product will be used.

☐ **Not Applicable.** Only water application will be the control method used. **Skip to 4-C.**

Application Area: ______________________________

Product Name: ______________________________

Contractor's Name: ______________________ Phone No: ____________

Application Rate: ________ Gallons of undiluted material per ☐ mile or ☐ acre treated.

Application Frequency: ________ Applications per ☐ week, ☐ month, ☐ year

Application Equipment: ______________________________

Number of Application Equipment Available: ______________________________

Application Equipment Capacity: ______________________________

Attach each of the following information that fully describes this product. Use the checklist below to make sure all information is submitted with this plan.

- ☐ Product Specifications (MSDS, Product Safety Data Sheet, etc.)
- ☐ Manufacturer's Usage Instructions (method, frequency, and intensity of application)
- ☐ Environmental impacts and approvals or certifications related to the appropriate and safe use for ground application.

Section 4 – Dust Control Methods – Page 3

Project Name: ______________________________

4-C Other Dust Control Methods

Check below the other types of dust control methods that will be employed at the construction site. (Rule 8021 Sec. 5.2)

☐ Physical barriers for restricting unauthorized vehicle access:
☐ Fences ☐ Gates ☐ Posts ☐ Berms ☐ Concrete Barriers
☐ Other: ______________________________

☐ Wind barriers Describe: ______________________________

☐ Posted speed limit signs meet State and Federal Department of Transportation standards. (Rule 8021 Sec. 5.3)
☐ Posted at 15 miles per hour, ☐ Posted at ________ miles per hour (less than 15 MPH)

☐ Re-establish vegetation for temporarily stabilizing previously disturbed surfaces.
Explain: ______________________________

☐ Apply and maintain gravel:
☐ On haul roads ☐ On access roads ☐ At equipment storage yards
☐ At vehicle traffic areas ☐ For temporarily stabilizing previously disturbed areas.
Explain: ______________________________

☐ Apply pavement:
Explain: ______________________________

☐ Other: ______________________________

4-D Contingencies

Contingencies to be implemented if application equipment becomes inoperable, more equipment is needed to effectively control fugitive dust emissions during active and inactive periods, accessibility limitations occur at the water sources, or staff is not available to operate the application equipment. Describe the contingencies that will be in place and when they will be implemented. Attach any additional information if needed. (Rule 4102 and Rule 8021 Sec. 6.3.6.6)

____
____
____
____
____

4-E Record keeping (Rule 8011 Sec. 6.2)

Records and any other supporting documents for demonstrating compliance must be maintained, but only for those days when a control measure is implemented. The District has developed record keeping forms that may be used for complying with this requirement. Check one or both below:

☐ Records will be maintained using the forms developed by the District.

☐ Records will be maintained using documents or forms developed by the owner or operator.

Explain and include copies: ______________________________

Dust Control Plan
Section 5 – Carryout and Trackout – Page 1

Project Name: ______________________________

5-A Treatments for Preventing Trackout

Select the control devices that will be used for preventing trackout from occurring onto paved public roads. Trackout is any material that adheres to vehicle tires and is deposited onto a paved public road or the paved shoulder of a paved public road. Check one or a combination that will apply to this project.

☐ **Grizzly:** Rails, pipes, or grates used to dislodge debris off of vehicles before exiting the site. Extends from the intersection with the paved public road surface for the full width of the unpaved exit surface for a distance of at least 25 feet. (Rule 8041 Sec. 5.9.1)

Describe: ______________________________

☐ **Gravel Pad:** A layer of washed gravel at least one (1) inch or larger in diameter, three (3) inches deep, and extends from the intersection with the public paved road surface for the full width of the unpaved exit surface for a distance of at least 50 feet. (Rule 8041 Sec. 5.9.2)

Gravel Size: __________ Inches

Pad Width: __________ Feet Length: _________ Feet Depth: _________ Inches

☐ **Paved Surface:** Extends from the intersection with the paved public road surface for the full width of the unpaved access road for at least 100 feet to allow mud and dirt to drop off of vehicles before exiting the site. (Rule 8041 Sec. 5.9.3)

Width: __________ Feet Length: _________ Feet

Mud and dirt deposits accumulating on paved interior roads will be removed with sufficient frequency, but not less frequently than once per workday. Cleanup will commence within ½ hour of generating any carryout and trackout. (Rule 8041 Sec. 5.8.2 and 5.9.3)

Clean-up Frequency: ______________________________

☐ **Wheel Washer:** Uses water to dislodge debris from tires and vehicle undercarriage. (Rule 8011 Sec. 3.73)

Describe: ______________________________

☐ **Other:** (Rule 8041 Sec. 5.8.1.2) ______________________________

5-B Treatments for Preventing Carryout

Report the required treatments that will be used for preventing carryout from occurring on paved public roads. Carryout occurs when materials from emptied or loaded haul trucks, vehicles, or trailers falls onto a paved public road or paved shoulder of a paved public road.

☐ No haul trucks will be routinely entering or leaving the project site.

Emptied Haul Trucks: (Rule 8031 Sec 5.0)

- ☐ Interior cargo compartments will be cleaned before leaving the project site.
- ☐ Cargo compartment will be covered with a tarp or suitable cover before leaving the project site.

Loaded Haul Trucks: Spillage or loss of materials from holes or other opening in the cargo compartment will be prevented when material is transported onto any paved public access road. (Rule 8031 Sec 5.0)

Select one or both of the required applications:

- ☐ Haul trucks will be loaded such that the freeboard is not less than six inches with water applied to the top of the load before leaving the project site.
- ☐ Cargo compartment and load will be covered with a tarp or suitable cover before leaving the project site.

☐ **Other:** ______________________________

Section 5 – Carryout and Trackout – Page 2

Project Name: ______________________________

5-C Cleaning up Carryout and Trackout

Check and report below the methods and frequency for cleaning up carryout and trackout from the surface and paved shoulders of paved public roads.

The use of blower devices, or dry rotary brushers or brooms, for removal of carryout and trackout from paved public roads is prohibited. (Rule 8041 Sec. 5.0).

In the event the control device becomes ineffective due to an accumulation of mud and dirt, material must be removed within ½ hour of the generation of carryout and trackout. (Rule 8041 Sec. 5.8.2.)

The project is located in:

☐ An **Urban Area,** within an incorporated city boundary or an unincorporated area surrounded by a city.

Minimum cleanup frequency will be at the end of the workday and removed immediately if carryout and trackout extends beyond 50 feet. (Rule 8041 Sec. 5.4)

☐ A **Rural Area,** located within an unincorporated area and not surrounded by an incorporated city.

- ☐ The construction project is less than 10 acres in size: minimum cleanup frequency is at the end of the workday. (Rule 8041 Sec. 5.1)
- ☐ Construction projects 10 or more acres in size: minimum cleanup frequency is end of the workday and immediately if carryout and trackout extends beyond 50 feet. (Rule 8041 Sec. 5.5)

Clean up Method: Check the method below that will be used for cleaning carryout and trackout.

☐ Manually sweeping and picking up. (Rule 8041 Sec. 5.7.1)

☐ Mechanical sweeping with a rotary brush or broom accompanied or preceded by water. (Rule 8041 Sec. 5.7.2)

Describe the types of equipment that will used:

____

☐ Operating a PM10-efficient street sweeper. (Rule 8041 Sec. 5.7.3)

Make and Model: ______________________________

☐ Flushing with water: allowed if: (Rule 8041 Sec. 5.7.4)

- No curbs or gutters are present.
- Using water will not result as a source of trackout and carryout.
- Using water will not result in adverse impacts on storm water drainage systems.
- Using water will not violate any National Pollutant Discharge Elimination System permit program.

5-D Record keeping for Cleanup of Carryout and Trackout (Rule 8011 Sec. 6.2)

Records and any other supporting documents for demonstrating compliance must be maintained. The District has developed a record keeping form specific for cleaning carryout and trackout from paved public roads and may be used for complying with this requirement. Check one or both below:

☐ Records will be maintained using the form developed by the District.

☐ Records will be maintained using documents or forms developed by the owner or operator.

Explain and include copies: ______________________________

Dust Control Plan
Section 6 – Certification

Project Name: ______________________________

6-A Certification

I certify that all information contained herein and information submitted in the attachments to this documents are true and correct.

Print Name	Title
Signature	Date

Phone Number	Fax Number	Cell Number

3.10 Noise

Analysis Summary

Noise generated by construction equipment will be localized with little impact on scattered residences.

Noise from hauling trucks would occur on roads throughout the Project area and on roads used to access the Project area. While limiting trucking to daytime hours will lessen the impact below the threshold, the increased noise will be noticed throughout the Project area

Introduction

The Project is in the jurisdiction of San Joaquin County and Sacramento County. The following discussion provides background information on noise terminology and describes the existing environment in terms of sensitive receptors, existing noise levels, and regulatory requirements.

Noise Terminology

Following are brief definitions of acoustic and vibration terminology used in this chapter:

- **Sound.** A vibratory disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB).** A unitless measure of sound on a logarithmic scale, which indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure is 20 micro-pascals.
- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.
- **Maximum Sound Level (L_{max}).** The maximum sound level measured during the measurement period.
- **Minimum Sound Level (L_{min}).** The minimum sound level measured during the measurement period.
- **Equivalent Sound Level (L_{eq}).** The equivalent steady state sound level that in a stated period of time would contain the same acoustical energy.

- **Percentile-Exceeded Sound Level (L_{xx}).** The sound level exceeded x% of a specific time period. L_{10} is the sound level exceeded 10% of the time.
- **Day-Night Level (L_{dn}).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.
- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period with 5 dB added to the A-weighted sound levels occurring during the period from 7:00 p.m. to 10:00 p.m. and 10 dB added to the A-weighted sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.
- **Peak Particle Velocity (PPV).** The maximum velocity of a particle in vibrating medium such as soil. PPV us usually expressed in inches/sec.

L_{dn} and CNEL values rarely differ by more than 1 dB. As a matter of practice, L_{dn} and CNEL values are considered to be equivalent and are treated as such in this assessment. In general, human sound perception is such that a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling or halving the sound level.

Sources of Information

The following key sources of information were used in the preparation of this section:

- *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.
- Hoover, R. M., and R. H. Keith. 1996. Noise control for buildings, manufacturing plants, equipment and products. Houston, TX: Hoover & Keith, Inc.
- San Joaquin County General Plan 2010: Volume I, 1992.
- E.S.Thalheimer. 2000. Construction noise control program and mitigation strategy at the Central Artery/Tunnel project, *Noise Control Engineering Journal*, Sept.
- Federal Transit Administration. 1995. Transit noise and vibration impact assessment. Washington, DC.
- Geier & Geier Consulting. 1997. Noise measurements of a clamshell dredge taken on September 23, 1997 to support the Oakland Harbor Navigation Improvement Project EIS. Oakland, CA.

Assessment Methods

The assessment of potential construction noise impacts was conducted using methodology developed by the Federal Transit Administration (FTA) (Federal

Transit Administration 1995). The types of construction equipment used for each proposed activity have been developed based on the description of the proposed activity. Reference noise levels for each piece of equipment were taken from FTA (1995). Utilization factors were estimated from factors provided in Thalheimer (2000).

Because no limitation on hours of construction has been provided, this analysis assumes construction could occur at night.

Physical Setting/Affected

Noise-Sensitive Land Uses

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Noise-sensitive land uses typically include residences, hospitals, schools, guest lodging, libraries, and certain types of recreational uses. A noise-sensitive land use can also be defined as an area of frequent human use that would benefit from a lowered noise level. In general, an area of frequent human use is an area where people spend at least 1 hour on a regular basis.

Noise-sensitive uses in the project area include isolated single-family residences surrounding the McCormack-Williamson Tract east and west levees and the west and south sides of Staten Island (see Figure 3.9-1).

Existing Noise Environment

The existing noise environment in the project area is governed primarily by traffic traveling on surrounding rural roadways, agricultural operations, and aircraft overflights. The noise environment is typical of a quiet rural setting. Other sources of noise in the area include those commonly associated with residential areas (e.g., landscape maintenance activities, barking dogs), recreational boating activity, and agricultural activity (e.g., tractors, harvesting equipment). Table 3.10-1 indicates typical ambient noise levels as a function of population density.

Table 3.10-1. Population Density and Associated Ambient Noise Levels

Location	L_{dn} (A-Weighted Decibel)
Rural	
Undeveloped	35
Partially developed	40
Suburban	
Quiet	45
Normal	50
Urban	
Normal	55
Noisy	60
Very noisy	65
National Research Council, U.S.A.	

Irrigation, drainage, and domestic use pumps that are operated in the area are also a source of noise. Table 3.10-2 identifies these pumps and their current operational modes. Sound levels produced by each pump are estimated based on the reported horsepower rating (Hoover & Keith 1996).

Regulatory Setting and Significance Criteria

Regulatory Setting

The Project alternatives lie in Sacramento and San Joaquin Counties. These jurisdictions have established policies and regulations concerning the generation and control of noise that could adversely affect their citizens and noise-sensitive land uses. The General Plan is a document required by state law that serves as the jurisdiction's blueprint for land use and development. The plan is a comprehensive, long-term document that provides details for the physical development of the jurisdiction, sets out policies, and identifies ways to put the policies into action. The General Plan provides an overall framework for development in the jurisdiction and protection of its natural and cultural resources. The Noise Element of the General Plan contains planning guidelines relating to noise. The noise element identifies policies to support achievement of those goals. The goals and policies contained in the general plan are applicable throughout the jurisdiction.

The following is a brief discussion of the General Plan policies and noise ordinance regulations implemented by the Sacramento and San Joaquin Counties to protect its citizens from the adverse effects of noise.

Table 3.10-2 Existing Pump Noise and Operation

Station Number or Item Code	Water Body	Purpose	Baseline Use	Quantity	Power Source	Rating (HP)	Sound Power (dB)	L_{eq} Sound Level at 50 ft (dBA) per Pump	Total L_{eq} Sound Level at 50 ft (dBA)
15+00	Mokelumne River	direct pumping for irrigation	75% during June, July, and August for crop irrigation	1	electric	25	106	74	74
30+00	Mokelumne River	direct pumping for irrigation	back-up only for crop irrigation	1	electric	10	102	70	70
80+00	Mokelumne River	direct pumping for irrigation	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	1	electric	20	105	73	73
145+00	Mokelumne River	drainage	1 hour per day throughout year, continuous during high-water events for drainage	1	electric	60	110	78	78
260+00	Snodgrass Slough	siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	1	gasoline	5	99	67	67
305+00	Snodgrass Slough	drainage	1 hour per week throughout year, continuous during high-water events for drainage	1	electric	50	109	77	77

Station Number or Item Code	Water Body	Purpose	Baseline Use	Quantity	Power Source	Rating (HP)	Sound Power (dB)	L_{eq} Sound Level at 50 ft (dBA) per Pump	Total L_{eq} Sound Level at 50 ft (dBA)
360+00	Lost Slough	siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	1	gasoline	5	99	67	67
PD	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	2	diesel	105	112	80	83
PP	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	2	propane	60	110	78	81
DW	underground well	domestic use	2 hours per day throughout year for domestic use	1	electric	1	92	60	60

County of Sacramento General Plan Noise Element

The Sacramento County General Plan Noise Element states that noise created by new non-transportation noise sources may not exceed the noise level standards shown in Table 3.10-3, as measured immediately within the property line of any affected residentially designated land.

Table 3.10-3. Noise Level Performance Standards[a] for Residential Areas Affected by Non-Transportation Noise[b]

Statistical Noise Level Descriptor	Exterior Noise Level Standards (dBA)	
	Daytime (7:00 a.m. to 10:00 p.m.)	Nighttime (10:00 p.m. to 7:00 a.m.)
L_{50}	50	45
L_{max}	70	65

Notes:

[a] These standards are for planning purposes and may vary from standards of the County Noise Ordinance that are for enforcement purposes.

[b] These standards apply to new or existing residential areas affected by new or existing non-transportation sources.

Source: County of Sacramento Planning and Community Development Department 1997.

County of Sacramento Noise Ordinance

The Sacramento County noise ordinance states that exterior noise limits 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. However, 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. Agricultural operations that occur between the hours of 6:00 a.m. and 8:00 p.m. are also exempt from the ordinance.

County of San Joaquin General Plan Policies

The noise section of the San Joaquin County General Plan states that 65 dB L_{dn} or less is considered acceptable for residential development and that development shall be planned and designed to minimize noise interference from outside noise sources. For schools, group care facilities, and hospitals, 60 dB L_{dn} or less is considered acceptable.

County of San Joaquin County Code

Chapter 9-1025.9 of the San Joaquin County Development Title is the county's regulation relating to noise. The section on stationary sources states that proposed projects that will create new stationary noise sources or expand existing stationary noise sources shall be required to mitigate the noise level from these stationary sources so as not to exceed the noise level standards specified in Table 3.10-4.

Table 3.10-4. San Joaquin County Development Title Maximum Allowable Exterior[1] Noise Exposure from Stationary Sources

Noise Level Descriptor	Daytime[2] (7 a.m.–10 p.m.)	Nighttime[2] (10 p.m.–7 a.m.)
Hourly L_{eq}	50 dBA	45 dBA
Maximum level (L_{max})	70 dBA	65 dBA

Notes:

[1] Where the location of outdoor activity areas is unknown or is not applicable, the noise standard shall be applied at the property line of the receiving land use. When determining the effectiveness of noise mitigation measures, the standards shall be applied on the receiving side of noise barriers or other property line noise mitigation measures.

[2] Each noise level standard specified shall be reduced by 5 dB for impulsive noise, single tone noise, or noise consisting primarily of speech or music.

Construction activities that occur between the hours of 6:00 a.m. and 9:00 p.m. are exempt from the County's noise ordinance. In addition, work performed by private or public utilities in the maintenance or modification of their facilities is exempt from the County's noise ordinance.

Significance Criteria

The State CEQA Guidelines, county standards, and standard professional practice were used to determine whether constructing and operating the Project alternatives would result in a significant noise impact. Impacts resulting from noise generated by constructing or operating the Project would be considered significant if the Project would:

- expose persons to or generate noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies;
- expose persons to or generate excessive groundborne vibration or groundborne noise levels;
- result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project; and

- result in a substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project;

Based on local noise criteria (Counties of San Joaquin and Sacramento), the Governor's Office of Planning and Research (OPR) standards, and FTA criteria, the following thresholds of significance have been developed for this project. Noise resulting from a Project alternative is considered significant if:

- construction noise would exceed 50 dBA (1-hour L_{eq}) at the nearest noise-sensitive land use between 8:00 p.m. and 10:00 p.m. or 45 dBA (1-hour L_{eq}) at the nearest noise-sensitive land uses between 8:00 p.m. and 6:00 a.m. on any day (any construction noise occurring outside of these hours is considered to result in less-than-significant noise impacts); or
- operation of facilities would result in noise that exceeds the acceptable noise standards of the relevant jurisdictions.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Under the No Project Alternative, current sources of noise in the area would continue as at present. Noise sources would include noise generated by agricultural operations, traffic noise from surrounding roadways, and aircraft overflights. Because no new facilities would be constructed and modifications to existing facilities would not occur, there would be no increase in existing noise levels, and thus no noise-related impacts.

2025 Conditions

Under the future no-project conditions (2025 conditions) there would be no additional noise in the Project area as a result of construction or operation. It is expected that minimal development would occur in this area and that 2025 noise conditions would be similar to the existing conditions described above. Therefore, there would be no noise-related impacts under the 2025 conditions.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir

- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property (*optional*)

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 1-A: Fluvial Process Optimization would involve the use of heavy construction equipment. Table 3.10-5 summarizes maximum noise levels produce by various types of construction equipment.

Table 3.10-5. Construction Equipment Inventory and Noise Emission Levels and Utilization Factor

Equipment	Typical Noise Level (dBA) 50 ft from Source1	Utilization Factor[5]
Backhoe	80	0.4
Concrete Pump	82	0.2
Crane, Derrick	88	0.2
Dozer	85	0.4
Dredge, Clamshell	84[2]	0.4
Dredge, Hydraulic	79[3]	1.0
Excavator/Shovel	82	0.4
Grader	85	0.4
Loader	85	0.4
Paver	89	0.5
Pile Driver (Impact)	10[1]	0.2
Pump (Dewatering)	59[4]	0.5
Roller/Sheep's Foot	74	0.5
Scraper	89	0.4
Truck	88	0.4
Tugboat	82[2]	0.5

Sources:

1 Federal Transit Administration 1995.

2 Geier & Geier Consulting 1997.

3 Jones & Stokes measurements for a similar dredging operation (ESA 2003).

4 Jones & Stokes calculations based on Hoover & Keith 1996.

5 Thalheimer 2000.

Under this alternative a reasonable worst-case assumption is that a grader, scraper, front-end loader, and heavy truck would be operating simultaneously in the work area. Table 3.10-5 shows the noise levels produced by each piece of equipment described above along with a related utilization factor (Thalheimer 2000). The predicted 1-hour L_{eq} value is calculated from the maximum noise level and the utilization factor. The combined noise level, assuming simultaneous operation of each piece of equipment, is provided along with predicted noise levels at various distances from the source. The predicted noise levels at various distances takes into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 3.10-6 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of construction operations.

Because construction activities for Alternative 1-A would take place within 2,500 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.
DWR will limit noise-generating construction activity within 2,500 feet of occupied residences and heavy trucking within 400 feet of occupied residences to the hours between 6:00 a.m. and 8:00 p.m.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 1-A, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation. It is not possible at this time to determine specific truck volumes on specific roadways. However, a reasonable worst-case assumption is that up to 20 heavy trucks per hour could use any given roadway. Using the Federal Highway Administration Traffic Noise Model (TNM) Version 2.5 and a nominal speed of 45 mph, 20 trucks per hour would produce the following hourly sound levels:

- 54 dBA at 100 feet
- 50 dBA at 200 feet
- 45 dBA at 400 feet

Because project-related trucking operations would take place within 400 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-3: Exposure of Noise-Sensitive Land Uses to Noise from Modified Pump Operations

Under Alternative 1-A the operation of pumps currently used in the project area (baseline use) would be modified. Table 3.10-7 compares the baseline pump use to the proposed use under Alternative 1-A.

Table 3.10-6. Heavy Construction Equipment

Source Data	Maximum Sound Level (dBA)	Utilization Factor	L_{eq} Sound Level (dBA)
Construction Condition: Site leveling			
Source 1: Grader—Sound level (dBA) at 50 feet =	85	0.4	81.0
Source 2: Truck—Sound level (dBA) at 50 feet =	88	0.4	84.0
Source 3: Scraper—Sound level (dBA) at 50 feet =	89	0.4	85.0
Source 4: Front End Loader—Sound level (dBA) at 50 feet =	85	0.4	81.0
Average Height of Sources—Hs (ft) =			10
Average Height of Receiver—Hr (ft.) =			5
Ground Type (soft or hard) =			soft
Calculated Data:			
All Sources Combined — L_{eq} sound level (dBA) at 50 feet =			89
Effective Height (Hs+Hr)/2 =			7.5
Ground factor (G) =			0.62

Distance Between Source and Receiver (ft.)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{eq} Sound Level (dBA)
50	0	0	89
100	-6	-2	81
200	-12	-4	73
300	-16	-5	69
400	-18	-6	66
500	-20	-6	63
600	-22	-7	61
700	-23	-7	59
800	-24	-7	58
900	-25	-8	56
1000	-26	-8	55
1200	-28	-9	53
1400	-29	-9	51
1600	**-30**	**-9**	**50**
1800	-31	-10	48
2000	-32	-10	47
2500	**-34**	**-10**	**45**
3000	-36	-11	43

Calculations based on FTA 1995.

Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers that may reduce sound levels further.

Table 3.10-7. Baseline Pump Use vs. Proposed Use under Alternative 1A

Station Number or Item Code	Water Body	Purpose	Baseline Use	Proposed Use Under Alternative 1A	Power Source	Rating (HP)
15+00	Mokelumne River	direct pumping for irrigation	75% during June, July, and August for crop irrigation	25% during June, July, August, September, and October to establish native vegetation	electric	25
30+00	Mokelumne River	direct pumping for irrigation	back-up only for crop irrigation	decommission	electric	10
80+00	Mokelumne River	direct pumping for irrigation	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	25% during June, July, August, September, and October to establish native vegetation	electric	20
145+00	Mokelumne River	Drainage	1 hour per day throughout year, continuous during high-water events for drainage	decommission	electric	60
260+00	Snodgrass Slough	Siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	same as baseline to establish native vegetation	gasoline	5
305+00	Snodgrass Slough	drainage	1 hour per week throughout year, continuous during high-water events for drainage	decommission	electric	50
360+00	Lost Slough	Siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	same as baseline to establish native vegetation	gasoline	5
PD	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission	diesel	105

Table 3.10-7. Continued

Station Number or Item Code	Water Body	Purpose	Baseline Use	Proposed Use Under Alternative 1A	Power Source	Rating (HP)
PP	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	Decommission	propane	60
DW	underground well	Domestic use	2 hours per day throughout year for domestic use	Decommission	electric	1

Overall pump operations under Alterative 1-A will be less than operations under current conditions. Noise generated by pump operations will therefore be less under Alternative 1-A than under current conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. Vibration produced by grading activities has been assessed using an analysis method recommended by FTA (Federal Transit Administration 1995). A reasonable worst-case assumption is that a bulldozer would generate the highest vibration of any heavy equipment used. The recommended reference vibration amplitude or reference peak particle velocity (PPV) for a large bulldozer is 0.089 inches per second at 25 feet. The estimated vibration amplitude at various distances has been calculated and is summarized in Table 3.10-8.

Table 3.10-8. Estimated Vibration Amplitude from a Large Bulldozer

Distance	PPV (inches/second)
25	0.089
50	0.031
100	0.011
200	0.0039

Source: California Department of Transportation 2004.

The threshold of perception for groundborne vibration is about 0.02 in/second (California Department of Transportation 2004). Accordingly, perceptible vibration from the operation of heavy equipment is expected to be limited to an area within about 75 feet of the activity. Because residences are not anticipated to be located within 75 feet of heavy equipment operation, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Excavate and Restore Grizzly Slough Property (Optional)

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for this measure would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Because construction activities for Alternative 1-OP1: Grizzly Slough Property Levee Breaches and Regrading (optional) would take place within 2,500 feet of two residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 1-OP1, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation and Navigation. Noise from heavy truck hauling is expected to similar to the truck hauling noise described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Mokelumne River Dredging (Optional)

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Transportation and placement of dredged material would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Because transportation and placement of dredged material would take place within 2,500 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 1-OP2, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation and Navigation. Noise from heavy truck hauling is expected to similar to the truck hauling noise described under Alternative 1-A.

For reasons described under Alternative 1-A this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-5: Exposure of Noise-Sensitive Land Uses to Noise from Hydraulic Dredging Activities

Table 3.10-9 shows the noise levels produced by hydraulic dredging and a related utilization factor (Thalheimer 2000). The predicted 1-hour L_{eq} value is calculated from the maximum sound level and the utilization factor.

Predicted noise levels at various distances from the source are also shown. The predicted noise levels at various distances take into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 3.10-6 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 650 feet and 45 dBA L_{eq} within 1,000 feet of the operations.

Because hydraulic dredging operations in the Mokelumne River would take place within 1,000 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-6: Exposure of Noise-Sensitive Land Uses to Noise from Clamshell Dredging Activities

Table 3.10-10 shows the noise levels produced by clamshell dredging and a related utilization factor (Thalheimer 2000). The predicted 1-hour L_{eq} valued is calculated from the maximum sound level and the utilization factor.

Predicted noise levels at various distances from the source are also shown. The predicted noise levels at various distances take into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 3.10-7 indicate that

Table 3.10-9. Baseline Pump Use vs. Proposed Use Under Alternative 1B

Station Number or Item Code	Water Body	Purpose	Baseline Use	Proposed Use under Alternative 1B	Power Source	Rating (HP)
15+00	Mokelumne River	direct pumping for irrigation	75% during June, July, and August for crop irrigation	25% during June, July, August, September, and October to establish native vegetation	electric	25
30+00	Mokelumne River	direct pumping for irrigation	back-up only for crop irrigation	decommission	electric	10
80+00	Mokelumne River	direct pumping for irrigation	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	25% during June, July, August, September, and October to establish native vegetation	electric	20
145+00	Mokelumne River	drainage	1 hour per day throughout year, continuous during high-water events for drainage	continuously for 5 days for up to 3 episodes per year during April and May, and as needed throughout year for drainage	electric	60
260+00	Snodgrass Slough	siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	same as baseline to establish native vegetation	gasoline	5
305+00	Snodgrass Slough	drainage	1 hour per week throughout year, continuous during high-water events for drainage	continuously for 5 days for up to 3 episodes per year during April and May, and as needed throughout year for drainage	electric	50
360+00	Lost Slough	siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	same as baseline to establish native vegetation	gasoline	5
PD	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	decommission	diesel	105
PP	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	decommission	propane	60
DW	underground well	domestic use	2 hours per day throughout year for domestic use	decommission	electric	1

Table 3.10-10. Baseline Pump Use vs. Proposed Use Under Alternative 1C

Station Number or Item Code	Water Body	Purpose	Baseline Use	Proposed Use Under Alternative 1C	Power Source	Rating (HP)
15+00	Mokelumne River	direct pumping for irrigation	75% during June, July, and August for crop irrigation	25% during June, July, August, September, and October to establish native vegetation	electric	25
30+00	Mokelumne River	direct pumping for irrigation	back-up only for crop irrigation	decommission	electric	10
80+00	Mokelumne River	direct pumping for irrigation	20% during April and May; 75% during June, July, and August; and 10% during September for crop irrigation	25% during June, July, August, September, and October to establish native vegetation	electric	20
145+00	Mokelumne River	drainage	1 hour per day throughout year, continuous during high-water events for drainage	operated continuously for 3 days for up to 3 episodes per year during April and May, and as needed throughout year for drainage	electric	60
260+00	Snodgrass Slough	siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	same as baseline to establish native vegetation	gasoline	5
305+00	Snodgrass Slough	drainage	1 hour per week throughout year, continuous during high-water events for drainage	relocated downstream to location just north of subsidence-reversal area cross-levee on Snodgrass Slough; operated continuously for 3 days for up to 3 episodes per year during April and May, and as needed throughout year for drainage	electric	50

Station Number or Item Code	Water Body	Purpose	Baseline Use	Proposed Use Under Alternative 1C	Power Source	Rating (HP)
360+00	Lost Slough	siphon priming for irrigation	20 minutes per week during June, July, and August to prime crop irrigation siphon	same as baseline to establish native vegetation	gasoline	5
PD	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	decommission	diesel	105
PP	interior ditches	2 portable pumps of this type for irrigation distribution	10 hours per day, 6 days per week during June, July, and August for crop irrigation	decommission	propane	60
DW	underground well	domestic use	2 hours per day throughout year for domestic use	decommission	electric	1

construction operations would result in noise that exceeds 50 dBA L_{eq} within 700 feet and 45 dBA L_{eq} within 1,100 feet of the operations.

Because clamshell dredging operations in the Mokelumne River would take place within 1,100 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-7: Exposure of Noise-Sensitive Land Uses to Noise from Dragline Dredging Activities

The dragline dredging method would require equipment similar in horsepower to clamshell dredging equipment and would result in the generation of similar noise levels. Table 3.10-7 shows the noise levels produced by clamshell dredging along with a related utilization factor (Thalheimer 2000). The predicted 1-hour L_{eq} valued is calculated from the maximum sound level and the utilization factor.

Predicted noise levels at various distances from the source are also shown. The predicted noise levels at various distances take into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 3.10-7 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 700 feet and 45 dBA L_{eq} within 1,100 feet of the operations.

Because dragline dredging operations in the Mokelumne River would take place within 1,100 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 1-B: Seasonal Floodplain Optimization would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Because construction operations for Alternative 1-B would take place within 2,500 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 1-B, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation and Navigation. Noise from heavy truck hauling is expected to similar to the truck hauling noise described under Alternative 1-A.

For reasons described under Alternative 1-A this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-3: Exposure of Noise-Sensitive Land Uses to Noise from Modified Pump Operations

Under Alternative 1-A the operation of pumps currently used in the project area (baseline use) will be modified. Table 3.10-11 compares the baseline pump use to the proposed use under Alternative 1-B.

Overall pump operations under Alternative 1-B will be less than operations under current conditions. Noise generated by pump operations will therefore be less under Alternative 1-A than under current conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-4: Exposure of Sensitive Land Uses to Ground borne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Table 3.10-11. Hydraulic Dredging

Source Data	Maximum Sound Level (dBA)	Utilization Factor	L_{eq} Sound Level (dBA)
Construction Condition: Site leveling			
Source 1: Hydraulic Dredging—Sound level (dBA) at 50 feet =	79	1	79.0
Average Height of Sources—Hs (ft) =			10
Average Height of Receiver—Hr (ft.) =			5
Ground Type (soft or hard) =			soft
Calculated Data:			
All Sources Combined — L_{eq} sound level (dBA) at 50 feet =			79
Effective Height (Hs+Hr)/2 =			7.5
Ground factor (G) =			0.62

Distance between Source and Receiver (ft.)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{eq} Sound Level (dBA)
50	0	0	79
100	-6	-2	71
200	-12	-4	63
300	-16	-5	59
400	-18	-6	55
500	-20	-6	53
650	**-22**	**-7**	**50**
700	-23	-7	49
750	-24	-7	48
900	-25	-8	46
1000	**-26**	**-8**	**45**
1200	-28	-9	43
1400	-29	-9	41
1600	-30	-9	40
1800	-31	-10	38
2000	-32	-10	37
2500	-34	-10	35
3000	-36	-11	32

Calculations based on FTA 1995.
Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers that may reduce sound levels further.

Because construction activities for Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal would take place within 2,500 feet of two residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 1-C, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation. Noise from heavy truck hauling is expected to similar to the truck hauling noise described under Alternative 1-A.

For reasons described under Alternative 1-A, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-3: Exposure of Noise-Sensitive Land Uses to Noise from Modified Pump Operations

Under Alternative 1-C the operation of pumps currently used in the Project area (baseline use) will be modified. Table 3.10-12 compares the baseline pump use to the proposed use under Alternative 1-C.

Overall pump operations under Alterative 1C will be less than operations under current conditions. Noise generated by pump operations will therefore be less under Alternative 1-C than under current conditions.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 2-A: North Staten Detention would involve the use of heavy construction equipment. Construction equipment and

Table 3.10-12. Clamshell Dredging

Source Data	Maximum Sound Level (dBA)	Utilization Factor	L_{eq} Sound Level (dBA)
Construction Condition: Site leveling			
Source 1: Clamshell Dredging—Sound level (dBA) at 50 feet =	84	0.4	80.0
Average Height of Sources—Hs (ft) =			10
Average Height of Receiver—Hr (ft.) =			5
Ground Type (soft or hard) =			Soft
Calculated Data:			
All Sources Combined — L_{eq} sound level (dBA) at 50 feet =			80
Effective Height (Hs+Hr)/2 =			7.5
Ground factor (G) =			0.62

Distance between Source and Receiver (ft.)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{eq} Sound Level (dBA)
50	0	0	80
100	-6	-2	72
200	-12	-4	64
300	-16	-5	60
400	-18	-6	56
500	-20	-6	54
600	-22	-7	52
700	**-23**	**-7**	**50**
750	-24	-7	49
900	-25	-8	47
1000	-26	-8	46
1100	**-27**	**-8**	**45**
	-29	-9	42
1600	-30	-9	41
1800	-31	-10	39
2000	-32	-10	38
2500	-34	-10	36
3000	-36	-11	34

Calculations based on FTA 1995.

Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers that may reduce sound levels further.

predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Because construction activities for Alternative 2-A: North Staten Detention would take place within 2,500 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 2-A, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation. It is not possible at this time to determine specific truck volumes on specific roadways. However, a reasonable worst-case assumption is that up to 20 heavy trucks per hour could use any given roadway. Using the Federal Highway Administration TNM Version 2.5 and a nominal speed of 45 mph, 20 trucks per hour would produce the following hourly sound levels:

- 54 dBA at 100 feet
- 50 dBA at 200 feet
- 45 dBA at 400 feet

Project-related trucking operations would take place within 400 feet of residences.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-4: Exposure of Sensitive Land Uses to Ground borne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-8: Exposure of Noise-Sensitive Land Uses to Noise from Additional Pump Operations

Under Alternative 2-A seven 400 HP dewatering pumps would be used to drain the North Staten Detention Basin. The pumps will run only during years of flooding, and will likely run continuously for 30 days. Figure 3.9-1 shows where these pumps would be located. The estimated noise level from operation of these dewatering pumps was calculated based on information provided by the project engineers and methodology developed by Hoover and Keith (Hoover and Keith 1996). Table 3.10-13 summarizes the noise level produced by the seven 400-HP, diesel-powered pumps. The combined noise level, assuming simultaneous operation of all seven pumps is 94 dBA.

Table 3.10-13. Alternative 2-A: North Staten Detention Basin Pump Noise

Purpose	Anticipated Use Under Alternative 2-A	Quantity	Power Source	Rating (HP)	Sound Power (dB)	Leq Sound Level at 50 ft (dBA)/Per Pump	Total Leq Sound Level at 50 ft (dBA)
Draining North Staten Detention Basin	During year of flooding, pumps will likely run continuously for 30 days	7	Diesel	400	118	86	94

Table 3.10-14 provides predicted noise level at various distances from the pumps. The predicted noise level at various distances takes into account geometric point source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 3.10-14 indicate that pump operations would result in noise that exceeds 50 dBA L_{eq} within 2,300 feet and 45 dBA L_{eq} within 3,500 feet of the operations.

Because there are no residences located within 3,500 feet of these pumps, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Table 3.10-14. Alternative 2-A: North Staten Detention Basin Pump Noise

Source Data	Maximum Sound Level (dBA)	Utilization Factor	L_{eq} Sound Level (dBA)
Entered Data:			
Operating Condition: Pumping			
Source 1: 7 -Pumps —Sound level (dBA) at 50 feet* =			94
			0
			0
Average Height of Sources—Hs (ft) =			5
Average Height of Receiver—Hr (ft.) =			5
Ground Type (soft or hard) =			soft
Calculated Data:			
All Sources Combined —Sound level (dBA) at 50 feet =			94
Effective Height (Hs+Hr)/2 =			5
Ground factor (G) =			0.66

Distance between Source and Receiver (ft.)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{eq} Sound Level (dBA)
50	0	0	94
250	-14	-5	75
500	-20	-7	67
900	-25	-8	61
1,000	-26	-9	59
1,250	-28	-9	57
1,500	-30	-10	55
1,750	-31	-10	53
2,000	-32	-11	51
2,300	**-33**	**-11**	**50**
2,500	-34	-11	49
3,000	-36	-12	47
3,250	-36	-12	46
3,500	**-37**	**-12**	**45**
4,000	-38	-13	43
4,250	-39	-13	43
4,500	-39	-13	42

Calculations based on FTA 1995.

Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers that may reduce sound levels further.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 2-B: West Staten Detention would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Construction activities for Alternative 2-B: West Staten Detention would take place within 2,500 feet of residences. This impact is therefore considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 2-B truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation. It is not possible at this time to determine specific truck volumes on specific roadways. However, a reasonable worst-case assumption is that up to 20 heavy trucks per hour could use any given roadway. Using the Federal Highway Administration TNM Version 2.5 and a nominal speed of 45 mph, 20 trucks per hour would produce the following hourly sound levels:

- 54 dBA at 100 feet
- 50 dBA at 200 feet
- 45 dBA at 400 feet

Project-related trucking operations would take place within 400 feet of residences.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-3: Exposure of Noise-Sensitive Land Uses to Noise from Modified Pump Operations

Under Alternative 2-B nine 250 HP dewatering pumps would be used to drain the West Staten Detention Basin. The pumps will run only during years of flooding, and will likely run continuously for 30 days. Figure 3.9-1 shows where these pumps would be located. The estimated noise level from operation of these dewatering pumps was calculated based on information provided by the project engineers and methodology developed by Hoover and Keith (Hoover and Keith 1996). Table 3.10-15 summarizes the noise level produced by the nine 250-HP, diesel-powered pumps. The combined noise level, assuming simultaneous operation of all seven pumps is 94 dBA.

Table 3.10-15. Alternative 2-B: West Staten Detention Basin Pump Noise

Purpose	Anticipated Use	Quantity	Power Source	Rating (HP)	Sound Power (dB)	L_{eq} Sound Level at 50 ft (dBA)/Per Pump	Total L_{eq} Sound Level at 50 ft (dBA)
Draining West Staten Detention Basin	During year of flooding, pumps will likely run continuously for 30 days	9	Diesel	250	116	84	94

Table 3.10-16 provides predicted noise level at various distances from the pumps. The predicted noise level at various distances takes into account geometric point source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in 3.10-16 indicate that pump operations would result in noise that exceeds 50 dBA L_{eq} within 2,300 feet and 45 dBA L_{eq} within 3,500 feet of the operations.

Because there are no residences located within 3,500 feet of these pumps, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 2-C: East Staten Detention would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Construction activities for Alternative 2-C: East Staten Detention would take place within 2,500 feet of residences. This impact is therefore considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Table 3.10-16. Alternative 2-B: West Staten Detention Basin Pump Noise

Source Data	Leq Sound Level (dBA)
Operating Condition: Pumping	
Source 1: 9 Pumps—Sound level (dBA) at 50 feet =	94
Average Height of Sources—Hs (ft) =	5
Average Height of Receiver—Hr (ft.) =	5
Ground Type (soft or hard) =	soft
Calculated Data:	
All Sources Combined — Leq sound level (dBA) at 50 feet =	95
Effective Height (Hs+Hr)/2 =	5
Ground factor (G) =	0.66

Distance between Source and Receiver (ft.)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated Leq Sound Level (dBA)
50	0	0	94
250	-14	-5	75
500	-20	-7	67
1,000	-26	-9	59
1,250	-28	-9	57
1,800	-31	-10	53
1,900	-32	-10	52
2,000	-32	-11	51
2,100	-32	-11	51
2,300	-33	-11	50
2,500	-34	-11	49
2,800	-35	-12	47
3,000	-36	-12	47
3,200	-36	-12	46
3,500	-37	-12	45
4,000	-38	-13	43
4,500	-39	-13	42
5,000	-40	-13	41

Note: This calculation does not include the effects, if any, of local shielding from walls, topography or other barriers that may reduce sound levels further.

Calculations based on FTA 1995

Impact NZ-2: Exposure of Noise-Sensitive Land Uses to Noise from Material Hauling Operations

Under Alternative 2-C, truck traffic would increase temporarily to remove and import levee materials and import riprap and other construction materials. A description of anticipated trucking activity is provided in Section 3.8, Transportation. It is not possible at this time to determine specific truck volumes on specific roadways. However, a reasonable worst-case assumption is that up to 20 heavy trucks per hour could use any given roadway. Using the Federal Highway Administration TNM Version 2.5 and a nominal speed of 45 mph, 20 trucks per hour would produce the following hourly sound levels:

- 54 dBA at 100 feet
- 50 dBA at 200 feet
- 45 dBA at 400 feet

Project-related trucking operations would take place within 400 feet of residences.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-3: Exposure of Noise-Sensitive Land Uses to Noise from Modified Pump Operations

Under Alternative 2-C eight 250-hp dewatering pumps would be used to drain the East Staten Detention Basin. The pumps would run only during years of flooding, and would likely run continuously for 30 days. Figure 3.9-1 shows where these pumps would be located. The estimated noise level from operation of these dewatering pumps was calculated based on information provided by the project engineers and methodology developed by Hoover and Keith (1996). Table 3.10-17 summarizes the noise level produced by the eight 250-HP, diesel-powered pumps. The combined noise level, assuming simultaneous operation of all seven pumps, is 93 dBA.

Table 3.10-17. Alternative 2-C: East Staten Detention Basin Pump Noise

Purpose	Anticipated Use	Quantity	Power Source	Rating (HP)	Sound Power (dB)	L_{eq} Sound Level at 50 ft (dBA) per Pump	Total L_{eq} Sound Level at 50 ft (dBA)
Draining East Staten Detention Basin	During year of flooding, pumps will likely run continuously for 30 days	8	Diesel	250	116	84	93

Table 3.10-18 shows predicted noise level at various distances from the pumps. The predicted noise level at various distances takes into account geometric point-source attenuation (6 dB per doubling of distance) and ground absorption (1 to 2 dB per doubling of distance). The results in Table 3.10-18 indicate that pump operations would result in noise that exceeds 50 dBA L_{eq} within 2,000 feet and 45 dBA L_{eq} within 3,200 feet of the operations.

Because there are no residences located within 3,200 feet of these pumps, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows

Table 3.10-18. Alternative 2-C: East Staten Detention Basin Pump Noise

Source Data	L_{eq} Sound Level (dBA)
Operating Condition: Pumping	
Source 1: 9 Pumps—Sound level (dBA) at 50 feet =	93
Average Height of Sources—Hs (ft) =	5
Average Height of Receiver—Hr (ft.) =	5
Ground Type (soft or hard) =	Soft
Calculated Data:	
All Sources Combined—L_{eq} sound level (dBA) at 50 feet =	93
Effective Height (Hs+Hr)/2 =	5
Ground factor (G) =	0.66

Distance between Source and Receiver (ft.)	Geometric Attenuation (dB)	Ground Effect Attenuation (dB)	Calculated L_{eq} Sound Level (dBA)
50	0	0	93
750	-24	-8	62
1,000	-26	-9	58
1,250	-28	-9	56
1,500	-30	-10	54
2,000	**-32**	**-11**	**50**
2,250	-33	-11	49
2,500	-34	-11	48
2,750	-35	-11	47
3,000	-36	-12	46
3,200	**-36**	**-12**	**45**
3,500	-37	-12	44
3,750	-38	-12	43
3,500	-37	-12	44
4,000	-38	-13	42
4,250	-39	-13	42
4,500	-39	-13	41
5,000	-40	-13	40

Note: This calculation does not include the effects, if any, of local shielding from walls, topography, or other barriers that may reduce sound levels further.

Calculations based on FTA 1995.

- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact NZ-1: Exposure of Noise-Sensitive Land Uses to Noise from General Construction Activities

Construction activities for Alternative 2-D: Dredging and Levee Modifications would involve the use of heavy construction equipment. Construction equipment and predicted noise levels are similar to those described above for Alternative 1-A: Fluvial Process Optimization. The results in Table 3.10-5 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 1,600 feet and 45 dBA L_{eq} within 2,500 feet of the operations.

Because construction operations for Alternative 2-D would take place within 2,500 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-4: Exposure of Sensitive Land Uses to Groundborne Vibration from Construction Activity

Noise-sensitive land uses could be exposed to vibration resulting from heavy equipment operation. For the reasons discussed under Alternative 1-A, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact NZ-5: Exposure of Noise-Sensitive Land Uses to Noise from Hydraulic Dredging Activities

Hydraulic dredging activities for Alternative 2-D: Dredging and Levee Modifications would involve the use of equipment, and predicted noise levels are similar to those described above for Alternative 1-OP2: Mokelumne River Dredging. The results in Table 3.10-6 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 650 feet and 45 dBA L_{eq} within 1,000 feet of the operations.

Because hydraulic dredging operations in the Mokelumne River would take place within 1,000 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-6: Exposure of Noise-Sensitive Land Uses to Noise from Clamshell Dredging Activities

Clamshell dredging activities for Alternative 2-D: Dredging and Levee Modifications would involve the use of equipment, and predicted noise levels are similar to those described above for Alternative 1-OP2: Mokelumne River Dredging. The results in Table 3.10-7 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 700 feet and 45 dBA L_{eq} within 1,100 feet of the operations.

Because clamshell dredging operations in the South Fork Mokelumne River would take place within 1,100 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Impact NZ-7: Exposure of Noise-Sensitive Land Uses to Noise from Dragline Dredging Activities

Dragline dredging activities for Alternative 2-D: Dredging and Levee Modifications would involve the use of equipment and predicted noise levels similar to those described above for Alternative 1-OP2: Mokelumne River Dredging. The results in Table 3.10-7 indicate that construction operations would result in noise that exceeds 50 dBA L_{eq} within 700 feet and 45 dBA L_{eq} within 1,100 feet of the operations.

Because dragline dredging operations in the Mokelumne River would take place within 1,100 feet of residences, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure NZ-1: Limit Noise-Generating Construction Activity and Heavy Trucking to Daytime Hours.

Significance after Mitigation: Less than significant.

Chapter 4
Biological Environment

This chapter provides environmental analyses relative to biological parameters of the project area. Components of this study include a setting discussion, impact analysis criteria, project effects and significance, and applicable mitigation measures. This chapter is organized as follows:

- Section 4.1, Vegetation and Wetlands;
- Section 4.2, Fisheries and Aquatics; and
- Section 4.3, Wildlife.

4.1 Vegetation and Wetlands

Analysis Summary

Summary of Significant Impacts

A summary of the potentially significant impacts on vegetation and wetlands and mitigation measures that are associated with each Project alternative is presented in Table 4.1-1. Please refer to impact sections below for Alternatives 1A, 1B, 1C, 2A, 2B, 2C, and 2D for more detailed discussions of all impacts and proposed mitigation measures.

Introduction

This section presents the results and the evaluation of the impacts of flood control and ecosystem restoration improvements on vegetation and wetlands and includes the following information:

- a summary of land cover types, including wetlands and other waters of the United States, in the Project area;
- a list of the special-status species that occur, or could occur, in the study area (Table 4.1-2);
- a description of Project effects on vegetation and wetland resources; and
- a description of specific measures to mitigate Project-related impacts on vegetation and wetland resources.

Sources of Information

The primary sources of information used to prepare the vegetation and wetlands section of this EIR are:

- a review of the Project alternatives, including the Project description and calculated acreages of potential impact and mitigation areas;
- a review of aerial photographs and habitat mapping provided by DWR, Jones & Stokes, and others;
- a review of relevant reports and studies prepared for the study and Project areas;
- a review of previous vegetation surveys that have been performed in the Project and study areas (e.g., Final Preliminary Delineation of Waters of the United States [Jones & Stokes 2004])

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000, including appendices;
- a review of the California Department of Fish and Game's (DFG's) Natural Diversity Database (CNDDB) for the Thornton, Isleton, Bouldin Island, Bruceville, and Terminous USGS 7.5-minute quadrangles (California Natural Diversity Database 2006);
- a species list obtained from the USFWS website for the Project, dated January 30, 2006 containing the following special-status species: Suisun Marsh aster (*Aster lentus),* delta tule pea (*Lathyrus jepsonii* var. *jepsonii),* and Mason's lilaeopsis (*Lilaeopsis masonii);* and
- Jones & Stokes 2004 special-status species survey [unpublished].

Assessment Methods

Impact Assessment Approach and Methods

This evaluation of impacts on vegetation and wetland resources, including special-status species, was based on an analysis of the Project alternatives and conceptual design drawing prepared by DWR. The permanent and temporary impact footprints for each Project component were developed by Jones & Stokes based on the information provided by DWR and based on assumptions of the corridor widths for permanent and temporary construction easements. The impact footprints for some or all Project components will likely be refined when detailed construction drawings are prepared for the Project.

Tables 4.1-3 and 4.1-4 summarize the assumptions used to develop the impact area footprints associated with the Alternative 1 and 2 Project components**.** Construction impacts on land cover types were assessed by comparing the projected footprint of proposed Project facilities and structures with the mapped land cover types. Loss of all vegetation is assumed within the footprint of these facilities and structures.

Three land cover type impact tables are provided for each alternative. The tables provide the following information:

- One table summarizes the permanent and temporary land cover type impacts for the alternative;
- One table summarizes the permanent land cover type impacts, by Project component, for the alternative; and
- One table summarizes the temporary land cover type impacts, by Project component, for the alternative.

Table 4.1-1. Summary of Significant Impacts and Mitigation Measures on Wetland and Vegetation Resources for the North Delta Improvements Program

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	VEG-1: Replace Valley/Foothill Riparian Cover Types VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources	Less than significant
VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover Types	Less than significant
VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources VEG-4: Replace Tidal Perennial Aquatic Cover Types	Less than significant
VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Types	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types	Less than significant
VEG-5: Establishment of Invasive Non-Native Plants	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	VEG-6: Avoid Introduction and Spread of New Noxious Weeds	Less than significant
VEG-6: Loss or Disturbance of Special-Status Species	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources VEG-7: Conduct Preconstruction Surveys for Special-Status Plants VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss	Less than significant
VEG-7: Loss or Disturbance of Perennial Grassland	1A, 1B, 1C, 2A, 2C, 2D	Significant	VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources VEG-9: Replace Perennial Grassland	Less than significant

Table 4.1-2. Special-Status Species with Potential to Occur in the Study Area

Species Name	Status [a] Federal	State	Other	Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
Suisun Marsh aster *Aster lentus*	SC	–	1B, CSC	Sacramento–San Joaquin Delta, Suisun Marsh, Suisun Bay, and Contra Costa, Napa, Sacramento, San Joaquin, and Solano Counties	Tidal brackish and freshwater marsh: 0–10 feet	August–November	Present throughout the study area (CNDDB 2006). 26 occurrences observed during project surveys. Probability of occurrence: high
Bristly sedge *Carex comosa*	–	–	2	Contra Costa, Lake, Mendocino, San Bernardino*, Santa Cruz*, San Francisco*, Shasta, San Joaquin, Sonoma Counties; Idaho, Oregon*, Washington, and elsewhere	Coastal prairie, marshes and swamps (lake margins), valley and foothill grassland: 0–1400 feet	May–September	No known CNDDB records for the study area (CNDDB 2006). 2 occurrences observed during project surveys. Probability of occurrence: high
Slough thistle *Cirsium crassicaule*	SC	–	1B, CSC	San Joaquin Valley and San Joaquin, Kings, and Kern Counties	Marsh along sloughs and canals, riparian scrub, and chenopod scrub: 10–300 feet	May–August	No known occurrences in the study area (CNDDB 2006) though suitable habitat is present. Not observed during project surveys. Probability of occurrence: low.
Delta coyote thistle *Eryngium racemosum*	–	CE	1B, CSC	San Joaquin River delta, floodplains, and adjacent Sierra Nevada foothills and Calaveras, Merced, San Joaquin*, and Stanislaus Counties	Riparian scrub, and seasonally inundated depressions along floodplains on clay soils: 10–250 feet	June–August	No known occurrences in the study area (CNDDB 2006), though marginal habitat is present. Not observed during project surveys. Probability of occurrence: low.
Rose-mallow *Hibiscus lasiocarpus*	–	–	2	Central and southern Sacramento Valley, deltaic Central Valley, and Butte, Contra Costa, Colusa, Glenn, Sacramento, San Joaquin, Solano, Sutter, and Yolo Counties	Wet banks and freshwater marshes: generally sea level to 135 feet	August–September	Present throughout the study area (CNDDB 2006). 12 occurrences observed during project surveys. Probability of occurrence: high

Species Name	Status [a] Federal	State	Other	Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	SC	–	1B, CSC	Central Valley (especially the San Francisco Bay region) and Alameda, Contra Costa, Fresno, Marin, Napa, Sacramento, San Benito, Santa Clara, San Joaquin, and Solano Counties	Coastal and estuarine marshes: sea level–15 feet	May–June	Present throughout study area (CNDDB 2006). 23 occurrences observed during project surveys. Probability of occurrence: high
Mason's lilaeopsis *Lilaeopsis masonii*	SC	R	1B, CSC	Southern Sacramento Valley, Sacramento–San Joaquin Delta, northeast San Francisco Bay area, and Alameda, Contra Costa, Marin*, Napa, Sacramento, San Joaquin, and Solano Counties	Freshwater and intertidal marshes and streambanks in riparian scrub: generally sea level–30 feet	April–October	Present in project area (CNDDB 2006). 3 occurrences observed during project surveys. Probability of occurrence: high
Delta mudwort *Limosella subulata*	–	–	2	Contra Costa, Sacramento, San Joaquin, and Solano Counties; Oregon; Atlantic coast	Intertidal marshes: sea level–10 feet	May–August	Present in project area (CNDDB 2006). 5 occurrences observed during project surveys. Probability of occurrence: high
Eel-grass pondweed *Potamogeton zosteriformis*	–	–	2	Contra Costa, Lake, Lassen, Modoc, and Shasta Counties; Idaho, Oregon, Utah, Washington and elsewhere	Marshes and swamps (assorted fresh water): sea level–6100 feet	June–July	One 1949 collection (CNDDB 2006) south of project area on Webb Island. Not observed during project surveys. Probability of occurrence: low.
Sanford's arrowhead *Sagittaria sanfordii*	SC	–	1B, CSC	Scattered locations in Central Valley and Coast Ranges	Freshwater marshes, sloughs, canals, and other slow-moving water habitats: sea level–1,850 feet	May–August	Present throughout study area (CNDDB 2006). 16 occurrences observed during project surveys. Probability of occurrence: high

Species Name	Status [a] Federal	State	Other	Distribution	Preferred Habitats	Period Identifiable	Occurrence in the Project Area
Marsh skullcap *Scutellaria galericulata*	–	–	2	Northern high Sierra Nevada, Modoc plateau, and El Dorado, Nevada, Placer, Plumas, Shasta, and Siskiyou Counties	Lower montane coniferous forest, meadows and seeps (mesic), marshes and swamps: sea level–6,300 feet	June–September	Questionable habitat in project area. One recorded site, out of normal range for species, is at the south end of Staten Island (CNDDB 2006). Not observed during project surveys. Probability of occurrence: low.
Blue skullcap *Scutellaria lateriflora*	–	–	2	Northern San Joaquin Valley, east of Sierra Nevada, Inyo and San Joaquin Counties, New Mexico, and Oregon	Mesic meadows, marshes, and swamps: generally sea level–1,500 feet	July–September	Very little suitable habitat in project area. Would only include nontidal emergent wetland. One CNDDB (2006) record 1 mile south of project area on Boudin Island. Not observed during project surveys. Probability of occurrence: low.

Table 4.1-3. Permanent and Temporary Impact Assumptions for Alternatives 1A – 1C

Project Component	Applicable Alternative	Permanent Impact Footprint Assumptions	Temporary Impact Footprint Assumptions
Degrade MWT East Levee	1A, 1B, 1C	Permanent impact footprint extends from summer water surface elevation on Lost Slough to 20 feet landward of the levee	Waterside temporary impact footprint extends from the summer water surface elevation on Lost Slough to 20 feet into the water Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint
Degrade MWT Southwest Levee	1A, 1B, 1C	Permanent impact footprint is all the terrestrial habitat on the section of the levee to be removed	Waterside temporary impact footprint extends from the summer water surface elevation to 20 feet into the water Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint
Reenforce Dead Horse Island East Levee	1A, 1B, 1C	Permanent impact footprint extends from the levee crown to the summer water surface elevation	Waterside temporary impact footprint extends from the summer water surface elevation to 20 feet into the water
Modify Downstream Levees	1A, 1B, 1C	None	Temporary impact footprint include the levee road surface and adjacent shoulder
Construction Transmission Tower Protective Levee	1A, 1B, 1C	Permanent impact footprint includes a 160-foot-wide band covering existing agricultural land	Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint on each side of new levee
Enhance Interior Levee Slope	1A, 1B, 1C	Permanent impact footprint extends landward for 120 feet beyond the levee crown	Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint
Modify Pump and Siphon Operations	1A, 1B, 1C	To be determined	To be determined
Breach Mokelumne River Levee	1A	Permanent impact footprint associated with the levee breach includes a 420-foot-long section of the levee section which will be removed Permanent impact footprint associated with the starter channel will include the surface area of	Temporary impact footprint on the levee includes a 50-foot-wide band upstream and downstream of the levee Waterside temporary impact footprint extends from the summer water surface elevation to 20 feet into the water

Project Component	Applicable Alternative	Permanent Impact Footprint Assumptions	Temporary Impact Footprint Assumptions
		the starter channel as measured from the top of bank of the starter channel.	Landside temporary impact footprint associated with the starter channel extends 100 feet beyond the permanent impact footprint for the starter channel
Allow Boating on Southwestern MWT[4]	1A, 1B, 1C	No permanent impacts anticipated	No temporary impacts anticipated
Construct Box Culvert Drains and Self-Regulating Tide Gates	1B, 1C	No permanent impacts anticipated	Waterside temporary impact footprint extends from summer water surface elevation to 10 feet into the water Landside impacts extends from bank line to 100 feet beyond the levee
Fill Wetlands Near MWT East Levee	1A, 1B, 1C	Permanent impact footprint includes the entire wetland basin on the west side of the MWT East Levee	No temporary impacts anticipated
Excavate Dixon and New Hope Borrow Sites	1A, 1B, 1C	Dixon Borrow Site: Permanent impact footprint include all lands on the eastern half of the borrow site. Large stand of riparian forest on the western half of the borrow site will be retained. New Hope Borrow Site: Permanent impact footprint includes all terrestrial land cover types within the borrow site.	Dixon Borrow Site: None New Hope Borrow Site: Temporary impact footprint includes the open water habitat within the borrow site.
Excavate and Restore Grizzly Slough Property Complete Levee Removal)	1A, 1B, 1C	Permanent impact footprint includes all agricultural lands that will be converted to native land cover types.	Temporary impact footprint includes all land cover types within the footprint of the levee to be removed. These land cover types will be restored following construction.

Project Component	Applicable Alternative	Permanent Impact Footprint Assumptions	Temporary Impact Footprint Assumptions
Dredging South Fork Mokelumne River	1A, 1B, 1C	Permanent impact footprint includes the loss of all riparian and wetland habitat on the waterside of the levee. Assumes the most environmentally damaging method (i.e. clamshell on dragline methods)	Temporary impact footprint include tidal perennial aquatic habitat and uplands on the landside of the levee used for disposal of dredge materials
Enhance Delta Meadow Property	1A, 1B, 1C	Not enough information to provide impact analysis at this time	Not enough information to provide impact analysis at this time
Modify Landform and Restore Agricultural Land to Habitat	1A, 1B, 1C	Permanent impacts include all agricultural lands on MWT and at the Grizzly Slough Restoration Project site that will be converted to native habitats. Permanent impact footprint at the Grizzly Slough Restoration Project includes the terrestrial habitats within the levee sections to be removed	No temporary impacts anticipated
Inundation of Riparian Habitat on Interior Levees	1A, 1B, 1C	Permanent impact footprint includes the lower half of the interior MWT levees that will be inundated by tidal activity or by seasonal ponding	No temporary impacts anticipated
Cross Levee Construction	1C	Permanent impact footprint includes a 63-foot-wide band along entire length of new levee	Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint on both sides of the new levee
Dredging		Permanent impact footprint includes the loss of all riparian habitat on the waterside of the levees Permanent impact footprint includes the loss of tidal emergent and tidal flat habitat	Temporary impact footprint includes the waterways that will be dredged and ruderal habitats on the waterside of the levee Temporary impact footprint will include the dredge spoil disposal sites on the landside of the levees (locations and acreages to be determined)

Table 4.1-4. Permanent and Temporary Impact Assumptions for Alternatives 2A – 2D

Project Component	Applicable Alternative	Permanent Impact Footprint Assumptions	Temporary Impact Footprint Assumptions
Construct Inlet Weir	2A, 2B, 2C	(Alternative 2A) Permanent impact footprint includes a 178-foot-wide band along existing road (Alternative 2B & 2C) Permanent impact footprint extends from the summer water surface elevation to 160 feet landward and covers 3000 feet of levee	(Alternative 2A) Temporary impact footprint extends 100 feet beyond the permanent impact footprint on each side of the weir. (Alternative 2B & 2C) Waterside temporary impact footprint extends 20 feet beyond the permanent impact footprint (Alternative 2B & 2C) Temporary impact footprint extends 100 feet beyond the permanent impact footprint on each side of the new levee
Construct Interior Detention Levee	2A, 2B, 2C	Permanent impact footprint includes a 200-foot-wide band covering existing agricultural land	Temporary impact footprint extends 100 feet beyond the permanent impact footprint on each side of the new levee Temporary impact footprint includes cutoff wall
Construct Outlet Weir	2A, 2B, 2C	Permanent impact footprint extends from summer water surface elevation of the MR to the landside toe of the existing levee and covers 3000 feet of the levee	Waterside temporary impact footprint extends from the summer water surface elevation to 20 feet into the water Landside temporary impact footprint extends 50 feet beyond the permanent impact footprint
Construct Detention Basin Drainage Pump Station	2A, 2B, 2C	None. All work will occur within the impact footprint of other project components	None. All work will occur within the impact footprint of other project components
Degrade Existing Levee		Permanent impact footprint extends from the summer water surface elevation of the river to 200 feet landward of the levee	Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint Waterside temporary impact footprint extends 20 feet beyond the permanent impact footprint
Reinforce Existing Levees	2A, 2B, 2C	Permanent impact footprint extends landward from the crown of the existing levee to 50 feet beyond the base	Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint
Replace Miller’s Ferry Bridge	2A, 2B, 2C	Permanent impact footprint includes all lands 100 feet upstream and downstream of existing bridge and 100 feet landward of the approaches.	Temporary impact footprint includes all lands within the footprint of the bridge to be removed.

Table 4.1-4. Continued

Project Component	Applicable Alternative	Permanent Impact Footprint Assumptions	Temporary Impact Footprint Assumptions
Replace New Hope Bridge	2A, 2B, 2C		Temporary impact footprint extends 100 feet upstream and downstream of existing bridge
Relocate Existing Structures	2A, 2B, 2C	To be determined	To be determined
Construct Setback Levee	2B, and 2C	Permanent impact footprint extends to the summer water surface elevation of the river to 200 feet landward to the setback levee	Landside temporary impact footprint extends 100 feet beyond the permanent impact footprint Waterside temporary impact footprint extends 20 feet beyond the permanent impact footprint
Modify Walnut Grove-Thornton Road and Staten Island Road	2A	None. All work will occur within the impact footprint of other project components	None. All work will occur within the impact footprint of other project components
Construct Wildlife Viewing Areas	2A, 2B, 2C	None. All work will occur within the impact footprint of other project components	None. All work will occur within the impact footprint of other project components
Excavation of Borrow Sites	2A, 2B, 2C	Permanent impact footprint includes all riparian, ruderal and nontidal wetland habitat	Temporary impact footprint includes all open water habitat
Inundation of Detention Basin	2A, 2B, 2C	None	Temporary impact will occur due to seasonal inundation of detention basins
Channel dredging	2D	Permanent impact footprint includes the loss of all riparian and wetland habitat on the waterside of the levee. Assumes the most environmentally damaging method (i.e. clamshell on dragline methods)	Temporary impacts include tidal perennial aquatic habitat and uplands on the landside of the levee used for disposal of dredge materials
Levee modifications on South Fork of Mokelumne River	2D	Permanent impact footprint extends from the water line to 50 feet landward of both east and west levees	Waterside impact extends from the bank line to 20 feet into the water towards the center of channel on both sides Landside impact extends 100 feet beyond the permanent impact footprint for both east and west levees
Crown Raise	2D	None	Temporary impact footprint includes the adjacent levee road and shoulders

Additional Data Needs

The Project footprint and actions for some Project components have not been defined at this time (e.g., Delta Meadows property, agricultural siphons); therefore, impacts were not assessed for these components.

Habitat mapping has not been performed in several locations, including the Grizzly Slough Restoration Project site, the borrow sites, and several locations associated with dredging and levee modifications along the Mokelumne River. Existing land cover types were evaluated based on aerial photograph interpretation. Additional field mapping and wetland delineations will need to be performed at these locations upon development of detailed project design and before implementation.

Development of Mitigation Measures

The mitigation measures for impacts on vegetation and wetland resources were developed through review of the MSCS (CALFED Bay-Delta Program 2000e), prior environmental impact studies and reports for affected resources, and professional judgment.

Special-Status Plants

Table 4.1-2 lists the special-status species that, based on results of field surveys and review of relevant literature and the CNDDB, are known to occur or could be present in the Project and study areas. Special-status species were considered to be present in the Project area if they were observed during field surveys, or if species' habitat is present in the Project or study areas and the area is within the known range of the species. This table also indicates whether the species is proposed for evaluation in this EIR.

For plant species known to occur in the Project area (rose-mallow *[Hibiscus lasiocarpus]*, Delta tule pea [*Lathyrus jepsonii* var. *jepsonii]*, Mason's lilaeopsis *[Lilaeopsis masonii]*, Delta mudwort *[Limosella subulata]*, Sanford's arrowhead *[Sagittaria stanfordii]*, bristly sedge *[Carex comosa]*, and Suisun Marsh aster *[Aster lentus]*), a species assessment based on a qualitative interpretation of available data and professional judgment was used to analyze the impacts and determine appropriate mitigation.

The environmental correlates affecting dispersal of intertidal plants include continuity of habitat and entrainment. Environmental correlates will be affected by environmental conditions that may be altered by the Project, including placement and operation of the weirs, proposed water diversions, flow velocity, and water level.

Establishment, growth, and maintenance of intertidal plants are affected by a number of environmental correlates, including contaminants, key habitat quantity, scour, physical injury, and competition. The environmental conditions affecting this set of correlates include tidal level, substrate, water salinity, nonnative competitors, and flow velocity.

Hydrologic Modeling

Hydrologic modeling was used to identify the location, frequency, and magnitude of water elevation changes expected to result from flow conditions with construction of the Project flood control and ecosystem restoration components (e.g., flooding of Staten Island and McCormack-Williamson Tract during high-flow events, inundation of floodplain created by setback levees, breaching of McCormack-Williamson Tract levees). Results of the hydrologic modeling were then used to evaluate the potential effects of changes in hydrology on existing land cover types and development of restored habitats.

Physical Setting/Affected Environment

Until the early 1800s, the Delta consisted primarily of a mosaic of tidal marshland dominated by bulrushes (*Scirpus* sp.) with a few low, natural levees that supported woody riparian vegetation, grassland, and upland shrubs (Thompson 1957). The relatively small portions of native grassland and upland areas were among the first areas of the Delta Region to be converted to agricultural lands. Agriculture in the Delta consisted primarily of dryland farming and land irrigated from artesian wells, groundwater pumping, and some creek canals. In the mid-1800s, levee construction increased, and marshland was drained to provide land for irrigated agriculture. By 1900, about one-half of the Delta's historical wetland areas had been diked and drained, and extensive reclamation continued through the 1940s. Today, agricultural land dominates the North Delta although some small, apparently natural islands remain in a quasinatural state, as do some in-channel islands that are remnants of dredging and levee construction.

Levees in the north Delta typically have waterside slopes that are fully covered with RSP and are actively maintained, which includes regular herbicide application to control vegetation that could destabilize the levee structure. As a result, there is little or no vegetation or exposed substrate on the actual levees, with the common exception of a fringe at the outside levee toe that is typically very sparsely vegetated and does not support special-status species. Interior areas of most north Delta islands are actively farmed and contain little or no natural (uncultivated) vegetation.

For the purpose of this assessment of potential impacts of this Project on vegetative and wetland resources, including special-status species, the terms *Project area* and *study area* are used. The "Project area" includes all lands within the footprint of the proposed Project actions (e.g., levee modifications areas, setback areas, inundation areas, channel dredging areas) and the proposed mitigation sites. The "study area" is a larger geographic area encompassing the

Project area and the channel dredging areas, as well as all lands within 1 mile of the Project boundaries. Habitat mapping is not available for the entire study area; therefore, the assessment of the land cover types in the study area, which are subtypes of the NCCP (Natural Community Conservation Plan) communities addressed in the MSCS (CALFED Bay-Delta Program 2000), is based on aerial photograph interpretation and site observations.

The study area allows a comparison of Project-related effects on the local environment in relation to similar land cover types in the vicinity of the Project activities. Land cover type acreages discussed in this section represent those areas that were surveyed and mapped by DWR and others. In some cases these acreage totals include only the mapped areas and do not represent the total land area in the study area.

Invasive Plant Species

Invasive plant species (e.g., noxious weeds) are now recognized worldwide as posing threats to biological diversity—second only to direct habitat loss and fragmentation. Noxious weeds are known to alter ecosystem functions such as nutrient cycles and hydrology, to outcompete and exclude native plants and animals, and to hybridize with native species. All natural communities are susceptible to invasion by noxious weeds. The presence and abundance of noxious weeds in an ecosystem are highly dynamic, subject to changes in the local environment.

In general, in the North Delta, the hydrological regime strongly affects the growth and survival of invasive plant species and native vegetation. A suite of nonnative species has already invaded extensive areas in the North Delta, and additional invasive species may also increase their distribution. At several Project sites, either invasive species are already present, or their propagules are regularly arriving. Currently, the most problematic species in the North Delta are water hyacinth (*Eichhornia crassipes*), egeria (*Egeria densa*), perennial pepperweed (*Lepidium latifolium*), and Himalayan blackberry (*Rubus discolor*). Each of these species is widespread, abundant, and extremely difficult to eradicate. Because problematic invasive species are present, or their propagules are present, disturbances can facilitate rapid invasions of sites.

The noxious weeds currently considered problematic in the study area—as well as their locations, infestation size, and ranking for control—can change in a short period as new noxious weeds are identified, infestation sizes increase or decrease, and priorities change. Generally, a majority of the study area is dominated by agricultural habitats that are routinely treated to control invasive plants. Although specific surveys to map the distribution and abundance of noxious weeds in the study area were not conducted, the noxious weeds are known to occur currently in the study area. Invasive species in the North Delta are discussed in the land cover types habitat descriptions.

Land Cover Types

A land cover type is the dominant feature of a unit of land surface that is defined by vegetation, water, or human uses (e.g., agricultural lands). For this EIR, land cover types were classified according to the NCCP habitat types presented in the CALFED MSCS (Multi-Species Conservation Strategy) (CALFED 2000). The CALFED MSCS habitats were defined such that CALFED could use existing GIS data to estimate the location and size of habitats and could compare this information with Ecosystem Restoration Program habitat restoration and enhancement targets. To facilitate the use of this information for various CALFED planning and Project-related documents as they pertain to the Project, the MSCS habitat types were used and expanded upon where a greater level of detail was required. Land cover types mapped in the study area by Jones & Stokes (April 2004) and by ESA (June 2004), and corresponding CALFED MSCS NCCP habitat types are listed in Table 4.1-5.

Methods and Results

Land cover types in the McCormack-Williamson Tract and Staten Island study area were mapped to a Project level using digital color aerial photography, flown in June 2002. The aerial photography was obtained for the study area and printed at a scale of 1 inch = 500 feet. Jones & Stokes botanists conducted field surveys in 2003 and 2004 (concurrent with wetland delineation surveys) to map and verify the land cover types in the study area. Land cover type characteristics were obtained from descriptions in the CALFED MSCS NCCP (CALFED 2000) and modified where necessary to represent conditions present in the study area. As part of the land cover type mapping, all Project-level land cover types were mapped and verified in the field. Following the field surveys, land cover types were digitized from field maps at a GIS workstation (ArcGIS), and acreages of land cover types were calculated in GIS.

Table 4.1-5 presents the extent of each Project-level land cover type in the study area for each island. The distribution of land cover types in the study area is shown in Attachment 4.1-1. Summary descriptions of each of the CALFED MSCS NCCP land cover types are described below.

Tidal Perennial Aquatic

Tidal perennial aquatic land cover is characterized by open water and is defined as deepwater aquatic (more than 3 meters [10 feet] deep from mean low tide), shallow aquatic (less than or equal to 3 meters [10 feet] deep from mean low tide), and unvegetated intertidal (tidal flats) zones of estuarine bays, river channels, and sloughs (CALFED Bay-Delta Program 2000a). In the study area, tidal perennial aquatic habitat includes river channels, sloughs, and tidal flats. Deep open-water areas are largely unvegetated, although beds of aquatic plants occasionally occur in shallower open-water areas.

Table 4.1-5. Classification of Land Cover Types for the North Delta Improvement Project

NCCP Land Cover Type Group	Corresponding Project Land Cover Type	Presence in the Project Area	Total Acreage of Land Cover Type in the Study Area
Tidal Perennial Aquatic (Aquatic Tidal—ESA)	Tidal Aquatic	Common throughout the study area.	2541.78
	Tideflat (mudflat)	Scattered but common throughout the study area.	4.38
Lacustrine (Aquatic Non-Tidal—ESA)	Farm and Borrow Pit Ponds	Very uncommon in the study area.	8.69
	Temporary Ag Ditch (<15 ft wide)	Very common throughout the study area, occurring on every island.	104.47
	Permanent Ag Ditch (>15 ft wide)	Very common throughout the study area, occurring on every island.	20.14
Tidal Freshwater Emergent Wetland	Tidal Freshwater Emergent Wetland	Common and scattered throughout the study area.	74.49
Nontidal Freshwater Emergent Wetland	Perennial Freshwater Emergent Wetland	Uncommon, only occurring in several places on Staten Island and McCormick-Williamson Tract. Also on DWR mitigation site on north end of Grizzly Slough property.	4.20
	Seasonal Freshwater Emergent Wetland (Seasonal Wetland—ESA)	Uncommon, only occurring in several places on Staten Island and McCormick-Williamson Tract.	10.78
Valley/Foothill Riparian (Riparian—ESA)	Cottonwood-Willow Woodland	Common in the study area.	30.97
	Valley Oak Riparian Woodland	Common in the study area.	15.72
	Nonnative Riparian Woodland	Uncommon in the study area.	1.55
	Riparian Scrub	Very common in the study area.	104.58
	Himalayan Blackberry	Very common in the study area on all island levees.	25.29
	Mixed Riparian Woodland	Uncommon, occurring only on the Mokelumne River north of	21.53

NCCP Land Cover Type Group	Corresponding Project Land Cover Type	Presence in the Project Area	Total Acreage of Land Cover Type in the Study Area
		New Hope Marina	
	Riparian Vegetation (unclassified)		972.95
Grassland	Annual Grassland	Uncommon in the study area	17.77
	Perennial Grassland	Very uncommon in the study area	4.64
	Ruderal/Forb (Upland—ESA)	Very common in the study area on all island levees	777.11
Upland Cropland (Upland—ESA)	Corn and Grain Fields	Most common habitat type in the study area	12,279.00
	Truck and Other Row Crops	Most common habitat type in the study area	14,005.99
	Orchard and Vineyard	Very common in the study area.	1,381.30
	Hay Crops	Very common in the study area.	4,719.62
	Fallow Fields	Common in the study area.	474.81
	Pasture	Uncommon in the study area.	312.33
Developed[2]	Developed	Scattered but common in the study area	721.27
Ornamental Plantings[2]	Ornamental Plantings	Uncommon in the study area	9.39
Unknown	Native Vegetation	Very common in the study area	1,357.64
Total			40,002.36

[1] The Natural Community Conservation Plan (NCCP) habitat group corresponds to the list of habitat types in the MSCS (CALFED 2000).

[2] Acreages based on habitat mapping and classification performed by DWR.

Typical tidal perennial aquatic plant species in shallow aquatic habitats include water hyacinth, water primrose (*Ludwigia peploides)*, Brazilian waterweed (*Egeria densa)*, common waterweed (*Elodeaa canadensis)*, hornwort (*Ceratophyllum demersum)*, parrot's feather (*Myriophyllum aquaticum)*, and western milfoil (*Myriophyllum hippuroides)*. Colonies of these aquatic plants are generally infrequent, but mats of noxious weeds, such as water hyacinth or Brazilian waterweed, can clog waterways, shade habitat for native aquatic vegetation, and smother low-growing intertidal vegetation when washed onto channel banks (California Exotic Pest Plant Council 1999; California Department of Boating and Waterways 2000, 2001). Additional problematic invasive species are Eurasian milfoil (*Myriophyllum spicatum*) and hydrilla (*Hydrilla verticillata*), which could become abundant in the North Delta.

Aquatic vegetation includes submerged plants generally rooted in the substrate, whose stems may partially extend above the water surface (e.g., during flowering or during low tide). Aquatic vegetation, when present, is generally restricted to waterways with low water velocities and areas with low levels of disturbance.

Tidal perennial aquatic habitats are jurisdictional waters of the United States under Section 404 of the CWA. Tidal perennial aquatic habitat is very common in the study area occurring on the North and South Fork Mokelumne River channels, Lost Slough, Beaver Slough, Snodgrass Slough, Dead Horse Cut, Hog Slough, Cosumnes River, Grizzly Slough, and Bear Slough. The general distribution of this habitat type is shown in Attachment 4.1-1.

No special-status plants are known to occur in tidal perennial aquatic habitat in the Project area.

Lacustrine

Lacustrine land cover is defined as portions of permanent bodies of water that do not support emergent vegetation and that are not subject to tidal exchange, including lakes, ponds, oxbows, gravel pits, and flooded islands (CALFED Bay-Delta Program 2000).

In the study area, this community is found in farm and borrow pit ponds and agricultural ditches on each of the islands. The permanent agricultural ditches occur throughout the islands. A large pond is also present at the borrow site. The general distribution of this habitat type is shown in Attachment 4.1-1. Some of these cover types are considered waters of the United States under Section 404 of the CWA.

No special-status plants are known to occur in lacustrine habitat in the Project area. Rose-mallow is known to occur in irrigation ditches within its range (California Natural Diversity Database 2006) and, therefore, has the potential to occur in this habitat.

Tidal Freshwater Emergent Wetland

In the Delta, tidal freshwater emergent wetland communities include portions of the intertidal zones supporting emergent wetland plant species that are not very tolerant of saline or brackish conditions. Tidal freshwater emergent wetland includes all or portions of the freshwater emergent wetland tidal and Delta sloughs and in-channel islands and shoals habitats (CALFED Bay-Delta Program 2000). In the Study Area, this community type occurs in tidally influenced waterways on in-channel islands and along some levees.

The Delta's tidal wetlands are dominated by clonal perennial plants, particularly tules (*Scirpus* spp.), and to a lesser extent cattails (*Typha* spp.), giant reed (*Phragmites australis*), and waterpepper (*Polygonum hydropiperoides*) (Hunter and Hart 2003). Tules, cattails, and giant reed are emergent macrophytes, large (up to 7 ft in height) rhizomatous plants rooted in the substrate with stems (culms) above the water surface. Seedling establishment takes place on exposed surfaces, but clonal growth allows their subsequent occupancy of lower elevation sites (i.e., in the lower intertidal zone). Their growth is reduced by submergence and by damage to their culms from wave action; thus vegetation dominated by emergent macrophytes is restricted to shallow water, typically <2 feet deep (Coops et al. 1991, 1996). Once emergent macrophytes establish on a site, their thick rhizomes, accumulating organic matter from abscised plant parts and trapped sediment, raise marsh elevation. However, in the absence of large inputs of sediments, this increase in elevation is very gradual (Simenstad et al. 2000).

In marsh vegetation, vegetation structure and species richness are strongly influenced by disturbance (e.g., wave action) and the range of elevations present at a site (Keddy 2000). Disturbance provides regeneration opportunities for annuals and short-lived perennials, provides the opportunity for additional species (also primarily clonal perennials) to colonize the site, and creates structural diversity. In the North Delta's tidal wetlands, the cover of woody species and species richness (i.e., number of species) increase with elevation. At upper elevations, emergent wetlands intergrade with the woody vegetation of adjacent riparian areas. Most woody plants in this transitional zone are shrubs and vines, including red osier dogwood (*Cornus stolonifera*), buttonbush (*Cephalanthus occidentalis*) and willows (*Salix* spp.).

At lower elevations, there is also a transitional zone between marsh and aquatic vegetation. In this zone, there are fewer species of emergent plants, tule stems are at a lower density and occasionally clumps or mats of submerged aquatics exist. These clumps or mats have creeping stems that are prostrate on the water but are rooted in the substrate. Native plants in the marsh fringe with this growth form include creeping water primrose (*Ludwigia peploides*), which has both native and nonnative subspecies, and floating pennywort (*Hydrocotyle ranunculoides*). This floating fringe may be absent or discontinuous and narrow (<1 m) or may extend out across the water surface for 1–3 m with plants rooted in the substrate at the marsh edge, and floating as a mat over deeper water. Other, smaller species of pennywort (*Hydrocotyle umbellata*, *H. verticillata*) also grow at the marsh edge, but tend to be on exposed muddy banks and flats.

In the study area, tidal freshwater emergent wetland is common along all river channels and sloughs. The distribution of this community in the study area is shown in Attachment 4.1-1. Tidal freshwater emergent wetlands are jurisdictional waters of the United States under Section 404 of the CWA.

This wetland community provides suitable habitat for the following special-status species: Suisun Marsh aster, slough thistle, rose-mallow, Delta tule pea, Mason's lilaeopsis, bristly sedge, Sanford's arrowhead, and Delta mudwort. Of these species, rose-mallow, Delta tule pea, Mason's lilaeopsis, bristly sedge, Sanford's arrowhead, and Delta mudwort were observed in the Project area (Table 4.1-2 and Figure 4.1-1).

Nontidal Freshwater Emergent Wetland

Nontidal freshwater emergent wetland is permanent wetlands, including meadows, and seasonal wetlands, dominated by wetland plant species that are not tolerant of saline or brackish conditions (CALFED Bay-Delta Program 2000). The seasonal wetland is dominated by herbaceous, emergent (rooted) macrophytes tolerant of seasonal soil saturation and/or ponding, including bulrush *(Scirpus* sp.) and cattail *(Typha* sp.) along channel margins of potential newly created channels on floodplain and/or other areas characterized by longer depth and duration wetland hydrology. Other common wet-tolerant species found in the surrounding Cosumnes River floodplain would be anticipated dominants in non-tule–dominated seasonal wetland habitat, including but not limited to cocklebur (*Xanthium strumarium),* native perennial sedge *(Cyperus eragrostis),* and least spikerush *(Edeocharis acicularis).* In the study area, this community is very uncommon, only occurring in narrow patches along agriculture ditches and adjacent to farm and borrow pit ponds on McCormack-Williamson Tract.

Nontidal freshwater permanent emergent wetland in the study area is dominated by tules and cattails and other species commonly found in tidal freshwater emergent wetland. The general distribution of this habitat type is shown in Attachment 4.1-1. Nontidal freshwater permanent emergent wetlands are jurisdictional waters of the United States under Section 404 of the CWA and are considered sensitive natural communities.

Nontidal freshwater emergent wetland habitats are suitable for the following special-status species: marsh skullcap (*Scutellaria galericulata),* blue skullcap (*S. lateriflora),* and eel-grass pondweed. The 2004 surveys and May & Associates 2002 survey failed to locate these species. Given the lack of current records in the Project area and the scarcity of nontidal freshwater emergent wetland habitats in the Project site, the potential for these species to occur is low.

Valley/Foothill Riparian

The valley/foothill riparian land cover type includes a variety of riparian habitats occurring on levees, along unmaintained channel banks of rivers and sloughs, and on the few in-channel islands that are in the Project area. Valley/foothill riparian habitats are common throughout the study area, although the most extensive stands occur in the northern portions of the study area at Delta Meadows and along the Mokelumne River. The distribution of valley/foothill riparian habitats is shown in Attachment 4.1-1.

Several subtypes of riparian habitat were mapped in the study area under the valley/foothill riparian land cover type, including cottonwood-willow woodland, valley oak riparian woodland, nonnative riparian woodland, riparian scrub, Himalayan blackberry, and mixed riparian woodland. The riparian zone in each of these communities is typically very narrow.

In the North Delta, riparian areas are frequently dominated by nonnative invasive species, particularly along levees. The most abundant of these are arundo (*Arundo donax*), black locust (*Robinia pseudoacacia*), Himalayan blackberry, fennel (*Foeniculum vulgare*), and pepperweed . However, a number of other species are locally problematic such as fig (*Ficus carica*) and tree-of-heaven (*Ailanthus altissima*). In addition to these species, several other species also occur in the Central Valley's riparian areas and are invasive elsewhere. Of these species, the two of greatest concern in the North Delta are tamarisk (*Tamarix* spp.) and red sesbania (*Sesbania punicea*). Although neither of these species is currently a major problem in the North Delta, the potential exists for these species to become more abundant.

Several invasive species occur in riparian habitats as well as wetland habitats. These species include Himalayan blackberry, Bermuda grass (*Cynodon dactylon*), perennial pepperweed, fennel, and purple loosestrife (*Lythrum salicaria)*. Species known to occur in riparian habitats can also affect wetland habitats by encroaching on the tidal zone at the base of levees and berms, possibly reducing the available habitat for native species.

Cottonwood-Willow Woodland: The cottonwood-willow woodland community typically occurs on levees and along unmaintained channel banks of North Delta sloughs and rivers. Dominant trees in this woodland are Fremont cottonwood (*Populus fremontii*), sandbar willow (*Salix exigua*), and Goodding's willow (*Salix gooddingii*). Trees that occur as associates in the overstory and as understory components are box elder (*Acer negundo*), Oregon ash (*Fraxinus latifolia*), sycamore (*Platanus racemosa*), white alder (*Alnus rhombifolia*), black walnut (*Juglans californica* var. *hindsii*), dogwood (*Cornus* sp.), and valley oak (*Quercus lobata*). Shrubs and herbaceous species in the cottonwood-willow woodland include Himalayan blackberry (*Rubus discolor*), California rose (*Rosa californica*), elderberry (*Sambucus mexicana*), California grape (*Vitis californica*), and rush (*Juncus* sp.). Two invasive nonnative species, giant reed (*Arundo donax*) and water hyacinth are found in this habitat. Jurisdictional cottonwood-willow woodland wetlands occur on the levee bank within high tide line and on in-channel islands. Cottonwood-willow woodland also occurs as a nonjurisdictional habitat on levee banks above the high tide line and on the landside of levee banks. No special-status species are expected to occur in this habitat.

Valley Oak Riparian Woodland: Valley oak riparian woodland includes areas where the dominant overstory is valley oak. Associate species are similar to those described for the cottonwood-willow woodland vegetation. This riparian woodland also occurs on banks in the study area. Areas of valley oak riparian woodland growing on levee banks within the high tide line may qualify as jurisdictional wetlands under Section 404 of the CWA and as waters under the Rivers and Harbors Act. No special-status species are expected to occur in this habitat.

Nonnative Riparian Woodland: Nonnative riparian woodland consists of introduced species such as black locust and giant reed with an understory of Himalayan blackberry. This habitat occurs as nonjurisdictional habitat on levee banks above the high tide line and on the landside of levee banks. No special-status species are expected to occur in this habitat.

Riparian Scrub: Riparian scrub occurs throughout the study area. Dominant tree and shrub species are primarily the same as those listed above for cottonwood-willow woodland, but individuals occur as saplings rather than mature trees. Several additional species identified in riparian scrub include buttonwillow (*Cephalanthus occidentalis*), cattail, tule, and sedge (*Carex* sp.). Invasive nonnative species in this habitat type are giant reed, black locust (*Robinia pseudoacacia*), and tree-of-heaven. Jurisdictional riparian scrub is located on in-channel islands, within the high tide line on levee banks, and in a depression on McCormack-Williamson Tract. This wetland type also occurs as a nonjurisdictional habitat on levee banks above the high tide line and on the landside of levee banks. Delta coyote-thistle (*Eryngium racemosum)* can occur in riparian scrub.

Himalayan Blackberry: Himalayan blackberry thickets intergrade with other riparian habitats. These thickets are characteristically monotypic stands of Himalayan blackberry and usually occur in association with ruderal habitats; however, a herbaceous understory is not evident in these thickets. No special-status species are expected to occur in this habitat.

Mixed Riparian Woodland: Mixed riparian woodland does not have one or two tree species that predominate; instead it is a mix of the riparian trees that grow in the vicinity. Species in this woodland include Fremont cottonwood, willow, box elder, valley oak, California grape, and other species observed in the cottonwood-willow woodland and valley oak woodland habitats. This habitat type occurs as a nonjurisdictional habitat on levee banks above the high tide line or on the landside of levee banks. No special-status species are expected to occur in this habitat.

DFG considers riparian communities to be rare natural communities and maintains a current list of these communities throughout the state in the CNDDB (California Natural Diversity Database 2006).

Grassland

Grasslands are limited in extent in the study area and are found only on a few levees. The main type of grassland is annual grassland, which is dominated by nonnative grasses such as bromes (*Bromus* spp), wild oats (*Avena* spp), and foxtail barley (*Hordeum murinum*); however, several small areas supporting perennial grassland dominated by creeping wildrye (*Leymus triticoides*) were found on Staten Island near the confluence of Beaver Slough and the South Fork Mokelumne River. CALFED Bay-Delta Program MSCS (2000) has identified the restoration of perennial grasslands as part of the ERP, and therefore this plant community is considered sensitive.

Ruderal forb habitat, a subtype under the grassland land cover type, occurs throughout the study area in much of the area not occupied by wetland or agricultural cover types (levees). This habitat is especially prevalent adjacent to agricultural fields and roads and on the landside levee slopes on Staten Island. Most of the uplands adjacent to study area wetlands are ruderal forb habitats. Typical species in the ruderal forb habitats include johnsongrass (*Sorghum halapense*), hirschfeldia (*Hirschfeldia incana*), bristly ox-tongue (*Picris echioides*), and white sweetclover (*Melilotus alba*).

Grassland habitats are limited in extent in the study area and are found only on a few levees in the study area (Jones & Stokes April 2004). The distribution of grassland habitats is shown in Attachment 4.1-1.

No special-status species are expected to occur in this cover type in the Project area.

Upland Cropland

Agricultural croplands in the Project area are dominated by seed and row crops such as corn, wheat, potatoes, and tomatoes. Typical weedy species growing in these areas include johnsongrass, cocklebur, and annual grasses. These croplands are adjacent to temporary agricultural ditches and, in a few areas, by permanent agricultural ditches. Ruderal forb habitat also borders agricultural cropland, particularly those fields nearest the levees. Most agricultural cropland in the study area is flooded during the winter months to attract waterfowl, is allowed to dry, and is then planted in crops through the growing season.

Agricultural cropland is the most common land cover type in the study area, occupying the interior of all islands. The distribution of upland croplands is shown in Attachment 4.1-1.

No special-status species are expected to occur in agricultural habitats because of the soil disturbance inherent in the agricultural practices of the Delta.

Developed/Ornamental Plantings

Developed areas and ornamental plantings occur throughout the study area at home sites, agricultural buildings, and several commercial sites. Developed areas include the buildings and pavement associated with roads and driveways as well as levees and farm roads. Ornamental plantings usually surround the developed areas and most often include a variety of nonnative species. Several of the home sites and landscaped areas occur at the bases of levees and are adjacent to riparian or ruderal forb habitats. The distribution of the developed/ornamental plantings land cover type is shown in Attachment 4.1-1.

Because of disturbance and ongoing maintenance activities, no special-status plant species are expected to occur in developed areas or areas with ornamental plantings.

Special-Status Plants

Special-status plants are species legally protected under CESA, the ESA, or other regulations, as well as species considered sufficiently rare by the scientific community to qualify for such listing. Special-status plants and animals are species in the following categories:

- species listed or proposed for listing as threatened or endangered under the ESA (50 CFR 17.12 and various notices in the FR [proposed species]);
- species that are candidates for possible future listing as threatened or endangered under the ESA (69 FR 24876, May 4, 2004);
- species listed or proposed for listing by the State of California as threatened or endangered under CESA (14 CCR 670.5);
- species that meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380);
- plants listed as rare under the California Native Plant Protection Act (California Fish and Game Code, Section 1900 *et seq.*);
- plants considered by CNPS to be “rare, threatened, or endangered in California” (Lists 1B and 2, available at <www.cnps.org/rareplants/inventory/6thEdition/htm>); and
- plants listed by CNPS as plants about which more information is needed to determine their status and plants of limited distribution (Lists 3 and 4, available at www.cnps.org/rareplants/inventory/6thEdition/htm>) that may be included as special-status species on the basis of local significance or recent biological information.

Methods and Results

Prior to studies conducted for this Project, several occurrences of special-status plants have been documented in the North Delta based on CNDDB records and previous surveys conducted by May & Associates on Staten Island and its levees in 2002 (May & Associates 2004). ESA also conducted a database query of the CNDDB and a site reconnaissance visit to the Grizzly Slough floodplain restoration Project site (ESA 2004). While information on special-status plants was well documented on Staten Island and its levees, records known in the area from the CNDDB (California Natural Diversity Database 2006) were not well documented. While CNDDB records for special-status plants in the study area existed, in many instances, occurrence records had nonspecific location information or were historical (i.e., occurrence information was last recorded before the 1970s, the occurrence was documented only from herbarium specimens, or the occurrence was only documented in the area from literature sources).

To investigate the current occurrences and distribution of special-status plants in the study area, Jones & Stokes botanists conducted botanical surveys during August and September 2004.

The goals of the surveys were as follows:

- document the presence (or absence) and distribution of historical (CNDDB 2004) and new special-status species occurrences and
- identify potential habitat for special-status species.

Surveys of waterways and in-channel islands were conducted from a slowly moving boat that allowed the botanists to readily access shallow water and tidal flat habitats. All areas with potential for special-status plants were visually surveyed from the boat or by foot where access would allow. While an effort was made to survey as much potential habitat as possible, areas exist in the study area that were not surveyed because physical access was not possible (e.g., the interior of larger in-channel islands). In many instances in the study area, levees along waterways were nearly unvegetated, proceeded to deepwater habitats fairly quickly, and provided little to no potential habitat for special-status plants.

Table 4.1-2 lists the special-status species that were observed during the field surveys or have suitable habitat in the study area or a historical range that includes the study area (Figure 4.1-1 shows the locations of special-status species).

Several special-status plants found in the study area occur almost exclusively in intertidal zones where they are inundated twice each day by high tides for varying periods of time during each month. These species include Mason's lilaeopsis, Delta mudwort, and Sanford's arrowhead. Although Sanford's arrowhead occurs in a variety of habitats in the Sacramento and San Joaquin Valleys that are not tidally influenced, Jones & Stokes botanists observed that in the study area it occurs almost exclusively in the intertidal zone. The remaining special-status plants found in the study area occur at the top of the intertidal zone and at higher elevations (mainly tidal freshwater emergent wetland and some valley/foothill riparian land cover types.) Though different aspects of the intertidal zone are used as habitat for the special-status species, the zone is still classified as a nontidal freshwater emergent wetland cover type. The general ecology and status of special-status plant species found in the study area are described in the following sections. Species that are found almost exclusively in intertidal locations are discussed first, followed by species typically found above the intertidal zone.

Masons Lilaeopsis

Mason's lilaeopsis was recorded at two sites in the southern portion of the study area on in-channel islands and tidal flats adjacent to levees during the 2004 special-status-plant surveys. The CNDDB also recorded this species throughout the study area in six sites. Field surveys conducted by May & Associates in 2002 recorded one occurrence (Figure 4.1-1).

Mason's lilaeopsis is a diminutive rhizomatous perennial herb that typically occurs on clay or silt tidal mudflats with high organic matter content (Golden and Fiedler 1991). It occurs in the lower reach of the Napa River and throughout the Delta.

Mason's lilaeopsis occurs almost exclusively in intertidal locations where it is inundated twice each day by high tides for varying periods of time during each month (Golden and Fiedler 1991; Zebell and Fiedler 1996). Populations generally occur at elevations varying from approximately 0.5 to 2 feet NGVD (California Department of Fish and Game 1995). Locations of this species can vary from year to year because of the transient nature of the mudflat habitat on which it grows. Both lack of siltation and accelerated erosion can remove habitat and individual plants. Mason's lilaeopsis successfully tolerates disturbance because it spreads vegetatively by rhizomes. No seedlings were observed during a survey of the entire range of Mason's lilaeopsis, although small tufts were seen floating in the Delta region, indicating that the lilaeopsis may colonize sites by the dispersal of vegetative mats through the Delta waterways (Golden and Fielder 1991).

The instability of Mason's lilaeopsis habitat on mudflats may reduce competition from other larger species (Zebell and Fiedler 1996). However, the lilaeopsis is subject to competition, particularly from water hyacinth in the San Joaquin River region (Golden and Fiedler 1991; Zebell and Fiedler 1996). Water hyacinth negatively affects Mason's lilaeopsis through competition for light, obstruction of habitat, prevention of colonization, and physical disturbance when washed onto the shoreline by wave action (Zebell and Fiedler 1996). Pampas grass (*Cortaderia selloana)* may also threaten the lilaeopsis (Golden and Fiedler 1991).

Mason's lilaeopsis occurs in habitats with water salinity from 0.25 up to 8.5 ppt and may tolerate even higher salinities (Golden and Fiedler 1991; Zebell and Fiedler 1996); however, growth and sexual reproduction may be depressed at higher salinity levels (Fiedler and Zebell 1993). Experiments on the response of Mason's lilaeopsis to crude oil at varying salinities indicate that crude oil significantly affects aboveground growth at salinity levels above 0 ppt (Zebell and Fiedler 1996).

This species appears to become less abundant as tidal range decreases. Tidal fluctuation has been implicated as an important factor in determining Mason's lilaeopsis abundance and suggests that alteration of the tidal regime could have an adverse effect on existing populations. Previous temporary barrier projects in the South Delta that have increased low-tide elevation have contributed to impacts on Mason's lilaeopsis. The increased low-tide elevation caused long-term inundation and loss of the Mason's lilaeopsis at sites monitored in the South Delta (California Department of Water Resources 2001).

Delta Mudwort

Delta mudwort was observed at five sites during the 2004 special-status-plant surveys and recorded at six sites on the CNDDB (Figure 4.1-1). No observations were recorded by May & Associates during their 2002 survey.

Delta mudwort is a low-growing, herbaceous perennial that occurs on muddy or sandy intertidal flats, sometimes in association with Mason's lilaeopsis (California Native Plant Society 2001; Golden and Fiedler 1991). Delta mudwort likely has habitat requirements similar to those described above for Mason's lilaeopsis, but the mudwort is known to be more sensitive to high salinity levels (Zebell and Fiedler 1996).

Sanford's Arrowhead

Sanford's arrowhead was recorded at 15 sites during the 2004 special-status-plant surveys (Figure 4.1-1). Records for the CNDDB show one occurrence of this species. May & Associates observed two sites during the 2002 surveys. This species was observed around the islands on tidal flat habitats.

Sanford's arrowhead is an aquatic perennial herb that occurs in shallow slow-water habitats such as sloughs, oxbow lakes, ditches, and some areas of tidally affected emergent marsh. It is widely distributed in California but is currently uncommon in areas of suitable habitat.

The habitat requirements for this species are variable; however, in the study area it occurs in the intertidal zone from approximately 0.5 to 2 feet NGVD, similar to the requirements for Mason's lilaeopsis. Observations of this species in the study area suggest that populations may be dependent on periodic scouring to decrease competition with other species.

Delta Coyote-Thistle

This species was not found in the study area during the 2004 surveys, although marginal riparian scrub and willow scrub habitat is present. There are no CNDDB records for Delta coyote-thistle in the study area. Given the lack of current or historical records in the study area, the potential for this species to occur is low.

Delta coyote-thistle is an annual to perennial herb (its life cycle depends on the hydrological regime) that occurs in seasonally wet depressions in riparian scrub habitats. Most occurrences have been affected by flood control activities and conversion of lowlands to agriculture. Most remaining occurrences are found in Merced County along the floodplain of the San Joaquin River. Delta coyote-thistle is thought to require seasonal flooding that scours the substrate and reduces competition from other species (California Department of Fish and Game 2000).

Rose-Mallow

Rose-mallow was observed at 11 sites during the 2004 special-status-plant surveys throughout the Project area. CNDDB has recorded this species at five sites, whereas May & Associates observed one occurrence (Figure 4.1-1).

Rose-mallow is a herbaceous perennial that spreads by rhizomes in freshwater marsh habitat. In the study area, this species was observed to occur primarily on clay banks in the intertidal zone from the 0 tide level to mean high tide, although some individual plants were observed at higher elevations on levees. The specific habitat requirements and processes for this species are largely unknown; however, observations by DWR (Witzman pers. comm.) suggest that the species appears to tolerate erosion until roots are exposed.

Marsh Skullcap

Marsh skullcap is a rhizomatous perennial herb that occurs in meadows, marshes, and swamps at elevations from 0 to 7,000 feet (California Native Plant Society 2001). The specific habitat requirements and processes for this species are unknown. It typically occurs in montane settings. Though the CNDDB had identified marsh skullcap at the south end of Staten Island in the South Fork Mokelumne River, the 2004 surveys and May & Associates 2002 survey did not re-observe this population. Given the lack of current records and suitable habitat in the study area, the potential for this species to occur is low.

Blue Skullcap

Blue skullcap is a perennial herb that occurs in meadows, marshes, and swamps (California Native Plant Society 2001), similar to marsh skullcap. The specific habitat requirements and processes for this species are also largely unknown.

A population was identified by the CNDDB a mile south of the Project site on Bouldin Island, but this species was not found in the study area during the 2004 surveys. Given the lack of current records and suitable habitat in the study area, the potential for this species to occur is low.

Suisun Marsh Aster

Suisun marsh aster was observed at 25 sites during the 2004 special-status-plant surveys (Figure 4.1-1). The CNDDB also recorded 10 occurrences in the study area. One occurrence was recorded by May & Associates in 2002.

Suisun Marsh aster is a perennial rhizomatous (i.e., it can spread vegetatively) herb that occurs in brackish and freshwater marsh habitat along tidal sloughs and rivers, usually at or near the water's edge, or in drainage and irrigation ditches (California Native Plant Society 2001).

In the study area, this species was observed to occur primarily on clay banks in the intertidal zone from the 0 tide level to mean high tide, although some individual plants were observed at higher elevations on levees and exposed wooden posts. The specific habitat requirements and processes for this species are largely unknown; however, it is likely sensitive to scour from wave action similar to other species that occur in the intertidal zone.

Eel-grass Pondweed

Eel-grass pondweed (*Potamogeton zosteriformis)* is a floating aquatic perennial herb that occurs in shallow-water habitats, marshes, and swamps (CNPS 2001). This species has a fairly extensive range across the northern United States but is considered rare or endangered in California and several other states. The CNDDB has nine occurrences recorded in California, although all but one are historical, collected at least 50 years ago. Only one recent collection in 1995 (Lassen County) is known from California. One historical collection (1949) is known from just south of the study area near Webb Island.

Although the species was not observed in the study area during surveys, it can be easily overlooked because of its diminutive nature and floating habit, and therefore it could occur in the Project area. However, given the lack of observations in California during the last 50 years, it is unlikely that this species would occur in the study area.

Bristly Sedge

Two populations of bristly sedge were located in the study area (Figure 4.1-1) during the 2004 surveys. There were no recorded observations by May & Associates or in the CNDDB (2006).

Bristly sedge is a perennial herb that occurs along tidal sloughs near the water's edge. This species occurs in Washington, Oregon and California. The California Native Plant Society has speculated that the species apparently has a wide distribution, but is apparently rarely collected or reported. Very few current records of this species are known from California.

The species appears to occupy the zone just above mean high tide. Because very few records are known in California, the habitat requirements of this species in California are largely unknown. It likely requires seasonal flooding but probably cannot tolerate extended periods of inundation.

Delta Tule Pea

Delta tule pea was recorded at 23 sites during the 2004 special-status-plant surveys (Figure 4.1-1). CNDDB records indicate eight sites in the study area. May & Associates did not observe any Delta tule pea during their 2002 survey.

Delta tule pea is a perennial herb that occurs along tidal sloughs, riverbanks, and levees near the water's edge. Some populations are partially inundated at high tide (California Department of Water Resources 1994). This species was observed by Jones & Stokes botanists during the 2004 surveys to occur in riparian scrub habitats and emergent wetland habitats.

Slough Thistle

Slough thistle (*Cirsium crassicaule)* is an annual herb that occurs in emergent wetland, riparian scrub, and chenopod scrub habitats at elevations from 10 to 300 feet (California Native Plant Society 2001). There were no CNDDB records in the study area. This species was not found in the study area during the 2004 Project surveys or the 2002 May & Associates survey. Although suitable habitat is present, given the lack of occurrence in the study area, the potential for this species to occur is low.

Waters of the United States

As defined under the CWA, waters of the United States are:

> (1) all waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide; (2) all interstate waters, including

> interstate wetlands; (3) all other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters…; (4) all impoundments of waters otherwise defined as waters of the United States under the definition; (5) tributaries of waters identified in paragraphs (a)(1)–(4) of this section; (6) the territorial seas; and (7) wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a)(1)(6) of this section" (33 CFR § 328.3).

Methods and Results

Waters of the United States were delineated in the McCormack-Williamson Tract and Staten Island portions of the study area to determine the location and extent of areas that would be regulated by the USACE under Section 404 of the CWA. The results of the delineation were summarized in a wetland delineation report (Jones & Stokes 2004). As detailed in the wetland delineation report, waters of the United States were delineated and mapped according to the methodology established in the *1987 Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987). For an area to be considered a wetland under the USACE's methodology, the area must normally support hydrophytic vegetation, hydric soil, and wetland hydrology (Environmental Laboratory 1987).

Surveys were conducted on various dates during October–November 2002 and in April 2003 to collect data on vegetation, soils, and hydrology. During the surveys, all potential waters of the United States were mapped and verified in the field on aerial photos (scale 1"=300'), and representative sites were sampled for vegetation, soils, and hydrology. Following field surveys, all wetland features were digitized at a geographic information system workstation (ArcGIS). Acreages of waters of the United States, including wetlands, were calculated using ArcGIS. Table 4.1-6 identifies the jurisdictional wetlands and other waters of the United States delineated in the study area. The distribution of waters of the United States in the study area is shown in Attachment 4.1-1. Jurisdictional acreages presented in this document should be considered preliminary, pending verification by the Sacramento District of the USACE.

Federal Requirements

Endangered Species Act

Section 7 of the ESA requires federal agencies, in consultation with USFWS and/or NOAA Fisheries, to ensure that their 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. The required steps in the Section 7 consultation process for listed plants or plants proposed for listing are as follows.

Table 4.1-6. Acreage of Wetlands and Other Waters of the United States in the Study Area

Land Cover Type	Jurisdictional Status	Acreage in Study Area[1]
Tidal Emergent Wetland	Wetland	74.49
Nontidal Perennial Freshwater Emergent Wetland	Wetland	4.20
Nontidal Seasonal Freshwater Emergent Wetland	Wetland	10.78
Cottonwood/Willow Woodland	Wetland	30.97
Riparian Scrub	Wetland	104.58
Total Wetlands		225.02
Tidal Aquatic	Other Water of the U.S.	1,509.20
Tideflat	Other Water of the U.S.	4.38
Permanent Agricultural Ditch	Other Water of the U.S.	20.14
Temporary Agricultural Ditch	Other Water of the U.S.	104.47
Farm/Borrow Pit/Blowout Pond	Other Water of the U.S.	8.69
Total Other Waters of the U.S.		1,646.88
Total Waters of the U.S.		1,871.90

[1] Acreages based on habitat mapping and classification performed by DWR.

- Agencies must request information from USFWS on the existence in a project area of listed plant species or species proposed for listing.
- Following receipt of the USFWS response to this request, agencies generally prepare a BA to determine whether any listed species or species proposed for listing are likely to be affected by a proposed action.
- Agencies must initiate formal consultation with USFWS if the proposed action might adversely affect listed species.
- USFWS must prepare a BO to determine whether the action would jeopardize the continued existence of listed species or adversely modify their critical habitat.
- If a finding of jeopardy or adverse modifications to critical habitat is made in the BO, USFWS must recommend reasonable and prudent alternatives that would avoid jeopardy, and the federal agency must modify the project to ensure that listed species are not jeopardized and that their critical habitat is not adversely modified (unless an exemption from this requirement is granted).

In the preparation of the Project EIR, the MSCS approach was used and an ASIP, serving as the equivalent to the CALFED Programmatic Project BA, has been prepared in compliance with Section 7 of the ESA.

Clean Water Act Section 404(b)(1) Guidelines and Section 401

Section 404

Section 404 of the CWA requires that a permit be obtained from the USACE for the discharge of dredged or fill material into “waters of the United States, including wetlands.” Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. Wetlands are defined for regulatory purposes, at 33 CFR 328.3 and 40 CFR 230.3, as areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

CWA Section 404(b) requires that the USACE issue permits in compliance with guidelines developed by EPA. These guidelines require that there be a demonstration that no alternative is available to meet the project purpose and need that does not result in a discharge of fill into waters. Once this first test has been satisfied, the project that is permitted must be the least environmentally damaging practical alternative before the USACE may issue a permit for the proposed activity.

Actions typically subject to Section 404 requirements are those that would take place in wetlands or stream channels that convey natural runoff, including intermittent streams, even if they have been realigned. Artificial channels that convey only irrigation water usually are not included, unless they connect directly to jurisdictional waters of the United States. In stream channels, a permit under Section 404 would be needed for any discharge activity below the ordinary high-water mark, which is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, or the presence of litter or debris.

The Programmatic ROD for the CALFED Final Programmatic EIS/EIR includes a CWA Section 404 MOU signed by Reclamation, EPA, the USACE, and DWR. Under the terms of the MOU, when a project proponent applies for a Section 404 individual permit for CALFED projects, the proponent is not required to reexamine program alternatives already analyzed in the Programmatic EIS/EIR. The USACE and EPA will focus on project-level alternatives that are consistent with the Programmatic EIS/EIR when they select the least environmentally damaging practicable alternative at the time of a Section 404 permit decision.

CWA Section 404 jurisdiction encompasses areas regulated under the Rivers and Harbors Act Section 10; the USACE typically combines the permit requirements of Section 10 and Section 404 into one permitting process (see *Section 10* below).

Section 401

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval [such as issuance of a Section 404 permit]) must also comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Board, and applications for water quality certification under CWA Section 401 typically are processed by the RWQCB with local jurisdiction. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States.

For purposes of this project, Reclamation will obtain certification from the Central Valley RWQCB under Section 401 of the CWA.

River and Harbors Appropriation Act of 1899

The River and Harbors Appropriation Act of 1899 addresses activities that involve the construction of dams, bridges, dikes, and other structures across any navigable water. Placing obstructions to navigation outside established federal lines and excavating from or depositing material in such waters require permits from the USACE. In the USACE Sacramento District, navigable waters of the United States in the Project Area that are subject to the requirements of the River and Harbors Appropriation Act are Middle River, San Joaquin River, Old River, and all waterways in the Sacramento–San Joaquin drainage basin affected by tidal action (U.S. Army Corps of Engineers 2003). Sections of the River and Harbors Act applicable to the Project are described below.

Section 9

Section 9 (33 USC 401) prohibits the construction of any dam or dike across any navigable water of the United States in the absence of Congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of the legislature of that state, if the location and plans or any modification thereof are approved by the Chief of Engineers and the Secretary of the Army.

Section 10

Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been recommended and authorized by the Chief of Engineers.

Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (May 24, 1977) requires federal agencies to prepare wetland assessments for proposed actions located in or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands. This section of the EIR/EIS describes impacts on wetlands and mitigation measures for reducing significant impacts.

State Requirements

California Endangered Species Act

CESA requires a state lead agency to consult formally with DFG when a proposed action may affect state-listed endangered or threatened species. The provisions of the ESA and CESA will often be activated simultaneously. The assessment of Project effects on plant species listed under both the ESA and CESA is addressed in USFWS's BOs. However, for those species listed only under CESA, DWR must formally consult with DFG, and DFG must issue a BO separate from USFWS's BO.

California State Wetlands Conservation Policy

The Governor of California issued an executive order on August 23, 1993, that created a California State Wetlands Conservation Policy. This policy is being implemented by an interagency task force that is jointly headed by the State Resources Agency and the California Environmental Protection Agency (Cal-EPA). The policy's three goals are to (Cylinder et al. 1995):

- ensure no overall net loss and a long-term net gain in wetlands acreage and values in a manner that fosters creativity, stewardship, and respect for private property;
- reduce the procedural complexity of state and federal wetland conservation program administration; and
- encourage partnerships that make restoration, landowner incentives, and cooperative planning the primary focus of wetlands conservation.

State Regional Water Quality Control Board

Water Code Section 13260 requires "any person discharging waste, or proposing to discharge waste, in any region that could affect the waters of the state to file a report of discharge (an application for waste discharge requirements)." Under the Porter-Cologne definition, the term *waters of the state* is defined as "any surface water or groundwater, including saline waters, within the boundaries of the state." Although all waters of the United States that are within the borders of California are also waters of the state, the converse is not true (i.e., in California, waters of the United States represent a subset of waters of the state). Thus, California retains authority to regulate discharges of waste into any waters of the state, regardless of whether the USACE has concurrent jurisdiction under Section 404.

Section 1602 of the California Fish and Game Code

DFG regulates work that will substantially affect resources associated with rivers, streams, and lakes in California, pursuant to Fish and Game Code Sections 1600–1607. Any action from a public project that substantially diverts or obstructs the natural flow or changes the bed, channel, or bank of any river, stream, or lake or uses material from a streambed must be previously authorized by DFG in a Lake or Streambed Alteration Agreement under Section 1602 of the Fish and Game Code. This requirement may, in some cases, apply to any work undertaken in the 100-year floodplain of a body of water or its tributaries, including intermittent streams and desert washes. As a general rule, however, it applies to any work done within the annual high-water mark of a wash, stream, or lake that contains or once contained fish and wildlife or that supports or once supported riparian vegetation.

Activities associated with the Project that require Section 1602 authorization and a Streambed Alteration Agreement include the modification and setting back of existing levees and flood conveyance improvements. These actions would result in the alteration of the flow in water bodies and occur within the annual high-water mark of water bodies that contain wildlife and support riparian vegetation.

This EIR will be used as the CEQA review document by DWR as part of a permit application, submitted to DFG for either continued authorization of activities under the existing agreement or for the issuance of a new Streambed Alteration Agreement (California Fish and Game Code 1600 *et seq.*).

Local Requirements

Sacramento County

Sacramento County has identified the value of its native and landmark trees and has adopted measures in its general plan to provide for their preservation. The Tree Ordinance (Chapter 19.04 of the County Code) Section 19.04.030 (6) contains the following definition: "*Landmark tree* means an especially prominent or stately tree on any land in Sacramento County, including privately owned land." Heritage trees are native oak trees that are 19 inches in diameter at breast height (dbh) or more. All native oaks are protected under the Conservation Element of the County of Sacramento General Plan. When development requires removal of native oaks, replacement planting is required pursuant to County policy. The Conservation Element also requires the preservation of landmark trees, as well as non-oak natives, such as California black walnuts and California sycamores, whenever possible. The following Conservation Element policies apply to the Project:

CO-130: Make every effort to protect and preserve non-oak native, excluding cottonwoods, and landmark trees and protect and preserve native oak trees measuring 6 inches in diameter at 4.5 feet above ground in urban and rural areas, excluding parcels zoned exclusively for agriculture.

CO-131: Native trees, other than oaks, that cannot be protected shall be replaced with in-kind species in accordance with established tree planting specifications, the combined diameter of which shall equal the combined diameter of the trees removed. In addition, with respect to oaks, a provision for a comparable on-site area for the propagation of oak trees may substitute for replacement tree planting requirements at the discretion of the County Tree Coordinator when removal of a mature oak tree is necessary in accordance with consistent policy.

CO-132: If the project site is not capable of supporting all the required replacement trees, a sum equivalent to the replacement cost of the number of trees that cannot be accommodated shall be paid to the County's Tree Preservation Fund. The replacement cost of the trees shall be established in accordance with the Council of Tree and Landscape Appraiser's standards for appraising trees.

Significance Criteria

The criteria for determining significant impacts on vegetation and wetlands were developed based on the State CEQA Guidelines and significance criteria established in the CALFED Programmatic EIS/EIR (CALFED Bay-Delta Program 2000b). Under CEQA, impacts are considered significant when project actions, viewed with past, current, and reasonably foreseeable future projects, potentially reduce the extent of the assessed vegetation communities and plant species (Public Resources Code section 21083; Guidelines section 15065). Significant impacts may occur through:

- temporary or permanent removal, filling, grading, or disturbance of waters of the United States, including wetlands and jurisdictional and nonjurisdictional woody riparian vegetation;
- temporary or permanent loss of occupied special-status species habitat or indirect or direct mortality of special-status species;
- a reduction in the area or geographic range of rare natural communities and significant natural areas;
- a conflict with the provisions of the MSCS (CALFED Bay-Delta Program 2000); or
- spreading or introducing new noxious weed species into the Project area.

Impacts and Mitigation of the Project Components

This section will identify impacts on vegetation and wetlands and recommended mitigation measures, by alternative.

One of the following CEQA conclusions will be determined for each impact:

- less than significant;
- significant;
- significant and unavoidable; or
- beneficial.

Significant and unavoidable impacts will have mitigation identified to reduce the magnitude of the impact. Impact conclusions will reference the significance criteria threshold used to determine each impact conclusion. The analysis will address direct and indirect effects.

Proposed mitigation measures will be consistent with the CALFED Programmatic EIS/EIR mitigation strategies for vegetation and wetlands resources.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of Project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of CALFED.

The discussion of significant impacts and mitigation measures in this section will include a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the project. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to the Project resource area are listed below; therefore, numbering may appear out of sequence. Some of these programmatic mitigation measures have already been incorporated into Project design, and others have been used in developing the mitigation measures presented in the impact analysis.

1. Avoid direct or indirect disturbance to wetland and riparian communities, special-status species habitat, rare natural communities, significant natural areas, and other sensitive habitat.

2. Restore and enhance sufficient in-kind wetland and riparian habitat or rare natural communities and significant natural areas at offsite locations (near Project area) before or at the time that Project impacts are incurred. Replace not only acreage lost, but also habitat value loss.

3. Design program features to permit on-site mitigation or nearby restoration of wetland, riparian habitat, special-status species habitat, rare natural communities, and significant natural areas that have been removed by permanent facilities.

4. Phase the implementation of ERP habitat restoration to offset temporary habitat losses and to restore habitat (including special-status species habitat) before, or at the same time that, Project impacts associated with the ERP are incurred.

5. Restore wetland and riparian communities, special-status species habitat, and wildlife use areas temporarily disturbed by on-site construction activities immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow the natural reestablishment of the affected plant community.

6. Avoid creating wetlands in areas with high concentrations of mercury in sediments and anaerobic conditions.

14. Avoid direct or indirect disturbance to areas occupied by special-status species.

17. Restore and enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been affected by the permanent removal of occupied habitat areas.

19. For species for which relocation or artificial propagation is feasible, establish additional populations of special-status species adversely affected by the Program in suitable habitat areas elsewhere within their historical range.

21. Avoiding direct or indirect disturbances to rare natural communities and significant natural areas.

23. Restoring rare natural communities or significant natural areas at or near affected locations after Program activities are completed.

27. Restore riparian vegetation disturbed by on-site construction activities immediately following construction.

29. Restore habitat temporarily disturbed by on-site construction activities immediately following construction.

30. Restore rare natural communities, significant natural areas, and wildlife use areas temporarily disturbed by on-site construction activities immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow the natural reestablishment of the affected plant community.

Assumptions

The Project would result in temporary and permanent impacts on vegetation and wetland resources in the Project area. Temporary impacts would be those that occur only during the construction period. Permanent impacts would be irreversible changes in land cover types. Tables 4.1-3 and 4.1-4 summarize the impact assumptions, in terms of permanent and temporary construction footprints, for each alternative and each Project component.

In assessing the magnitude of possible impacts, the following Project understandings and assumptions were made regarding construction, Project operations, and maintenance activities.

- The protection of farmland as a result of various Project components (i.e., levee raising, dredging, etc.) is not considered to have a significant effect on vegetation and wetland resources in this analysis and is therefore not discussed further.
- All riparian vegetation down to msl is assumed to be affected by degrading levees regardless of the amount of degradation that will occur.

- All dredged material will be deposited in drying basins on agricultural lands and will not affect sensitive natural communities or wetlands. Agricultural lands are not sensitive vegetation communities so Project effects are considered to be less than significant and therefore not discussed further.
- Project effects on annual grassland land cover types and artificial vegetation community types, including ruderal and landscaping, are considered to be less than significant because they are not sensitive vegetation communities. However, annual grassland and ruderal cover types provide valuable wildlife habitat and are discussed in Chapter 4.3.
- Project effects on Himalayan blackberry and nonnative riparian are considered to be less than significant because they are not sensitive vegetation communities. However, these riparian areas provide valuable wildlife habitat and are discussed in Chapter 4.3.
- Mason’s lilaeopsis, Delta mudwort, Sanford’s arrowhead, rose-mallow, Suisun Marsh aster, Delta tule pea, and bristly sedge occur in the tidal freshwater emergent wetland habitat. Specific Project impacts on special-status plants, and mitigation, are assumed to be similar and will be discussed under one section.
- Initial dredging would occur as an optional part of Project construction, and additional maintenance conveyance dredging for maintenance purposes is expected to be repeated on a roughly 15-year interval, with approximately 20% of the channel area dredged per episode. It is assumed that dredging of the channels would affect only the channel bottom and would not affect intertidal vegetation.
- The effects of channel dredging would vary depending on the method used. For the purpose of this analysis it is assumed that one of the following methods would be used: hydraulic, clamshell, or dragline.
    - Hydraulic dredging would have no effect on riparian vegetation because it is assumed that all dredging operations would occur from the water and that the placement of conveyance pipes, settling basins, and dredging spoils would be placed outside of the dripline of riparian vegetation that would be fenced before implementation of dredging activities.
    - Clamshell dredging could require the removal of dense stands of riparian vegetation to allow for vertical and swing clearance of the excavator. For the purpose of this impact assessment it is assumed that all riparian vegetation on North Fork Mokelumne River would be removed and that riparian vegetation on the South Fork Mokelumne River could be avoided. It is assumed that all riparian vegetation removed would not be restored in order to facilitate future dredging operations.
    - Dragline dredging would require the removal of riparian vegetation to allow equipment access. For the purpose of this impact assessment it is assumed that all riparian vegetation in the channel dredging area would be removed. It is assumed that not all riparian vegetation removed would be restored in order to facilitate future dredging operations.

- Before construction begins, DWR would obtain all necessary permits pertaining to affected waters of the United States. Grading or other construction activities in all habitats on the waterside of levees would require a Streambed Alteration Agreement from DFG. Discharge of dredged or fill materials into waters of the United States, including that associated with gate construction and placement of siphon extensions, would require a CWA Section 404 permit from USACE and Section 401 certification from the RWQCB. Grading would require a CWA Section 402 permit and preparation of SWPPP. Because the Project area includes navigable waterways, work within the channels is also subject to USACE jurisdiction under the Rivers and Harbors Act of 1899. The permitting process would also require compensation for construction, initial dredging, and maintenance dredging impacts.
- Irrigation and drainage pumps that are being used for agricultural purposes will be selectively decommissioned or reused to facilitate habitat development. This is not considered to have a significant effect on vegetation and wetland resources in this analysis and is therefore not discussed further.
- Boating will be allowed as an optional component on southeastern McCormack-Williamson Tract. Speeds will be kept to less than 5 miles per hour, consistent with the surrounding Delta Meadows property, and no construction will be required. This is not considered to have a significant effect on wetland resources in this analysis and is therefore not discussed further.

To assist in evaluating project effects, anticipated land cover types and impacts are shown in Figures 4.1-2 through 4.1-15 (at the end of this section).

Alternative NP: No Project

Under the No Project Alternative, if the Project were not implemented, the Project components described under the alternatives in Chapter 2 would not be constructed. It is expected that farming would continue and cropland would be the dominant cover type consistent with the existing condition.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir

- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Refer to Tables VEG-1 and VEG-2 in Attachment 4.1-1 for detailed impact acreages.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss of riparian land cover types (Tables VEG-1 and VEG-2 in Attachment 4.1-1). These actions would result in the permanent and temporary loss of 166.07 acres of valley/foothill riparian land cover types.

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations would include the inundation of riparian vegetation on the interior levees of McCormack-Williamson Tract.

However, as one of the Project components of this alternative, riparian land cover types will be created on McCormack-Williamson Tract and Grizzly Slough Property. This will result in a net increase in these sensitive natural communities in the Project Area.

The permanent impacts on 152.59 acres and the temporary impacts on 13.46 acres of foothill/woodland riparian cover type as a result of construction activities and Project operations are considered significant. The loss of 166.07

acres of woody riparian cover types as a result of Project activities would be considered a significant impact because it would result in the loss of woody riparian vegetation and the reduction of the extent of riparian communities, fragmenting existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Compensation will include restoring or enhancing in-kind riparian habitat at a ratio of 2–5 acres for each acre affected. This mitigation is consistent with the MSCS Conservation Measure to "restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts are incurred before implementing actions that could result in the loss or degradation of habitat" (CALFED Bay-Delta Program 2000e). As much of the mitigation habitat as possible will be created on site or near the Project area. This mitigation is consistent with the following MCSC Conservation Measure (CALFED Bay-Delta Program 2000e):

> To the extent practicable, include Project design features that allow for onsite reestablishment and long-term maintenance of riparian vegetation following Project construction.

Restoration of the riparian communities would be done immediately following construction activities by controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow the natural reestablishment of the affected plant community. Flooding events would import propagules such as willows, cottonwoods, and perennial herbs that would naturally colonize frequently flooded portions of the site.

In addition to the requirements of the MSCS Conservation Measures, DWR will prepare a revegetation plan and monitor the restoration or enhancement mitigation sites. The revegetation plan will be prepared by a qualified restoration ecologist and reviewed by the appropriate agencies. The revegetation plan will specify the planting stock appropriate for each riparian land cover type and each mitigation site, ensuring the use of genetic stock from the North Delta area. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan. Planting will be maintained for a minimum of 5 years, including weed removal, irrigation, and herbivory protection.

DWR will monitor the plantings annually for 4 years, followed by monitoring in years 8 and 10 following initial mitigation implementation, to ensure they have established successfully. DWR will submit annual monitoring reports of survival for the first 4 years to the regulatory agencies issuing permits related to habitat impacts—DFG, USACE, and USFWS. Replanting will be necessary if success criteria are not being met. The riparian habitat mitigation will be considered successful when the number of sapling trees established meet the success criteria, the habitat no longer requires active management, and vegetation is arranged in groups that, when mature, replicate the area, natural structure, and species composition of similar riparian habitats in the region.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, 5, 23, 27, 29, and 30.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

DWR will include the following measures to minimize indirect impacts on sensitive natural communities, including riparian habitats, waters of the United States, and special-status plants:

1. DWR will provide an on-site biologist/environmental monitor who will be responsible for monitoring implementation of the conditions in the state and federal permits (CWA Section 401, 402, and 404; ESA Section 7; Fish and Game Code Section 1601; Project plans (SWPPP); and EIS/EIR mitigation measures).
2. The on-site biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to construction sites and channel dredge areas based on mapping of existing land cover types and special-status plant species, unless observed field conditions warrant a modification of the environmentally sensitive area boundaries. To avoid construction-phase disturbance of sensitive habitats immediately adjacent to the Project site, the monitor will identify the boundaries and add a 50-foot buffer where feasible with orange construction barrier fencing. The fencing will be mapped on the Project construction drawings. Erosion control fencing will also be placed at the edges of construction where the construction activities are upslope of wetlands and channels to prevent washing of sediments from the construction site into surrounding environmentally sensitive areas. The environmentally sensitive–area and erosion-control fencing will be installed before any construction activities are initiated, and it will be maintained throughout the construction period.
3. DWR will provide a worker environmental training program for all construction personnel before the start of construction activities. The program will educate workers about special-status species, riparian habitats, and waters of the United States present on and adjacent to the site, and the regulations and penalties for unmitigated effects on these sensitive biological resources.
4. Where feasible, construction will avoid and minimize trimming or complete removal of vegetation.
5. Following construction, the construction contractor will remove all litter and construction debris and implement a revegetation plan for temporarily disturbed vegetation in the construction zones. The elements that should be

included in the revegetation of these sites are described in Mitigation Measures VEG-1, VEG-3, VEG-5, VEG-8, and VEG-9. This mitigation measure is consistent with CALFED Mitigation Measures 1, 3, 5, 14, 21, 29, 30.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss of nontidal freshwater emergent wetland land cover types. These actions would result in the permanent and temporary loss of 51.68 acres of nontidal freshwater emergent wetland, including 4.84 acres of perennial freshwater emergent wetland and 46.84 acres of seasonal wetlands (Tables VEG-1 and VEG-2 in Attachment 4.1-1). Impacts on nontidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the filling of nontidal wetland on McCormack-Williamson Tract, the cutting of wetland vegetation or disruption of the root zone as a result of ground-disturbing activities, and the inundation of nontidal wetlands.

The permanent impact on 51.6 acres and the temporary impacts on 0.08 acre of nontidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of up to 51.68 acres of nontidal freshwater emergent wetland vegetation as a result of Project construction and operations is considered a significant impact because it would result in the reduction of the extent of nontidal freshwater emergent wetland communities, which are a sensitive natural communities.

Determination of Significance: Significant

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.
Compensation will include restoring or enhancing in-kind wetland habitat at a ratio of 2–5 acres for each acre affected. This mitigation is consistent with the MSCS Conservation Measure to "restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts are incurred before implementing actions that could result in the loss or degradation of habitat" (CALFED Bay-Delta Program 2000e). As much of the mitigation habitat as possible will be created on site or near the Project area. This mitigation is consistent with the following MCSC Conservation Measure (CALFED Bay-Delta Program 2000e):

> To the extent practicable, include Project design features that allow for onsite reestablishment and long-term maintenance of natural seasonal wetland

vegetation (includes nontidal emergent wetland cover types) following Project construction.

Restoration of the wetland communities would be done immediately following construction activities by controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow the natural reestablishment of the affected plant community. Flooding events would import propagules that would naturally colonize frequently flooded portions of the site.

In addition to the requirements of the MSCS Conservation Measures, DWR will prepare a revegetation plan and monitor the restoration or enhancement mitigation sites. The revegetation plan will be prepared by a qualified restoration ecologist and reviewed by the appropriate agencies. The revegetation plan will specify the planting stock appropriate for each nontidal freshwater emergent wetland land cover type and each mitigation site, ensuring the use of genetic stock from the North Delta area. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan. Planting will be maintained for a minimum of 5 years, including weed removal and herbivory protection.

DWR will monitor the plantings annually for 4 years, followed by monitoring in years 8 and 10 after initial mitigation implementation, to ensure they have established successfully. For the first 4 years, DWR will submit annual monitoring reports of survival to the regulatory agencies issuing permits related to habitat impacts—DFG, USACE, and USFWS. Replanting will be necessary if success criteria are not being met. The nontidal freshwater emergent wetland habitat mitigation will be considered successful when the number of emergent wetland species established meet the success criteria, the habitat no longer requires active management, and vegetation is arranged in groups that, when mature, replicate the area, natural structure, and species composition of similar nontidal freshwater emergent wetland habitats in the region.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, 5, 23, 29, and 30.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss of tidal perennial aquatic land cover types, which include deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. These actions would result in the permanent and temporary loss of 278.07 acres of tidal perennial aquatic land cover types (Tables VEG-1 and VEG-2 in Attachment 4.1-1). Impacts on tidal perennial aquatic habitat resulting from implementation of Project components and dredging may include the removal or filling of tidal perennial aquatic habitat.

However, as one of the Project components of this alternative, tidal perennial aquatic land cover types will be created on McCormack-Williamson Tract.

Tidal perennial aquatic habitat is waters of the United States and is regulated by the USACE under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

The permanent impacts on 3.85 acres and the temporary impacts on 274.22 acres of tidal perennial aquatic land cover type as a result of construction are considered significant. The loss of up to 278.07 acres of tidal perennial aquatic habitat as a result of Project construction, Project operations, and dredging would be considered a significant impact because it would result in the reduction of the extent of tidal perennial aquatic habitat.

Determination of Significance: Significant

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Compensation will include restoring or enhancing in-kind tidal perennial aquatic habitat at a ratio of 2–5 acres for each acre affected. This mitigation is consistent with the MSCS Conservation Measure to "restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts on habitat are incurred" (CALFED Bay-Delta Program 2000e). As much of the mitigation habitat as possible will be created on site or near the Project area.

Restoration of the tidal perennial aquatic habitats will be done immediately following construction activities.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, 5, and 29.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Type.

Implementation of Project components, Project operations, and dredging associated with Alternative 1-A would result in the loss of tidal freshwater emergent wetland land cover types. These actions would result in the permanent and temporary loss of 11.08 acres of tidal wetlands (Tables VEG-1 and VEG-2 in Attachment 4.1-1). Impacts on tidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat.

However, as one of the Project components of this alternative, tidal freshwater emergent wetland land cover types will be created on McCormack-Williamson Tract and Grizzly Slough Property. This will result in a net increase of this land cover type in the Project area.

The permanent impacts on 11.08 acres of tidal freshwater emergent wetland land cover type as a result of construction and dredging are considered significant. The loss of up to 11.08 acres of tidal freshwater emergent wetland vegetation as a result of channel dredging would be considered a significant impact because it would result in the reduction of the extent of tidal freshwater emergent wetland communities, which would also result in the loss of suitable habitat for Suisun Marsh aster, Delta tule pea, rose-mallow, Mason's lilaeopsis, bristly sedge, and Delta mudwort.

Determination of Significance: Significant

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Compensation will include restoring or enhancing in-kind wetland habitat at a ratio of 2–5 acres for each acre affected. This mitigation is consistent with the MSCS Conservation Measure to "restore or enhance 2 to 5 acres of additional in-kind habitat for every acre of affected habitat near where impacts are incurred before implementing actions that could result in the loss or degradation of habitat" (CALFED Bay-Delta Program 2000e). As much of the mitigation habitat as possible will be created on site or near the Project area. This mitigation is consistent with the following MCSC Conservation Measure (CALFED Bay-Delta Program 2000e):

> To the extent practicable, include Project design features that allow for onsite reestablishment and long-term maintenance of tidal freshwater emergent wetland vegetation following Project construction.

Restoration of the wetland communities will be done immediately following construction activities by controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow the natural reestablishment of the affected plant community. Flooding events would import propagules that would naturally colonize frequently flooded portions of the site.

In addition to the requirements of the MSCS Conservation Measures, DWR will prepare a revegetation plan and monitor the restoration or enhancement mitigation sites. The revegetation plan will be prepared by a qualified restoration ecologist and reviewed by the appropriate agencies. The revegetation plan will specify the planting stock appropriate for each tidal freshwater emergent wetland

land cover type and each mitigation site, ensuring the use of genetic stock from the North Delta area. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan. Planting will be maintained for a minimum of 5 years, including weed removal and herbivory protection.

DWR will monitor the plantings annually for 4 years, followed by monitoring in years 8 and 10 following initial mitigation implementation, to ensure they have established successfully. For the first 4 years, DWR will submit annual monitoring reports of survival to the regulatory agencies issuing permits related to habitat impacts—DFG, USACE, and USFWS. Replanting will be necessary if success criteria are not being met. The tidal freshwater emergent wetland habitat mitigation will be considered successful when the number of emergent wetland species established meet the success criteria, the habitat no longer requires active management, and vegetation is arranged in groups that, when mature, replicate the area, natural structure, and species composition of similar tidal freshwater emergent wetland habitats in the region.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, 5, 23, 29, and 30.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Virtually all Project activities and natural processes have the potential to introduce nonnative invasive plants to the Project area. Construction and operational activities could result in the introduction or spread of noxious weed species, which could displace native species, thereby changing the diversity of species or number of any species of plants. Soil-disturbing activities during construction could promote the introduction of plant species that are not currently found in the Project area, including exotic pest plant species. Construction activities could also spread exotic pest plants that already occur in the Project. One noxious weed, giant reed, has been documented in the Project area. Introduction or spread of noxious weeds in the Project area would be considered a significant impact because it would result in degradation of special-status plant habitat and riparian communities.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.
DWR will include the following measures in the Project construction conditions to minimize the potential for the introduction of new noxious weeds and the spread of weeds previously documented in the Project area:

- Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weed infestations.
- Treat isolated infestations of giant reed or other noxious weeds identified in the Project area with approved eradication methods at an appropriate time to prevent further formation of seed and destroy viable plant parts and seed.
- Minimize surface disturbance to the greatest extent possible.
- Seed all disturbed areas with certified weed-free native and nonnative mixes, as provided in the revegetation plan developed in cooperation with DFG. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.
- Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing.
- Restore or enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been adversely affected by the permanent removal of occupied habitat areas.

This mitigation measure is consistent with CALFED Programmatic Mitigation Strategy 5.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Delta mudwort, Mason's lilaeopsis, Sanford's arrowhead, rose-mallow, Delta tule pea, Suisun Marsh aster, and bristly sedge all use similar habitats. These species have been observed in intertidal areas within mudflats in the tidal freshwater emergent marsh habitat cover type throughout the Project site. Implementation of Project components, Project operations, and dredging associated with Alternative 1-A would directly or indirectly affect these special-status species.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-Status Plants.
Within 1 year before initiating construction or channel dredging, DWR will conduct special-status-plant surveys of all proposed areas of disturbance. The purpose of these surveys will be to verify that the locations of special-status plants in the 2004 surveys are extant, identify any new special-status plant occurrences, cover any portions of the Project area not previously identified, and

map tidal mud flat habitat in the Project area, including the construction footprints and dredging areas. The survey also will evaluate the habitat quality based on surrounding habitats (e.g., adjacent levee banks with RSP based on surrounding habitats (e.g., adjacent levee banks with RSP would lower the habitat quality, adjacent riparian vegetation would increase habitat quality). The extent of both habitat occupied by special-status plant species and unoccupied tidal mud flat habitat will be quantified for use in determining the amount of habitat mitigation required under Mitigation Measure VEG-5.

This mitigation is consistent with the MSCS Conservation Measure stating (CALFED Bay-Delta Program 2000e):

> before implementing actions that could result in take or the loss or degradation of occupied habitat, conduct surveys in suitable habitat within portions of the species' range that CALFED actions could affect to determine the presence and distribution of the species.

The extent of mitigation of direct loss of or indirect impacts on special-status plants will be based on these survey results. Locations of special-status plants in proposed construction areas will be recorded using a GPS unit and flagged.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss. Any stands of special-status plants found during preconstruction surveys that can be avoided in the construction area will be fenced, including a buffer of 50 feet on all sides. If the special-status plants cannot be avoided, DWR will salvage the plants before the onset of the activities. Salvaged plants will be transplanted immediately to an area of suitable habitat.

DWR will initiate mitigation of unavoidable loss of any special-status plants before construction and will base the compensation on the survey results obtained from the preconstruction surveys. The MSCS conservation measure for habitat compensation states, "for each linear foot of occupied habitat lost, create 5 to 10 linear feet of suitable habitat, of equal or higher habitat quality, within 1 year of loss" (CALFED Bay-Delta Program 2000e). Compensation for loss of special-status plants as a result of construction for the Project, therefore, will include creation of new tidal mud flat habitat at a ratio of 5–10 linear feet for each linear foot removed by the Project. The quality of the removed occupied habitat will be evaluated during the preconstruction survey required under Mitigation Measure VEG-7. Low-quality mud flat habitat at the base of levee banks with RSP, for example, would be mitigated at a ratio of 5:1 (5 linear feet created for each linear foot removed), while high-quality mud flat habitat adjacent to emergent wetland and/or riparian vegetation would be mitigated at or near the 10:1 (10 linear feet created for each linear foot removed) mitigation ratio. DWR will identify suitable habitat creation sites that are located as close to the site of plant removal as possible; are areas with minimal boat wakes, shallow water, and slow water velocities; and are not likely to be dredged or have other improvements constructed.

Created habitat will have a suitable mud flat substrate at appropriate elevations (approximately 0.5–2 feet NGVD) with minimal disturbance from boat wakes, channel dredging, and levee maintenance. DWR will obtain mitigation site access through a conservation easement or fee title. To the extent practicable, mitigation sites will be located near ongoing or future ERP Projects. If off-site mitigation sites are identified, mitigation will be implemented before the loss of occupied habitat, and salvaged plant material will be planted at the mitigation site. If on-site mitigation sites will be used, salvaged plant material will be stockpiled or propagated at a native plant nursery for planting later, and mitigation will be implemented as soon as practicable after completion of construction or dredging activities.

If off-site mitigation is necessary, a location that does not currently support tidal flats will be selected. If water is too deep at a potential mitigation site, dredged material could be used to construct a bench area as substrate for the tidal mud flat habitat. Prior to use, however, such material will be analyzed for the presence of contaminants such as heavy metals. Excessively high levels of contaminants may prohibit the use of dredged materials for bench construction. This mitigation approach is also likely to require additional permitting under Sections 401 and 404 of the CWA for placement of fill in waters of the United States. (Satisfies CALFED Programmatic Mitigation Measure 6.)

As experimental compensation in additional to the MSCS measure, DWR will prepare a transplanting plan for the special-status plants. As these special-status plants have habitat requirements similar to those described for Mason’s lilaeopsis (Golden and Fiedler 1991; Zebell and Fielder 1996), the methods outlined in the monitoring plan for transplanting Mason’s lilaeopsis in Barker Slough (California Department of Water Resources 1990b) will be adapted to the special-status plants.

The plan will include a success criterion for the transplanted plants to achieve 80% survival at the end of a 5-year monitoring period and additional compensatory measures to implement if the survival rate is not achieved.

All unavoidable stands of special-status plants to be removed from the construction area will be salvaged and transplanted to a portion of the created suitable habitat. Areas of occupied habitat will also be considered for enhancement, if transplanting is possible without disturbance of the existing special-status plants. DWR will obtain site access through a conservation easement or fee title.

DWR will maintain the transplant areas for a minimum of 5 years, including replanting, removing trash or debris washed onshore, and removing nonnative species, if possible, without disturbing the special-status plants.

DWR will monitor the transplanted plants for at least 10 years after transplanting, at 5-year intervals. Monitoring will include measurement of cover of the transplanted plants using large-sized quadrants or, preferably, a transect method. For each monitoring period, DWR and Reclamation will submit a report to DFG describing the results of the monitoring period. The reports will include the monitoring data and a discussion of any problems with the plants and the measures implemented or proposed to correct the problems. The reports will also indicate the annual precipitation and note the occurrence of drought conditions or above-normal flooding events. This information will assist in evaluating whether the transplanted plants have been able to tolerate more than just normal precipitation years. If the monitoring period has coincided with an extended period of drought or high precipitation, DFG may request additional monitoring to measure the response of transplants to a greater range of natural processes.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 14, 17, and 19.

Significance after Mitigation: Less than significant.

Impact VEG-7: Loss or Disturbance of Perennial Grassland.

Implementation of Project components such as channel dredging activities would result in the temporary loss of 0.92 acre of perennial grassland (Tables VEG-1 and VEG-2 in Attachment 4.1-1). Temporary impacts on perennial grasslands resulting from channel dredging may include the mowing or the crushing of perennial grasslands.

For the purpose of this analysis, it is assumed that the hydraulic, clamshell, and dragline dredging methods would have the same effect on perennial grassland.

The temporary impacts on 0.92 acre of perennial grassland would be considered significant because it would affect the extent of this sensitive habitat.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-9: Replace Perennial Grassland.
Compensation will include restoring or enhancing in-kind perennial grassland habitat at a ratio of 1-3 acres for each acre affected. This mitigation is consistent with the MSCS Conservation Measure which states, "before implementing actions that could result in the loss or degradation of habitats occupied by the evaluated species, restore or enhance 1 to 3 acres of grassland within the current range of affected species, and near where impacts would occur" (CALFED Bay-Delta Program 2000e).

Restoration of the perennial grassland community will be done immediately following construction activities by controlling nonnative plants to improve conditions for reestablishing native plants.

In addition to the requirements of the MSCS Conservation Measures, DWR will prepare a revegetation plan and monitor the restoration or enhancement mitigation sites. The revegetation plan will be prepared by a qualified restoration ecologist and reviewed by the appropriate agencies. The revegetation plan will specify the planting stock appropriate for the perennial grassland community and each mitigation site, ensuring the use of genetic stock from the North Delta area. The plan will employ the most successful techniques available at the time of planting. Success criteria will be established as part of the plan. Planting will be maintained for a minimum of 5 years, including weed removal and herbivory protection.

DWR will monitor the plantings annually for 4 years, followed by monitoring in years 8 and 10 following initial mitigation implementation, to ensure they have established successfully. For the first 4 years, DWR will submit annual monitoring reports of survival to the regulatory agencies issuing permits related to habitat impacts—DFG, USACE, and USFWS. Replanting will be necessary if success criteria are not being met. The perennial grassland habitat mitigation will be considered successful when the species established meet the success criteria, the habitat no longer requires active management, and vegetation is arranged in groups that, when mature, replicate the area, natural structure, and species composition of similar perennial grassland habitats in the region.

Specific mitigation funding sources are not identified at this time, but funding will be required and could include contributions from Proposition 13 (Safe Drinking Water, Clean Water, Watershed Protection, and Flood Protection Act 2000), Proposition 204 (SB 900) (Safe, Clean, Reliable Water Supply Act 1996), and/or water contractor contributions.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, 5, and 30.

Significance after Mitigation: Less than significant.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows

- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Refer to Tables VEG-3 and VEG-4 in Attachment 4.1-1 for detailed impact acreages for Alternative 1-B.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of riparian land cover types. These actions would result in the permanent and temporary loss of 166.56 acres of valley/foothill riparian land cover types (Tables VEG-3 and VEG-4 in Attachment 4.1-1).

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations will include the inundation of riparian vegetation on the interior levees of McCormack-Williamson Tract.

However, as one of the Project components of this alternative, riparian land cover types will be created on McCormack-Williamson Tract and Grizzly Slough Property. This will result in a net increase in these sensitive natural communities in the Project Area.

The permanent impacts on 152.34 acres and the temporary impacts on 14.22 acres of foothill/woodland riparian cover type as a result of construction activities and Project operations are considered significant. The loss of 166.56 acres of woody riparian cover types as a result of Project construction would be considered a significant impact because it would reduce the extent of riparian communities, resulting in the fragmentation of existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Impacts of Project components and Project operations associated with Alternative 1-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of tidal perennial aquatic land cover types, which includes deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. These actions would result in the permanent and temporary loss of 278.13 acres of tidal perennial aquatic land cover types (Tables VEG-3 and VEG-4 in Attachment 4.1-1). Impacts on tidal perennial aquatic habitat resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on McCormack-Williamson Tract and Dead Horse Island.

Tidal perennial aquatic habitat is waters of the United States and is regulated by the USACE under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

The permanent impacts on 3.85 acres and the temporary impacts on 274.28 acres of tidal perennial aquatic land cover type as a result of construction are considered significant. The loss of up to 278.13 acres of tidal perennial aquatic habitat as a result of Project construction and operations would be considered a significant impact.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Types.

Impacts of Project components and Project operations associated with Alternative 1-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Impacts of Project components and Project operations associated with Alternative 1-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Impacts of Project components and Project operations associated with Alternative 1-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-status Plants.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.

Significance after Mitigation: Less than significant.

Impact VEG-7: Loss or Disturbance of Perennial Grassland.

Implementation of Project components and Project operations associated with Alternative 1-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-9: Replace Perennial Grassland.

Significance after Mitigation: Less than significant.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Refer to Tables VEG-5 and VEG-6 in Attachment 4.1-1 for detailed impact acreages for Alternative 1-C.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-C would result in the loss of riparian land cover types. These actions would result in the permanent and temporary loss of 166.53 acres of valley/foothill riparian land cover types (Tables VEG-5 and VEG-6 in Attachment 4.1-1).

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations will include the inundation of riparian vegetation on the interior levees of McCormack-Williamson Tract.

However, as one of the Project components of this alternative, riparian land cover types will be created on McCormack-Williamson Tract and Grizzly Slough Property. This will result in a net increase in these sensitive natural communities in the Project Area.

The permanent impacts on 152.39 acres and the temporary impacts on 14.14 acres of foothill/woodland riparian cover type as a result of construction activities and Project operations are considered significant. The loss of 166.53 acres of woody riparian cover types as a result of Project construction would be considered a significant impact because it would reduce the extent of riparian communities, resulting in the fragmentation of existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Impacts of Project components and Project operations associated with Alternative 1-C would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 1-C would result in the loss of tidal perennial aquatic land cover types, which include deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. These actions would result in the permanent and temporary loss of 278.22 acres of tidal perennial aquatic land cover types (Tables VEG-5 and VEG-6 in Attachment 4.1-1). Impacts on tidal perennial aquatic habitat resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on McCormack-Williamson Tract and Dead Horse Island.

Tidal perennial aquatic habitat is water of the United States and is regulated by the USACE under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

The permanent impacts on 3.85 acres and the temporary impacts on 274.37 acres of tidal perennial aquatic land cover type as a result of construction are considered significant. The loss of up to 278.22 acres of tidal perennial aquatic habitat as a result of Project construction and operations would be considered a significant impact.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Types.

Impacts of Project components and Project operations associated with Alternative 1-C would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Implementation of Project components and Project operations associated with Alternative 1-C would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Impacts of Project components and Project operations associated with Alternative 1-C would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-Status Plants.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.

Significance after Mitigation: Less than significant.

Impact VEG-7: Loss or Disturbance of Perennial Grassland.

Impacts of Project components and Project operations associated with Alternative 1-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-9: Replace Perennial Grassland.

Significance after Mitigation: Less than significant.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Refer to Tables VEG-7 and VEG-8 in Attachment 4.1-1 for detailed impact acreages for Alternative 2-A.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss of valley/foothill riparian land cover types. These actions would result in the permanent and temporary loss of up to

21.41 acres of valley/foothill woodland habitat (Tables VEG-7 and VEG-8 in Attachment 4.1-1).

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations would include the inundation of riparian vegetation on the interior levees of Staten Island and vegetation removal as part of the maintenance of the weirs, roads, and levees.

However, as one of the Project components of this alternative, riparian land cover types will be created on McCormack-Williamson Tract and Grizzly Slough Property. This will result in a net increase in these sensitive natural communities in the Project area.

The permanent impacts on 20.81 acres and the temporary impacts on 0.59 acres of valley/foothill riparian cover types as a result of construction activities and Project operations are considered significant. The loss of 21.41 acres of woody riparian cover types as a result of Project construction would be considered a significant impact because it would reduce the extent of riparian communities, resulting in the fragmentation of existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss of nontidal freshwater emergent wetland land cover types. These actions would result in the permanent and temporary loss of 8.08 acres of nontidal freshwater emergent wetland, including the loss of 1.20 acres of perennial freshwater emergent wetland and 6.88 acres of seasonal wetlands (Tables VEG-7 and VEG-8 in Attachment 4.1-1). Impacts on nontidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the filling of nontidal wetland on Staten Island, the cutting of wetland vegetation or disruption of the root zone as a result of ground-disturbing activities, and the inundation of nontidal wetlands.

The permanent impacts on 2.11 acres and the temporary impacts on 5.97 acres of nontidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of up to 8.08 acres of nontidal freshwater emergent wetland vegetation as a result of Project construction and operations would be considered a significant impact because it would reduce the extent of nontidal freshwater emergent wetland communities, which are a sensitive natural communities.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss of tidal perennial aquatic land cover types, which include deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. These actions would result in the permanent and temporary loss of 5.63 acres of tidal perennial aquatic land cover types (Tables VEG-7 and VEG-8 in Attachment 4.1-1). Impacts on tidal perennial aquatic habitat resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on Staten Island.

Tidal perennial aquatic habitat is water of the United States and is regulated by the USACE under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

The permanent impacts on 3.58 acres and the temporary impacts on 2.15 acres of tidal perennial aquatic land cover type as a result of construction are considered significant. The loss of up to 5.63 acres of tidal perennial aquatic habitat as a result of Project construction and operations would be considered a significant impact because it would reduce the extent of tidal perennial aquatic habitat.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Type.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss of tidal freshwater emergent wetland land cover types. These actions would result in the permanent and temporary loss of 0.65 acres of tidal wetlands (Tables VEG-7 and VEG-8 in Attachment 4.1-1). Impacts on tidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on Staten Island.

The permanent impacts on 0.37 acre and the temporary impacts on 0.28 acre of tidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of up to 0.65 acre of tidal freshwater emergent wetland vegetation as a result of channel dredging would be considered a significant impact because it would result in the reduction of the extent of tidal freshwater emergent wetland communities, which would also result in the loss of suitable habitat for Suisun Marsh aster, Delta tule pea, rose-mallow, Mason's lilaeopsis, bristly sedge, and Delta mudwort.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Impacts of Project components and Project operations associated with Alternative 2-A would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Delta mudwort, Mason's lilaeopsis, Sanford's arrowhead, rose-mallow, Delta tule pea, Suisun Marsh aster, and bristly sedge all use similar habitats. These species have been observed in intertidal areas within mudflats in the tidal freshwater emergent marsh habitat cover type throughout the Project site. Implementation of Project components and operations associated with Alternative 2-A would directly or indirectly affect these special-status species. The impacts of Project components and Project operations on special-status species would be considered significant impacts.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-Status Plants.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.

Significance after Mitigation: Less than significant.

Impact VEG-7: Loss or Disturbance of Perennial Grassland.

Implementation of Project components would result in the permanent loss of 3.19 acres of perennial grassland (Tables VEG-7 and VEG-8 in Attachment 4.1-1). Permanent impacts on perennial grasslands resulting from Project components may include the burial of perennial grasslands by RSP.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-9: Replace Perennial Grassland.

Significance after Mitigation: Less than significant.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Refer to Tables VEG-9 and VEG-10 in Attachment 4.1-1 for detailed acreages for Alternative 2-B.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of valley/foothill riparian land cover types. These actions would result in the permanent and temporary loss of up to 20.3 acres of valley/foothill riparian cover type (Tables VEG-9 and VEG-10 in Attachment 4.1-1).

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations would include the inundation of riparian vegetation on the interior levees of Staten Island and vegetation removal as part of the maintenance of the weirs, roads, and levees.

The permanent impacts on 19.71 acres and the temporary impacts on 0.59 acres of valley/foothill riparian cover types as a result of construction activities and Project operations are considered significant. The loss of 20.3 acres of woody riparian cover types as a result of Project construction would be considered a significant impact because it would reduce the extent of riparian communities, which are rare natural communities.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of nontidal freshwater emergent wetland land cover types. These actions would result in the permanent loss of 1.39 acres of nontidal freshwater emergent wetland (Tables VEG-9 and VEG-10 in Attachment 4.1-1). Impacts on nontidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the filling of nontidal wetland on Staten Island, the cutting of wetland vegetation or disruption of the root zone as a result of ground-disturbing activities, and the inundation of nontidal wetlands.

The permanent impacts on 1.39 acres of nontidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of nontidal freshwater emergent wetland vegetation as a result of Project construction and operations would be considered a significant impact because it would reduce the extent of nontidal freshwater emergent wetland communities, which are sensitive natural communities.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of tidal perennial aquatic land cover types, which include deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. These actions would result in the permanent and temporary loss of 11.3 acres of tidal perennial aquatic land cover types (Tables VEG-9 and VEG-10 in Attachment 4.1-1). Impacts on tidal perennial aquatic habitat resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on Staten Island.

Tidal perennial aquatic habitat is water of the United States and is regulated by the USACE under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

The permanent impacts on 3.65 acres and the temporary impacts on 7.65 acres of tidal perennial aquatic land cover type as a result of construction are considered significant. The loss of up to 11.3 acres of tidal perennial aquatic habitat as a result of Project construction and operations would be considered a significant impact because it would reduce the extent of tidal perennial aquatic habitat.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Type

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of tidal freshwater emergent wetland land cover types. These actions would result in the temporary loss of 0.04 acre of tidal wetlands (Tables VEG-9 and VEG-10 in Attachment 4.1-1). Impacts on tidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on Staten Island.

The temporary impacts on 0.04 acre of tidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of tidal freshwater emergent wetland vegetation would be considered a significant impact because it would reduce the extent of tidal freshwater emergent wetland communities, which would also result in the loss of suitable habitat for Suisun Marsh aster, Delta tule pea, rose-mallow, Mason's lilaeopsis, bristly sedge, and Delta mudwort.

Determination of Significance: Significant

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Implementation of Project components and Project operations associated with Alternative 2-B would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Impacts of Project components and Project operations associated with Alternative 2-B would be the same as those described for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-Status Plants.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.

Significance after Mitigation: Less than significant.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Refer to Tables VEG-11 and VEG-12 in Attachment 4.1-1 for detailed acreages for Alternative 2-C.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss of valley/foothill riparian land cover types. These actions would result in the permanent and temporary loss of up to 24.71 acres of valley/foothill habitats (Tables VEG-11 and VEG-12 in Attachment 4.1-1).

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations will include the inundation of riparian vegetation on the interior levees of Staten Island and vegetation removal as part of the maintenance of the weirs, roads, and levees.

However, as one of the Project components of this alternative, riparian land cover types will be created on McCormack-Williamson Tract and Grizzly Slough Property. This will result in a net increase in these sensitive natural communities in the Project Area.

The permanent impacts on 20.14 acres and the temporary impacts on 4.57 acres of valley/foothill riparian cover types as a result of construction activities and Project operations are considered significant. The loss of 24.71 acres of woody riparian cover types as a result of Project construction would be considered a significant impact because it would reduce the extent of riparian communities, resulting in the fragmentation of existing riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Impacts of Project components and Project operations associated with Alternative 2-C would be the same as those described in Alternative 2-A

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss of tidal perennial aquatic land cover types, which include deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. These actions would result in the permanent and temporary loss of 5.5 acres of tidal perennial aquatic land cover types (Tables VEG-11 and VEG-12 in Attachment 4.1-1). Impacts on tidal perennial aquatic habitat resulting from implementation of Project components may include the removal or filling of tidal perennial aquatic habitat on Staten Island.

Tidal perennial aquatic habitat is water of the United States and is regulated by the USACE under Section 404 of the CWA and the Rivers and Harbors Act, and by the RWQCB under Section 401 of the CWA, with oversight by the EPA. This habitat is additionally regulated by DFG under Section 1600 *et seq.* of the California Fish and Game Code. Fish and other aquatic wildlife occupy this habitat.

The permanent impacts on 1.01 acres and the temporary impacts on 4.49 acres of tidal perennial aquatic land cover type as a result of construction are considered significant. The loss of up to 5.5 acres of tidal perennial aquatic habitat as a result of Project construction and operations would be considered a significant impact.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Type

Implementation of Project components associated with Alternative 2-C would result in the temporary loss of tidal freshwater emergent wetland land cover types. These actions would result in the temporary loss of 0.81 acre of tidal wetlands (Tables VEG-11 and VEG-12 in Attachment 4.1-1).

The temporary impacts on 0.81 acres of tidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of tidal freshwater emergent wetland vegetation would be considered a significant impact because it would reduce the extent of tidal freshwater emergent wetland communities, which would also result in the loss of suitable habitat for Suisun Marsh aster, Delta tule pea, rose-mallow, Mason's lilaeopsis, bristly sedge, and Delta mudwort.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Impacts of Project components and Project operations associated with Alternative 2-C would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Impacts of Project components and Project operations associated with Alternative 2-C would be the same as those described for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-Status Plants.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.

Significance after Mitigation: Less than significant.

Impact VEG-7: Loss or Disturbance of Perennial Grassland.

The impacts of Project components and Project operations associated with Alternative 2-C would be the same as those described in Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-9: Replace Perennial Grassland.

Significance after Mitigation: Less than significant.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

Dredging is proposed along the South Fork Mokelumne River, Snodgrass Slough, Dead Horse Cut, and around the New Hope Bridge in combination with a modified setback levee. It is assumed that one of three dredging methods would be used: hydraulic, clamshell, or dragline. Refer to Table VEG-13 in Attachment 4.1-1 for detailed acreages for Alternative 2-D.

Impact VEG-1: Loss or Disturbance of Valley/Foothill Riparian Land Cover Types.

Implementation of Project components and operations associated with Alternative 2-D would result in the loss of riparian land cover types. These actions would result in the permanent and temporary loss of 116.33 acres of valley/foothill riparian land (Table VEG-13 in Attachment 4.1-1).

The permanent impacts on 78.12 acres and the temporary impacts on 38.21 acres of foothill/woodland riparian cover type as a result of Project components and Project operations are considered significant.

Determination of Significance: Significant.

Mitigation Measure VEG-1: Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact VEG-2: Loss or Disturbance of Nontidal Freshwater Emergent Wetland Land Cover Types.

Implementation of Project components and Project operations associated with Alternative 2-D would result in the loss of nontidal freshwater emergent wetland land cover types. These actions would result in the temporary loss of 1.96 acres of nontidal freshwater emergent wetland, including 0.29 acre of perennial freshwater emergent wetland and 1.67 acres of seasonal wetlands (Table VEG-13 in Attachment 4.1-1). Impacts on nontidal freshwater emergent wetland vegetation resulting from implementation of Project components may include the cutting of wetland vegetation or disruption of the root zone as a result of ground-disturbing activities, and the inundation of nontidal wetlands.

The temporary impacts on 1.96 acres of nontidal freshwater emergent wetland land cover type as a result of construction are considered significant. The loss of up to 1.96 acres of nontidal freshwater emergent wetland vegetation as a result of Project construction and operations would be considered a significant impact.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-3: Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact VEG-3: Loss or Disturbance of Tidal Perennial Aquatic Land Cover Types.

Implementation of Project components and operations associated with Alternative 2-D would result in the loss of tidal perennial aquatic land cover type. These actions would result in the permanent and temporary loss of 383.24 acres of tidal perennial aquatic habitat (Table VEG-13 in Attachment 4.1-1). Implementation of dredging activities would result in the loss of tidal perennial aquatic land cover types, which include deepwater aquatic, shallow aquatic, and unvegetated intertidal zone. For the purpose of this analysis, it is assumed that one of the following methods will be used: hydraulic, clamshell, or dragline.

Each of these dredging methods would have the same effect on tidal perennial aquatic habitat because each method would affect the same surface area of open water. Of the three methods, hydraulic dredging would have more localized effects. Clamshell and dragline dredging would result in greater disturbance of the channel bed. No mitigation would be required for the temporary disturbance of tidal perennial aquatic habitat resulting from channel dredging.

The permanent impacts on 16.77 acres and the temporary impacts on 363.05 acres of tidal perennial aquatic land cover type as a result of Project components and Project operations are considered significant. The loss of up to 383.24 acres of tidal perennial aquatic habitat would be considered a significant impact.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-4: Replace Tidal Perennial Aquatic Land Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-4: Loss or Disturbance of Tidal Freshwater Emergent Wetland Land Cover Type.

Implementation of Project components and operations associated with Alternative 2-D would result in the loss of tidal freshwater emergent wetland land cover type. Implementation of dredging activities would result in the permanent loss of 16.40 acres of tidal freshwater emergent marsh habitat (Table VEG-13 in Attachment 4.1-1). For the purpose of this analysis, it is assumed that one of the following methods will be used: hydraulic, clamshell, or dragline.

The permanent impacts on 16.40 acres of tidal freshwater emergent wetland land cover type as a result of channel dredging are considered significant because they would reduce the extent of tidal freshwater emergent wetland communities, which would result in the loss of suitable habitat for Suisun Marsh aster, Delta tule pea, rose-mallow, Mason’s lilaeopsis, bristly sedge, and Delta mudwort.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-5: Replace Tidal Freshwater Emergent Wetland Cover Types.

Significance after Mitigation: Less than significant.

Impact VEG-5: Establishment of Invasive Nonnative Plants.

Impacts of Project components and Project operations associated with Alternative 2-D would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-6: Avoid Introduction and Spread of New Noxious Weeds during Project Construction and Dredging.

Significance after Mitigation: Less than significant.

Impact VEG-6: Loss or Disturbance of Special-Status Species.

Impacts of Project components and Project operations associated with Alternative 2-D would be the same as those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-7: Conduct Preconstruction Surveys for Special-status Plants.

Mitigation Measure VEG-8: Avoid and Minimize Impacts on Special-Status Species and Compensate for Special-Status Species Loss.

Significance after Mitigation: Less than significant.

Impact VEG-7: Loss or Disturbance of Perennial Grassland.

Implementation of Project components and Project operations associated Alternative 2-D would result in the permanent and temporary loss of 4.63 acres of perennial grassland (Table VEG-13 in Attachment 4.1-1).

For the purpose of this analysis, it is assumed that hydraulic, clamshell, and dragline dredging methods would have the same effect on perennial grassland. Impacts on perennial grasslands resulting from channel dredging may include the mowing, crushing, or burial.

The temporary impacts on 1.46 acres and permanent impacts 3.17 acres of perennial grassland would be considered significant because they would affect the extent of this habitat.

Determination of Significance: Significant.

Mitigation Measure VEG-2: Avoid and Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure VEG-9: Replace Perennial Grassland.

Significance after Mitigation: Less than significant.

Attachment 4.1-1

Impacts by Land Cover Type and Anticipated Land Cover Types

Table VEG-1. Permanent Impacts to Land Cover Types Associated with Alternative 1-A–Fluvial Process Optimization

		Construction Related Effects[1]																			
		Permanent Effects																	Operations-Related Effects		
													Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property [6]	Optional Project Components					
Wildlife Habitats	Land Cover Type	Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	0.02	0.40	0.21														0.63			0.63
	Tideflat (mudflat)															3.22		3.22			3.22
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland															11.08		11.08			11.08
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland											2.87	1.39					4.26	0.50		4.76
	Seasonal freshwater emergent wetland														46.84			46.84			46.84
Lacustrine	Farm and borrow pit ponds											8.69						8.69			8.69
	Temporary agricultural ditch (<15 ft wide)	0.01	0.04			0.12	0.13		0.03			0.12						0.45	8.10		8.55
	Permanent agricultural ditch (>15 ft wide)																		2.97		2.97
Valley/foothill riparian	Cottonwood-willow woodland	1.00	0.22											18.95		21.47		41.64			41.64
	Valley oak riparian woodland	0.23					1.06		0.78						60.73	0.06		62.86			62.86
	Himalayan blackberry		2.13			0.16	3.92									0.83		7.04		0.94	7.98
	Riparian scrub	2.09	2.79				4.10		0.08							13.16		22.22	4.37	0.03	26.62
	Mixed riparian woodland															13.49		13.49			13.49

Wildlife Habitats	Land Cover Type	Construction Related Effects[1] – Permanent Effects: Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Excavate and Restore Grizzly Slough Property [6]: Complete Levee Removal	Optional Project Components: Dredging South Fork Mokelumne River[7]	Optional Project Components: Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Operations-Related Effects: Modify Landform and Restore Agricultural Land to Habitat	Operations-Related Effects: Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent and Operations-Related Effects)
	Nonnative Riparian woodland																				
Grassland	Annual grassland	0.17			0.49		0.01							33.28				33.95	0.08		34.03
	Perennial grassland																				
	Ruderal/forb	6.98	6.33	1.53	28.17	0.70	20.45		0.45			13.92						78.53	6.30	7.81	92.64
Upland Cropland	Corn and grain fields	0.01	0.02			14.74	16.95		19.87			0.81	71.81		350.96			475.17	1217.08	0.55	1692.80
Developed	Developed				0.60	0.01	1.49											2.10	6.19		8.29
Ornamental Plantings	Ornamental plantings				0.49													0.49			0.49
	Totals	**10.51**	**11.93**	**1.74**	**29.75**	**15.73**	**48.11**	**0**	**21.21**	**0**	**0**	**26.41**	**73.20**	**52.23**	**458.53**	**63.31**	**0**	**812.66**	**1,245.59**	**9.33**	**2,067.58**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Enhance interior levee slopes on McCormack-Williamson Tract: This component includes impacts associated with the removal of farm residences and infrastructure on McCormack-Williamson Tract.
3. Modify pump and siphon operations: Impacts have not be determined at this time because specific impact footprints have not been determined.
4. Allow boating on southwestern McCormack-Williamson Tract: This impact will not have any impacts on land cover types.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Restore Grizzly Slough Property: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation. Impacts identified in this table represent the most environmentally damaging alternative
(i.e., complete removal of the Grizzly Slough levees).
7. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
8. Enhance Delta Meadows Property: Land cover types have not been mapped in this area. Impacts have not be determined at this time because specific impact footprints have not been determined.

		Construction Related Effects[1]																			
		Permanent Effects																			
													Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property [6]	Optional Project Components			Operations-Related Effects		
Wildlife Habitats	Land Cover Type	Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent Temporary and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	0.54		1.30												272.38		274.22			274.22
	Tideflat (mudflat)																				
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland																				
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland						0.08											0.08			0.08
	Seasonal freshwater emergent wetland																				
Lacustrine	Farm and borrow pit ponds													43.20				43.20			43.20
	Temporary agricultural ditch (<15 ft wide)	0.14	0.04			0.19	0.67		0.03									1.07			1.07
	Permanent agricultural ditch (>15 ft wide)	0.03																0.03			0.03
Valley/foothill riparian	Cottonwood-willow woodland	0.41							0.01									0.42			0.42
	Valley oak riparian woodland	0.03							0.03						8.95			9.01			9.01
	Himalayan blackberry		0.01			0.14	0.03											0.18			0.18
	Riparian scrub	0.56					3.29											3.85			3.85
	Mixed riparian woodland																				
	Nonnative riparian woodland																				

		Construction Related Effects[1]																			
		Permanent Effects																	Operations-Related Effects		
													Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property[6]	Optional Project Components					
Wildlife Habitats	Land Cover Type	Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent Temporary and Operations-Related Effects)
Grassland	Annual grassland	0.01																0.01			0.01
	Perennial grassland															0.92		0.92			0.92
	Ruderal/forb	1.36	1.89	0.36		0.46	3.30		0.12							46.12		53.61			53.61
Upland Cropland	Corn and grain fields	3.49	6.43			18.37	31.82		12.89							0.75		73.75			73.75
Developed	Developed					0.10	0.76									0.57		1.43			1.43
Ornamental Plantings	Ornamental plantings																				
Unknown3																					
	Totals	**6.57**	**8.37**	**1.66**	**0**	**19.26**	**39.95**	**0**	**13.08**	**0**	**0**	**0**	**0**	**0**	**8.95**	**320.74**	**0**	**461.78**	**0**	**0**	**461.78**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Enhance interior levee slopes on McCormack-Williamson Tract: This component includes impacts associated with the removal of farm residences and infrastructure on McCormack-Williamson Tract.
3. Modify pump and siphon operations: Impacts have not be determined at this time because specific impact footprints have not been determined.
4. Allow boating on southwestern McCormack-Williamson Tract: This impact will not have any impacts on land cover types.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Restore Grizzly Slough Property: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation. Impacts identified in this table represent the most environmentally damaging alternative (i.e., complete removal of the Grizzly Slough levees).
7. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
8. Enhance Delta Meadows Property: Land cover types have not been mapped in this area. Impacts have not be determined at this time because specific impact footprints have not been determined.

Table VEG-3. Permanent Impacts to Land Cover Types Associated with Alternative 1-B–Seasonal Floodplain Optimization

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]																	Operations-Related Effects		Grand Total (Permanent and Operations-Related Effects)
		Permanent Effects																Permanent Effects (Total)			
		Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property[6]	Optional Project Components					
													Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]		Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	
Tidal perennial aquatic habitat	Tidal aquatic	0.02	0.40	0.21														0.63			0.63
	Tideflat (mudflat)															3.22		3.22			3.22
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland															11.08		11.08			11.08
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland											2.87	1.39					4.26	0.50		4.76
	Seasonal freshwater emergent wetland														46.84			46.84			46.84
Lacustrine	Farm and borrow pit ponds											8.69						8.69			8.69
	Temporary agricultural ditch (<15 ft wide)	0.01	0.04			0.12	0.13					0.12						0.42	8.13		8.55
	Permanent agricultural ditch (>15 ft wide)																		2.97		2.97
Valley/foothill riparian	Cottonwood-willow woodland	1.00	0.22											18.95		21.47		41.64			41.64
	Valley oak riparian woodland	0.23					1.60								60.73	0.06		62.62			62.62
	Himalayan blackberry		2.13			0.16	3.92									0.83		7.04		0.94	7.98
	Riparian scrub	2.09	2.79				4.17									13.16		22.21	4.37	0.03	26.61
	Mixed riparian woodland															13.49		13.49			13.49

		Construction Related Effects[1]																			
		Permanent Effects																			
													Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property [6]	Optional Project Components			Operations-Related Effects		
Wildlife Habitats	Land Cover Type	Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent and Operations-Related Effects)
	Nonnative riparian woodland																				
Grassland	Annual grassland	0.17			0.49		0.01							33.28				33.95	0.08		34.03
	Perennial grassland																				
	Ruderal/forb	6.98	6.33	1.53	28.17	0.70	20.54					13.92						78.17	6.27	7.81	92.25
Upland Cropland	Corn and grain fields	0.01	0.02			14.74	17.69					0.81	71.81		350.96			456.04	1246.75	0.55	1703.34
Developed	Developed				0.60	0.01	1.49											2.10	6.19		8.29
Ornamental Plantings	Ornamental plantings				0.49													0.49			0.49
	Totals																				
		10.51	**11.93**	**1.74**	**29.75**	**15.73**	**49.55**	**0**	**0**	**0**	**0**	**26.41**	**73.20**	**52.23**	**458.53**	**63.31**	**0**	**792.89**	**1275.26**	**9.33**	**2,077.48**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Enhance interior levee slopes on McCormack-Williamson Tract: This component includes impacts associated with the removal of farm residences and infrastructure on McCormack-Williamson Tract.
3. Modify pump and siphon operations: Impacts have not be determined at this time because specific impact footprints have not been determined.
4. Allow boating on southwestern McCormack-Williamson Tract: This impact will not have any impacts on land cover types.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Restore Grizzly Slough Property: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation. Impacts identified in this table represent the most environmentally damaging alternative (i.e., complete removal of the Grizzly Slough levees).
7. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
8. Enhance Delta Meadows Property: Land cover types have not been mapped in this area. Impacts have not be determined at this time because specific impact footprints have not been determined.

Wildlife Habitats	Land Cover Type	Construction Related Effects[1] – Permanent Effects: Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Excavate and Restore Grizzly Slough Property [6]: Complete Levee Removal	Optional Project Components: Dredging South Fork Mokelumne River[7]	Optional Project Components: Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Operations-Related Effects: Modify Landform and Restore Agricultural Land to Habitat	Operations-Related Effects: Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent Temporary and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	0.54		1.30							0.06					272.38		274.28			274.28
	Tideflat (mudflat)																				
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland																				
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland						0.08											0.08			0.08
	Seasonal freshwater emergent wetland																				
Lacustrine	Farm and borrow pit ponds													43.20				43.20			43.20
	Temporary agricultural ditch (<15 ft wide)	0.14	0.04			0.19	0.68				0.02							1.07			1.07
	Permanent agricultural ditch (>15 ft wide)	0.03																0.03			0.03
Valley/foothill riparian	Cottonwood-willow woodland	0.41																0.41			0.41
	Valley oak riparian woodland	0.03													8.95			8.98			8.98
	Himalayan blackberry		0.01			0.14	0.03				0.13							0.31			0.31
	Riparian scrub	0.56					3.29				0.66							4.51			4.51
	Mixed riparian woodland																				

Wildlife Habitats	Land Cover Type	Construction Related Effects[1] – Permanent Effects: Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Excavate and Restore Grizzly Slough Property [6]: Complete Levee Removal	Optional Project Components: Dredging South Fork Mokelumne River[7]	Optional Project Components: Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Operations-Related Effects: Modify Landform and Restore Agricultural Land to Habitat	Operations-Related Effects: Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent Temporary and Operations-Related Effects)
	Nonnative riparian woodland																				
Grassland	Annual grassland	0.01																0.01			0.01
	Perennial grassland															0.92		0.92			0.92
	Ruderal/forb	1.36	1.89	0.36		0.46	3.30				0.51					46.12		54.00			54.00
Upland Cropland	Corn and grain fields	3.49	6.43			18.37	33.12				1.02					0.75		63.18			63.18
Developed	Developed					0.10	0.76									0.57		1.43			1.43
Ornamental Plantings	Ornamental plantings																				
Unknown3																					
	Totals	**6.57**	**8.37**	**1.66**	**0**	**19.26**	**41.26**	**0**	**0**	**0**	**2.40**	**0**	**0**	**43.20**	**08.95**	**320.74**	**0**	**461.78**	**0**	**0**	**461.78**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Enhance interior levee slopes on McCormack-Williamson Tract: This component includes impacts associated with the removal of farm residences and infrastructure on McCormack-Williamson Tract.
3. Modify pump and siphon operations: Impacts have not be determined at this time because specific impact footprints have not been determined.
4. Allow boating on southwestern McCormack-Williamson Tract: This impact will not have any impacts on land cover types.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Restore Grizzly Slough Property: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation. Impacts identified in this table represent the most environmentally damaging alternative (i.e., complete removal of the Grizzly Slough levees).
7. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
8. Enhance Delta Meadows Property: Land cover types have not been mapped in this area. Impacts have not be determined at this time because specific impact footprints have not been determined.

		Construction Related Effects[1]																				
		Permanent Effects																				
														Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property[6]	Optional Project Components			Operations-Related Effects		
Wildlife Habitats	Land Cover Type	Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reinforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Construct Cross Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	0.02	0.40	0.21															0.63			0.63
	Tideflat (mudflat)																3.22		3.22			3.22
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland																11.08		11.08			11.08
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland												2.87	1.39					4.26	0.50		4.76
	Seasonal freshwater emergent wetland															46.84			46.84			46.84
Lacustrine	Farm and borrow pit ponds												8.69						8.69			8.69
	Temporary agricultural ditch (<15 ft wide)	0.01	0.04			0.12	0.05	0.13					0.12						0.47	7.92		8.39
	Permanent agricultural ditch (>15 ft wide)																			2.97		2.97
Valley/foothill riparian	Cottonwood-willow woodland	1.00	0.22												18.95		21.47		41.64			41.64
	Valley oak riparian woodland	0.23						1.6								60.73	0.06		62.62			62.62
	Himalayan blackberry		2.13			0.16	0.06	3.92									0.83		7.10		0.93	8.03
	Riparian scrub	2.09	2.79				0.01	4.17									13.16		22.22	4.37	0.02	26.61
	Mixed riparian woodland																13.49		13.49			13.49

		Construction Related Effects[1]																				
		Permanent Effects																		Operations-Related Effects		
														Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property[6]	Optional Project Components					
Wildlife Habitats	Land Cover Type	Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reinforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Construct Cross Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent and Operations-Related Effects)
	Nonnative Riparian woodland																					
Grassland	Annual grassland	0.17			0.49			0.01							33.28				33.95	0.08		34.03
	Perennial grassland																					
	Ruderal/forb	6.98	6.33	1.53	28.17	0.70	0.17	20.45					13.92						78.34	5.98	7.73	92.05
Upland Cropland	Corn and grain fields	0.01	0.02			14.74	3.24	17.69					0.81	71.81		350.96			459.28	1228.92	0.55	1688.75
Developed	Developed				0.60	0.01	0.03	1.49											2.13	6.01		8.14
Ornamental Plantings	Ornamental plantings				0.49														0.49			0.49
	Totals	**10.51**	**11.93**	**1.74**	**29.75**	**15.73**	**3.56**	**49.55**	**0**	**0**	**0**	**0**	**26.41**	**73.20**	**52.23**	**458.53**	**63.31**	**0**	**796.45**	**1256.75**	**9.23**	**2,062.43**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Enhance interior levee slopes on McCormack-Williamson Tract: This component includes impacts associated with the removal of farm residences and infrastructure on McCormack-Williamson Tract.
3. Modify pump and siphon operations: Impacts have not be determined at this time because specific impact footprints have not been determined.
4. Allow boating on southwestern McCormack-Williamson Tract: This impact will not have any impacts on land cover types.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Restore Grizzly Slough Property: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation. Impacts identified in this table represent the most environmentally damaging alternative
   (i.e., complete removal of the Grizzly Slough levees).
7. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
8. Enhance Delta Meadows Property: Land cover types have not been mapped in this area. Impacts have not be determined at this time because specific impact footprints have not been determined.

Table VEG-6. Temporary Impacts to Land Cover Types Associated with Alternative 1-C–Floodplain Enhancement and Subsidence Reversal

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]: Permanent Effects: Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Construct Cross Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Excavate and Restore Grizzly Slough Property [6]: Complete Levee Removal	Optional Project Components: Dredging South Fork Mokelumne River[7]	Optional Project Components: Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Operations-Related Effects: Modify Landform and Restore Agricultural Land to Habitat	Operations-Related Effects: Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent Temporary and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	0.54		1.30								0.15					272.38		274.37			274.37
	Tideflat (mudflat)																					
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland																					
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland							0.08											0.08			0.08
	Seasonal freshwater emergent wetland																					
Lacustrine	Farm and borrow pit ponds														43.20				43.20			43.20
	Temporary agricultural ditch (<15 ft wide)	0.14	0.04			0.19	0.12	0.69				0.03							1.21			1.21
	Permanent agricultural ditch (>15 ft wide)	0.03																	0.03			0.03
Valley/foothill riparian	Cottonwood-willow woodland	0.41																	0.41			0.41
	Valley oak riparian woodland	0.03														8.95			8.98			8.98
	Himalayan blackberry		0.01			0.14	0.21	0.03				0.15							0.54			0.54
	Riparian scrub	0.56					0.14	3.29				0.22							4.21			4.21
	Mixed riparian woodland																					
	Nonnative riparian woodland																					

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]																				
		Permanent Effects																				
														Excavate Dixon and New Hope Borrow Sites[5]		Excavate and Restore Grizzly Slough Property [6]	Optional Project Components			Operations-Related Effects		
		Degrade McCormack-Williamson Tract East Levee	Degrade McCormack-Williamson Tract Southwest Levee	Reenforce Dead Horse Island East Levee	Modify Downstream Levees	Construction Transmission Tower Protective Levee	Construct Cross Levee	Enhance Interior Levee Slope[2]	Modify Pump and Siphon Operations[3]	Breach Mokelumne River Levee	Allow Boating on Southwestern McCormack-Williamson Tract[4]	Construct Box Culvert Drains and Self-Regulating Tide Gates	Fill Wetlands Near McCormack-Williamson Tract East Levee	Northern Borrow Site	Southern Borrow Site	Complete Levee Removal	Dredging South Fork Mokelumne River[7]	Enhance Delta Meadow Property[8]	Permanent Effects (Total)	Modify Landform and Restore Agricultural Land to Habitat	Inundation of Riparian Habitat on Interior Levees	Grand Total (Permanent Temporary and Operations-Related Effects)
Grassland	Annual grassland	0.01																	0.01			0.01
	Perennial grassland																0.92		0.92			0.92
	Ruderal/forb	1.36	1.89	0.36		0.46	0.40	3.30				0.24					46.12		54.13			54.13
Upland Cropland	Corn and grain fields	3.49	6.43			18.37	15.10	33.13				0.53					0.75		77.80			77.80
Developed	Developed					0.10	0.14	0.76									0.57		1.57			1.57
Ornamental Plantings	Ornamental plantings																					
Unknown3																						
	Totals	**6.57**	**8.37**	**1.66**	**0**	**19.26**	**16.11**	**41.28**	**0**	**0**	**0**	**1.32**	**0**	**0**	**43.20**	**8.95**	**320.74**	**0**	**461.78**	**0**	**0**	**461.78**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Enhance interior levee slopes on McCormack-Williamson Tract: This component includes impacts associated with the removal of farm residences and infrastructure on McCormack-Williamson Tract.
3. Modify pump and siphon operations: Impacts have not be determined at this time because specific impact footprints have not been determined.
4. Allow boating on southwestern McCormack-Williamson Tract: This impact will not have any impacts on land cover types.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Restore Grizzly Slough Property: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation. Impacts identified in this table represent the most environmentally damaging alternative (i.e., complete removal of the Grizzly Slough levees).
7. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
8. Enhance Delta Meadows Property: Land cover types have not been mapped in this area. Impacts have not be determined at this time because specific impact footprints have not been determined.

Table VEG-7. Permanent Impacts to Land Cover Types Associated with Alternative 2-A–North Staten Detention

		Construction Related Effects[1]																
		Permanent Effects																
														Excavate Dixon and New Hope Borrow Sites[6]				
Wildlife Habitats	Land Cover Type	Construct Staten Island Weir	Construct Interior Detention Levee	Construct Outlet Weir	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Modify Walnut Grove-Thornton Road and Staten Island Road[4]	Construct Wildlife Viewing Areas[5]	Northern Borrow Site	Southern Borrow Site	Permanent Effects (Total)	Operations-Related Effects Inundation of Detention Basin[7]	Grand Total (Permanent and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic			0.05		3.39		0.12								3.56		3.56
	Tideflat (mudflat)					0.02										0.02		0.02
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland			0.37												0.37		0.37
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland						0.26							1.39		0.76		0.76
	Seasonal freshwater emergent wetland						1.35									1.35		1.35
Lacustrine	Farm and borrow pit ponds															43.20		43.20
	Temporary agricultural ditch (<15 ft wide)	0.17	1.59	0.01			1.45									3.22		3.22
	Permanent agricultural ditch (>15 ft wide)		1.02													1.02		1.02
Valley/foothill riparian	Cottonwood-willow woodland					0.26									18.95	19.21		19.21
	Valley oak riparian woodland															0		0
	Himalayan blackberry						0.73									0.73		0.73
	Riparian scrub					0.84			0.03							0.87		0.87
	Mixed riparian woodland																	
	Nonnative riparian woodland																	
Grassland	Annual grassland														33.28	33.28		33.28
	Perennial grassland						3.19									3.19		3.19
	Ruderal/forb	5.77	0.65	10.24		12.32	63.87	0.48	0.38							93.71		93.71
Upland cropland	Corn and grain fields	7.39	62.97	0.08			23.74							71.81		165.99		165.99
Developed	Developed	3.94	15.72				2.94	0.15	0.35							23.10		23.10

		Construction Related Effects[1]																
		Permanent Effects																
														Excavate Dixon and New Hope Borrow Sites[6]				
Wildlife Habitats	Land Cover Type	Construtct Staten Island Weir	Construct Interior Detention Levee	Construct Outlet Weir	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Modify Walnut Grove-Thornton Road and Staten Island Road[4]	Construct Wildlife Viewing Areas[5]	Northern Borrow Site	Southern Borrow Site	Permanent Effects (Total)	Operations-Related Effects Inundation of Detention Basin[7]	Grand Total (Permanent and Operations-Related Effects)
Ornamental plantings	Ornamental plantings																	
Unknown																		
	Totals	**17.27**	**81.95**	**10.75**	**0**	**16.83**	**97.53**	**0.75**	**0.76**	**0**	**0**	**0**	**0**	**73.20**	**52.23**	**350.38**	**0**	**350.38**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Construction of the pump station will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of pump station construction.
3. Impacts associated with this project component have not been determined because the location and size of the new building locations have not been determined. It is anticipated that structures will be relocated to agricultural lands.
4. Modifications of Walnut Grove-Thornton Road and Staten Island Road will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of roadway modifications.
5. Construction of the wildlife viewing areas will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of wildlife viewing area construction.
6. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
7. No permanent impacts are expected due to seasonal inundation of the detention basin.

Wildlife Habitats	Land Cover Type	Construction Related Effects[1] – Temporary Effects: Construtct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Modify Walnut Grove-Thornton Road and Staten Island Road	Construct Wildlife Viewing Areas[4]	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Temporary Effects (Total)	Operations-Related Effects Inundation of Detention Basin	Grand Total (Temporary and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic			0.70				0.64	0.64							1.98		1.98
	Tideflat (mudflat)			0.03					0.04							0.07		0.07
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland			0.24					0.04							0.28		0.28
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland						0.18									0.18	0.26	0.44
	Seasonal freshwater emergent wetland						3.89									3.89	1.64	5.53
Lacustrine	Farm and borrow pit ponds														43.2	43.20		43.2
	Temporary agricultural ditch (<15 ft wide)	0.03	0.03				0.39									0.72	12.15	12.87
	Temporary agricultural ditch (>15 ft wide)		0.01													0.01		0.01
Valley/foothill riparian	Cottonwood-willow woodland								0.55							0.55		0.55
	Valley oak riparian woodland															0		0
	Himalayan blackberry															0		0
	Riparian scrub							0.03	0.01							0.04		0.04
	Mixed Riparian woodland															0		0
	Nonnative riparian woodland															0		0
Grassland	Annual grassland															0		0
	Perennial grassland															0		0
	Ruderal/forb	0.03	0.31	0.38		3.02	4.60	0.01	0.09							8.44	2.72	11.16
Upland cropland	Corn and grain fields	19.08	79.46			7.72	70.49									176.75	2009.4	2186.15
Developed	Developed	0.09	1.49				1.61	0.08	0.04							3.31	25.22	28.53

		Construction Related Effects[1]																
		Temporary Effects																
														Excavate Dixon and New Hope Borrow Sites[5]				
Wildlife Habitats	Land Cover Type	Construct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Modify Walnut Grove-Thornton Road and Staten Island Road	Construct Wildlife Viewing Areas[4]	Northern Borrow Site	Southern Borrow Site	Temporary Effects (Total)	Operations-Related Effects Inundation of Detention Basin	Grand Total (Temporary and Operations-Related Effects)
Ornamental plantings	Ornamental plantings																	
Unknown3																		
	Totals	**19.23**	**81.57**	**1.35**	**0**	**10.74**	**81.16**	**0.76**	**1.41**	**0**	**0**	**0**	**0**	**0**	**43.2**	**239.42**	**2051.39**	**2290.81**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Construction of the pump station will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of pump station construction.
3. Impacts associated with this project component have not been determined because the location and size of the new building locations have not been determined. It is anticipated that structures will be relocated to agricultural lands.
4. Construction of the wildlife viewing areas will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of wildlife viewing area construction.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.

Table VEG-9. Permanent Impacts to Land Cover Types Associated with Alternative 2-B–West Staten Detention

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]														Operations-Related Effects Inundation of Detention Basin[6]	Grand Total (Permanent and Operations-Related Effects)
		Permanent Effects															
													Excavate Dixon and New Hope Borrow Sites[5]				
		Construct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Northern Borrow Site	Southern Borrow Site	Permanent Effects (Total)		
Tidal perennial aquatic habitat	Tidal aquatic	0.54	0.09	0.99				0.12			1.91				3.65		7.61
	Tideflat (mudflat)														0		0.04
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland														0		0.04
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland												1.39		1.39		0
	Seasonal freshwater emergent wetland														0		0
Lacustrine	Farm and borrow pit ponds														0		0
	Temporary agricultural ditch (<15 ft wide)	0.01	0.95				2.16				0.60				3.72		3.72
	Permanent agricultural ditch (>15 ft wide)		1.68												1.68		1.68
Valley/foothill riparian	Cottonwood-willow woodland														18.95		18.95
	Valley oak riparian woodland														0		0
	Himalayan blackberry										0.73				0.73		0.73
	Riparian scrub							0.03	0.03						0.0		0.03
	Mixed riparian woodland														0		0
	Nonnative riparian woodland														0		0
Grassland	Annual grassland						3.12							33.28	36.40		36.4
	Perennial grassland														0		0
	Ruderal/forb	1.14	0.69	7.72			35.14	0.48	0.38		22.23				67.78		67.78
Upland cropland	Corn and grain fields	0.09	84.06				12.33				11.41		71.81		179.70		179.70
Developed	Developed	3.11	25.19					0.15	0.35		1.50				30.3		30.3

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]														Operations-Related Effects Inundation of Detention Basin[6]	Grand Total (Permanent and Operations-Related Effects)
		Permanent Effects													Permanent Effects (Total)		
		Construct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site			
Ornamental plantings	Ornamental plantings	4.04													4.04		4.04
Unknown																	
	Totals	**8.93**	**112.66**	**8.71**	**0**	**0**	**52.75**	**0.75**	**0.76**	**0**	**38.38**	**0**	**73.20**	**52.23**	**348.37**	**0**	**348.37**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Construction of the pump station will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of pump station construction.
3. Impacts associated with this project component have not been determined because the location and size of the new building locations have not been determined. It is anticipated that structures will be relocated to agricultural lands.
4. Construction of the wildlife viewing areas will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of wildlife viewing area construction.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. No permanent impacts are expected due to seasonal inundation of the detention basin.

		Construction Related Effects[1]														Operations-Related Effects	
		Temporary Effects															
													Excavate Dixon and New Hope Borrow Sites[5]				
Wildlife Habitats	Land Cover Type	Construtct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Northern Borrow Site	Southern Borrow Site	Temporary Effects (Total)	Inundation of Detention Basin	Grand Total (Temporary and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	1.09		1.40				0.64	0.64		3.84				7.61		7.61
	Tideflat (mudflat)								0.40						0.04		0.04
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland								0.04						0.04		0.04
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland																
	Seasonal freshwater emergent wetland																
Lacustrine	Farm and borrow pit ponds													43.20	43.20		43.20
	Temporary agricultural ditch (<15 ft wide)		0.61				0.31				0.07				0.99	12.35	13.34
	Temporary agricultural ditch (>15 ft wide)		0.06												0.06		0.06
Valley/foothill riparian	Cottonwood-willow woodland														0.55		0.55
	Valley oak riparian woodland								0.55								
	Himalayan blackberry																
	Riparian scrub							0.03	0.01						0.04		0.04
	Mixed riparian woodland																
	Nonnative riparian woodland																
Grassland	Annual grassland						0.29								0.29		0.29
	Perennial grassland																
	Ruderal/forb	0.41	0.5				1.74	0.01	0.09		0.19				2.94	3.99	6.93
Upland cropland	Corn and grain fields	0.80	108.15				42.63				18.39				169.97	1571.18	1741.15
Developed	Developed	1.81	2.43					0.08	0.04		0.17				4.53	4.29	8.82

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]															
		Temporary Effects														Operations-Related Effects	Grand Total (Temporary and Operations-Related Effects)
		Construtct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Temporary Effects (Total)	Inundation of Detention Basin	
Ornamental plantings	Ornamental plantings	2.62													2.62	0.72	3.34
Unknown																	
	Totals	**6.73**	**111.75**	**1.4**	**0**		**44.97**	**0.76**	**1.41**	**0**	**22.66**	**0**	**0**	**43.20**	**232.88**	**1592.53**	**1825.41**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Construction of the pump station will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of pump station construction.
3. Impacts associated with this project component have not been determined because the location and size of the new building locations have not been determined. It is anticipated that structures will be relocated to agricultural lands.
4. Construction of the wildlife viewing areas will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of wildlife viewing area construction.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.

Table VEG-11. Permanent Impacts to Land Cover Types Associated with Alternative 2-C–East Staten Detention

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]														Operations-Related Effects Inundation of Detention Basin	Grand Total (Permanent and Operations-Related Effects)
		Permanent Effects															
		Construct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Excavate Dixon and New Hope Borrow Sites[5]		Permanent Effects (Total)		
													Northern Borrow Site	Southern Borrow Site			
Tidal perennial aquatic habitat	Tidal aquatic	0.46		0.01				0.12			0.25				0.84		0.84
	Tideflat (mudflat)	0.17													0.17		0.17
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland														0		0
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland						0.26						1.39		1.65		1.65
	Seasonal freshwater emergent wetland						1.35								1.35		1.35
Lacustrine	Farm and borrow pit ponds														0		0
	Temporary agricultural ditch (<15 ft wide)		1.27	0.04			0.29				0.31				1.91		1.91
	Permanent agricultural ditch (>15 ft wide)		0.78												0.78		0.78
Valley/foothill riparian	Cottonwood-willow woodland	0.49									0.27			18.95	19.71		19.71
	Valley oak riparian woodland														0		0
	Himalayan blackberry														0		0
	Riparian scrub	0.40							0.03						0.43		0.43
	Mixed riparian woodland														0		0
	Nonnative riparian woodland														0		0
Grassland	Annual grassland													33.28	33.28		33.28
	Perennial grassland						3.19								3.19		3.19
	Ruderal/forb	8.14	0.72	10.08			26.35	0.48	0.38		19.98				66.13		66.13
Upland cropland	Corn and grain fields	1.12	65.84	0.23			9.02				11.90		71.81		159.92		159.92

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]														Operations-Related Effects Inundation of Detention Basin	Grand Total (Permanent and Operations-Related Effects)
		Permanent Effects													Permanent Effects (Total)		
		Construct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Excavate Dixon and New Hope Borrow Sites[5]				
													Northern Borrow Site	Southern Borrow Site			
Developed	Developed		13.80					0.15	0.35		0.33				14.63		14.63
Ornamental plantings	Ornamental plantings														0		0
Unknown																	
	Totals	**10.78**	**82.41**	**10.36**	**0**	**0**	**40.46**	**0.75**	**0.76**	**0**	**33.04**	**0**	**73.20**	**52.23**	**303.99**	**0**	**303.99**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Construction of the pump station will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of pump station construction.
3. Impacts associated with this project component have not been determined because the location and size of the new building locations have not been determined. It is anticipated that structures will be relocated to agricultural lands.
4. Construction of the wildlife viewing areas will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of wildlife viewing area construction.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.
6. Dredging South Fork Mokelumne River: Impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).
7.

Table VEG-12. Temporary Impacts to Land Cover Types Associated with Alternative 2-C–East Staten Detention

Wildlife Habitats	Land Cover Type	Construction Related Effects[1]: Temporary Effects: Construtct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Excavate Dixon and New Hope Borrow Sites[5]: Northern Borrow Site	Excavate Dixon and New Hope Borrow Sites[5]: Southern Borrow Site	Temporary Effects (Total)	Operations-Related Effects Inundation of Detention Basin	Grand Total (Temporary and Operations-Related Effects)
Tidal perennial aquatic habitat	Tidal aquatic	0.91		0.41				0.64	0.64		1.74				4.34		4.34
	Tideflat (mudflat)	0.05		0.03					0.04		0.03				0.15		0.15
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland			0.11					0.04		0.66				0.81		0.81
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland						0.18								0.18	0.26	0.44
	Seasonal freshwater emergent wetland						3.89								3.89	1.64	5.53
Lacustrine	Farm and borrow pit ponds													43.20	43.20		43.20
	Temporary agricultural ditch (<15 ft wide)		0.32				0.23				0.03				0.58	8.96	9.54
	Temporary agricultural ditch (>15 ft wide)		0.01												0.01		0.01
Valley/foothill riparian	Cottonwood-willow woodland	0.14							0.55		3.23				3.92		3.92
	Valley oak riparian woodland														0		0
	Himalayan blackberry														0		0
	Riparian scrub	0.20						0.03	0.01		0.41				0.65		0.65
	Mixed riparian woodland														0		0
	Nonnative riparian woodland														0		0
Grassland	Annual grassland														0		0
	Perennial grassland														0		0
	Ruderal/forb	0.03	0.28	0.83			3.82	0.01	0.09		1.54				6.60	2.73	9.33
Upland cropland	Corn and grain fields		79.78				24.93				14.97				119.68	1528.47	1648.15
Developed	Developed		1.3					0.08	0.04		1.65				3.07	14.63	17.70

		Construction Related Effects[1]															
		Temporary Effects															
													Excavate Dixon and New Hope Borrow Sites[5]				
Wildlife Habitats	Land Cover Type	Construtct Staten Island Weir	ConstructInterior Detention Levee	Construct Basin Spillway	Construct Pump Station[2]	Degrade Existing Levees	Reinforce Existing Levees	Replace Miller's Ferry Bridge	Replace New Hope Bridge	Relocate Existing Structures[3]	Construct Setback Levee	Construct Wildlife Viewing Areas[4]	Northern Borrow Site	Southern Borrow Site	Temporary Effects (Total)	Operations-Related Effects Inundation of Detention Basin	Grand Total (Temporary and Operations-Related Effects)
Ornamental plantings	Ornamental plantings														0		0
Unknown																	
	Totals	**1.33**	**81.69**	**1.38**	**0**	**0**	**33.05**	**0.76**	**1.41**	**0**	**24.26**	**0**	**0**	**43.20**	**143.88**	**1556.69**	**1700.57**

Notes:

1. Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.
2. Construction of the pump station will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of pump station construction.
3. Impacts associated with this project component have not been determined because the location and size of the new building locations have not been determined. It is anticipated that structures will be relocated to agricultural lands.
4. Construction of the wildlife viewing areas will occur within the footprint of impacts associated with other project components. No additional impacts will occur as a result of wildlife viewing area construction.
5. Excavate Dixon and New Hope borrow sites: Land cover types have not been mapped in the field. The land cover types used in this analysis are based on aerial photograph interpretation.

Table VEG-13. Permanent and Temporary Impacts to Land Cover Types Associated with Alternative 2-D–Dredging and Levee Modifications

		Construction-Related Effects[1]								
		Permanent Effects				Temporary Effects				
Wildlife Habitats	Land Cover Types	Channel Dredging[2]	Levee Modifications on North Fork Mokelumne River	Levee Crown Raise	Total Permanent Effects	Channel Dredging[2]	Levee Modifications on North Fork Mokelumne River	Levee Crown Raise	Total Temporary Effects	Totals for Alternative
Tidal perennial aquatic habitat	Tidal aquatic		12.92	0.43	13.35	366.47			366.47	379.82
	Tideflat (mudflat)	2.43	0.99		3.42				0.00	3.42
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	9.94	2.39	4.07	16.40				0.00	16.40
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland				0.00		0.29		0.29	0.29
	Seasonal freshwater emergent wetland				0.00		1.67		1.67	1.67
Lacustrine	Farm and borrow pit ponds				0.00				0.00	0.00
	Temporary agricultural ditch (<15 ft wide)				0.00		3.02		3.02	3.02
	Permanent agricultural ditch (>15 ft wide)				0.00		0.34		0.34	0.34
Valley/foothill riparian	Cottonwood-willow woodland	20.09	1.86		21.95				0.00	21.95
	Valley oak riparian woodland	0.91	0.86		1.77		0.43		0.43	2.20
	Himalayan blackberry	0.14	5.26		5.40		3.29		3.29	8.69
	Riparian scrub	24.24	5.48		29.72		31.93		31.93	61.65
	Mixed riparian woodland	9.14	9.85		18.99		2.56		2.56	21.55
	Nonnative riparian woodland	0.29			0.29				0.00	0.29
Grassland	Annual grassland				0.00				0.00	0.00
	Perennial grassland		3.17		3.17	0.06	1.40		1.46	4.63
	Ruderal/forb		129.04	30.53	159.57	29.84	58.85		88.69	248.26
Upland cropland	Corn and grain fields		18.35		18.35	0.04	88.01		88.05	106.40
Developed	Developed		0.60		0.60	5.27	2.06		7.33	7.93
Ornamental plantings	Ornamental plantings		1.54		1.54		0.48		0.48	2.02
Unknown[3]			6.07	5.94	12.01		20.43		20.43	32.44
	Totals	67.18	198.38	40.97	306.53	401.68	214.76	0.00	616.44	922.97

[1] Project impact footprints are based on a review of the project description, conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes.

[2] Dredging impacts identified in this table represent the most environmentally damaging dredging action (i.e., clamshell or dragline dredging using land-based equipment).

[3] The "Unknown" land cover type represents impact areas in which land cover type mapping is not available.

4.2 Fisheries and Aquatics

Analysis Summary

This section describes the existing environmental conditions and the consequences of the Project on fisheries and aquatics in the Project vicinity. Specifically, this section evaluates and discusses the effects of the construction and operation of the Project in terms of movement of any resident or migratory fish species; loss of habitat quality or quantity; effects on rare or endangered species or habitat of the species; effects on fish communities or species protected by applicable environmental plans and goals; and degradation of aquatic ecosystem processes. Significance of impacts is determined by using significance criteria set forth in the State CEQA Guidelines and significance criteria established in the CALFED Programmatic EIS/EIR.

Introduction

This section includes the following information:

- a description of the affected environment for the selected species, and
- a description of the effects (i.e., environmental consequences) of each Project alternative on fish and fish habitat, including identification of significant impacts and measures to mitigate significant impacts.

This assessment covers species in aquatic environments potentially affected by the Project, including the Mokelumne River (North and South Forks), Sacramento River, and the Delta. The effects of the Project on habitat conditions common to multiple species and life stages are evaluated in detail. Available information was used to identify relationships between species and their habitats, as well as current species distributions in the Project area and the potential impacts of the various Project alternatives on important local fish species.

Approximately 40 fish species, comprising native and alien (introduced) freshwater, estuarine, and euryhaline marine species are found in the Delta; about one-half of these species are introduced (Moyle 2002:35). The introduced fishes tend to be the most abundant, while native species constitute an increasingly minor proportion of the fish fauna (Moyle 2002:35). This impact assessment is limited to species that support important sport and commercial fisheries, species that are unique to the Bay-Delta environment, species that may be in danger of extinction, and species that, when considered as a group, encompass the range of potential responses to the effects of Project construction and operation.

The special-status species that could potentially occur in the Project area that are included in this impact assessment are:

- Central Valley fall-/late fall–run Chinook salmon (ESA, species of concern; state species of special concern);
- Sacramento River winter-run Chinook salmon (ESA and CESA, endangered);
- Central Valley spring-run Chinook salmon (ESA and CESA, threatened);
- Central Valley steelhead (ESA, threatened);
- delta smelt (ESA and CESA, threatened);
- green sturgeon (ESA, threatened; state species of special concern);
- Sacramento splittail (state species of special concern);
- longfin smelt (state species of special concern);
- river lamprey (state species of special concern); and
- Pacific lamprey.

In addition to the special-status species potentially occurring in the Project area, the following important sport fish are also included in the assessment:

- white sturgeon,
- striped bass, and
- warmwater gamefish (e.g., largemouth bass, sunfish, and catfish).

Detailed assessments of Project effects on most species are included in this document. However, several species share similar life histories and habitat requirements. To minimize redundant discussion and provide a more concise document, Project impacts on several similar species may be combined in the text when appropriate. Although many other fish species occur in the Delta in addition to those listed above, detailed assessments of potential impacts on these other species from the Project may not be provided, in situations where it is assumed that the impact analyses for the species listed above encompass the species' responses to potential effects associated with Project construction and/or operation.

Sources of Information

The current status of fish and aquatic resources in the Project area and the assessment of potential effects of the Project on these resources were developed based on information available in the scientific literature, contacts with resource agencies and other experts, and analyses of data collected as part of other programs (e.g., Interagency Ecological Program [IEP] fish sampling data). Specifically, past and present studies and analyses of the biological and physical conditions of the Bay-Delta served as important sources of information for this assessment. Information used to prepare this section included:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000, including appendices;
- Relevant DWR, TNC, and University of California, Davis, reports;
- CNDDB and other databases;
- Relevant resource agency survey results;
- EBMUD fish sampling results for the lower Mokelumne River;
- Resource experts contacted; and
- Other sources as appropriate.

Assessment Approach and Methods

The assessment of effects considers the occurrence and potential occurrence of species and species' life stages relative to the magnitude, timing, frequency, and duration of Project activities, including breaching of levees, dredging, and flood control operations. The assessment links Project actions to changes in environmental correlates, where environmental correlates are environmental conditions or suites of environmental conditions that individually or synergistically affect the survival, growth, fecundity, and movement of a species. Environmental correlates addressed in this assessment include spawning habitat quantity, rearing habitat quantity, migration habitat condition, water temperature, food, and entrainment onto flooded islands.

Impact Mechanisms

Impact mechanisms are specific Project actions that, when undertaken, could result in an adverse or beneficial impact on habitat conditions common to multiple species and life stages in the North Delta, as well as factors affecting population abundance and distribution of individual species throughout the Bay-Delta estuary. Construction- and operation-related action elements that are common among the various Project alternatives and options are presented in Tables 2-2a and 2-2b. Impact mechanisms associated with construction- and operation-related action elements that could affect fisheries and aquatic ecosystem resources are identified in Table 4.2-1 and 4.2-2, respectively.

Physical Setting/Affected Environment

This assessment covers species in aquatic environments potentially affected by the Project, including the Sacramento River, North and South Fork Mokelumne River, and the Delta. Table 4.2-3 lists some of the native and nonnative fishes that occur in the Central Valley system that could be affected by implementation of the Project alternatives.

Although many fish species occur in the affected aquatic environment, the assessment focuses on Central Valley fall-/late fall–run Chinook salmon, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, delta smelt, green sturgeon, splittail, striped bass (an important sport fish), white sturgeon, and warmwater game fish species (e.g., largemouth bass, sunfish).

In addition, critical habitat encompasses the study area for the following special-status fish species:

- Central Valley steelhead,
- Central Valley spring-run Chinook salmon,
- Sacramento River winter-run Chinook salmon, and
- delta smelt.

The response of the selected species to Project actions provides an indicator of the potential response of other species. The full range of environmental conditions and fish habitat elements potentially affected is encompassed by the assessment for the species specifically discussed.

This section includes the following information:

- a summary of significant impacts that could result from implementation of the Project alternatives;
- a description of the affected environment for the selected species; and
- a description of the effects (environmental consequences) of each Project alternative on fish and fish habitat, including identification of significant impacts and measures to mitigate significant impacts.

Aquatic Ecosystems of the Project Area

The aquatic ecosystems in the Project area include the Delta and the North and South Forks Mokelumne River. Other aquatic ecosystems of importance are the Cosumnes and Sacramento Rivers. The Mokelumne, Cosumnes, and Sacramento Rivers provide freshwater flow into the Delta year-round.

Delta

The Delta is a complex network of more than 700 miles of tidally influenced channels and sloughs (Simi and Ruhl 2004:1). The Delta area includes tidally influenced areas from the Sacramento River at the confluence with the American River and the San Joaquin River at Vernalis downstream to Chipps Island (CALFED 2000:6.1-7). (Figure 1-1.) The bulk of the total freshwater inflow to the Delta originates from the Sacramento River to the north, and most of the total inflow occurs during winter and early spring (CALFED 2000:6.1-8). From the

Table 4.2-1. Fisheries and Aquatic Ecosystem Impact Mechanisms Associated with Project Construction-Related Action Elements

	Project Construction-Related Action Elements													
Impact Mechanisms	DL	W	IL	LR	WL	BL	D	RL	DP	RR	RP	TG	FP	CH
Heavy equipment used in channel		X				X	X	X	X		X			
Remove and disturb channel bottom and channel bank substrate		X				X	X		X		X	X		
Release of stored channel sediment		X				X	X				X			
Potential release of contaminants from channel sediments		X				X	X				X			
Potential incidental discharge of levee material into adjacent channels	X	X	X		X	X			X		X			
Potential for accidental spill of petroleum products	X	X	X	X	X	X	X	X	X	X	X			X
Change channel conveyance capacity		X				X	X	X			X			
Disturbance and temporary and permanent removal of aquatic or terrestrial vegetation	X	X	X	X	X	X	X	X	X	X	X		X	X
Potential for drift of applied herbicides into non-target areas														X
Potential incidental discharge of road construction material into channel				X					X	X	X			
Divert water for conveyance of dredged sediments (hydraulic dredging only)							X							
Discharge of dredge conveyance water into channels							X							
Bury channel bottom and channel bank substrate within the footprint of the extended levee cross-section								X						
Potential transport of imported sediment and associated contaminants into channel													X	

DL = Degrade Levees	BL = Breach Levees	RB = Remove and Replace Bridges
W = Construct Weirs	D = Dredge Channels	TG = Install Tide Gates
IL = Construct Interior Island Levees	RL = Raise Levees	FP = Fill Placement
LR = Construct Levee Roads	DP = Install/Upgrade Drainage Pumps and Siphons	CH = Create Habitats
WL = Construct Wildlife-Friendly Levees	RR = Raise/Realign Roads	

Table 4.2-2. Fisheries and Aquatic Ecosystem Impact Mechanisms Associated with Project Operations-Related Action Elements

Impact Mechanisms	Project Maintenance- and Operations -Related Action Elements[a]										
	RV	PS	PR	PC	MD	RR	RS	OW	OD	MH	MA
Heavy equipment used in channel					X						
Potential for drift of applied herbicides into non-target areas	X									X	X
Remove and disturb channel bottom and channel bank substrate					X		X				
Release of stored channel sediment					X						
Potential release of contaminants from channel sediments					X						
Potential for accidental spill of petroleum products	X[b]	X	X		X	X	X			X[b]	X[b]
Change channel conveyance capacity					X						
Disturbance and temporary and permanent removal of aquatic or terrestrial vegetation	X	X	X		X	X	X	X		X	X
Potential incidental discharge of levee/road refurbishment material into channel		X				X					
Divert water for conveyance of dredged sediments (hydraulic dredging only)					X						
Discharge of dredge conveyance water into channels					X						
Periodic inundation of vegetation and habitats (up to X days every 10 years on average)								X			
Potential release of farming-related and other contaminants (e.g., fertilizers, pesticides, petroleum-based chemicals) into channels downstream of detention pumps									X		
Entrainment and stranding of fish and other aquatic organisms								X			
Change in stage and duration flows and extent and duration of inundated floodplain in upstream and downstream channels								X			
Capture of sediments transported by flood flows								X			
Injury and mortality of fish and other aquatic organisms									X		

[a] The project components with which each project operations-related element is associated are presented in Chapter 2.

RV = Periodic removal of vegetation to maintain structures
PS = Periodic placement of soil to maintain structures
PR = Placement of rock revetment to maintain structures
RR = Refurbish and grade road surfaces
MD = Periodic maintenance dredging (5-10 year intervals)
PC = Periodic placement of cement or comparable material to maintain structures
RS = Replace Water Control Structures (1 replacement/structure over term of assessment)
OW = Operate Weirs, Levee Breaches, and Levee Setbacks
OD = Operate Detention Basin Pumps
MH = Maintain Created and Existing Habitats
MA = Maintain Agricultural Infrastructure on Staten Island

[b] X = Effect likely be the same or less than associated with current farming operations.

Table 4.2-3. Central Valley Species Potentially Affected by the Proposed Alternatives

Common Name—Origin	Scientific Name	Distribution
Native		
Lamprey (2 species)	*Lampetra* spp.	Central Valley rivers; Delta; San Francisco Bay estuary
Chinook salmon (winter-, spring-, fall-, and late fall–runs)	*Oncorhynchus tshawytscha*	Central Valley rivers; Delta; San Francisco Bay estuary
Chum salmon (rare)	*Oncorhynchus keta*	Central Valley rivers; Delta and San Francisco Bay estuary
Steelhead/rainbow trout	*Oncorhynchus mykiss*	Central Valley rivers; Delta and San Francisco Bay estuary
White sturgeon	*Acipenser transmontanus*	Central Valley rivers; Delta; San Francisco Bay estuary
Green sturgeon	*Acipenser medirostris*	Central Valley rivers; Delta; San Francisco Bay estuary
Longfin smelt	*Spirinchus thaleichthys*	Delta and San Francisco Bay estuary
Delta smelt	*Hypomesus transpacificus*	Delta and San Francisco Bay estuary
Wakasagi	*Hypomesus nipponensis*	Central Valley rivers and reservoirs; Delta
Sacramento sucker	*Catostomus occidentalis*	Central Valley rivers; Delta
Sacramento squawfish	*Ptychocheilus grandis*	Central Valley rivers; Delta
Splittail	*Pogonichthys macrolepidotus*	Central Valley rivers; Delta and San Francisco Bay estuary
Sacramento blackfish	*Orthodon microlepidotus*	Central Valley rivers; Delta
Hardhead	*Mylopharodon conocephalus*	Central Valley rivers; Delta
Hitch	*Lavina exilicauda*	Central Valley rivers; Delta
Tule perch	*Hysterocarpus traskii*	Central Valley rivers; Delta
Threespine stickleback	*Gasterosteus aculaetus*	Central Valley rivers; Delta; San Francisco Bay estuary
Nonnative		
Golden shiner	*Notemigonus crysoleucas*	Central Valley rivers and reservoirs; Delta
Fathead minnow	*Pimephales promelas*	Central Valley rivers and reservoirs; Delta
Goldfish	*Carassius auratus*	Central Valley rivers and reservoirs; Delta
Carp	*Cyprinus carpio*	Central Valley rivers and reservoirs; Delta
Threadfin shad	*Dorosoma petenense*	Central Valley rivers and reservoirs; Delta
American shad	*Alosa sapidissima*	Central Valley rivers; Delta; San Francisco Bay estuary
Black bullhead	*Ictalurus melas*	Central Valley rivers and reservoirs; Delta
Brown bullhead	*Ictalurus nebulosus*	Central Valley rivers and reservoirs; Delta
White catfish	*Ictalurus catus*	Central Valley rivers; Delta

Table 4.2-3. Continued

Common Name—Origin	Scientific Name	Distribution
Channel catfish	*Ictalurus punctatus*	Central Valley rivers and reservoirs; Delta
Western		
Mosquitofish	*Gambusia affinis*	Central Valley rivers and reservoirs; Delta
Inland silverside	*Menidia audena*	Central Valley rivers; Delta
Striped bass	*Morone saxatilis*	Central Valley rivers and reservoirs; Delta; San Francisco Bay estuary
Bluegill	*Lepomis macrochirus*	Central Valley rivers and reservoirs; Delta
Green sunfish	*Lepomis cyanellus*	Central Valley rivers and reservoirs; Delta
Redear sunfish	*Lepomis microlophus*	Central Valley rivers and reservoirs; Delta
Warmouth	*Lepomis gulosus*	Central Valley rivers and reservoirs; Delta
White crappie	*Pomoxis annularis*	Central Valley rivers and reservoirs; Delta
Black crappie	*Pomoxis nigromaculatus*	Central Valley rivers and reservoirs; Delta
Largemouth bass	*Micropterus salmoides*	Central Valley rivers and reservoirs; Delta
Spotted bass	*Micropterus punctulatus*	Central Valley rivers and reservoirs; Delta
Small mouth bass	*Micropterus dolomieui*	Central Valley rivers and reservoirs; Delta
Bigscale logperch	*Percina macrolepida*	Central Valley rivers; Delta
Yellowfin goby	*Acanthogobius flavimanus*	Delta and San Francisco Bay estuary
Chameleon goby	*Tridentiger trigonocephalus*	Delta and San Francisco Bay estuary

southeast side of the Delta, the San Joaquin River contributes a high percentage of inflowing nutrients and food resources (CALFED 2000:6.1-11). Numerous distributaries flow through the low-lying tidal area of the Delta.

Aquatic habitats have changed in the Delta throughout the years. Historically, wetlands dominated the Delta and included backwater areas, tidal sloughs, and channels that drained wetland complexes (CALFED 2000:6.1-7). Currently, the Delta consists of islands surrounded by leveed channels. Most of the islands are below sea level and used primarily for agriculture. The land surfaces on many of the islands have subsided up to 10 m below sea level because of compaction, oxidation, and erosion of the peat soils (Jassby and Cloern 2000). Levees are maintained to prevent flooding (Moyle 2002:32). Vegetation is removed from levees, primarily to facilitate inspection, repair, and flood fighting when necessary (CALFED 2000:6.1-7–8). Aquatic habitats in the Delta consist of areas of deep water, sloughs, and shallow lakes. Some channel sections have been deepened and straightened by dredging either for shipping or for more efficient water conveyance. The shallow-water habitats are limited to areas of backwater sloughs and narrow margins of channels and lakes (Kimmerer 2004:7). The amount of shallow water and shaded riverine habitat throughout the Delta is much less now than it was historically (CALFED 2000:6.1-7–8).

Mokelumne and Cosumnes Rivers

The Mokelumne and Cosumnes Rivers are located east of the Project area. They join near the upstream boundary of the Project area and from there the Mokelumne River flows southwesterly before joining the San Joaquin River (Figure 1-1). The confluence of the Mokelumne and Cosumnes Rivers is affected by tidal action in the Delta.

Mokelumne River

The Mokelumne River, an east Delta tributary, drains more than 660 square miles, with its headwaters at an elevation of 10,000 feet on the Sierra Nevada crest. The Mokelumne River is joined by the Cosumnes River a short distance upstream (east) of the Project area. In the Project area, the Mokelumne River splits into two separate channels: the North and South Fork Mokelumne River. Staten Island is bounded to the west by the North Fork Mokelumne River and to the east by the South Fork Mokelumne River. The Mokelumne River exhibits a typical Central Valley streamflow pattern, with high spring flows, very low summer and fall flows, and moderate winter flows. Flows in the lower Mokelumne River are regulated by three major reservoirs: Salt Springs, Pardee, and Camanche. Camanche Reservoir, the lowest reservoir in the watershed, is operated by EBMUD for irrigation storage, streamflow regulation, and flood control. Below Camanche Reservoir, water is diverted along the Mokelumne River for irrigation. One of the largest diversions occurs at Woodbridge Dam. Woodbridge Dam and Canal are operated by the WID near the city of Lodi.

Historical and ongoing land-use and water-management practices have affected the habitat in the lower Mokelumne River. For example, significant losses of riparian and riverine aquatic vegetation have occurred along the lower river and the stream channel has become armored in many places from the lack of new gravels, low streamflows, and the construction of levees for flood control (CALFED Bay-Delta Program 1999). These factors have led to channel incision and have resulted in the channel being disconnected from its historical floodplain (Merz and Setka 2004:2). As a result, the quantity and quality of spawning and rearing habitat in the lower Mokelumne River have been adversely affected. To address these issues, a collaborative effort was initiated in the 1990s to improve conditions for anadromous fish and other wildlife species in the lower Mokelumne River. This effort has included improving fish passage at Woodbridge Dam, improving fish screening for the WID diversion canal and other existing riparian diversions, and enhancing the riparian corridor.

Chinook salmon and steelhead are raised at the Mokelumne River Fish Hatchery, which is owned by EBMUD and operated by DFG. Located at the base of Camanche Dam, the fish hatchery was constructed in 1963 to mitigate the impacts of construction of Camanche Dam, which was completed in 1964.

Cosumnes River

The Cosumnes River is located in southern Sacramento County. The Cosumnes River is a small river with its headwaters in the western Sierra Nevada. Elevations range from near 8,000 feet to near sea level at its confluence with the Mokelumne River. It is the largest undammed river draining the west slope of the Sierra Nevada (Florsheim and Mount 2002:68).

Currently, the lower portion of the watershed includes more than 50,000 acres of cropland and almost 16,000 acres of orchards and vineyards. The lower watershed also supports a large valley oak riparian woodland and an important waterfowl wintering area on more than 12,000 acres at the Cosumnes River Preserve. In addition to supporting the oak riparian woodland and waterfowl habitat, the Cosumnes River Preserve includes 645 acres of floodplain habitat (Jones and Stokes and NHC 2003:2.1), which provides spawning and rearing habitat for many floodplain species, including splittail.

Sacramento River

The Sacramento River is one of the two major river systems in the Central Valley. It flows southward toward the San Joaquin River, enters the Delta, and ends at Suisun Bay (Figure 1-1).

Historically, the volume of flow in the Sacramento River system generally decreased in the downstream direction. Floodflows spilled into adjacent flood basins that were separated from the mainstem by natural levees. The magnitude of floodflows that entered these adjacent flood basins created several distributary flood paths across the flat valley floor into which the mainstem would spill. The Yolo Basin, west of Sacramento, and the American Basin, northeast of the confluence of the Sacramento and American Rivers, are two of these historical overflow basins (U.S. Army Corps of Engineers and The Reclamation Board 2002:100).

The lower Sacramento River currently is a single-channel watercourse with moderate to low sinuosity, and the river is confined by levees immediately adjacent to the riverbanks. The gradient of the river channel is relatively flat and becomes more so as it approaches the Delta (U.S. Army Corps of Engineers and The Reclamation Board 2002:100).

Most of the acreage adjacent to the Sacramento River is protected by levees, and long sections of the river have been straightened to maximize agricultural land and improve channel conveyance capacity. Consequently, the frequently inundated floodplain is limited to a narrow terrace. Miles of meanders, backwaters, and sloughs have been eliminated; and less than 5% of historical wetlands remains. As in the Delta, levees are reinforced and kept relatively free of vegetation, measures that have greatly reduced the occurrence of sloughs and side channels, the supply of organic material, and the quality of invertebrate and fish habitat in the river ecosystem (CALFED 2000:6.1-10).

The Sacramento River and its tributaries provide important migration, spawning, and rearing habitat for many fish species, including fall-, winter- and spring-run Chinook salmon, Central Valley steelhead, white and green sturgeon, striped bass, and lamprey. Many of these species use the channels of the North Delta for migration as adults and juveniles and for rearing as juveniles on their way to the ocean. The North Delta is connected to the Sacramento River by the DCC and Georgiana Slough (Figure 1-1).

Delta Cross Channel

The DCC was constructed by Reclamation in 1951 as part of the CVP to allow more Sacramento River flow to move across the Delta toward the CVP Tracy facility and the DMC. The DCC was designed to increase net flow in the San Joaquin River channel at Antioch, so that less salinity intrusion of Suisun Bay water would move upstream. The gates can be opened and closed in response to water quality, flood protection, and fish protection requirements. When the DCC gates are open, Sacramento River water is diverted into the Mokelumne River and eventually the San Joaquin River. The DCC has two gates that can be operated independently and are usually closed when high flows (20,000 to 25,000 cfs) in the Sacramento River threatens flooding in the central Delta, or when needed to protect emigrating juvenile salmon (Bureau of Reclamation no date). The DCC gates are generally open from June to October and are closed approximately 10 days in November, 15 days in December, and 20 days in January. Since 1993, the DCC gates have been closed every day in February–April and most of May for salmon protection (Kimmerer 2004:21).

Aquatic Habitats

Aquatic habitats in the North Delta consist of perennial, intertidal, and seasonal habitats. Fish and other species use these habitats for growth, survival, and reproduction. Fish use these habitats differently, depending on species and life stage. Many different aquatic habitats exist in the study area and can be characterized more broadly as: nearshore, open-water (pelagic) and floodplain. These habitats are described in greater detail below.

Nearshore

Nearshore areas support large and diverse fish and wildlife populations. These areas are important to fish for rearing and migration, they create attachment sites for aquatic insects (a food source for fish), and provide fish with shelter from predators. For example, juvenile Chinook salmon and steelhead rely on nearshore habitats as fry, smolt, or yearlings and to some extent as adults. In addition, vegetated nearshore habitat can also provide spawning areas for some fish species, such as splittail, delta smelt, black bass, and sunfish.

Open Water

Open-water habitat includes areas of channels and sloughs that are free of instream structure, such as vegetation and woody material, and away from the shoreline. Typically, open water habitats have greater water depths and water velocities than nearshore habitat.

Delta smelt, striped bass, American shad, and longfin smelt are found primarily in open-water habitat. In addition, adult and juvenile salmonids use mid-channel areas for migration.

Floodplain

Recognition is growing that naturally functioning floodplains provide many benefits, including direct economic benefits, ecosystem services, and habitat for a wide diversity of species (Bayley 1995; Tockner and Stanford 2002, as cited in Ahearn et al. 2006). Floodplains provide freshwater habitat for the migration, reproduction, and rearing of native fishes (Moyle et al. 2003; Crain et al. 2004), and mitigate flood damage to human settlements (Sommer et al. 2001, cited in Moyle et al. 2005).

Floodplains are highly productive habitats that flood during high flows in the winter and spring. Floodplains are important habitats for young fish, especially Chinook salmon and splittail (Moyle et al. 2005:21). Chinook salmon, which spawn in freshwater rivers and streams upstream of the Delta, use inundated floodplain habitats (when available) for rearing. Chinook salmon growth has been shown to be faster on floodplain habitat than in river systems (Sommer et al. 2000). Sacramento splittail, which spawn in inundated floodplains, produce the highest numbers of young when flows are high and floodplain habitat is inundated (Moyle 2002:148).

Fish Resources

A mixture of fresh- and saltwater fish historically composed the fish fauna of the Delta, including purely freshwater species (e.g., thicktail chub [now extinct], hitch, blackfish, pikeminnow), an endemic species (delta smelt), anadromous species that spent part of their life cycles in the Delta (Chinook salmon, steelhead, sturgeon, longfin smelt, and lamprey), marine species (starry flounder, staghorn sculpin) that spent their juvenile stages in the Delta, and freshwater species tolerant of moderate salinities (e.g., Sacramento perch, tule perch, splittail, and prickly sculpin). (Moyle 2002.) Presently, the Delta continues to have a mixture of fresh- and saltwater fish; however, some native species are extinct, and many others are reduced in numbers. Further changes in the species composition in the Delta have occurred as a result of intended and accidental species introductions, many species of which compete with or prey on the native species. As a consequence of these introductions and physical changes to the Delta environment, alien species now dominate the fish community in many locations.

Numerous programs have been, and continue to be, implemented to monitor the status of Delta species. These surveys are described below and include midwater trawl surveys, egg and larval surveys, beach seine surveys, and electrofishing surveys.

Monitoring Surveys

Numerous programs to monitor the occurrence and relative abundance of fish species in the Delta have, or continue to be, implemented by several resource agencies. These programs are summarized below and include mid-water trawl surveys, beach seine surveys, townet surveys, real time monitoring, and short-term electrofishing surveys. Although some of the monitoring programs discussed below are intended to monitor a single species (e.g., the summer townet survey provides an index of striped bass abundance), their capture data, when viewed in aggregate, provide meaningful information relevant to the species' timing of occurrence and abundance relative to other species (especially nonnative species). Fish occurrence information for the Project area was gathered from, but not limited to, the following monitoring programs or surveys:

- DFG's 20 mm Delta Smelt Survey,
- DFG's Summer Townet Survey,
- DFG's Fall Midwater Trawl Survey (MWT),
- USFWS's Beach Seine Survey,
- EBMUD's Electrofishing Survey,
- EBMUD's Lower Mokelumne River Fish Community Report, and
- UC Davis McCormack-Williamson Tract baseline fisheries data.

The 20 mm Delta Smelt Survey monitors postlarval and juvenile delta smelt distribution and relative abundance throughout their historical spring range in the Delta and San Francisco estuary. Sampling surveys occur every 2 weeks, averaging 8–10 surveys annually and covering stations throughout the Delta and downstream to the eastern portion of San Pablo Bay and Napa River. The closest sampling station to the North Delta is at Little Potato Slough near the southern tip of Staten Island (Figure 1-1). Samples are collected using an egg and larval net with a very fine mesh.

The Summer Townet Survey was initiated by DFG in 1959 to provide an index of striped bass abundance. This survey uses oblique tows in mid-channel sites located throughout the Delta, Suisun Bay, and San Pablo Bay to sample young-of-year fish. Sampling is conducted twice monthly in the summer. The closest sampling site to the North Delta is at Little Potato Slough near the southern tip of Staten Island (Figure 1-1). Since 1990, data typically have been collected at this sampling site in June and July, or July and August. Data were not collected at this location in 1993 and from 1996 through 1998. From 1999 through 2002, data were collected in only one month (June or August).

The MWT survey was initiated by DFG in 1967 to sample striped bass. DFG records the occurrence of other species in most years. This monitoring program currently samples 100 sites extending from San Pablo Bay to Rio Vista on the lower Sacramento River, and to Stockton on the San Joaquin River. Five sites are sampled in the North Delta—one on the North Fork Mokelumne River on lower Staten Island; three on the South Fork Mokelumne River at Beaver, Hog, and Sycamore Sloughs; and one at Little Potato Slough (Figure 1-1). Data are collected during the period September–December; however, from 1991 through 2001 data also were collected during January through March and occasionally in April, May, June, and August.

USFWS's Beach Seine Survey weekly surveys are used to estimate the relative inter- and intra-annual abundance and distribution of all four races of Chinook salmon juveniles (fall-, late fall–, winter-, and spring-run), using the Delta as a rearing and nursery area. Beach seining has been conducted since 1976 on the Sacramento River and in the North and Central Delta.

EBMUD has been sampling the lower Cosumnes River near its confluence with the Mokelumne River since February 1998. The program was expanded in 2000 and 2001 to include: three sites on the North Fork Mokelumne River adjacent to Staten Island; four sites along the South Fork Mokelumne River adjacent to Staten Island; and one site on the Mokelumne River adjacent to McCormick-Williamson Tract (Figure 1-1). Sampling is conducted by boat electrofishing and occurs seasonally: January/February, April/May, July/August, and October/November. In addition, EBMUD published a report describing the results of a comprehensive fish community assessment in the Mokelumne River. The report summarizes fish capture data gathered from January 1997 to June 2004 in reaches ranging from the river mouth to Camanche Dam. Fish occurrence information for the lowest reach, which includes portions of the Project area, was collected by boat electrofishing. Boat electrofishing data were collected mainly seasonally during January, May, late July, and October.

UC Davis staff collected baseline fish occurrence information in the vicinity of McCormack-Williamson Tract during 2000 and 2001. The objective of the fish sampling was to gather baseline fisheries information to support informed assessments of the potential impacts on local fish communities from various proposed restoration strategies for McCormack-Williamson Tract. Fish occurrence data were collected seasonally using boat electrofishing at 11 sites surrounding the McCormack-Williamson Tract.

Species Composition

The Sacramento–San Joaquin River system and estuary, including the lower Mokelumne River, supports more than 40 species of anadromous, freshwater, and estuarine fish. Table 4.2-3 lists fish species expected to occur, or that may occur, in the Project area.

Anadromous Species

Anadromous species are species that live in the ocean as adults and return to freshwater rivers and streams to spawn. After the young hatch, fry and juveniles of anadromous species spend a variable amount of time in fresh water (depending on species and race), where they rear before emigrating to the ocean as juveniles. Anadromous fish species include Chinook salmon, Central Valley steelhead, green and white sturgeon, American shad, striped bass, and lamprey. Most of these species are native to the Sacramento-San Joaquin River system, with the exception of striped bass and American shad, which were introduced to California from the East Coast during the late 1800s. Although American shad and striped bass are not protected species in California, they support important recreational fisheries.

Freshwater Species

Freshwater species are those fish species that spend their entire life in fresh water. As such, these species often have low tolerances for saltwater. In the Delta, introduced freshwater fish species outnumber native species. Catfish (channel and white), black bass (e.g., largemouth, smallmouth, spotted, and redeye bass), sunfish (e.g., green sunfish, bluegill) have dispersed to most habitats in the Delta and Central Valley rivers and streams following their introduction many years ago.

Estuarine Species

Estuarine species are those fish species that spawn in fresh water and are able to tolerate variable levels of salinity during their juvenile and adult life stages. These species include delta smelt, longfin smelt, and Sacramento splittail.

Special-Status Species

Special-status species are species that are legally protected or that are otherwise considered sensitive by federal and state agencies. They include species that are protected under the federal Endangered Species Act (ESA), the California Endangered Species Act (CESA), those considered candidates for listing as threatened or endangered under the state and federal ESA, and species identified by DFG, National Marine Fisheries Service (NMFS), and USFWS as species of concern.

Special-status species known, or with potential, to occur in the Project area are: Central Valley fall-/late fall–run Chinook salmon, Central Valley winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, delta smelt, Sacramento splittail, longfin smelt, and green sturgeon. Most of these species only occur in the North Delta seasonally; splittail are the only species likely to be a resident in the vicinity of the Project area.

The occurrence, life history, and status of the above species are discussed below.

Species Occurrence, Life History, and Status in the North Delta

Central Valley Chinook Salmon

General Life History

Four races of Chinook salmon (*Oncorhynchus tshawytscha*) occur in the Central Valley. The names of the Chinook salmon runs (i.e., fall, late fall, winter, and spring) reflect the variability in timing of migration and spawning of the adult life stage (Table 4.2-4). Central Valley fall-/late fall–run Chinook salmon are a species of concern under the ESA. Sacramento River winter-run and Central Valley spring-run Chinook salmon are listed as endangered and threatened species, respectively, under the ESA and CESA.

Although the four races of Chinook salmon have the same physical appearance and similar habitat requirements, some subtle, yet important, differences exist among the races and among the different spawning runs. Chinook salmon can be classified into two generalized freshwater life history types (Healey 1991). Ocean type Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or juveniles within the first year. Fall-/late fall–run Chinook salmon exhibit an ocean-type life history. In contrast, stream-type Chinook salmon enter fresh water months before spawning, and the young reside in fresh water for a year or more before emigrating to the ocean. Spring-run Chinook salmon exhibit a stream-type life history. Winter-run Chinook salmon have characteristics of both stream- and ocean-type life histories: adults exhibit a stream type characteristic of delayed spawning following freshwater entry, while juveniles migrate to the ocean within about 7 months following emergence from the gravel (ocean-type characteristic).

Generally, adult Chinook salmon spend 2–5 years in the ocean before migrating upstream in the Sacramento and San Joaquin Rivers. Spawning occurs in the cool reaches of Central Valley rivers that are downstream of the terminal dams and in tributary streams. Chinook salmon spawning generally occurs in swift-flowing riffles or along the edges of runs containing clean, loose gravel. After the eggs hatch, juvenile Chinook salmon remain in fresh water for 3–14 months (depending on race) before emigrating to the ocean.

Table 4.2-4. Life Stage Timing and Distribution of Selected Species Potentially Affected by the Proposed Project Alternatives

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Late Fall–Run Chinook Salmon													
Adult Migration	SF Bay to Upper Sacramento River and Tributaries, Mokelumne River, and San Joaquin River Tributaries	■	■								■	■	■
Spawning	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries	■	■	■									
Egg Incubation	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries	■	■	■	■	■							
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries			■	■	■	■	■	■	■	■	■	
Juvenile Movement and Rearing	Upper Sacramento River and Tributaries, Mokelumne River and San Joaquin River Tributaries	■	■	■	■	■	■				■	■	■
Fall-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries							■	■	■	■	■	■
Spawning[1]	Upper Sacramento River and Tributaries										■	■	■
Egg Incubation[1]	Upper Sacramento River and Tributaries	■	■	■							■	■	■
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries	■	■	■	■	■	■						
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay		■	■	■	■	■						

Table 4.2-4. Continued

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Spring-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River and Tributaries												
Spawning	Upper Sacramento River and Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries												
Juvenile Rearing (Natal Stream)	Upper Sacramento River and Tributaries												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Winter-Run Chinook Salmon													
Adult Migration and Holding	SF Bay to Upper Sacramento River												
Spawning	Upper Sacramento River												
Egg Incubation	Upper Sacramento River												
Juvenile Rearing (Natal Stream)	Upper Sacramento River to SF Bay												
Juvenile Movement and Rearing	Upper Sacramento River to SF Bay												

Table 4.2-4. Continued

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Steelhead													
Adult Migration	SF Bay to Upper Sacramento River and Tributaries												
Spawning	Upper Sacramento River and Tributaries												
Egg Incubation	Upper Sacramento River and Tributaries												
Juvenile Rearing	Upper Sacramento River and Tributaries to SF Bay												
Juvenile Movement	Upper Sacramento River and Tributaries to SF Bay												
Sacramento Splittail													
Adult Migration	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Sacramento River and San Joaquin River												
Spawning	Suisun Marsh, Upper Delta, Yolo and Sutter Bypasses, Lower Sacramento and San Joaquin Rivers												
Larval and Early Juvenile Rearing and Movement	Suisun Marsh, Upper Delta, Yolo Bypass, Sutter Bypass, Lower Sacramento and San Joaquin Rivers												
Adult and Juvenile Rearing	Delta, Suisun Bay												

	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Delta Smelt													
Adult Migration	Delta	X	X	X									X
Spawning	Delta, Suisun Marsh	X	X	X	X	X	/	/					
Larval and Early Juvenile Rearing	Delta, Suisun Marsh	X	X	X	X	X	X	/					
Estuarine Rearing: Juveniles and Adults	Lower Delta, Suisun Bay	X	X	X	X	X	X	X	X	X	X	X	X

/ Low probability of occurrence, not included in the assessment of the project effect.

X Primary occurrence included in the assessment of project effects.

Notes:

[1] Spawning and incubation occurs from October to February in the Feather, American, and Mokelumne Rivers

Sources: Brown 1991; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996c; McEwan 2001; Moyle 2002; Hallock 1989.

Cover, space, and food are necessary components of Chinook salmon rearing habitat. Suitable habitat includes areas with instream and overhead cover in the form of cobbles, rocks, undercut banks, downed trees, and large, overhanging tree branches. The organic materials forming fish cover also provide sources of food in the form of both aquatic and terrestrial insects.

Juvenile Chinook salmon move downstream in response to many factors, including inherited behavior, habitat availability, flow, competition for space and food, and water temperature. The number of juveniles that migrate and the timing of movement are highly variable. Storm events and the resulting high flows appear to trigger movement of substantial numbers of juvenile Chinook salmon to downstream habitats. In general, juvenile abundance in the Delta appears to be higher in response to increased flow (U.S. Fish and Wildlife Service 1993).

Whether entering the Delta and estuary as fry or juveniles (including smolts), Central Valley Chinook salmon must pass through the Delta on their way to the ocean. More specific information on the timing of the different races and life stages of Chinook salmon is provided below.

Fall-Run Chinook Salmon

Adult fall-run Chinook salmon enter the Sacramento and San Joaquin River systems from July through December and spawn from late September through December, with a peak in October and November (Table 4.2-4). Newly emerged fry remain in shallow, lower-velocity edgewaters (California Department of Fish and Game 1998). Shortly after emergence from the redds, most fry disperse downstream toward the Delta and into the San Francisco Bay estuary. Juveniles migrate to the ocean from October to June (Table 4.2-4). Natural spawning populations of fall-run Chinook salmon occur in the Sacramento River, most tributaries of the Sacramento and San Joaquin River, and tributaries of the eastern Delta including the Cosumnes and Mokelumne Rivers.

Based on monitoring of adult passage at Woodbridge Dam, adult fall-run Chinook salmon enter the Mokelumne River from August to December, with a peak in October and November (East Bay Municipal Utility District unpublished data). Spawning occurs primarily from late October through January (Merz and Setka 2004). After emerging from the gravels, fry and juveniles disperse toward the Delta from January into July, with the majority of juveniles emigrating during March–May. Based on monitoring of juvenile migration, approximately 20% of the juvenile Chinook salmon in the Mokelumne River emigrate to the Delta after June 1 (East Bay Municipal Utility District unpublished data). Fall-run Chinook salmon in the Mokelumne River are the result of in-river production and hatchery releases.

The Mokelumne River Fish Hatchery (MRFH), which is owned by EBMUD but operated by DFG, was constructed in 1963 to mitigate the loss of anadromous fish spawning habitat when Camanche Dam was constructed. The hatchery produces both Chinook salmon and steelhead and was remodeled recently to increase rearing capacity and hatchery efficiency. In 2002, approximately 8,000 adult fall-run Chinook salmon returned to the hatchery, providing nearly 10 million eggs. The MRFH releases approximately 2 million of its Chinook salmon to San Pablo Bay for salmon fishery enhancement and approximately 4 million to the Mokelumne River near Thornton for mitigation purposes (Workman pers. comm.). In 2003, EBMUD began an experimental program that allows for the volitional release of approximately 100,000 juvenile Chinook salmon from the MRFH.

Estimates of adult escapement in the river have increased following the 1987–1992 drought, when significantly fewer adult Chinook salmon returned to the Mokelumne River. Over the last decade, adult escapement estimates have ranged from approximately 5,000 to more than 10,000 adults and are above the estimated long-term (1940–2003) average of nearly 4,000 adults (East Bay Municipal Utility District 2006). Along with the increase in adult escapement in the Mokelumne River since the 1987–1992 drought, there has been a corresponding increase in the number of redds in the river. For example, 844 Chinook salmon redds were observed during surveys in 2002, a significant increase over the 71 redds that were observed in 1990 during the drought (East Bay Municipal Utility District 2006). However, it is not known what proportion of the current in-river production may be the result of spawning of hatchery-produced adults.

Late Fall–Run Chinook Salmon

Adult late fall–run Chinook salmon enter the river from October through April, with a peak in December. Like fall-run Chinook salmon, late fall–run Chinook salmon spawn soon after entering their natal streams. Spawning occurs from early January through April (peak in February and March), and emergence begins in April and extends through June. Late fall–run Chinook salmon migrate downstream as juveniles or yearlings during November through May. Natural spawning populations of late fall–run Chinook salmon occur in the Sacramento River, between Keswick Dam to just below Red Bluff.

Winter-Run Chinook Salmon

Adult winter-run Chinook salmon leave the ocean and migrate through the Delta into the Sacramento River from December through July (Table 4.2-4). Spawning takes place from mid-April through August, and incubation continues through October (Table 4.2-4). Juvenile winter-run Chinook salmon rear and migrate in the Sacramento River from July through March (Hallock and Fisher 1985; Smith pers. comm.). Juveniles have been observed in the Delta during October through December, especially during high Sacramento River discharge in response to fall and early-winter storms. Winter-run salmon juveniles migrate through the Delta to the ocean from December through as late as May (Stevens 1989). Natural spawning populations of winter-run Chinook salmon occur in the upper Sacramento River and Battle Creek.

Spring-Run Chinook Salmon

Historical records indicate that adult spring-run Chinook salmon enter the mainstem Sacramento River in March and continue to their spawning streams where they hold in deep cold pools until September (Table 4.2-4). Unlike fall- and late fall–run, spring-run Chinook salmon are sexually immature during their spawning migration. Spawning occurs in gravel beds in late August through

October, and emergence begins in December. Spring-run Chinook salmon migrate downstream as young-of-year or yearling juveniles. Young-of-year juveniles move between February and June, and yearling juveniles migrate from October to March, with peak migration in November (Cramer and Demko 1997). Data from the CVP and SWP salvage records indicate that most spring-run Chinook salmon smolts are present in the Delta from mid-March through mid-May, depending on flow conditions (California Department of Fish and Game 2000). Natural spawning populations of Central Valley spring-run Chinook salmon are presently restricted to the accessible portions of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (California Department of Fish and Game 1998).

Adults and juveniles of all four races of Chinook salmon occur, or have the potential to occur, in the North Delta at one time or another. The Staten Island MWT and EBMUD electrofishing surveys have provided the most consistent catch data in the North Delta with respect to Chinook salmon. Fish population sampling indicates that Chinook salmon typically are present in North Delta channels from January through June, and from September through November. Based on EBMUD sampling, juveniles dominate the catch during winter and spring, while adults and some larger juveniles are present in the catch during fall. Chinook salmon typically are one of the most abundant native species collected by these two surveys; however their overall abundance relative to the capture of all other species combined is low, accounting for 0.7% and 2.6% of the total catch for the MWT and electrofishing surveys, respectively.

Central Valley Steelhead

Central Valley steelhead (*O. mykiss*) are the anadromous (sea-run) form of rainbow trout. Central Valley steelhead are listed as threatened under the ESA.

Steelhead have one of the most complex life histories of any salmonid species. Steelhead are anadromous, but some individuals may complete their life cycle in a given river reach without ever going to the ocean. Freshwater residents typically are referred to as rainbow trout, while anadromous individuals are called steelhead (National Marine Fisheries Service 1996a).

Historical records indicate that adult steelhead enter the mainstem Sacramento River in July, peak in abundance in September and October, and continue migrating through February or March (Table 4.2-4) (McEwan and Jackson 1994; Hallock 1989). Most steelhead spawn from December through April (Table 4.2-2), with most spawning occurring from January through March. Unlike Pacific salmon, some steelhead may survive to spawn more than one time, returning to the ocean between spawning migrations.

Juvenile migration to the ocean generally occurs from December through August (Table 4.2-4). Most Sacramento River steelhead migrate in spring and early summer (Reynolds et al. 1993). Sacramento River steelhead generally migrate as 1-year-olds at a length of 6 to 8 inches (15.2 to 20.3 cm) (Barnhart 1986; Reynolds et al. 1993). Although steelhead have been collected in most months at the state and federal pumping plants in the Delta, the peak numbers salvaged at these facilities occur in March and April in most years. Juvenile steelhead feed on a variety of aquatic and terrestrial insects and other small invertebrates.

After 2–3 years of ocean residence, adult steelhead return to their natal stream to spawn as 3- or 4-year-olds (National Marine Fisheries Service 1998).

Fish population sampling (i.e., the Staten Island MWT and EBMUD electrofishing surveys) indicates that steelhead typically are present in North Delta channels from January through May, and November. Based on EBMUD catch data for steelhead, juveniles dominate the catch in all months, and some adults have been collected in January, May and November. Approximately 10% of the steelhead captured in the EBMUD electrofishing surveys have been adipose clipped, indicating hatchery origin (unlike Chinook salmon, all hatchery steelhead are given an adipose fin clip before being released). Overall, steelhead abundance in the catch relative to other species is low, accounting for 0.3% and 0.8% of the total catch for the MWT and electrofishing surveys, respectively. In the Mokelumne River, some wild steelhead spawn every year and the Mokelumne River Fish Hatchery releases about 180,000 yearling steelhead annually from approximately 300,000 steelhead eggs procured from the Feather River Hatchery and, on average, about 85,000 eggs procured from returning adults to the Mokelumne River hatchery (Smith pers. comm.). In the past, Nimbus Hatchery steelhead were used to supply eggs to the Mokelumne River Fish Hatchery because of the small size of the run of returning adults in the Mokelumne River (McEwan 2001:11); DFG discontinued the importation of steelhead eggs from the Nimbus Hatchery in 2001 (Smith pers. comm.). The MRFH releases hatchery steelhead to the Mokelumne River near Thornton.

Delta Smelt

Delta smelt (*Hypomesus transpacificus*) are a slender-bodied fish that typically are less than 4 inches long. Delta smelt are listed as threatened under the ESA and CESA.

Estuarine rearing habitat for juvenile and adult delta smelt is typically found in the waters of the lower Delta and Suisun Bay where salinity is between 2 and 7 ppt. Delta smelt tolerate salinities ranging from 0 to 19 ppt. They typically occupy open shallow (less than 10 feet deep) waters but also occur in the main channel in the region where fresh water and brackish water mix. The zone may be hydraulically conducive to their ability to maintain position and metabolic efficiency (Moyle 2002).

Adult delta smelt begin their spawning migration into the upper Delta beginning in December or January (Table 4.2-4). Migration may continue over several months. Spawning occurs between January and July, with peak spawning during April through mid-May (Moyle 2002). Spawning occurs along the channel edges in the upper Delta, including the Sacramento River above Rio Vista, Cache Slough, Lindsey Slough, and Barker Slough. Spawning has been observed in the Sacramento River up to Garcia Bend during drought conditions, possibly attributable to adult movement farther inland in response to saltwater intrusion (Wang and Brown 1993). Eggs are broadcast over the bottom, where they attach to firm substrate, woody material, and vegetation. Hatching takes approximately

9 to 13 days, and larvae begin feeding 4 to 5 days thereafter. Newly hatched larvae contain a large oil globule and as a result are semibuoyant. Larval smelt feed on rotifers and other zooplankton. As their fins and swim bladder develop, they move higher into the water column. Larvae and juveniles gradually move downstream toward rearing habitat in the estuarine mixing zone (Wang 1986).

Delta smelt have been captured during sampling of North Delta monitoring sites from February through June. Overall, their current abundance in the catch is quite low, accounting for less than 1% of the total abundance of all species in the catch for all sites and sampling methods combined. Data for the Staten Island summer townet survey (at Little Potato Slough), which offers the best indication of long-term trends in catch data for delta smelt because of the longevity of the this sampling program, indicates that delta smelt were consistently captured during the 1960s and 1970s although their abundance relative to other species in the catch was low. Following 1981, delta smelt have been captured only once (1990) in the Staten Island summer townet survey. Since 1990, delta smelt have represented from 0 to 2.5% of the total catch in the various other surveys of the North Delta. The Staten Island MWT and 20 mm townet survey have consistently captured more delta smelt than electrofishing, and reflect the ability of this gear to sample open-water habitats that are favored by delta smelt.

Sacramento Splittail

Sacramento splittail (*Pogonichthys macrolepidotus*) were endemic to the sloughs, lakes, and rivers of California’s Central Valley but are now confined to the downstream reaches of the Sacramento and San Joaquin Rivers, and the Delta. Splittail are a CESA species of special concern.

Adult splittail are adapted for living in estuarine waters with widely fluctuating environmental conditions. They are found mostly in the Delta, Suisun Bay, Suisun Marsh, lower Napa and Petaluma Rivers, and other parts of the San Francisco estuary (Moyle 2002). In the Delta, they are most abundant in the north and west portions when the population is low; however, they are more evenly distributed in the Delta following years with more successful spawning. Like delta smelt, splittail are tolerant of salinities (commonly found at salinities between 10 and 18 ppt), although they seem to prefer lower salinities.

Adult splittail exhibit a gradual movement upstream during winter and spring, presumably to forage and spawn in flooded areas. They have been observed to leave Suisun Bay and the Delta during December through March (Table 4.2-4), and it appears that the Yolo and Sutter Bypasses provide important spawning habitat in years when the bypasses are flooded (Sommer et al. 1997). Both male and female splittail become sexually mature by their second winter at about 3.9 inches (10 cm) in length. Female splittail are capable of producing more than 100,000 eggs per year (Daniels and Moyle 1983; Moyle et al. 1989). Adhesive eggs are deposited over flooded terrestrial or aquatic vegetation when water temperature is between 48°F and 68°F (8.9°C and 20°C) (Moyle 2002; Wang 1986). Splittail spawn in late April and May in Suisun Marsh and between early March and May in the upper Delta and lower reaches and flood bypasses of the Sacramento and San Joaquin Rivers, and on the Cosumnes River Preserve (Moyle et al. 1989, 2004). Spawning has been observed to occur as early as

January and may continue through early July (Table 4.2-4) (Wang 1986; Moyle 2002).

The diet of adults and juveniles includes decayed organic material; earthworms, clams, insect larvae, and other invertebrates; and fish. The mysid *Neomysis mercedis* is a primary prey species, although decayed organic material constitutes a larger percentage of the stomach contents (Daniels and Moyle 1983).

Larval splittail are commonly found in shallow, vegetated areas near spawning habitat. Larvae eventually move into deeper and more open-water habitat as they grow and become juveniles. During late winter and spring, young-of-year juvenile splittail (i.e., production from spawning in the expected to be present in the flood bypasses when these areas are inundated during the winter and spring (Jones & Stokes Associates 1993; Sommer et al. 1997).

In the North Delta, splittail have been captured by all survey methods (townet, MWT, and electrofishing). Splittail have been collected at monitoring sites in the North Delta in January, February, March, May, June, August, October, and December. Overall, their abundance in the catch is quite low, accounting for less than 0.5% of the total abundance of all species in the catch for all sites and sampling methods combined. Their low abundance and sporadic occurrence in the catch, in combination with the relatively limited sampling, makes it difficult to conclude with any certainty any trends in the species' abundance patterns, timing of occurrence, or preference for habitats in the North Delta, except that their abundance relative to other species (especially non-natives) is quite low. For example, during the past 7 years of sampling by EBMUD using electrofishing, only 20 splittail have been captured from North Delta sampling sites despite sampling during periods when the species would be expected to occur either as adults migrating to upstream spawning areas or as juveniles moving downstream to the Delta.

Longfin Smelt

Longfin smelt (*Spirinchus thaleichthys*) are small euryhaline anadromous fish found in open waters of bays and estuaries. DFG has designated the longfin smelt as a species of special concern. The following text presents a summary of the life history and distribution information presented in Moyle (2002).

Historically, longfin smelt populations were found in Humboldt Bay and in the San Francisco estuary, as well as estuaries of the Klamath and Eel Rivers. In the San Francisco estuary, longfin smelt are rarely found upstream of Rio Vista in the Sacramento arm and Medford Island on the San Joaquin side. Concentrations of adults are usually found in Suisun, San Pablo, and North San Francisco Bays (Moyle 2002) across a wide range of salinities. However, after the juvenile stage, the longfin smelt tend to prefer salinities of 15–30 ppt. They are generally found in open water from the middle to the bottom of the water column.

The distribution of longfin smelt in the San Francisco estuary generally shifts downstream during summer, followed by an upstream shift in fall as adults begin to move into freshwater to spawn. Spawning occurs below Medford Island in the San Joaquin River and below Rio Vista on the Sacramento River. Spawning occurs mainly from February through April, but may happen as early as November and extend into June (Moyle 2002). Adults lay adhesive eggs over sandy and gravel substrates and often die after spawning.

Embryos hatch in about 40 days at 7°C. The buoyant embryos move into the upper part of the water column and are carried into the estuary. High outflows transport the larvae into Suisun and San Pablo Bays, where survival is often better than during low outflow years, when larvae move into the western Delta and Suisun Bay. Rearing habitat conditions are more favorable in Suisun and San Pablo Bays than in the Delta, where juveniles may become entrained and exposed to more adverse conditions (Moyle 2002).

Although longfin smelt are included in species lists furnished by the USFWS for the Project area, they have seldom been collected in the vicinity of the Project area. Fish sampling data from DFG's Bay-Delta Monitoring program indicate that only 10 longfin smelt were captured during the 20 mm Delta Smelt Survey near the Project area (Station 919) for the period of record from 1995 to 2005 (California Department of Fish and Game 2006). Data collected as part of the IEP monitoring program indicate that only one longfin smelt was caught near the Project area (summer townet survey, station 919) for the period of record from 1961 to 2005 (BDAT 2006). No longfin smelt were captured as part of sampling conducted by DFG (The Delta Resident Fish Monitoring Program) and UC Davis.

Green Sturgeon

The southern DPS (Distinct Population Segment) of green sturgeon (*Acipenser medirostris*) is currently listed as threatened under the ESA and as a California species of special concern. The southern DPS boundary includes all populations of green sturgeon south of the Eel River, with the only known population being in the Sacramento River (Adams et al. 2002).

Green sturgeon are the most widely distributed sturgeon species, known to range from nearshore waters of Mexico to the Bering Sea (Adams et al. 2002:1). Despite this large geographic range, the only known spawning locations for green sturgeon occur in the Klamath, Sacramento, and Rogue Rivers (Adams et al. 2002:1). In the southern DPS, adults and juveniles occur in the upper Sacramento River, where the majority of spawning occurs. Incidental capture of larval green sturgeon in salmon out-migrant traps indicates that the lower Feather River may be a principal spawning area, but spawning there has never been substantiated (Adams et al. 2002, 5). Juveniles are captured annually at trapping facilities at the Red Bluff Diversion Dam (RBDD) and the Glenn-Colusa Irritation District (GCID) pump on the Sacramento River (Adams et al. 2002:5). Adams et al. (2002) indicates that there is no documentation of green sturgeon currently spawning in the San Joaquin River. Young green sturgeon have been taken at Santa Clara Shoal, Brannan Island State Recreational Area, but these fish may have originated from another location (Adams et al. 2002).

Green sturgeon are the most marine species of sturgeon, making extensive oceanic migrations and coming into freshwater rivers only to spawn. Adults migrate into rivers to spawn from April to July, with May to June being the peak season. Green sturgeon first reach sexual maturity at age 15 for males and 17 for females, with spawning thought to occur every 3 to 5 years (Tracy 1990 in Adams et al. 2002). Preferred spawning substrate is likely large cobble but can range from clean sand to bedrock (Moyle 1992 in Adams et al. 2002:8). Eggs are broadcast and externally fertilized in relatively fast water and probably in depths >3 m. The importance of water quality is uncertain, but a small amount of silt is known to prevent the eggs from adhering to each other, thus increasing survival (Moyle 2002:111).

Following hatching, young green sturgeon grow rapidly. By 45 days post-hatching, juvenile green sturgeon grow to 74 mm (approximately 3 inches). Based on trapping at the RBDD and the GCID trap (downstream of RBDD), juvenile green sturgeon average 29 mm in June–July at RBDD and 36 mm in July at GCID (Adams et al. 2002:9). Juvenile sturgeon may spend between 1 and 3 years in freshwater before migrating to the ocean (Adams et al. 2002, 9) but may spend time near estuaries at first to rear (Moyle 2002:111). Juvenile green sturgeon have been collected in the Sacramento River, near Hamilton City, and in the Delta and San Francisco Bay. According to Kohlhorst et al. (1991), juveniles inhabit the estuary until they are approximately 4 to 6 years old, when they migrate to the ocean.

Adults and juvenile sturgeon are benthic (bottom) feeders but may also take small fish. Juveniles in the Sacramento–San Joaquin estuary feed primarily on opossum shrimp and amphipods (Moyle 2002:110).

River Lamprey

River lamprey (*Lampetra ayresi*) are currently listed by DFG as a species of special concern but have no other state or federal listing status (California Department of Fish and Game 2005:23). Although widely believed to be in decline, the exact status of this species is uncertain. Currently, very little information describing the abundance and distribution of river lamprey is available, perhaps partly because they are often overlooked and seldom studied.

Precise knowledge of the distribution of river lamprey in California is limited because of a lack of data and only a basic understanding of their life history (Moyle 2002:101–103). River lamprey are thought to occur throughout Pacific coast streams, but their occurrence in California includes tributaries to San Francisco Bay such as the Napa River, Sonoma Creek and Alameda Creek, and the Sacramento, San Joaquin, and Russian Rivers (Moyle et al. 1995:23–24; Moyle 2002:101–103).

Limited information is available regarding the life history of this species in California, and current accounts are based largely on information from Canadian populations (Moyle 2002:101–103). River lamprey are semelparous (i.e., they die after spawning) anadromous fish with long freshwater rearing periods. Adults return to freshwater to spawn in fall and winter, but spawning usually occurs in February through March in gravely riffles (Moyle 2002:101–103). Juvenile river lamprey (ammocoetes) remain in silty backwater habitats where they filter feed on various microorganisms for approximately 3–5 years before migrating to the ocean during late spring periods (Moyle et al. 1995:23; Moyle

2002:101–103). Adult lamprey feed on other fish and may reach a total length of around 17 cm (Moyle et al. 1995).

Pacific Lamprey

Pacific lamprey (*L. tridentata*) are found throughout Pacific coast streams, including streams in the Central Valley. Little information is currently available regarding the status of this species, and much of the life history information presented here is taken from Moyle (2002). Pacific lamprey are anadromous predatory fish, spending the predatory adult phase of their lives in the ocean.

Adult lamprey return to freshwater rivers to spawn between early March and late June, although the timing of migration may vary between river systems (Moyle 2002:97). They are capable of moving long distances upstream over considerable obstacles, with recent migrants observed in Deer Creek, a distance of roughly 440 km from the ocean (Moyle 2002:97). Spawning takes place in fairly swift currents in riffle areas containing gravel substrates. Eggs are laid into a nest excavated in the gravels and buried with finer gravels, sand, and silts. After hatching, juvenile lamprey are called ammocoetes. After spending a short time in the gravel after hatching, ammocoetes are washed downstream into suitable areas of sand or mud (Moyle 2002:98). Ammocoetes burrow into the soft substrates and begin a filter-feeding life stage that may last for 5–7 years. Upon completing the filter-feeding stage, the ammocoetes undergo a dramatic transformation to active predatory adults.

When the transformation is complete, Pacific lamprey then migrate to sea presumably during high flow events. Once at sea, Pacific lamprey begin to forage by latching on to the sides various fish species. Once attached, they begin to suck blood and body fluids from their prey. The predatory phase is usually short, lasting only 6 to 19 months (Moyle 2002:95).

Other Species

The assessment of impacts for the Project focus mainly on the special-status fish species described above. However, Central Valley rivers and the Delta support many other native and nonnative fish species that may be affected by the Project (Table 4.2-3). In general, the effects of the Project on other fish species are assumed to be encompassed in the assessment for the selected species.

In general, native species, such as Sacramento pikeminnow, hardhead, Sacramento sucker, and California roach spawn early in the spring. With some exceptions, nonnative species, such as green sunfish, bluegill, white and channel catfish, and largemouth bass, spawn later in the spring and in the summer. Nonnative species are more successful in disturbed environments than native species. In general, they are adapted to warm, slow-moving, and nutrient-rich waters (Moyle 2002). Nonnative species dominate the fish communities in the Delta and lower reaches of the Sacramento and San Joaquin Rivers and their tributaries, and this group is known to prey on smaller resident and migratory fishes, including juvenile Chinook salmon and steelhead (Moyle 2002).

Introduced species account for more than 85% of the catch at monitoring sites in the North Delta. In general, the proportion of the catch composed of nonnative species is highest during the summer, when water temperatures are at their warmest and many of the juveniles of native species (e.g., Chinook salmon, steelhead) have emigrated. Of the introduced species, American and threadfin shad, largemouth and spotted bass, sunfish, and striped bass appear to be the most abundant in the North Delta, based on the fish survey data. Striped bass, black bass, and sunfish are important sport fish that support a popular recreational fishery year round.

White Sturgeon

White sturgeon (*Acipenser transmontanus)* range in salt water from Mexico north to the Gulf of Alaska (Moyle 2002:107). Adults migrate to freshwater spawning areas in the Sacramento and Feather Rivers (winter through spring) (Moyle 2002:107). Larvae and young juveniles migrate to the lower parts of estuaries from early spring through mid-summer (Schafter 1997; Moyle 2002). They are most abundant in the San Francisco estuary (Moyle 2002:107).

Spawning migrations appear to be triggered by high flow of cold water associated with runoff from winter storms and spring snowmelt (Schafter 1997; Moyle 2002). White sturgeon spawn in fresh water, presumably in deep, fast currents of major rivers (Moyle 2002). Most of the white sturgeon life cycle is spent in the lower portions of the estuary and the Pacific Ocean. In the San Francisco estuary, white sturgeon most commonly spawn in the Sacramento River; juveniles have also been found in the Feather River, indicating that white sturgeon may also use the Sacramento's major tributaries for spawning (Schafter 1997; Moyle 2002).

White sturgeon spawning migrations may be dependent on the availability of cool water as these fish typically overwinter in fresh water between 7 and 12^{o}C (Cech and Doroshov 2004). Egg production in white sturgeon requires that females be exposed to cold (~10^{o}C) water (Cech and Doroshov 2004). The hatching success of white sturgeon eggs decreases at water temperatures above 20^{o}C, and no eggs hatch after incubation at and above 23^{o}C (Wang et al. 1985 *as cited in* Cech and Doroshov 2004). Larval white sturgeon showed a marked decline in survivorship at temperatures above 20^{o}C. Sturgeon are benthic foragers that have been reported to consume opossum shrimp, amphipods, small fish, clams, and crabs (Moyle 2002).

White sturgeon have been caught throughout the Sacramento River and Delta sampling areas. The majority of fish have been caught in the Chipps Island midwater trawl, the Putah Creek Sinks fyke net, and the Skinner Fish Facility (BDAT no date). As noted above, most white sturgeon reside in Suisun and San Pablo Bays (California Department of Fish and Game no date) and San Francisco Bay. White sturgeon may occur in the North Delta during their upstream spawning migration to the Sacramento River.

Striped Bass

Striped bass (*Morone saxatilis*) are one of the most abundant fish in the San Francisco estuary and are widely distributed along the Pacific coast (Moyle 2002:367). They are the most important sportfish in the estuary.

Striped bass spend most of their lives in San Pablo and San Francisco Bays and move upstream to spawn. Spawning can occur as early as April but peaks in May and early June when water temperatures range from 14 to 20°C. Spawning occurs in the Delta and in the Sacramento River. In the Sacramento River, striped bass spawn from below the mouth of the Feather River upstream to Colusa (Moyle 2002). During wet years, spawning may occur in the Sacramento River portion of the Delta and in the San Joaquin River upstream of the Delta. In low flow years, spawning may occur in the Delta. The exact location and timing of spawning is dependent on water temperature, flow, and salinity conditions. For this reason, there are two main spawning areas in the Delta: in the Sacramento River as far downstream as Isleton and in the San Joaquin River and its sloughs from Venice Island downstream to Antioch (Moyle 2002).

Striped bass spawn in open water, and their eggs must remain suspended in the current to prevent mortality. Embryos and larvae in the Sacramento River are carried into the Delta and Suisun Bay where rearing appears to be best (Moyle 2002). Larval and juvenile striped bass feed mainly on invertebrates, including copepods and opossum shrimp. Fish become a more important part of their diet as they grow in size (Moyle 2002). Young striped bass tend to accumulate in or just upstream of the estuary’s freshwater/saltwater mixing zone, and this region is critical nursery habitat (California Department of Fish and Game 1991a). Striped bass reach maturity at 4 to 6 years of age. Adult striped bass are open-water predators and opportunistic feeders and in the Delta feed mostly on threadfin shad and smaller striped bass (Moyle 2002:366).

Striped bass populations in the Delta have been in steady decline since the late 1970s. A changing atmospheric-oceanic climate may be at the root of this decline. The decline in striped bass abundance may be related to increasing ocean temperatures (Bennett and Howard 1999). Hatchery-raised striped bass were planted in the Delta between 1981 and 1992 to supplement wild populations (Moyle 2002). However, this practice was temporarily halted in 1992 because of concerns over striped bass predation on listed species. Since 1993, a pen-rearing program has been implemented that raises striped bass salvaged from the state fish trap at the SWP pumps. The striped bass are raised to a larger size before being released; they account for approximately 2% of the adult population (Moyle 2002).

Striped bass have been captured by all survey methods (i.e., townet, MWT, and electrofishing) in the North Delta, although their abundance in electrofishing catch is less numerous than it is for townet and MWT surveys. Striped bass typically are captured at North Delta monitoring sites from April through August, and occasionally have been captured in January, October, and November. Young-of-year, juveniles, and adults are collected frequently by the various surveys. Striped bass are often the most numerous species in the catch.

Warmwater Game Species

Warmwater game species include black bass (e.g., largemouth bass, smallmouth bass, spotted bass, and redeye bass), sunfish (e.g., bluegill, redear sunfish, green sunfish), and catfish (e.g., channel and white catfish, and bullhead). All of these introduced species support recreational fisheries; largemouth bass support one of the most popular recreational fisheries, including professional bass tournaments (Moyle 2002).

In California, these species are often the most abundant fishes in reservoirs, sloughs, and low elevation waterways and are quite abundant in the freshwater portions of the Delta. Centrarchids (i.e., black bass and sunfish) are carnivorous and construct open nests in the substrate to protect their eggs and young from predators (Moyle 2002). Similarly, the catfishes support popular recreational fisheries in warm waters of California, including the Delta. They attain large sizes and are highly edible, and therefore are popular among people looking to eat their catch. Catfish spawn in cavities, including submerged logs, broken concrete, and submerged burrows. Adults protect their eggs and young from predators.

Because of the immense popularity of largemouth bass with the recreating public, additional information on the life history of largemouth bass is provided below.

Largemouth Bass

Largemouth bass (*Micropterus salmoides*) were first introduced into California in 1874 and have since spread to most suitable waters. They are normally found in warm, quiet waters with low turbidity and beds of aquatic plants. Largemouth bass are an important sport fishery component of the Central Valley, including the Delta, and are one of the most sought after warmwater game fish in California. Largemouth bass are extremely vulnerable to angling, and this vulnerability helps to support a popular fishery, including bass tournaments that are popular among amateur and professional bass anglers.

Largemouth bass spawn for the first time during their second or third spring. Spawning activity usually begins in April, when water temperature reaches 61 degrees Fahrenheit, but could continue through June. Males build nests in sand, gravel, or debris-laden bottoms at a depth of 3 to 6 feet. The eggs adhere to the substrate and hatch in 2 to 5 days. The sac fry usually spend 5 to 8 days in or around the nest.

Largemouth bass are carnivorous. For the first month or two, fry feed mainly on rotifers and small crustaceans. By the time they are 2 to 3 inches long, they feed primarily on aquatic insects and fish fry. After reaching a length of 4 inches, largemouth bass feed primarily on fish (both native and introduced species) and large aquatic invertebrates. Optimal temperatures for growth are 68 to 86ºF.

In the Delta, largemouth bass populations are expanding. It has been postulated that this expansion is in response to increased habitat provided by the invasion of *Egeria densa* (an introduced aquatic weed) (Moyle 2002).

Largemouth bass have been captured by all survey methods in the North Delta; however, their relatively high abundance in electrofishing surveys probably reflects the bias of this gear toward shallow, nearshore habitats with extensive cover, which is favored by this species. Overall, largemouth bass account for approximately 10% of the total electrofishing catch in the North Delta.

Factors That Affect Abundance of Fish Species

Information relating abundance with environmental conditions is most available for listed species, especially Chinook salmon. The following section focuses on factors that have potentially affected the abundance of listed species in the Central Valley. Although not all species are discussed, factors affecting the listed species are assumed also to affect the abundance of other native and nonnative species in similar fashion.

Spawning Habitat Area

Spawning habitat area may limit the production of juveniles and subsequent adult abundance of some species. Spawning habitat area for fall-/late fall–run Chinook salmon, which compose more than 90% of the Chinook salmon returning to the Central Valley streams, has been identified as limiting their population abundance. Existing spawning habitat area has not been identified as a limiting factor for the less-abundant winter-run and spring-run Chinook salmon (National Marine Fisheries Service 1996b; U.S. Fish and Wildlife Service 1996), although habitat may be limiting in some streams (e.g., Butte Creek) during years of high adult abundance.

Spawning habitat area is defined by a number of factors such as gravel size and quality and water depth and velocity. Although maximum usable gravel size depends on fish size, a number of studies have determined that Chinook salmon require gravel ranging from approximately 0.1 inch (0.3 cm) to 5.9 inches (15 cm) in diameter (Raleigh et al. 1986). Steelhead prefer substrate no larger than 3.9 inches (10 cm) (Bjornn and Reiser 1991). Water depth criteria for spawning vary widely, and there is little agreement among studies about the minimum and maximum values for depth (Healey 1991). Salmonids spawn in water depths that range from a few inches to several feet. A minimum depth of 0.8 foot (0.2 m) for Chinook salmon and steelhead spawning has been widely used in the literature and is within the range observed in some Central Valley rivers (California Department of Fish and Game 1991b). In general, water should be at least deep enough to cover the adult fish during spawning. Minimum water depth for steelhead spawning has been observed to be enough to cover the fish (Bjornn and Reiser 1991). Many fish spawn in deeper water. Velocity that supports spawning ranges from 0.8 fps to 3.8 fps (0.2 to 1.2 m/sec) (U.S. Fish and Wildlife Service 1994).

Delta smelt spawn in fresh water at low tide on aquatic plants, submerged and inshore plants, and over sandy and hard bottom substrates of sloughs and shallow edges of channels in the upper Delta and Sacramento River above Rio Vista (Wang 1986; Moyle 2002). Spawning habitat area has not been identified as a factor affecting delta smelt abundance (U.S. Fish and Wildlife Service 1996), but little is known about specific spawning areas and requirements in the Delta.

A lack of sufficient seasonally flooded vegetation may limit splittail spawning success (Young and Cech 1996; Sommer et al. 1997). Splittail spawn over flooded vegetation and debris on floodplains inundated by high flows from February to early July in the Sacramento River and San Joaquin River systems. The onset of spawning appears to be associated with rising water levels, increasing water temperature, and day length (Moyle 2002). The Sutter and Yolo Bypasses along the Sacramento River are important spawning habitat areas during high flow.

Rearing Habitat Area

Rearing habitat area may limit the production of juveniles and subsequent adult abundance of some species. USFWS (1996) has indicated rearing habitat area in Central Valley streams and rivers limits the abundance of juvenile fall-run and late fall–run Chinook salmon and juvenile steelhead. Rearing habitat for salmonids is defined by environmental conditions such as water temperature, DO, turbidity, substrate, water velocity, water depth, and cover (Jackson 1992; Bjornn and Reiser 1991; Healey 1991). Chinook salmon also rear along the shallow vegetated edges of Delta channels (Grimaldo et al. 2000).

Environmental conditions and interactions among individuals, predators, competitors, and food sources determine habitat quantity and quality and the productivity of the stream (Bjornn and Reiser 1991). Everest and Chapman (1972) found juvenile Chinook salmon and steelhead of the same size using similar in-channel rearing area.

Rearing area varies with flow. High flow increases the area available to juvenile Chinook salmon because they extensively use submerged terrestrial vegetation on the channel edge and the floodplain. Deeper inundation provides more overhead cover and protection from avian and terrestrial predators than shallow water (Everest and Chapman cited in Jackson 1992). In broad, low-gradient rivers, change in flow can greatly increase or decrease the lateral area available to juvenile Chinook salmon, particularly in riffles and shallow glides (Jackson 1992).

Rearing habitat for larval and early juvenile delta smelt encompasses the lower reaches of the Sacramento River below Isleton and the San Joaquin River below Mossdale. Estuarine rearing by juveniles and adults occurs in the lower Delta and Suisun Bay. USFWS (1996) has indicated that loss of rearing habitat area would adversely affect the abundance of larval and juvenile delta smelt. The area and quality of estuarine rearing habitat is assumed to be dependent on the downstream location of approximately 2 ppt salinity (Moyle et al. 1992). The condition where 2 ppt salinity is located in the Delta is assumed to provide less habitat area and lower quality than the habitat provided by 2 ppt salinity located farther downstream in Suisun Bay. During years of average and high outflow, delta smelt may concentrate anywhere from the Sacramento River around Decker Island to Suisun Bay (Moyle 2002). This geographic distribution may not always be a function of outflow and 2 ppt isohaline position. Outflow and the position of the 2 ppt isohaline may account for only about 25% of the annual variation in abundance indices for delta smelt (California Department of Water Resources and Bureau of Reclamation 1994).

Rearing habitat has not been identified as a limiting factor in splittail population abundance, but as with spawning, a lack of sufficient seasonally flooded vegetation may be limiting population abundance and distribution (Young and Cech 1996). Rearing habitat for splittail encompasses the Delta, Suisun Bay, Suisun Marsh, the lower Napa River, the lower Petaluma River, and other parts of San Francisco Bay (Moyle 2002). In Suisun Marsh, splittail concentrate in the dead-end sloughs that have small streams feeding into them (Daniels and Moyle 1983; Moyle 2002). As splittail grow, salinity tolerance increases (Young and Cech 1996). Splittail are able to tolerate salinity concentrations as high as 29 ppt and as low as 0 ppt (Moyle 2002).

Migration Habitat Conditions

The Sacramento, Feather, Yuba, American, and Mokelumne Rivers and the Delta provide a migration pathway between fresh water and ocean habitats for adult and juvenile steelhead and all runs of Chinook salmon.

Migration habitat conditions include streamflows that provide suitable water velocities and depths that provide successful passage. Flow in the Sacramento, Feather, Yuba, American, and Mokelumne Rivers and in the Delta provides the necessary depth, velocity, and water temperature; however, flow and environmental conditions in the Central Valley are not always at optimal levels (e.g., see discussion below for water temperature). In the Delta, the channel pathways affect migration of juvenile Chinook salmon. Juvenile Chinook salmon survival is lower for fish migrating through the central Delta (i.e., diverted into the DCC and Georgiana Slough) than for fish continuing down the Sacramento River (Newman and Rice 1997). Similarly, juvenile Chinook salmon entering the Delta from the San Joaquin River appear to have higher survival if they remain in the San Joaquin River channel instead of moving into Old River and the South Delta (Brandes and McLain 2001).

Larval and early juvenile delta smelt are transported by currents that flow downstream into the upper end of the mixing zone of estuary where incoming saltwater mixes with outflowing fresh water (Moyle et al. 1992). Reduced flow may adversely affect transport of larvae and juveniles to rearing habitat.

Adult splittail gradually move upstream during the winter and spring months to spawn. Year class success of splittail is positively correlated with wet years, high Delta outflow, and floodplain inundation (Sommer et al. 1997; Moyle 2002). Low flow impedes access to floodplain areas that support rearing and spawning.

Water Temperature

Fish species have different responses to water temperature conditions depending on their physiological adaptations. Salmonids in general have evolved under conditions in which water temperatures need to be relatively cool. Delta smelt and splittail can tolerate warmer temperatures. In addition to species-specific thresholds, different life stages have different water temperature requirements. Eggs and larval fish are the most sensitive to warm water temperature.

Unsuitable water temperatures for adult salmonids such as Chinook salmon and steelhead during upstream migration lead to delayed migration and potential lower reproduction. Elevated summer water temperatures in holding areas cause mortality of spring-run Chinook salmon (U.S. Fish and Wildlife Service 1996). Warm water temperature and low DO also increase egg and fry mortality.

USFWS (1996) cited elevated water temperatures as limiting factors for fall- and late fall–run Chinook salmon.

Juvenile salmonid survival, growth, and vulnerability to disease are affected by water temperature. In addition, water temperature affects prey species abundance and predator occurrence and activity. Juvenile salmonids alter their behavior depending on water temperature, including movement to take advantage of local water temperature refugia (e.g., movement into stratified pools, shaded habitat, subsurface flow) and to improve feeding efficiency (e.g., movement into riffles).

Water temperature in Central Valley rivers frequently exceeds the tolerance of Chinook salmon and steelhead life stages. For example, adult fall-run Chinook salmon have been observed to stop their upstream migration when water temperatures exceed 66ºF (Hallock et al. 1970). For Chinook salmon eggs and larvae, survival during incubation is assumed to decline with increasing temperature between 54ºF and 61ºF (12.2°C and 16.1°C). (Myrick and Cech 2001; Seymour 1956 cited in Alderice and Velsen 1978.) For juvenile Chinook salmon, survival is assumed to decline as temperature warms from 64ºF to 75ºF (17.8°C to 23.9°C) (Myrick and Cech 2001; Rich 1987). Relative to rearing, Chinook salmon require cooler temperatures to complete the parr-smolt transformation and to maximize their saltwater survival. Successful smolt transformation is assumed to deteriorate at temperatures ranging from 63ºF to 73ºF (17.2°C to 22.8°C) (Marine 1997 cited in Myrick and Cech 2001; Baker 1995).

For steelhead, successful adult migration and holding are assumed to deteriorate as water temperature warms between 52ºF and 70ºF (11.1°C and 21.1°C). Adult steelhead appear to be much more sensitive to thermal extremes than are juveniles (National Marine Fisheries Service 1996a; McCullough 1999). Conditions supporting steelhead spawning and incubation are assumed to deteriorate as temperature warms between 52ºF and 59ºF (11.1°C and 15°C) (Myrick and Cech 2001). Juvenile rearing success is assumed to deteriorate at water temperatures ranging from 63ºF to 77ºF (17.2°C to 25°C) (Raleigh et al. 1984; Myrick and Cech 2001). Relative to rearing, smolt transformation requires cooler temperatures, and successful transformation occurs at temperatures ranging from 43ºF to 50ºF (6.1°C to 10°C). Juvenile steelhead, however, have been captured at Chipps Island in June and July at water temperatures exceeding 68ºF (Nobriga and Cadrett 2001). Juvenile Chinook salmon have also been observed to migrate at water temperatures warmer than expected based on laboratory experimental results (Baker 1995).

Delta smelt and splittail populations are adapted to water temperature conditions in the Delta. Delta smelt may spawn at temperatures as high as 72ºF (22.2°C) (U.S. Fish and Wildlife Service 1996) and can rear and migrate at temperatures as warm as 82ºF (Swanson and Cech 1995). Splittail may withstand temperatures as warm as 91ºF but prefer temperatures between 66ºF and 75ºF (18.9°C and 23.9°C) (Young and Cech 1996).

Entrainment

All fish species are entrained to varying degrees by the SWP and CVP Delta export facilities and many other smaller diversions in the Delta and Central Valley rivers. Fish entrainment and subsequent mortality are highly variable among species and may be a function of the size of the diversion, the location of the diversion, the behavior of the fish (Swanson et al. 2004, 2005), and other factors, such as fish screens, presence of predatory species, and water temperature. Diversions that divert relatively little water of the total channel with low approach velocities are assumed to minimize stress and protect fish from entrainment.

Juvenile striped bass populations have steadily declined since the mid-1960s partially because of entrainment losses of eggs and young fish at water diversions (Foss and Miller 2001). The CVP and SWP fish facilities indicate entrainment of adult delta smelt during spawning migration from December through April (California Department of Water Resources and Bureau of Reclamation 1994). Juveniles are entrained primarily from April through June. Young-of-year splittail are entrained between April and August when fish are moving downstream into the estuary (Cech et al. 1979 as cited in Moyle 2002). Juvenile Chinook salmon are entrained in all months but primarily from November through June when juveniles are migrating downstream.

Although several studies documenting entrainment at small, unscreened Delta diversions are available, few address population-level impacts or accurately estimate the total loss of fish at the diversions studied (Moyle and Israel 2005). Some diversions may in fact entrain large numbers of individuals. However, many studies report capturing mostly larval or post-larval fish, with the majority of the catch being dominated by nonnative species such as gobies, threadfin shad and striped bass (Cook and Buffaloe 1998; Nobriga et al. 2004).

Contaminants

In the Sacramento and San Joaquin River basins, industrial and municipal discharge and agricultural runoff transport contaminants into rivers and streams that ultimately flow into the Delta. Principal pollutants in the Delta are agricultural chemicals and their derivatives (Herbold et al. 1992:14). Organophosphate insecticides, such as carbofuran, chlorpyrifos, and diazinon, are present throughout the Central Valley and are dispersed in agricultural and urban runoff. The “first-flush” storm event or the “dormant spray” storm event is of most concern because of the higher concentration of contaminants in the runoff. In particular, diazinon and chlorpyrifos are applied to control wood-boring insects in dormant stone fruit orchards from December to February (Zamora, et al. 2003:2). These contaminants enter river in winter runoff and enter the estuary in concentrations that can be toxic to invertebrates (CALFED 2000). Unlike severe bioaccumulators such as organochlorine pesticides, organophosphate pesticides are typically metabolized by most invertebrates. However, some organophosphate pesticides do not bioaccumulate, and some do bioaccumulate. In particular, diazinon has a solubility of 68.9 mg/L (at 20ºC), but should not bioaccumulate in aquatic organisms (Zamora, et al. 2003:2). Chlorpyrifos, on the other hand, is more persistent in the environment and tends to be hydrophobic to the water column. Chlorpyrifos has a lower solubility than diazinon (1.12 mg/L at 24ºC), and has a significant potential to bioaccumulate in aquatic organisms (Zamora, et al. 2003:2). Because some organophosphate may accumulate in living organisms, they may become toxic to fish species, especially those life stages that remain in the system year-round and spend considerable time there during the early stages of development, such as Chinook salmon, steelhead, splittail, and delta smelt.

Mercury contamination from historical mining activities is extensive on both sides of the Central Valley, and occurs primarily from widely scattered hydraulic mining debris along eastside tributaries and active abandoned mines and associated debris piles on the west side. These sources continue to deposit significant amounts of mercury into the Bay-Delta system. The Cosumnes River, Yolo Bypass, and Sacramento River are the primary ongoing sources of mercury contamination in the Bay-Delta. Mercury occurs in several forms, including pure elemental mercury and toxic methylmercury. Mercury is mobile in aquatic systems as aqueous mercury or when attached to suspended particulate matter. Methylmercury is a significant water quality concern because small amounts can bioaccumulate in fish to levels that are toxic to humans and wildlife. In the Delta, mercury concentrations in bluegill, Sacramento sucker, and largemouth bass have been found to exceed the human health standard of 0.5 ppm by 2 to 6 times (Slotten 1991).

Other contaminants of particular concern in the Bay-Delta include high concentrations of trace elements such as selenium, copper, cadmium and chromium; however, their effects on higher trophic levels are poorly understood, in part as a result of the complex distribution of high concentrations in both time and space (Herbold et al. 1992:14). In general, it appears that the highest concentrations occur in areas where human activity adjacent to the bay is also the highest. Although these trace elements also occur naturally, concentrations of these trace elements have been found to be high enough to adversely affect the growth and reproduction of aquatic animals in laboratory experiments (Herbold et al. 1992:14)

Further discussion on water quality constituents of concern in the Delta can be found in Section 3.4, "Water Quality."

Predation

Nonnative species cause substantial predation mortality on native species. Studies at Clifton Court Forebay estimated predator-related mortality of hatchery-reared fall-run Chinook salmon to be from about 60% to more than 95%. Although the predation contribution to mortality is uncertain, the estimated mortality suggests that striped bass and other predatory fish, primarily nonnative, pose a threat to juvenile Chinook salmon moving downstream, especially where the stream channel has been altered from natural conditions. Turbulence after passing over dams and other structures may disorient juvenile Chinook salmon and steelhead, increasing their vulnerability to predators. Predators such as striped bass, largemouth bass, and catfish also prey on delta smelt and splittail (U.S. Fish and Wildlife Service 1996). However, the extent that these predators may affect delta smelt and splittail populations is unknown.

Food

Food availability and type affect survival of fish species. Species such as threadfin shad and wakasagi may affect delta smelt survival through competition for food. Introduction of nonnative food organisms may also have an effect on delta smelt and other species' survival. Nonnative zooplankton species are more difficult for small smelt and striped bass to capture, increasing the likelihood of larval starvation (Moyle 2002). Splittail feed on opossum shrimp, which in turn feed on native copepods that have shown reduced abundance, potentially attributable to the introduction of nonnative zooplankton and the Asiatic clam *Potamorcorbula amurensis*. In addition, flow affects the abundance of food in rivers, the Delta, and Suisun Bay. In general, higher flows result in higher productivity, including the higher input of nutrients from channel margin and floodplain inundation and higher production resulting when low salinity occurs in the shallows of Suisun Bay. Higher productivity increases the availability of prey organisms for delta smelt and other fish species.

Regulatory Setting

The following federal, state, and local laws, regulations, ordinances, and rules are related to biological resources and the construction and operation of the Project alternatives.

Federal

Endangered Species Act

The ESA of 1973 protects fish and wildlife species that have been identified by the USFWS and/or NMFS as threatened or endangered, and their habitats. *Endangered* refers to species, subspecies, or distinct population segments that are in danger of extinction through all or a significant portion of their range; *threatened* refers to species, subspecies, or distinct population segments that are likely to become endangered in the near future.

The ESA is administered by USFWS and NMFS. In general, NMFS is responsible for protection of ESA-listed marine species and anadromous fishes, while other listed species are under USFWS jurisdiction.

The following sections summarize specific provisions of Sections 9 and 7 of the ESA.

ESA Prohibitions (Section 9)

ESA Section 9 prohibits the take of any fish or wildlife species listed under the ESA as endangered. Take of threatened species is also prohibited under Section

9 unless otherwise authorized by federal regulations.[1] *Take*, as defined by the ESA, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." *Harm* is defined as "any act that kills or injures the species, including significant habitat modification." In addition, Section 9 prohibits removing, digging up, cutting, and maliciously damaging or destroying federally listed plants on sites under federal jurisdiction.

ESA Authorization Process for Federal Actions (Section 7)

ESA Section 7 provides a means for authorizing take of threatened and endangered species by federal agencies. It applies to actions that are conducted, permitted, or funded by a federal agency. Under Section 7, the federal agency conducting, funding, or permitting an action (the lead agency) must consult with USFWS or NMFS, as appropriate, to ensure that the proposed action will not jeopardize endangered or threatened species or destroy or adversely modify designated critical habitat. If a proposed project "may affect" a listed species or designated critical habitat, the lead agency is required to prepare a biological assessment (BA) evaluating the nature and severity of the expected effect. In response, USFWS or NMFS issues a biological opinion (BO), with a determination that the proposed action either

- may jeopardize the continued existence of one or more listed species (*jeopardy finding*) or result in the destruction or adverse modification of critical habitat (*adverse modification finding*), or
- will not jeopardize the continued existence of any listed species (*no jeopardy finding*) or result in adverse modification of critical habitat (*no adverse modification finding*).

The BO issued by USFWS or NMFS may stipulate discretionary "reasonable and prudent" conservation measures. If the Project would not jeopardize a listed species, USFWS or NMFS issues an incidental take statement to authorize the proposed activity.

Critical Habitat

Critical habitat, as defined in ESA Section 3, is:

I. the specific area within the geographic area occupied by a species, at the time it is listed in accordance with ESA, on which are found those biological features

   i. essential to the conservation of the species and

   ii. that may require special management considerations or protection; and,

II. specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

[1] In some cases, exceptions may be made for threatened species under ESA Section 4[d]; in such cases, the USFWS or NMFS issues a "4[d] rule" describing protections for the threatened species and specifying the circumstances under which take is allowed.

Aquatic habitats in the North Delta have been designated as critical habitat for the following species:

- Central Valley steelhead, and
- delta smelt.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation requires all federal agencies to consult with NMFS regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect essential fish habitat (EFH). EFH 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 should also be considered EFH. The phrase *adversely affect* refers to the creation of any impacts that reduce the quality or quantity of EFH. Federal activities that occur outside an EFH but that may, nonetheless, have an impact on EFH waters and substrate must also be considered in the consultation process. Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon Fishery Management Plan must also be considered.

State

California Endangered Species Act

CESA, administered by DFG, protects wildlife and plants listed by the California Fish and Game Commission as threatened and endangered under the act. CESA prohibits all persons from taking species that are state-listed as threatened or endangered except under certain circumstances; the CESA definition of *take* is any action or attempt to "hunt, pursue, catch, capture, or kill."

CESA Section 2081 provides a means by which agencies or individuals may obtain authorization for incidental take of state-listed species, except for certain species designated as "fully protected" under the California Fish and Game Code (see below). Take must be incidental to, and not the purpose of, an otherwise lawful activity. Requirements for a Section 2081 permit are similar to those used in the ESA Section 7 process. They include identification of impacts on listed species, development of mitigation measures that minimize and fully mitigate impacts, development of a monitoring plan, and assurance of funding to implement mitigation and monitoring.

California Fish and Game Code

Protections for Individual Species

The California Fish and Game Code (Code) provides protection from take for a variety of species. *Take* is defined under the Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill."

Certain species are considered *fully protected*, meaning that the Code explicitly prohibits all take of individuals of these species, except for take required for scientific research, which may be authorized by DFG in some situations. Section 5050 of the Code lists fully protected amphibians and reptiles, Section 5515 lists fully protected fishes, Section 3511 lists fully protected birds, and Section 4700 lists fully protected mammals.

Section 1600 Lake or Streambed Alteration Agreement Program

DFG regulates work that will substantially affect resources associated with rivers, streams, and lakes in California, pursuant to California Fish and Game Code Sections 1600–1607. Under Section 1602 of the California Fish and Game Code, any state or local governmental agency or public utility must notify DFG if it proposes to (1) divert, obstruct, or change the natural flow or bed, channel, or bank of any river, stream, or lake designated by DFG in which there is at any time an existing fish or wildlife resource or from which these resources derive benefit, (2) use materials from the streambeds designated by DFG, or (3) dispose or deposit debris, waste, or other materials containing crumbled, flaked, or ground pavement where it can pass into any river, stream, or lake designated by DFG.

Any person, governmental agency, or public utility proposing any activity that will divert or obstruct the natural flow or change the bed, channel, or bank of any river, stream, or lake or proposing to use any material from a streambed must first notify DFG of such proposed activity. This notification requirement applies to any work undertaken in the 100-year floodplain of a body of water or its tributaries, including intermittent streams and desert washes. In practice, however, the notification requirement generally applies to any work in the riparian corridor of a wash, stream, or lake that contains or once contained fish and wildlife or supports or once supported riparian vegetation.

Other Agreements

CALFED Bay-Delta Program

The mission of CALFED 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 System." This plan covers a multitude of activities, including storage, conveyance, levee integrity, water supply reliability, water use efficiency, water quality, water transfers, ecosystem restoration, and natural resource science studies.

Significance Criteria

Assessment species are selected based on listing under the ESA and CESA, listing in environmental management plans (e.g., local environmental plans and state resource agency plans), and ecological, economic, or social importance. The criteria for determining significant impacts on fisheries and aquatic ecosystems were developed based on the State CEQA Guidelines and significance criteria established in the CALFED Programmatic EIS/EIR (CALFED Bay-Delta Program 2000). Under CEQA, impacts are considered significant when Project actions, viewed with past, current, and reasonably foreseeable future Projects, potentially reduce the abundance and distribution of the assessed fish species (Public Resources Code section 21083; Guidelines section 15065). Significant impacts may occur through substantial:

- interference with the movement of any resident or migratory fish species;
- long- or short-term loss of habitat quality or quantity;
- adverse effects on rare or endangered species or habitat of the species that affect population abundance or distribution;
- adverse effects on fish communities or species protected by applicable environmental plans and goals; or
- degradation of aquatic ecosystem processes or the reduction of the structural characteristics of the aquatic ecosystem that support fish communities or species protected by applicable environmental plans.

The threshold for determining if an impact is "substantial" is any change in environmental conditions with Project implementation that could reduce the long-term average abundance or distribution of special-status species and species with economic or social value. A substantial change in the abundance and distribution of species likely would be detectable within the range of natural variability over time.

Determination of significance requires that the species population abundance and distribution would likely be reduced. Change in survival, growth, reproduction, and movement for any given life stage, however, may not affect the abundance and distribution of a species. Quantifying population-level effects is complicated by annual variation in species abundance and distribution in response to variable environmental conditions that may or may not be driven by human activities. In addition, beneficial effects may offset adverse effects for specific aspects of specific life stages, resulting in beneficial or minimal impacts on the overall population.

The significance thresholds under CEQA for species population abundance and distribution require maintenance of population resilience and persistence.

Resilience is the ability of the species to increase in abundance and distribution in response to improved environmental conditions. Persistence is the ability of the species to sustain itself through periods of adverse environmental conditions. The thresholds include:

- any permanent change in an environmental correlate that would substantially reduce the average abundance of the population over a range of weather-related conditions (e.g., water year types);
- any change in an environmental correlate that would permanently limit the geographic range and the seasonal timing of any life stage; and
- any potential reduction in population abundance, distribution, and production for years with deficient environmental conditions (e.g., water years 1987–1991 or years where weather-related conditions fall below the lowest 20th percentile).

The impact determinations under CEQA—beneficial, less than significant, significant, but avoidable with mitigation, and significant and unavoidable—are not to be confused with effects determinations for listed species and critical habitat that would be addressed during consultation under the federal ESA. Under the federal ESA, effects determinations include: No Effect; May Effect, Not Likely to Adversely Affect (NLAA); and Likely to Adversely Affect (LAA). A determination of No Effect means literally that no effect whatsoever will occur to the listed species or designated critical habitat. An NLAA determination includes effects that are insignificant and/or discountable and that do not rise in scope to the level of "take." Effects that result in short- or long-term incidental take of listed species or designated critical habitat support a determination of LAA.

While significance thresholds under CEQA may or may not be reached for this project, thereby leading to impact conclusions of less than significant and significant (but avoidable), these impact conclusions do not mean necessarily that project effects will not rise in scope to a level of LAA. Issues regarding LAA and take of special-status species will be addressed under the state and federal ESA consultation process.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of the CALFED program.

The discussion of significant impacts and mitigation measures in this section includes a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the Project. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to fish in the Project resource area are listed below.

The following mitigation measures will reduce potential effects of implementation of the Project alternatives on fisheries and aquatic systems (CALFED 2000 Appendix A):

1. Implement BMPs, including a storm water pollution prevention plan, toxic materials control and spill response plan, and vegetation protection plan.
2. Limit construction activities to windows of minimal species vulnerability.
3. Create additional habitat for desired species, including increased aquatic area and structural diversity through construction of setback levees and channel islands.
5. Operate new and existing diversions to avoid and minimize effects on fish--avoid facility operations during periods of high species vulnerability.
9. Coordinate and maximize water supply system operations flexibility consistent with seasonal flow and water temperature needs of desired species.
13. Use cofferdams to construct levees and channel modifications in isolation from existing waterways.
14. Use sediment curtains to contain turbidity plumes during dredging.
15. Schedule ground disturbing construction during the dry season.
16. Follow established and proper procedures and regulations for identifying, removing and disposing of contaminated materials.
17. Utilize the criteria and objectives in the Water Transfer Program, in conjunction with existing legal constraints on water transfers, to protect against adverse effects due to water transfers. The criteria for future water transfer proposals include: Transfers must not harm fish and wildlife resources and their habitats.

Impacts and Mitigation of the Project Alternatives

This assessment covers species that occur or have the potential to occur in aquatic environments potentially affected by the Project, including the North Delta, the Mokelumne and Cosumnes Rivers, and the Sacramento River. Although many fish species occur in the affected aquatic environment, the assessment focuses on special-status and important game fish species, including: Central Valley fall-/late fall–run Chinook salmon (ESA, species of concern), Sacramento River winter-run Chinook salmon (ESA and CESA, endangered), Central Valley spring-run Chinook salmon (ESA and CESA, threatened), Central Valley steelhead (ESA, threatened), delta smelt (ESA and CESA, threatened), green sturgeon (ESA, threatened), Sacramento splittail (ESA listing withdrawn [species of concern], state species of special concern), longfin smelt (state species of special concern), river lamprey (state species of special concern), Pacific lamprey, white sturgeon, striped bass, and black bass (and other sunfish).

Effects of North Delta Improvements Program Actions

Implementation of some of the Project actions could have short- and long-term (e.g., permanent) effects. Short-term effects are temporary and are primarily associated with the potential for disturbance or direct injury and mortality of fish and temporary loss of habitat. *Long-term* refers to effects that likely continue to affect species over several generations, well after completion of the Project action. Short- and long-term effects associated with Project actions are generally described below.

Short-Term Effects

Construction activities, including degrading and breaching levees, modifying landform and restoring agricultural land to habitat, and placing material for RSP could temporarily increase turbidity and suspended sediment in adjacent river channels and sloughs near construction sites. In addition, inundation of island habitat immediately following levee degrading or breaching could also result in temporary increases in turbidity and suspended sediment in newly inundated habitats and surrounding areas. Because the Project area is located downstream of all salmon, steelhead, lamprey, and sturgeon spawning areas on the Cosumnes, Mokelumne, and Sacramento Rivers and their tributaries, no impacts on spawning success or habitat suitability for anadromous fish would occur. Potential impacts on spawning success of warmwater game species are also considered less than significant because only small portions of these populations would be potentially affected by construction activities and because most spawning is believed to occur in slow-moving backwater areas or sloughs away from the main river channel.

Resident and migratory fish species would be temporarily displaced from construction areas during periods of in-water construction (e.g., levee degrading, placement of RSP). Both juvenile and adult fish will likely avoid these areas in response to disturbance and noise caused by in-water activities such as excavation associated with levee degrading and breaching and placement of material for RSP. The timing of these construction activities would occur in summer (i.e., during periods of relatively low river flow and dry weather) when adults and juveniles of anadromous species are less likely to be present in the North Delta. Rearing juveniles and adults of Delta species that are present and displaced from active construction areas may be temporarily exposed to predators while they attempt to locate suitable habitat.

Short-term increases in turbidity and suspended sediment may disrupt feeding activities of fish or result in temporary displacement of fish from preferred habitats. Juvenile Chinook salmon and steelhead, when present, could be directly affected because they depend on sight to feed. High concentrations of suspended sediment can also bury stream substrates that provide habitat for aquatic invertebrates, an important food source for many species, including juvenile salmonids. Consequently, growth rates of fish could be reduced if suspended sediment and turbidity levels substantially exceed ambient levels for prolonged periods. Potential impacts on water quality associated with construction activities are also addressed in Section 3.4, Water Quality.

Toxic substances used at construction sites, including gasoline, lubricants, and other petroleum-based products, could enter aquatic habitats as a result of spills or leakage from machinery or storage containers. These substances can kill aquatic organisms through exposure to lethal concentrations or exposure to nonlethal levels that cause physiological stress and increased susceptibility to other sources of mortality. Petroleum products also tend to form oily films on the water surface that can reduce dissolved oxygen levels available to aquatic organisms. Potential impacts on water quality associated with hazardous materials and contaminants are also addressed in Section 3.4, Water Quality.

Noise, vibrations, artificial light, and other physical disturbances caused by heavy equipment operation (e.g., dredging, pile driving) can harass fish, disrupt or delay normal activities, and cause injury or mortality. The potential magnitude of effects depends on a number of factors, including the type and intensity of the disturbance, proximity of the action to the water body, timing of actions relative to the occurrence of sensitive life stages, and frequency and duration of activities. For most activities, the effects on fish would be limited to avoidance behavior in response to movements, noises, and shadows caused by construction equipment operating in or adjacent to the water body. However, survival may be altered if these activities are of sufficient duration and magnitude to affect growth and spawning success. Injury or mortality may result from direct and indirect contact with machinery, sound pressure (e.g., pile driving), and physiological stress.

Long-Term Effects

General Effects

Past levee construction, channel realignment, and bank protection projects in the Delta have reduced the structural and hydraulic diversity of natural shorelines by eliminating overhanging and submerged woody vegetation (living and dead); undercut banks; and variation in water depths, velocities, and substrates. As a result, unvegetated banks with RSP support lower densities of juvenile Chinook salmon (U.S. Fish and Wildlife Service 1993:8). Removal of riparian vegetation in nearshore areas results in the loss of a primary source of instream and overhead cover (trees, limbs, logs, and root masses) for juvenile salmonids and other aquatic species. Instream and overhead cover elements are important components of shaded riverine aquatic (SRA) cover. Simple revetted slopes protected with RSP generally create nearshore hydraulic conditions characterized by greater depths and faster, more uniform water velocities than are found along natural banks. Higher water velocities tend to inhibit deposition and retention of sediment and woody debris. These changes reduce the range of habitats in comparison with the range found on natural shorelines, especially by eliminating the shallow, slow-velocity habitat preferred by many fish, including young salmonids.

Riverine Habitat Effects

Riverine habitat includes nearshore habitat that provides vegetative cover for a number of fish and wildlife species. Mitigation actions proposed for riparian and SRA cover impacts at RSP and levee degradation sites, in combination with proposed planting of reconfigured landslide levee slopes, would mitigate impacts on riverine habitat to a large degree. The remainder of the riverine habitat affected is largely characterized by areas of unvegetated, revetted areas and generally have lower habitat value for native fish species because of lack of cover and appropriate substrates for spawning (e.g., splittail) and invertebrate food production. Losses of riverine habitat will not adversely affect fish migration because access to upstream and downstream spawning and rearing areas will not be impeded and impacts on riverine habitat will be fully mitigated. Open-water riverine habitat would not be permanently affected, and native and resident fish species that use this habitat for feeding and movement (e.g., sturgeon, delta smelt) would be minimally affected.

Shaded Riverine Aquatic Cover Effects

Impacts on SRA cover are the major potential impact of levee degrading, levee breaching, and placement of RSP. SRA cover and its unique and irreplaceable value are described above under General Impacts. The impacts on SRA cover vary considerably among different locations (because of variability in existing occurrence of SRA cover) and proposed bank treatments (e.g., levee degradation versus levee breaching).

Because of its unique biological attributes and its increasing scarcity throughout the Sacramento and San Joaquin River systems, SRA cover has been designated a Resource Category 1 by USFWS (U.S. Fish and Wildlife Service 1992). A Category 1 habitat classification is defined by USFWS as “unique and irreplaceable on a national basis or in the ecoregion.” Accordingly, USFWS recommends that Project proponents actively seek impact avoidance and mitigation measures that result in no loss of existing SRA cover habitat value.

Mitigation of SRA cover effects would be in the form of revegetation to offset affected SRA cover and placement of instream woody material at proposed RSP sites to minimize habitat fragmentation.

Estuarine and Floodplain Effects

Levee degrading and levee breaching would result in both adverse and beneficial impacts on fish species as a result of changes in the quantity and quality of shallow-water habitat and frequency and duration of floodplain inundation.

Benefits associated with floodplain inundation include increased habitat diversity and area, input of large quantities of terrestrial material into the aquatic food web, and deceased competition (Sommer et al. 2001:326). Improved habitat conditions occurring in inundated floodplains are believed to be responsible for faster growth and migration rates in salmon and improved survival (Sommer et al. 2001:330–331). In contrast, floodplains can be a sink for fish production as a result of stranding and mortality from predation by birds and piscivorous fishes. Determinants of stranding potential on floodplains include the rate of stage reduction during floodplain drainage, topography, and possibly other factors.

While birds and piscivorous fishes may benefit from stranded fish, it is believed that the creation of large areas of rearing habitat results in the creation of refuges for young fish and decreases the probability that young fish will encounter a predator (Sommer et al. 2005:1502).

The creation of shallow-water habitat, however, may result in an increase in predator habitat, especially if permanent shallow-water habitat is created. In general, floodplain habitat that is seasonally inundated in winter and spring and then dewatered during summer and fall tends to favor native floodplain-spawning and -rearing fish species, while avoiding creating conditions that benefit alien species at the expense of native species.

Alternative NP: No Project

Under the No Project alternative, the Project components would not be built or operated. There would be no efforts to increase flood control or restore habitat for wildlife and fish. Under this alternative, all construction- and operation-related impacts that potentially could occur with implementation of the Project components would be avoided, including beneficial impacts. The existing conditions discussed above would be expected to continue. For example, there would be no creation of new floodplain spawning and rearing habitat for native fishes. Under this alternative, the trend in native fish population abundance and distribution would likely continue to follow existing long-term trends in response to changing habitat conditions and ongoing effects associated with introduced species. Alternately, the possibility for unintended colonization of newly restored native fish habitats by invasive species would be avoided.

Alternative 1-A: Fluvial Process Optimization

This section identifies potential construction- and operation-related impacts and mitigation for the Fluvial Process Optimization (1-A) alternative (Figure 2-1). Project action elements associated with this alternative include:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations

- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact mechanisms related to each Project action elements presented above are shown in Table 4.2-1. Impact mechanisms associated with each maintenance- and operation-related element are shown in Table 4.2-2.

This section also identifies the impacts and mitigation for the Fluvial Process Optimization (1-A) alternative with the following operational and maintenance-related action elements as related to fisheries and aquatic resources:

- periodic vegetation removal,
- placement of rock revetment,
- operation of weirs, levee breaches, and setback levees,
- maintenance of existing habitats and those created under this option,
- non-motorized boating,
- continued existence of starter channels, and
- continued existence of tidal habitats.

Sedimentation and Turbidity

Project actions that disturb the soil adjacent to the shoreline or areas that subsequently become inundated during high flow and placement of rock in the river could temporarily increase turbidity and suspended sediment in the North Delta. Increases in sedimentation and turbidity have been shown to adversely affect photosynthesizing plants and attached organisms, benthic invertebrates, and fish (Waters 1995). Disturbance to, and mobilization of, finer-sized particles (e.g., clay, silt, sand) are of most concern because of their potential to adversely affect aquatic plants and animals. The combination of the abundance of finer-sized material (the Delta's geology and sediment transport regime results in a sediment composition that is dominated by finer-sized substrates) and proposed operation of heavy equipment in or near aquatic habitats could result in the mobilization of fine sediments if BMPs and other measures intended to protect water quality are not implemented. In addition to increasing sedimentation in aquatic habitats, fine sediments entering aquatic habitats have the potential to remain in suspension for long periods of time, thereby elevating turbidity over time and space.

Increases in sedimentation and turbidity can adversely affect aquatic plants by: causing abrasion to plant surfaces and attached biota; uprooting or smothering rooted plants; and reducing light penetration in aquatic habitats, thereby adversely affecting the availability of light that is necessary for photosynthesis. Potential effects of increased suspended and deposited sediments on macroinvertebrates, an important fish food item, range from impairing respiration function to smothering organisms inhabiting the substrate.

High concentrations of suspended sediment can have both direct and indirect effects on fish. Chronic exposure to high turbidity and suspended sediment may affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). In general, larger fish tend to be more tolerant than smaller fish, while eggs and fry are the least tolerant. Chinook salmon and steelhead spawning habitat (and, therefore, eggs and yolk-sac fry) will not be affected because the project site is located downstream of all spawning areas in the Sacramento and Mokelumne Rivers and their tributaries. In-water construction activities are not likely to cause direct mortality of fish because the expected increases in turbidity and suspended sediment would be of short duration, limited in extent, and monitored for compliance with regulatory standards. In addition, any localized increases in suspended sediment and turbidity likely would be diluted quickly as a result of the mixing potential associated with the strong channel currents. Potential impacts on fish species will likely be limited to indirect effects resulting from the behavioral response of fish to turbid water and suspended sediment in the affected portion of the river.

Potential behavior effects associated with elevated levels of suspended sediment and turbidity include avoidance of high turbidity, changes in foraging ability, increased predation risk, and reduced territoriality. For example, salmonid rearing habitat quality and quantity may be reduced by fine sediment (Bash et al. 2001; Meehan 1991). Deposition of excessive fine sediment on the stream bottom could eliminate habitat for aquatic insects; reduce density, biomass, number, and diversity of aquatic insects and vegetation; and reduce the suitability of spawning habitat for estuarine species that spawn in the North Delta (e.g., delta smelt, splittail). Substantial sediment input could adversely affect the migration of migratory species. However, most increases in turbidity and suspended sediment would occur during approved work windows such as the summer period when fewer individuals of migratory species (e.g., Chinook salmon, steelhead, splittail, sturgeon) are likely to be present in the North Delta.

The diets of many species, especially juvenile salmonids, consist mostly of macroinvertebrates living in aquatic environments. Large amounts of fine sediments reduce or eliminate much of the suitable substrate necessary for macroinvertebrate production, essentially limiting the food available to juvenile salmonids (Meehan 1991) and other species.

The level of effect will be dependent upon the proximity of the Project site to fish habitat, and the duration, intensity, and disturbance that may be associated with a Project action.

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

Implementing Alternative-1A would require phased construction to complete the associated Project components (see above). Construction activities and techniques under this alternative have the potential to increase sedimentation and turbidity and subsequently negatively affect fish.

Reduced water quality associated with construction activities could adversely affect resident and migratory species, including delta smelt, splittail, Chinook salmon (all races), steelhead, striped bass, sturgeon, and other gamefish, and their habitats. Impacts of reduced water quality are assumed to affect all fish species in the Project area. However, the risk to species from degradation of water quality may differ depending on the timing of occurrence and life stages present. For example, because egg and larval life stages generally are more sensitive than older juveniles and adults to changes in water quality, those species that spawn and rear in the Delta are assumed to be most susceptible to water quality effects. In this respect, the discussion of this impact is not detailed by each species, but presented as a general impact for all fish species with an emphasis on early life and migratory stages.

Disturbance of soil adjacent to the shoreline and placement of RSP along levee toes and faces would temporarily increase turbidity (suspended sediments) above natural background levels in the immediate vicinity of these activities, potentially affecting fish species. It is expected that turbidity resulting from construction and maintenance activities would be intense in the vicinity of the activity but would rapidly attenuate with time and space.

Localized increases in turbidity could adversely affect fish and their habitat. However, quantifying turbidity levels and their effect on fish species is complicated by several factors. Turbidity associated with an instream activity will typically decrease with increasing distance from the site of the disturbance. The rate at which turbidity levels attenuate depends on the quantity of materials in suspension, the particle size of suspended sediments (smaller particles remain in suspension longer), dilution effects, and the physical and chemical properties of the sediments.

High concentrations of suspended sediment can have direct and indirect effects on fish. In general, larger fish tend to be more tolerant than smaller fish, while eggs and fry are the least tolerant. For salmonids, elevated turbidity levels have been observed to elicit several behavioral and physiological responses: gill flaring, coughing, avoidance, and increase in blood sugar levels. These responses indicate some level of stress. Stress responses are generally higher with increasing turbidity and decreasing particle size. Turbidity may reach levels associated with avoidance behavior and reduced feeding success. Migrating adult salmonids have been reported to avoid high silt loads or cease migration when such loads are unavoidable (Cordone and Kelley 1961 as cited by Bjornn and Reiser 1991). Juvenile salmonids tend to avoid streams that are chronically turbid (Lloyd et al. 1987) or move laterally or downstream to avoid turbidity plumes (Sigler et al. 1984).

The effects on juveniles and adults of Delta species are assumed to be similar to those discussed above for salmonids, except that Delta species are generally more tolerant of elevated turbidity and sedimentation levels, which naturally are more common in the Delta (high winds and tidal currents contribute to increased suspended sediments in the Delta). It is assumed that effects on Delta species are encompassed by the assessment of effects discussed above for salmonids, which have relatively narrow tolerances for environmental conditions compared to other species.

Prolonged reductions in water transparency attributable to turbidity could also reduce light available for photosynthesis, reducing primary and secondary production and, potentially, the availability of food for fish and other aquatic organisms (Waters 1995). Although elevated turbidity levels typically have a negative effect on fish, moderate levels of turbidity (e.g., 35–150 nephelometric turbidity units [NTUs]) have been shown to have beneficial effects through increased foraging rates presumably in response to reduced vulnerability to sight-feeding predators (Gregory and Northcote 1993).

When suspended particles settle from the water column, they contribute to sedimentation. Sedimentation can bury or suffocate eggs and developing embryos and result in indirect effects (e.g., displacement of prey availability and future spawning habitat, burial or smothering of aquatic vegetation and structural cover). Smothering of submerged aquatic vegetation may reduce the spawning habitat available for species such as splittail, delta smelt, and longfin smelt.

Construction-related effects associated with increased sedimentation and turbidity that have the potential to affect native and resident fish species, including anadromous species, are considered to be less than significant.

The potential for adverse effects on fish is low because:

- Environmental commitments, including an erosion and sediment control plan, SWPPP, hazardous materials management plan, spoils disposal plan, and environmental training, will be developed and implemented before and during construction activities (see Chapter 2, "Project Description," and Section 3.4, "Water Quality"). BMPs would be incorporated into a SWPPP and a toxic materials control and spill response plan as part of the NPDES requirements. NPDES permits typically govern construction activities such as grading, revegetation, and recontouring of disturbed areas; require the construction and operation of sediment catch basins; and govern the handling of on-site hazardous materials such as fuel, oil, and lubricants and construction-related materials such as concrete. The intent of NPDES permits is to reduce the potential for sediments and hazardous materials to enter waterways. Careful adherences to the Project's environmental commitments would eliminate the likelihood of any substantial contaminant input.

- Implementation of BMPs during construction activities, including the installation of silt curtains adjacent to construction sites, would limit the potential for disturbed soils to enter waterways, thereby limiting the potential for long-term increases in fine sediment input that may have adverse effects on aquatic communities through increased sedimentation or turbidity (see Chapter 2).
- Any increases in turbidity and sedimentation that may occur during Project construction and maintenance would be temporary and limited to a small portion of the Delta (the cumulative length of Delta channels is several hundred miles, and the water surface area of the Delta exceeds 60,000 acres [California Department of Water Resources 1995]) and would be diluted quickly because of river currents and tidal flushing.
- In-water construction (e.g., levee degradation, RSP) would be limited to authorized in-channel work windows as described under Environmental Commitments in Chapter 2. By limiting in-water construction to the dry season and during periods of relatively low fish abundance, and outside the principal spawning and migration season, of sensitive native species (e.g., delta smelt, splittail, salmonids), DWR would avoid or minimize the potential for impacts on fish from increases in suspended sediment and turbidity potentially caused by Project construction.
- Migratory and resident fish will likely move upstream, downstream, or laterally to an unaffected portion of the river in response to in-channel work and would therefore be unaffected by any increases in turbidity or sedimentation should they occur.
- If present, migratory species, such as adult and juvenile salmonids, would be expected to bypass channel reaches with elevated turbidity and sediment levels because a sufficient portion of the channel's width (i.e., zone of passage) would remain unaffected.

Sedimentation and turbidity effects would have a less-than-significant adverse impact on any fish species, including special-status species, because expected increases in turbidity and suspended sediment would be temporary, limited to a small portion of available habitat, and would occur primarily during authorized work windows when the relative abundance of sensitive fish species is low (i.e., during the summer); therefore, this impact is considered less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Hazardous Materials and Contaminants

Project actions may require fairly common construction materials (e.g., concrete) and petroleum products (e.g., fuels, lubricants, hydraulic fluids) that may be toxic to fish and other aquatic organisms. DWR or its contractor may store small quantities of these materials adjacent to construction sites, in staging areas. An accidental spill or inadvertent discharge of these materials adjacent to or in a water body potentially could affect the water quality of a river, slough, or wetland and thereby affect fish or fish habitat.

Hazardous materials that enter aquatic environments could pollute water and ultimately reduce the health and survival of fish that occur there. The potential magnitude of biological effects resulting from accidental or unintentional actions depends on a number of factors, including the proximity to the water body; the type, amount, concentration and solubility of the contaminant; and the timing and duration of the discharge. Contaminants can affect survival and growth rates, as well as the reproductive success, of fish and other aquatic organisms. The level of effect depends on species and life stage sensitivity, duration and frequency of exposure, condition or health of individuals (e.g., nutritional status), and physical or chemical properties of the water (e.g., temperature, dissolved oxygen).

Impact Fish-2: Temporary Disturbance, Direct Injury, and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

Project actions that involve the storage, use, or discharge of toxic and other harmful substances near streams and other water bodies (or in areas that drain to these water bodies) can result in contamination of these water bodies and potentially affect fish and other aquatic organisms. Potential impacts can range from avoidance of habitat in the vicinity of the Project site to mortality, which could occur through exposure to lethal concentrations of contaminants or exposure to nonlethal levels that cause physiological stress and increased susceptibility to other sources of mortality (e.g., predation, disease). Project actions that could result in the accidental or unintentional runoff or discharge of toxic materials and other harmful substances to aquatic environments include:

- potential accidental spill of petroleum products;
- potential accidental spill of herbicides;
- storage of pavement, petroleum products, concrete, and other construction materials;
- potential accidental spill of lubricants; and
- discharge of water from construction areas.

The operation of heavy equipment, cranes, dredges, and other construction equipment in or near water bodies can result in accidental spills and leakage of fuel, lubricants, hydraulic fluids, and coolants. Asphalt, wet concrete, and other construction materials used during construction may fall directly into water bodies or enter aquatic habitats in surface water runoff. Other sources of contaminants include the discharges from vehicle and concrete washout facilities.

The potential magnitude of biological effects resulting from these accidental or unintentional actions depends on a number of factors, including the proximity of aquatic habitats to the stream; the type, amount, concentration and solubility of the contaminant; and the timing and duration of the discharge. Contaminants can affect survival and growth rates, as well as the reproductive success, of fish and other aquatic organisms. The level of effect depends on species and life stage sensitivity, duration and frequency of exposure, condition or health of individuals, and physical and chemical properties of the water (e.g., temperature, dissolved oxygen).

Under the Project, accidental spills of herbicides and construction materials, such as concrete, fuels, oils, and sealants, are not expected. Careful adherence to the Project's spill prevention and response plan, as described in the Environmental Commitments section of Chapter 2, would ensure that equipment is available, workers are trained, and a management system is in place to prevent or respond to accidental spills. The spill prevention and response plan defines requirements for storage, handling, and containment of hazardous materials to emphasize protection of water quality. Important components of the plan include stipulations that hazardous materials will be stored and construction vehicles and equipment will be maintained outside of river channels and areas prone to inundation. Implementing BMPs, constructing only during authorized work windows that restrict the timing, duration, and extent of in-water work, will prevent accidental spills and unintentional actions from reaching levels that would cause measurable effects on survival, growth, and reproductive success of substantial portions of fish populations.

Contaminant effects would have a less-than-significant adverse impact on any fish species populations because any accidental spills would be contained quickly, effects on fish would be temporary and limited to a small portion of available habitat, and the potential for adverse water quality effects would be limited to periods when the relative abundance of sensitive fish species is low (i.e., during the summer); therefore, this impact is considered less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Disturbance and Direct Injury

Noise, vibrations, artificial light, and other physical disturbances can harass fish, disrupt or delay normal activities, or cause injury or mortality. The potential magnitude of effects depends on a number of factors, including the type and intensity of the disturbance, proximity of the action to the water body, timing of actions relative to the occurrence of sensitive life stages, and frequency and duration of activities. For most activities, the effects on fish will be limited to avoidance behavior in response to movements, noises, and shadows caused by construction personnel and equipment operating in or adjacent to the water body. However, survival may be altered if disturbance causes fish to leave protective habitat (e.g., increased exposure to predators) or the disturbance is of sufficient duration and magnitude to affect growth and spawning success. Injury or mortality may result from direct and indirect contact with humans and machinery, sound pressure (pile driving), and physiological stress.

Physical disturbance and injury is most likely to occur during in-water work. Construction-related activities that may involve in-water work include:

- degrading and breaching levees,
- installing RSP, and
- driving sheet piles.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

Construction elements of Alternative 1-A would involve using heavy equipment and other techniques that potentially would result in direct injury, including mortality, to fish in the Project area. In-water construction associated with levee breaches, levee degradation, and construction of a floodplain starter-channel could directly kill or injure fish through direct contact with construction equipment. Furthermore, placement of RSP could directly kill or injure fish present during time of rock placement. Resident fish, such as bass and sunfish, that use nearshore habitats are the most likely to be affected because these species would be most abundant in these habitats during time of construction (i.e., summer and early fall). In contrast, sensitive native species, such as delta smelt, splittail, and juvenile salmonids, would be less likely to be affected because these species typically occur in the Project site only seasonally (fall, winter and spring); consequently, their relative abundances in the Project area at the time of construction would be low.

Direct injury and mortality associated with direct contact with construction equipment and placement of RSP during construction would have a less-than-significant impact on fish species occurring in the Project area. The number of fish potentially injured during construction would likely be small because:

- in-water construction (e.g., levee degradation,) would be limited to periods of low abundance, and outside the principal spawning and migration season, of sensitive native species (e.g., delta smelt, splittail, salmonids);
- most fish will likely move upstream, downstream, or laterally to avoid the affected portion of the river in response to in-channel work;
- in-water construction activity would occur over a relatively short period (i.e., about two construction seasons); and
- the aquatic habitat that would be directly affected by construction equipment and placement of RSP represents a small percentage of the total stream habitat available, thereby limiting the number of fish potentially exposed to direct injury and mortality.

Determination of Significance: Less than significant.

Mitigation: None required.

Changes to Riparian Vegetation and Shaded Riverine Aquatic Cover

Riparian vegetation directly influences the quality of fish habitat, affecting cover, food, in-stream habitat complexity, streambank stability, and temperature regulation. Large woody debris usually originates from riparian trees and provides cover and habitat complexity in aquatic environments, an essential component of fish habitat. The roots of riparian vegetation at the land-water interface and on adjacent berms provide streambank stability and cover for rearing fish (Meehan 1991). Fine tree branches submerged in flowing water also provide habitat and are believed to provide greater value than large logs that create deadwater zones. Low-hanging branches are used by fish for escape cover from avian and terrestrial predators. Overhead riparian vegetation and instream woody material, including tree roots, woody material, and undercut banks, are important elements of SRA cover.

Riparian vegetation also provides shade and an insulating canopy that moderates water temperatures in both summer and winter. While the influence of shade on regulating river temperatures decreases as rivers become larger, the moderating effects of shade on nearshore water temperatures may be important to some fish species, including juvenile salmonids, during the growing season. The loss of riparian vegetation and shade is not expected to have a significant effect on overall water temperature in the North Delta; however, increases in solar radiation in nearshore areas currently shaded could cause water temperatures to increase along the channel margins, thereby adversely affecting habitat conditions in localized areas.

Riparian vegetation influences the food chain of a stream, providing organic detritus and terrestrial insects. Sunken logs and root systems provide stable substrates for attachment of aquatic organisms. Terrestrial organisms falling from overhanging branches contribute to the food base of the aquatic community. Salmonids in particular are primarily insectivores and feed mainly on drifting food organisms. River productivity is increased at all trophic levels by inputs of logs, branches, leaves, and detritus from overhanging vegetation and flooded steambanks and terraces. Input of vegetative debris provides substrates and foods for many species of aquatic invertebrates, which are eaten in turn by several fish species, including salmonids.

Because of the numerous ways riparian vegetation influences the stream ecosystem, the effects of altering riparian vegetation are highly variable, ranging from increased sedimentation and warmer localized stream temperatures to decreased food production and habitat complexity.

The Project would require the removal of riparian vegetation in several areas in the Project area. Removal of riparian vegetation would expose soils to erosive forces such as wind and rain, and could reduce overhead and instream cover (e.g., SRA cover). Cover encompasses the physical components of the stream environment that provide shelter, hiding, resting, and feeding areas for fish and other aquatic organisms. Construction-related activities may disturb or remove riparian vegetation, large woody debris, aquatic vegetation, and channel substrates and directly affect the quantity and quality of cover for fish and aquatic invertebrates. Project components that could affect riparian vegetation and cover include:

- degrading and breaching levees,
- placement of RSP, and
- dredging (see Dredge South Fork Mokelumne River Optional Alternative).

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

Some construction actions under this alternative (levee degradation, levee breaching) would result in the direct removal of riparian vegetation, some of which supports SRA cover habitat. Currently, much of the McCormack-Williamson Tract east levee and the levees surrounding the Grizzly Slough property are covered with riparian vegetation that provides extensive habitat heterogeneity and SRA cover habitat.

Construction elements of Alternative 1-A would involve the following:

- degrading 3,700 feet of the McCormack-Williamson Tract east levee to function as a weir;
- degrading 3,500 feet of the McCormack-Williamson Tract southwest levee to function as a weir;
- reinforcing 3,000 feet of the Dead Horse Island east levee;
- breaching 300 feet of the Mokelumne River levee of McCormack-Williamson Tract; and
- breaching or degrading portions of levees along the DWR-owned Grizzly Slough property adjacent to Bear and Grizzly Sloughs.

These actions would result in the permanent and temporary loss of up to 166.07 acres of valley/foothill riparian land cover types (see Impact VEG-1 in Section 4.1, "Vegetation and Wetlands," and Tables VEG-1 and VEG-2 in Attachment 4.1-1). Because much of this habitat also supports riparian vegetation that makes up SRA cover, these actions also would remove SRA cover. However, not all affected riparian vegetation supports SRA cover. For example, riparian vegetation on the interior levees of McCormack-Williamson Tract that would be inundated following degrading of the southwest levee would not result in any impacts on SRA cover because this vegetation currently does not support any SRA cover (i.e., it is presently located on the island side of the levee and is too far from the water's edge to support SRA cover). Following degrading of the southwest levee, however, flooding of McCormack-Williamson Tract would result in the inundation of this riparian vegetation which may result in creating additional SRA cover that partially or completely offsets the amount of SRA cover removed by Alternative 1-A actions.

No impacts on SRA cover would be expected as a result of reinforcing the Dead Horse Island east levee because the entire east levee is currently protected with RSP and supports a minimal amount of riparian vegetation. Levee degrading and breaching would result in the permanent loss of riparian vegetation and SRA cover habitat because following vegetation removal and levee excavation, the newly functioning weirs would be lined with RSP, precluding future establishment and growth of riparian vegetation. Table 4.3-5 summarizes the permanent and temporary effects of each Project component and Project operations on riparian habitat.

The effects of channel dredging on SRA cover would vary depending on the dredging method employed. For the purpose of this analysis it is assumed that one of the following dredging methods would be used: hydraulic, clamshell, or dragline.

- Hydraulic dredging would have no effect on SRA cover because it is assumed that all dredging operations would occur from the water; that the placement of conveyance pipes, settling basins, and dredging spoils would be placed outside of the dripline of riparian vegetation; and riparian vegetation would be fenced prior to implementation of dredging activities to prevent unintended impacts on SRA cover.
- Clamshell dredging could require the removal of dense stands of riparian vegetation, including vegetation supporting SRA cover, to allow for vertical and swing clearance of the excavator. For the purpose of this impact assessment it is assumed that all riparian vegetation, including vegetation supporting SRA cover, on the North Fork Mokelumne River in the channel dredging area would be removed and that SRA cover on the South Fork of the river could be avoided. It is assumed that all riparian vegetation removed, including vegetation supporting SRA cover, would not be restored in order to facilitate future dredging operations.
- Dragline dredging would require the removal of riparian vegetation, including vegetation supporting SRA cover, to allow equipment access. For the purpose of this impact assessment it is assumed that all riparian vegetation, including vegetation supporting SRA cover, in the channel dredging area would be removed. It is assumed that all riparian vegetation, and therefore SRA cover, removed would not be restored in order to facilitate future dredging operations.

The loss of riparian vegetation that supports SRA cover as a result of construction and Project operation activities would also result in fragmentation of existing SRA cover. Although some of the existing SRA cover is currently fragmented, further loss or fragmentation of SRA cover is considered to be significant. The additional fragmentation of SRA cover in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region.

Removal of SRA cover as a result of construction activities and Project operation (dredging) is considered a significant impact because of the unique value and relatively scarcity of this cover type in the Sacramento and San Joaquin River systems, and because SRA cover is an essential component of fish habitat, especially for listed salmonids.

Determination of Significance: Significant.

Mitigation Measure Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites.

To minimize SRA cover losses and reduce habitat fragmentation at degraded levee sites, DWR will incorporate instream woody material into RSP. Instream woody material will consist of multibranched pieces of wood more than 3 feet in length and 2 inches in diameter firmly anchored to shore at an elevation that is mostly submerged at low water levels. This measure will provide woody instream cover to replace, in part, that removed during construction. SRA cover would not be expected to be replaced by natural recruitment at degraded levee sites because RSP is would preclude revegetation at these sites.

Site-specific consideration of this mitigation measure will be evaluated to address potential effects on recreation safety both during and after construction. Issues of liability associated with placing material directly in the water column, and hydraulic concerns, may limit the use of this mitigation measure.

Mitigation Measure Fish-2: Quantify and Replace Affected Shaded Riverine Aquatic Cover.

Following final project designs and at least 1 year prior to Project construction, DWR will conduct surveys to quantify existing and affected SRA cover (in linear feet and area), including SRA cover supported by existing streamside riparian vegetation and instream woody material and riparian vegetation that currently does not support SRA cover but may support such cover in the future as a result of Project operation (e.g., that resulting from inundation of McCormack-Williamson Tract). For purposes of classification, SRA cover includes terrestrial (e.g., shoreline) and floodplain areas that support riparian vegetation and living or dead vegetation that are inundated during mean high water. In addition, the area of existing SRA cover includes aquatic areas extending from the shoreline to the outermost toward mid-channel) extension of either the vegetative canopy overhanging the water or the living or dead vegetation (Fris and Dehaven 1993). If surveys determine that a net loss in SRA cover will result from construction activities and Project operation, DWR will replace, in association with replanted riparian vegetation (see Mitigation Measure VEG-1), all affected SRA cover by planting riparian vegetation in shoreline and floodplain areas.

Candidate SRA cover mitigation areas include terrestrial (e.g., shoreline) and floodplain areas that are inundated during mean high water. Streamside vegetation plantings may also count towards SRA cover if they occur within 15 feet (horizontal distance) of the edge of the wetted channel (i.e., low-flow channel). SRA cover, represented by overhead vegetation and instream woody material in this analysis, is a Resource Category 1. The USFWS's mitigation goal for a Resource Category 1 habitat is no loss of existing habitat quantity or value. DWR will consult with fishery resource agencies (DFG, NMFS, and USFWS), RWQCB, and EBMUD to determine the appropriate candidate SRA cover mitigation areas and replacement ratio for affected SRA cover. Replacement ratios for SRA cover impacts often exceed the affected amount to account for the temporal loss of habitat value while newly replanted vegetation matures.

Although on-site mitigation is preferred, off-site mitigation for SRA cover losses may be needed to provide full compensation if existing constraints prevent full replacement of affected SRA cover quantities and values in the Project area.

Significance after Mitigation: Less than significant.

Floodplain Inundation

Floodplains were and continue to be an important habitat feature contributing to the abundance of native fish species in the Central Valley. Much of the land in the Central Valley presently available as floodplain habitat is agricultural land (e.g., Sutter and Yolo Bypasses) that floods only in years of above-average precipitation. Whether natural or modified, floodplains typically support riparian forests and a variety of wetlands. When inundated, these areas provide extensive rearing habitat for many fish species by providing abundant invertebrate food sources, low velocity refugia, and cover from predators (Holland and Huston 1985; Holland 1986; Moyle 2002:29; Paller 1967 in Crain et al. 2004). Juvenile salmonids in particular benefit from the extensive shallow, low-velocity areas as a result of abundant prey, suitable water temperatures, increased cover from inundated vegetation (riparian and agricultural) and elevated turbidity, and slower water velocities that help to regulate energy expenditures (Sommer et al. 2005:1500). Salmon rear on floodplain habitats on the Sacramento and the nearby Cosumnes Rivers for extended periods of time (Sommer et al. 2005:1499; Moyle et al. *in press*). In the Yolo Bypass, the mean floodplain rearing period for Chinook salmon may last from 33 to 56 days and provide excellent growth rates (Sommer et al. 200:1493).

Floodplain habitat also provides spawning habitat for other species, including native cyprinids (i.e., minnows) and alien fish species such as black bass and sunfish. For example, adult splittail spawn on terrestrial vegetation and debris on floodplains when inundation occurs during late winter and early spring (Moyle 2002:149).

The net benefit to native fish species from floodplain inundation, however, is dependent on several factors, including the timing and duration of flooding, water velocity and temperature, and the potential for fish stranding. For example, on the Cosumnes River, alien fish species have been observed to dominate floodplain habitats when flows are low and temperatures are high. Conversely, native larval fishes appear to benefit most from a natural hydrologic cycle in the spring that includes higher flows and cool temperatures (Crain et al. 2004:125). In addition, native fishes such as prickly sculpin, Sacramento sucker, and splittail (as well as nonnative common carp and bigscale logperch) are often associated with deeper inundation and lower temperatures, while alien species such as sunfish, bass, and inland silverside are associated with shallower inundation and higher temperatures (Crain et al. 2004:125).

Unless adequate connections between the floodplain and North Delta channels are maintained, floodplain inundation may increase the risk to native fish species by delaying migration or causing fish to become stranded as floodflows recede. Inundation of floodplain habitat may also attract piscivorous and avian predators, thereby exposing native fish to greater numbers of predators as they move onto inundated floodplains.

Based on studies from the Cosumnes River floodplain (Crain et al. 2004:140), strategies for maximizing benefits to native species with respect to managed floodplains may include: (1) limiting flooding to February through April followed by rapid draining, (2) limiting perennial aquatic habitat that supports alien fishes and (3) maintaining a mosaic of habitats on the floodplain that includes an abundance of annual terrestrial vegetation available for flooding.

Impact Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail, Delta Smelt, and Other Floodplain-Spawning Species, as a Result of Project Operation.

Project components include operation of the McCormack-Williamson Tract for flood control and breaching or degrading portions of levees along the Grizzly Slough property adjacent to Bear and Grizzly Sloughs. These actions would result in the flooding of habitats more frequently and for longer duration than under existing conditions.

Under Alternative 1-A, flow would begin spilling into McCormack-Williamson Tract over the north levee when water surface elevations reach 8.5 feet msl. However, because the southwestern levee will be degraded to –2.5 feet msl, water would begin to enter the McCormack-Williamson Tract from the south immediately as river levels surrounding the tract begin to rise. Water surface elevations of 8.5 feet msl generally occur during January through April and could inundate the tract for several weeks at a time (see Appendix E, Alternative 1-A for a more complete conceptual description of anticipated function).

The major objective of Alternative 1-A is to provide increased floodwater conveyance and habitat restoration by recreating floodplain habitat on the McCormack-Williamson Tract and Grizzly Slough property. If implemented, this alternative would create floodplain habitat on McCormack-Williamson Tract and on the Grizzly Slough Property. Although the precise acreage of additional floodplain habitat that would be created is difficult to quantify, these actions will increase the amount of floodplain habitat in the Project area compared to existing conditions. Results of hydrologic modeling indicate that up to 80% of this floodplain habitat on McCormack-Williamson Tract would be inundated at least once every 2 years. Floodflows that overtop the levees surrounding the McCormack-Williamson Tract would inundate the island with several feet of water.

In addition, on McCormack-Williamson Tract minor grading would occur to ensure native vegetation types would be restored, the landform would be modified to ensure positive drainage and provide more diverse geomorphic surfaces, and agricultural crops would be discontinued, and the land would be restored to native vegetation types for wildlife habitat. Similar work on the Grizzly Slough property would be undertaken to ensure that the potential for creating conditions for fish-stranding are minimized or avoided.

Flooding of McCormack-Williamson Tract under this alternative would occur in winter and spring when adult splittail are moving upstream to spawn. Floodplain inundation, coupled with the flooding of terrestrial vegetation, would increase the quantity and quality of spawning habitat for splittail and other floodplain-spawning species. The precise amount of suitable spawning habitat area that could be created for splittail and other floodplain-spawning species would depend on various factors, including the area of land inundated, water depths in inundated areas, and the timing and duration of inundation relative to the needs of spawning fish and rearing fry and juveniles. This impact is considered beneficial because implementation of the option will increase the amount and quality of spawning habitat in the North Delta for splittail and other floodplain-spawning species, relative to existing conditions.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation.

As discussed above under Impact Fish-5, implementation of Alternative 1-A would create additional floodplain habitat as a result of degrading the east and southwest levees on McCormack-Williamson Tract. In addition, up to 356 acres of perennial tidal shallow-water habitat would be created by lowering the elevation of the southwest levee to match the elevation of the island floor (i.e., between –1 foot and –2.5 feet). This would allow tidal water onto the tract from the southern end, facilitating the formation of dendritic intertidal channels at elevations near sea level and keeping the southernmost portion of the tract as shallow open water. Up to approximately 350 acres of floodplain habitat would be created on the Grizzly Slough property.

Juvenile Chinook salmon, splittail, and delta smelt rear in the North Delta. The creation of floodplain and tidal shallow-water habitat under this alternative is expected to benefit these species by:

- creating high quality floodplain rearing habitat,
- increasing food availability, and
- increasing growth rates.

Floodplain Rearing

Operation of McCormack-Williamson Tract for flood control would increase rearing habitat availability and quality when the floodplain is inundated. The precise area of suitable rearing habitat that would be created as a result of floodplain inundation would depend on various factors, including the area of land inundated, water depths in inundated areas, the occurrence of structural cover during inundation (e.g., vegetation), and the timing and duration of inundation relative to the rearing needs of fish.

Implementation of Alternative 1-A would likely have greater benefit for juvenile fall-run Mokelumne River Chinook salmon than any race of Sacramento River Chinook salmon because of the proximity of McCormack-Williamson Tract to the Mokelumne River (i.e., access to McCormack-Williamson Tract by Mokelumne River fish is not dependent on operation of the DCC gates). While on the floodplain, juvenile Chinook salmon exhibit a wide variety of habitat preferences. Based on studies in the Yolo Bypass, juvenile Chinook salmon have been found to be most numerous in low-velocity refugia in association with flooded trees, shoals, and the downstream portions of levees (Sommer et al. 2001:12). These types of habitats also would be present on McCormack-Williamson Tract as agriculture ceases and land use transitions to a more natural floodplain community. A major benefit of floodplain habitat is that it provides proportionally much more shoreline habitat than adjacent river channels in the form of internal levee structures, broad shoals, and flooded riparian patches (Sommer et al. 2001:12). In addition to Chinook salmon, other species, including splittail and delta smelt, would be expected to benefit from the creation of tidal shallow-water and floodplain habitat. For example, in the nearby Cosumnes River, juvenile splittail have been observed to rear on the newly created floodplain before emigrating to adjacent river channels and the estuary as floodwaters recede (Sommer et al. 2001:11).

Relative to historical extent, existing shallow vegetated areas in the Delta are limited. Therefore, the creation of additional shallow vegetated areas that may represent habitat for juvenile Chinook salmon, splittail, and delta smelt would represent a beneficial impact for these species.

Food Availability

Restoration of floodplain habitats would create excellent feeding opportunities for several juvenile fish species in the North Delta. Sommer et al. (2001:330) reported that juvenile Chinook salmon rearing on the Yolo Bypass floodplain had higher growth rates than juvenile Chinook salmon that remained in adjacent river channels. Higher growth rates resulted from increased water temperatures and higher prey consumption. The study found that juvenile Chinook salmon consumed significantly more prey items than in-river salmon, and were subsequently able to meet the higher metabolic demands of associated with the higher water temperatures found there.

Floodplains in the Central Valley are recognized as being the dominant source of organic carbon for the estuary in wet years (Jassby et al. 1995 as reported in Sommer et al. 2001). The biomass of phytoplankton, a high quality source of organic carbon for the estuary's food web, often increases in response to floodplain inundation, presumably in response to increased shallow-water area, increased residence time of water, and warmer water temperature in the floodplain (Sommer et al. 2001). Phytoplankton are responsible for most of the primary production in the estuary, and their biomass in the estuary has experienced a long-term decline, presumably in response to grazing by introduced bivalves, water exports and low outflow, and climate change (Sommer et al. 2001).

Floodplain systems can also be an important source of primary productivity. Although it is difficult to predict how much additional organic carbon will be available from inundation of additional floodplain area, any increase in primary production resulting from floodplain inundation is considered to be a benefit to the North Delta ecosystem. Studies from the Cosumnes River indicate that periodic connection and disconnection of the floodplain can provide downstream aquatic ecosystems with a source of concentrated algal biomass (Ahearn et al. *in press*). Increases in primary productivity can lead to increased fish production through greater food availability and is considered to be a beneficial impact.

Growth Rates

Habitat conditions during floodplain inundation can result in increased growth rates for fish as a result of higher water temperatures and greater abundance of quality food items (such as dipteran larvae). The combination of warmer water temperatures and increased food availability results in increased feeding success for young fish (Sommer et al. 2001:12). Studies show that juvenile Chinook salmon rearing on the Yolo Bypass floodplain had higher growth rates than juvenile Chinook salmon that remained in adjacent river channels (Sommer et al. 2001:12). The study also found that juvenile Chinook salmon on the floodplain consumed significantly more prey items and benefited from the warmer water temperatures found on the floodplain. Although this research focused on Chinook salmon, it is expected that other species such as splittail and Delta smelt may benefit in similar ways. Increased growth rates for fish in floodplain habitats are believed to be the result of the occurrence of extensive shallow, low-velocity areas combined with abundant prey resources and reduced energy expenditures (Sommer et al. 2005:1500). Increased growth rates in fish can improve juvenile survival by reducing their vulnerability to predation and through an improvement in condition factor (i.e., fitness) and is considered to be a beneficial impact.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-7: Fish Entrapment or Delayed Migration from Project Operation.

Project components, including operation of the McCormack-Williamson Tract for flood control, would result in more frequent and longer duration flooding of the tract than under existing conditions. Flow would begin spilling into McCormack-Williamson Tract over the east levee when water surface elevations reached 8.5 feet msl. However, because the southwestern levee will be degraded to –2.5 feet msl, water would begin to enter the McCormack-Williamson Tract from the south immediately as river levels surrounding the tract begin to rise. Water surface elevations of 8.5 feet msl generally occur during January through April and could inundate the tract for several weeks at a time (see Appendix D, Alternative 1-A for a more complete conceptual description of anticipated function).

Minor grading would occur on McCormack-Williamson Tract to ensure that native-vegetation types would be restored. In addition, the landform would be modified to ensure positive drainage to reduce the potential for fish stranding and to provide more diverse geomorphic surfaces. Agricultural crops would be discontinued on the tract, and the land would be restored to native vegetation types for wildlife habitat.

Floodflows that overtop the levees surrounding the McCormack-Williamson Tract would inundate the island with several feet of water. Flows over the levees would be expected to divert fish, including anadromous and special-status species, onto the tract. Entrainment of fish with diversion of flow onto managed floodplains (e.g., the Sutter and Yolo Bypasses) is a well-known occurrence in the Central Valley (Sommer et al. 2005:1495).

Under Alternative 1-A, during receding flood events, floodwaters would naturally drain from McCormack-Williamson Tract by gravity into the adjacent channels of Snodgrass Slough and the Mokelumne River. The McCormack-Williamson Tract floodplain would drain mainly through the southern end of the tract across the degraded weir (at –2.5 feet msl) and created tidal habitat. Additional floodplain draining may occur in the upper tract through the "starter channel" excavated to maintain a perennial connection with the Mokelumne River (See Appendix D, Alternative 1-A for more details of anticipated operation).

This alternative includes restoration of the Grizzly Slough property, which would also provide extensive floodplain habitat for North Delta fish species. Gradients across the Grizzly Slough floodplain would facilitate floodwater drainage through the northwest corner of the property and are not expected to pose a fish-stranding risk.

Flooding of McCormack-Williamson Tract and the Grizzly Slough property would occur in the winter and early spring when juvenile Chinook salmon and other species are in the North Delta. While the proposed modification to the landform on McCormack-Williamson Tract would ensure positive drainage to reduce the potential for fish stranding for fish diverted onto McCormack-

Williamson Tract, diversion of fish onto McCormack-Williamson Tract could result in the potential for delayed migration or entrapment of fish if scour holes or other low-lying areas that pond water form and become isolated from main channels. However, this potential is dependent on a number of variables, including the frequency and duration of floodflows that overtop the weirs, the coincidence of floodflows with the migration timing of adult and juvenile fish, and the behavior of adult and juvenile.

The potential for fish stranding of Chinook salmon (all races), steelhead, splittail, and delta smelt is discussed below.

Fall-/Late Fall–Run Chinook Salmon

Because the timing of emergence from gravels coincides with winter flows and their tendency to migrate to the Delta and the San Francisco Bay estuary shortly after emergence, juvenile fall-run Chinook salmon would be particularly vulnerable to entrainment with diversion of floodflows onto McCormack-Williamson Tract. Closure of the DCC gates in January and February–May would limit the potential for Sacramento River juvenile fall-run Chinook salmon migrating downstream to the Delta to be diverted into the Mokelumne River where they would be susceptible to diversion onto McCormack-Williamson Tract. In addition, because the DCC gates are usually closed when Sacramento River flows exceed 20,000–25,000 cfs, the risk for diverting significant numbers of juvenile fall-run Chinook salmon from the Sacramento River to the Mokelumne River during operation of McCormack-Williamson Tract is probably small. In contrast, juvenile fall-run Chinook salmon produced in the Mokelumne and Cosumnes Rivers would be at greater risk for diversion onto McCormack-Williamson Tract during Project operation because of the proximity of the Mokelumne River to McCormack-Williamson Tract.

Spring-Run Chinook Salmon

Spring-run Chinook salmon spawn only in the upper reaches of the Sacramento River and several of its tributaries (e.g., Butte, Deer, and Mill Creeks). Therefore, the occurrence of juvenile spring-run in the North Delta is largely dependent on their diversion to the Mokelumne River when the DCC gates are open. Because juvenile spring-run Chinook salmon begin entering the Delta as early as October, some juvenile spring-run may enter the North Delta when the DCC gates are open in October—January and could be diverted onto McCormack-Williamson Tract when the weirs are overtopped by floodflows. However, closure of the DCC gates in February–May would minimize the potential for spring-run young-of-year and smolts to be diverted onto McCormack-Williamson Tract. Overall, the potential for substantial numbers of juvenile spring-run Chinook salmon to be stranded on McCormack-Williamson Tract during receding flow events would likely be small.

Winter-Run Chinook Salmon

Like spring-run, winter-run Chinook salmon occur only in the Sacramento River. In general, juvenile winter-run enter the Delta at about the same time as described for spring-run. Consequently, the potential for juvenile winter-run to occur on McCormack-Williamson Tract and be at risk for stranding would be similar to that described for spring-run.

Steelhead

Sampling data indicate that steelhead are present in North Delta channels January–May, and in November and that juveniles are more abundant than adults. Unlike juvenile Chinook salmon, steelhead juveniles are less likely to use floodplain habitats for rearing. However, the diversion of flows over the weirs on McCormack-Williamson Tract would result in the potential for some migrating steelhead—young-of-year, juveniles, or smolts—also to be diverted onto McCormack-Williamson Tract, where they could be subject to delayed migration or entrapment as flows recede. For the same reasons as discussed above for fall-run Chinook salmon, the potential for diversion of steelhead onto McCormack-Williamson Tract would be greatest for Mokelumne River steelhead.

Splittail

Upstream movement of adult splittail is strongly correlated with flow events during February–April (Moyle et al. 2004:15). Seasonal inundation of floodplains and riparian areas provides both spawning and foraging habitat for splittail. For example, spawning has been documented on flooded areas along the lower Cosumnes River. While floodplain spawning requires relatively large increases in flows, some spawning likely occurs almost annually along river edges and backwater areas in response to small increases in flow.

Flooding of McCormack-Williamson Tract would likely result in the use of newly created floodplain habitat by adult splittail for spawning and foraging. This preference for inundated floodplains by adult splittail, combined with the strong association of splittail larvae with shallow edge habitat (Moyle et al. 2004:17), would likely make splittail a candidate for stranding as flows recede if ponding of water on McCormack-Williamson Tract were to occur.

Delta Smelt

Delta smelt are known to occur in the Mokelumne River system. Beginning in the fall, delta smelt begin moving upstream from the western Delta and Suisun Bay and into freshwater to spawn. Spawning typically occurs from December to July and is believed to occur in shallow, vegetated areas. Beaver, Hog, and Sycamore Sloughs (Figure 1-1) have been identified as important delta smelt spawning habitat (U.S. Fish and Wildlife Service 1996:27).

The occurrence of delta smelt in the Mokelumne River, the timing of their upstream movement from the western Delta, and their preference for shallow-water habitat for spawning indicate that the potential exists for delta smelt to actively move onto the tract in response to tidal flooding or be diverted from the Mokelumne River when floodflows overtop the weir. Stranding of delta smelt adults and larvae could occur if declining water surface elevations following inundation of McCormack-Williamson Tract result in the formation of isolated ponds as flows recede.

Although DWR would make minor grading and other modifications to the landform on McCormack-Williamson Tract to ensure positive drainage for reducing the potential for fish stranding, the potential remains for high flows to scour areas on McCormack-Williamson Tract that result in the formation of standing water that could become isolated and strand fish as floodflows recede. However, effects of potential fish stranding on native species associated with floodplain inundation and shallow-water habitat would probably be offset, to some degree, by the benefits of floodplain inundation and shallow-water habitat described above (e.g., increased food supply and growth rates). While it is not possible to predict the frequency or magnitude of fish stranding, this impact is considered to be significant because the potential exists for large areas to be scoured and form isolated pools that could result in stranding of fish, including special-status species. Furthermore, the potential for fish stranding to adversely affect the movement of any migratory species or result in mortality would contradict the intended goals of the ecosystem restoration component of the Project.

Determination of Significance: Significant

Mitigation Measure Fish-3: Monitor for Fish Stranding and Fill Any Substantial Scour Pools Formed following Large Flood Events That Result in Significant Flooding of McCormack-Williamson Tract. The potential exists for fish, including migratory juvenile fish, to become trapped in scour holes and other depressions that may form on McCormack-Williamson Tract and the Grizzly Slough property during Project operation as floodwaters recede. DWR will monitor McCormack-Williamson Tract and the Grizzly Slough property following flood events that inundate significant portions of the created floodplains to identify areas that may have scoured and that have resulted in fish stranding. If monitoring indicates that fish stranding has occurred, DWR will use appropriate methods (e.g., seining, electrofishing), as authorized, as soon as possible following isolation of the water body to remove stranded fish. Rescued fish will be released to the nearest main channel area. Qualified fish biologists will conduct monitoring and fish rescue operations. To reduce the potential for further fish stranding at locations where scour pools have formed following floodplain inundation, DWR will then use appropriate methods (e.g., grading, rock placement) to fill in new scour holes to reduce their potential to strand fish in the future. Scour areas and depressions that are identified to be potential stranding sites will be filled that year before the beginning of the next winter season.

Significance after Mitigation: Less than significant.

Impact Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation.

Alternative 1-A would create seasonally inundated floodplain habitat as well as up to 356 acres of perennial tidal shallow waters. Increased shallow-water habitat in and around the McCormack-Williamson Tract may lead to greater predation of sensitive fish species, such as Chinook salmon, delta smelt, and splittail, that use floodplain habitats. The following impact mechanisms may occur under this alternative:

- Loss of native fish in inundated floodplain habitat from predation as a result of increased abundance of invasive predatory fish species.
- Increased predator habitat.

Predation in Shallow Water

Annual flooding of McCormack-Williamson Tract, the establishment of a tidal channel with the breaching of the Mokelumne River levee, and the reintroduction of tidal flow to the southern portion of the McCormack-Williamson Tract is expected to result in the inundation of floodplain habitat and up to 356 acres of perennial shallow-water habitat. The inundation of additional floodplain habitat could increase the vulnerability to predation for native fish species that use inundated floodplain habitats. Project operation would result in the creation of additional perennial shallow-water habitat that could lead to an increase the abundance of invasive nonnative predatory fish species through increases in the quantity or quality of spawning and rearing habitat for these species. In addition, the creation of floodplain and shallow-water habitats could increase availability of habitat for predators during periods when these habitats are inundated. Native fish drawn into inundated floodplain and the tidal shallow-water habitats voluntarily or involuntarily may experience reduced survival through increased predation by piscivorous fish and birds.

Data collected near the McCormack-Williamson Tract from various fish sampling programs indicates that nonnative predatory fish such as largemouth bass, sunfish, and striped bass make up large percentages of the catch each year. As these species are already abundant in the waters adjacent to the McCormack-Williamson Tract, it is reasonable to assume that they will colonize any new suitable habitat that becomes available. Perennial water on floodplains as either ponds or sloughs mainly support invasive fish such as bass and sunfish that may be significant predators on native fish species (Feyrer et al. 2004:335). Crain et al. (2004:125) reported similar findings on the Cosumnes River, where alien fish species were found to dominate floodplain habitats when flows were low and temperatures were high.

The abundance of nonnative fish species could increase in response to an increase in the abundance or quality of spawning and rearing habitat associated with Project operation. However, the response of nonnative fish species populations to the increase in habitat availability would depend on a number of factors, including the amount of floodplain area inundated, the depth of water (many species spawn at water depths of less than 3 feet), and the timing and duration of inundation relative to the needs of these species. In general, the potential for effects would be greatest for operations that create perennial shallow-water habitats compared to operations that result in seasonal inundation of floodplain habitats because perennial shallow-water habitats are more likely than seasonal floodplain habitats to meet the spawning and rearing needs of nonnative species. Perennial shallow-water habitat that is created is also likely to be colonized by invasive aquatic weeds such as *Egeria densa*. Invasive aquatic weeds are believed to have led to further increases in habitat for nonnative fish species in the Delta (Moyle 2002:401).

Native fish species occupying inundated floodplain habitats and perennial shallow-water habitat may also experience reduced survival from predation by fish-eating birds that are attracted to shallow water. Birds such as grebes, herons, egrets, and white pelicans are commonly observed feeding in flooded agricultural fields and inundated floodplain habitats. The rate of predation would depend on several factors, including the depth and transparency of the water (predation rates would be lower in water having greater depths and low transparency), the density and behavior of fish and birds in flooded habitats, and the presence of cover available to fish from submerged and overhanging vegetation. However, Sommer et al. (2005:13) suggested that wading birds are not likely to have a significant population effect because of their low density in relation to the overall expanse of floodplain rearing area available. Predation from birds would be limited when the floodplain is fully inundated, abundant flooded vegetation is available, or water turbidity is high.

Increases in predators or predator habitat associated with the addition of shallow-water habitat and seasonally inundated floodplain habitat could cause an increase in mortality of native fish species. However, effects of increased predation on native species associated with floodplain inundation and shallow-water habitat would probably be offset, to some degree, by the benefits of floodplain inundation and shallow-water habitat described above (e.g., increased food supply and growth rates). In the absence of suitable quantities of cover, shallow-water habitat may provide greater benefits to predatory alien species and piscivorous birds at the expense of native fish species. For this reason this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-4: Develop and Implement a Floodplain and Shallow-Water Tidal Marsh Habitat Restoration and Monitoring Plan. DWR, in consultation with DFG, NMFS, and USFWS, will prepare a Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan to ensure that ecosystem restoration benefits for fish species are maximized, while minimizing the potential for adverse effects on native fish species from habitat creation (e.g., creation of predator habitat). The plan will provide the Corps and the resource agencies with sufficient information to determine the adequacy of the proposed mitigation and to issue a Section 404 permit. The Corps will approve the plan prior to Project construction activities that affect the Corps jurisdictional areas in the Project area.

The plan will be prepared to meet or exceed the specifications and mitigation requirements pertaining to Corps jurisdictional areas as specified by resource agency requirements. The plan will also be provided to the State Water Board to determine the adequacy of the proposed mitigation with respect to water quality and to issue a Section 401 water quality certification for the Project.

The goal of the mitigation effort is to avoid and minimize adverse effects on native species from creation of predator habitat, as well as maximizing benefits to native fish species through ecosystem restoration. To support this goal, the

Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan will meet the following objectives:

- to the extent practicable, design floodplain and shallow water tidal marsh habitats to maximize potential benefits to native fish species, while minimizing the creation of habitat favoring predatory fish species;
- facilitate early development of floodplain and shallow water tidal marsh habitats so that potential benefits are maximized as close to construction as is practicable;
- integrate concerns for special-status species (e.g., delta smelt, splittail, and Chinook salmon) into the habitat restoration design to the maximum degree practicable; and
- design the floodplain and shallow-water tidal marsh habitats so that, once established, they will require little or no maintenance.

DWR will submit a performance monitoring report to the Corps at the end of each monitoring year. The report will summarize monitoring methods, results, progress toward meeting the final performance standards, and corrective actions taken. The Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan will be fully developed as part of the AMP.

Significance after Mitigation: Less than significant.

Change in Timing and Magnitude of Water Diversions and Agricultural Discharges

There are at least 2,209 diversions in the Delta (Herren and Kawasaki 2001:347). Most water diversions are unscreened and, as such, are believed to be a significant cause of the loss and decline of many resident and migratory fish species (Herren and Kawasaki 2001:348).

Fish entrained in either unscreened or poorly screened diversions are assumed to be killed as a result of passage through the pump or diversion into agricultural drains and fields. To prevent fish, especially migratory and other sensitive species like Chinook salmon, steelhead, and delta smelt, from being entrained in these diversions, resource agencies (DFG, NMFS, and USFWS) have enacted fish screen requirements, particularly with respect to diversions that have the potential to entrain listed species.

The vulnerability of fish to diversion is assumed to vary according to species, time of day, the proportion of flow diverted, physical configuration of the diversion (e.g., depth of diversion opening) and, possibly, the ebb and flow of tides (Moyle and Israel 2005:25). While it is inconclusive whether individual diversions result in negative consequences for fish populations, it can be argued that the cumulative impact of having many unscreened diversions can be detrimental to fish populations.

Agricultural discharges may also contribute to factors that adversely affect fisheries resources. Agricultural cropland is a major nonpoint source of nitrogen and phosphorus contributing to the nutrient enrichment of waterways, which can contribute to the eutrophication of waterways. Elevated nitrogen and phosphorus levels can affect the delicate balance between undesirable algal species, such as blue-green algae, and desirable flora. Typically, water bodies receiving excessive nutrient loads are most susceptible to blooms of blue-green algae. These algae are very prolific when excessive levels of nitrogen, phosphorus, or both are present and may alter the aquatic food chain if they become overly abundant. The algae blooms are unsightly and may pose problems (such as toxicity and bad taste or odor) to recreational users of the water. The algae can also consume much of the dissolved oxygen, creating stressful and sometimes, fatal conditions for fish and other aquatic life that depend on dissolved oxygen for survival. This problem is more acute when the waters are stagnant or have slow circulation.

Under existing conditions, McCormack-Williamson Tract contains water management infrastructure to facilitate agricultural practices, including approximately five irrigation pumps and siphons that draw water out of adjacent waterways and two drainage pumps that return excess water to the surrounding waterways, in addition to portable pumps and a domestic well pump. Table 2-3 lists the existing pumps at McCormack-Williamson Tract.

Impact Fish-9: Forgone Water Diversion and Agricultural Discharges.

McCormack-Williamson Tract contains water management infrastructure to facilitate agricultural practices, including approximately five irrigation pumps and siphons that draw water out of adjacent waterways and two drainage pumps that return excess water to the surrounding waterways, in addition to portable pumps and a domestic well pump. The irrigation and drainage pumps are located around the perimeter of McCormack-Williamson Tract (see Table 2-3 and Figure 2-1).

Under existing conditions, pumped water volumes (i.e., af per month) vary by diversion and month (Table 2-4). Various species of resident and migratory fish, including special-status species, are likely entrained by these unscreened diversions. However, it is not known to what degree these unscreened agricultural diversions entrain fish because entrainment rate is dependent on many factors such as species, fish size, life stage, swimming performance, fish behavior, fish abundance (density), diversion rate, and diversion configuration.

The existing pumps and water management infrastructure would be selectively decommissioned or reused to facilitate habitat development. Table 2-4 describes the change in use for each pump that would occur under Alternative 1-A. As discussed in Chapter 2 under Environmental Commitments, DWR would screen the remaining agricultural diversions following current DFG and NMFS screening guidelines. The net effect of implementing Alternative 1-A and screening the remaining pumps would be a reduction in total diversion and fish entrainment associated with in-river diversions to McCormack-Williamson Tract and improved water quality conditions in adjacent waterways from reduced discharge of agricultural runoff. Although difficult to quantify, the net effect of adding fish screens to existing agricultural diversions and forgone pumping and agricultural discharge on fisheries is considered to be beneficial.

Determination of Significance: Beneficial.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This section summarizes the impacts and mitigation for the components of Alternative 1-B (Figure 2-15):

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact mechanisms related to each Project action element presented above are shown in Table 4.2-1. Impact mechanisms associated with each maintenance- and operation-related element are shown in Table 4.2-2.

This section also summarizes the impacts and mitigation for the Seasonal Floodplain Optimization (1-B) alternative with the following operational and maintenance-related action elements as related to fisheries and aquatic resources:

- periodic vegetation removal,

- periodic placement of soil,
- placement of rock revetment,
- replacement of water control structures,
- operation of weirs, levee breaches and setback levees,
- maintenance of existing habitats and those created under this option, and
- tide gate operation.

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

Some construction actions under Alternative 1-B (levee degradation, levee breaching, tide gate construction) would result in the direct removal of riparian vegetation, some of which supports SRA cover habitat. Construction activities would result in the loss of SRA cover in similar amounts as that described under Alternative 1-A. However, because Alternative 1-B would not involve the breaching of the Mokelumne River levee, SRA cover losses under this alternative would be slightly less (up to approximately 300 feet less) than under Alternative 1-A. For reasons described under Alternative 1-A, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites.

Mitigation Measure Fish-2: Replace Affected Shaded Riverine Aquatic Cover.

Significance after Mitigation: Less than significant.

Impact Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail and Other Floodplain-Spawning Species, as a Result of Project Operation.

Under Alternative 1-B, levee breaching and degrading would occur on McCormack-Williamson Tract and Grizzly Slough. The timing, frequency, and duration of floodplain inundation on the tract would be different from floodplain inundation described under Alternative 1-A because the southwest levee would be degraded to 5.5 msl instead of –2.5 msl. For example, the higher elevation of the degraded southwest levee would mean that flooding of the tract from the southwest would not occur as early as it would under Alternative 1-A; however, the tract would flood from spills over the east levee with the same frequency and duration as under Alternative 1-A. In addition to the higher levee elevation, the proposed use of self-regulating tide gates would prevent tidal flooding of the island during low-flow seasons. Under Alternative 1-B, up to approximately 900 acres of land on McCormack-Williamson Tract would be subject to seasonal flooding. Floodplain inundation on the Grizzly Slough property would be similar to that described under Alternative 1-A.

Overall use of McCormack-Williamson Tract by floodplain-spawning species under Alternative 1-B could be greater than the use expected under Alternative 1-A because more seasonal floodplain habitat would be created. However, the benefits of this increased availability of floodplain habitat could be diminished by the potential increase in stranding potential because water would pond behind the degraded southwest levee, and fish occupying habitats on the tract would have to exit the tract through either the tide gates or the drainage pumps. In addition, the higher elevation of the degraded southwest levee remnant would prevent tidal flooding of the southern end of the tract; consequently movement of fish from the main channel onto the tract may be less than expected under Alternative 1-A.

Relative to existing conditions, operations under Alternative 1-B would potentially increase spawning habitat on McCormack-Williamson Tract for floodplain-spawning species; therefore, this impact is considered to be a benefit for the same reasons discussed under Alternative 1-A.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation.

Under Alternative 1-B, up to 900 acres of floodplain habitat would be created as a result of degrading the east and southwest levees on McCormack-Williamson Tract. Approximately 350 acres of additional floodplain habitat would be created on the Grizzly Slough property. The tidal shallow-water habitat described under Alternative 1-A would not be created under this alternative.

Overall use of McCormack-Williamson Tract by floodplain-rearing species under Alternative 1-B could be greater than the use expected under Alternative 1-A because more seasonal floodplain habitat would be created. However, the benefits of this increased availability of floodplain rearing habitat could be diminished by the potential increase in stranding potential because water would pond behind the degraded southwest levee, and fish occupying habitats on the tract would have to exit the tract through either the tide gates or the drainage pumps. In addition, the higher elevation of the degraded southwest levee remnant would prevent tidal flooding of the southern end of the tract; consequently movement of fish from the main channel onto the tract may be less than expected under Alternative 1-A.

Relative to existing conditions, operations under Alternative 1-B would increase rearing habitat on McCormack-Williamson Tract for floodplain-rearing species; therefore, this impact is considered to be a benefit for the same reasons discussed under Alternative 1-A.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-7: Fish Entrapment or Delayed Migration from Project Operation.

Project components on McCormack-Williamson Tract would be the same as described under Alternative 1-A, except that:

- the southwest levee on McCormack-Williamson Tract would be lowered to 5.5 feet msl instead of –2.5 feet msl;
- breaching of the Mokelumne River levee would not occur;
- grading to encourage formation of dendritic channels would not occur;
- pumping would be required to facilitate drainage of the tract during warm weather; and
- box culvert drains and self-regulating tide gates would be constructed.

Under Alternative 1-B, flooding of McCormack-Williamson Tract would occur more frequently than under existing conditions because the east and southwest levees would be lower than under existing conditions. The resulting increase in the frequency of flooding of the tract relative to existing conditions would likely increase the potential for fish stranding as floodflows recede. In addition, the potential for fish stranding would be greater than expected under Alternative 1-A because under Alternative 1-B water would pond behind the southwest levee, which would be degraded only to an elevation of 5.5 feet msl, instead of –2.5 feet msl under Alternative 1-A.

Fish occupying inundated habitats on McCormack-Williamson Tract under Alternative 1-B would be able to leave the tract only as water drains through the tide gates or is pumped over the levee once water surface elevations on the tract drop below the elevations of the constructed weirs. Because water trapped behind the levees on McCormack-Williamson Tract would only drain through the tide gates when water surface elevations in the channel are lower than those on the tract (i.e., typically twice a day when tides are receding), fish occupying inundated habitats on McCormack-Williamson Tract would have less opportunity than under Alternative 1-A to reenter the Delta, thereby potentially increasing their risk to migration delays or, worse, stranding. Fish occupying inundated habitats on McCormack-Williamson Tract may experience reduced survival because of predation, worsening environmental conditions (e.g., increasing water temperature), and habitat dessication or direct injury and mortality from passage through the pumps. In general, survival rates for many native species would be expected to decline as the season progresses in response to increasingly unfavorable water quality (e.g., increasing water temperature), and possibly other factors. By contrast, alien species may be more likely to reenter Delta channels because of their greater tolerance of warmwater conditions.

Under Alternative 1-B, the potential for fish stranding as a result of Project operation would be greater than that discussed under Alternative 1-A because:

- there would be no perennial connection between the created floodplain and adjacent river channels, such as the "starter channel" or the intertidal habitat proposed under Alternative 1-A; therefore, drainage of the floodplain would occur through the box culvert/nekton gates and by pumping; and,
- fish behavior or other factors may prevent or discourage fish from using the box culverts, tide gates, and pumps to reenter the Delta.

The greatest potential for fish stranding would likely occur at the southern portion of the tract against the southwest levee where water would pond behind the levee. The floodplain elevation at this location is lower than the water surface elevation in the adjacent Delta channels and would preclude this area of the tract from draining completely, thereby requiring that pumps be used to fully dewater the island.

As discussed above under Alternative 1-A, fish stranding can often be avoided through proper grading and drainage of the floodplain. However, even on properly managed floodplains, stranding can continue to be a problem at specific locations. For example, in the Yolo Bypass it has been documented that areas with engineered water control structures have comparatively higher rates of fish stranding than areas lacking these structures (Sommer et al. 2005:1493). It is believed that stranding occurs more frequently in the vicinity of artificial water control structures because of the unusual hydraulics created by these structures (Sommer et al. 2005:1503). Under Alternative 1-B, proposed artificial water control structures include box culverts, tide gates, and infrastructure related to drainage pumps.

Although floodwaters would drain from McCormack-Williamson Tract by gravity flow through the tide gates, or through the use of pumps, fish behavior and other factors may also prevent or discourage fish from leaving McCormack-Williamson Tract. For example, juvenile salmon and steelhead may not enter the box culverts as water drains through the tide gates if water velocities at the culverts are insufficient to attract fish to the culvert openings. Significant delays in emigration could expose fish to declining environmental conditions, thereby resulting in reduced growth and survival of individuals, or cause fish to leave the tract when conditions in the Delta are less favorable. Fish unable or unwilling to emigrate from the tract along with drainage through the tide gates would require passage through the pumps to safely return to the Delta. Without appropriate measures, such as the use of passage-friendly pumps, fish entrained with water pumped from the tract to the Delta may experience direct injury or mortality.

Operation of McCormack-Williamson Tract under Alternative 1-B is considered to be a significant impact because of the expected frequency that McCormick-Williamson Tract would flood, the relatively large extent of floodplain habitat that would be created under this alternative, the lack of a permanent open water connection between the created floodplain and the adjacent Delta channels, and the potential for Project operation to strand special-status species.

Determination of Significance: Significant.

Mitigation Measure Fish-5: Replace Existing Drainage Pumps on McCormack-Williamson Tract with Fish-Friendly Pumps.

Existing drainage pumps on McCormack-Williamson Tract would be used, in combination with tide gates, to facilitate drainage of McCormack-Williamson Tract following overtopping of the east and southwest levees during flood events. Because these pumps were designed for drainage and not fish passage, it is likely that fish that pass through these pumps during drainage of McCormack-Williamson Tract could be injured or killed. In order to prevent fish stranding on

McCormack-Williamson Tract and to provide fish with safe passage to adjacent waterways, DWR will replace existing drainage pumps that do not currently meet safe passage standards for fish. In addition, DWR will coordinate with DFG, NMFS, and USFWS in designing and implementing the appropriate pump configuration to ensure that fish-friendly pumps safely pass special-status fish species.

Mitigation Measure Fish-6: Conduct More Detailed Analysis of Box Culvert Design and Installation to Ensure Minimal Ponding of Water on the Southern Portion of McCormack-Williamson Tract.
As part of the detailed project design process, more rigorous assessment of the design and operation of box culverts will be conducted prior to installation. This study will identify potential drainage problems associated with the low subsided elevations on the McCormack-Williamson Tract southwestern border and the higher river channel elevations. The analysis will include a depth profile of potential stranding pools behind the box culverts to address fish habitat concerns. The box culvert design or installation will be modified to reduce the amount of standing water left on the tract during drainage. In addition, this study will identify key modifications to the pump stations on McCormack-Williamson Tract to minimize stranding areas during pumping of residual floodwaters.

Mitigation Measure Fish-7: Operate McCormack-Williamson Tract to Minimize Long-Term Storage of Floodwaters.
Prolonged detention of floodwaters on McCormack-Williamson Tract may delay the emigration of fish, including juvenile salmonids, from the island. In addition, fish held in detained floodwaters on the island may experience declining water quality conditions if water and fish are held late into the season. To reduce the potential for fish to be exposed to declining water quality conditions, DWR will operate McCormack-Williamson Tract, to the extent practicable, to release floodwaters in a timely fashion and in a manner consistent with flood control goals and objectives. By adhering to this measure, DWR will minimize the potential for delaying the migration of fish that are diverted over the weirs and exposing fish to declining water quality conditions that may occur with long-term storage of floodwaters on McCormack-Williamson Tract.

Significance after Mitigation: Less than significant.

Impact Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation.

Alternative 1-B would create approximately 900 acres of seasonally inundated floodplain habitat on McCormack-Williamson Tract. Increased shallow-water habitat in McCormack-Williamson Tract may create predator habitat and lead to greater mortality of special-status fish species from increased predation, as discussed under Alternative 1-A.

Overall, the amount of potential predator habitat that potentially would be created under Alternative 1-B would be less than the amount that would be created under Alternative 1-A because perennial shallow-water habitat would not be created, thereby limiting the potential for the establishment of predator populations. For these reasons, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-9: Forgone Water Diversion and Agricultural Discharges.

Under Alternative 1-B, the selective decommissioning or reuse of existing pumps and water management infrastructure would be the same as described under Alternative 1-A, except that pumping would be required to facilitate drainage of the tract during warm weather. Table 2-5 describes the change in use for each pump that would occur under Alternative 1-B.

Overall pump operations under Alternative 1-B would be less than operations under existing conditions. Fish entrainment and water quality effects that occur under existing pumping and drainage conditions would be reduced, for the same reasons discussed under Alternative 1-A.

For reasons described under Alternative 1-A, this impact is considered to be beneficial.

Determination of Significance: Beneficial.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This section summarizes the impacts and mitigation for the components of Alternative 1-C (Figure 2-19):

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat

- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact mechanisms related to each Project action element presented above are shown in Table 4.2-1. Impact mechanisms associated with each maintenance- and operation-related element are shown in Table 4.2-2.

This section also summarizes the impacts and mitigation for the Seasonal Floodplain Enhancement and Subsidence Reversal (1-C) Alternative with the following operational and maintenance-related action elements as related to fisheries and aquatic resources:

- periodic vegetation removal,
- placement of RSP,
- replacement of water control structures,
- operation of weirs, levee breaches, and setback levees,
- maintenance of existing habitats and those created under this option, and
- tide gate operation.

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

This impact is the same as described under Alternative 1-B.

Determination of Significance: Significant.

Mitigation Measure Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites.

Mitigation Measure Fish-2: Replace Affected Shaded Riverine Aquatic Cover.

Significance after Mitigation: Less than significant.

Impact Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail and Other Floodplain-Spawning Species, as a Result of Project Operation.

This impact is the same as described under Alternative 1-B.

Determination of Significance: Beneficial.

Mitigation: No mitigation required.

Impact Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation.

Under Alternative 1-C, up to 641 acres of floodplain habitat would be created as a result of degrading the east and southwest levees on McCormack-Williamson Tract. Approximately 350 acres of additional floodplain habitat would be created on the Grizzly Slough property. Some tidal shallow-water habitat would be created (some tidal action would occur primarily for water quality).

Under Alternative 1-C, benefits of floodplain inundation would be similar to, but slightly less than, those described under Alternative 1-B.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-7: Fish Entrapment or Delayed Migration from Project Operation.

Project components on McCormack-Williamson Tract would be the same as described under Alternative 1-B, except that:

- A cross-levee would be constructed to create a subsidence-reversal demonstration area.

Because the cross-levee would be constructed at the same elevation as the degraded southwest levee (i.e., 5.5 feet msl), the frequency of flooding of McCormack-Williamson Tract under Alternative 1-C would be similar to the frequency of flooding under Alternative 1-B. In addition, drainage of floodwaters on McCormack-Williamson Tract would occur through a combination of tide gates and pumping, as described under Alternative 1-B. While the potential for this impact under Alternative 1-C would be similar to that under Alternative 1-B, the potential for stranding of fish could occur in two separate areas: behind the degraded southwest levee and the cross-levee.

For reasons discussed under Alternative 1-B, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-5: Replace Existing Drainage Pumps on McCormack-Williamson Tract with Fish-Friendly Pumps.

Mitigation Measure Fish-6: Conduct More Detailed Analysis of Box Culvert Design and Installation to Ensure Minimal Ponding of Water on the Southern Portion of McCormack-Williamson Tract.

Mitigation Measure Fish-7: Operate McCormack-Williamson Tract to Minimize Long-Term Storage of Floodwaters.

Significance after Mitigation: Less than significant.

Impact Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation.

Alternative 1-C would create approximately 641 acres of seasonally inundated floodplain habitat on McCormack-Williamson Tract. Increased shallow-water habitat in McCormack-Williamson Tract may create predator habitat that could lead to greater mortality of special-status fish species from increased predation, as discussed under Alternative 1-A.

Overall, the amount of potential predator habitat that would be created under Alternative 1-C would be similar to the amount that potentially would be created under Alternative 1-B. However, because some tidal shallow-water habitat would be created under Alternative 1-C, potential exists for predator populations to become established, which could affect the survival of native and special-status fish species that are diverted onto the tract. However, because the limited tidal flooding of the tract would be accomplished by the use of flap gates instead of by a permanent open water connection with the adjacent channel, fewer numbers of native and special-status fish species could potentially use this habitat and be at risk of increased predation.

For the reasons discussed under Alternative 1-A, this impact is considered less than significant.

Determination of Significance: Less than significant.

Mitigation: No mitigation required.

Impact Fish-9: Forgone Water Diversion and Agricultural Discharges.

Under Alternative 1-C, the selective decommissioning or reuse of existing pumps and water management infrastructure would be the same as described under Alternative 1-A, except that pumping would be required to facilitate drainage of the tract during warm weather. Table 2-5 describes the change in use for each pump that would occur under Alternative 1-C.

Overall pump operations under Alternative 1-C would be less than operations under existing conditions. Fish entrainment and water quality effects that occur under existing pumping and drainage conditions would be reduced, for the same reasons discussed under Alternative 1-A.

For reasons described under Alternative 1-A, this impact is considered to be beneficial.

Determination of Significance: Beneficial.

Mitigation: None required.

Dredge South Fork Mokelumne River (Optional)

This alternative is optional in Group 1 and provides additional channel capacity through dredging the river bottom. The Dredge South Fork Mokelumne River Optional Alternative includes the following components:

- Dredge Mokelumne River, Snodgrass Slough, and Dead Horse Cut
- Drying operations

Dredging would increase the channel capacity in locations where sedimentation has occurred. The cross-sectional limits would be determined during detailed engineering to minimize potential effects on shallow aquatic habitat and levee stability but would generally follow the channel centerline with side slopes of 2:1 (horizontal:vertical) or steeper. Up to 1,350,000 cubic yards of channel sediment would be dredged under this optional alternative. Dredging would be limited to July, August, and September (see Chapter 2, "Project Description").

The Project may use one or more dredging methods determined through a balance of regulatory constraints, effectiveness, and efficiency. The methods include:

- hydraulic dredging,
- clamshell dredging, and
- dragline dredging.

Each of these dredging methods is described further in the Chapter 2, "Project Description."

Dredging also would entail constructing drying basins on the landside of the levees. The drying basins would be used for the decanting and drying process for dredged material. The basins would be constructed adjacent to the channel or suitable interior low areas. No in-water disposal of dredged sediments would occur, and sedimentation impacts often associated with in-water disposal of dredge spoils would be avoided.

Dredging has the potential to create turbidity and sedimentation, release toxics and other harmful substances to surface waters, disturb or injure fish, modify shallow vegetated areas, and remove bottom substrates and associated benthic organisms. Impacts on fish and aquatic habitats from dredging are discussed in greater detail below. For purposes of the impact analysis, it is assumed that the dredging method with the greatest potential for impacts on fish and aquatic habitats would be used.

Sedimentation and Turbidity

Dredging and related activities have the potential to increase sedimentation and turbidity in nearby areas as a result of disturbance to bottom sediments. In general, hydraulic dredging has less potential to cause excessive sedimentation and turbidity in the channel than clamshell and dragline dredging.

General effects associated with increases in sedimentation and turbidity on fish and aquatic habitats have been discussed previously under Alternative 1-A.

Impact Fish-10: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Increases in Sedimentation and Turbidity as a Result of Dredging Activities.

Under the Dredge South Fork Mokelumne River Option, up to 1,350,000 cubic yards of channel sediment would be dredged, which could result in increases in sedimentation and turbidity of surrounding surface waters. Increases in sedimentation and turbidity have been shown to adversely affect fish physiology, behavior, and habitat (see discussion above under Impact Fish-1).

By transferring dredge spoils to land-based drying basins, DWR would avoid sedimentation and turbidity impacts commonly associated with in-water disposal of dredged material. In addition, impacts on adult and juvenile salmonids, delta smelt, and splittail largely would be avoided by limiting the period of dredging to July–September when abundance of these species is low or environmental conditions in the North Delta are less likely to support these species. However, increases in sedimentation and turbidity as a result of dredging activities could adversely affect sturgeon, striped bass, and freshwater game species.

While the potential exists for dredging to increase sedimentation and turbidity, minimal effects on fish and aquatic habitats are expected for the following reasons:

- sedimentation and turbidity from dredging would be limited in time and space;
- no washing of equipment or material would occur in the water;
- spoils would be transferred to land-based drying ponds, rather than being disposed of in-water;
- fish encountering elevated turbidity plumes likely would avoid harmful concentrations by moving laterally across the channel to areas with ambient turbidity levels; and

- the diluting effect of river flow and tidal exchange would likely disperse suspended sediments relatively quickly.

This impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Hazardous Materials and Contaminants

Contaminants can affect survival and growth rates, as well as the reproductive success of fish and other aquatic organisms. The level of effect depends on species and life stage sensitivity, duration and frequency of exposure, condition or health of individuals (e.g., nutritional status), and physical or chemical properties of the water (e.g., temperature, dissolved oxygen).

The potential magnitude of biological effects resulting from release of contaminants depends on a number of factors, including the type, amount, concentration, and solubility of the contaminant and the timing and duration of the exposure.

More specific information of the effects of pollutants on fish is presented above under Alternative 1-A.

Impact Fish-11: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Release of Pollutants during Dredging.

Potential impacts can range from avoidance of habitat in the vicinity of the Project site to mortality, which could occur through exposure to lethal concentrations of contaminants or exposure to nonlethal levels that cause physiological stress and increased susceptibility to other sources of mortality (e.g., predation and disease).

The operation of heavy equipment, cranes, barges, and dredges can result in accidental spills and leakage of fuel, lubricants, hydraulic fluids, and coolants. Contaminants associated with dredged sediments may be resuspended in the water column. Resuspended contaminants could be transported by river flow and tidal action to other parts of the Delta, thereby exposing aquatic organisms and humans through bioaccumulation and biomagnification in the food web. (Nightingale and Simenstad 2001:67).

Under the Project, a sampling and analysis plan for proposed dredging areas will be prepared within 1 year of proposed dredging activities, as described in the Environmental Commitments section of Chapter 2. If sampling indicates any layer of toxic materials above applicable standards, contractors will dredge so that either that layer is not disturbed or the entire layer is removed (see Section 3.4, Water Quality). This impact is considered to be less than significant because the potential for the release of pollutants during dredging would be minimized as a result of implementation of the environmental commitments.

Determination of Significance: Less than significant.

Mitigation: None required.

Disturbance and Direct Injury or Mortality

Dredging would generate noise, vibrations, artificial light, and other physical disturbances that can harass fish and disrupt or delay normal activities. In addition, dredging could cause injury to or direct mortality of fish, especially from entrainment (e.g., hydraulic dredging) or from coming in direct contact with the dredge.

Noise has been shown to influence fish behavior. Fish detect and respond to sound to avoid predators, hunt for prey, and for social interaction (Nightingale and Simenstad 2001:64–65). The behavioral responses of fish associated with noise impacts ranges from a classic fright response (e.g., startle behavior) to avoidance of areas. In extreme situations, fish can experience mortality from underwater pressure waves. Unlike pile driving and other construction activities that result in more intense bursts of sound energy, dredging is more likely to produce less intense, but continuous, noise levels over longer periods of time.

Susceptibility of fish to entrainment is influenced by the type of dredging equipment employed. For example, fish entrainment rates generally have been shown to be greater for hydraulic dredges than for mechanical dredges, because of the strong suction field associated with hydraulic dredges (Nightingale and Simenstad 2001:51). The potential for entrainment also depends on many other factors, including:

- the abundance, swimming ability (which is positively related to size), and behavioral response of fish to dredging activities;
- the total area dredged; and
- the speed at which dredging is conducted.

In general, it is assumed that hydraulic dredging has the greatest potential for entrainment of fish because of the strong suction field created by the dredge. In addition, benthic species (e.g., sculpin, sturgeon, sucker) are probably more at risk for entrainment than other species because of their stronger association with the substrate than other fish species (e.g., juvenile salmonids, delta smelt).

Impact Fish-12: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Entrainment during Dredging.

Dredging may disturb and injure or kill fish. In addition, fish that come within the "zone of influence" of the suction pipe of the hydraulic dredge may be drawn into the dredge along with water and the dredged sediments. Fish also may be injured or killed if they come in contact with the bucket or clamshell of mechanical dredges. Noise from dredging operations could disrupt fish migration and feeding or cause fish to leave areas of cover where they would be prone to predation.

The potential for direct injury and entrainment of juvenile salmonids from dredging would largely be avoided because DWR would limit dredging to the June–August period when juvenile salmonids in the North Delta are least abundant. In the unlikely event that juvenile salmonids are present at the time of dredging, the potential for injury or entrainment of juveniles would likely be small because dredging would occur in mid-channel areas away from where juvenile salmonids are typically found; young juvenile salmonids frequent nearshore areas near cover while migrating juveniles (e.g., smolts) are typically found in the upper portion of the water column and are less likely to be associated with the channel bottom.

Direct injury and entrainment effects on delta smelt associated with dredging are also likely to be minimal because delta smelt abundance in the North Delta is relatively low, and delta smelt are more strongly associated with the upper portion of the water column than the channel bottom.

The susceptibility of sturgeon to entrainment, especially from hydraulic dredging, may be higher than the risk of entrainment for other species (e.g., Chinook salmon) because of their strong association with bottom substrates. It is assumed that the potential for entrainment of sturgeon would be greater when hydraulic dredging methods are employed compared to mechanical methods. However, the potential for entrainment also depends on other factors, including:

- the abundance, swimming ability (which is positively related to size), and behavioral response of sturgeon to dredging activities;
- the total area dredged; and
- the speed at which dredging is conducted.

The lack of reliable estimates of green sturgeon abundance in the Project study area and information on the behavioral response of green sturgeon to dredging activities make it difficult to estimate with certainty the number of green sturgeon that potentially would be entrained during dredging activities. However, it is likely that dredging would have minimal impact on sturgeon for three reasons:

1. Dredging would only occur during authorized work windows (e.g., summer) over several years, thereby limiting the magnitude of the impact in any given year.

2. Fish sampling data suggest that sturgeon abundance in the North Delta is low, although low abundance of sturgeon in the catch may reflect sampling error and not true abundance. Low abundances of sturgeon in the North Delta study area would mean that the potential for entrainment from dredging also is probably low; and,
3. Fish in general are known to avoid areas of disturbance. Juvenile sturgeon would likely exhibit avoidance behavior in the immediate vicinity of dredging operations as a result of the associated noise and disturbance, although the degree to which sturgeon would avoid these areas is unknown. The fact that dredging operations generally proceed relatively slowly increases the likelihood that sturgeon would have opportunities to avoid dredging areas.

While the incremental effects of dredging on individual populations of fish are anticipated to be relatively small, the cumulative effects of repeated dredging over time on fish populations, many of which are rare or declining in number, could contribute to present and ongoing impacts on these species. For this reason, this impact is considered to be significant.

Determination of Significance: Significant

Mitigation Measure Fish-8: Incorporate Best Management Practices and Other Minimization Measures into the Dredging Sampling and Analysis Plan.

DWR will reduce the potential for this impact to a level of insignificance by incorporating BMPs and other minimization measures to reduce the level of impacts on fish from dredging. The plan shall be prepared following completion of detailed engineering specifications that define the specific volume and area to be dredged and shall be submitted to DFG, NMFS, and USFWS for review prior to initiation of dredging activities. Specific BMPs and other minimization measures in the plan shall include:

- limiting dredging to approved work windows such as summer (the precise dates will be developed in consultation with DFG, USFWS, and NMFS and will include the stipulation that fishery resource agencies must concur in writing with any extensions for dredging outside of the authorized period;
- reducing the volume of material that must be dredged and the frequency of dredging, whenever possible;
- using dredge types and methods that result in the least adverse impact on fish and their habitat (e.g., hydraulic dredging should be used in areas where sedimentation and turbidity issues are of most concern);
- operating hydraulic dredges only with the intake at or below the surface of the material being dredged to reduce the potential for entrainment of fish; (the intake shall be raised above the channel bed only for brief periods of purging or flushing of the intake system as necessary for the safe and efficient operation of the dredge);

- monitoring turbidity at 100 feet upstream and downstream of the dredge—dredging shall immediately cease when turbidity levels downstream of the dredge are elevated by more than 10% of ambient turbidity levels (as determined from upstream measurements);
- if a fish kill occurs or fish are observed in distress, ceasing dredging immediately and notifying DFG and NMFS immediately;
- where practicable, using excluder devices or similar equipment on hydraulic dredge equipment to cause fish to leave areas affected by the dredging equipment–dredges equipped with excluder devices have been shown to substantially reduce fish entrainment, especially for benthic species (Nightingale and Simenstad 2001);
- minimizing ambient light changes caused by nighttime artificial lighting on dredging structures that may alter prey-predator relationships and increase predation risks for special-status species.

Significance after Mitigation: Less than significant.

Changes to Migration, Spawning and Rearing Habitat Area

North Delta channels provide important habitats supporting migration, spawning, and rearing functions for many fish species, including special-status species. As previously mentioned, Chinook salmon, steelhead, sturgeon, and striped bass spawn upstream of the Delta. In addition, the study area does not support conditions that provide spawning habitat for these species; consequently, aquatic habitats in the North Delta only support migration and rearing functions for these species.

The physical parameters that define migration, spawning, and rearing habitat in the Delta include water depth and velocity, substrate, and cover. Many fish species have a strong reliance upon shallow-water habitats, especially nearshore habitats, for seeking prey and shelter from excessive water velocities and predation by larger fish. Nearshore habitats in the Delta provide a complex mix of water depth and velocity, substrate type (i.e., size), and cover types that native species have evolved with and upon which they rely on for their reproduction, growth, and survival. The complexity and variability of nearshore habitats are greatest in areas where natural fluvial and geomorphic processes are at play and riparian and submerged aquatic vegetation are abundant.

Open-water habitats also are important to migratory and resident fish species. For example, adults and larger juveniles of migratory species use these areas for movement, while pelagic species, such as delta smelt, rear in shallow, open-water habitats.

Dredging has the potential to affect one or more physical components that support migration, spawning, or rearing functions for migratory and resident species. For example, dredging would result in bathymetric changes in the channels by lowering the channel beds, thereby affecting water surface elevations. Changes in water surface elevations could result in adverse effects on the quantity and quality of shallow-water and nearshore habitats through dewatering.

Impact Fish-13: Changes in Habitat Availability and Quality for Fish as a Result of Disturbance and Water Surface Elevation Changes from Dredging.

As an optional element of Alternative 1-A, dredging would occur in portions of the Mokelumne River, Snodgrass Slough, and Dead Horse Cut (Figure 2-14). Dredging would lower the channel bed by removing accumulated sediments and without appropriate measures could reduce the amount of shallow-water habitat used by rearing fish. This impact, however, is considered to be less than significant because:

- dredging would increase channel depth, but the overall shallow-water habitat area would remain unchanged and habitat quality would be similar following the temporary disturbance of substrate (i.e., there would be minimal loss of shallow-water habitat);
- dredging would not affect substrates in nearshore habitats; and
- the cumulative length of Delta channels is several hundred miles and the water surface area of the Delta exceeds 60,000 acres (California Department of Water Resources 1995), so the length of channel proposed for dredging represents only a small fraction of the cumulative length of channels and fish habitat in the Delta.

Determination of Significance: Less than significant.

Mitigation: None required.

Removal of Bottom Substrates and Benthic Organisms

Dredging would lower the channel bed. Sediments removed from the channel bed provide habitat for benthic invertebrates, which are important as food organisms for many species of fish. The effects on invertebrate communities from dredging can range from negligible to severe, with impacts ranging from short to long term (Nightingale and Simenstad 2001:73–74). Generally, benthic communities are affected less by short-term, small-scale dredging Projects than by long-term, large-scale Projects.

Benthic communities often recolonize dredged areas quite rapidly. Recolonization has been hypothesized to occur as organisms are introduced to disturbed areas along with immigration of sediments associated with slumping of channel walls adjacent to dredged areas or from the migration of organisms from more distant areas (e.g., from upstream) (Nightingale and Simenstad 2001:74). Substantial recovery of benthic communities has been shown to occur within 3 months in some cases (Nightingale and Simenstad 2001:74). In the Delta, studies have documented the return of benthic communities that were affected by changes in salinity (Markham 1986; Vayssieres and Peterson 2003).

Impact Fish-14: Changes in Prey Availability for Fish as a Result of Disturbance to Channel Bed and Removal of Sediments during Dredging.

As an optional element of Alternative 1-A, dredging would occur in portions of the Mokelumne River, Snodgrass Slough, and Dead Horse Cut (Figure 2-14). Dredging would lower the channel bed by removing accumulated sediments that may produce food for fish. This impact is assumed to include all areas that would be dredged. However, dredging is expected to have minimal effect on prey availability for fish, especially over the long term, because:

- dredging would occur over several years, reducing the magnitude of the impact in any given year;
- similar vegetated areas and bottom substrates in adjacent channel reaches (both laterally and longitudinally) would be unaffected and would continue to support habitat for benthic invertebrates;
- invertebrate drift from upstream areas would continue to provide a prey base for fish in areas affected by dredging;
- benthic invertebrates are expected, based on changes in benthic invertebrate abundance observed in response to changes in salinity (Markham 1986; Vayssieres and Peterson 2003) and dredging (Wilson 1998), to recolonize bottom substrates disturbed by dredging relatively quickly;
- disposal of material in off-site settling basins would avoid impacts of sedimentation on the benthic community that are often associated with in-water disposal of dredge spoils; and
- dredging would be focused in mid-channel areas and would largely avoid the shallow vegetated margins of the channels. In a study of cross-channel variability in benthic habitat in the Delta portion of the Sacramento River, benthic species richness and abundance was found to be lower (by an order of magnitude or more for abundance) in mid-channel areas than on the channel sides. These differences presumably occur in response to variations in physical processes across the channel that affect substrate particle size and organic matter content. (Vayssieres and Peterson 2003.)

Prey habitat loss associated with dredging would have a less-than-significant impact on fish species, especially over the long term.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This section identifies potential construction- and operation-related impacts and mitigation for the North Staten Detention (2-A) alternative (Figure 2-22). Project action elements associated with this alternative include:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact mechanisms related to each Project action element presented above are shown in Table 4.2-1. Impact mechanisms associated with each maintenance- and operation-related element are shown in Table 4.2-2.

This section also summarizes the impacts and mitigation for the North Staten Detention (2-A) alternative with the following operational and maintenance-related action elements as related to fisheries and aquatic resources:

- periodic vegetation removal,
- placement of RSP,
- periodic placement of cement,
- replacement of water control structures,
- operation of weirs, levee breaches and setback levees, and
- operation of detention basin.

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A..

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

Some construction actions under Alternative 2-A (levee degradation, levee reinforcement, outlet weir and drainage pump outfall construction) would result in the direct removal of riparian vegetation, some of which supports SRA cover habitat. Construction activities would result in the loss of vegetation that supports SRA cover. As discussed under Alternative 1-A, SRA cover, represented by overhead vegetation and instream woody material in this analysis, is a Resource Category 1. The USFWS's mitigation goal for a Resource Category 1 habitat is no loss of existing habitat value.

Determination of Significance: Significant.

Mitigation Measure Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites.
Mitigation Measure Fish-2: Replace Affected Shaded Riverine Aquatic Cover.

Significance after Mitigation: Less than significant.

Impact Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail and Other Floodplain-Spawning Species, as a Result of Project Operation.

Under Alternative 2-A, the North Staten Island levee would be degraded from an existing elevation of 15 feet msl to a lower elevation (to be determined in Project design through hydraulic modeling). Assuming that the elevation of the degraded levee would permit the area between the degraded levee and the constructed inlet weir to act as a floodplain, the availability and quality of spawning habitat for floodplain-spawning species may increase, relative to existing conditions, for similar reasons discussed under Alternative 1-A. The precise amount would depend on water depth and velocities, timing of inundation relative to the needs of spawning fish, and possibly other factors.

For the reasons discussed under Alternative 1-A, this impact is considered a benefit.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation.

Under Alternative 2-A, floodplain habitat would be created as a result of degrading the northern levee on Staten Island.

Overall use of this area by floodplain-rearing species would depend on the final elevation of the degraded northern levee on Staten Island. Levee elevations that allow frequent and prolonged flooding during high winter and spring flows would result in greater quantity and quality of rearing habitat because of increased availability of inundated floodplain and reduced potential for fish stranding. In contrast, higher levee elevations would result in less frequent inundation of floodplain habitats and, possibly, shorter duration of inundation; these conditions would reduce the quantity and quality of rearing habitat for fish and increase the potential for fish stranding behind raised levees as flows recede.

Relative to existing conditions, degrading of the northern levee on Staten Island under Alternative 2-A would increase rearing habitat for floodplain-rearing species; therefore, this impact is considered to be a benefit for the same reasons discussed under Alternative 1-A.

Determination of Significance: Beneficial

Mitigation: None required.

Impact Fish-7: Fish Entrapment or Delayed Migration from Project Operation.

Project components include operation of Staten Island as on off-channel flood detention basin. Under Alternative 2-A, the North Staten Island detention basin would consist of approximately 2,350 acres of land with a capacity of approximately 48,350 acre-feet. Flow would begin spilling onto Staten Island over the constructed North Staten Island inlet weir when water surface elevations reach 10 feet msl. Once the detention basin filled, excess water would pass over the constructed North Staten Island outlet weir (located along the existing east levee adjacent to the South Fork Mokelumne River). Water surface elevations of 10 feet msl have a statistical probability of occurring no more frequently than once every 10 years and generally occur during January through April. Depending on the magnitude and duration of the flood event, flows that result in overtopping of the Staten Island weir could inundate the basin for several weeks at a time, resulting in the entrapment or delayed migration of fish, including special-status species (see Appendix E, Alternative 2-A for a more complete conceptual description of anticipated function).

Because the elevation of the detention basin would be below the water surface elevation of the surrounding channels, drainage of the detention basin would require operation of up to seven 42-inch-diameter pumps to drain the basin within 30 days. The pumps would be integrated with the outlet weir, located at the southeastern corner of the detention basin. For purposes of this analysis, it is assumed that to minimize mortality at the pumps, at least one of the pumps would be a fish-friendly design, such as a centrifugal type. A slot channel would be excavated in the basin to direct fish toward the fish-friendly pumps. Other pumps would be screened and barricaded to prevent fish attraction and entrainment.

Hydrologic analyses indicate that the detention basin will intercept and detain a fraction of floodflows during the peak of events that may be exceeded on average once every 10 years. It is expected that the periods during which peak flows will be diverted will last only a few days. For example, modeled floodflows for the north Staten Island weir using 1997 hydrology indicate that peak flows equaling those that occurred in early January would flow over the weir for approximately 48 hours (Fleenor pers. comm.).

Delayed migration or entrapment of fish is dependent on a number of variables, such as the capacity of the detention basin; the frequency and duration of floodflow diversion; the coincidence of floodflow diversion with the migration timing of adult and juvenile fish; the abundance (density) of fish moving downstream in the DCC, Snodgrass Slough, and the North Mokelumne River; and the behavior of adult and juvenile fish during high-flow events. Adults and juvenile outmigrants may move into the detention basin during high-flow events in winter and early spring and experience delays in migration or, worse, become stranded by receding flows. The formation of isolated pool habitats in the detention basin could increase the potential for fish entrapment during receding flows. Prolonged retention of floodwaters in the detention basin could subject entrapped fish to increased mortality through predation, competition for resources (such as food), and declining water quality conditions (e.g., elevated water temperatures).

Existing information is insufficient to precisely quantify potential impacts on fish, including special-status species, from the proposed operation of the Staten Island off-channel detention basin. However, the potential for impacts can be qualitatively examined based on the scientific literature and general information on the life history, relative abundance, and distribution of the species of concern. The following analysis focuses on current federal and state-listed species and those species most likely to be affected by the proposed project.

Salmonids originating from the Sacramento River system (i.e., fall-, late fall–, winter- and spring-run Chinook salmon; steelhead) may occur in the North Mokelumne River as a result of passage through the DCC and Snodgrass Slough. Passage through the DCC would be limited to periods when the DCC gates are open. During February through April, when the DCC gates are closed, salmonids originating in the Sacramento River would not be expected to be at risk of diversion in the off-channel detention basin; fish migrating downstream in the Sacramento River would remain in the river as a result of closure of the DCC gates and would therefore not be diverted to the North Mokelumne River. However, any fish that pass through the DCC during their downstream migration prior to closure of the DCC gates may rear temporarily in the North Mokelumne River and be subject to diversion into the detention basin during periods when flows spill over the inlet weir. Salmonids originating in the Mokelumne River system (fall-run Chinook salmon, steelhead) have the greatest potential for exposure to diversion into the detention basin because the North Mokelumne River serves as a primary migration route through the Delta. During the winter and early spring, Chinook salmon and steelhead migrating down the North Mokelumne River may be diverted into the detention basin. However, potential diversion into the detention basin would occur infrequently (i.e., on average once every 10 years) and for short duration (as discussed before, the periods during which peak flows would be diverted are expected at most to last only for a few days). The potential for diversion of salmonids that are rearing in the North Mokelumne River in the vicinity of the inlet weir and upstream habitats, including salmonids originating in the Sacramento River, would be further minimized because many juveniles would be expected to move downstream in response to increased flows prior to water surface elevations reaching 10 ft msl. Based on the effects described above, operation of the off-channel detention basin would not be expected to divert a substantial proportion of any population of salmonids. However, the potential for entrapment and delayed migration of salmonids would conflict with the goals of the ecosystem restoration component of this project.

Little information is available on the relative abundance and distribution of green sturgeon in the Delta. General life history information suggests that juveniles may be present year-round. However, their benthic orientation and dependence on benthic prey may decrease their exposure to diversion into the off-channel detention basin; only surface flows from the North Mokelumne River would be diverted into the off-channel detention basin.

Juvenile splittail may be at risk of diversion if high-flow events overtop the inlet weir following adult spawning. However, potential diversion into the detention basin would occur infrequently (i.e., on average once every 10 years) and for short duration (as discussed before, the periods during which peak flows would be diverted are expected at most to last only for a few days), diversion of a substantial proportion of juvenile splittail spawned upstream in the Mokelumne River system would not be expected.

Delta smelt also may be at risk of exposure to the diversion. Their potential for entrainment with floodflows diverted into the detention basin could occur during their dispersal from upstream spawning areas to downstream rearing areas in the lower Delta and Suisun Bay. However, entrainment of substantial numbers of delta smelt would not likely occur during operation of the off-channel detention basin because delta smelt spawning and early rearing appear to be concentrated downstream of the proposed site for the inlet weir in most years.

Fish diverted into the detention basin could experience delayed migration, stranding, injury, or mortality while in the detention basin. Furthermore, fish may become injured or suffer mortality if they become impinged on the screens or become trapped behind barricades at pumps used to drain the detention basin. Finally, fish that are safely passed through the pumps may also suffer mortality from predators (e.g., striped bass) in the river that may be attracted to prey exiting the pump outfalls.

Because Staten Island would remain in agricultural production, it is possible that water could pond in isolated areas of the detention basin as the basin drains if the landform is not modified to eliminate or connect isolated depressions that may exist on the island. In addition, new depressions could form from scour and channel cutting as water spills over the inlet weir and begins to fill the basin. Fish that are diverted into the detention basin from the Mokelumne River channels could become stranded and ultimately suffer mortality if these low-lying areas lose their connection with the pumps at the extreme southeastern corner of the detention basin.

Effects of the operation of the detention basin on fish diverted from the North Mokelumne River will be minimized by draining the detention basin within 30 days following inundation. By quickly draining the detention basin and thereby limiting the time that fish will be detained in the basin, DWR will reduce the potential for delaying the movements of juvenile fish drawn into the detention basin and the potential for increased mortality as a result of changing environmental conditions in the detention basin or predation.

Any adverse effects from entrapment would be offset, to a degree, by the development of floodplain habitat associated with the degraded north levee that would benefit fish species in most years.

Operation of the Staten Island off-channel detention basin under Alternative 2-A is considered to be a significant impact because of the lack of certainty surrounding the quantification of this potential impact with available information, the relatively large size of the detention basin, the potential for direct injury or mortality to fish as they pass through the pumps and reenter the river, and the potential for special-status fish species to be injured or killed. Allowable take of listed species would be determined through Section 7 ESA consultation.

Determination of Significance: Significant.

Mitigation Measure Fish-9: Design and Operate Detention Basin Drainage Facility to Safely Pass and Return Fish to South Fork Mokelumne River.
DWR will design and operate the drainage facility for the detention basin to safely pass and return fish to the South Fork Mokelumne River. Elements to be included in the design shall include, but not be limited to:

- incorporating as many pumps of a type proven to safely pass fish (e.g., a centrifugal pump)into the drainage facility as feasible;
- screening all other pumps to prevent entrainment of fish;
- ensuring that the interior surface of all fish-friendly pump intake and outlet pipes are free of sharp edges;
- ensuring that pump intake and outlet pipes are designed and constructed with gradual turns to minimize turbulence within the pumps that could cause injury to fish passing through the pumps; and,
- designing the outlets of the pump discharge pipes to ensure that they remain below the water surface of the South Fork Mokelumne River when the pumps are predicted to be operating.

In addition, DWR will coordinate with DFG, NMFS, and USFWS in the design and operation of the drainage facility to ensure that the drainage facility will safely pass special-status fish species.

Mitigation Measure Fish-10: Fill or Grade Low-lying Areas in North Staten Detention Basin to Reduce Fish-Stranding Risks.
To eliminate potential stranding in the detention basin, DWR will fill any large expanses of low-lying areas to reduce the potential for standing water to form during detention basin operation. These areas would be filled during construction of other Alternative 2-A components as part of the Project implementation.

Mitigation Measure Fish-11: Monitor for and Fill Any Scour Pools Formed following Operation of North Staten Island Detention Basin.
The potential exists for fish, including migratory juvenile fish, to become trapped in new scour holes and other depressions that may form following operation of the North Staten Island detention basin. DWR will monitor the detention basin following flood events that result in overtopping of the inlet weir to identify where areas have scoured and pose a stranding risk to fish. If monitoring indicates that fish stranding has occurred, DWR will use appropriate methods (e.g., seining, electrofishing) as soon as possible following isolation of the water body to remove stranded fish. Rescued fish will be released to the nearest main channel area. Qualified fish biologists will conduct monitoring and fish rescue

operations. To reduce the potential for further fish stranding, DWR will then use appropriate methods (e.g., grading, rock placement) to fill in new scour holes to reduce their potential to strand fish in the future. Scour areas and depressions that are identified to be potential stranding sites will be filled that year before the beginning of the next winter season.

Mitigation Measure Fish-12: Conduct More Detailed Analysis of Slot Channel Design, Fish-Friendly Pump Design, and Outlet Weir Design to Minimize Stranding of Fish.
A more rigorous assessment of the design and operation of pumps, slot channels and outlet weirs will be conducted prior to installation as a component of detailed project design. These studies will identify potential drainage problems associated with the low subsided elevations on the detention basin, potential problems routing fish to the fish-friendly pumps, and problems fish may encounter while exiting across the outlet weir structure. Analysis will include a depth profile of potential stranding pools on the detention basin floor. The pump, slot channel, and outlet weir design and installation will be modified to reduce the amount of standing water left on the tract during drainage and to facilitate fish movement toward the pumps and outlet weir. In addition, this study will identify key modifications to the fish-friendly pump station to minimize stranding areas during pumping of detention floodwaters. Once a design that minimizes stranding is finalized and implemented, this impact could be regarded as less than significant.

Significance after Mitigation: Less than significant.

Impact Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation.

Alternative 2-A would create approximately 2,350 acres of seasonally inundated habitat on Staten Island through flooding of the detention basin. Flooding of the detention basin could lead to increased mortality of fish, including special-status species, by creating shallow-water habitat that favors predators. However, by designing the detention basin to flood on average only once every 10 years and by operating the detention basin such that floodwaters are drained within approximately 30 days following inundation, DWR would avoid the potential for creating predator habitat in the detention basin for piscivorous fish species. However, some predation could be expected to occur from avian predators while the detention basin is flooded for the same reasons discussed under Alternative 1-A.

In addition to creating seasonally inundated habitat in the detention basin, operation of Alternative 2-A would create up to 78 acres of floodplain habitat as a result of degrading the northern levee on Staten Island. Because the final elevation for the degraded levee is unknown, it is assumed for purposes of this analysis that the entire area would be perennial shallow-water habitat. The creation of perennial shallow-water habitat would have the potential to create predator habitat that could lead to increased predation on native fish species, for the same reasons discussed above under Alternative 1-A.Increases in predators or predator habitat associated with the addition of shallow-water habitat could cause an increase in mortality of native fish species from increased predation. However, effects of increased predation on native species associated with the addition of shallow-water habitat would probably be offset, to some degree, by the benefits (e.g., increased food supply and growth rates) of shallow-water habitat discussed above under Alternative 1-A.

Fish that are diverted into the off-channel detention basin may experience increased mortality from predation as they are pumped off Staten Island and returned to the river. Predatory fish (e.g., striped bass) are known to be attracted to outfalls where prey may be available. Fish being pumped off the island may become disoriented and, therefore, may be more vulnerable to predation than they would be if they were to remain in the river and not be diverted into the detention basin.

In the absence of suitable quantities of cover, shallow-water habitat may provide greater benefits to predatory alien species and piscivorous birds at the expense of native fish species. Operations of the off-channel detention basin that divert native fish and release them back to the river could result in greater mortality than if these fish were to remain in the river. For this reason this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-4: Develop and Implement a Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan.

Mitigation Measure Fish-13: Design and Operate the Pump Outfalls to Avoid or Minimize Predation Effects.
DWR will conduct a rigorous assessment of the design and operation of the proposed fish-friendly pumps and outfalls prior to installation and operation. This assessment will identify potential problems associated with the safe return of fish to the river. Measures to provide for the safe return of fish pumped from the detention basin include, but are not limited to, placing the pump outfalls at a location in the river that minimizes the attraction of predators, restricting the pumping of fish off the island to periods of high turbidity or at night to reduce predator success, or holding pumped fish for a period that allows them to regain their orientation before being released to the river. Once a design that minimizes the risk of predation is finalized and implemented, this impact could be regarded as less than significant.

Significance after Mitigation: Less than significant.

Alternative 2-B: West Staten Detention

This section summarizes the impacts and mitigation for Alternative 2-B: West Staten Detention and its components (Figure 2-29):

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact mechanisms related to each Project action element presented above are shown in Table 4.2-1. Impact mechanisms associated with each maintenance- and operation-related element are shown in Table 4.2-2.

This section also summarizes the impacts and mitigation for the West Staten Detention (2-B) alternative with the following operational and maintenance-related action elements as related to fisheries and aquatic resources:

- periodic vegetation removal,
- placement of RSP,
- periodic placement of cement,
- replacement of water control structures,
- operation of weirs, levee breaches, and setback levees,
- maintenance of created and existing habitats, and
- operation of detention basin.

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

Some construction actions under Alternative 2-B (levee degradation, levee reinforcement, outlet weir and drainage pump outfall construction, and levee breaching) would result in the direct removal of riparian vegetation, some of which supports SRA cover habitat. Construction activities would result in the loss of riparian vegetation that supports SRA cover. As discussed under Alternative 1-A, SRA cover, represented by overhead vegetation and instream woody material in this analysis, is an important component of fish habitat, especially for salmonids, and a Resource Category 1. The USFWS's mitigation goal for a Resource Category 1 habitat is no loss of existing habitat value.

Under Alternative 2-B, the Staten Island west levee would be degraded from its existing elevation to 6 feet msl to function as habitat. This action would occur in association with the construction of a setback levee, which would be located approximately 125 to 500 feet east of, and parallel to, the North Fork Mokelumne River (the final setback distance would be refined through hydraulic analyses). Riparian and emergent vegetation would be planted or allowed to colonize the levee and would compensate for the loss of SRA cover associated with construction. This action would compensate, in part or wholly, for construction-related losses of SRA cover under Alternative 2-B. However, because construction-related losses of SRA cover would result in permanent loss of habitat at specific locations (e.g., at sites proposed with RSP) and would contribute to historical and ongoing habitat fragmentation of SRA cover in the Delta, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites.

Mitigation Measure Fish-2: Replace Affected Shaded Riverine Aquatic Cover.

Significance after Mitigation: Less than significant.

Impact Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail and Other Floodplain-Spawning Species, as a Result of Project Operation.

Under Alternative 2-B, the Staten Island west levee would be degraded from its existing elevation to 6 feet msl to function as habitat. This action would occur in association with the construction of a setback levee, which would be located approximately 125 to 500 feet east of, and parallel to, the North Fork Mokelumne River (the final setback distance would be refined through hydraulic analyses). Riparian and emergent vegetation would be planted or allowed to colonize the levee; however, the channel-side of the degraded west levee would not be reconfigured to avoid disturbing existing habitat. A 20-foot-wide bench would be constructed at about 4 feet msl on the riverside of the setback levee to facilitate development of a floodplain meander channel and positive drainage returning to the main channel of the river. The degraded west levee would be breached in several locations to facilitate tidal exchange between the North Fork Mokelumne River and the constructed meander channel at low flow and high tide.

Degradation of the existing west Staten Island levee in conjunction with construction of the Staten Island west setback levee would potentially increase the availability and quality of spawning habitat for floodplain-spawning species, relative to existing conditions, for similar reasons discussed under Alternative 1-A. The precise amount of created spawning habitat would depend on water depth and velocities, timing of inundation relative to the needs of spawning fish, and possibly other factors.

For the reasons discussed under Alternative 1-A, this impact is considered a benefit.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation.

Under Alternative 2-B, floodplain and shallow-water habitat would be created as a result of the combined actions of degrading the west levee and constructing the west setback levee on Staten Island, breaching the existing west Staten Island levee, and constructing a floodplain bench and meandering channel on the riverside of the constructed setback levee.

The mosaic of habitat types that would be created as a result of these combined actions would be expected to increase the quantity and quality of rearing habitat for fish, including floodplain-rearing species such as juvenile Chinook salmon, splittail, and delta smelt, relative to existing conditions.

The impact of increased availability and quality of rearing habitat on native fish species is considered to be a benefit for the same reasons discussed under Alternative 1-A.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-7: Fish Entrapment or Delayed Migration from Project Operation.

Project components include operating the West Staten Island detention basin. Flow would begin spilling into the detention basin over the constructed west Staten Island inlet weir when water surface elevations reach 9 feet msl. Once the detention basin fills, excess water would pass over the constructed west Staten Island outlet weir (located along the existing east levee adjacent to the South Fork Mokelumne River). Water surface elevations of 9 feet msl generally occur during January through April and could inundate the basin for several weeks at a time (see Appendix E, Alternative 2-A for a more complete conceptual description of anticipated function).

Under Alternative 2-B, the West Staten Island detention basin would consist of approximately 1,600 acres of land with a capacity of approximately 35,600 af. Because the elevation of the detention basin would be below the water surface elevation of the surrounding channels, drainage of the detention basin would require operation of up to nine 30-inch-diameter pumps to drain the basin within 30 days. The pumps would be located at the extreme southwestern corner of the detention basin. For purposes of this analysis, it is assumed that to minimize mortality at the pumps, at least one of the pumps would be a fish-friendly design, such as a centrifugal type. A slot channel would be excavated in the basin to direct fish toward the fish-friendly pumps. Other pumps would be screened to prevent fish entrainment.

The potential for fish stranding, and direct injury and mortality from pumping under Alternative 2-B would be similar to that discussed above under Alternative 2-A; however because the capacity of the West Staten Island detention basin would be about 13,000 af less than the capacity of the North Staten Island detention basin, fewer Mokelumne River fish would probably be diverted into the detention basin under this alternative than under Alternative 2-A.

Operation of the West Staten Island detention basin under Alternative 2-B is considered to be a significant impact because of the relatively large size of the detention basin, the potential for direct injury or mortality to fish as they pass through the pumps, and the potential for special-status fish species to be stranded.

Determination of Significance: Significant.

Mitigation Measure Fish-9: Design and Operate Detention Basin Drainage Facility to Safely Pass and Return Fish to Mokelumne River.

Mitigation Measure Fish-10: Fill or Grade Low-lying Areas in North Staten Detention Basin to Reduce Fish-Stranding Risks.

Mitigation Measure Fish-11: Monitor for and Fill Any Scour Pools Formed following Operation of North Staten Island Detention Basin.

Mitigation Measure Fish-12: Conduct More Detailed Analysis of Slot Channel Design, Fish-Friendly Pump Design, and Outlet Weir Design to Minimize Stranding of Fish.

Significance after Mitigation: Less than significant.

Impact Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation.

Implementing Alternative 2-B would create approximately 1,600 acres of seasonally inundated habitat on Staten Island through flooding of the west detention basin. Flooding of the detention basin could lead to increased mortality of fish, including special-status species, by creating shallow-water habitat that favors predators, as discussed above under Alternatives 1-A and 2-A.

For reasons discussed under Alternatives 1-A and 2-A, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-4: Develop and Implement a Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan.

Mitigation Measure Fish-13: Design and Operate the Pump Outfalls to Avoid or Minimize Predation Effects.

Significance after Mitigation: Less than significant.

Alternative 2-C: East Staten Detention

This section summarizes the impacts and mitigation for the Alternative 2-C: East Staten Detention and its components (Figure 2-32):

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

Some construction actions under Alternative 2-C (levee degradation, levee reinforcement, outlet weir and drainage pump outfall construction, and levee breaching) would result in the direct removal of riparian vegetation, some of which supports SRA cover habitat. Construction activities would result in the loss of riparian vegetation that supports SRA cover. As discussed under Alternative 1-A, SRA cover, represented by overhead vegetation and instream woody material in this analysis, is an important component of fish habitat, especially for salmonids and a Resource Category 1. The USFWS's mitigation goal for a Resource Category 1 habitat is no loss of existing habitat value.

Under Alternative 2-C, impacts related to removal of SRA cover habitat would be similar to those described under Alternative 2-B, except that the location and total linear feet of affected habitat would change. For reasons discussed under Alternative 1-A, loss of SRA cover habitat is considered to be a significant impact.

Determination of Significance: Significant.

Mitigation Measure Fish-1: Incorporate Instream Woody Material into Rock Slope Protection at Degraded Levee Sites.

Mitigation Measure Fish-2: Replace Affected Shaded Riverine Aquatic Cover.

Impact Fish-5: Increased Availability and Quality of Spawning Habitat for Splittail and Other Floodplain-Spawning Species, as a Result of Project Operation.

Under Alternative 2-C, the east Staten Island levee would be degraded from its existing elevation to function as habitat. This action would be the same as described under Alternative 2-B, except for the location, which is the east levee of Staten Island on the South Fork Mokelumne River.

Degradation of the east Staten Island levee in conjunction with construction of the Staten Island east setback levee would potentially increase the availability and quality of spawning habitat for floodplain-spawning species, elative to existing conditions, for similar reasons discussed under Alternative 1-A and 2-B. The amount of additional potential spawning habitat would depend on water depth and velocities, timing of inundation relative to the needs of spawning fish, and possibly other factors.

For the reasons discussed under Alternative 1-A, this impact is considered a benefit.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-6: Increased Availability and Quality of Rearing Habitat for Juvenile Chinook Salmon, Splittail, and Delta Smelt, as a Result of Project Operation.

Under Alternative 2-C, floodplain and shallow-water habitat would be created as a result of the combined actions of degrading the east levee and constructing the east setback levee on Staten Island, breaching the existing east Staten Island levee, and constructing a floodplain bench and meandering channel on the riverside of the constructed setback levee.

The mosaic of habitat types that would be created as a result of these combined actions would be expected to increase the quantity and quality of rearing habitat for fish, including floodplain-rearing species such as juvenile Chinook salmon, splittail, and delta smelt, relative to existing conditions.

The impact of increased availability and quality of rearing habitat on native fish species is considered to be a benefit for the same reasons discussed under Alternative 1-A.

Determination of Significance: Beneficial.

Mitigation: None required.

Impact Fish-7: Fish Entrapment or Delayed Migration from Project Operation.

Under Alternative 2-C, the East Staten Island detention basin would consist of approximately 1,600 acres of land with a capacity of approximately 32,400 acre-feet. Impacts on fish associated with stranding and passage through pumps during basin draining would be similar to those described under Alternative 2-B, except that the location of the diversion and discharge of water would be on the South Fork Mokelumne River.

Operation of the East Staten Island detention basin under Alternative 2-C is considered to be a significant impact for the same reasons discussed under Alternatives 1-A and 2-B.

Determination of Significance: Significant.

Mitigation Measure Fish-9: Design and Operate Detention Basin Drainage Facility to Safely Pass and Return Fish to Mokelumne River.

Mitigation Measure Fish-10: Fill or Grade Low-lying Areas in North Staten Detention Basin to Reduce Fish-Stranding Risks.

Mitigation Measure Fish-11: Monitor for and Fill Any Scour Pools Formed following Operation of North Staten Island Detention Basin.

Mitigation Measure Fish-12: Conduct More Detailed Analysis of Slot Channel Design, Fish-Friendly Pump Design, and Outlet Weir Design to Minimize Stranding of Fish.

Significance after Mitigation: Less than significant.

Impact Fish-8: Potential for Loss of Native Fish from Predation as a Result of Project Operation.

Implementing Alternative 2-C would create approximately 1,600 acres of seasonally inundated habitat on Staten Island through flooding of the east detention basin. Flooding of the detention basin could lead to increased mortality of fish, including special-status species, by creating shallow-water habitat that favors predators, as discussed above under Alternatives 1-A and 2-A.

For reasons discussed under Alternatives 1-A and 2-A, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-4: Develop and Implement a Floodplain and Shallow Water Tidal Marsh Habitat Restoration and Monitoring Plan.

Mitigation Measure Fish-13: Design and Operate the Pump Outfalls to Avoid or Minimize Predation Effects.

Significance after Mitigation: Less than significant.

Alternative 2-D: Dredging and Levee Modifications

This section summarizes the impacts and mitigation for this alternative and its components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact mechanisms related to each Project action element presented above are shown in Table 4.2-1. Impact mechanisms associated with each maintenance- and operation-related element are shown in Table 4.2-2.

Dredging the South Fork Mokelumne River and modifying levees are two components of the Alternative 2-D flood control option. This flood control option would modify the system in its existing configuration by dredging channels and raising levees.

Dredging is proposed along the South Fork Mokelumne River to increase channel capacity in locations where sedimentation has occurred. The dredged material would be used for levee construction and ecosystem restoration. Three different methods of dredging are proposed: hydraulic, clamshell, and dragline. The precise method that would be selected to conduct channel dredging would depend on several factors such as whether dredging could be accomplished from a barge or from shore, site conditions (e.g., restrictions caused by riparian vegetation or channel width), the opportunities for disposal of dredge spoils (e.g., proximity to settling ponds), cost, and water quality concerns (e.g., turbidity). All dredge spoils would be disposed of directly into detention basins on nearby islands or to a barge and subsequently transferred to land-based detention basins. No in-water disposal of dredge spoils would occur. A description of each proposed method of channel dredging is discussed in greater detail in Chapter 2.

Under the dredging component, all channels would be dredged within the first 2 years to increase channel capacity. Dredging would commence no earlier than June and would conclude no later than August and would be conducted in accordance with DFG dredging guidelines. The specific volume and area limits would be established during detailed engineering to ensure no measurable increases in downstream water surface elevation. Subsequent maintenance dredging would be required every 5 (worst-case scenario) to 10 years thereafter to maintain channel capacity. Maintenance dredging will not affect more than 20% of the originally dredged extent of channel.

Dredging would remove and disturb the channel bottom and aquatic vegetation would be removed within the footprint of the dredging. Organisms on the channel bottom would be removed. Local noise, physical movement, and vibration caused by the dredge may temporarily cause fish and other aquatic organisms to move out of adjacent habitats. Spill of petroleum products and suspension of sediment may occur during dredge operation. Contaminants introduced into the channel, including suspended sediment, may adversely affect organisms, causing mortality from acute toxicity and suffocation of fish eggs and sessile organisms.

Under the levee-raising component, levees would be raised along portions of the South Fork Mokelumne River, North Fork Mokelumne River, and Sycamore Slough (Figure 2-33) to increase channel capacity. The profile of existing levees on both banks would be raised in parallel. Increasing the profile of the levee would require that the cross section of the existing levee be widened. Maintenance activities on raised levees would include placement of RSP and soil to maintain levees, and periodic application of herbicides and mechanical removal of vegetation to control invasive plants.

Construction activities associated with raising the profile and widening the cross-section of levees would remove, disturb, modify, and replace channel bottom and channel bank substrates. Aquatic and riparian vegetation would be affected within the footprint of the raised levee and the footprint of RSP placed to maintain levees along the levee face and adjacent channel bottom. Organisms on the channel bottom and bank could be crushed during placement of RSP and other materials. The removal or burial of existing riparian vegetation along the levee face would result in the temporary and permanent loss of habitat used by fish for spawning and rearing. Local noise, physical movement, and vibration generated during construction may temporarily cause individuals to move out of adjacent habitat.

During levee construction, there is a potential for spill of petroleum products and suspension of sediments associated with operation of equipment and disturbance of soil. Contaminants introduced into the channel, including suspended sediment, may adversely affect organisms, causing mortality from acute toxicity and suffocation of fish eggs and sessile organisms.

Impacts on fish and aquatic habitats from dredging and levee modifications are discussed in greater detail below. For purposes of the impact analysis, it is assumed that the dredging method with the greatest potential for impacts on fish and aquatic habitats would be used.

Sedimentation and Turbidity

Dredging and related activities have the potential to increase sedimentation and turbidity in nearby areas as a result of disturbance to bottom sediments. In general, hydraulic dredging has less potential to cause excessive sedimentation and turbidity in the channel than clamshell and dragline dredging.

General effects on fish and aquatic habitats associated with increases in sedimentation and turbidity have been discussed above under Alternative 1-A.

Impact Fish-10: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Increases in Sedimentation and Turbidity as a Result of Dredging Activities.

Under Alternative 2-D, channel sediment would be dredged, which could result in increases in sedimentation and turbidity of surrounding surface waters. Increases in sedimentation and turbidity have been shown to adversely affect fish physiology, behavior, and habitat (see discussion above under Alternative 1-A, Impact Fish-1).

By transferring dredge spoils to land-based drying basins, DWR would avoid sedimentation and turbidity impacts commonly associated with in-water disposal of dredge material. In addition, impacts on adult and juvenile salmonids, delta smelt, and splittail largely would be avoided by limiting the period of dredging to July–September when abundance of these species is low or environmental conditions in the North Delta are less likely to support these species. However, increases in sedimentation and turbidity as a result of dredging activities could adversely affect sturgeon, striped bass, and freshwater game species.

While the potential exists for dredging to increase sedimentation and turbidity, minimal effects on fish and aquatic habitats are expected for the following reasons:

- sedimentation and turbidity from dredging would be limited in time and space;
- no washing of equipment or material would occur in the water;
- spoils would be transferred to land-based drying ponds, rather than being disposed of in-water;
- fish encountering elevated turbidity plumes likely would avoid harmful concentrations by moving laterally across the channel to areas with ambient turbidity levels; and
- the diluting effect of river flow and tidal exchange would likely disperse suspended sediments relatively quickly.

This impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Hazardous Materials and Contaminants

Contaminants can affect survival and growth rates, as well as the reproductive success of fish and other aquatic organisms. The level of effect depends on species and life stage sensitivity, duration and frequency of exposure, condition or health of individuals (e.g., nutritional status), and physical or chemical properties of the water (e.g., temperature, dissolved oxygen).

The potential magnitude of biological effects resulting from release of contaminants depends on a number of factors, including the type, amount, concentration, and solubility of the contaminant and the timing and duration of the exposure.

More specific information of the effects of pollutants on fish is presented above under Alternative 1-A.

Impact Fish-11: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Release of Pollutants during Dredging.

Potential impacts can range from avoidance of habitat in the vicinity of the Project site to mortality, which could occur through exposure to lethal concentrations of contaminants or exposure to nonlethal levels that cause physiological stress and increased susceptibility to other sources of mortality (e.g., predation and disease).

The operation of heavy equipment, cranes, barges, and dredges can result in accidental spills and leakage of fuel, lubricants, hydraulic fluids, and coolants. Contaminants associated with dredged sediments may be resuspended in the water column. Resuspended contaminants could be transported by river flow and tidal action to other parts of the Delta, thereby exposing aquatic organisms and humans through bioaccumulation and biomagnification in the food web. (Nightingale and Simenstad 2001:67).

Under the Project, a sampling and analysis plan for proposed dredging areas will be prepared within 1 year of proposed dredging activities, as described in the Environmental Commitments section of Chapter 2. If sampling indicates any layer of toxic materials above applicable standards, contractors will dredge so that either that layer is not disturbed or the entire layer is removed (see Section 3.4, Water Quality). This impact is considered to be less than significant because the potential for the release of pollutants during dredging would be minimized as a result of implementation of the environmental commitments.

Determination of Significance: Less than significant.

Mitigation: None required.

Disturbance and Direct Injury or Mortality

Dredging would generate noise, vibrations, artificial light, and other physical disturbances that can harass fish and disrupt or delay normal activities. In addition, dredging could cause injury to or direct mortality of fish, especially from entrainment (e.g., hydraulic dredging) or from coming in direct contact with the dredge.

Noise has been shown to influence fish behavior. Fish detect and respond to sound to avoid predators, hunt for prey, and for social interaction (Nightingale and Simenstad 2001:64–65). The behavioral responses of fish associated with noise impacts ranges from a classic fright response (e.g., startle behavior) to avoidance of areas. In extreme situations, fish can experience mortality from underwater pressure waves. Unlike pile driving and other construction activities that result in more intense bursts of sound energy, dredging is more likely to produce less intense, but continuous, noise levels over longer periods of time.

Susceptibility of fish to entrainment is influenced by the type of dredging equipment employed. For example, fish entrainment rates generally have been shown to be greater for hydraulic dredges than for mechanical dredges because of the strong suction field associated with hydraulic dredges (Nightingale and Simenstad 2001:51). The potential for entrainment also depends on many other factors, including:

- the abundance, swimming ability (which is positively related to size), and behavioral response of fish to dredging activities;
- the total area dredged; and
- the speed at which dredging is conducted.

In general, it is assumed that hydraulic dredging has the greatest potential for entrainment of fish because of the strong suction field created by the dredge. In addition, benthic species (e.g., sculpin, sturgeon, sucker) are probably more at risk for entrainment than other species because of their stronger association with the substrate than other fish species (e.g., juvenile salmonids, delta smelt).

Impact Fish-12: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, from Entrainment during Dredging.

Dredging may disturb and injure or kill fish. In addition, fish that come within the “zone of influence” of the suction pipe of the hydraulic dredge may be drawn into the dredge along with water and the dredged sediments. Fish also may be injured or killed if they come in contact with the bucket or clamshell of mechanical dredges. Noise from dredging operations could result in disruption to fish migration and feeding, or cause fish to leave areas of cover where they would be prone to predation.

The potential for direct injury and entrainment of juvenile salmonids from dredging would largely be avoided because DWR would limit dredging to the June–August period when juvenile salmonids in the North Delta are least abundant. In the unlikely event that juvenile salmonids are present at the time of dredging, the potential for injury or entrainment of juveniles would likely be small because dredging would occur in mid-channel areas away from where juvenile salmonids are typically found; young juvenile salmonids frequent nearshore areas in proximity to cover, while migrating juveniles (e.g., smolts) are typically found in the upper portion of the water column and are less likely to be associated with the channel bottom.

Direct injury and entrainment effects on delta smelt associated with dredging are also likely to be minimal because delta smelt abundance in the North Delta is relatively low and delta smelt are more strongly associated with the upper portion of the water column than the channel bottom.

The susceptibility of sturgeon to entrainment, especially from hydraulic dredging, may be higher than the risk of entrainment for other species (e.g., Chinook salmon) because of their strong association with bottom substrates. It is assumed that the potential for entrainment of sturgeon would be greater when hydraulic dredging methods are employed, compared to mechanical methods. However, the potential for entrainment also depends on other factors, including:

- the abundance, swimming ability (which is positively related to size), and behavioral response of sturgeon to dredging activities;
- the total area dredged; and
- the speed at which dredging is conducted.

The lack of reliable estimates of green sturgeon abundance in the Project study area and information on the behavioral response of green sturgeon to dredging activities make it difficult to estimate with certainty the number of green sturgeon that potentially would be entrained during dredging activities. However, it is likely that dredging would have minimal impact on sturgeon for three reasons.

1. Dredging would be limited to authorized work windows (e.g., summer) over several years, thereby limiting the magnitude of the impact in any given year.
2. Fish sampling data suggest that sturgeon abundance in the North Delta is low, although low abundance of sturgeon in the catch may reflect sampling error and not true abundance. Low abundances of sturgeon in the North Delta study area would mean that the potential for entrainment from dredging also is probably low; and,
3. Fish in general are known to avoid areas of disturbance. Juvenile sturgeon would likely exhibit avoidance behavior in the immediate vicinity of dredging operations as a result of the associated noise and disturbance, although the degree to which sturgeon would avoid these areas is unknown. The fact that dredging operations generally proceed relatively slowly

increases the likelihood that sturgeon would have opportunities to avoid dredging areas.

While the incremental effects of dredging on individual populations of fish are anticipated to be relatively small, the cumulative effects of repeated dredging over time on fish populations, many of which are rare or declining in number, could contribute to present and ongoing impacts on these species. For this reason, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-8: Incorporate Best Management Practices and Other Minimization Measures into the Dredging, Sampling, and Analysis Plan.

Significance after Mitigation: Less than significant.

Changes to Migration, Spawning and Rearing Habitat Area

North Delta channels provide important habitats supporting migration, spawning, and rearing functions for many fish species, including special-status species. As previously mentioned, Chinook salmon, steelhead, sturgeon, and striped bass spawn upstream of the Delta. In addition, the study area does not support conditions that provide spawning habitat for these species; consequently, aquatic habitats in the North Delta only support migration and rearing functions for these species.

The physical parameters that define migration, spawning, and rearing habitat in the Delta include water depth, velocity, substrate, and cover. Many fish species have a strong reliance upon shallow-water habitats, especially nearshore habitats, for seeking prey and shelter from excessive water velocities and predation by larger fish. Nearshore habitats in the Delta provide a complex mix of water depth and velocity, substrate type (size), and cover types that native species have evolved with and upon which they rely on for their reproduction, growth, and survival. The complexity and variability of nearshore habitats are greatest in areas where natural fluvial and geomorphic processes are at play and riparian and submerged aquatic vegetation are abundant.

Open-water habitats also are important to migratory and resident fish species. For example, adults and larger juveniles of migratory species use these areas for movement, and pelagic species, such as delta smelt, rear in shallow, open-water habitats.

Dredging has the potential to affect one or more physical components that support migration, spawning, or rearing functions for migratory and resident species. For example, dredging will result in bathymetric changes in the channels by lowering the channel beds, thereby affecting water surface elevations. Changes in water surface elevations could result in adverse effects on the quantity and quality of shallow-water and nearshore habitats through dewatering.

Impact Fish-13: Changes in Habitat Availability and Quality for Fish as a Result of Disturbance and Water Surface Elevation Changes from Dredging.

Under Alternative 2-D, dredging would occur in portions of the Mokelumne River, Snodgrass Slough, and Dead Horse Cut (Figure 2-14). Dredging would lower the channel bed by removing accumulated sediments and without appropriate measures could reduce the amount of shallow-water habitat used by rearing fish.

This impact, however, is considered to be less than significant because:

- dredging would increase channel depth, but the overall shallow-water habitat area would remain unchanged and habitat quality would be similar following the temporary disturbance of substrate (i.e., there would be minimal loss of shallow-water habitat);
- dredging would not affect substrates in nearshore habitats; and,
- the cumulative length of Delta channels is several hundred miles and the water surface area of the Delta exceeds 60,000 acres (California Department of Water Resources 1995), and the length of channel proposed for dredging represents a small percentage of the cumulative length of channels in the Delta.

Determination of Significance: Less than significant.

Mitigation: None required.

Removal of Bottom Substrates and Benthic Organisms

Dredging would lower the channel bed. Sediments removed from the channel bed provide habitat for benthic invertebrates, which are important as food organisms for many species of fish. The effects on invertebrate communities from dredging can range from negligible to severe with impacts ranging from short- to long-term (Nightingale and Simenstad 2001:73–74). Generally, benthic communities are affected less by short-term, small-scale dredging projects than by long-term, large-scale projects.

Benthic communities often recolonize dredged areas quite rapidly. Recolonization has been hypothesized to occur as organisms are introduced to disturbed areas along with immigration of sediments associated with slumping of channel walls adjacent to dredged areas or from the migration of organisms from more distant areas (e.g., from upstream) (Nightingale and Simenstad 2001:74). Substantial recovery of benthic communities has been shown to occur within 3 months in some cases (Nightingale and Simenstad 2001:74). In the Delta, studies have documented the return of benthic communities that were affected by changes in salinity (Markham 1986; Vayssieres and Peterson 2003).

Impact Fish-14: Loss of Fish from Reduced Spawning and Rearing Habitat.

Dredging the South Fork of the Mokelumne River could reduce the availability and quality of spawning habitat for fish species that spawn in the Delta. Dredging could adversely affect spawning habitat in the Project area by reducing the area of shallow-water habitat and cover needed by spawning fish and attachment sites for developing eggs. Because Chinook salmon, steelhead, and sturgeon only spawn upstream of the Delta, dredging would not affect spawning habitat or success for these species.

Delta smelt spawn in the Delta. As indicated in the affected environment, existing information does not indicate that spawning habitat is limiting population abundance and production for delta smelt (U.S. Fish and Wildlife Service 1996). However, dredging could permanently modify shallow areas that may provide spawning habitat for delta smelt. The area of shallow-water habitat affected by dredging will depend on the final Project design. The loss of spawning habitat in the Delta has not been explicitly identified as a factor contributing to the decline of delta smelt. However, spawning delta smelt can occur in the Mokelumne River system (U.S. Fish and Wildlife Service 1996). Relative to spawning habitat in other areas of the Delta, spawning habitat along the North Delta channels is likely of minor importance to maintaining population abundance. Furthermore, nonnative species currently dominate the fish community in shallow areas of the North Delta (Table 4.2-3) and many of these species prey on delta smelt eggs, larvae, and juveniles.

Some splittail spawn in and downstream of the Delta (U.S. Fish and Wildlife Service 1996), where adults deposit eggs on vegetation along the edges of tidal channels. Shallow areas that may provide spawning habitat for splittail could be permanently modified by dredging and ongoing maintenance activities. The area of shallow-water habitat affected by dredging will depend on the final Project design. Relative to spawning on inundated floodplain (Sommer et al. 1997), spawning habitat along the North Delta channels is likely of minor importance to maintaining population abundance. Furthermore, nonnative species currently dominate the fish community in shallow areas of the North Delta and many of these species prey on splittail eggs, larvae, and juveniles (Moyle 2002).

Although striped bass spawn primarily in the Sacramento and San Joaquin Rivers upstream of the Delta, some spawning occurs in the Delta during wet years (Moyle 2002). The main spawning areas in the Delta include the Sacramento River from Isleton to Butte City and the San Joaquin River and its sloughs from Venice Island down to Antioch. Most spawning occurs in the Sacramento River, however (Moyle 2002). Spawning habitat area for striped bass would not be affected by channel dredging in the North Delta because striped bass eggs are not dependent on the channel bottom or aquatic vegetation for survival; rather, they must remain suspended in the water column.

For the reasons described above, this impact is considered to be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-15: Changes in Prey Availability for Fish as a Result of Disturbance to Channel Bed and Removal of Sediments during Dredging.

Under Alternative 2-D, dredging would occur in portions of the Mokelumne River, Snodgrass Slough, and Dead Horse Cut (Figure 2-14). Dredging would lower the channel bed by removing accumulated sediments that may produce food for fish. This impact is assumed to include all areas that would be dredged. However, dredging is expected to have minimal effect on prey availability for fish, especially over the long term because:

- dredging would occur only during authorized work windows over several years, reducing the magnitude of the impact in any given year;
- similar vegetated areas and bottom substrates in adjacent channel reaches (both laterally and longitudinally) would be unaffected and would continue to support habitat for benthic invertebrates;
- invertebrate drift from upstream areas would continue to provide a prey base for fish in areas affected by dredging;
- benthic invertebrates are expected, based on changes in benthic invertebrate abundance observed in response to changes in salinity (Markham 1986; Vayssieres and Peterson 2003) and dredging (Wilson 1998), to recolonize bottom substrates disturbed by dredging relatively quickly;
- disposal of material in off-site settling basins would avoid impacts of sedimentation on the benthic community that are often associated with in-water disposal of dredge spoils; and
- dredging would be focused in mid-channel areas, and would largely avoid the shallow vegetated margins of the channels. In a study of cross-channel variability in benthic habitat in the Delta portion of the Sacramento River, benthic species richness and abundance was found to be lower (by an order of magnitude or more for abundance) in mid-channel areas than on the channel sides. These differences presumably occur in response to variations in physical processes across the channel that affect substrate particle size and organic matter content. (Vayssieres and Peterson 2003.)

Prey habitat loss associated with dredging would have a less-than-significant impact on fish species, especially over the long term.

Determination of Significance: Less than significant.

Mitigation: None required.

Retrofit or Replace Millers Ferry Bridge (Optional)

This alternative is optional in Group 2 and may be necessary to allow for construction of a weir and to accommodate a potential realignment of Walnut Grove–Thornton Road. This bridge (along with the New Hope Bridge) historically has been a constriction point in the system during flood events. Options for Millers Ferry Bridge are opening one or more new bays to extend the bridge along its length and widen the channel area, or completely replacing the bridge. Figure 2-27 provides an overview of the Millers Ferry Bridge plan.

For purposes of this analysis, it is assumed that the option of completely replacing the bridge is implemented because this option would result in greater disturbance to the channel, and hence, greater potential to adversely affect fish. In addition, it is also assumed that pile driving will be required as part of construction of the bridge support structure and that maintenance will require the permanent removal of all riparian vegetation in the footprint of bridge construction to facilitate conveyance of floodflows.

Impact Fish-1: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-2: Temporary Disturbance and Possible Mortality of Fish, including Special-Status Species, as a Result of Accidental Spills of Construction Materials.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact Fish-3: Loss of Fish, including Special-Status Species, from Direct Injury as a Result of Construction.

Construction elements of the Retrofit or Replace Millers Ferry Bridge Option would involve using heavy equipment and other techniques that potentially would result in direct injury, including mortality, to fish in the Project area. In-water construction and other activities such as pile driving would result in noise, vibrations, artificial light, and other physical disturbances that can harass fish, disrupt or delay normal activities, or cause injury or mortality. The potential magnitude of effects depends on a number of factors, including the type and intensity of the disturbance, proximity of the action to the water body, timing of actions relative to the occurrence of sensitive life stages, and frequency and duration of activities. Injury or mortality may result from direct and indirect contact with humans and machinery, sound pressure (e.g., pile driving), and physiological stress.

Project actions that cause no direct harm but may temporarily disturb fish include movement of construction equipment, lighting, removal and disturbance of riparian vegetation, and grading and construction along the waters' edge.

Potential direct effects of pile-driving activities include increased noise and turbidity. Researchers have suggested that fish, including salmonids, can hear pile-driving noise approximately 2,000 feet from the source (Feist et al. 1992). Feist further concluded that pile driving did in fact alter the distribution and behavior of juvenile pink and chum salmon. The potential for impacts on fish from pile-driving activities depends on the distance and duration of those activities.

Short-term noise disturbance caused by pile driving would occur during construction. Pile driving can generate intense sound pressure that can injure or kill fish. The effects on fish can range from avoidance to direct mortality depending on the species, life stage, and intensity of the pressure waves. Factors that influence the intensity of pressure waves include proximity to the source, the maximum force generated and the rate at which it is generated, and the characteristics of the medium (e.g., water and substrate) through which the waves travel.

Pile-driving activities have the greatest potential to affect fish during bridge construction because of the direct disturbance to the channel and the intense sound pressure that is generated when driving piles directly into, or adjacent to, aquatic habitats. In addition to causing direct injury or mortality, pile driving could discourage adult and juvenile fish, including anadromous salmonids, from migrating past the construction site. Because of the potential for direct injury or mortality of fish from underwater sound pressure waves and the potential for pile driving to disrupt the normal migration behavior of adult and juvenile fish, especially anadromous salmonids, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-14: Limit Pile-Driving Activities to Daytime Hours and from June 1 to August 31.

To minimize disturbance to migrating juvenile and adult fish, DWR or its contractors will limit pile-driving activities to daytime hours to allow uninterrupted movement of fish for approximately 8 hours each day. In addition, pile driving will be limited to the June 1–August 31 period to avoid peak occurrences of sensitive life stages of special-status species.

Significance after Mitigation: Less than significant.

Impact Fish-4: Loss of Shaded Riverine Aquatic Cover as a Result of Construction.

Bridge construction would require that all riparian vegetation in the footprint of bridge construction be removed to facilitate conveyance of future floodflows. Permanent removal of riparian vegetation in the bridge footprint would result in the permanent loss of riparian vegetation that provides SRA cover. As discussed under Alternative 1-A, SRA cover, represented by overhead vegetation and instream woody material in this analysis, is a Resource Category 1. The USFWS mitigation goal for a Resource Category 1 habitat is no net loss of existing habitat value.

For reasons described under Alternative 1-A, this impact is considered to be significant.

Determination of Significance: Significant.

Mitigation Measure Fish-2: Replace Affected Shaded Riverine Aquatic Cover.

Significance after Mitigation: Less than significant.

Retrofit or Replace New Hope Bridge (Optional)

Alteration or replacement of New Hope Bridge may be necessary to allow construction of a weir and to accommodate a potential realignment of Walnut Grove–Thornton Road. This bridge, along with Millers Ferry Bridge, historically has been a constriction point in the system during flood events. New Hope Bridge is at the crossing of Walnut Grove–Thornton Road and the South Fork Mokelumne River. Figure 2-28 provides an overview of the New Hope bridge plan.

For purposes of this analysis, assumptions related to complete replacement of the bridge and construction techniques are the same as described for the Retrofit or Replace Millers Ferry Bridge Option. For this reason, potential impacts and related mitigation associated with implementation of the Retrofit or Replace New

Hope Bridge Option would be similar to those described under the Retrofit or Replace Millers Ferry Bridge Option, except that the location would be different.

4.3 Wildlife

Analysis Summary

This section describes the wildlife resources in the Project area and the potential; impacts on these resources resulting from implementation of the Project. A summary of the potentially significant impacts on wildlife and mitigation measures that are associated with each Project alternative is presented in Table 4.3-1. Please refer to impact sections below for Alternatives 1-A, 1-B, 1-C, 2-A, 2-B, 2-C, and 2-D for more detailed discussions of all impacts and proposed mitigation measures.

Introduction

The study area contains a mosaic of land cover types, including agricultural lands, riparian habitat, tidal and nontidal emergent wetland, tidal perennial aquatic, grassland and ruderal vegetation, and developed lands. These land cover types support numerous common and special-status wildlife species. This section contains the following information:

- a summary of the significant impacts on wildlife and wildlife habitats and associated mitigation measures for each Project alternative (Table 4.3-1).
- a summary of land cover types found in the study area and their importance to wildlife resources (Table 4.3-2);
- a list of the special-status species that occur, or could occur, in the study area (Table 4.3-3);
- a description of Project effects on wildlife resources; and
- specific measures to mitigate Project-related impacts on wildlife.

For the purpose of this assessment of potential impacts of this Project on wildlife resources, including special-status species, the terms *Project area* and *study area* are used. The Project area includes all lands within the footprint of the proposed Project actions (e.g., levee modifications areas, setback areas, inundation areas, channel dredging areas) and the proposed mitigation sites. The study area is a larger geographic area encompassing the Project area and the channel dredging areas and all lands within 1 mile of Project features. Habitat mapping is not available for the entire study area; therefore, the assessment of the land cover types in the study area is based on aerial photograph interpretation and site observations.

The study area allows a comparison of Project-related effects on the local environment in relation to similar land cover types in the vicinity of the Project activities. Land cover type acreages discussed in this section represent those areas that were surveyed and mapped by DWR and others. Additional information related to land cover types is provided in Section 4.1, Vegetation and Wetlands.

Sources of Information

The following key sources of information were used in the preparation of this section:

- a review of the Project alternatives, including the Project description and calculated acreages of potential impact and mitigation areas;
- a review of aerial photographs and habitat mapping provided by DWR, Jones & Stokes, and others;
- a review of relevant reports and studies prepared for the study and Project areas;
- a review of previous wildlife surveys that have been performed in the study and Project areas (e.g., Point Reyes Bird Observatory 2001; May & Associates 2003);
- a review of the CNDDB (California Natural Diversity Database 2006);
- a species list obtained from the USFWS website for the Project, dated January 30, 2006 (Attachment 4.3-1); and
- the wildlife resources sections of the CALFED Programmatic EIR/EIS and the CALFED Multi-Species Conservation Strategy (MSCS).

The CNDDB search included all USGS quadrangle maps in the study and Project areas, including the Bouldin Island, Bruceville, Isleton, Terminous, and Thornton West 7.5-minute quadrangles. The USFWS species list includes special-status species that occur, or may occur, in these quadrangles.

Assessment Methods

This evaluation of impacts on wildlife resources, including special-status species, was based on:

- an analysis of the Project alternatives, including conceptual design drawings prepared by DWR, and assumptions on footprint dimensions developed by Jones & Stokes (Tables 4.1-3 and 4.1-4);
- a review of available data and reports from other surveys performed in the study and Project areas;
- habitat mapping provided by DWR, Jones & Stokes, and others; and
- field surveys and literature reviews.

Table 4.3-1. Summary of Significant Impacts and Mitigation Measures on Wildlife Resources for the North Delta Improvements Program

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-1: Loss of Riparian-Associated Wildlife Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-1: Replace Riparian Land Cover Types WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources	Less than significant
WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-4: Replace Wetland Land Cover Types	Less than significant
WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-5: Compensate for Loss of Tidal Perennial Aquatic Habitat	Less than significant
WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-6: Replace Nontidal Wetland Land Cover Types	Less than significant
WILD-5: Loss of Agricultural Land and Ruderal – Associated Wildlife Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Less than Significant	None	N/A
WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities	1A, 1B, 1C, 2A, 2B, 2C, 2D	Less than Significant	None	N/A

Table 4.3-1. Continued

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat	Less than significant
WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs WILD-MM-9: Avoid and Minimize Impacts on Elderberry Shrubs WILD-MM-10: Compensate for Unavoidable Impacts on Elderberry Shrubs	Less than significant
WILD -9: Potential Effects on Giant Garter Snake	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-4: Replace Wetland Land Cover Types WILD-MM-11: Conduct Preconstruction Surveys for Giant Garter Snake WILD-MM-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat	Less than significant

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-1: Replace Riparian Land Cover Types WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks prior to Construction and Maintenance WILD-MM-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites WILD-MM-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat WILD-MM-16: Avoid Removal of Occupied Nest Sites	Less than significant
WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-17: Conduct Preconstruction Surveys for Burrowing Owls WILD-MM-18: Minimize Construction-Related Disturbances near Occupied Nest Sites WILD-MM-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites WILD-MM-20: Mitigation of Impacts on Occupied Burrows WILD-MM-21: Replace Lost Burrowing Owl Foraging Habitat	Less than significant

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-12: Loss or Disturbance of Raptor Nest Sites as a Result of Construction Activities and Channel Dredging	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-1: Replace Riparian Land Cover Types WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-4: Replace Wetland Land Cover Types WILD-MM-6: Replace Nontidal Wetland Land Cover Types	Less than significant
WILD-13: Loss of Western Pond Turtle or Suitable Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-4: Replace Wetland Land Cover Types WILD-MM-17: Conduct Preconstruction Surveys for Burrowing Owls WILD-MM-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat	Less than significant
WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-1: Replace Riparian Land Cover Types WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-4: Replace Wetland Land Cover Types WILD-MM-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites WILD-MM-20: Mitigation of Impacts on Occupied Burrows WILD-MM-23: Conduct Preconstruction Surveys for Tricolored Blackbird WILD-MM-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies	Less than significant

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-1A-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-4: Replace Wetland Land Cover Types WILD-MM-25: Conduct Preconstruction Surveys for California Black Rail WILD-MM-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites	Less than significant
WILD-1A-16: Loss or Disturbance of Rookeries	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-4: Replace Wetland Land Cover Types WILD-MM-27: Conduct Preconstruction Surveys to Locate Rookeries WILD-MM-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries WILD-MM-29: Avoid Removal of Occupied Rookeries WILD-MM-30: Replace Lost Breeding Habitat	Less than significant

Table 4.3-1. Continued

Impact	Applicable Alternative	Level of Significance Before Mitigation	Mitigation Measure	Level of Significance after Mitigation
WILD-1A-19: Loss or Disturbance of Migratory Birds	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources	Less than significant
WILD-2A-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities	1A, 1B, 1C, 2A, 2B, 2C, 2D	Significant	WILD-MM-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance WILD-MM-3: Minimize Impacts on Sensitive Biological Resources WILD-MM-31: Conduct Preconstruction Surveys for Bats	Less than significant

Table 4.3-2. Crosswalk between Land Cover Types and Wildlife Habitats in the Study Area

Wildlife Habitat Associations[1]	Land Cover Types in the Study Area		Total Acres for Wildlife Habitat Association
	NDIP Land Cover Type	Acres	
Tidal perennial aquatic	Tidal perennial aquatic	2541.78	2,541.78
	Tidal mudflat	4.38	4.38
Tidal freshwater emergent marsh	Tule and cattail tidal emergent wetland	74.49	74.49
Lacustrine (aquatic nontidal)	Farm and borrow pit ponds	8.69	133.30
	Temporary Ag Ditch (<15 ft wide)	104.47	
	Permanent Ag Ditch (>15 ft wide)	20.14	
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	4.20	14.98
	Seasonal freshwater emergent wetland	10.78	
Valley/foothill riparian (woodland)	Cottonwood-willow woodland	30.97	1,042.72
	Valley oak riparian woodland	15.72	
	Mixed riparian woodland	21.53	
	Nonnative riparian woodland	1.55	
	Riparian vegetation (unclassified)	972.95	
Valley/foothill riparian (scrub)	Riparian scrub	104.58	129.87
	Himalayan blackberry	25.29	
Grassland	Annual grassland	17.77	1,111.85
	Perennial grassland	4.64	
	Permanent pasture	312.33	
	Ruderal/forb	777.11	
Upland cropland	Corn and grain fields	12279.00	32,860.72
	Truck and other row crops	14005.99	
	Orchard and vineyard	1381.30	
	Hay crops	4719.62	
	Fallow fields	474.81	
Developed lands	Developed land	721.27	721.27
Ornamental landscape	Ornamental landscape	9.39	9.39
Unknown[2]	n/a	1357.64	1357.64
Totals		40,002.39	40,002.39

Notes:

1 Wildlife habitats are based on the NCCP habitat types.

2 *Unknown* refers to areas within the impact footprints for which land cover types have not been mapped. Include native vegetation.

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Invertebrates						
Vernal pool fairy shrimp *Branchinecta lynchi*	T/--	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County; isolated populations also in Riverside County	Common in vernal pools; also found in sandstone rock outcrop pools	Habitat loss to agricultural and urban development	Low; vernal pools absent; no records near the study area (CNDDB 2006)	No
Vernal pool tadpole shrimp *Lepidurus packardi*	E/--	Shasta County south to Merced County	Vernal pools and ephemeral stock ponds	Habitat loss to agricultural and urban development	Low; vernal pools absent; one record about 3.1 miles north east of the study area in vernal pool terrain (CNDDB 2006)	No
Longhorn fairy shrimp *Branchinecta longiantenna*	E/--	Eastern margin of central Coast Ranges from Contra Costa County to San Luis Obispo County	Small, clear pools in sandstone rock outcrops of clear to moderately turbid clay- or grass-bottomed pools	Habitat loss to agricultural and urban development	Low; vernal pools absent; no records near the study area (CNDDB 2006)	No
Delta June beetle *Polyphylla stellata*	FSC/--	Sacramento-San Joaquin River Delta region	Sand deposits along riverine habitats	Alteration of riverine habitats	Low; no records near the study area (CNDDB 2006)	No
Ricksecker's water scavenger beetle *Hydrochara rickseckeri*	P/-	Known only from pond and vernal pool habitats scattered around the San Francisco Bay area, including Marin, Sonoma, Alameda, San Joaquin and Contra Costa counties	Seasonal wetlands and small ponds habitats; restricted to fresh water areas	Habitat loss and degradation of aquatic habitats	Low; no suitable pond or vernal pool habitat in study area; one record about 1.2 miles east of the study area (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	T/--	Streamside habitats below 3,000 feet through the Central Valley of California	Riparian and oak savanna habitats with elderberry shrubs; elderberries are host plant	Loss and fragmentation of riparian habitats	High; one record about 5.6 miles northeast of the study area (CNDDB 2006); elderberry shrubs grow extensively along the levees of the McCormack-Williamson Tract and shrubs were recorded on Staten Island (May & Associates 2003). Elderberry shrubs are also expected to occur at Grizzly Slough restoration area	Yes
Amphibians						
California tiger salamander *Ambystoma californiense (=A. tigrinum c.)*	C/SSC	Central Valley, including Sierra Nevada foothills, up to approximately 1,000 feet, and coastal region from Butte County south to Santa Barbara County	Small ponds, lakes, or vernal pools in grasslands and oak woodlands for larvae; rodent burrows, rock crevices, or fallen logs for cover for adults and for summer dormancy	Loss of grasslands, vernal pools, and other wetlands to agricultural development and urbanization	Low; vernal pools absent; small ponds on McCormack-Williamson Tract are isolated and were created as the result of scour or borrow material excavation; no records near the study area (CNDDB 2006)	No
Western spadefoot *Scaphiopus hammondii*	FSC/SSC, P	Sierra Nevada foothills, Central Valley, Coast Ranges, coastal counties in southern California	Shallow streams with riffles and seasonal wetlands, such as vernal pools in annual grasslands and oak woodlands	Alteration of stream habitats by urbanization and hydroelectric projects, loss of seasonal wetlands and vernal pools	Low, vernal pools and other suitable wetlands absent; no records near the study area (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Reptiles						
Western pond turtle *Clemmys marmorata*	FSC/SSC, P	In California, range extends from Oregon border of Del Norte and Siskiyou Counties south along coast to San Francisco Bay, inland through Sacramento Valley, and on the western slope of Sierra Nevada. Also occurs along the central coast of California east to the Sierra Nevada and along the southern California coast inland to the Mojave and Sonora Deserts	Woodlands, grasslands, and open forests; occupies ponds, marshes, rivers, streams, and irrigation canals with muddy or rocky bottoms and with watercress, cattails, water lilies, or other aquatic vegetation	Loss and alteration of aquatic and wetland habitats, habitat fragmentation	High; suitable habitat present along both forks of the Mokelumne River; several records within or near the study area (CNDDB 2006, May & Associates 2003)	Yes
California horned lizard *Phrynosoma coronatum frontale*	FSC/SSC, P	Sacramento Valley, including foothills, south to southern California; Coast Ranges south of Sonoma County; below 4,000 feet in northern California	Grasslands, brushlands, woodlands, and open coniferous forest with sandy or loose soil; requires abundant ant colonies for foraging	Loss of habitat from agriculture and urban development, habitat fragmentation	Low; no suitable habitat in study area or nearby; no records near the study area (CNDDB 2006)	No
San Joaquin whipsnake *Masticophis flagellum ruddocki*	FSC/SSC, P	From Colusa County in the Sacramento Valley southward to the grapevine in the San Joaquin Valley and westward into the inner coast ranges; an isolated population occurs at Sutter Buttes; known elevational range from 20 to 900 meters	Occurs in open, dry, vegetative associations with little or no tree cover; in valley grassland and saltbush scrub associations; often in association with mammal burrows	Loss of habitat from agriculture and urban development, habitat fragmentation	Low; no suitable grassland or chaparral habitat in study area or nearby; no records near the study area (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Giant garter snake *Thamnophis gigas*	T/T	Central Valley from Fresno north to the Gridley/Sutter Buttes area; has been extirpated from areas south of Fresno	Sloughs, canals, and other small waterways where there is a prey base of small fish and amphibians; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter	Loss of habitat from agriculture and urban development, habitat fragmentation	Moderate; there are several occurrences near the study area; the Mokelumne River and other major waterways in project area provide low to moderate quality habitat along levees; potential habitat present in the project area with irrigation canals and other land side water bodies. (Hanse 2002, May & Associates 2003 CNDDB 2006)	Yes
Birds						
Aleutian Canada goose *Branta canadensisleucopareia*	FSC/--	Breeds in the Aleutian Islands and winter along the Pacific coast and the Central Valley, especially in the San Joaquin Valley – especially in Stanislaus County; entire population stages near Crescent City during spring before migrating to breeding grounds	Roosts in large marshes, flooded fields, stock ponds, and reservoirs; forages in pastures, meadows, and harvested grainfields; corn is especially preferred	Introduction of predators on breeding grounds, loss of traditional wintering habitat in the Central Valley; Aleutian Canada geese declined to about 700 individuals in the 1970s; due to protection of their breeding habitats and protection under the ESA, their numbers have now recovered to 40,000-45,000 individuals (May & Associates 2003)	High; flocks of up to 20,000 individuals have been seen in agricultural fields of the study area (May & Associates 2003)	Yes

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Double-crested cormorant *Phalacrocorax auritus* (breeding rookery)	--/SSC	Resident throughout California in coastal region and along major rivers, inland marshes, lakes and reservoirs.	Rocky coastlines, beaches, inland ponds, and lakes; needs open water for foraging, and nests in riparian forests or on protected islands, usually in snags	Loss of coastal and riparian breeding sites, human disturbance	Moderate; some suitable riparian breeding habitat in study area; no breeding records (CNDDB 2006); nonbbreeding birds observed in study area (May & Associates 2003)	Yes, only if breeding rookeries are observed in the study area
Least bittern *Ixobrychus exilis*	FSC/SSC	Permanent resident along the Colorado River and Salton Sea and in isolated areas in Imperial, San Diego, and Los Angeles Counties; summers at Tulare Lake and parts of the Central Valley, and Siskiyou, and Modoc counties.	Marshes and along pond edges, where tules and rushes can provide cover; nests are built low in the tules over the water	Loss of wetlands to agriculture and urban development	Low; some suitable marsh habitats near the study area; no records near the study area (CNDDB 2006)	No
Great blue heron *Ardea herodias* (breeding rookery)	–/SSC	Permanent resident in wetlands throughout California.	All wetland habitats. Nests in colonies in trees.		Moderate; some suitable riparian breeding habitat in study area; no records of breeding rookeries near the study area (CNDDB 2006); nonbbreeding birds observed in study area (May & Associates 2003)	Yes, only if breeding rookeries are observed in the study area

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Great egret *Ardea alba* (breeding rookery)	–/SSC	Permanent resident in wetlands throughout the lowlands of California.	Prefers emergent marshes, ponds but will occasionally forage along creeks, rivers and lakes. Nests in colonies in trees.		Moderate; some suitable riparian breeding habitat in study area; no records of breeding rookeries near the study area (CNDDB 2006); nonbbreeding birds observed in study area (May & Associates 2003)	Yes, only if breeding rookeries are observed in the study area
Snowy egret *Egretta thula* (breeding rookery)	–/SSC	Permanent resident in wetlands throughout the lowlands of California.	Prefers emergent marshes, ponds but will occasionally forage along creeks, rivers and lakes. Nests in emergent wetland vegetation.		Moderate;, some suitable marsh breeding habitat in study area; no records of breeding rookeries near the study area (CNDDB 2006); nonbbreeding birds observed in study area (May & Associates 2003)	Yes, only if breeding rookeries are observed in the study area
Black-crowned night-heron *Nycticorax nycticorax* (breeding rookery)	–/SSC	Permanent resident in wetlands throughout the lowlands of California.	Prefers emergent marshes, ponds but will occasionally forage along creeks, rivers and lakes. Nests in colonies in trees.		Moderate; some suitable marsh breeding habitat in study area; no records of breeding rookeries near the study area (CNDDB 2006) but known to breed on instream islands of the South Fork of the Mokelumne River and nonbreeding birds observed in study area (May & Associates 2003)	Yes, only if breeding rookeries are observed in the study area

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
White-faced ibis *Plegadis chihi* (breeding rookery)	FSC/-	Both resident and winter populations on the Salton Sea and in isolated areas in Imperial, San Diego, Ventura, and Fresno Counties; breeds at Honey Lake, Lassen County, at Mendota Wildlife Management Area, Fresno County, and near Woodland, Yolo County; winters in Merced County and along the Sacramento River in Colusa, Glenn, Butte, Sutter, and Yolo Counties	Prefers freshwater marshes with tules, cattails, and rushes, but may nest in trees and forage in flooded agricultural fields, especially flooded rice fields	Loss of wetlands to agriculture and urban development	Moderate; some suitable marsh breeding habitat and extensive suitable foraging habitats in the study area; no records of breeding rookeries near the study area (CNDDB 2006)	Yes, only if breeding rookeries are observed in the study area
White-tailed kite *Elanus leucurus*	--/FP	Lowland areas west of Sierra Nevada from head of Sacramento Valley south, including coastal valleys and foothills to western San Diego County at the Mexico border	Low foothills or valley areas with valley or live oaks, riparian areas, and marshes near open grasslands for foraging	Loss of grassland and wetland habitats to agriculture and urban development	High; suitable breeding and foraging habitats present in study area; no records in the study area (CNDDB 2006); known to forage in the study area (May & Associates 2003)	Yes
Bald eagle *Haliaeetus leucocephalus*	T, PR/E	Nests in Siskiyou, Modoc, Trinity, Shasta, Lassen, Plumas, Butte, Tehama, Lake, and Mendocino Counties and in the Lake Tahoe Basin; reintroduced into central coast; winter range includes the rest of California, except the southeastern deserts, very high altitudes in the Sierras, and east of the Sierra	In western North America, nests and roosts in coniferous forests within 1 mile of a lake, a reservoir, a stream, or the ocean	Nest sites vulnerable to human disturbance, pesticide contamination	Moderate; some suitable foraging and roosting habitat in study area; no records in the study area (CNDDB 2006)	Yes

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
		Nevada south of Mono County; range expanding				
Northern harrier *Circus cyaneus*	--/SSC	Throughout lowland California; has been recorded in fall at high elevations	Grasslands, meadows, marshes, and seasonal and agricultural wetlands providing tall cover	Loss of habitat to agricultural and urban development	High; suitable breeding and foraging habitat present in study area; no breeding records in the study area (CNDDB 2006); known to forage in the study area (May & Associates 2003)	Yes
Cooper's hawk *Accipiter cooperii*	--/SSC	Throughout California except high altitudes in the Sierra Nevada; permanent residents occupy the rest of the state	Nests primarily in riparian forests dominated by deciduous species; also nests in densely canopied forests from digger pine-oak woodland up to ponderosa pine; forages in open woodlands	Human disturbance at nest sites, loss of riparian habitats, especially in the Central Valley; pesticide contamination	Moderate; some suitable foraging and roosting habitat in study area; no breeding records in the study area (CNDDB 2006); known to forage in the study area (May & Associates 2003)	Yes
Swainson's hawk *Buteo swainsoni*	--/T	Lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley; the state's highest nesting densities occur near Davis and Woodland, Yolo County; a few individuals are apparently year-round residents in the Delta	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, grain fields, and vegetable crops	Loss of riparian, agriculture, and grassland habitats; vulnerable to human disturbance at nest sites	High; extensive areas of suitable foraging and breeding habitat; documented breeding records in the study area (CNDDB 2006); observed foraging in the study area (May & Associates 2003)	Yes

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Ferruginous hawk *Buteo regalis*	FSC/SSC	Does not nest in California; winter visitor along the coast from Sonoma County to San Diego County, east-ward to the Sierra Nevada foothills and southeastern deserts, the Inyo-White Mountains, the plains east of the Cascade Range, and Siskiyou County	Open terrain in plains and foothills where ground squirrels and other prey are available	Conversion of grasslands for agriculture and urban development	Moderate; some suitable foraging and roosting habitat in study area; no records (CNDDB 2006)	No
Golden eagle *Aquila chrysaetos*	PR/SSC, FP	Foothills and mountains throughout California; uncommon non-breeding visitor to lowlands such as the Central Valley	Cliffs and escarpments or tall trees for nesting; annual grasslands, chaparral, and oak wood-lands with plentiful medium and large-sized mammals for prey	Habitat loss to urbanization; vulnerable to disturbance at nest sites	Moderate; some suitable foraging and roosting habitat in study area; no records (CNDDB 2006)	No
American peregrine falcon *Falco peregrinus anatum*	FSC/E	Permanent resident on the north and south Coast Ranges; may summer on the Cascade and Klamath Ranges south through the Sierra Nevada to Madera County; winters in the Central Valley south through the Transverse and Peninsular Ranges and the plains east of the Cascade Range	Nests and roosts on protected ledges of high cliffs, usually adjacent to lakes, rivers, or marshes that support large populations of other bird species	Pesticide contamination; population recovering	Moderate; some suitable foraging and roosting habitat in study area; no records (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Prairie falcon *Falco mexicanus*	--/SSC	Found as permanent resident on the south Coast, Transverse, Peninsular, and northern Cascade Ranges, the southeastern deserts, Inyo-White Mountains, Modoc, Lassen, and Plumas Counties, and the foothills surrounding the Central Valley; winters in the Central Valley, along the coast from Santa Barbara County to San Diego County, and in Marin, Sonoma, Humboldt, Del Norte, and Inyo Counties	Cliffs or escarpments for nesting; adjacent dry, open terrain or uplands, marshes, and seasonal marshes for foraging	Possibly pesticide contamination, robbing of eyries by falconers and illegal shooting, human disturbance at nest site	Moderate; some suitable foraging and roosting habitat in study area; no breeding habitat in the study area; known to forage in the study area (May & Associates 2003)	No
Yellow rail *Coturnicops noveboracensis*	--/SSC	Records of potential breeding populations in Siskiyou, Modoc and Mono counties; recent winter records on the coast from Del Norte County to San Diego County as well as near the North Delta at Grizzley Island.	Freshwater marshes, brackish marshes, coastal salt marshes, and grassy meadows	Decline of wintering populations may be related to a decline of breeding grounds	Low; some suitable marsh habitat but no records in the study area (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Black rail *Laterallus jamaicensis*	FSC/T	Permanent resident in the San Francisco Bay and east-ward through the Delta into Sacramento and San Joaquin Counties; small populations in the western foothills of the northern Sierra Nevada, as well as in Marin, Santa Cruz, San Luis Obispo, Orange, Riverside, and Imperial counties	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations	Loss of wetland habitat	Moderate; some suitable habitat in along the South Fork Mokelumne River (May & Associates 2003); one record about 1.2 miles south of Staten Island (CNDDB 2006)	Yes
Greater sandhill crane *Grus canadensis tabida*	--/T	Breeds on meadows and sedge marshes east of the Cascade Range and south to Sierra County; winters in the Central Valley, southern Imperial County, Lake Havasu National Wildlife Refuge, and the Colorado River Indian Reserve	Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water	Loss of freshwater marsh nesting habitat, disturbance by cattle during nesting, illegal hunting	High; suitable foraging and roosting habitat in study area; Staten Island is an important roosting area (Littlefield and Ivey 2000)	Yes
Mountain plover *Charadrius montanus*	C/SSC	Does not breed in California; in winter, found in the Central Valley south of from Colusa County, along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego Counties; parts of Imperial, Riverside, Kern, and Los Angeles Counties	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grainfields	Loss of habitat to agriculture and urban development; decline of California's wintering population may be attributable to disturbance of breeding population	Low; some suitable roosting and foraging habitat present in study area; no records (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Black tern *Chlidonias niger*	FSC/SSC	Spring and summer resident of the Central Valley, Salton Sea, and northeastern California where suitable emergent wetlands and rice fields occur	Freshwater wetlands, lakes, ponds, moist grasslands, and agricultural fields; feeds mainly on fish and invertebrates while hovering over water	Loss of wetland nesting and foraging habitat	Moderate; some suitable roosting and foraging habitat present in study area; no records (CNDDB 2006)	No
Western yellow-billed cuckoo *Coccyzus americanus occidentalis*	--/E	Nests along the upper Sacramento, lower Feather, south fork of the Kern, Amargosa, Santa Ana, and Colorado Rivers	Wide, dense riparian forests with a thick understory of willows for nesting; sites with a dominant cottonwood overstory are preferred for foraging; may avoid valley oak riparian habitats where scrub jays are abundant	Loss of riparian habitat to agriculture and water control development, possibly pesticide contamination	Low; no suitable breeding or foraging habitat in study area; no records in the study area (CNDDB 2006)	No
Western burrowing owl *Athene cunicularia hypugea*	FSC/SSC	Lowlands throughout California, including the Central Valley, northeastern plateau, southeastern deserts, and coastal areas; rare along south coast	Rodent burrows in sparse grassland, desert, and agricultural habitats	Loss of habitat, human disturbance at nesting burrows	High; suitable breeding and foraging habitat present along levee roads; known to occur on Staten Island (May & Associates 2003); suitable habitat also present on McCormack-Willimason Tract	Yes

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Long-eared owl *Asio otus*	--/SSC	Permanent resident east of the Cascade Range from Placer County north to the Oregon border, east of the Sierra Nevada from Alpine County to Inyo County, along the coast from Sonoma County to San Luis Obispo County, and eastward over the north Coast Ranges to Colusa County; winters in the Central Valley, Mojave and Sonora Deserts, and the Inyo-White Mountains; summers along the eastern rim of the Central Valley and Sierra foothills from Tehama County to Kern County	Dense riparian stands of willows, cottonwoods, live oaks, or conifers; uses adjacent open lands for foraging; nests in abandoned crow, hawk, or magpie nests	Loss of riparian habitats	Low; no suitable breeding or foraging habitat in study area; no records in the study area (CNDDB 2006)	No
Short-eared owl *Asio flammeus*	--/SSC	Permanent resident along the coast from Del Norte County to Monterey County although very rare in summer north of San Francisco Bay, in the Sierra Nevada north of Nevada County, in the plains east of the Cascades, and in Mono County; small, isolated populations also nest in the Central Valley; winters on the coast from San Luis Obispo County to San Diego County, in the Central Valley from	Freshwater and salt marshes, lowland meadows, and irrigated alfalfa fields; needs dense tules or tall grass for nesting and daytime roosts	Loss of wetland and grassland habitats to agriculture and urban development	Moderate; suitable breeding and foraging habitat present along levee roads and agricultural fields in study area; known to occur in the study area (May & Associates 2003)	Yes

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
		Tehama County to Kern County, in the eastern Sierra Nevada from Sierra County to Alpine County, on the Channel Islands, and in Imperial County				
Willow flycatcher *Empidonax traillii*	FSC/E	Summer range includes a narrow strip along the eastern Sierra Nevada from Shasta County to Kern County, and along the western Sierra Nevada from El Dorado County to Madera County; widespread in migration	Riparian areas and large, wet meadows with abundant willows for breeding; usually found in riparian habitats during migration	Loss of riparian breeding habitat, nest parasitism by brown-headed cowbirds	Low; no suitable riparian breeding or foraging habitat in study area; no breeding records in the study area (CNDDB 2006)	No
Loggerhead shrike *Lanius ludovicianus*	FSC/-	Resident and winter visitor in lowlands and foothills throughout California; rare on coastal slope north of Sonoma County.	Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches	Loss of habitat and pesticide use; still widespread in California	Moderate; suitable breeding and foraging habitat present in study area; known to occur in the study area (May & Associates 2003)	No
California horned lark *Eremophila alpestris actia*	–/SSC	Found throughout open grasslands and agricultural fields in the coastal region from Humboldt south to San Diego, and inland from the delta region south into the San Joaquin Valley and throughout much of southern California.	Common, abundant resident in a variety of open habitats, usually where large trees and shrubs are absent; grasslands and deserts to dwarf shrub habitats above tree line	Loss of habitat and pesticide use; still widespread in California	Moderate; suitable foraging habitat in study area; known to occur in the study area (May & Associates 2003)	Yes

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Bank swallow *Riparia riparia*	--/T	The state's largest remaining breeding populations are along the Sacramento River from Tehama County to Sacramento County and along the Feather and lower American Rivers and Cache Creek, in the Owens Valley; nesting areas also include the plains east of the Cascade Range south through Lassen County, northern Siskiyou County, and small populations near the coast from San Francisco County to Monterey County	Nests in bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam to allow digging	Loss of natural earthen banks to bank protection and flood control, erosion control related to stream regulation by dams	Low; no suitable bluffs or banks in study area; possibly could occur in migration; no records in the study area (CNDDB 2006)	No
California yellow warbler *Dendroica petechia brewsteri*	--/SSC	Nests over all of California but rarely in the Central Valley, and not in the Mojave Desert region; winters along the Colorado River and in parts of Imperial and Riverside Counties.	Nests in riparian areas dominated by willows, cottonwoods, sycamores, or alders or in mature chaparral; may also use oaks, conifers, and urban areas near streamcourses	Loss of riparian breeding habitats, nest parasitism by brown-headed cowbirds	Low; no suitable riparian breeding habitat in study area, could occur in migration; no records in the study area (CNDDB 2006)	No
Yellow-breasted chat *Icteria virens*	--/SSC	Uncommon breeder in lowland California but more common in western foothills of the Sierra Nevada and in the North Coast Range.	Nests in dense riparian habitats dominated by willows, alders, Oregon ash, tall weeds, blackberry vines, and grapevines	Loss of riparian breeding habitat	Low; no suitable riparian breeding or foraging habitat in study area, could occur in migration; no records in the study area (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Modesto song sparrow *Melospiza melodia malliardi*	--SSC	Resident in the Central Valley below 200' elevation from Colusa County south to Stanislaus County, including the Suisun Marsh	Riparian and freshwater marsh habitats along rivers, streams and marshes	Habitat loss and degradation	High; suitable breeding habitat present in the study are known to occur in the study area (May & Associates)	Yes
Grasshopper sparrow *Ammodramus savannarum*	--/SSC	Breeds along the Sierra foothills, edges of the Central Valley, Coast Ranges, and coastal areas from Humboldt County south to San Diego County	Dry grasslands with scattered shrubs for song perches	Loss of habitat from urbanization in south coastal areas; has probably always been rare and localized elsewhere in the state	Low; no suitable grassland habitat in study area; no records in the study area (CNDDB 2006)	No
Tricolored blackbird *Agelaius tricolor*	FSC/SSC	Largely endemic to California; permanent residents in the Central Valley from Butte County to Kern County; at scattered coastal locations from Marin County south to San Diego County; breeds at scattered locations in Lake, Sonoma, and Solano Counties; rare nester in Siskiyou, Modoc, and Lassen Counties	Nests in dense colonies in emergent marsh vegetation, such as tules and cattails, or upland sites with blackberries, nettles, thistles, and grainfields; nesting habitat must be large enough to support 50 pairs; probably requires water at or near the nesting colony; requires large foraging areas, including marshes, pastures, agricultural wetlands, dairies, and feedlots, where insect prey is abundant	Loss of wetland and upland breeding habitats from conversion to agriculture and urban development and to water development projects, pesticides contamination, human disturbance of nesting colonies	High; suitable winter foraging habitat in the study area; known to occur in the study area, (May & Associates 2003), no known breeding colonies in the study area (CNDDB 2006)	Yes
Yellow-headed blackbird (nesting) *Xanthocephalus xanthocephalus*	FSC/--	Uncommon breeding bird in marshes in the Central Valley, and in eastern and southern California.	Nests in dense colonies in emergent marsh vegetation, such as tules and cattails.		Low; some suitable marsh breeding habitat in study area; no records in the study area (CNDDB 2006)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
Mammals						
Yuma Myotis *Myotis yumanensis*	FSC, LS/–	Considered common and widespread in northern California in a variety of habitats from sea level to about 2,400 m in the Sierra Nevada; uncommonly up to 3,350 m	Roosts colonially in a variety of natural and human-made sites, including caves, mines, buildings, bridges, and trees; in northern California, maternity colonies are usually in fire-scarred redwoods, pines, or oaks; forages for insects over water bodies	Human disturbance of roosting and maternity sites	Low; some suitable roosting habitat may exist under bridges in the study area; no records in the study area (CNDDB 2006)	Yes
Pallid Bat *Antrozous pallidus*	FS, LS/SSC	Low elevations throughout California	Rocky outcrops, cliffs, and crevices for roosting; access to open habitats required for foraging	Human disturbance of roosting and maternity sites	Low; some suitable roosting habitat may exist under bridges in the study area; no records in the study area (CNDDB 2006)	Yes
Pale Townsend's Big-eared Bat *Corynorhinus townsendii pallescens*	FSC, FS, LS/SSC	Klamath Mountains, Cascades, Sierra Nevada, Central Valley, Transverse and Peninsular Ranges, Great Basin, and Mojave and Sonora Deserts	Mesic habitats; gleans insects from brush or trees and feeds along habitat edges; roosting and maternity sites in caves, mines, tunnels, and buildings	Unclear; possibly human disturbance of roosting and maternity sites	Low; some suitable roosting habitat may exist under bridges in the study area; no records in the study area (CNDDB 2006)	Yes
Riparian brush rabbit *Sylvilagus bachmani riparius*	E/E	Known from three natural populations in San Joaquin County: Paradise Cut, Lathrop Oxbow, and Caswell Memorial State Park	Riparian habitats within floodplains with brushy understory for cover	Loss and degradation of floodplain riparian habitats; mortality during high flow events if suitable upland escape cover is absent	Low; no records in the study area (CNDDB 2006, May & Associates 2003)	No

Common and Scientific Name	Status [a] Federal/State	California Distribution	Habitats	Reason for Decline	Potential for Occurrence in Study Area	Proposed for Evaluation in the EIR
San Joaquin Valley woodrat *Neotoma fuscipes riparia*	E/CSC	Historical distribution along the San Joaquin, Stanislaus, and Tuolumne Rivers, and Caswell State Park in San Joaquin, Stanislaus, and Merced Counties; presently limited to San Joaquin County at Caswell State Park and a possible second population near Vernalis.	Riparian habitats with dense shrub cover, willow thickets, and an oak overstory.	Loss and degradation of floodplain riparian habitats	Low; outside the species known range; no records in the study area (CNDDB 2006)	No
American Badger *Taxidea taxus*	–/SSC	Most of California except extreme north coastal regions of Humboldt, Del Norte, and Siskiyou Counties	Suitable habitats include herbaceous and shrub communities and open stages of most other habitats with dry, friable soils where dens are excavated; home ranges can be up to 243 hectares	Reason for decline unclear; probably related to habitat loss in developed and agricultural areas where soils are excavated	Low; some suitable burrowing habitat may exist along levee roads and margins of agricultural fields; no records in the study area (CNDDB 2006)	No

Common Names are state- and/or federally-listed species.
[a] Status definition:

Federal

E = Listed as Endangered under the federal Endangered Species Act.
T = Listed as Threatened under the federal Endangered Species Act.
C = Candidate for listing as either threatened or endangered under the Federal Endangered Species Act.
P = Petitioned for listing as either threatened or endangered under the federal Endangered Species Act.
PR = Protected under the Bald Eagle and Golden Eagle Protection Act
FSC = Federal Species of Concern; species for which existing information indicates it may warrant listing but for which substantial biological information is lacking.
– = No listing or special status.

State

E = Listed as endangered under the California Endangered Species Act.
T = Listed as threatened under the California Endangered Species Act.
FP = Fully protected under the California Fish and Game Code.
PR = Protected under the California Fish and Game Code.
SSC = Considered a Species of Special Concern by the California Department of Fish and Game
– = No listing or special status.

Specific information pertaining to field surveys and literature reviews performed and provided by DWR, TNC, and others is provided in the individual species accounts in the sections that follow.

Table 4.3-3 lists the special-status species that, based on results of field surveys and review of relevant literature and the CNDDB, are known to occur or could be present in the Project and study areas. Animal species were considered to be present in the Project area if they were observed during field surveys or if species' habitat present in the Project or study area is within the known range of the species. This table also indicates whether the species is proposed for evaluation in this EIR.

The following sections describe the occurrence of habitats and wildlife species, including special-status species, associated with each land cover type present in the Project area.

Physical Setting/Affected Environment

Historically, the study area consisted of a mosaic of tidal marshlands dominated by bulrushes and cattails with a few low, natural levees that supported woody riparian vegetation, grassland, and upland shrubs (Thompson 1957). Today, agricultural land dominates the study and Project areas. Levees in the North Delta typically have waterside slopes that are rock-lined or dominated by ruderal vegetation. Most levees in the North Delta region are actively maintained to control woody vegetation that could destabilize the levee structure. In many areas, the interior areas of the islands are actively farmed and contain little or no natural vegetation. Consequently, most remaining undisturbed native land cover types in the study area, including woody riparian vegetation, occur along interior levees. However, levees surrounding the McCormack-Williamson Tract and Grizzly Slough have well-developed riparian vegetation on both the waterside and interior levees that provides high-quality habitat for a diversity of wildlife, including several special-status species.

Land cover types in the study area can be divided into artificial and natural vegetation communities. Agriculture and landscaped and developed lands are artificial vegetation communities because they are maintained by frequent human disturbance and other activities (i.e., plowing, discing, and herbicide applications). The other vegetation communities and the aquatic communities are natural community types. Both the artificial and natural community types are addressed as NCCP communities in the MSCS (CALFED Bay-Delta Program 2000a). The mapped land cover types are described in Section 4.1, Vegetation and Wetlands. Table 4.3-2 includes a crosswalk between the CALFED NCCP communities, where applicable, and the land cover types described in this document, and it identifies the acreage of each land cover type in the study area.

Wildlife Habitat—Land Cover Type Associations in the Study Area

This section summarizes the land cover types identified in the study and Project areas and describes the possible relationship between land cover types and the wildlife habitats addressed in this analysis. Land cover types are described in Section 4.1, Vegetation and Wetlands. While land cover types emphasize floristic composition, structure, and other physical attributes, wildlife habitat associations emphasize a land cover type's function and value for wildlife species. In some instances two or more land cover types may provide similar functions and values for wildlife (e.g., cottonwood-willow woodland and valley oak riparian woodland).

The following sections summarize the relationship between wildlife habitats and the associated land cover types in the Project area that were identified in Section 4.1, Vegetation and Wetlands, and summarized in Table 4.3-2. Additionally, this section identifies the functions and values of each wildlife habitat, identifies associated common and special-status wildlife species, and identifies supporting ecological processes in the Project area. For the purpose of this discussion, the general wildlife groups are waterfowl, shorebirds, water and wading birds, songbirds, raptors, mammals, reptiles, and amphibians. The habitat associations of special-status species are discussed briefly in this section and in more detail in the individual accounts (see Special-Status Species below). Common and scientific names of all animal species mentioned in the text are provided in Attachment 4.3-2.

Six natural land cover types and three artificial land cover types are present in the study area (Table 4.3-2). The natural land cover types are tidal perennial aquatic, tidal and nontidal emergent wetland, riparian woodland, riparian scrub, and grassland/ruderal. The artificial land cover types are agricultural and developed lands and ornamental landscaping.

The following sections:

- describe the wildlife species and land cover types associated with each habitat type,
- identify the functions and values of each land cover type, and
- identify associated common wildlife species.

Tidal Perennial Aquatic

The tidal perennial aquatic land cover type is present throughout the study area. Tidal perennial aquatic habitat includes deepwater, shallow aquatic, and unvegetated intertidal areas in sloughs and channels.

Deepwater areas are largely unvegetated; however, beds of aquatic plants occasionally occur in shallower open-water areas. Deepwater areas provide foraging, roosting, and escape cover for a number of diving ducks, cormorants, grebes, and other waterfowl that are permanent residents or that winter in the Project area.

Shallow aquatic areas may include shallow open-water areas or areas dominated by tidal perennial aquatic plant species, such as water hyacinth or water primrose. Colonies of these aquatic plants are generally infrequent but provide important habitat for a number of species. Shallow aquatic areas provide foraging habitat for wading birds, diving and dabbling ducks, other waterfowl species, kingfishers, and wading birds. Shallow aquatic areas provide rearing, escape cover, and foraging for reptiles and amphibians and may be used as foraging habitat by river otter and raccoon.

Tidal flats provide important foraging habitat for migratory, resident, and wintering shorebirds, wading birds, and numerous other bird species. Tidal flats typically contain large concentrations of aquatic invertebrates and mollusks that serve as the primary food source of shorebirds.

Typical birds that forage and roost in tidal perennial aquatic habitats are a variety of waterfowl, including mallard, lesser scaup, greater scaup, ring-necked ducks, redhead, and canvasback; wading birds, such as great blue heron, great egret, and snowy egret, forage on the shoreline of the tidal perennial aquatic habitat. Special-status species that may visit tidal perennial wetlands include giant garter snake, western pond turtle, and black rail.

Tidal Emergent Wetland

Wetlands are considered to be among the most productive wildlife habitats in California. Tule and cattail tidal emergent wetland, herein referred to as tidal emergent wetland, includes portions of the intertidal zones of the Delta that support emergent wetland plant species. Tidal emergent wetland occurs along all channels. This habitat typically occurs in small isolated patches or narrow discontinuous bands throughout the study area.

Characteristic waterbirds that nest in tidal emergent wetlands in the North Delta are Canada goose, mallard, cinnamon teal, gadwall, Virginia rail, sora, American coot, common moorhen, killdeer, and Wilson’s snipe. These species are joined by a host of migratory waterfowl in fall, and many may remain in the county through the winter and spring. Typical migratory and wintering waterfowl in the county include American wigeon, northern shoveler, northern pintail, green-winged teal, ring-necked duck, bufflehead, common goldeneye, and ruddy duck.

Amphibians and reptiles that may inhabit these wetlands include western toad, Pacific chorus frog, western pond turtle, giant garter snake, common garter snake, and western aquatic garter snake. The most common mammals in these habitats are a variety of foraging bats, vagrant shrew, dusky shrew, ornate shrew, American beaver, and muskrat.

Special-status animals that are known to use tidal emergent wetlands include western pond turtle, giant garter snake, redhead, bald eagle, northern harrier, white-tailed kite, black rail, Modesto song sparrow, and tricolored blackbird, and an unknown number of bat species (e.g., long-eared myotis, long-legged myotis, Yuma myotis).

Nontidal Emergent Wetland

Nontidal emergent wetland includes perennial and seasonal emergent wetlands that occur throughout the Project area. Like tidal emergent wetlands, nontidal emergent wetlands support a relatively small number of vertebrate species compared to many other terrestrial ecosystems. This is because many small mammal species (e.g., most rodents) avoid flooded areas and saturated soils. In contrast, many species and large numbers of waterbirds are drawn to nontidal emergent wetlands (Zeiner et al. 1990).

Characteristic waterbirds that visit nontidal emergent wetlands include snowy egret, black-crowned night-heron, white-faced ibis, Canada goose, mallard, gadwall, cinnamon teal, American wigeon, gadwall, killdeer, and Wilson's snipe.

Nontidal emergent wetland ecosystems in the North Delta provide breeding habitat for several special-status animals, including giant garter snake, western pond turtle, northern harrier, Modesto song sparrow, and tricolored blackbird.

Riparian Woodland

Riparian woodlands in the study area consist of cottonwood-willow woodland, valley oak woodland, mixed riparian woodland, and nonnative riparian woodland. Riparian woodlands provide food, water, migration and dispersal corridors, and escape, nesting, and thermal cover for a high diversity of wildlife species. Birds are found in particularly high diversity and numbers in riparian woodlands of the North Delta (Point Reyes Bird Observatory 2001). Characteristic breeding birds are downy woodpecker, black phoebe, warbling vireo, western scrub-jay, bushtit, Bewick's wren, house wren, American robin, orange-crowned warbler, yellow-breasted chat, black-headed grosbeak, lazuli bunting, spotted towhee, song sparrow, house finch, and lesser goldfinch. Riparian areas are also attractive to migratory species, including a variety of flycatchers, vireos, warblers, tanagers, and grosbeaks.

Most amphibians, reptiles, and mammals use riparian corridors for cover, shade, and a source of water. Amphibians and reptiles in riparian woodlands may include ensatina, California slender salamander, Pacific treefrog, western toad, common garter snake, gopher snake, western skink, southern alligator lizard, and western fence lizard. Bats frequently forage for insects over riparian areas in river canyons, and many individuals may roost in riparian trees (Zeiner et al. 1990).

A number of special-status animal species are known to occur in riparian woodlands in the North Delta: valley elderberry longhorn beetle (VELB), western pond turtle, giant garter snake, Swainson's hawk, osprey, white-tailed kite, Cooper's hawk, long-eared owl, willow flycatcher, purple martin, bank swallow, yellow warbler, yellow-breasted chat, Modesto song sparrow, tricolored blackbird, and an unknown number of bat species (e.g., long-eared myotis, long-legged myotis, and Yuma myotis).

Nonnative animals that may occur in these woodlands include European starling, Virginia opossum, and black rat. Livestock operations attract brown-headed cowbirds, a native North American species that expanded its range into California in the early 1900s. Brown-headed cowbirds parasitize the nests of other native songbirds and reduce their reproductive success (Grinnell and Miller 1944; Beedy and Granholm 1985; Gaines 1992). In riparian woodlands of the North Delta, brown-headed cowbirds are most common in disturbed areas and in early successional stands, especially where livestock are present within about 4 miles of breeding areas (Rothstein et al. 1984).

Amphibians and reptiles in valley oak riparian woodland are mostly those of open grassland ecosystems: California slender salamander, western toad, common garter snake, gopher snake, western skink, southern alligator lizard, and western fence lizard. The grassland component attracts bird species such as American kestrel, lark sparrow, western meadowlark, and Bullock's oriole, while oaks provide food for various songbirds and nesting sites for cavity nesters such as woodpeckers, oak titmouse, ash-throated flycatcher, house wren, Bewick's wren, and violet-green swallow. Typical mammals in these ecosystems include mule deer, California ground squirrel, and western gray squirrel. Special-status wildlife species that may occur in valley oak riparian woodland of the study area are VELB, western pond turtle (if suitable aquatic habitats are present), Swainson's hawk, white-tailed kite, Cooper's hawk, purple martin, yellow warbler, and an unknown number of bat species (e.g., long-eared myotis, long-legged myotis, and Yuma myotis). Nonnative animals that may occur in these habitats are European starling, Virginia opossum, and house mouse.

Riparian Scrub

Riparian scrub in the study area consists of Himalayan blackberry and riparian scrub land cover types. Riparian scrub habitats in the Project area are dominated by shrubs, Himalayan blackberries, and elderberries, but most lack woody riparian vegetation. For this reason, these habitats tend to support fewer wildlife species than nearby riparian woodlands. Characteristic breeding birds are black phoebe, bushtit, Bewick's wren, house wren, American robin, orange-crowned warbler, yellow-breasted chat, lazuli bunting, spotted towhee, California towhee, song sparrow, house finch, and lesser goldfinch. Mammals, reptiles, and amphibians in these habitats are similar to those found in riparian woodlands, except that tree-dwelling species such as western gray squirrels are typically not present. Elderberry shrubs are widespread in riparian scrub habitats surrounding the McCormack-Williamson Tract, and stems >1 inch in diameter provide suitable habitat for the federally listed (threatened) VELB.

Grassland

Despite the dominance of introduced plants and their relative lack of vertical structure, grasslands support a higher diversity of animals than some other terrestrial and aquatic habitats. They provide abundant food and cover for high numbers of rodents and other small mammals. Consequently, several raptors, including red-tailed hawk, red-shouldered hawk, Swainson's hawk, white-tailed kite, and American kestrel, thrive in grasslands. Other characteristic wildlife species may include gopher snake, western kingbird, western bluebird, western meadowlark, black-tailed jackrabbit, California ground squirrel, Botta's pocket gopher, and American badger.

Special-status animals that may use grasslands in the North Delta study area for breeding or as visitors are western pond turtle, giant garter snake, northern harrier, Swainson's hawk, ferruginous hawk, rough-legged hawk, western burrowing owl, loggerhead shrike, and tricolored blackbird. Exotic and invasive animal species that are characteristic of grasslands include European starling, house mouse, and black rat.

Ruderal Lands

Ruderal lands occur throughout the Project area. Native species that may occur in ruderal lands in the North Delta include yellow-billed magpie, American crow, western scrub-jay, house wren, Brewer's blackbird, and brown-headed cowbird. Exotic fruits and flowers may attract Anna's hummingbird, rufous hummingbird, California towhee, spotted towhee, golden-crowned sparrow, white-crowned sparrow, American goldfinch, raccoon, and striped skunk. Likewise, ruderal lands are attractive to introduced species such as Virginia opossum, Norway rat, black rat, and house mouse,

Agricultural Lands

Agricultural lands occur throughout the Project area. During fall migration (which begins in late June), flooded agricultural fields can provide prime habitat for a wide variety of shorebird species and waterfowl. Hundreds or thousands of individuals of more than a dozen species forage for invertebrates during brief stopovers on their way south. Common shorebirds and wading birds include killdeer, greater yellowlegs, long-billed curlew, dunlin, least sandpiper, long-billed dowitcher, great blue heron, great egret, snowy egret, and white-faced ibis. These shorebird and waterbird concentrations attract raptors, especially northern harrier, American peregrine falcon, and bald eagle.

When fields are not flooded, rodent populations in the fields may also attract raptors, including red-tailed hawk, American kestrel, and short-eared owl. Other typical birds that forage in agricultural lands include red-tailed hawk, American kestrel, California quail, mourning dove, western kingbird, American crow, western meadowlark, Brewer's blackbird, American pipit and red-winged blackbird. A few mammals (e.g., black-tailed jackrabbit, desert cottontail, pocket gopher, and California ground squirrel) may have natal burrows along the margins of agricultural fields.

Special-status species that may occur in agricultural lands (especially flooded fields) in the North Delta region include large concentrations of greater sandhill cranes, northern harrier, bald eagle, and giant garter snake.

Developed Lands

Developed lands are lands with roadways, including levee and farm roads, and residential and storage buildings. In the North Delta study area, typical urban/suburban predators are feral and free-ranging cats and dogs, raccoons, striped skunks, opossums, coyotes, western scrub-jays, and American crows. Nonnative species in developed areas can include Virginia opossum, black rat, house mouse, house sparrow, and European starling. Various species of bats, including some special-status species, may roost in buildings or other structures.

Ornamental Landscaping

Special-status animals that are known to visit ornamental landscaping of the North Delta study area are yellow warbler, Modesto song sparrow, and tricolored blackbird. Other native species that may occur in these areas are yellow-billed magpie, American crow, western scrub-jay, house wren, and brown-headed cowbird. Exotic fruits and flowers, bird baths, and hummingbird and seed feeders attract Anna’s hummingbird, rufous hummingbird, California towhee, spotted towhee, golden-crowned sparrow, white-crowned sparrow, and American goldfinch. Likewise, vegetable garden produce and pet food put out overnight are irresistible attractants for resident mammals such as Virginia opossum, Norway rat, black rat, house mouse, raccoon, and striped skunk.

Eucalyptus trees flower in winter, producing large quantities of high-quality nectar, and are, consequently, highly attractive to a variety of nectar- and insect-foraging birds. Anna’s hummingbird, rufous hummingbird, ruby-crowned kinglet, bushtit, yellow-rumped warbler, American goldfinch, and house finch are among the species that are especially abundant in eucalyptus groves.

Special-Status Animals

Special-status animals are legally protected under the federal Endangered Species Act (ESA), the CESA, or other regulations and species that are considered sufficiently rare by the scientific community to qualify for such listing. Special-status wildlife are species that are:

- listed or proposed for listing as threatened or endangered under ESA (50 CFR 17.11 [listed wildlife], and various notices in the FR [proposed species]);

- candidates for possible future listing as threatened or endangered under ESA (66 FR 54808, October 30, 2001);
- listed or proposed for listing by the State of California as threatened or endangered under CESA (14 CCR 670.5);
- identified as species of concern that have the potential to occur in the Project area because suitable or marginal habitat may exist for those species; species of special concern to the DFG and Special Animals list (California Department of Fish and Game 2001) (mammals) that have the potential to occur in the Project area because suitable or marginal habitat may exist for those species;
- identified as species determined to meet the definitions of rare or endangered under CEQA (State CEQA Guidelines, Section 15380); or
- fully protected under California Fish and Game Code Section 3511(birds), Section 4700 (mammals), Section 5515 (fish), and Section 5050 (reptiles and amphibians).

This section summarizes the special-status species analysis for the study area. Special-status species that have the potential to occur in the study area were determined through a review of various sources, including a USFWS species list and a review of the CNDDB (Table 4.3-3). Those species that are likely to occur in the study area are evaluated in this section.

The following sections describe special-status species that are known or are likely to occur in the study and Project areas. The following information is provided for each species:

- habitat requirements;
- suitable land cover types—wildlife habitats available for each species in the Project area;
- surveys performed for the species in the study and Project area; and
- the status of each species in the Project area.

A summary list of special-status wildlife species that could be present in the Project area was generated from the USFWS species list provided for the Project (U.S. Fish and Wildlife Service 2006), the CNDDB (California Natural Diversity Data Base 2006), and a review of Project related documents (Table 4.3-3). The special-status species listed in Table 4.3-3 include species that may occur or have been observed in the Project area. Many of these species are known to occur in the Project area. The other species are not known to occur in the Project area, but they occur or historically have occurred in the study area, and the Project area contains breeding or nonbreeding habitat for these species.

The species with potential to occur in the study area include:

- VELB;
- western pond turtle;

- giant garter snake;
- Aleutian Canada goose;
- colonial waterbirds (i.e., cormorant, heron, egret, and ibis breeding rookeries);
- white-tailed kite;
- bald eagle;
- northern harrier;
- Swainson's hawk;
- California black rail;
- greater sandhill crane;
- western burrowing owl;
- short-eared owl;
- Modesto song sparrow;
- tricolored blackbird; and
- bats (Yuma myotis, pallid bat, and pale Townsend's big-eared bat).

Valley Elderberry Longhorn Beetle

VELB is federally listed as threatened (California Department of Fish and Game 2006). VELB is closely associated with blue elderberry (*Sambucus mexicana*), the obligate host plant for the beetle's larvae. Occupied shrubs have stems >1 inch diameter. Adult VELBs feed on foliage and are active from early March through early June. The beetles mate in May, and females lay eggs on living elderberry shrubs. Larvae bore through the stems of the shrubs to create an opening in the stem within which they pupate. After metamorphosing into an adult, the beetle chews a circular exit hole through which it emerges (Barr 1991).

Elderberry shrubs in California's Central Valley are commonly associated with riparian habitats, but they also occur in oak woodlands and savannas and in disturbed areas. Species-specific surveys were conducted for VELB along the levees of McCormack-Williamson Tract in August 2004 (Stillwater Sciences 2004) and at Staten Island in October 2002 (May & Associates 2003). Surveys were conducted and habitat assessed and mapped according to USFWS survey protocol (U.S. Fish and Wildlife Service 1999). VELB surveys were not conducted in the interiors of these islands (in agricultural lands) because elderberry shrubs that provide habitat for these species are not present in these locations because of frequent plowing and other agricultural activities. Elderberry shrubs grow extensively around the waterside and interior levees of the McCormack-Williamson Tract and at Grizzly Slough. A total of 24 stems or stem clusters were counted at Staten Island in 2002 (May & Associates 2003). A records search did not identify any VELB occurrences in the study or Project areas; the closest occurrence is near the Cosumnes River, approximately 2 miles north of the Grizzly Slough project area (California Natural Diversity Data Base 2006).

Western Pond Turtle

The western pond turtle is a federal species of concern and a state species of special concern (California Department of Fish and Game 2006). They inhabit permanent or nearly permanent waters with little or no current (Behler and King 1998). The channel banks of inhabited waters usually have thick vegetation, but basking sites such as logs, rocks, or open banks must also be present (Zeiner et al. 1988). Eggs are laid in nests along sandy banks of large slow-moving streams or in upland areas, including grasslands, woodlands, and savannas. Nest sites are typically found on unshaded slopes that have a high clay or silt composition in soil at least 4 inches deep (Jennings and Hayes 1994).

Western pond turtles are known to use the riverine habitats along both forks of the Mokelumne River where more than 30 individuals have been observed; they also use some of the main agricultural ditches in the study area (May & Associates 2003). Additionally, there are nine NDDB records of western pond turtle occurring in the North and South Forks of the Mokelumne River (California Natural Diversity Data Base 2006). They also have been observed at the construction sites and in some channel dredging areas in the Project area.

Giant Garter Snake

Giant garter snakes are state- and federally listed as threatened (California Department of Fish and Game 2006). They are endemic to emergent wetlands in the Central Valley. The species' habitat includes marshes; sloughs; ponds; small lakes; and low-gradient waterways, such as small streams, irrigation and drainage canals, and rice fields (58 FR 54053, October 20, 1993). The giant garter snake is active from approximately May through October and hibernates during the remainder of the year (Hansen and Brode 1980).

The giant garter snake requires adequate water with herbaceous, emergent vegetation for protective cover and foraging habitat. All three habitat components (cover and foraging habitat, basking areas, and protected hibernation sites) are required. Riparian woodlands and large rivers typically do not support giant garter snakes because these habitats lack emergent vegetative cover, basking areas, and prey populations (Hansen and Brode 1980).

A records search did not identify any occurrences in the study area (California Natural Diversity Data Base 2006). However, several records document giant garter snakes approximately 2 miles east of the study area, and some suitable habitat exists along large agricultural ditches and along some levees in the Project area.

Aleutian Canada Goose

Formerly federally listed as threatened, the Aleutian Canada goose has been de-listed by USFWS and is now a federal species of concern (California Department of Fish and Game 2006). Their global population had declined to about 700 individuals in the 1970s then increased to about 4,000 in the mid-1980s (Amaral 1985). Today, the Aleutian Canada goose population is about 40,000–45,000 individuals. Their entire population breeds in the Aleutian Islands and winters (October to March) along the Pacific coast and California's Central Valley, primarily in the San Joaquin Valley (Amaral 1985).

During the winter months, Aleutian Canada geese graze in open fields within commuting distance of water for roosting. Prior to 1999, there were only six confirmed records for in San Joaquin County (San Joaquin Council of Governments 1999). In recent years, however, flocks of up to 20,000 individuals have been were observed feeding and roosting in the agricultural fields of Staten Island during winter 2002–2003 (May & Associates 2003; Ivey pers. comm.).

Colonial Waterbirds (Breeding Rookeries)

A variety of wading birds commonly forage and roost in the study and Project areas, including: double-crested cormorant, great blue heron, great egret, snowy egret, and white-faced ibis. All of these species nest in colonies in trees and sometimes in dense, emergent wetland vegetation. Breeding colonies of these species are considered sensitive in California (California Department of Fish and Game 2006). They are common year-round residents of the North Delta region, where they forage for small rodents, eggs and nestlings of birds, amphibians, reptiles, fish, and large invertebrates. They are often found hunting in the open, along water edges, and open agricultural fields and grasslands. Sometimes congregations of several dozen may be found in areas of concentrated prey such as drying ponds and newly plowed or flooded fields (May & Associates 2003). Despite the common occurrence of herons, cormorants, egrets, and ibis in the study area, no occupied breeding colonies are known to exist (California Natural Diversity Data Base 2006)

White-Tailed Kite

White-tailed kites are designated as a fully protected species in California (California Department of Fish and Game 2006). This species declined dramatically throughout California during the early part of this century (Grinnell and Miller 1944) but is now fairly common in suitable habitats, particularly in the Central Valley. The species' decline has been attributed to loss of grassland and wetland habitats to agriculture and urban development.

White-tailed kites inhabit open lowland grassland, riparian woodland, seasonal wetlands, and scrub areas. Some large shrubs or trees are required for nesting. In the Project area, cottonwood-willow woodland and valley oak riparian woodland provide nesting and roosting habitat for this species. Communal night roosting is common during the non-breeding season. Grasslands, agricultural lands, and pasturelands in the study area support foraging habitat for white-tailed kite that breed or winter in the Delta (Zeiner et al. 1990a).

White-tailed kites are frequently observed foraging in agricultural fields of the Project area throughout the fall, winter, and spring, and they potentially nest in the study area. One pair of kites was observed roosting in riparian trees along the South Fork Mokelumne River at Staten Island (May & Associates 2003). Suitable nest trees occur throughout most of the study area on levees and on adjacent lands.

Bald Eagle

Bald eagles are federally listed as threatened and state-listed as endangered (California Department of Fish and Game 2006). They are uncommon winter visitors to the North Delta region. They forage primarily on waterfowl in this area, but will also take fish, mammals, and other birds (Zeiner et al. 1990a). They are attracted to large concentrations of waterfowl and will frequently scavenge on dead animals, including waterfowl killed or wounded by hunters. Although they often perch on the ground, including on levees, especially when consuming prey, bald eagles roost primarily on large trees for protection at night and for looking for foraging opportunities. No records of this species are currently documented in the study area (California Natural Diversity Data Base 2006).

Northern Harrier

Northern harriers are considered a bird species of special concern in California (California Department of Fish and Game 2006). They nest and roost in tall grasses and forbs in wetlands and field borders (Zeiner et al. 1990a). They often roost on the ground in shrubby vegetation, often near the edges of marshes or in ruderal grasslands (Brown and Amadon 1968). They are permanent residents in the study and Project areas, and their breeding range in California includes most of the Central Valley, the Delta, Suisun Marsh, and portions of San Francisco Bay (Zeiner et al. 1990a).

A records search did not identify any occurrences of nesting northern harriers in the study or Project areas (California Natural Diversity Database 2006). In the Project area, ruderal and wetland habitats provide suitable nesting and roosting habitat, and wintering birds are consistently observed foraging over agricultural fields at Staten Island (May & Associates 2003). Foraging habitat in the Project area includes agricultural lands, pasturelands, and wetlands.

Swainson's Hawk

Swainson's hawks are state-listed as threatened in California (California Department of Fish and Game 2006). Conversion of native grassland and woodland communities to agricultural uses is the primary cause of their decline, although several agricultural crops are considered suitable Swainson's hawk foraging habitat, including grain (e.g., corn and wheat) and vegetable crops (e.g., tomatoes and sugar beets), alfalfa, and pasture. The remaining populations of Swainson's hawks have shifted into areas that continue to provide suitable nesting habitat close to suitable agricultural foraging habitat (California Department of Fish and Game 1994). Typical Swainson's hawk nesting habitat consists of a riparian corridor for nesting and agricultural crops for foraging. They usually nest in mature trees, with valley oak, cottonwood, willows, sycamores, and walnuts the preferred tree species. In the Central Valley, Swainson's hawks feed primarily on small rodents (such as voles) and large insects, usually in fields that support low vegetative cover (to provide access to the ground) and provide the highest densities of prey (Zeiner et al. 1990a).

Swainson's hawks are summer residents in the study and Project areas, and small numbers of this species are known to winter in the North Delta. At least six nests have been documented in the Project area, including four on levees surrounding the McCormack-Williamson Tract and two at Staten Island (California Natural Diversity Data Base 2006). Several of these nest sites are within approximately ½-mile of proposed features of the Project.

California Black Rail

California black rails are state-listed as threatened in California (California Department of Fish and Game 2006). They occupy tidal and nontidal emergent wetlands in the study area, but there are no documented records in the Project area (California Natural Diversity Data Base 2006). The dominant plant species in marshes inhabited by California black rail are generally tules or cattails. Nests are built in the lower portions of emergent wetlands. They nest from mid-March through July. During winter, black rails may be widely distributed in the marshes and may use the upper marsh vegetation for cover, especially during extreme high tides or high flow events (Zeiner et al. 1990a).

Tidal emergent wetland and nontidal emergent wetland in the study area provide habitat for California black rail. These land cover type occur in varying densities throughout the study and Project areas and may include small or large patches of emergent wetland vegetation at the toe of the levees or on the perimeter of in-channel islands. The larger patches of wetland vegetation may provide suitable nesting and foraging habitat for this species. There are no CNDDB records of California black rail in the study area; however, no formal surveys have been conducted for this species in the Project area. High flow events during the winter could affect populations of this species if they occur in the Project area because suitable high marsh habitat may not be available as refugia from such events.

Greater Sandhill Crane

Greater sandhill cranes are state-listed as threatened and as fully protected in California (California Department of Fish and Game 2006). They occur as winter residents in the study area and are in the North Delta region from early September until early March (Ivey and Herziger 2003). It is estimated that between 3,400 and 6,000 greater sandhill cranes winter in the Sacramento Valley and the North Delta (California Department of Fish and Game 2000; Pacific Flyway Council 1997; Pogson and Lindstedt 1991). Suitable winter foraging habitat is present on agricultural lands and pasturelands in the study area. During winter, greater sandhill cranes feed on grasses, forbs, waste grains, small mammals, amphibians, snakes, and invertebrates (Zeiner et al. 1990a). They feed and roost in pastures, flooded and unflooded grain fields, and seasonal wetlands. Wheat and corn fields are favored along with newly flooded fields, where they feed on unharvested grains, rodents, and invertebrates (Ivey and Herziger 2003).

Greater sandhill cranes winter in the North Delta region in much smaller numbers than their abundant relatives, lesser sandhill cranes. Staten Island is an especially important agricultural area that is managed for this large wintering population of both subspecies of cranes (Littlefield and Ivey 2000, Ivey and Herziger 2003). Many greater sandhill cranes use Staten Island exclusively, though some will move to other locations during the winter. Some of these cranes were documented as having small home ranges that averaged only 0.66 square miles throughout the winter (Ivey and Herziger 2003). Sandhill cranes also forage and roost at the McCormack-Williamson Tract and throughout the wetland and grassland portions of the Cosumnes River Preserve.

Western Burrowing Owl

Western burrowing owls are considered a bird species of special concern in California (California Department of Fish and Game 2006). They are permanent residents throughout the North Delta region. Suitable habitat for burrowing owls occurs in ruderal habitats, especially along canals and levees, and in the vicinity of agricultural lands throughout the study area. They nest and roost in abandoned ground-squirrel and other small-mammal burrows as well as artificial burrows (e.g., culverts, concrete slabs, and debris piles). The owl's breeding season is from March to August, peaking in April and May (Zeiner et al. 1990a).

A CNDDB records search did not identify any western burrowing owl occurrences in the study area (California Natural Diversity Data Base 2006). Surveys performed on Staten Island identified four occurrences of wintering western burrowing owl (May & Associates 2003). Nesting burrowing owls have not been observed in the study area. The high level of ground-squirrel control in the study area has limited the number of burrows suitable for burrowing owl use. Burrowing owls might potentially nest in the study area if suitable burrows were available (e.g., through installation of artificial burrows).

Short-Eared Owl

Short-eared owls are considered a bird species of special concern in California (California Department of Fish and Game 2006). Breeding populations of short-eared owls have been extirpated from the San Joaquin Valley (Remsen 1978); however, this species still breeds in the southern portion of the Sacramento Valley (Yolo and Solano Counties), the Delta, and Suisun Marsh. They are most likely to occur in the North Delta region during the winter months, with migrating birds arriving in September and October and leaving in April; the breeding season is from late March to July (Zeiner et al. 1990a). Nests are built on the ground in tall stands of grasses in lowland habitats near hunting grounds in marshes, meadows, and even agricultural fields (Grinnell and Miller 1944).

Although potential nesting and roosting habitat for short-eared owls occurs in ruderal habitats and seasonal wetlands throughout the study area, this species has not been documented to breed in the study area (California Natural Diversity Data Base 2006). Wintering individuals have been observed foraging at Staten Island (May & Associates 2003). Agricultural lands, grasslands, and ruderal habitats in the study area provide suitable roosting and foraging areas for this species. Ruderal habitat is typically dominated by grasses and forbs that provide suitable roosting and foraging habitat for short-eared owls.

California Horned Lark

California horned larks are considered a bird species of special concern in California (California Department of Fish and Game 2006). The California horned lark is one of 16 subspecies of the horned lark, and one of eight horned lark subspecies that breed in California. The California horned lark is a resident along the California Coast Range and the San Joaquin Valley, occurring primarily from Capetown in Humboldt County south to Baja California (Behle 1942). They occur in open habitats, including the fallow grain fields, short-grass prairies, grazed grasslands, alkali flats, open coastal plains, mountain meadows, and valley floors (Behle 1942, Grinnell and Miller 1944). California horned larks are abundant on low, level, or rolling open pastureland. During the breeding season, the subspecies ranges from sea level to 8,500 feet (2,591 m) elevation (Behle 1942).

Horned larks were consistently observed throughout fall, winter, and spring in the portions of the study area dominated by ruderal vegetation (i.e., along roads and levees) (May & Associates 2003). California horned larks potentially nest in portions of the study area dominated by ruderal vegetation; however they have not been documented to breed in the study area (California Natural Diversity Data Base 2006).

Modesto Song Sparrow

The "Modesto race" of the song sparrow is considered a bird species of special concern in California (California Department of Fish and Game 2006). They occur in the Central Valley from Colusa County in the north and Stanislaus County in the south, below 200 feet in elevation and east of Suisun Marsh (Grinnell and Miller 1944). This song sparrow occurs in riparian and freshwater marsh habitats along rivers, streams, and marshes. It also occurs along large ditches and drainage canals in agricultural areas (Zeiner et al. 1990a). Suitable song sparrow habitat occurs along both forks of the Mokelumne River and in the main ditch. Modesto song sparrows are year-round residents and were consistently observed during surveys along the North and South Fork of the Mokelumne River, the main ditch, and along levees (May & Associates 2003).

Tricolored Blackbird

Tricolored blackbirds are considered a bird species of special concern in California (California Department of Fish and Game 2006). They are permanent residents in the Sacramento and San Joaquin Valleys, and they winter in large flocks in the North Delta region. Historically, tricolored blackbirds nested primarily in emergent wetlands (Neff 1937). Recent studies indicate that an increasing percentage of nest sites are found in areas where the dominant land cover type consists of Himalayan blackberry stands, grain fields, and riparian scrub vegetation (DeHaven et al. 1975; Beedy and Hamilton 1999). In the study area, suitable nesting habitat is present in extensive stands of emergent wetland vegetation and riparian scrub vegetation. The tricolored blackbird breeding season is from mid-March to late July. Tricolored blackbirds have three basic requirements for selecting their breeding colony sites:

- open, accessible water;
- a protected nesting substrate, including flooded, thorny, or spiny vegetation; and
- a suitable foraging space providing adequate insect prey within a few miles of the nesting colony (Beedy and Hamilton 1997).

In the study area, tricolored blackbird foraging habitat includes ruderal vegetation dominated by grasses and agricultural fields (such as large tracts of alfalfa with continuous mowing schedules and recently tilled fields). Tricolored blackbirds also forage occasionally in riparian scrub habitats and along marsh borders. Most tricolored blackbirds forage within 3 miles (5 kilometers) of their colony sites (Orians 1961) but commute distances of up to 8 miles (13 kilometers) have been reported (Beedy and Hamilton 1999). Tricolored blackbirds have not been documented to breed in the study or Project areas (California Natural Diversity Data Base 2006). However, large flocks of blackbirds, including some tricolored blackbirds, have been observed in agricultural fields on Staten Island (May & Associates 2003).

Bats

Several species of bats, including Yuma myotis *(Myotis yumanensis)*, pallid bat *(Antrozous pallidus)*, and pale Townsend's big-eared bat *(Corynorhinus townsendi pallescens)* have potential to roost and breed in the study area, but no records of these species have been documented in the Project area (California Natural Diversity Data Base 2006). Suitable habitat exists under bridges, in old houses and ranch buildings, and in cavities and crevices of mature riparian trees and valley oaks.

Regulatory Setting and Significance Criteria

This section provides preliminary information on the major requirements for permitting and environmental review and consultation related to wildlife resources for implementation of the Project. Certain state and federal regulations require issuance of permits before Project implementation; other regulations require agency consultation but may not require issuance of any entitlements before Project implementation. The Project's requirements for permits and environmental review and consultation may change during the EIS/EIR review process as discussions with involved state and federal agencies proceed.

Federal Requirements

Federal Endangered Species Act

Section 7 of the ESA requires federal agencies, in consultation with USFWS and/or NOAA Fisheries, to ensure that their 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. The required steps in the Section 7 consultation process are:

- Agencies must request information from USFWS and/or NOAA Fisheries on the existence in a Project area of special-status species or species proposed for listing.
- Following receipt of the USFWS/NOAA Fisheries response to this request, agencies generally prepare a BA to determine whether any listed species, species proposed for listing, or special-status species are likely to be affected by a proposed action.
- Agencies must initiate formal consultation with USFWS and/or NOAA Fisheries if the proposed action would/may adversely affect any listed or proposed species.
- USFWS and/or NOAA Fisheries must prepare a BO to determine whether the action would jeopardize the continued existence of special-status species or adversely modify their critical habitat.

- If a finding of jeopardy or adverse modifications is made in the BO, USFWS and/or NOAA Fisheries must recommend reasonable and prudent alternatives that would avoid jeopardy, and the federal agency must modify Project approval to ensure that special-status species are not jeopardized and that their critical habitat is not adversely modified (unless an exemption from this requirement is granted).

In the preparation of the Project EIR, the MSCS approach was used and an action-specific implementation plan (ASIP), serving as the equivalent of the CALFED Programmatic Project BA, will be prepared in compliance with Section 7 of the ESA.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 USC 703) enacts the provisions of treaties between the United States, Great Britain, Mexico, Japan, and the Soviet Union and authorizes the U.S. Secretary of the Interior to protect and regulate the taking of migratory birds. It allows for the establishment of seasons and bag limits for hunted species and protects migratory birds, their occupied nests, and their eggs (16 USC 703; 50 CFR 21; 50 CFR 10). Most actions that result in taking or in permanent or temporary possession of a protected species constitute violations of MBTA. Examples of permitted actions that do not violate MBTA are the possession of a hunting license to pursue specific gamebirds, legitimate research activities, display in zoological gardens, bird-banding, and other similar activities. USFWS is responsible for overseeing compliance with MBTA, and the U.S. Department of Agriculture's Animal Damage Control Officer makes recommendations on related animal protection issues.

State Requirements

California Endangered Species Act

The California ESA requires a state lead agency to consult formally with DFG when a proposed action may affect state-listed endangered or threatened species. The provisions of ESA and CESA often will be activated simultaneously. The assessment of Project effects on species listed under both ESA and CESA is addressed in USFWS's and NOAA Fisheries' BOs. However, for those species listed only under CESA, DWR must formally consult with DFG. DFG will ensure that the Project complies with the provisions of CESA.

Active Raptor Nests

Active raptor nests are protected by the DFG, and their destruction or disturbance would be considered a violation of Sections 3503 and 3503.5 of the California Fish and Game Code.

Significance Criteria

The criteria for determining significant impacts on biological resources were developed by reviewing State CEQA Guidelines and the CALFED Programmatic EIS/EIR (CALFED Bay-Delta Program 2000b). Based on these sources of information, constructing and operating the Project may result in a significant impact if it would result in:

- a temporary or permanent loss or degradation of any riparian, wetland, or other sensitive natural community identified in local, state, or federal regional plans, policies, or regulations;
- a temporary or permanent disruption of wildlife movement or fragmentation or isolation of riparian habitats;
- a temporary or permanent loss or disturbance of important upland land cover types used by wildlife for breeding, roosting, or foraging habitat;
- a temporary or permanent loss or disturbance of important agricultural land cover types used by wildlife for breeding, roosting, or foraging habitat;
- direct mortality to, or lowered reproductive success of, federally or state-listed wildlife species or loss of habitat of these species, including the loss of occupied or suitable habitat for these species;
- direct mortality to, or lowered reproductive success of, substantial portions of local populations of species that are candidates for federal or state listing or that are California species of special concern, including the loss of occupied or suitable habitat for these species; and
- temporary disturbance or mortality of special-status species resulting from implementation of mitigation measures or habitat management actions.

Beneficial effects include changes that would result in net increases in the extent or quality of native riparian, wetland, or upland wildlife habitats. Substantial beneficial effects are identified as significant effects.

Impacts and Mitigation of the Project Alternatives

This evaluation of impacts on wildlife resources, including special-status species, was based on an analysis of the Project alternatives and conceptual design drawing prepared by DWR. The permanent and temporary impact footprints for each Project component were developed by Jones & Stokes based on the information provided by DWR and based on assumptions of the corridor widths for permanent and temporary construction easements. The impact footprints for some or all Project components likely will be refined when detailed construction drawings are prepared for the Project. The Project footprint and actions for some Project components have not been defined at this time (e.g., Delta Meadows property, agricultural siphons); therefore, impacts of these components were not assessed.

Habitat mapping has not been performed in several locations, including the Grizzly Slough site, the borrow sites, and several locations associated with dredging and levee modifications along the Mokelumne River. Existing land cover types were evaluated based on aerial photograph interpretation. Additional field mapping and wetland delineations will need to be performed at these locations before subsequent revisions to this document.

Tables 4.1-3 and 4-1-4 summarize the assumptions used to develop the impact area footprints associated with the Alternative 1 and 2 Project components. Three land cover type impact tables containing the following information are provided for each alternative.

- One table summarizes the permanent and temporary land cover type impacts for the alternative (provided in this section).
- One set of tables summarizes the permanent land cover type impacts, by Project component, for the alternative (provided in Attachment 4.1-1). This table includes a breakdown of Project effects attributable to construction and operations-related actions, including the optional Project components.
- One set of tables summarizes the temporary land cover type impacts, by Project component, for the alternative (provided in Attachment 4.1-1. This table includes a breakdown of Project effects attributable to construction and operations-related actions, including the optional Project components.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of the CALFED program (CALFED Bay-Delta Program 2000c).

The discussion of significant impacts and mitigation measures in this section includes a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the Project. These programmatic mitigation measures are numbered as they appear in the ROD, and only those measures relevant to the vegetation and wildlife in the Project resource area are listed below; therefore, numbering may appear out of sequence.

1. Avoid direct or indirect disturbance to wetland and riparian communities, special-status species habitat, rare natural communities, significant natural areas, and other sensitive habitat.
2. Restore and enhance sufficient in-kind wetland and riparian habitat or rare natural communities and significant natural areas at off-site locations (near project sites) before or at the time that project impacts are incurred. Replace not only acreage lost, but also habitat value loss.

3. Design Program features to permit on-site mitigation or nearby restoration of wetland, riparian habitat, special-status species habitat, rare natural communities, and significant natural areas that have been removed by permanent facilities.

4. Phase the implementation of Ecosystem Restoration Program habitat restoration to offset temporary habitat losses and to restore habitat (including special-status species habitat) before, or at the same time that, project impacts associated with the Ecosystem Restoration Program are incurred.

5. Restore wetland and riparian communities, special-status species habitat, and wildlife use areas temporarily disturbed by on-site construction activities. immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow for the natural reestablishment of the affected plant community.

6. Avoid creating wetlands in areas with high concentrations of mercury in sediments and anaerobic conditions.

7. Phase the implementation of modifications to levees that would be necessary to meet PL 84-99 standards in order to minimize the effects of fragmentation of riparian habitats and associated wildlife.

8. Implement BMPs such as avoiding disturbance to highly erodible soils and installing siltation barriers and detention basins to reduce the potential for siltation of nearby wetlands.

9. Maintain sufficient outflow downstream of constructed off-stream reservoirs to maintain existing downstream wetland riparian communities.

10. Restore or enhance sufficient waterfowl foraging habitat near existing use areas to offset impacts on the abundance, quality and availability of waterfowl forage. Restoration and enhancement actions include restoring and managing seasonal wetlands for wintering waterfowl, producing crops with high forage value (such as corn and rice), and modifying farming practices to increase forage availability (for example, leaving portions of forage crops unharvested through winter or shallowly flooding fields).

11. Avoid important wildlife habitat areas, such as critical deer winter range and fawning habitat.

12. Restore and enhance important wildlife habitat use areas temporarily disturbed by on-site construction activities by planting and maintaining native species immediately following construction.

13. Restore and enhance upland habitat areas within affected watersheds or in another watershed if sufficient habitat enhancement is unavailable within the affected watershed. This could include modifying existing land management practices (for example, grazing and fire management practices) to improve conditions for the natural reestablishment and long-term maintenance of affected plant communities and habitats.

14. Avoid direct or indirect disturbance to areas occupied by special-status species.
15. Avoid construction or maintenance activities within or near occupied special-status species habitat areas or important wildlife use areas when species may be sensitive to disturbance, such as during the breeding season.
16. Restore habitat areas occupied by special-status species that are temporarily disturbed by on-site construction activities immediately following construction.
17. Restore and enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been affected by the permanent removal of occupied habitat areas.
18. Phase habitat restoration actions to restore sufficient suitable habitat to minimize the adverse effects of impacts on occupied special-status species habitats before impacts are incurred.
19. For species for which relocation or artificial propagation is feasible, establish additional populations of special-status species adversely affected by the Program in suitable habitat areas elsewhere within their historical range.
20. Provide incentives to alter agricultural practices to improve habitat conditions for affected special-status species that use agricultural lands. This could include planting and managing crops to increase the availability or quantity of forage for affected species.
21. Avoid direct or indirect disturbances to rare natural communities and significant natural areas.
22. Restore or enhance disturbed rare natural communities or significant natural areas at off-site locations before, or when, Program actions that could affect these communities are incurred.
23. Restore rare natural communities or significant natural areas at or near affected locations after Program activities are completed.
24. Manage recreation-related activities on lands managed under the Program to minimize or avoid potential adverse effects of recreation-related activities on sensitive habitats, important wildlife use areas, and special-status species.
25. Phase ERP to initially restore natural waterfowl foraging on agricultural lands with low forage value while restored habitat with high forage value develops.
26. Phase ERP to initially restore wetland habitat with high forage value to offset the loss of agricultural foraging habitat that may result from the ERP.
27. Restore riparian vegetation disturbed by on-site construction activities immediately following construction.
28. Restore or enhance sufficient in-kind riparian habitat at off-site locations, near project sites, in a manner that reduces the degree of existing habitat fragmentation before, or when, project impacts are incurred to offset habitat losses.

29. Restore habitat temporarily disturbed by on-site construction activities immediately following construction.

30. Restore rare natural communities, significant natural areas, and wildlife use areas temporarily disturbed by on-site construction activities immediately following construction. Example actions include direct planting of native plants, controlling nonnative plants to improve conditions for reestablishing native plants, and enhancing and restoring the original site hydrology to allow for the natural reestablishment of the affected plant community.

31. Restore and enhance suitable habitat areas that are occupied by, or are near and accessible to, special-status species that have been adversely affected by the permanent removal of occupied habitat areas.

Alternative NP: No Project

Under the No Project Alternative, if the Project were not implemented, the Project components described under the alternatives in Chapter 2 would not be constructed. It is expected that farming would continue and cropland would be the dominant cover type consistent with the existing condition.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program

- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat that could result from implementing Alternative 1-A. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 1-A. Table 4.3-4 summarizes the permanent and temporary land cover type impacts for the alternative. The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact.

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the permanent or temporary loss of up to 166.07 acres of riparian habitat, including 127.44 acres of riparian woodland and 38.63 acres of riparian scrub habitat. Table 4.3-4 summarizes the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations could include the inundation of riparian vegetation on the interior levees of McCormack-Williamson Tract.

The effects of channel dredging would vary, depending on the method used. For the purpose of this analysis it is assumed that one of the following methods would be used: hydraulic, clamshell, or dragline.

- Hydraulic dredging would have no effect on riparian vegetation because it is assumed that all dredging operations would take place from the water and that conveyance pipes, settling basins, and dredging spoils would be placed outside the dripline of riparian vegetation, which would be fenced before implementation of dredging activities

Table 4.3-4. Summary of Impacts for Alternative 1-A—Fluvial Process Optimization

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	0.63	274.22	274.85
	Tideflat (mudflat)	3.22	0.00	3.22
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	11.08	0.00	11.08
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	4.76	0.08	4.84
	Seasonal freshwater emergent wetland	46.84	0.00	46.84
Lacustrine	Farm and borrow pit ponds	8.69	43.20	51.89
	Temporary agricultural ditch (<15 ft wide)	8.55	1.07	9.62
	Permanent agricultural ditch (>15 ft wide)	2.97	0.03	3.00
Valley/foothill riparian	Cottonwood-willow woodland	41.64	0.42	42.06
	Valley oak riparian woodland	62.86	9.01	71.89
	Himalayan blackberry	7.98	0.18	8.16
	Riparian scrub	26.62	3.85	30.47
	Mixed riparian woodland	13.49	0.00	13.49
	Nonnative Riparian woodland	0	0	0
Grassland	Annual grassland	34.03	0.01	34.04
	Perennial grassland	0.00	0.92	0.92
	Ruderal/forb	92.64	53.61	146.25
Upland Cropland	Corn and grain fields	1692.80	73.75	1766.55
Developed	Developed	8.29	1.43	9.72
Ornamental Plantings	Ornamental plantings	0.49	0.00	0.49
	Totals	2067.58	461.78	2529.38

- Clamshell dredging could require the removal of dense stands of riparian vegetation to allow for vertical and swing clearance of the excavator. For the purpose of this impact assessment, it is assumed that all riparian vegetation on the North Fork Mokelumne River would be removed and that riparian vegetation on the South Fork Mokelumne River could be avoided. It is assumed that to facilitate future dredging operations none of the vegetation removed would be restored.
- Dragline dredging would require the removal of riparian vegetation to allow for equipment access. For the purpose of this impact assessment, it is assumed that all riparian vegetation in the channel dredging area would be removed. It is assumed that to facilitate future dredging operations none of the vegetation removed would be restored.

The loss of riparian habitat as a result of construction activities and Project operations would also result in fragmentation of riparian habitats. Although some existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community in the North Delta region. This impact is considered to be significant. Implementation of Mitigation Measures WILD-1, WILD-2, and WILD-3 and environmental commitments (Chapter 2) would reduce this impact to a less-than-significant level.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, and 5.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

The study area is located in and adjacent to habitat that supports nesting birds protected under the MBTA. Protective fencing will be used to protect nesting habitat outside of the construction and maintenance areas. DWR will perform preconstruction surveys to determine whether nesting birds, including migratory birds, raptors, and special-status bird species, are present within or immediately adjacent to the Project sites and associated staging and storage areas.

Under this Alternative, DWR will remove all woody and herbaceous vegetation from the construction areas during the nonbreeding season for most migratory bird species (September 1–February 1) to minimize effects on nesting birds. During the breeding season, all vegetation will be maintained to a height of approximately 6 inches to minimize the potential for bird nesting. If construction occurs during the breeding season and not all affected vegetation has been removed, a qualified biologist will survey the construction area for active nests and young migratory birds immediately before construction. If active nests or migratory birds are found within the boundaries of the construction area, DWR will develop appropriate measures and will inform DFG of its actions and the potential impacts on these species. Inactive migratory bird nests (excluding raptors) located outside of the construction areas will be preserved. If an inactive migratory bird nest is located in any of these areas, it will be removed before the start of the breeding season (approximately February 1).

If an active raptor nest is found outside the construction areas, a buffer zone will be created around the nest tree. The recommended buffer, as identified by DFG, is 250 feet (Sections 3503 and 3503.5 of the California Fish and Game Code). A larger buffer zone will be established around Swainson's hawk nest sites, as described under Mitigation Measure WILD-10: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 2, 5, and 14.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

DWR will include the following measures to minimize indirect impacts on wildlife and wildlife habitat:

1. DWR will provide an on-site biologist/environmental monitor who will be responsible for monitoring implementation of the conditions in the state and federal permits (CWA Section 401, 402, and 404; ESA Section 7; Fish and Game Code Section 1601; Project plans (SWPPP); and EIS/EIR mitigation measures).
2. The on-site biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to each of the Project sites and channel dredge areas based on existing land cover type and special-status plant species mapping, unless observed field conditions warrant a modification of the environmentally sensitive area boundaries. To avoid construction-phase disturbance of sensitive habitats immediately adjacent to the Project site, the monitor will identify the boundaries and add a 50-foot buffer where feasible with orange construction barrier fencing. The fencing will be mapped on the Project construction drawings. Erosion control fencing also will be placed at the edges of construction where the construction activities are upslope of wetlands and channels to prevent washing of sediments from the construction site into surrounding environmentally sensitive areas. The environmentally sensitive area and erosion-control fencing will be installed before any construction activities are initiated, and it will be maintained throughout the construction period.
3. DWR will provide a worker environmental training program for all construction personnel before the start of construction activities. The program will educate workers about special-status species, riparian habitats, and waters of the United States present on and adjacent to the site, and the regulations and penalties for unmitigated effects on these sensitive biological resources.

4. Where feasible, construction will avoid and minimize trimming or complete removal of vegetation.
5. Following construction, the construction contractor will remove all litter and construction debris and implement a revegetation plan for temporarily disturbed vegetation in the construction zones. The elements that should be included in the revegetation of these sites are described in Section 4.1, Vegetation and Wetlands.

This mitigation measure is consistent with CALFED Mitigation Measures 2, 3, 4, 5, and 6.

Significance after Mitigation: Less than significant.

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the permanent or temporary loss of up to 11.08 acres of tidal freshwater wetland habitat. Table 4.3-4 summarizes the permanent and temporary effects of each Project component and Project operations on tidal freshwater emergent habitat.

Impacts on tidal freshwater wetland vegetation may include the complete removal of vegetation, the cutting of wetland vegetation, or disruption of the root zone as a result of ground-disturbing activities.

The effects of channel dredging would vary depending on the method used. For the purpose of this analysis, it is assumed that one of the following methods would be used: hydraulic, clamshell, or dragline.

- Hydraulic dredging would have no effect on tidal freshwater wetland vegetation because it is assumed that all dredging operations would take place from the water and that conveyance pipes and settling basins would be placed outside of the dripline of riparian vegetation. It is also assumed that tidal freshwater wetland vegetation would not be removed using this method.
- Clamshell dredging could result in the removal of tidal freshwater wetland vegetation. For the purpose of this impact assessment, it is assumed that all tidal freshwater wetland on the mainstem and South Fork Mokelumne River would be removed.
- Dragline dredging would result in the removal of tidal freshwater wetland vegetation. For the purpose of this impact assessment, it is assumed that all tidal freshwater wetland vegetation in the channel dredging area would be removed.

The loss of tidal freshwater wetland habitat as a result of construction activities and Project operations would also result in fragmentation of existing tidal freshwater wetland habitats. Although some of the existing tidal freshwater wetland vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of tidal freshwater wetland habitat in the Project area is considered to be significant. The additional fragmentation of tidal freshwater wetland habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community. Implementation of Mitigation Measures WILD-2, WILD-3, WILD-4, and WILD-5 and environmental commitments (Chapter 2) would reduce this impact to a less-than-significant level.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, as described in Section 4.1, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

DWR will compensate for the permanent loss of tidal perennial aquatic habitat caused by construction activities at a ratio of 2 acres for each acre affected. Mitigation of Project impacts would take place on site in the southern portion of the McCormack-Williamson Tract in the areas that will become tidally influenced after Project construction is completed.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 2, 3, 4, 5, 6, 22, 23, and 29.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the permanent loss of up to 3.85 acres and the temporary loss of 274.22 acres of tidal perennial aquatic habitat. Table 4.3-4 summarizes the effects of each Project component and Project operations on tidal perennial aquatic habitats. Construction impacts on tidal perennial aquatic habitat may include the placement of fill material or disturbance resulting from in-channel work. Long-term Project operations would not affect tidal perennial aquatic habitat.

During construction, areas upstream and downstream of the in-channel work areas would be temporarily affected by placement of sheetpile-braced cofferdams and channel dredging associated with these construction activities. Temporary disturbance of tidal perennial aquatic habitat would occur during perennial construction of several Project features. Temporary disturbance would occur as a result of any dewatering activities, as well as work in the channel associated with retrofitting agricultural siphons.

Tidal perennial aquatic habitat in the channel dredging areas includes deepwater aquatic, shallow aquatic, and unvegetated tidally influenced zones. Channel dredging would result in temporary impacts on tidal aquatic habitat. For the purpose of this analysis it is assumed that one of the following methods would be used: hydraulic, clamshell, or dragline. Each of these dredging methods would have the same effect on tidal perennial aquatic habitat because each method would affect the same surface area of open water. Of the three methods, hydraulic dredging would have more localized effects. Clamshell and dragline dredging would result in greater disturbance of channel bed.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the permanent and temporary loss of up to 51.68 acres of nontidal freshwater emergent wetland habitat. Table 4.3-4 summarizes the effects of each Project component on nontidal freshwater wetland habitat. Impacts on nontidal freshwater wetland vegetation may include the filling of nontidal wetlands on McCormack-Williamson Tract, the cutting of wetland vegetation or disruption of the root zone as a result of ground-disturbing activities, and the inundation of nontidal wetlands as a result of Project operations. The loss of nontidal freshwater wetland vegetation as a result of Project construction would result in the reduction in the extent of nontidal freshwater wetland communities, which are rare natural communities.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.
Impacts on nontidal wetlands would be mitigated by implementation of Mitigation Measure VEG-3, as described in Section 4.1, Vegetation and Wetlands. Where impacts on wetlands cannot be avoided, the area of effect would be kept to the minimum possible. Loss of, or impacts on, these habitats will be compensated for as part of compliance with the state and federal wetland permitting process.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 2, 3, 4, 5, 6, 22, 23, and 29.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the permanent and temporary loss of up to 1,766.55 acres of agricultural land. The Project would result in the permanent and temporary loss of up to 181.21 acres of ruderal habitat. Table 4.3-4 summarizes the effects of each Project component on agricultural land and ruderal habitat.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities.

The operation of heavy equipment during construction activities and dredging could affect wildlife species that are unable to relocate to adjacent areas, such as small mammals, amphibians, reptiles, and nesting birds. Construction activities could result in direct mortality to common wildlife species. Construction activities would also temporarily disturb wildlife use of affected or adjacent land cover types.

Vegetation protection measures will be incorporated as an environmental commitment, and preconstruction surveys will be performed before starting construction activities.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the permanent loss of 1,692.80 acres and the temporary loss of 73.75 acres of agricultural land on McCormack-Williamson Tract as a result of construction activities and agricultural land conversion to native land cover types (Table 4.3-4). This action would result in the permanent loss of some sandhill crane foraging and roosting habitat. Construction activities on McCormack-Williamson Tract would have a relatively small direct impact on foraging habitat. Project operations, however, would have a substantial impact on foraging habitat because the McCormack-Williamson Tract would be allowed to convert to native land cover types. It is estimated that approximately 2/3 of the McCormack-Williamson Tract would be inundated on a daily or regular basis. These areas would be converted to tidal perennial aquatic habitat and tidal emergent wetland habitat. The northern portion of McCormack-Williamson Tract would be allowed to convert to riparian habitat. Although McCormack-Williamson Tract was not identified as a key foraging habitat area (Ivey and Herzog 2003), McCormack-Williamson Tract is used by cranes (Jones & Stokes field observation).

Construction activities that occur during the period when sandhill cranes are present in the study area (approximately September–February) could also result in disturbance of foraging cranes or limit the availability of McCormack-Williamson Tract as foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.
Impacts on greater sandhill crane foraging habitat would be mitigated by creating suitable foraging habitat at an off-site conservation area or obtaining a conservation easement of lands that provide suitable foraging habitat for greater sandhill cranes. Agricultural lands will be provided at a ratio of 2:1 and located on lands that will be preserved and maintained by DWR. DWR will provide funding for the long-term management and monitoring of these lands and will prepare a monitoring plan for the mitigation site.

This mitigation measure is consistent with CALFED Mitigation Measures 3,5, 10, 12,17, and 20.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss or disturbance of VELB habitat (Table 4.3-4). Elderberry shrubs and areas of suitable habitat for elderberry shrubs occur throughout the study area, including the McCormack-Williamson Tract levees, other Project levees, at the Grizzly Slough site and at the borrow sites. A large number of shrubs and shrub clusters are located on McCormack-Williamson Tract levees. Because a complete census of elderberry shrubs has not been performed, no data are available at this time.

Elderberry shrubs and shrub clusters on McCormack-Williamson Tract would be affected by several Project components, including levee degradation, enhancing interior levee slopes, and breaching the Mokelumne River levee. Elderberry shrubs and shrub clusters occurring on the lower portion of the interior Mokelumne River levees may be affected by inundation. Elderberry shrubs may also occur at the Grizzly Slough site and the borrow sites, but this area has not been surveyed for elderberry shrubs.

Impacts may include the direct removal of shrubs or soil disturbance within the USFWS's recommended 100-foot-wide buffer. Access roads associated with construction would be restricted to the top of the levee or existing farm roads on the inboard side of the levee. Vehicle access could occur within the USFWS's recommended 100-foot buffer zone.

Elderberry shrubs that occur on the lower portion of the interior levee slopes would be subject to permanent, daily, or seasonal inundation. For the purpose of this evaluation, it is assumed that elderberry shrubs that are inundated permanently or daily would not survive and would be permanently lost and that elderberry shrubs not subject to seasonal inundation would survive.

The effects of channel dredging on elderberry shrubs would be similar to the effects stated for riparian habitat, above. For the purpose of this analysis, it is assumed that one of the following methods would be used: hydraulic, clamshell, or dragline.

- Hydraulic dredging would have no effect on elderberry shrubs because it is assumed that all dredging operations would occur from the water and that conveyance pipes and settling basins would be placed as far as possible from elderberry shrubs.
- Clamshell dredging could require the removal of dense stands of riparian vegetation, including elderberry shrubs, to allow for vertical and swing clearance of the excavator. For the purpose of this impact assessment, it is assumed that all elderberry shrubs on the mainstem of the Mokelumne River would be removed and that elderberry shrubs on the South Fork Mokelumne River could be avoided.
- Dragline dredging would require the removal of riparian vegetation, including elderberry shrubs, to allow equipment access. For the purpose of this impact assessment, it is assumed that all elderberry shrubs occurring in the channel dredging area would be removed.

Although this alternative would result in the loss of VELB habitat overall, the Project would have a beneficial effect on VELB habitat because construction of the McCormack-Williamson Tract interior levee improvements and conversion of agricultural land on McCormack-Williamson Tract and Grizzly Slough to native land cover types would increase the extent of potential VELB habitat in the Project area.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.
A qualified biologist will perform an elderberry shrub survey before starting construction and channel dredging, sediment disposal activities, and mitigation site implementation to ensure that elderberry shrubs, if present, are identified. The on-site biologist will field stake the locations of elderberry shrubs and shrub clusters before construction begins. Orange exclusion fencing will be installed around each elderberry shrub and shrub cluster. DWR will attempt to perform construction and dredging operations without affecting elderberry shrubs and to maintain a 100-foot buffer zone around all elderberry shrubs, to the greatest extent possible. However as a result of the dimensions of the work areas, it is anticipated that work could occur within the 100-foot buffer zone.

The surveys will be performed according to the USFWS VELB compensation guidelines (U.S. Fish and Wildlife Service 1999). During the preconstruction and postconstruction surveys the following information will be recorded for each shrub or shrub cluster:

- the number of stems greater than 1 inch in diameter,
- the number of stems less than 1 inch in diameter,
- the approximate height and width of the elderberry shrub or shrub cluster,
- the presence of VELB exit holes, and
- the dominant vegetation that is associated with the elderberry shrub or shrub cluster.

The location of each elderberry shrub or shrub cluster will be mapped using GPS, and a site map will be prepared identifying the location and size of each shrub and shrub cluster. DWR will use this site map to determine vehicle and equipment haul routes and work areas. Following completion of construction and dredging activities, DWR will evaluate the elderberry shrubs to determine whether any shrubs were damaged by Project activities. If damage occurs to elderberry shrubs, DWR will consult with USFWS on appropriate mitigation.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Wherever feasible, DWR will avoid and minimize Project effects on elderberry shrubs. Avoidance and minimization efforts will be performed according to the USFWS VELB compensation guidelines (U.S. Fish and Wildlife Service 1999). If elderberry shrubs with one or more stems measuring 1 inch or greater in diameter at ground level or plants with visible evidence of exit holes are located within or adjacent to proposed construction or dredging areas, DWR will implement the following actions:

- Install exclusion fencing around each elderberry shrub and shrub cluster.
- Avoid disturbance to VELB by establishing and maintaining, to the maximum extent feasible, a 100-foot buffer around elderberry plants identified as suitable habitat. If a 100-foot buffer cannot be maintained, DWR will consult and gain approval from the USFWS for measures that would minimize disturbance and promptly restore the damaged area.
- Fence and flag all buffer areas and place signs every 50 feet along the edge of the avoidance area, as described in the VELB compensation guidelines (U.S. Fish and Wildlife Service 1999).

Train construction personnel to recognize elderberry shrubs and to determine the presence of VELB from exit holes on stems. All construction personnel should receive USFWS–approved environmental awareness training before undertaking work at construction sites.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

If avoidance and minimization of effects on VELB habitat are not possible, DWR will compensate for unavoidable effects based on the VELB conservation guidelines (U.S. Fish and Wildlife Service 1999). Mitigation efforts may include transplanting elderberry shrubs, planting additional elderberry and associated plant species at an on-site or off-site mitigation area, or purchasing VELB mitigation credits at a USFWS–approved mitigation bank.

This mitigation measure is consistent with CALFED Mitigation Measures 2, 5, 12, 16, 22, and 27.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss or disturbance of giant garter snake habitat (Table 4.3-4). Construction in areas adjacent to nontidal freshwater emergent wetlands and irrigation ditches associated with agricultural land on McCormack-Williamson Tract, Grizzly Slough, or at the borrow sites would remove habitat for the giant garter snake. Direct impacts on individuals of this species could occur during construction.

Construction activities would affect 51.68 acres of nontidal wetland habitat and 20.21 acres of ponds and agricultural ditches. Construction activities also would affect adjacent upland habitat.

Operation of Alternative 1-A would include the inundation of McCormack-Williamson Tract as a result of daily tidal action in the lower and central portion of the tract and the seasonal inundation of the upper portion of the tract during high-flow events in the Mokelumne River. Operation of Alternative 1-A at the Grizzly Slough site includes the seasonal inundation of the upper portion of the tract during high-flow events in the Mokelumne River.

Based on these assumptions, operation of Alternative 1-A would result in the permanent loss of up to 71.89 acres of aquatic habitat and an undetermined amount of upland habitat for giant garter snake on McCormack-Williamson Tract. However, the conversion of the southern portion of the McCormack-Williamson Tract to tidal perennial aquatic and tidal emergent wetland habitat would increase the quantity of giant garter snake habitat in the Project area. At the Grizzly Slough site, operation of Alternative 1-A would result in the seasonal inundation of upland hibernacula that does not occur under existing conditions but would also result in the conversion of agricultural land to native land cover types, some of which would benefit giant garter snake.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Preconstruction surveys for giant garter snake will be conducted in all suitable breeding and foraging habitat in the vicinity of Project or mitigation activities to ensure that this species is not present in these locations. Surveys will also be performed at all mitigation sites before implementation of the mitigation features. Surveys will be performed during the active period of the snake (May 1–October 1). If surveys must be conducted during the species' inactive period, DWR will contact USFWS to determine whether additional measures are necessary to minimize and avoid take (U.S. Fish and Wildlife Service 1997). Preconstruction surveys will be performed by a qualified biologist within 24-hours of commencement of construction or dredging activities. The survey results will be provided to USFWS before starting construction activities.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Construction and channel dredging activities could occur throughout the year and would overlap the giant garter snake active and inactive periods. To the greatest extent practicable, major construction activities that could affect giant garter snake breeding and foraging habitat will be avoided during the active period. If Project construction activities necessitate dewatering wetland habitat during the snake's active period, that habitat will remain dry for at least 15 consecutive days before excavation or refilling (U.S. Fish and Wildlife Service 1997). If construction activities will be conducted during the species' inactive period, DWR will contact USFWS to determine whether additional measures are necessary to minimize and avoid take.

Clearing of wetland vegetation will be confined to the minimal area necessary to complete the desired activities. The movement of heavy equipment will be restricted to established roadways or constructed haul roads to minimize habitat disturbance.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss or disturbance of Swainson's hawk habitat (Table 4.3-4). Effects on Swainson's hawk would include the loss or disturbance of active nests and the loss or disturbance of foraging habitat.

Approximately 127.44 acres of riparian woodland that provide nesting habitat for Swainson's hawk would be affected by construction and channel dredging. The construction of Project components and conversion of agricultural lands to native land cover types would result in the permanent loss of 1,981.79 acres of foraging habitat, including 1,853.50 acres of permanent impacts and 128.29 acres of temporary impacts. Operation of Alternative 1-A, including the permanent and daily inundation of McCormack-Williamson Tract and the conversion of agricultural land at McCormack-Williamson Tract and at the Grizzly Slough site, would result in the permanent loss of agricultural land that provides foraging habitat for this species.

Noise and visual disturbances associated with operation of equipment and other construction- and maintenance-related activities within up to ½ mile of occupied nest sites could adversely affect nesting Swainson's hawks. Noise and visual disturbances of sufficient magnitude could result in the nest abandonment, a reduction in the level of care provided by adults (e.g., duration of brooding, frequency of feeding), or forced fledging. If these situations occur, they could reduce the likelihood of successful production of young during the year of disturbance. The number of nests or young that could be affected will be determined annually during the preconstruction surveys and active construction period surveys, as described below.

Nest-site removal or disturbance would occur only if Swainson's hawks were nesting at the time the trees are removed or the area around the nest is disturbed by these activities. Because Swainson's hawk nest sites may vary from year to year, the number of nest sites that could be affected by the Project may vary annually. Preconstruction surveys will be performed throughout the spring months to determine whether nest sites are located within ½ mile of proposed Project activities.

Overall, this alternative would have a beneficial effect on Swainson's hawk nesting habitat because conversion of agricultural land to native riparian and valley oak habitat would increase the number of potential nest trees in the Project area. However, conversion of agricultural land to native riparian and wetland land cover types would result in an overall decrease in Swainson's hawk foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance. Preconstruction surveys for Swainson's hawk will be conducted at and adjacent to all locations to be disturbed by construction and channel dredging to ensure that this species is not nesting in these locations. Surveys will also be performed at all mitigation sites before implementation of the mitigation features. Preconstruction surveys will consist of surveying all potential nest sites within ½ mile of proposed construction features, borrow sites, and mitigation sites. Surveys will be performed several times during the breeding season to avoid and minimize effects on late-nesting birds. Nest sites will be marked on an aerial photograph, and the position will be recorded using GPS.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites. Construction would occur throughout the year and would overlap with the Swainson's hawk breeding season. To the greatest extent practicable, major construction activities that would occur within ½ mile of an active Swainson's hawk nest should be avoided during the breeding season. If practicable, construction or dredging activities that would result in the greatest disturbance to an active nest site will be deferred until after or as late in the breeding season as possible. DWR will notify DFG of the locations of active nest sites identified during the preconstruction surveys and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

DFG requires that a ½-mile buffer be established around all active Swainson's hawk nests between March 1 and August 15 (California Department of Fish and Game 1994). Potential nesting trees within the construction footprint will be removed before construction and before nesting by individual pairs is initiated. Potential nest trees outside the construction footprint will be retained. Vegetation will be removed before the nesting season for migratory birds and Swainson's hawk (i.e., removal will occur between September 1 and February 1).

Because of the relatively narrow width of the Project area and the location and dimensions of the proposed work areas and access roads to riparian vegetation that currently provide nesting habitat for Swainson's hawks, a ½-mile buffer may not be feasible in all areas. DWR will maximize the buffer width around active nest sites on a site-by-site basis and will consult with DFG on the buffer widths before initiating construction-related activities. If possible, DWR will delay construction and maintenance around individual raptor nests until after the young have fledged. DWR will immediately cease work and contact DFG if a young bird has prematurely fledged the nest as a result of construction or maintenance activities.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Based on the presence of suitable habitat, it is assumed that construction activities will occur within ½ mile of active nest sites. As a result, DWR will compensate for foraging habitat at one of the following ratios (California Department of Fish and Game 1994):

- provide 1 acre of suitable foraging habitat (e.g.; Habitat Management [HM] lands) for each acre of affected habitat (1:1 ratio)—
    - at least 10% of these lands will include a fee title acquisition or conservation easement allowing for active management of the land to manage for active prey production, and
    - the remaining 90% of the HM lands will be protected by a conservation easement on agricultural or other lands that provide suitable foraging habitat for Swainson's hawks; or
- provide ½ acre of HM land, with a fee title acquisition or conservation easement allowing for active management of the land to manage for active prey production (0.5:1 ratio).

DWR will also provide funding to ensure that these lands will be managed to provide Swainson's hawk foraging habitat. This funding will consist of a site management endowment at a rate to be determined by DFG.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 5, 12, 16, 17, 22, 23, and 29.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

As stated under WILD-13, preconstruction surveys will be performed to identify active nest sites before implementing construction, dredging, or mitigation activities. DWR will remove suitable nest trees in locations where trees are scheduled for removal before the start of the nesting season. Additionally, before February 15 of each construction season, DWR will remove all suitable nesting habitat for migratory birds in areas where vegetation is scheduled to be cleared. Removal of vegetation before the nesting season will ensure that occupied nests are not removed. If construction, dredging, or mitigation activities require the removal of additional vegetation not previously designated for removal, DWR will perform clearance surveys to determine whether nesting hawks are present. If additional tree removal is required, it will be deferred until after the breeding season.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss or disturbance of suitable burrowing owl habitat (Table 4.3-4). Effects on burrowing owl would include the loss or disturbance of active nests and foraging habitat.

Construction in areas containing occupied burrowing owl burrows could cause direct mortality of nesting owls or nest abandonment. Construction activities and Project operations would affect 181.21 acres of ruderal and grassland vegetation. Permanent impacts on ruderal vegetation would include all land within the footprint of levees where RSP would be placed and the conversion of ruderal habitat to tidal perennial aquatic, tidal emergent wetland, and riparian habitats. Temporary impacts on ruderal vegetation would include temporary construction easements adjacent to the permanent impact areas. Impacts on ruderal vegetation may include the complete removal or cutting (e.g., mowing) of vegetation.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.
Preconstruction surveys for western burrowing owls will be conducted at and adjacent to all locations to be disturbed by construction and channel dredging to ensure that this species is not nesting or roosting in these locations. Surveys will also be performed at all mitigation sites before implementation of the mitigation features. Preconstruction surveys will be performed according to the DFG guidelines for this species (California Department of Fish and Game 1995b). Surveys will consist of surveying all suitable nesting and roosting habitat within 500 feet of proposed construction features, dredging and deposition areas, and mitigation sites, as well as along all haul roads located on levees or at the toe of the levees.

Surveys will be conducted during both the wintering and nesting seasons, unless the species is detected during the first survey. The winter survey will be conducted between December 1 and January 31 (if possible). Nesting surveys will be conducted between April 15 and July 15 to correspond with the peak of the breeding season. Surveys will be performed in the early morning and evening as specified in the DFG guidelines. Pedestrian survey transects will be spaced to provide 100% visual coverage of the ground surface. Disturbance of occupied burrows during the surveys will be avoided to the greatest extent practicable. In addition to the seasonal surveys, a preconstruction survey will be conducted within 30 days before construction to ensure that no additional owls have established territories since the initial surveys.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Burrowing owls may use the nest burrows as roosting sites throughout the year or may move into other burrows not used for nesting outside of the breeding season. Major construction and dredging activities that would result in the greatest disturbance to an active nest or roost sites will be deferred until after or as late in the breeding season as possible.

The following activities are considered impacts on western burrowing owls (California Department of Fish and Game 1995b):

- disturbance within approximately 160 feet (50 meters), which may result in harassment of owls at occupied burrows;
- destruction of natural and artificial burrows; and
- destruction or degradation of foraging habitat within 330 feet (100 meters) of an occupied burrow.

DWR will notify DFG of the locations of occupied burrows identified during the preconstruction surveys and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

If practicable, active nest and roost sites will be avoided during Project implementation. To avoid impacts during the nonbreeding season (September 1–January 31), no activities should occur within 160 feet of occupied burrows. To avoid impacts during the breeding season (February 1–August 31) no activities should occur within 250 feet of occupied burrows. Avoidance of occupied burrows also requires that a minimum of 6.5 acres of foraging habitat be permanently preserved around each occupied burrow (California Department of Fish and Game 1995b).

If active burrows are identified during the preconstruction surveys, DWR will coordinate with DFG to identify the appropriate avoidance and minimization measures and to determine the configuration of the foraging habitat to be permanently preserved.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

If the destruction of occupied burrows is unavoidable, existing unsuitable burrows will be enhanced or new, artificial burrows will be created in accordance with the DFG guidelines (California Department of Fish and Game 1995b). New or enhanced burrows will be provided at a ratio of 2:1 and located on lands that will be preserved and maintained by DWR. DWR will provide funding for the long-term management and monitoring of these lands and will prepare a monitoring plan for the burrowing owl mitigation site.

Passive relocation techniques will be used to clear burrowing owls from occupied burrows. These techniques are described in the DFG guidelines for this species. Passive relocation techniques and artificial burrow designs will be approved by DFG before implementing this mitigation measure. Passive relocation will not be allowed until after the breeding season if it is determined that eggs or nestlings are present.

This mitigation measure is consistent with CALFED Mitigation Measures 17 and 31.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

If it is determined that occupied burrows are present in the Project area, DWR will mitigate the loss or disturbance of foraging habitat by implementing the following measures:

1. Permanently preserve 6.5 acres of foraging habitat around each occupied burrow that is avoided. The 6.5 acres may include an approximately 300-foot radius around each burrow or an alternate configuration totaling 6.5 acres, as approved by DFG.
2. Permanently preserve 6.5 acres of foraging habitat around each newly constructed or enhanced burrow. The 6.5 acres may include an approximately 300-foot radius around each burrow or an alternate configuration totaling 6.5 acres, as approved by DFG.

Based on the preconstruction survey results, DWR will avoid and minimize impacts on burrowing owls and acquire, protect, or manage suitable burrowing owl foraging habitat in the Project vicinity or, pending approval of DFG, purchase mitigation or conservation bank credits at an approved bank.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 5, 16, 17, 23, 29, and 31.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

The study area is known or expected to provide nesting habitat for northern harriers, white-tailed kites, Cooper's hawk, short-eared owl, and several other raptor species. Construction could result in loss or disturbance of raptor nests. Construction activities and Project operations would result in the permanent and temporary loss of nest trees, nesting substrate, and foraging area (Table 4.3-4).

Noise and visual disturbances associated with operation of equipment and other construction- and maintenance-related activities within up to ¼ mile of occupied nest sites could adversely affect nesting raptors. Noise and visual disturbances of sufficient magnitude could result in the nest abandonment, a reduction in the level of care provided by adults (e.g., duration of brooding, frequency of feeding), or forced fledging. If these situations occur, it could reduce the likelihood of successful production of young during the year of disturbance. The number of nests or young that could be affected will be determined annually during the preconstruction surveys and active construction period surveys, as described below.

The loss of active nests would occur if nest-site removal or disturbance occurs when raptors are nesting. The removal of nests or nesting trees will occur outside of the nesting season. Because nest sites may vary from year to year, the number of nest sites that could be affected by the Project may vary annually. Preconstruction surveys will be performed throughout the spring months to determine whether nest sites are located within ¼ mile of proposed Project activities.

Overall, the Project would have beneficial effects on some raptor species and adverse impacts on other species. Some species would benefit from an increase in nesting habitat because conversion of agricultural land to native riparian and valley oak habitat would increase the quantity of potential nest trees in the Project area. However, conversion of agricultural land to native riparian and wetland land cover types would decrease nesting and foraging habitat for some species such as Swainson's hawk, northern harrier, and white-tailed kite.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss or disturbance of western pond turtle habitat (Table 4.3-4). Effects on western pond turtle include the loss or disturbance of active nests and the loss or disturbance of foraging habitat.

Construction activities and channel dredging in areas within or adjacent to wetland and aquatic habitats, including tidal perennial aquatic, tidal and nontidal emergent wetland, off-channel ponds, and irrigation ditches, could cause direct mortality of, or remove habitat for, western pond turtles.

Most habitat effects would be temporary because most of the affected habitats would be restored following construction. There would be permanent impacts on breeding habitat on all land within the footprint of the construction features, including the extent of levee slopes where RSP would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of channel bed excavation, cutting of vegetation, or the placement of fill material on existing wetlands. Impacts on individuals of this species could also occur during construction or channel dredging.

Overall, this Project alternative would have beneficial effects on western pond turtles because degradation of the McCormack-Williamson Tract levees and the permanent inundation of the southern portion of the island would result in an increase of tidal perennial aquatic and tidal emergent wetland in the study area.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.
Western pond turtles are known to occur in the waterways of the Project area and are expected to occur in suitable off-channel habitats. Because these waterways are large, open systems, it is not feasible to clear and permanently exclude all western pond turtles from the construction sites. A qualified biologist will conduct preconstruction surveys to determine the approximate population density of turtles in the construction areas. Where practical, DWR will install sheet piles, cofferdams, or other measures to minimize sedimentation between the in-channel construction zones and adjacent waterways. This system would minimize the degradation of aquatic habitats outside the construction zone and inhibit the movement of some turtles into the construction zone. These measures will not be used at the channel dredging sites because these sites will be continually moving along the channels during the dredging process, and such measures would not be feasible. Turtles found in the work area will be captured and transported to a nearby location outside of the work area.

To avoid the loss of western pond turtle and eggs as a result of construction, DWR will install plastic orange mesh exclusion fencing or silt exclusion fencing on the channel banks to prevent turtles from nesting in the work areas. The fencing will be installed to a depth of 6 inches below the ground surface to prevent turtles from going under the fence. Fences will be installed before the nesting season (i.e., March 1) and will remain in place through August. The fencing may be removed before grading.

An on-site biologist will be present during all in-channel activities to relocate western pond turtles outside of the construction zones.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbird Nesting Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A would result in the loss or disturbance of tricolored blackbird habitat (Table 4.3-4). Effects on tricolored blackbird include the loss or disturbance of active nests and nesting habitat and the loss or disturbance of foraging habitat during Project construction.

Impacts on riparian scrub and tidal emergent wetland that provides suitable nesting habitat are described above under the impact statements for these land cover types. Impacts on wetland vegetation may include the complete removal of vegetation as a result of excavating channel beds, cutting vegetation, or the placing fill material on existing wetlands.

Overall, this Project alternative would have a beneficial effect on tricolored blackbird nesting habitat because degradation of the McCormack-Williamson Tract levees and the permanent inundation of the southern portion of the island would result in an increase in tidal emergent wetland in the Project area. Conversion of the remainder of the McCormack-Williamson Tract and the Grizzly Slough site to native land cover types may result in an increase of suitable tricolored blackbird nesting habitat, but it also would result in a decrease of foraging habitat in the Project area. The loss of foraging habitat is not considered significant because the ruderal habitats and agricultural lands in which this species may forage are abundant in the study area and represent a small percent of the overall potential agricultural land foraging habitat for tricolored blackbirds in the North Delta region.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Preconstruction surveys for tricolored blackbird nesting colonies will be conducted at and adjacent to all locations to be disturbed by construction and channel dredging to ensure that this species is not nesting in these locations. Surveys will also be performed at all mitigation sites before implementation of the mitigation features.

Preconstruction surveys will consist of surveying all suitable breeding habitat in the vicinity of Project or mitigation activities. Pedestrian survey transects will be used to provide 100% visual coverage of the suitable breeding habitat. Nest colony surveys are recommended to begin at the end of April with subsequent surveys occurring throughout the breeding season (Beedy and Hamilton 1997). If a nesting colony is observed, the location will be marked on an aerial photograph, and the position will be recorded using GPS.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies. Portions of the construction and channel dredging activities would occur throughout the year and would overlap the tricolored blackbird breeding season (mid-April–July). To the greatest extent practicable, major construction activities that occur within ¼ mile of tricolored blackbird nest sites will be avoided during the breeding season. If practicable, construction and dredging activities that would result in the greatest disturbance to an active nest sites will be deferred until after or as late in the breeding season as possible. DWR will notify DFG of the locations of active nest sites identified during the preconstruction surveys and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat.

Implementation of Project components and Project operations associated with Alternative 1-A could result in the loss or disturbance of California black rail habitat (Table 4.3-4). Effects on California black rail include the loss or disturbance of active nests and nesting habitat and the loss or disturbance of foraging habitat.

Construction activities and channel dredging resulting in the loss or disturbance of 11.08 acres of tidal emergent wetland and 51.68 acres of nontidal emergent wetland habitat could result in loss or disturbance of California black rail nests or potential nesting habitat. There would be permanent impacts on wetland vegetation within the construction footprint, including the extent of levee slopes where RSP would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of excavating channel beds, cutting vegetation, or placing fill material on existing wetlands.

Overall, this Project alternative would have a beneficial effect on California black rail breeding habitat because degradation of the McCormack-Williamson Tract levees and the permanent inundation of the southern portion of the island would result in an increase in tidal emergent wetland in the Project area.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Preconstruction surveys for California black rail will be conducted at and adjacent to all locations to be disturbed by construction and channel dredging to ensure that this species is not nesting in these locations. Surveys will also be performed at all mitigation sites before implementation of the mitigation features. Preconstruction surveys will consist of surveying all suitable breeding habitat in the vicinity of Project or mitigation activities.

Surveys will be performed to record species presence and density and abundance. Surveys will be performed in all tidal emergent wetlands that are greater than 1.2 acres (0.5 hectare) in total area and have shallow water or moist soil conditions (Arizona Game and Fish Department 2002). Fixed, permanent survey points will be selected and marked in the field and by using a GPS receiver. Surveys will be performed several times during the breeding season to avoid and minimize effects on late nesting birds. The surveys will be performed during periods of good weather (e.g., clear to cloudy skies, no precipitation, minimal wind). The survey points will be surveyed in either the early morning or evening. Morning surveys will begin within 30 minutes of sunrise and will be completed within 4 hours after sunrise. Evening surveys will begin 4 hours before sunset and be completed before dark (Arizona Game and Fish Department 2002). A recording of a black rail call will be played at varying intervals and records of responses will be recorded. The playback interval will follow the guidelines identified in the black rail monitoring protocol (Arizona Game and Fish Department 2002). If a response is heard, the location will be marked on an aerial photograph, and the position will be recorded using GPS.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1, 11, and 14.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Portions of the construction and dredging activities would occur throughout the year and would overlap the California black rail breeding season (mid-March–July). To the greatest extent practicable, major construction activities that would be near expected California black rail nest sites will be avoided during the breeding season. If practicable, construction or dredging activities that would result in the greatest disturbance to an active nest site will be deferred until after or as late in the breeding season as possible. DWR will notify DFG of active nest sites identified during the preconstruction surveys and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1, 11, 15, and 21.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

Implementation of Project components and Project operations associated with Alternative 1-A could result in the loss or disturbance of active rookeries of colonial waterbirds (Table 4.3-4). Effects on active rookeries include the loss or disturbance of active nests and nesting habitat and the loss or disturbance of foraging habitat.

Construction activities and channel dredging may result in the direct removal of rookeries or the disturbance of occupied rookeries. Rookery nesting species that could be affected include great blue heron, great egret, snowy egret, black-crowned night-heron, double-crested cormorant, and white-faced ibis. Rookery removal or disturbance would occur only if birds are nesting at the time the trees are removed or disturbed by these activities.

Implementation of Alternative 1-A would result in the removal of riparian habitat that could support active nest sites (Table 4.3-4). Riparian-related impacts would affect 127.44 acres of riparian woodland and 30.47 acres of riparian scrub vegetation. Preconstruction surveys will be performed throughout the spring to determine whether nest sites are located within ¼ mile of proposed Project activities.

Noise and visual disturbances associated with operation of equipment and other construction- and maintenance-related activities within ¼ mile of occupied nest sites could adversely affect species nesting in active rookeries. Noise and visual disturbances of sufficient magnitude could result in nest abandonment, reduction in the level of care provided by adults for eggs and young (e.g., duration of brooding, frequency of feeding), or forced fledging. If these situations occur, it could reduce the likelihood of successful production of young during the year of disturbance. The number of nests or young that could be affected will be determined annually during the preconstruction surveys and active construction period surveys, as described below.

Determination of Significance: Significant**.**

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Preconstruction surveys for rookeries will be conducted at and adjacent to all locations to be disturbed by construction and channel dredging. Surveys will also be performed at all mitigation sites before implementation of the mitigation features. Preconstruction surveys will consist of surveying all potential nest sites within ¼ mile of proposed construction features, channel dredging areas, and mitigation sites. Surveys will be performed several times during the breeding season to avoid and minimize impacts on late-nesting birds. Rookery locations will be marked on an aerial photograph, and the position will be recorded using GPS. Preconstruction survey data will be used in accordance with conservation measures listed below.

This mitigation measure is consistent with CALFED Mitigation Measures 1 and 21.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Portions of the construction and channel dredging activities will occur throughout the year and will overlap with the breeding season. To the greatest extent practicable, major construction activities that will occur within ¼ mile of an active rookery will be avoided during the breeding season. If practicable, construction and dredging activities that would result in the greatest disturbance to an active rookery will be deferred until after or as late in the breeding season as possible. DWR will notify DFG of the locations of active rookeries identified during the preconstruction surveys and will coordinate with DFG on appropriate avoidance and minimization measures on a case-by-case basis.

This mitigation measure is consistent with CALFED Mitigation Measures 1 and 21.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries.

As stated under Mitigation Measure WILD-28, preconstruction surveys will be performed to identify active rookeries before implementing construction, dredging, or mitigation activities. Before the start of the nesting season, DWR will remove suitable nest trees in locations where trees are scheduled for removal. Additionally, before February 15 of each construction season, DWR will remove all suitable nesting habitat in areas where vegetation is scheduled to be cleared. Removal of vegetation before the nesting season will ensure that occupied nests are not removed. If construction, dredging, or mitigation activities require the removal of additional vegetation not previously designated for removal, DWR will perform clearance surveys to determine whether nesting black-crowned night-herons and other species that nest in rookeries are present. If rookeries are present, vegetation removal will be deferred until after the breeding season.

This mitigation measure is consistent with CALFED Mitigation Measures 1 and 21.

Mitigation Measure WILD-30: Replace Lost Breeding Habitat. DWR will compensate for the unavoidable loss of riparian habitat caused by Project implementation by restoring or enhancing in-kind riparian and valley oak habitat. This compensation will restore or enhance in-kind habitat at a ratio of 3 acres for each acre affected, as described in the mitigation measures for riparian habitat in Section 5.1.

This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 2, 3, 4, and 5.

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

Construction activities and channel dredging could result in loss or disturbance of Aleutian Canada goose wintering and foraging habitat on agricultural lands in the Project area. Impacts on agricultural land include 1,692.80 acres of permanent and 73.75 acres of temporary impacts.

Overall, Alternative 1-A would result in a decrease of Aleutian Canada goose habitat because degradation of the McCormack-Williamson Tract levees and the permanent inundation of the southern portion of the island would result in an increase in tidal emergent wetland in the Project area. Additionally the conversion of the remainder of the McCormack-Williamson Tract and the Grizzly Slough site to native land cover types would result in the permanent loss of foraging habitat for this species.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

Construction activities and channel dredging could result in temporary loss or disturbance of bald eagle wintering and foraging habitat. Overall, the Project would have a net increase in tidal perennial aquatic and emergent wetland habitat and would result in an increase in foraging habitat for this species.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

The study area provides nesting habitat for migratory birds as well as resident birds protected under the MBTA. Construction would result in loss or disturbance of nesting habitat for many species, including special-status species such as California horned lark, loggerhead shrike, and Modesto song sparrow. Construction activities and channel dredging would result in the permanent and temporary loss of nest trees, nesting substrate, and foraging area.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities.

The study area is expected to provide breeding and roosting habitat for bats, including special-status species (Table 4.3-3). Construction activities expected to affect bat habitat include the relocation of existing structures on McCormack-Williamson Tract and the removal of some large trees in the work areas. These activities would result in the temporary loss of habitat and the loss of bats if they are roosting during the period when the structures or large trees are removed

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-31: Conduct Preconstruction Surveys for Bats.

A qualified biologist will conduct acoustic and visual surveys for bats one or two times between April and August before construction begins. The biologist should determine whether the structures and bridges to be removed are being used as day, night, and/or maternal roost. If large trees and structures are to be removed prior to the end of the maternity season (late August), they will be surveyed for exit flights in order to be sure that roosting bats will not be harmed in tree or structure removal. If any special-status bat species are discovered roosting on the structures or the bridges, work on the bridges should be avoided until after migration in late fall when bats are less likely to be roosting in these areas. Removal of existing structures and work on the bridges should begin during late fall or winter (November 1–March 1). The biologist should confirm that the bats have vacated the work areas before the start of construction activities. If construction during this time period is not possible, the biologist will consult with DFG to determine appropriate mitigation measures, which may include constructing and placing bat boxes near the bridge or exclusion of bats from the bridge through accepted means. Implementation of these measures would prevent injury and mortality of special-status bats and other bat species. This mitigation measure is consistent with CALFED Programmatic Mitigation Measures 1 and 21.

Significance after Mitigation: Less than significant.

Alternative 1-B: Seasonal Floodplain Optimization—

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat as a result of implementing Alternative 1-B. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 1-B.

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact. Table 4.3-5 summarizes the Project impacts on wildlife habitat by Project component. The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15.

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-B would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A. As a result, the tract would not be subject to daily tidal fluctuation and would retain water for longer periods of time. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of 166.07 acres of riparian-associated wildlife habitat. This total is slightly less than the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Table 4.3-5. Summary of Impacts for Alternative 1B—Seasonal Floodplain Optimization

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	0.63	274.28	274.91
	Tideflat (mudflat)	3.22	0.00	3.22
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	11.08	0.00	11.08
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	4.76	0.08	4.84
	Seasonal freshwater emergent wetland	46.84	0.00	46.84
Lacustrine	Farm and borrow pit ponds	8.69	43.20	51.89
	Temporary agricultural ditch (<15 ft wide)	8.55	1.07	9.62
	Permanent agricultural ditch (>15 ft wide)	2.97	0.03	3.00
Valley/foothill riparian	Cottonwood-willow woodland	41.64	0.41	42.06
	Valley oak riparian woodland	62.62	8.98	71.60
	Himalayan blackberry	7.98	0.31	8.29
	Riparian scrub	26.61	4.51	31.12
	Mixed Riparian Woodland	13.49	0.00	13.49
	Nonnative Riparian woodland	0.00	0.00	0.00
Grassland	Annual grassland	34.03	0.01	34.04
	Perennial grassland	0.00	0.92	0.92
	Ruderal/forb	92.25	54.00	146.25
Upland Cropland	Corn and grain fields	1703.34	63.18	1766.52
Developed	Developed	8.29	1.43	9.72
Ornamental Plantings	Ornamental plantings	0.49	0.00	0.49
	Totals	2077.48	452.41	2529.90

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-B would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of 3.22 acres of riparian-associated wildlife habitat. This total is the same as the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-B would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of 274.85 acres of tidal perennial aquatic–associated wildlife habitat. This total is the same as the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-B would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of 51.68 acres of nontidal freshwater emergent wetland–associated wildlife habitat. This total is the same as the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-B would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of 146.25 acres of ruderal habitat and 1,766.52 acres of agricultural land. These totals are the same as the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat as a Result of Construction Activities and Channel Dredging.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Replace Wetland Land Cover Types

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

This impact is the same as described under Alternative 1-A.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries

Mitigation Measure WILD-30: Replace Lost Breeding Habitat

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-31: Conduct Preconstruction Surveys for Bats.

Significance after Mitigation: Less than significant.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat as a result of implementing Alternative 1-C. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 1-C. The Project components included in this analysis are listed in Table 4-3.6.

Table 4.3-6. Summary of Impacts for Alternative 1-C—Floodplain Enhancement & Subsidence Reversal

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	0.63	274.37	275.00
	Tideflat (mudflat)	3.22	0.00	3.22
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	11.08	0.00	11.08
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	4.76	0.08	4.84
	Seasonal freshwater emergent wetland	46.84	0.00	46.84
Lacustrine	Farm and borrow pit ponds	8.69	43.20	51.89
	Temporary agricultural ditch (<15 ft wide)	8.39	1.21	8.60
	Permanent agricultural ditch (>15 ft wide)	2.97	0.03	3.00
Valley/foothill riparian	Cottonwood-willow woodland	41.64	0.41	42.05
	Valley oak riparian woodland	62.62	8.98	71.60
	Himalayan blackberry	8.03	0.54	8.57
	Riparian scrub	26.61	4.21	30.82
	Mixed Riparian Woodland	13.49	0.00	13.49
	Nonnative Riparian woodland	0.00	0.00	0.00
Grassland	Annual grassland	34.03	0.01	34.04
	Perennial grassland	0.00	0.92	0.92
	Ruderal/forb	92.05	54.13	146.18
Upland Cropland	Corn and grain fields	1688.75	77.80	1766.55
Developed	Developed	8.14	1.57	9.71
Ornamental Plantings	Ornamental plantings	0.49	0.00	0.49
	Totals	2062.43	467.46	2528.89

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact. Table 4.3-6 summarizes the Project impacts on wildlife habitat. The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-C would be similar to those described in Alternatives 1-A and 1B, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A and a cross levee would be constructed. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-C would result in the loss of 166.53 acres of riparian-associated wildlife habitat. This total is similar to the impacts associated with Alternatives 1-A and 1-B. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-C would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A. As a result, the tract would not be subject to daily tidal fluctuation and the tract would retain water for longer periods of time. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-B would result in the loss of 3.22 acres of riparian-associated wildlife habitat. This total is the same as the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-C would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A and a cross levee would be constructed. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-C would result in the loss of 275.00 acres of tidal perennial aquatic–associated wildlife habitat. This total is the slightly more than the impacts associated with Alternative 1-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-C would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A and a cross levee would be constructed. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-C would result in the loss of 51.68 acres of nontidal freshwater emergent wetland–associated wildlife habitat. This total is the same as the impacts associated with Alternatives 1-A and 1-B. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

The implementation of Project components and Project operations associated with Alternative 1-C would be similar to those described in Alternative 1-A, except the southwest levee of McCormack-Williamson Tract would not be lowered as significantly as proposed under Alternative 1-A and a cross levee would be constructed. The impact mechanisms would be the same as those identified for Alternative 1-A.

Implementation of Project components and Project operations associated with Alternative 1-C would result in the loss of 146.25 acres of ruderal habitat and 1,766.52 acres of agricultural land. These totals are the same as the impacts associated with Alternatives 1-A and 1-B. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries.

Mitigation Measure WILD-30: Replace Lost Breeding Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-31: Conduct Preconstruction Surveys for Bats.

Significance after Mitigation: Less than significant.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat as a result of implementing Alternative 2-A. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 2-A.

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact. Table 4.3-7 summarizes the Project impacts on wildlife habitat by Project component. The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15.

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss of riparian-associated wildlife habitat. These actions would result in the permanent and temporary loss of up to 21.40 acres of riparian habitat, including the loss of 19.76 acres of riparian woodland and 1.64 acres of riparian scrub habitat. Table 4.3-7 summarizes the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from Project operations would include the inundation of riparian vegetation on the interior levees and in the invert of the detention basin.

The loss of riparian habitat as a result of construction and Project operations activities would also result in fragmentation of riparian habitats. Although some of the existing riparian vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of riparian habitat is considered to be significant. The additional fragmentation of riparian habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the permanent and temporary loss of up to 0.65 acre of tidal freshwater emergent wetland habitat. The Project would result in the permanent loss of up to 0.37 acre and the temporary loss of 0.28 acre of tidal freshwater wetland habitat. Table 4.3-7 summarizes the permanent and

Table 4.3-7. Summary of Impacts for Alternative 2-A—North Staten Detention

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	3.56	1.98	5.54
	Tideflat (mudflat)	0.02	0.07	0.09
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	0.37	0.28	0.65
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	0.76	0.44	1.20
	Seasonal freshwater emergent wetland	1.35	5.53	6.88
Lacustrine	Farm and borrow pit ponds	43.20	0.00	43.20
	Temporary agricultural ditch (<15 ft wide)	3.22	12.87	16.09
	Permanent agricultural ditch (>15 ft wide)	1.02	0.01	1.03
Valley/foothill riparian	Cottonwood-willow woodland	19.21	0.55	19.76
	Valley oak riparian woodland	0.00	0.00	0.00
	Himalayan blackberry	0.73	0.00	0.73
	Riparian scrub	0.87	0.04	0.91
	Mixed Riparian Woodland	0.00	0.00	0.00
	Nonnative Riparian woodland	0.00	0.00	0.00
Grassland	Annual grassland	33.28	0.00	33.28
	Perennial grassland	3.19	0.00	3.19
	Ruderal/forb	93.71	11.16	104.87
Upland Cropland	Corn and grain fields	165.99	2009.40	2175.39
Developed	Developed	23.10	28.53	51.63
Ornamental Plantings	Ornamental plantings	0.00	0.00	0.00
	Totals	393.58	2070.86	2464.44

temporary effects of each Project component and Project operations on tidal freshwater emergent habitat.

Impacts on tidal freshwater wetland vegetation may include the complete removal of vegetation, the cutting of wetland vegetation, or disruption of the root zone as a result of ground-disturbing activities, specifically those actions that would affect the waterside of the levees. Project operations would not result in the loss of tidal freshwater wetlands.

The loss of tidal freshwater wetland habitat as a result of construction activities and Project operations would also result in fragmentation of existing tidal freshwater wetland habitats. Although some of the existing tidal freshwater wetland vegetation is fragmented and composed of disjunct patches of vegetation, loss or further fragmentation of tidal freshwater wetland habitat in the Project area is considered to be significant. The additional fragmentation of tidal freshwater wetland habitat in the study area contributes to the increasing and cumulative degradation of this sensitive natural community.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the permanent and temporary loss of up to 5.63 acres of tidal perennial aquatic habitat, including 5.54 acres of tidal perennial aquatic habitat and 0.09 acre of tidal flat. The Project would result in the permanent loss of up to 3.58 acres and the temporary loss of 2.05 acres of tidal perennial aquatic habitat. Tidal perennial aquatic habitat in the channel dredging areas includes deepwater aquatic, shallow aquatic, and unvegetated intertidal zones.

Table 4.3-7 summarizes the effects of each Project component and Project operations on tidal perennial aquatic habitat. Impacts on tidal perennial aquatic habitat may include the placement of fill material or disturbance resulting from in-channel work. Project operations would not affect tidal perennial aquatic habitat.

During construction, areas upstream and downstream of the in-channel work areas would be temporarily affected by placement of sheetpile-braced cofferdams and channel dredging associated with these construction activities. Temporary disturbance of tidal perennial aquatic habitat would occur during construction of several Project features. Temporary disturbance would occur as a result of any dewatering activities, as well as work in the channel associated with retrofitting agricultural siphons.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the permanent and temporary loss of up to 8.08 acres of nontidal freshwater emergent wetland habitat, including the permanent loss of up to 2.11 acres and the temporary loss of 5.97 acres. Table 4.3-7 summarizes the effects of each Project component on nontidal freshwater wetland habitat. Impacts on nontidal freshwater wetland vegetation may include the filling of nontidal wetlands on Staten Island, the cutting of wetland vegetation, or disruption of the root zone as a result of ground-disturbing activities.

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Nontidal freshwater emergent wetland habitat that occurs in the detention basin would be subject to long-term inundation. For the purpose of this evaluation, it is assumed that this vegetation would not be affected by Project operations.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the permanent and temporary loss of 2,175.39 acres of agricultural land and 141.34 acres of grassland and ruderal habitat. The Project would result in the permanent loss of up to 165.99 acres and the temporary loss of 2,009.40 acres of agricultural land. The Project would result in the permanent loss of up to 130.18 acres and the temporary loss of 11.16 acres of ruderal habitat. Table 4.3-7 summarizes the effects of each Project component on agricultural land and ruderal habitat.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the permanent loss of 165.99 acres of agricultural land on Staten Island as a result of construction activities (Table 4.3-7). This action would result in the permanent loss of sandhill crane foraging habitat. Construction activities on Staten Island would have a relatively small direct impact on foraging habitat. Project operations, however, would affect 2,009.40 acres of agricultural land when the detention basin is inundated. This could have a substantial impact on foraging habitat because agricultural practices and crop rotation could be affected by prolonged inundation of the detention basin.

Construction activities that occur during the period when sandhill cranes are present in the study area (approximately September–February) could also result in temporary disturbance of roosting and foraging cranes or limit the availability of portions of Staten Island as roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of VELB habitat (Table 4.3-7). Elderberry shrubs and areas of suitable habitat for elderberry shrubs are known to occur on Staten Island (May & Associates 2004). Elderberry shrubs and areas of suitable habitat for elderberry shrubs are expected to occur at the Grizzly Slough site and at the borrow sites. A complete census of elderberry shrubs has not been performed; therefore, no existing conditions information is available at this time.

Impacts may include the removal of shrubs or soil disturbance within the USFWS's recommended 100-foot-wide buffer. Access roads associated with construction of features would be restricted primarily to the top of the levee or existing farm roads on the landside of the levee. Temporary access roads may be constructed on other portions of Staten Island to facilitate construction. Vehicle access could occur within the USFWS's recommended 100-foot buffer zone.

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that elderberry shrubs occurring in the inundation zone would not survive.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of giant garter snake habitat (Table 4.3-7). Construction in areas adjacent to nontidal freshwater emergent wetlands and irrigation ditches associated with agricultural land on Staten Island, Grizzly Slough or at the borrow sites would remove habitat for the giant garter snake. Direct impacts on individuals of this species could also occur during construction.

Construction activities would affect 68.40 acres of nontidal wetland habitat, including 6.35 acres of permanent impacts and 62.05 acres of temporary impacts. Construction activities also would affect an undetermined quantity of adjacent upland habitat

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that giant garter snake that overwinter in the detention basin would not survive.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of Swainson's hawk habitat (Table 4.3-7). Effects on Swainson's hawk include the loss or disturbance of active nests and the loss or disturbance of foraging habitat.

The construction of Project components would result in the loss of 2,316.73 acres of foraging habitat, including 296.17 of permanent impacts and 2,020.56 acres of temporary impacts. Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin during the spring months would result in the temporary loss of 2,009.40 acres of foraging habitat.

Nest removal and disturbance mechanisms are the same as those identified for Alternative 1-A. The construction of Project components would result in the loss of 19.76 acres of nesting habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of burrowing owl habitat (Table 4.3-7). Effects on burrowing owl include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Nest removal and disturbance mechanisms are the same as those identified for Alternative 1-A.

Construction in areas containing occupied burrowing owl burrows could cause direct mortality of nesting owls or nest abandonment. Construction activities and Project operations would affect 141.34 acres of ruderal vegetation. Permanent impacts would occur on 130.18 acres of ruderal vegetation, including all land within the footprint of levees where RSP would be placed. Temporary impacts on 11.16 acres of ruderal vegetation would include temporary construction easements adjacent to the permanent impact areas. Impacts on ruderal vegetation may include the complete removal or cutting (e.g., mowing) of vegetation.

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that suitable nesting and roosting burrows would be inundated and could result in the loss of burrowing owls.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of western pond turtle habitat (Table 4.3-7). Effects on western pond turtle include the loss or disturbance of active nests and the loss or disturbance of foraging habitat.

Construction activities within or adjacent to wetland and aquatic habitats, including tidal perennial aquatic, tidal and nontidal emergent wetland, off-channel ponds, and irrigation ditches, could cause direct mortality of, or remove habitat for, western pond turtles.

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin would not affect pond turtle breeding habitat because nest construction and egg laying would occur after the basin is dewatered. Inundation of the detention basin would result in a temporary increase in tidal perennial aquatic habitat for this species.

Most habitat effects would be temporary because most of the affected habitats would be restored following construction. Permanent impacts on breeding habitat would occur on all land within the construction footprint and the extent of levee slopes where RSP would be placed. Impacts on wetland vegetation may include the complete removal of vegetation as a result of channel bed excavation, cutting of vegetation, or the placement of fill material on existing wetlands. Impacts on individuals of this species could also occur during construction or channel dredging.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of tricolored blackbird habitat (Table 4.3-7). Effects on tricolored blackbird include the loss or disturbance of active nests and nesting habitat and the loss or disturbance of foraging habitat. Impact mechanisms are the same as those identified for Alternative 1-A.

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin would result in the temporary loss of 2,012.12 acres of foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of California black rail habitat (Table 4.3-7). Effects on California black rail include the loss or disturbance of active nests and nesting habitat and the loss or disturbance of foraging habitat. Impact mechanisms are the same as those identified for Alternative 1-A.

Construction activities resulting in the loss or disturbance of tidal and nontidal emergent wetland habitat could result in loss or disturbance of California black rail nests or potential nesting habitat. Impacts on tidal and nontidal freshwater emergent wetland vegetation include 8.73 acres of permanent and temporary impacts—2.48 acres of permanent impacts and 6.25 acres of temporary impacts.

Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the agricultural ditches on Staten Island would result in the temporary loss of roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

Implementation of Project components and Project operations associated with Alternative 2-A would result in the loss or disturbance of active rookeries (Table 4.3-7). Effects on active rookeries include the loss or disturbance of active nests and nesting habitat and the loss or disturbance of foraging habitat.

Project implementation would result in the removal of riparian habitat that could support active nest sites (Table 4.3-7). Impact mechanisms are the same as those identified for Alternative 1-A. Operation of Alternative 2-A includes the inundation of North Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the riparian habitat could result in the loss of rookeries if inundation occurred after nest establishment.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries.

Mitigation Measure WILD-30: Replace Lost Breeding Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

Construction activities resulting in the loss or disturbance of agricultural land could result in loss or disturbance of Aleutian Canada goose wintering and foraging habitat. Impacts on agricultural land include 165.99 acres of permanent and 2,009.40 acres of temporary impacts.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities.

The study area is expected to provide breeding and roosting habitat for bats, including special-status species (Table 4.3-7). Construction activities expected to affect bat habitat include the relocation of existing structures on Staten Island and work associated with the Miller's Ferry and New Hope bridges. These activities would result in the temporary loss of habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-31: Conduct Preconstruction Surveys for Bats.

Significance after Mitigation: Less than significant.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee

- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat as a result of implementing Alternative 2-B. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 2-B. The Project components included in this analysis are listed in Table 4-3.8.

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact. Table 4.3-8 summarizes the Project impacts on wildlife habitat by Project component. The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15.

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of 20.30 acres of riparian-associated wildlife habitat. This total is approximately 1 acre less than the impacts associated with Alternative 2-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Although several Alternative 2-B Project components provide the same function as those identified under 2-A, they are located on different parts of Staten Island. The Project components of Alternative 2-B are described in Chapter 2. The impact mechanisms on riparian vegetation would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Table 4.3-8. Summary of Impacts for Alternative 2-B—West Staten Detention

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	3.65	7.61	11.26
	Tideflat (mudflat)	0	0.04	0.04
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	0	0.04	0.04
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	1.39	0.00	1.39
	Seasonal freshwater emergent wetland	0	0.00	0
Lacustrine	Farm and borrow pit ponds	0.00	43.20	43.20
	Temporary agricultural ditch (<15 ft wide)	3.72	13.34	17.06
	Permanent agricultural ditch (>15 ft wide)	1.68	0.06	1.74
Valley/foothill riparian	Cottonwood-willow woodland	18.95	0.55	19.50
	Valley oak riparian woodland	0.00	0.00	0.00
	Himalayan blackberry	0.73	0.00	0.73
	Riparian scrub	0.03	0.04	0.07
	Mixed riparian woodland	0.00	0.00	0.00
	Nonnative riparian woodland	0.00	0.00	0.00
Grassland	Annual grassland	36.40	0.29	36.69
	Perennial grassland	0.00	0.00	0.00
	Ruderal/forb	67.78	6.93	74.71
Upland cropland	Corn and grain fields	179.70	1741.15	1920.85
Developed	Developed	30.30	8.82	39.12
Ornamental plantings	Ornamental plantings	4.04	3.34	7.38
	Totals	348.37	1825.41	2173.80

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of 0.04 acre of tidal freshwater emergent wetland–associated wildlife habitat. This total is slightly less than the impacts associated with Alternative 2-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on tidal freshwater emergent wetland habitat.

Although several Alternative 2-B Project components provide the same function as those identified under 2-A, they are located on different parts of Staten Island. The Project components of Alternative 2-B are described in Chapter 2. The impact mechanisms on tidal freshwater emergent wetland would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of 11.26 acres of tidal perennial aquatic–associated wildlife habitat. This total is approximately twice the impact associated with Alternative 2-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on tidal freshwater emergent wetland habitat.

Although several Alternative 2-B Project components provide the same function as those identified under 2-A, they are located on different parts of Staten Island. The Project components of Alternative 2-B are described in Chapter 2. The impact mechanisms on tidal perennial aquatic habitat would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss of 1.39 acres of nontidal freshwater emergent wetland–associated wildlife habitat. This total is approximately seven acres less than the impact associated with Alternative 2-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on nontidal freshwater emergent wetland habitat.

Although several of the Alternative 2-B Project components provide the same function as those identified under 2-A, they are located on different parts of Staten Island. The Project components of Alternative 2-B are described in Chapter 2. The impact mechanisms on nontidal freshwater emergent wetland habitat would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the permanent and temporary loss of agricultural land and ruderal habitat. Impact mechanisms are the same as those identified for Alternative 2-A.

The Project would result in the permanent loss of up to 179.70 acres and the temporary loss of 1,741.15 acres of agricultural land. Alternative 2-B would affect approximately 250 fewer acres than Alternative 2-A. The Project would result in the permanent loss of up to 104.18 acres and the temporary loss of 7.22 acres of ruderal habitat. Table 4.3-8 summarizes the effects of each Project component on agricultural land and ruderal habitat. Alternative 2-B would affect approximately 30 fewer acres than Alternative 2-A

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities.

This impact is the same as described under alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the permanent loss of 179.70 acres of agricultural land on Staten Island as a result of construction activities (Table 4.3-8). This action would result in the permanent loss of sandhill crane foraging habitat. Construction activities on Staten Island would have a relatively small direct impact on foraging habitat. Project operations, however, would affect 1,741.15 acres of agricultural land when the detention basin is inundated. This could have a substantial impact on foraging habitat because agricultural practices and crop rotation could be affected by prolonged inundation of the detention basin.

Construction activities that occur during the period when sandhill cranes are present in the study area (approximately September–February) could also result in temporary disturbance of roosting and foraging cranes or limit the availability of portions of Staten Island as roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

This impact is the same as described under alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss or disturbance of giant garter snake habitat (Table 4.3-8). Impact mechanisms potentially affecting giant garter snakes and habitat for this species are the same as those identified for Alternative 2-A.

Construction activities would affect 63.39 acres of giant garter snake aquatic habitat, including 6.79 acres of permanent impacts and 56.60 acres of temporary impacts. Construction activities also would affect an undetermined quantity of adjacent upland habitat. Impact mechanisms are similar to those identified for Alternative 2-A. These impacts are approximately 5 acres less than Alternative 2A. Operation of Alternative 2-B includes the inundation of West Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that giant garter snake overwintering in the detention basin would not survive.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss or disturbance of Swainson's hawk habitat (Table 4.3-8). Effects on Swainson's hawk include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Impact mechanisms are similar to those identified for Alternative 2-A.

The construction of Project components would result in the loss of 2,032.25 acres of foraging habitat—283.88 acres of permanent loss and 1,748.37 acres of temporary impacts. Operation of Alternative 2-B includes the inundation of West Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin during the spring months would result in the temporary loss of 1,748.37 acres of foraging habitat.

Nest removal and disturbance mechanisms are the same as those identified for Alternative 2-A. The construction of Project components would result in the loss of 20.30 acres of nesting habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

Implementation of Project components and Project operations associated with Alternative 2-B would result in the loss or disturbance of burrowing owl habitat (Table 4.3-8). Effects on burrowing owl include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Impact mechanisms are similar to those identified for Alternative 2-A.

Construction activities and Project operations would affect 111.40 acres of ruderal and grassland vegetation, including 104.18 acres of permanent impacts and 7.22 acres of temporary impacts. Alternative 2B would affect approximately 26 fewer acres than Alternative 2A.

Operation of Alternative 2-B includes the inundation of West Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that suitable nesting and roosting burrows would be inundated and could result in the loss of burrowing owls.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

This impact is the same as described under alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat.

This impact is the same as described under alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat

The implementation of Project components and Project operations associated with Alternative 2-B would be similar to those described in Alternative 2-A. The impact mechanisms would be the same as those identified for Alternative 2-A. Implementation of Project components and Project operations associated with Alternative 2-B would have effects on tricolored blackbird similar to those of Alternative 2-A.

Operation of Alternative 2-B includes the inundation of West Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin would result in the temporary loss of 1,741.15 acres of foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat.

The implementation of Project components and Project operations associated with Alternative 2-B would be similar to those described in Alternative 1-A. The impact mechanisms would be the same as those identified for Alternative 1-A. Implementation of Project components and Project operations associated with Alternative 2-B would have effects on California black rail habitat similar to those of Alternative 2-A.

Operation of Alternative 2-B includes the inundation of West Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the agricultural ditches on Staten Island would result in the temporary loss of 63.39 acres of roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

This impact is the same as described under alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries.

Mitigation Measure WILD-30: Replace Lost Breeding Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

Construction activities resulting in the loss or disturbance of agricultural land could result in loss or disturbance of Aleutian Canada goose wintering and foraging habitat. Impacts on agricultural land include 179.70 acres of permanent and 1,741.15 acres of temporary impacts.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-31: Conduct Preconstruction Surveys for Bats.

Significance after Mitigation: Less than significant.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat as a result of implementing Alternative 2-C. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 2-C. The Project components included in this analysis are listed in Table 4-3.9.

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact. Table 4.3-9 summarizes the Project impacts on wildlife habitat by Project component. The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15.

Table 4.3-9. Summary of Impacts for Alternative 2-C – East Staten Detention

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	0.84	4.34	5.18
	Tideflat (mudflat)	0.17	0.15	0.32
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	0.00	0.81	0.81
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	0.76	0.44	1.20
	Seasonal freshwater emergent wetland	1.35	5.53	6.88
Lacustrine	Farm and borrow pit ponds	0	43.20	43.20
	Temporary agricultural ditch (<15 ft wide)	1.91	9.54	11.45
	Permanent agricultural ditch (>15 ft wide)	0.78	0.01	0.79
Valley/foothill riparian	Cottonwood-willow woodland	19.71	3.92	23.63
	Valley oak riparian woodland	0.00	0.00	0.00
	Himalayan blackberry	0.00	0.00	0.00
	Riparian scrub	0.43	0.65	1.08
	Mixed riparian woodland	0.00	0.00	0.00
	Nonnative riparian woodland	0.00	0.00	0.00
Grassland	Annual grassland	33.28	0.00	33.28
	Perennial grassland	3.19	0.00	3.19
	Ruderal/forb	66.13	9.33	75.46
Upland cropland	Corn and grain fields	159.92	1648.15	1808.07
Developed	Developed	14.63	17.70	32.33
Ornamental plantings	Ornamental plantings	0.00	0.00	0.00
Totals		303.10	1743.77	2046.87

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss of 24.71 acres of riparian-associated wildlife habitat. This total is approximately 3.31 acres more than the impacts associated with Alternative 2-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Although several of the Alternative 2-C Project components provide the same function as those identified under 2-A or 2-B, they are located on different parts of Staten Island. The Project components of Alternative 2-C are described in Chapter 2. The impact mechanisms on riparian vegetation would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss of 0.81 acre of tidal freshwater emergent wetland–associated wildlife habitat. This total is slightly more than the impacts associated with Alternatives 2-A and 2-B. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on tidal freshwater emergent wetland habitat.

Although several of the Alternative 2-C Project components provide the same function as those identified under 2-A or 2-B, they are located on different parts of Staten Island. The Project components of Alternative 2-C are described in Chapter 2. The impact mechanisms on tidal freshwater emergent wetland would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss of 5.18 acres of tidal perennial aquatic–associated wildlife habitat. This total is similar to the impacts associated with Alternative 2-A and approximately half the amount of impact associated with Alternative 2B. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on tidal perennial aquatic habitat.

Although several of the Alternative 2-C Project components provide the same function as those identified under 2-A or 2-B, they are located on different parts of Staten Island. The Project components of Alternative 2-C are described in Chapter 2. The impact mechanisms on tidal perennial aquatic habitat would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss of 63.52 acres of nontidal freshwater emergent wetland–associated wildlife habitat. This total is similar to the impacts associated with Alternative 2-B and approximately 5 acres less than the impacts associated with Alternative 2-A. The tables in Attachment 4.1-1 summarize the permanent and temporary effects of each Project component and Project operations on nontidal freshwater emergent wetland habitat.

Although several of the Alternative 2-C Project components provide the same function as those identified under 2-A or 2-B, they are located on different parts of Staten Island. The Project components of Alternative 2-C are described in Chapter 2. The impact mechanisms on nontidal freshwater emergent wetland would be similar to those identified for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the permanent and temporary loss of agricultural land and ruderal habitat. The Project would result in the permanent loss of up to 159.92 acres and the temporary loss of 1648.15 acres of agricultural land. The Project would result in the permanent loss of up to 102.60 acres and the temporary loss of 9.33 acres of ruderal habitat. Table 4.3-9 summarizes the effects of each Project component on agricultural land and ruderal habitat.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species as a Result of Construction Activities.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the permanent loss of 159.92 acres of agricultural land on Staten Island as a result of construction activities (Table 4.3-9). This action would result in the permanent loss of sandhill crane foraging habitat. Construction activities on Staten Island would have a relatively small direct impact on foraging habitat. Project operations, however, would affect 1,648.15 acres of agricultural land when the detention basin is inundated. This could have a substantial impact on foraging habitat because agricultural practices and crop rotation could be affected by prolonged inundation of the detention basin.

Construction activities that occur during the period when sandhill cranes are present in the study area (approximately September–February) could also result in temporary disturbance of roosting and foraging cranes or limit the availability of portions of Staten Island as roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake.

Construction activities would affect 63.52 acres of giant garter snake aquatic habitat, including 4.80 acres of permanent impacts and 57.72 acres of temporary impacts. Construction activities also would affect an undetermined quantity of adjacent upland habitat. Impact mechanisms are similar to those identified for Alternative 2-A. These impacts are similar to those associated with Alternatives 2A and 2B. Operation of Alternative 2-C includes the inundation of East Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that giant garter snake overwintering in the detention basin would not survive.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss or disturbance of Swainson's hawk habitat (Table 4.3-9). Effects on Swainson's hawk include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Impact mechanisms are similar to those identified for Alternative 2-A.

The construction of Project components would result in the loss of 1,919.90 acres of foraging habitat, including 262.52 acres of permanent impacts and 1,657.48 acres of temporary impacts. Operation of Alternative 2-C includes the inundation of East Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin during the spring months would result in the temporary loss of 1,657.48 acres of foraging habitat.

Nest removal and disturbance mechanisms are the same as those identified for Alternative 1-A. The construction of Project components would result in the loss of 23.63 acres of nesting habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

Implementation of Project components and Project operations associated with Alternative 2-C would result in the loss or disturbance of burrowing owl habitat (Table 4.3-9). Effects on burrowing owl include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Impact mechanisms are similar to those identified for Alternative 2-A.

Construction activities and Project operations would affect 111.93 acres of ruderal and grassland vegetation—102.60 acres would experience permanent impacts and 9.33 acres would experience temporary impacts. Alternative 2C would affect approximately 26 acres less than Alternative 2A and would affect an amount of habitat similar to Alternative 2B.

Operation of Alternative 2-C includes the inundation of East Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. For the purpose of this evaluation, it is assumed that suitable nesting and roosting burrows would be inundated and could result in the loss of burrowing owls.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat.

The implementation of Project components and Project operations associated with Alternative 2-C would be similar to those described in Alternative 2-A. The impact mechanisms would be the same as those identified for Alternative 2-A. Implementation of Project components and Project operations associated with Alternative 2-C would have effects on tricolored blackbird similar to those of Alternative 2-A.

Operation of Alternative 2-C includes the inundation of East Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the detention basin would result in the temporary loss of 1,657.48 acres of foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat

The implementation of Project components and Project operations associated with Alternative 2-C would be similar to those described in Alternative 1-A. The impact mechanisms would be the same as those identified for Alternative 1-A. Implementation of Project components and Project operations associated with

Alternative 2-C would have effects on California black rail habitat similar to those of Alternatives 2-A and 2-B. Operation of Alternative 2-C includes the inundation of East Staten detention basin as a result of seasonal inundation during high-flow events in the Mokelumne River. Inundation of the agricultural ditches on Staten Island would result in the temporary loss of 63.52 acres of roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries.

Mitigation Measure WILD-30: Replace Lost Breeding Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

Construction activities resulting in the loss or disturbance of agricultural land could result in loss or disturbance of Aleutian Canada goose wintering and foraging habitat. Impacts on agricultural land include 159.92 acres of permanent impacts and 1,648.15 acres of temporary impacts.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-20: Loss or Disturbance of Bats and Bat Habitat as a Result of Construction Activities.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-31: Conduct Preconstruction Surveys for Bats.

Significance after Mitigation: Less than significant.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

This section summarizes the analysis of Project-related effects on wildlife and wildlife habitat as a result of implementing Alternative 2-D. The alternative analysis includes a discussion of effects resulting from the construction and operation of Alternative 2-D. The Project components included in this analysis are listed in Table 4-3.10.

The following sections address both species impacts and wildlife habitat impacts. Wildlife habitat impacts may affect all species, including special-status species and common wildlife species, whereas species impacts focus on specific special-status species. Mitigation measures were developed for both habitat and species impacts. A mitigation measure may apply to more than one impact. Table 4.3-10 summarizes the Project impacts on wildlife habitat by Project component.

Table 4.3-10. Summary of Impacts for Alternative 2-D

		Permanent Effects	Temporary Effects	Total
Tidal perennial aquatic habitat	Tidal aquatic	13.35	366.47	379.82
	Tideflat (mudflat)	3.42	0.00	3.42
Tidal freshwater emergent marsh habitat	Tidal freshwater emergent wetland	16.40	0.00	16.40
Nontidal freshwater emergent wetland	Perennial freshwater emergent wetland	0.00	0.29	0.29
	Seasonal freshwater emergent wetland	0.00	1.67	1.67
Lacustrine	Farm and borrow pit ponds	0.00	0.00	0.00
	Temporary agricultural ditch (<15 ft wide)	0.00	3.02	3.02
	Permanent agricultural ditch (>15 ft wide)	0.00	0.34	0.34
Valley/foothill riparian	Cottonwood-willow woodland	21.95	0.00	21.95
	Valley oak riparian woodland	1.77	0.43	2.20
	Himalayan blackberry	5.40	3.29	8.69
	Riparian scrub	29.72	31.93	61.65
	Mixed riparian woodland	18.99	2.56	21.55
	Nonnative riparian woodland	0.29	0.00	0.29
Grassland	Annual grassland	0.00	0.00	0.00
	Perennial grassland	3.17	1.46	4.63
	Ruderal/forb	159.57	88.69	248.26
Upland cropland	Corn and grain fields	18.35	88.05	106.40
Developed	Developed	0.60	7.33	7.93
Ornamental plantings	Ornamental plantings	1.54	0.48	2.02
Unknown[1]		12.01	20.43	32.44
Totals		306.53	616.44	922.97

[1] Land cover type mapping has not been performed within the entire footprint of the affected areas.

The permanent and temporary land cover type impacts, by Project component, are summarized in Attachment 4.1-1 and shown on Figures 4.1-2 through 4.1-15.

Impact WILD-1: Loss of Riparian-Associated Wildlife Habitat.

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the loss of riparian-associated wildlife habitat. These actions would result in the permanent and temporary loss of up to 116.33 acres of riparian habitat, including 45.99 acres of riparian woodland and 70.34 acres of riparian scrub habitat. Table 4.3-10 summarizes the permanent and temporary effects of each Project component and Project operations on riparian habitat.

Impacts on riparian vegetation resulting from implementation of Project components may include the complete removal of trees and shrubs, limb pruning, and disruption of the root zone as a result of ground-disturbing activities. Impacts on riparian vegetation resulting from channel dredging are described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-2: Loss of Tidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the permanent loss of up to 16.40 acres of tidal freshwater emergent wetland habitat. Impact mechanisms are similar to those described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Significance after Mitigation: Less than significant.

Impact WILD-3: Loss or Disturbance of Tidal Perennial Aquatic–Associated Wildlife Habitat.

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the permanent and temporary loss of up to 379.82 acres of tidal perennial aquatic habitat. The Project would result in the permanent loss of up to 13.35 acres and the temporary loss of 366.47 acres of tidal perennial aquatic habitat. Impact mechanisms are similar to those described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-4: Loss or Disturbance of Nontidal Freshwater Emergent Wetland–Associated Wildlife Habitat.

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the permanent and temporary loss of up to 1.96 acres of nontidal freshwater emergent wetland habitat. Impact mechanisms are similar to those described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-5: Loss of Agricultural Land and Ruderal-Associated Wildlife Habitat.

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the loss of 106.40 acres of agricultural land and 252.89 acres of ruderal habitat. The Project would result in the permanent loss of up to 18.35 acres and the temporary loss of 88.05 acres of agricultural land. The Project would result in the permanent loss of up to 162.74 acres and the temporary loss of 90.15 acres of ruderal habitat. Impact mechanisms are similar to those described under Alternative 2-A.

Impacts on agricultural land and ruderal habitat may include the loss or disturbance of habitat as a result of ground-disturbing activities and the inundation of these habitats as a result of Project operations. The effect on common and special-status wildlife species from loss of this agricultural land and ruderal habitat is considered less than significant because these land cover types are common in the Project area. Potential effects on special-status species from the loss of agricultural land and ruderal habitat, and associated mitigation measures, are described below under the sections related to individual species.

Determination of Significance: Less than significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Impact WILD-6: Temporary Disturbance and Possible Mortality of Common Wildlife Species.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-7: Potential Effects on Greater Sandhill Crane as a Result of Loss of Agricultural Lands.

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the permanent loss of 106.40 acres of agricultural land on Staten Island as a result of construction activities (Table 4.3-10). This action would result in the permanent loss of 18.35 acres of sandhill crane foraging habitat. Construction activities on Staten Island would have a relatively small direct impact on foraging habitat.

Construction activities that occur during the period when sandhill cranes are present in the study area (approximately September–February) could also result in temporary disturbance of roosting and foraging cranes or limit the availability of portions of Staten Island as roosting and foraging habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-7: Compensate for the Loss of Greater Sandhill Crane Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-8: Potential Effects on Valley Elderberry Longhorn Beetle.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure WILD-8: Perform Preconstruction and Postconstruction Surveys for Elderberry Shrubs.

Mitigation Measure WILD-9: Avoid and Minimize Impacts on Elderberry Shrubs.

Mitigation Measure WILD-10: Compensate for Unavoidable Impacts on Elderberry Shrubs.

Significance after Mitigation: Less than significant.

Impact WILD-9: Potential Effects on Giant Garter Snake

Implementation of channel dredging and levee modifications associated with Alternative 2-D would result in the loss or disturbance of giant garter snake habitat (Table 4.3-10). Impact mechanisms are similar to those described under Alternative 1-A.

Construction activities would affect 1.96 acres of nontidal wetland habitat. Construction activities also would affect an undetermined quantity of adjacent upland habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-11: Conduct Preconstruction Surveys for Giant Garter Snake.

Mitigation Measure WILD-12: Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-10: Loss or Disturbance of Swainson's Hawk Nests or Foraging Habitat

Implementation of channel dredging and levee modifications associated with Alternative 2-D could result in the loss or disturbance of Swainson's hawk habitat (Table 4.3-10). Impact mechanisms are similar to those described under Alternative 1-A.

Channel dredging and levee modifications would result in the loss of 359.29 acres of foraging habitat, 181.09 acres of which would be permanently affected, and 178.20 acres of which would experience temporary impacts.

Nest removal and disturbance mechanisms are the same as those identified for Alternative 1-A. The construction of Project components would result in the loss of 45.99 acres of nesting habitat.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-13: Perform Preconstruction Surveys for Nesting Swainson's Hawks before Construction and Maintenance.

Mitigation Measure WILD-14: Avoid and Minimize Construction-Related Disturbances within ½ Mile of Active Swainson's Hawk Nest Sites.

Mitigation Measure WILD-15: Replace or Compensate for the Loss of Swainson's Hawk Foraging Habitat.

Mitigation Measure WILD-16: Avoid Removal of Occupied Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-11: Loss or Disturbance of Nesting or Wintering Western Burrowing Owls.

Implementation of Project components and Project operations associated with Alternative 2-D would result in the loss or disturbance of burrowing owl habitat (Table 4.3-10). Effects on burrowing owl include the loss or disturbance of active nests and the loss or disturbance of foraging habitat. Impact mechanisms are similar to those identified for Alternative 1-A.

Construction activities and Project operations would affect 252.89 acres of ruderal and grassland vegetation, 162.74 acres of which would be permanently affected and 90.15 acres of which would experience temporary impacts.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-17: Conduct Preconstruction Surveys for Burrowing Owls.

Mitigation Measure WILD-18: Minimize Construction-Related Disturbances near Occupied Nest Sites.

Mitigation Measure WILD-19: Avoid or Minimize Disturbance to Active Nest and Roost Sites.

Mitigation Measure WILD-20: Create New or Enhance Existing Suitable Burrows.

Mitigation Measure WILD-21: Replace Lost Burrowing Owl Foraging Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-12: Loss or Disturbance of Raptor Nest Sites.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Significance after Mitigation: Less than significant.

Impact WILD-13: Loss of Western Pond Turtle or Suitable Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-5: Compensate for Loss of Tidal Perennial Aquatic Habitat.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-22: Avoid and Minimize Construction-Related Disturbances in the Vicinity of Occupied Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-14: Loss of Tricolored Blackbirds or Suitable Nesting Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-23: Conduct Preconstruction Surveys for Tricolored Blackbird.

Mitigation Measure WILD-24: Minimize Construction-Related Disturbances in the Vicinity of Active Tricolored Blackbird Colonies.

Significance after Mitigation: Less than significant.

Impact WILD-15: Loss or Disturbance of California Black Rail or Suitable Nesting Habitat.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-4: Implement Mitigation Measure VEG-3, Replace Nontidal Freshwater Emergent Wetland Cover.

Mitigation Measure WILD-6: Replace Nontidal Wetland Land Cover Types.

Mitigation Measure WILD-25: Conduct Preconstruction Surveys for California Black Rail.

Mitigation Measure WILD-26: Minimize Construction-Related Disturbances in the Vicinity of Active California Black Rail Nest Sites.

Significance after Mitigation: Less than significant.

Impact WILD-16: Loss or Disturbance of Colonial Waterbird Rookeries.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-1: Implement Mitigation Measure VEG-1, as described in Section 4.1, Replace Valley/Foothill Riparian Cover Types.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Mitigation Measure WILD-27: Conduct Preconstruction Surveys to Locate Rookeries.

Mitigation Measure WILD-28: Minimize Construction-Related Disturbances within ¼ Mile of Active Rookeries.

Mitigation Measure WILD-29: Avoid Removal of Occupied Rookeries.

Mitigation Measure WILD-30: Replace Lost Breeding Habitat.

Significance after Mitigation: Less than significant.

Impact WILD-17: Loss or Disturbance of Aleutian Canada Goose.

Construction activities resulting in the loss or disturbance of agricultural land could result in loss or disturbance of Aleutian Canada goose wintering and foraging habitat. Impacts on agricultural land include 18.35 acres of permanent and 88.05 acres of temporary impacts.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-18: Loss or Disturbance of Wintering Bald Eagle.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact WILD-19: Loss or Disturbance of Migratory Birds.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure WILD-2: Avoid and Minimize Effects on Nesting Birds during Construction and Maintenance.

Mitigation Measure WILD-3: Minimize Impacts on Sensitive Biological Resources.

Significance after Mitigation: Less than significant.

Attachment 4.3-1

Federal Endangered and Threatened Species List

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species
that Occur in or may be Affected by Projects in the
THORNTON (479B)
U.S.G.S. 7 1/2 Minute Quad

Database Last Updated: December 23, 2005

Document Number: 060130052308

Listed Species

Invertebrates

Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus - Critical habitat, delta smelt (X)
Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T)
Oncorhynchus mykiss - Critical habitat, Central Valley steelhead (X)
Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)
Oncorhynchus tshawytscha - Critical Habitat, Central Valley spring-run chinook (X)
Oncorhynchus tshawytscha - winter-run chinook salmon, Sacramento River (E)

Amphibians

Ambystoma californiense - California tiger salamander, central pppulation (T)
Rana aurora draytonii - California red-legged frog (T)

Reptiles

Thamnophis gigas - giant garter snake (T)

Birds

Haliaeetus leucocephalus - bald eagle (T)

Proposed Species

Fish

Acipenser medirostris - green sturgeon (P)

Candidate Species

Fish

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)

Species of Concern

Invertebrates

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)
Branchinecta mesovallensis - Midvalley fairy shrimp (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish

Lampetra ayresi - river lamprey (SC)
Lampetra hubbsi - Kern brook lamprey (SC)
Lampetra tridentata - Pacific lamprey (SC)
Pogonichthys macrolepidotus - Sacramento splittail (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians

Rana boylii - foothill yellow-legged frog (SC)
Spea hammondii (was Scaphiopus h.) - western spadefoot toad (SC)

Reptiles

Anniella pulchra pulchra - silvery legless lizard (SC)
Clemmys marmorata marmorata - northwestern pond turtle (SC)
Clemmys marmorata pallida - southwestern pond turtle (SC)

Birds

Agelaius tricolor - tricolored blackbird (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Baeolophus inornatus - oak titmouse (SLC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Charadrius montanus - mountain plover (SC)
Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Grus canadensis tabida - greater sandhill crane (CA)
Lanius ludovicianus - loggerhead shrike (SC)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Riparia riparia - bank swallow (CA)
Selasphorus rufus - rufous hummingbird (SC)

Mammals

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Eumops perotis californicus - greater western mastiff-bat (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)

Plants

Aster lentus - Suisun Marsh aster (SC) ✓
Lathyrus jepsonii var. jepsonii - delta tule-pea (SC) ✓
Lilaeopsis masonii - Mason's lilaeopsis (SC) ✓

Key:

(E) *Endangered* - Listed (in the Federal Register) as being in danger of extinction.
(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
(P) *Proposed* - Officially proposed (in the Federal Register) for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Marine Fisheries Service. Consult with them directly about these species.
Critical Habitat - Area essential to the conservation of a species.
(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
(C) *Candidate* - Candidate to become a proposed species.
(CA) Listed by the State of California but not by the Fish & Wildlife Service.
(D) *Delisted* - Species will be monitored for 5 years.
(SC) *Species of Concern*/(SLC) Species of Local Concern - Other species of concern to the Sacramento Fish & Wildlife Office.
(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, or may be affected by projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regard-less of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the quad or quads covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the nine surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

State-Listed Species

If a species has been listed as threatened or endangered by the State of California, but not by us nor by the National Marine Fisheries Service, it will appear on your list as a Species of Concern. However you should contact the California Department of Fish and Game Wildlife and Habitat Data Analysis Branch for official information about these species.

Your Responsibilities Under the Endangered Species Act

All plants and animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compen-sates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our critical habitat page for maps.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

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Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6580.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed, candidate and special concern species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. In this case, that would be April 30, 2006.

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species
that Occur in or may be Affected by Projects in the
ISLETON (480A)
U.S.G.S. 7 1/2 Minute Quad

Database Last Updated: December 23, 2005

Document Number: 060130052423

Listed Species

Invertebrates

Branchinecta conservatio - Conservancy fairy shrimp (E)
Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Elaphrus viridis - delta green ground beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus - Critical habitat, delta smelt (X)
Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T)
Oncorhynchus mykiss - Critical habitat, Central Valley steelhead (X)
Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)
Oncorhynchus tshawytscha - Critical Habitat, Central Valley spring-run chinook (X)
Oncorhynchus tshawytscha - Critical habitat, winter-run chinook salmon (X)
Oncorhynchus tshawytscha - winter-run chinook salmon, Sacramento River (E)

Amphibians

Ambystoma californiense - California tiger salamander, central pppulation (T)
Rana aurora draytonii - California red-legged frog (T)

Reptiles

Thamnophis gigas - giant garter snake (T)

Birds

Haliaeetus leucocephalus - bald eagle (T)
Rallus longirostris obsoletus - California clapper rail (E)

Proposed Species

Fish

Acipenser medirostris - green sturgeon (P)

Candidate Species

Fish

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)
Oncorhynchus tshawytscha - Critical habitat, Central Valley fall/late fall-run chinook (C)

Species of Concern

Invertebrates

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)
Branchinecta mesovallensis - Midvalley fairy shrimp (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish

Lampetra ayresi - river lamprey (SC)
Lampetra tridentata - Pacific lamprey (SC)
Pogonichthys macrolepidotus - Sacramento splittail (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians

Spea hammondii (was Scaphiopus h.) - western spadefoot toad (SC)

Reptiles

Clemmys marmorata marmorata - northwestern pond turtle (SC)

Birds

Agelaius tricolor - tricolored blackbird (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Baeolophus inornatus - oak titmouse (SLC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Charadrius montanus - mountain plover (SC)
Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Grus canadensis tabida - greater sandhill crane (CA)
Lanius ludovicianus - loggerhead shrike (SC)
Laterallus jamaicensis coturniculus - black rail (CA)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Riparia riparia - bank swallow (CA)
Selasphorus rufus - rufous hummingbird (SC)
Selasphorus sasin - Allen's hummingbird (SC)

Mammals

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Eumops perotis californicus - greater western mastiff-bat (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)
Neotoma fuscipes annectens - San Francisco dusky-footed woodrat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)

Plants

Aster lentus - Suisun Marsh aster (SC) ✓
Lilaeopsis masonii - Mason's lilaeopsis (SC) ✓

Key:

(E) *Endangered* - Listed (in the Federal Register) as being in danger of extinction.
(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
(P) *Proposed* - Officially proposed (in the Federal Register) for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Marine Fisheries Service. Consult with them directly about these species.
Critical Habitat - Area essential to the conservation of a species.
(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
(C) *Candidate* - Candidate to become a proposed species.
(CA) Listed by the State of California but not by the Fish & Wildlife Service.
(D) *Delisted* - Species will be monitored for 5 years.
(SC) *Species of Concern*/(SLC) Species of Local Concern - Other species of concern to the Sacramento Fish & Wildlife Office.
(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, or may be affected by projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regard-less of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the quad or quads covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the nine surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

State-Listed Species

If a species has been listed as threatened or endangered by the State of California, but not by us nor by the National Marine Fisheries Service, it will appear on your list as a Species of Concern.

However you should contact the California Department of Fish and Game Wildlife and Habitat Data Analysis Branch for official information about these species.

Your Responsibilities Under the Endangered Species Act

All plants and animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compen-sates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our critical habitat page for maps.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

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Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6580.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed, candidate and special concern species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. In this case, that would be April 30, 2006.

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species
that Occur in or may be Affected by Projects in the
BOULDIN ISLAND (480D)
U.S.G.S. 7 1/2 Minute Quad

Database Last Updated: December 23, 2005

Document Number: 060130052514

Listed Species

Invertebrates

Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus - Critical habitat, delta smelt (X)
Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T)
Oncorhynchus mykiss - Critical habitat, Central Valley steelhead (X)
Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)
Oncorhynchus tshawytscha - Critical habitat, winter-run chinook salmon (X)
Oncorhynchus tshawytscha - winter-run chinook salmon, Sacramento River (E)

Amphibians

Ambystoma californiense - California tiger salamander, central pppulation (T)
Rana aurora draytonii - California red-legged frog (T)

Reptiles

Thamnophis gigas - giant garter snake (T)

Birds

Haliaeetus leucocephalus - bald eagle (T)
Rallus longirostris obsoletus - California clapper rail (E)

Proposed Species

Fish

Acipenser medirostris - green sturgeon (P)

Candidate Species

Fish

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)
Oncorhynchus tshawytscha - Critical habitat, Central Valley fall/late fall-run chinook (C)

Species of Concern

Invertebrates

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)

Branchinecta mesovallensis - Midvalley fairy shrimp (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish

Lampetra ayresi - river lamprey (SC)
Lampetra tridentata - Pacific lamprey (SC)
Pogonichthys macrolepidotus - Sacramento splittail (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians

Spea hammondii (was Scaphiopus h.) - western spadefoot toad (SC)

Reptiles

Anniella pulchra pulchra - silvery legless lizard (SC)
Clemmys marmorata marmorata - northwestern pond turtle (SC)
Clemmys marmorata pallida - southwestern pond turtle (SC)
Phrynosoma coronatum frontale - California horned lizard (SC)

Birds

Agelaius tricolor - tricolored blackbird (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Baeolophus inornatus - oak titmouse (SLC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Calypte costae - Costa's hummingbird (SC)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Charadrius montanus - mountain plover (SC)
Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Grus canadensis tabida - greater sandhill crane (CA)
Lanius ludovicianus - loggerhead shrike (SC)
Laterallus jamaicensis coturniculus - black rail (CA)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Riparia riparia - bank swallow (CA)
Selasphorus rufus - rufous hummingbird (SC)
Selasphorus sasin - Allen's hummingbird (SC)
Toxostoma redivivum - California thrasher (SC)

Mammals

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Eumops perotis californicus - greater western mastiff-bat (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)

Neotoma fuscipes annectens - San Francisco dusky-footed woodrat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)

Plants

Aster lentus - Suisun Marsh aster (SC) ✓
Lathyrus jepsonii var. jepsonii - delta tule-pea (SC) ✓
Lilaeopsis masonii - Mason's lilaeopsis (SC) ✓

Key:

(E) *Endangered* - Listed (in the Federal Register) as being in danger of extinction.
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Plants

Any plants on your list are ones that have actually been observed in the quad or quads covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the nine surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

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Critical Habitat

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Candidate Species

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Species of Concern

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Wetlands

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Updates

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Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species
that Occur in or may be Affected by Projects in the
TERMINOUS (479C)
U.S.G.S. 7 1/2 Minute Quad

Database Last Updated: December 23, 2005

Document Number: 060130052554

Listed Species

Invertebrates

Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus - Critical habitat, delta smelt (X)
Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T)
Oncorhynchus mykiss - Critical habitat, Central Valley steelhead (X)
Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)
Oncorhynchus tshawytscha - winter-run chinook salmon, Sacramento River (E)

Amphibians

Ambystoma californiense - California tiger salamander, central pppulation (T)
Rana aurora draytonii - California red-legged frog (T)

Reptiles

Thamnophis gigas - giant garter snake (T)

Birds

Haliaeetus leucocephalus - bald eagle (T)

Proposed Species

Fish

Acipenser medirostris - green sturgeon (P)

Candidate Species

Fish

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)

Species of Concern

Invertebrates

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)
Branchinecta mesovallensis - Midvalley fairy shrimp (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish

Lampetra ayresi - river lamprey (SC)
Lampetra hubbsi - Kern brook lamprey (SC)
Lampetra tridentata - Pacific lamprey (SC)
Pogonichthys macrolepidotus - Sacramento splittail (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians

Spea hammondii (was Scaphiopus h.) - western spadefoot toad (SC)

Reptiles

Anniella pulchra pulchra - silvery legless lizard (SC)
Clemmys marmorata marmorata - northwestern pond turtle (SC)
Clemmys marmorata pallida - southwestern pond turtle (SC)
Phrynosoma coronatum frontale - California horned lizard (SC)

Birds

Agelaius tricolor - tricolored blackbird (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Charadrius montanus - mountain plover (SC)
Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Grus canadensis tabida - greater sandhill crane (CA)
Lanius ludovicianus - loggerhead shrike (SC)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Selasphorus rufus - rufous hummingbird (SC)
Toxostoma redivivum - California thrasher (SC)

Mammals

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Eumops perotis californicus - greater western mastiff-bat (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)

Plants

Aster lentus - Suisun Marsh aster (SC)
Lathyrus jepsonii var. jepsonii - delta tule-pea (SC)
Lilaeopsis masonii - Mason's lilaeopsis (SC)

Key:

(E) *Endangered* - Listed (in the Federal Register) as being in danger of extinction.
(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
(P) *Proposed* - Officially proposed (in the Federal Register) for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Marine Fisheries Service. Consult with them directly about these species.
Critical Habitat - Area essential to the conservation of a species.
(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
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(D) *Delisted* - Species will be monitored for 5 years.
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(X) *Critical Habitat* designated for this species

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All plants and animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

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Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

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Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6580.

Updates

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Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species
that Occur in or may be Affected by Projects in the
BRUCEVILLE (496C)
U.S.G.S. 7 1/2 Minute Quad

Database Last Updated: December 23, 2005

Document Number: 060130053157

Listed Species

Invertebrates

Branchinecta lynchi - vernal pool fairy shrimp (T)
Desmocerus californicus dimorphus - valley elderberry longhorn beetle (T)
Lepidurus packardi - vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus - Critical habitat, delta smelt (X)
Hypomesus transpacificus - delta smelt (T)
Oncorhynchus mykiss - Central Valley steelhead (T)
Oncorhynchus mykiss - Critical habitat, Central Valley steelhead (X)
Oncorhynchus tshawytscha - Central Valley spring-run chinook salmon (T)
Oncorhynchus tshawytscha - winter-run chinook salmon, Sacramento River (E)

Amphibians

Ambystoma californiense - California tiger salamander, central pppulation (T)
Rana aurora draytonii - California red-legged frog (T)

Reptiles

Thamnophis gigas - giant garter snake (T)

Birds

Haliaeetus leucocephalus - bald eagle (T)

Proposed Species

Fish

Acipenser medirostris - green sturgeon (P)

Candidate Species

Fish

Oncorhynchus tshawytscha - Central Valley fall/late fall-run chinook salmon (C)
Oncorhynchus tshawytscha - Critical habitat, Central Valley fall/late fall-run chinook (C)

Species of Concern

Invertebrates

Anthicus antiochensis - Antioch Dunes anthicid beetle (SC)
Anthicus sacramento - Sacramento anthicid beetle (SC)
Branchinecta mesovallensis - Midvalley fairy shrimp (SC)
Linderiella occidentalis - California linderiella fairy shrimp (SC)

Fish

Lampetra ayresi - river lamprey (SC)
Lampetra hubbsi - Kern brook lamprey (SC)
Lampetra tridentata - Pacific lamprey (SC)
Pogonichthys macrolepidotus - Sacramento splittail (SC)
Spirinchus thaleichthys - longfin smelt (SC)

Amphibians

Rana boylii - foothill yellow-legged frog (SC)
Spea hammondii (was Scaphiopus h.) - western spadefoot toad (SC)

Reptiles

Clemmys marmorata marmorata - northwestern pond turtle (SC)
Phrynosoma coronatum frontale - California horned lizard (SC)

Birds

Agelaius tricolor - tricolored blackbird (SC)
Athene cunicularia hypugaea - western burrowing owl (SC)
Baeolophus inornatus - oak titmouse (SLC)
Branta canadensis leucopareia - Aleutian Canada goose (D)
Buteo regalis - ferruginous hawk (SC)
Buteo Swainsoni - Swainson's hawk (CA)
Carduelis lawrencei - Lawrence's goldfinch (SC)
Chaetura vauxi - Vaux's swift (SC)
Charadrius montanus - mountain plover (SC)
Elanus leucurus - white-tailed (=black shouldered) kite (SC)
Empidonax traillii brewsteri - little willow flycatcher (CA)
Falco peregrinus anatum - American peregrine falcon (D)
Grus canadensis tabida - greater sandhill crane (CA)
Lanius ludovicianus - loggerhead shrike (SC)
Limosa fedoa - marbled godwit (SC)
Melanerpes lewis - Lewis' woodpecker (SC)
Numenius americanus - long-billed curlew (SC)
Picoides nuttallii - Nuttall's woodpecker (SLC)
Plegadis chihi - white-faced ibis (SC)
Riparia riparia - bank swallow (CA)
Selasphorus rufus - rufous hummingbird (SC)

Mammals

Corynorhinus (=Plecotus) townsendii townsendii - Pacific western big-eared bat (SC)
Myotis ciliolabrum - small-footed myotis bat (SC)
Myotis volans - long-legged myotis bat (SC)
Myotis yumanensis - Yuma myotis bat (SC)
Perognathus inornatus - San Joaquin pocket mouse (SC)

Plants

Lathyrus jepsonii var. jepsonii - delta tule-pea (SC)
Lilaeopsis masonii - Mason's lilaeopsis (SC)

Key:

(E) *Endangered* - Listed (in the Federal Register) as being in danger of extinction.
(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.
(P) *Proposed* - Officially proposed (in the Federal Register) for listing as endangered or threatened.
(NMFS) Species under the Jurisdiction of the National Marine Fisheries Service. Consult with them directly about these species.
Critical Habitat - Area essential to the conservation of a species.
(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.
(C) *Candidate* - Candidate to become a proposed species.
(CA) Listed by the State of California but not by the Fish & Wildlife Service.
(D) *Delisted* - Species will be monitored for 5 years.
(SC) *Species of Concern*/(SLC) Species of Local Concern - Other species of concern to the Sacramento Fish & Wildlife Office.
(X) *Critical Habitat* designated for this species

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Attachment 4.3-2

Common and Scientific Species Names

Attachment 4.3-2

Common and Scientific Species Names

Wildlife Discussed in This Report

Common Name	Scientific Name
Birds	
American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Black-crowned night-heron	*Nycticorax nycticorax*
Snowy egret	*Egretta thula*
White-faced ibis	*Plegadis chihi*
Tundra swan	*Cygnus columbianus*
Greater white-fronted goose	*Anser albifrons*
Aleutian Canada goose	*Branta canadensis leucoparia*
Canada goose	*Branta canadensis*
Snow goose	*Chen caerulescens*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
American wigeon	*Anas americana*
Northern shoveler	*Anas clypeata*
Cinnamon teal	*Anas cyanoptera*
Green-winged teal	*Anas crecca*
Gadwall	*Anas strepera*
Greater scaup	*Aythya marila*
Lesser scaup	*Aythya affinis*
Redhead	*Aythya americana*
Canvasback	*Aythya valisineria*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
Ruddy duck	*Oxyura jamaicensis*
Ring-necked duck	*Aythya collaris*
Bald eagle	*Haliaeetus leucocephalus*
Cooper’s hawk	*Accipiter cooperii*
Red-shouldered hawk	*Buteo lineatus*
Red-tailed hawk	*Buteo jamaicensis*
Ferruginous hawk	*Buteo regalis*

Common Name	Scientific Name
Rough-legged hawk	*Buteo lagopus*
Swainson’s hawk	*Buteo swainsoni*
American peregrine falcon	*Falco peregrinus*
Osprey	*Pandion haliaetus*
Northern harrier	*Circus cyaneus*
American kestrel	*Falco sparverius*
White-tailed kite	*Elanus leucurus*
California quail	*Callipepla californica*
Sora	*Porzana carolina*
American coot	*Fulica americana*
Common moorhen	*Gallinula chloropus*
California black rail	*Laterallus jamaicensis coturniculus*
Virginia rail	*Rallus limicola*
Greater sandhill crane	*Grus canadensis*
Killdeer	*Charadrius vociferus*
Wilson’s snipe	*Gallinago delicata*
Dunlin	*Calidris alpina*
Western sandpiper	*Calidris mauri*
Least sandpiper	*Calidris minutilla*
Black-necked stilts	*Himantopus mexicanus*
Avocet	*Recurvirostra americana*
Greater yellowlegs	*Tringa melanoleuca*
Long-billed curlew	*Numenius americanus*
Long-billed dowitcher	*Limnodromus scolopaceus*
Mourning dove	*Zenaida macroura*
Long-eared owl	*Asio otus*
Short-eared owl	*Asio flammeus*
Western burrowing owl	*Athene cunicularia hypugea*
Anna’s hummingbird	*Calypte anna*
Rufous hummingbird	*Selasphorus rufus*
Downy woodpecker	*Picoides pubescens*
Black phoebe	*Sayornis nigricans*
Ash-throated flycatcher	*Myiarchus cinerascens*
Willow flycatcher	*Empidonax traillii*
Western kingbird	*Tyrannus verticalis*
California horned lark	*Eremophila alpestris actia*
Horned lark	*Eremophila alpestris*
Purple martin	*Progne subis*
Bank swallow	*Riparia riparia*
Violet-green swallow	*Tachycineta thalassina*
Western scrub-jay	*Aphelocoma californica*
Yellow-billed magpie	*Pica nuttalli*
American crow	*Corvus brachyrhynchos*
Bushtit	*Psaltriparus minimus*

Common Name	Scientific Name
Oak titmouse	*Baeolophus inornatus*
Bewick's wren	*Thryomanes bewickii*
House wren	*Troglodytes aedon*
Ruby-crowned kinglet	*Regulus calendula*
Western bluebird	*Sialia mexicana*
American robin	*Turdus migratorius*
American pipit	*Anthus rubescens*
Loggerhead shrike	*Lanius ludovicianus*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermivora celata*
Yellow-rumped warbler	*Dendroica coronata*
Yellow warbler	*Dendroica petechia*
Yellow-breasted chat	*Icteria virens*
Lazuli bunting	*Passerina amoena*
Black-headed grosbeak	*Pheucticus melanocephalus*
California towhee	*Pipilo crissalis*
Spotted towhee	*Pipilo maculatus*
Lark sparrow	*Chondestes grammacus*
Modesto song sparrow	*Melospiza melodia mailliardi*
Song sparrow	*Melospiza melodia*
Golden-crowned sparrow	*Zonotrichia atricapilla*
White-crowned sparrow	*Zonotrichia leucophrys*
Brewer's blackbird	*Euphagus cyanocephalus*
Tricolored blackbird	*Agelaius tricolor*
Red-winged blackbird	*Agelaius phoeniceus*
Western meadowlark	*Sturnella neglecta*
Brown-headed cowbird	*Molothrus ater*
Bullock's oriole	*Icterus bullockii*
House finch	*Carpodacus mexicanus*
Lesser goldfinch	*Carduelis psaltria*
American goldfinch	*Carduelis tristis*
European starling	*Sturnus vulgaris*
Mammals	
Coyotes	*Canis latrans*
Mule deer	*Odocoileus hemionus*
Raccoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Dusky shrew	*Caenolestes fuliginosus*
Ornate shrew	*Sorex ornatus*
Vagrant shrew	*Sorex vagrans*
Virginia opossum	*Didelphis virginiana*
American badger	*Taxidea taxus*
American beaver	*Castor canadensis*
Black-tailed jackrabbit	*Lepus californicus*

Common Name	Scientific Name
Desert cottontail	*Sylvilagus audubonii*
Muskrat	*Ondatra zibethicus*
Pocket gopher	*Thomomys talpoides*
Botta's pocket gopher	*Thomomys bottae*
Western gray squirrel	*Sciurus griseus*
California ground squirrel	*Spermophilus beecheyi*
Long-eared myotis	*Myotis evotis*
Long-legged myotis	*Myotis volans*
Pallid bat	*Antrozous pallidus*
Pale Townsend's big-eared bat	*Plecotus townsendii*
Yuma myotis	*Myotis yumanensis*
House mouse	*Mus musculus*
Norway rat	*Rattus norvegicus*
Black rat	*Rattus rattus*
Reptiles	
Western pond turtle	*Clemmys marmorata*
Common garter snake	*Thamnophis sirtalis*
Western aquatic garter snake	*Thamnophis Couchii*
Giant garter snake	*Thamnophis gigas*
Gopher snake	*Pituophis catenifer*
Southern alligator lizard	*Elgaria multicarinata*
Western fence lizard	*Sceloporus occidentalis*
Western skink	*Eumeces skiltonianus*
Amphibians	
Pacific tree frog	*Pseudacris regilla*
Western toad	*Bufo boreas*
Ensatina	*Ensatina eschscholtzii*
California slender salamander	*Batrachoseps attenuatus*
Invertebrates	
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*

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Chapter 5
Land Use, Social Issues, and Economics

This chapter provides environmental analyses relative to social parameters of the project area. Components of this study include a setting discussion, impact analysis criteria, project effects and significance, and applicable mitigation measures. This chapter is organized as follows:

- Section 5.1, Land Use, Recreation, and Economics;
- Section 5.2, Population, Housing, and Environmental Justice;
- Section 5.3, Utilities and Public Services;
- Section 5.4, Power Production and Energy;
- Section 5.5, Visual Resources;
- Section 5.6, Public Health and Environmental Hazards; and
- Section 5.7, Cultural Resources.

5.1 Land Use, Agriculture, Recreation, and Economics

Introduction

This section describes the existing environmental conditions and the consequences of the Project alternatives on land use, recreation, and economics. Specifically, it evaluates and discusses the consequences and benefits resulting from construction and operation of the Project and recommends measures to mitigate potential significant impacts to the environment.

The primary concerns related to land use are the Project changes to land. The Project may remove some land from agricultural production and change the use to ecosystem restoration and the construction of flood control facilities and levees. Also evaluated are the possible effects of Project operations on adjacent farmland from seepage. The primary concern related to recreation is the short-term disruption of recreation opportunities (specifically, recreational boating and wildlife viewing) associated with Project construction and operations. The primary concerns related to economic conditions are long-term and short-term effects on employment, income, and businesses.

Analysis Summary

The project incorporates an approach balancing the benefits of flood management to neighboring agriculture land, maintaining some agricultural production and open space/restoration uses consistent with the state and local policies and plans, while minimizing impacts on recreation.

Implementation of any of the Group 1 alternatives and implementation of Alternatives 2-A, 2-B, and 2-c could result in changes to land use as a result of permanent and temporary alterations of the physical conditions and natural processes on the agricultural land. Permanent changes include levees constructed on a portion of approximately 194 acres on Staten Island. Temporary and/or long-term changes include short-term flooding, dredging, bridge replacement and/or improvements.

To the extent that there might be significant adverse environmental impacts caused by farmland loss, a balanced use of the three islands in this Project could offset impacts to farmland loss. The Project provides long-term benefits to agriculture production by implementing flood control management that will protect downstream farmland and the Project may continue to use habitat friendly crops. McCormack-Williamson Tract has approximately 1473 farmable acres and the Grizzly Slough Property 300 farmable acres, some of which can used for multiple benefits. The agricultural production continuing on Staten Island, the largest island of the Project consisting of 8400 farmable acres, will also balance the impacts to farmland overall.

Some short-term recreation impacts would be associated with construction of any of the Project alternatives; however, the overall long-term effect of the Project alternatives on recreation opportunities in the North Delta area would be beneficial.

No significant economic impacts are associated with any of the Project alternatives. All impacts are discussed in detail under Impacts and Mitigation of the Project Alternatives.

Sources of Information

The following key sources of information were used as background and reference in the preparation of this section, but not relied upon as this EIR is project specific:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000.
- Delta Protection Commission Land Use and Resource Management Plan for the Primary Zone of the Delta, adopted February 1995 and reprinted May 2002.
- County of Sacramento General Plan, December 1993, as amended.
- San Joaquin County General Plan 2010, July 1992.
- San Joaquin County General Plan 2010 Review, March 2000.
- 2004 County Agricultural Commissioners' Data, October 2005.
- California Department of Water Resources Land Use Mapping Data for San Joaquin County, 1996.
- California Department of Water Resources Land Use Mapping Data for Sacramento County, 2000.
- Sacramento–San Joaquin Delta Boating Needs Assessment, December 2002.
- California County Economic Forecasts: 2005-2025, September 2005.
- California Department of Conservation, Division of Land Resource Protection: Sacramento County Williamson Act Lands 2005.

Assessment Methods

Land Use

The California Department of Conservation's Land Evaluation and Site Assessment (LESA) model was used as one tool to analyze the potential significance of Project-related alterations of agricultural land. The LESA model is a point-based approach for rating the relative importance of agricultural land resources based on specific measurable features. Input to the California LESA Model includes soil resource quality, a project's size, water supply, surrounding agricultural lands, and surrounding protected resource lands. For a given project, these factors are rated, weighted, and combined, resulting in a single numeric score. The project score can help agencies evaluate the impact of an action on the agricultural or potential agricultural use of a piece of land.

This model has limits in fully assessing the potential environmental impacts of a project analysis needed for CEQA. The environmental significance of Project-related changes was analyzed qualitatively and included an analysis of current land use, benefits to agriculture, sustainability of agriculture and other factors.

Recreation

Effects on recreation related to implementation of the Project were evaluated qualitatively. Generally, construction activities (levee degradation, channel dredging, and bridge retrofit/replacement) could result in a short-term loss of recreation opportunities by disrupting use of recreation areas or recreational boating corridors. A long-term effect could occur if a recreation opportunity is eliminated as a result of permanent Project-related structures or operations. Long-term beneficial effects could occur if new or enhanced recreation opportunities are created through Project implementation, or if a Project component reduces illegal access (i.e. trespassing) by raising awareness of approved access locations.

Economics

NEPA/CEQA Issues

Social and economic changes resulting from a project are addressed somewhat differently under CEQA than under NEPA. CEQA does not consider economic or social changes resulting from a project as adverse effects on the environment. If a physical change in the environment is caused by economic or social effects, the physical change may be regarded as an adverse effect. Additionally, under CEQA, the economic or social effect of a project may be used to determine the significance of physical changes caused by the project.

Because the economic effects of this Project do not change the physical environment and because the economic and social effects of this project are not large enough to be used in determining the significance of land use changes, a CEQA analysis is not necessary and is not included in this chapter. However, in keeping with the recommendation of the Secretary for Resources, this chapter does include a separate section that describes the social and economic consequences of potential agricultural land use changes.

Under NEPA, economic and social effects must be discussed if they are inter-related to the natural or physical environmental effects of a project. It is possible that economic effects of this project are related to the physical environmental effects. However, NEPA does not require that economic impacts be judged for significance. Therefore, this chapter provides a description of economic effects but does not attempt to determine the significance of any economic effects.

In any alternative, DWR will be responsive to local environmental, economic and social concerns. See LU-3 for a commitment to work with the relevant local public entities.

IMPLAN Model

The direct and indirect economic effects of constructing and operating the Project were estimated using IMPLAN. IMPLAN is a model that estimates changes in economic activity as a result of changes in final expenditures. For the Project, changes in final expenditures were entered into IMPLAN for each of the primary economic sectors that would be affected: agriculture, restoration, and construction. The model was used to estimate the long-term changes in employment and income in Sacramento and San Joaquin counties as a result of changes in agricultural production attributable to the Project. It was also used to estimate the short-term changes in employment and income attributable to construction-related expenditures.

Physical Setting/Affected Environment

Land Use

Agriculture is the predominant land use in the North Delta region. The area consists primarily of agricultural lands within a network of waterways and levees. Farmers divert water from the Delta channels to irrigate crops. Agricultural lands in the North Delta region are typically high quality, and much of the land is considered prime farmland by the California Department of Conservation. Some delta farmland is subject to frequent or occasional flooding and lack of adequate water supplies or subsidence can reduce the agricultural productivity of the land. Crops grown in the North Delta include field crops, grain and hay, truck crops, berries, grapes, and nursery crops (see Figure 5.1-1).

Land use decisions in the Project area are guided by the general plans of Sacramento County and San Joaquin County, as well as the DPC's Land Use and Resource Management Plan for the Primary Zone of the Delta. The DPC plans for and guides the conservation and enhancement of the natural resources in the Delta, while sustaining agriculture and meeting increased recreational demand. The majority of the Project area is within the jurisdiction of the DPC (this jurisdictional area is referred to as the Delta Primary Zone). A small portion of the Project area is located within the legal Delta, but outside of the jurisdiction of the DPC. This area is referred to as the Delta Secondary Zone.

Sacramento County

McCormack-Williamson Tract

McCormack-Williamson Tract is owned and managed by TNC as part of its Cosumnes River Preserve. The island contains approximately 1,473 farmable acres and is farmed by a tenant farmer under the oversight of TNC. Typically, the tenant farmer implements a crop rotation consisting of one-third wheat, one-third tomatoes, and one-third safflower, milo, or corn (Whitener pers. comm. [a]). McCormack-Williamson Tract is under Williamson Act contract as prime farmland.

As described in Section 3.2, Flood Control and Levee Stability, McCormack-Williamson Tract was one of the last pieces of land in the North Delta area to be reclaimed, and therefore its levees are required by legal agreement to be lower in elevation than surrounding levees. This has caused McCormack-Williamson Tract to flood during high-flow events more frequently than surrounding islands. McCormack-Williamson Tract flooded in 1938, 1950, 1955, 1958, 1964, 1986, and 1997. Anecdotal research shows that although McCormack-Williamson Tract is considered prime farmland by the California Department of Conservation and the U.S. Department of Agriculture (USDA) Soil Conservation Service, actual profitability of the lands is adversely affected by the high cost of repairing levees and restoring the farmland after flood events.

KCRA (a television broadcasting station) holds an easement on the northwest portion of McCormack-Williamson Tract where they maintain their television transmission tower. Impacts of the Project on utilities and public services are addressed in Section 5.3 and will not be discussed further in this section.

There are no permanent residents on McCormack-Williamson Tract, but migrant farmworkers do reside seasonally in trailers on the island. Impacts of the Project on population and housing are addressed in Section 5.2 and will not be discussed further in this section.

McCormack-Williamson Tract lies within the primary zone of the DPC. The findings, policies, and recommendations of the DPC's Land Use and Resource Management Plan for the Primary Zone of the Delta therefore apply to the island, as do the policies of the Sacramento County General Plan. These policies are described further under the Regulatory Setting.

Grizzly Slough Property

The Grizzly Slough property is owned by DWR. The northern end of the property is under a DFG easement as a mitigation wetland, and the remainder of the property contains approximately 300 farmable acres, which are farmed by a tenant farmer under contract with DWR. The tenant farmer has farmed a variety of crops in the past, including watermelon, corn, rice, oats, and pumpkins. Crops that demand a significant amount of water (rice and corn) are no longer grown on the Grizzly Slough property because of shortages of water during the summer months and insufficient pumping capacity. These water supply issues have limited the number of crops that can successfully grow on the Grizzly Slough property. The tenant farmer has grown melon crops in recent years with limited success (Rodriguez pers. comm.). The Grizzly Slough property is considered prime farmland by the California Department of Conservation, but it is not under Williamson Act contract. There are no residents on the Grizzly Slough Property.

The Grizzly Slough property is located in the DPC's secondary zone. This means that the property is outside the jurisdiction of the DPC, but the DPC's Land Use and Resource Management Plan for the Primary Zone of the Delta does make some recommendations for the secondary zone. These policies, and those of the Sacramento County General Plan, are described further under the Regulatory Setting.

San Joaquin County

Staten Island

Similar to McCormack-Williamson Tract, Staten Island is owned and managed by TNC as part of its Cosumnes River Preserve, with a flood easement held by DWR. The island contains approximately 8,400 acres of farmable land. TNC oversees farming operations on Staten Island and typically plants approximately 7,400 acres in corn and approximately 1,000 acres in wheat (Whitener pers. comm. [b]). Staten Island is under Williamson Act contract as prime farmland.

Staten Island lies within the jurisdiction of the DPC. The findings, policies, and recommendations of the DPC's Land Use and Resource Management Plan for the Primary Zone of the Delta therefore apply to the island, as do the policies of the San Joaquin County General Plan. These policies are described further under the Regulatory Setting.

Recreation

Delta Region

Water historically has been, and continues to be, one of the best attractants for a variety of outdoor recreation activities. Not only does it provide opportunities for water-based recreational uses such as boating, fishing, and swimming, but it also enhances land-based recreational uses such as camping, hiking, wildlife viewing, and driving for pleasure. Although the Delta environment has been altered extensively over the past 100+ years through reclamation and some development, it contains more than 1,000 miles of navigable waterways.

Consequently, most recreational use in the Delta is water-oriented, with fishing and boating accounting for about 70% of Delta recreation use. In addition, the Delta retains unique natural aesthetic values that enhance a variety of other recreational uses, including camping, sailing, hunting, windsurfing, water-skiing, and wildlife viewing and photography. In 2000, boaters accounted for approximately 6.5 million user days. Boaters and anglers spend more than $810 million in and around the Delta annually. This figure also does not account for land-based day trips and other recreational activities (such as wildlife observation) that also occur in the Delta on a regular basis (University of California at Berkeley Department of Agricultural and Resource Economics 1998).

Some aspects of recreational use are unique to the Delta when compared to other freshwater systems and reservoir facilities. While during drought years reservoir levels drop, resulting in less surface elevation for boating, water levels in the Delta remain generally the same. Also, the Delta is less restrictive than other areas in terms of types of water craft permitted, the number of boats (all classes) allowed on any given day, and types of engine or fuel systems permitted. In addition, the Delta is linked to the early development of both the state (California's gold rush era) and its agricultural industry and thus offers numerous educational and exploration opportunities associated with that history.

The Delta is located in the center of the rapidly urbanizing areas of Rio Vista, West Sacramento, Sacramento, Elk Grove, Lodi, Stockton, Lathrop, Tracy, and numerous communities in eastern Contra Costa County. According to the Delta Boating Needs Assessment (Dangerwood Group 2002), 75% of surveyed boat owners who reported having recently visited the Delta live within 75 miles of the Delta. The Delta Boating Needs Assessment thus defines the Delta's primary market area (PMA) as Alameda, Calaveras, Contra Costa, Marin, Napa, Sacramento, San Francisco, San Joaquin, San Mateo, Santa Clara, Santa Cruz, Solano, and Stanislaus Counties. The population in this area has increased approximately 1.6% annually since 1980, numbering nearly nine million people in 2000. In addition, California Department of Motor Vehicles boat registrations statewide have increased at an average annual rate of 2.6% since 1981. Within the PMA, more than 257,000 vessels (including personal watercraft) were registered in 2002. The increasing population within the Delta's PMA, as well as the increase in boat ownership, is expected to significantly increase the number of annual visitor-use days in the Delta. All of these factors make the Delta an important and unique regional recreation resource.

Although most of the Delta's navigable waterways are under the jurisdiction of the State Lands Commission and therefore considered "public lands," the use of these waterways for recreational purposes is limited because most of the land and levee areas needed to access these waterways are in private ownership. Consequently, most recreational use of the Delta occurs where private marinas and publicly owned land areas provide access to Delta waterways. While fishing from levees is a popular recreational activity in the Delta currently, bank anglers are often trespassing on privately owned levees. Reclamation District officials, who cite problems with vandalism and trash, have recently begun posting "No Trespassing" signs along public roads on top of these private levee systems.

Most Delta recreational facilities are privately owned marinas; a facilities inventory update conducted in 2000 lists approximately 100 marinas in the Delta providing a variety of services including berthing, boat rentals, marine supplies, courtesy docks, camping and day use facilities, and food and beverage services.

Project Area

Typical recreation uses in the Project area include motor boating, canoeing and kayaking, waterskiing, fishing, and camping, with windsurfing and sailing occurring in the western portion of the study area and wildlife observation occurring on some lands owned by public or nonprofit entities. Following is a brief description of the local land and water areas used for recreation activities.

Stone Lakes National Wildlife Refuge (U.S. Fish and Wildlife Service)

The Stone Lakes National Wildlife Refuge, which was established in 1992, contains almost 4,200 acres that are currently in public ownership or under easement. Access to the refuge is currently limited; a wildlife-viewing platform is open to the public every other Saturday, a volunteer program is in place, and trails are accessible on certain dates. Recreational improvements under construction include a small non-motorized boat launch, waterfowl hunting blinds, wildlife viewing blinds, parking areas, and access trails and roads.

Delta Meadows River Park (California Department of Parks and Recreation)

The California Department of Parks and Recreation's (DPR's) Delta Meadows Park is located just east of the town of Locke. The park is characterized by unique natural features—a labyrinth of sloughs, channels, and islands teeming with native riparian vegetation and terrestrial wildlife. The unique natural character of the area makes Delta Meadows a popular non-motorized-boating destination, as well as a popular mooring area for houseboats during the summer. It is accessible primarily by boat but may also be reached via a gravel road (see Figure 2-14 in Chapter 2, "Project Description"). Recreation facilities are limited to a launching area for canoes and kayaks, a portable toilet, a large trash receptacle, and a small walking trail on the old railroad alignment along Railroad Slough. Fishing is permitted, although no improved fishing access facilities exist. DPR leads educational canoeing tours in the spring and fall for a small fee; these tours have been increasing in popularity since the beginning of the program. DPR staff indicates that they are drafting a General Plan for the Delta Meadows property, but recent funding shortfalls have temporarily put this effort on hold.

Brannan Island State Recreation Area (DPR)

Brannan Island State Recreation Area is a 336-acre park owned and operated by DPR, bordered by the Sacramento River, Three Mile Slough, and Seven Mile Slough on Brannan Island. Complete with a six-lane launch ramp, campsites and boat-camping sites, shoreline swimming access, and easy access from State Route 160, it is a very popular recreation area and receives its highest use in May through October. There are several day-use and picnicking areas at Brannan Island State Recreation Area: Windy Cove, the Seven Mile Slough day use area, and The Ramadas.

Cliffhouse Fishing Access (Sacramento County)

The Cliffhouse Fishing Access park, owned and managed by Sacramento County, is very popular for fishing and clamming, and the park has also experienced an insurgence of windsurfers in recent years. The park has a portable toilet and a few picnic benches.

Georgiana Slough Fishing Access (Sacramento County)

Located on the west side of Georgiana Slough, The Georgiana Slough Fishing Access, owned and managed by Sacramento County, includes a small canoe- and kayak-launching area, a courtesy dock, a designated fishing area, a picnic area, restrooms, and parking for day use.

Westgate Landing (San Joaquin County)

Westgate Landing, owned and managed by San Joaquin County, is one of the most popular public recreation sites in the Delta and is often referenced as a potential model for any development of future day-use destination areas. This park has 30 berths and a courtesy dock, a designated fishing area, a park and picnic area, 14 campsites, restrooms, and day-use parking area.

Walnut Grove Public Dock (Walnut Grove Homeowners & Merchants Association)

The Sacramento Housing and Redevelopment Agency funded the construction of a community dock along Walnut Grove's waterfront in 2000. The dock is free for day use, and overnight and extended use permits are available for a fee from the Walnut Grove Chamber of Commerce. The dock is handicap accessible, and fishing is allowed from the dock, as long as it does not interfere with boats.

Isleton Public Dock (City of Isleton)

The Wildlife Conservation Board is funding a portion of the construction of a community dock along Isleton's waterfront. Planned recreational improvements include a barrier-free fishing pier, boat dock, parking lot, and restroom.

Cosumnes River Preserve (Multiple Ownership)

The Cosumnes River Preserve is owned and managed by several entities, including TNC, the Bureau of Land Management, Ducks Unlimited, DFG, DWR, and the Sacramento County Department of Regional Parks, Recreation, and Open Space. Restoration of riparian vegetation and wetland areas is ongoing, and some areas of the Preserve have been developed for public recreational use. Public use occurs primarily at the preserve's Visitor's Center and on two trails through a variety of riparian, grassland, and wetland habitats. In addition, there are two canoe and kayak launching areas on the preserve. Hunting, fishing, and motorized boating activities are not permitted on the preserve, and many areas are closed to public use.

McCormack-Williamson Tract and Staten Island both fall within the Cosumnes River Preserve. McCormack-Williamson Tract was purchased with grant funds from the CALFED ERP, and the Staten Island acquisition was equally funded with ERP grant funds and Proposition 13 flood control funds. Both properties are owned and managed by TNC. Staten Island has limited access for bird watching after harvest has been completed in the early fall.

Privately Owned Marinas

In addition to the water and land areas listed above, 21 privately owned marinas are located in the Project area. These marinas provide nearly 1,500 boat berths and more than 1,100 individual camping sites, in addition to several fuel docks, pumpouts, markets, and food and beverage services.

Economics

California is the nation's largest agricultural producer, and the world's fifth largest supplier of food and agricultural commodities. California's agricultural producers received $31.8 billion for their products in 2004; $2.93 billion of this was for field crops, the dominant type of agriculture on the properties affected by the Project (California Department of Food and Agriculture 2006). This section describes the economic conditions in the counties that would be directly affected by construction of the Project. These counties are Sacramento and San Joaquin.

Sacramento County

Sacramento County is home to the California state capital, the city of Sacramento. Sacramento County's extensive transportation facilities (east-west and north-south highway and railway corridors, airports, and a shipping port) make it a hub of business activity in northern California. Sacramento County has a population of 1.37 million people and almost 582,000 wage and salary jobs. The per capita income in the county is $30,660, and the average salary per worker is $49,000.

While employment in the nearby Bay Area declined by 1% last year, employment in Sacramento County grew by 1%. In 2004, nearly 6,000 total wage and salary jobs were created in Sacramento County. Non-farm employment grew at the same rate. The unemployment rate declined to 5.2% in 2004.

The principal sectors producing jobs in Sacramento County are business services, government, retail trade, and leisure and hospitality. The recreation and leisure services sector is creating more job opportunities as the greater valley population continues to grow. Sacramento County remains in the top 10 of the fastest growing county populations in California.

Employment and population growth is expected to continue at rapid rates in Sacramento County over the next several years. Inland counties like Sacramento will dominate growth in the state because of the relative affordability and higher production of homes. The County is expected to continue to experience growth in total wage and salary job creation through 2011.

Table 5.1-1 shows the typical yields and values per acre in Sacramento County for the crops grown on the McCormick-Williamson Tract.

Table 5.1-1. Typical Annual Yields and Values in Sacramento County for Crops Grown on McCormack-Williamson Tract

	Tonnage per Acre	Value per Ton	Value per Acre
Wheat (All)	2.5	$106.60	$266.50
Tomatoes (Processing)	31.9	$48.20	$1,537.58
Safflower	1.1	$227.38	$250.12
Milo	Not available	Not available	Not available
Corn (Grain)	4.8	$106.00	$508.80
Corn (Silage)	26.7	$23.00	$614.10

Source: California Agricultural Statistics Service 2005.

Table 5.1-2 shows the typical yields and values per acre in Sacramento County for the crops grown on the Grizzly Slough Property.

Table 5.1-2. Typical Annual Yields and Values in Sacramento County for Crops Grown on the Grizzly Slough Property

	Tonnage per Acre	Value per Ton	Value per Acre
Watermelon	Not available	Not available	Not available
Corn (Grain)	4.8	$106.00	$508.80
Corn (Silage)	26.7	$23.00	$614.10
Rice (Milling)	4.1	$199.01	$815.94
Oats (Grain)	1.8	$60.22	$108.40
Pumpkins	13.8	$236.95	$3,269.91

Source: California Agricultural Statistics Service 2005.

San Joaquin County

The location of San Joaquin County makes it a hub for business as well, because it lies where the San Joaquin Valley, Bay Area, and Sacramento Valley come together. The San Joaquin Valley is one of the fastest growing regions in California. San Joaquin County has a population of 653,300 people and more than 217,400 wage and salary jobs. The per capita income in the county is $25,050, and the average salary per worker is $37,720.

Employment growth in the greater northern California region was stagnant in 2004, primarily because of the weak Bay Area labor market. While employment in the Bay Area fell another 1% last year, employment in San Joaquin County grew by 1.3%. In 2004, 2,800 total wage and salary jobs were created in San Joaquin County. Non-farm employment grew at a faster rate of 1.8%, adding almost 3,500 jobs. The unemployment rate dropped sharply in 2004 to 8.7%, which is still higher than in Sacramento County. The higher unemployment rate reflects seasonal employment attributable to the agriculture sector.

The principal sectors that are producing jobs in San Joaquin County are leisure services, professional services, education and healthcare services, and construction. The construction sector created the most new jobs in 2004 because of the large number of new homes being permitted in the county. Employment in manufacturing increased 2% in 2004.

Population growth remains over 3% per year in San Joaquin County. The fastest growing city in the county is Tracy, which grew 4.7%. The largest city in the county, Stockton, grew 2.9% last year. These communities are thriving from a growing population sector that commutes to the East Bay or Santa Clara County for work each day.

Employment and population growth is expected to continue at healthy rates in San Joaquin County over the next several years, as the inland counties continue to dominate growth in the state (because of the relative affordability and higher production of housing). Like Sacramento County, San Joaquin County is expected to continue to experience growth in total wage and salary job creation through 2011.

Table 5.1-3 shows the typical yields and values per acre in San Joaquin County for the crops grown on Staten Island.

Table 5.1-3. Typical Annual Yields and Values in San Joaquin County for Crops Grown on Staten Island

	Tonnage per Acre	Value per Ton	Value per Acre
Wheat (All)	2.61	$125.05	$326.38
Corn (Grain)	4.47	$155.05	$514.09
Corn (Silage)	31.2	$20.59	$642.41

Source: California Agricultural Statistics Service 2005.

Regulatory Setting, Significance Criteria, and Programmatic Mitigation Measures

Regulatory Setting

Federal

Farmland Protection Policy Act

If a federal lead agency is selected for the Project, that agency will comply with the Farmland Protection Policy Act (FPPA) by coordinating with the Natural Resources Conservation Service (NRCS) The FPPA directs federal agencies to consider the effects of federal programs or activities on farmland and ensure that such federal programs, to the extent practicable, are compatible with state, local, and private farmland protection programs and policies. The rating process established under FPPA was developed to help assess options for land use on an evaluation of productivity weighed against commitment to urban development. This project will not result in urban development.

State

California Land Conservation Act of 1965

The California Land Conservation Act of 1965 (Williamson Act) helps preserve agricultural and open space lands by discouraging conversion to urban uses. The act creates an arrangement whereby private landowners enter into a 10-year contract with counties and cities to maintain their land in agricultural and compatible open-space uses in exchange for a reduction in property taxes. The contract is automatically renewed for 1 additional year unless it is cancelled. The contract may be cancelled if the land is being converted to an incompatible use.

Both Staten Island and McCormack-Williamson Tract are currently in private ownership (TNC) and are under Williamson Act contract. No actions are proposed in the Project that would convert these lands to a use incompatible with their Williamson Act contracts or result in the removal of adjacent Williamson Act land from agricultural or open-space use. The large majority of Staten Island would remain in agricultural production. As described in Section 51201(e) of the Williamson Act, "*Compatible use* includes agricultural use, recreational use or open-space use." The specific Williamson Act contract (contract 76-AP-028) for McCormack-Williamson Tract specifies in Exhibit B, Subdivision P, that fish and wildlife enhancement and preservation is a compatible land use.

At this time, it is uncertain what entity will assume long-term ownership of Staten Island and McCormack-Williamson Tract. If the ownership of Williamson Act land is transferred to the State, the Williamson Act contract for that land would be rendered null and void, as the State does not pay property tax. Rendering the contract null and void for Staten Island or McCormack-Williamson Tract would not be considered an impact under the implementation conditions of the Project, as the Project would keep the islands in agriculture or open space in perpetuity.

California Resources Agency Direction

In an October 27, 2004, memorandum, the Secretaries of the Resources Agency and the Department of Food and Agriculture stated that the two agencies were "committed to working together to ensure that the policies of each agency are, to the fullest extent possible, complementary, rather than conflicting." In a May 4, 2005, memorandum to Resources Agency departments, boards, and commissions, the Secretary for Resources stated "in selecting and developing resource related projects, departments under Resources Agency should consider ways to reduce effects on productive agricultural lands" and encouraged departments to incorporate, where appropriate, the strategies identified in the CALFED EIR to reduce the impact of the CALFED Ecosystem Restoration Program on agricultural land and water use.

The Secretary further recommended several steps departments should take in cases involving agricultural lands. These included (1) projects should include both restoration and agricultural preservation efforts; (2) CEQA documents involving resource-related projects that involve agricultural land should include a separate section that describes the social and economic consequences of a conversion; and (3) the lead agency should analyze each situation on a case-by-case basis.

Regional

1992 Delta Protection Act

The State's 1992 Delta Protection Act designates the Delta Primary Zone as an area for protection from intrusion of nonagricultural uses (Section 29703a) and establishes the DPC. The DPC is a State created entity that plans for and guides the conservation and enhancement of the natural resources in the Delta, while sustaining agriculture and meeting increased recreational demand. The entire Project area is located within the legal Delta, and the majority of the region is in the Delta Primary Zone (the central area of the Delta that is under the jurisdiction of the DPC). A small portion of the Project area is located within the legal Delta but outside of the jurisdiction of the DPC. This area is referred to as the Delta Secondary Zone. As described in the Setting section, McCormack-Williamson Tract is located in the Delta Primary Zone, and the Grizzly Slough property is located in the Delta Secondary Zone. Land use policies are described further in the Regulatory Setting.

In 1995, the DPC adopted its regional plan, *Land Use and Resource Management Plan for the Primary Zone of the Delta*, which outlines findings, policies, and recommendations to guide land use and resource management decisions in the Primary Zone of the Delta. Although the DPC does not have jurisdiction over the Delta Secondary Zone, the Land Use and Resource Management Plan for the Primary Zone of the Delta does make some recommendations for the secondary zone. The specific applicable policies and recommendations are described in Attachment 5.1-1.

County of Sacramento General Plan

The Sacramento County General Plan designates McCormack-Williamson Tract and the Grizzly Slough property as “Agricultural Cropland,” with an overlying “Resource Conservation Area” (RCA) on the northern half of McCormack-Williamson Tract and over the entire Grizzly Slough property. According to the Sacramento County General Plan, the “Agricultural Cropland” designation represents:

> agricultural lands most suitable for intensive agriculture. The agricultural activities included are row crops, tree crops, irrigated grains and dairies. The designation is generally limited to areas where soils are rated from Class I to Class IV by the Soil Conservation Service, or are classified Prime, Statewide, or Unique significance by the State of California Conservation Department. These lands have at least some of the following attributes: deep to moderately deep soils, abundant to ample water supply, distinguishable geographic boundaries, absence of incompatible residential uses, absence of topographical constraints, good to excellent crop yields, and large to moderate sized farm units. These attributes indicate the need for ambitious preservation policies and techniques. The Agricultural Cropland designation allows single-family dwelling units at a density no greater than 40 acres per unit.

According to the Sacramento County General Plan, the purpose of the “Resource Conservation Area” designation, which applies to the northern half of McCormack-Williamson Tract and to the entire Grizzly Slough property, is to:

> identify areas with special resource management needs. The designation targets certain natural resources as being important on the Land Use Diagram while recognizing the validity of the underlying land use designation. The intent is to develop programs and incentives to assist landowners with resource protection and enhancement. Compliance with the Resource Conservation designation will rely on the voluntary support of landowners who seek cooperative conservation agreements with the County. The Resource Conservation combining land use category may be combined with Recreation, Natural Preserve, Agricultural-Cropland, General Agriculture/80 acre, and General Agriculture/20 acre Land Use Designations in suitable areas outside the Urban Service Boundary. Designated natural resource conservation areas on the Diagram may be somewhat generalized, and target resources may not exist on all property within the delineated area. Resource Conservation areas address vernal pools, wetland creation, waterfowl management, peat soil conservation, and Blue Oak woodland harvesting.

According to the County of Sacramento, the intent of the RCA designation is to identify significant natural resources that deserve protection (Morse pers. comm.). Upon creating the RCA designation, the County hoped to be able to work with landowners to enhance habitat and protect valuable natural resources on lands with the RCA designation. Although this designation (which overlies other traditional land use designations, such as “Agriculture”) has no regulatory function, alteration of agricultural land to habitat (as is proposed under alternatives 1-A, 1-B, and 1-C) is consistent with the spirit of the RCA.

Relevant Sacramento County General Plan Land Use goals, objectives, and policies are described in Attachment 5.1-1.

San Joaquin County General Plan

The 1992 San Joaquin County General Plan incorporates policies developed by the DPC under the Delta Protection Act. The Community Development Section (IV) of the general plan addresses protection of open space and natural resources. Section VI of the general plan addresses the protection of resources, including agricultural lands. The General Plan was reviewed and updated in March 2000.

The San Joaquin County General Plan 2010 applies a land use designation of "General Agriculture" to Staten Island and also identifies Staten Island as a "Significant Natural Resource Area" (to be protected from the adverse impacts of development). The General Plan describes crop production, feed and grain storage and sales, aerial crop spraying, and animal raising and sales as typical land uses under the "General Agriculture" zoning designation. San Joaquin County's General Plan 2010 Review recognizes Staten Island as "CALFED Habitat Land" and acknowledges CALFED's programmatic goal of converting approximately 160,000 total acres of Delta farmland to wildlife habitat. The General Plan Review does express concern over the potential "catastrophic" loss of farmland in San Joaquin County because of urbanization pressures.

Relevant San Joaquin County General Plan Land Use goals, objectives, and policies are described in Attachment 5.1-1.

Significance Criteria

Land Use

For the purposes of this analysis, impacts on land use are considered significant if implementation of the alternatives would:

- conflict with applicable environmental plans or policies adopted by agencies with jurisdiction over the project;
- conflict with general plan designations or zoning;
- cause substantial and permanent or long-term changes in the physical condition or natural processes that provide the land's resource qualities for agriculture where the land is categorized as prime, statewide important, or unique farmland;
- cause substantial adverse effects on adjacent agricultural operations (for example, creation of no-spray zones adjacent to new habitat, siltation from levee construction, or other incompatible uses); or
- cause a substantial inconsistency with objectives of local, regional, and state plans.

Recreation

For the purposes of this analysis, impacts on recreation could be considered significant if implementation of the alternatives would result in:

- a substantial change in recreation opportunities or use in the Project area or region.

Economics

For the purposes of this analysis, impacts on land use and agriculture could be considered significant if implementation of the alternatives would result in:

- a substantial change in employment.

Programmatic Strategies Dealing with Land Use and Recreation

The August 2000 CALFED Programmatic Record Of Decision (ROD) includes a helpful list of strategies to consider in the development and implementation of Project-specific actions that could affect agricultural lands. The Sacramento County General Plan has incorporated the same strategies. Many of these strategies have been built into the Project description as balancing factors of agriculture use and habitat restoration consistent with the CALFED ROD and the Sacramento County General Plan, detailed below.

Agricultural Land Use

1. Site and align Program features to avoid or minimize impacts on agriculture.

3. Implement features that are consistent with local and regional land use plans.

4. Involving all affected parties, especially landowners and local communities, in developing appropriate configurations to achieve the optimal balance between resource impacts and benefits.

6. Support the testing and application of alternative crops to idled farmland (for example, agroforestry or energy crops)

8. Support the California Farmland Conservancy Program in acquiring easements on agricultural land in order to prevent its conversion to urbanized uses and increase farm viability..

9. Restore existing degraded habitat as a priority before converting agricultural land.

10. Focus habitat restoration efforts on developing new habitat on public lands before converting agricultural land.

11. Focusing restoration efforts on acquiring lands that can meet ecosystem restoration goals from willing sellers where at least part of the reason to sell is an economic hardship (for example, land that floods frequently or where levees are too expensive to maintain.

15. Include provisions in floodplain restoration efforts for compatible agricultural practices.

17. Using a planned or phased habitat development approach in concert with adaptive management.

19. Develop buffers and other tangible support for remaining agricultural lands. Vegetation planted on these buffers should be compatible with farming and habitat objectives.

20. In implementing levee reconstruction measures, work with landowners to establish levee reconstruction methods that avoid or minimize the use of agricultural land.

22. Implementing erosion control measures to the extent possible during and after project construction activities. These erosion control measures can include grading the site to avoid acceleration and concentration of overland flows, using silt fences or hay bales to trap sediment, and revegetating areas with native riparian plants and wet meadow grasses.

23. Protecting exposed soils with mulches, geotextiles, and vegetative ground covers to the extent possible during and after project construction activities in order to minimize soil loss.

28. Analyze, dredge, and handle dredge materials in accordance with permit requirements. Permits will incorporate mitigation strategies to prevent release of contaminants of concern.

30. Implement seepage control measures.

Recreation

1. Incorporate Project-level recreation improvements and enhancements.
2. Maintain boating access to prime areas.
3. Identify and mark alternate boating routes.
4. Construct portage facilities.
6. Provide public information regarding alternate access.
7. Avoid construction during peak-use seasons and times.
8. Post warning signs and buoys in channels.
9. Work with recreational interests to protect and enhance recreation resources.
10. Provide in-kind recreation facilities.
11. Relocate or construct new recreation facilities and infrastructure.

14. Purchase trail rights-of-way or recreational easements.
15. Provide or improve vehicle access and parking for recreation areas.
16. Provide access to waterfront areas and island edges.
17. Create new day-use boating and camping areas.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Under No Project conditions, no change in land use, recreation, or economics from current conditions is expected, although long-term impacts to land use may result with flooding, subsidence and/or effects from climate change.

Agricultural production would continue on McCormack-Williamson Tract, the Grizzly Slough property, and Staten Island. However, as described in Section 3.2, Flood Control and Levee Stability, there is a possibility that McCormack-Williamson Tract will experience flooding again within the 20-year planning horizon. Given the current conditions of the island (ownership, marginal agricultural profitability, water supply issues that limit crop types), it is uncertain whether the island would be restored to agriculture after a flooding event

Demand for recreational opportunities in the North Delta area would continue to increase, without the beneficial impacts of the recreational enhancements proposed by the Project (described below under Impacts REC-3, REC-4, REC-5, and REC-7.)

Alternative 1-A: Fluvial Process Optimization

This section summarizes the impacts for Alternative 1-A.

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure

- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River (optional)
- Enhance Delta Meadows Property (optional)

Impact LU-1: Loss of Farmland.

Implementation of Alternative 1-A could reduce approximately 1773 acres from agricultural production on McCormack-Williamson Tract and on the Grizzly Slough property, converting the land to wildlife habitat. Both of these properties are considered prime farmland by the California Department of Conservation and the USDA Natural Resources Conservation Service (NRCS). Table 5.1-4 below puts the loss of farmland and prime farmland associated with Alternative 1-A in context with the farmland and prime farmland in the rest of Sacramento County, as well as into context with the other alternatives.

Table 5.1-4. Farmland and Prime Farmland Lost under Group 1 Alternatives Compared with Other Alternatives

	Total Acres of Farmland Lost[1]	Total Acres of Farmland in County	Percent Loss of Farmland	Total Acres Prime Farmland in County	Percent Loss of Prime Farmland
Alternatives 1-A, 1-B, and 1-C[2]	1,773	391,524	0.45%	111,984	1.58%
Alternative 2-A[3]	194	775,114	0.03%	415,527	0.05%
Alternative 2-B[3]	198	775,114	0.03%	415,527	0.05%
Alternative 2-C[3]	156	775,114	0.02%	415,527	0.04%

[1] All farmland lost under all alternatives is considered prime farmland by the California Department of Conservation.

[2] Sacramento County.

[3] San Joaquin County.

As discussed in Chapter 1, the purpose of the Project is to implement flood control improvements in a manner that benefits aquatic and terrestrial habitats, species, and ecological processes. Flood control improvements are needed to reduce damage to land uses including agricultural lands, infrastructure, and the Bay-Delta ecosystem resulting from overflows caused by insufficient channel capacities and catastrophic levee failures in the 197 square mile Project Study area. This area includes the three properties that are the focus of the study (Staten Island, McCormack-Williamson Tract, and Grizzly Slough).

Land use changes will occur at all three properties depending on whether Group 1 and/or Group 2 actions are implemented. However, farmland acreage adjacent to the three properties will be protected with the flood control improvements identified by the Project. For example, the 1986 flood event inundated over 30,000 acres of farmland in addition to the Staten, McCormack-Williamson, and Grizzly Slough parcels (Van Loben Sels pers.com.). This was due to the uncontrolled surge of water originating from the Cosumnes River, Morrison Creek, Dry Creek, and Mokelumne River watersheds. The three Group 1 alternatives were developed to regulate these peak flows in such a manner as to minimize flood-related damage both upstream and downstream of the project area thereby protecting adjacent agricultural lands. The change in land use practices per acre per island with the implementation of either Group 1 or Group 2 actions is detailed in Table 5.1-5.

Table 5.1-5. Total Farmland Acreage per Tract and Percentage of Farmland Acreage Lost per Tract with the Implementation of Group 1 and Group 2 Alternatives

	Total Farmland Acreage	Alternatives 1-A, 1-B, and 1-C	%	Alternative 2A	%	Alternative 2B	%	Alternative 2C	%
Grizzly Slough	**300**	300	100	0	0	0	0	0	0
McCormack Williamson Tract	**1473**	1473	100	0	0	0	0	0	0
Staten Island	**8400**	0	0	194	2.4	198	2.4	156	1.8

The California Department of Conservation's LESA model was used as one tool to analyze the significance of agricultural land alteration for Group 1 and 2 alternatives.

The LESA analysis for Alternative 1-A resulted in a total score of 79.6 for McCormack-Williamson Tract, and a total score of 73.8 for the Grizzly Slough property. (The LESA score sheets are included in Attachment 5.1-2.). These scores would indicate that, according to the model, the project might have a potentially significant impact on the agricultural environment. However, other qualitative factors were used to supplement the use of the model and to more fully evaluate the potential significance of the impact of the Project on the environment. These factors include land subsidence on Staten Island, degraded land quality and water access for agriculture on Grizzly Slough and McCormack-Williamson Tract, and benefits of flood protection to Staten Island and other adjacent lands (thereby contributing to the protection of ongoing agricultural practices for surrounding lands).

As described in earlier section, the Project continues agricultural use on Staten Island and has been designed to include agricultural benefits, including providing additional flood protection for agricultural use on the islands and neighboring areas. The Mokelumne and Cosumnes Rivers and the Morrison Creek stream group do not have sufficient channel capacity to safely convey peak historical flows from Sierra Nevada watersheds such as that occurred during the 1986 and 1997 flood events through the North Delta to the San Joaquin River. This lack of channel capacity, in combination with the flow constrictions in vulnerable areas and the increase in sedimentation levels, results in flood events for the North Delta. Implementation of any one of the three Group 1 Alternatives will control floodwaters coming through McCormack-Williamson Tract in a way that minimizes the surge effect, i.e., avoids the historical occurrence of a large pulse of water from McCormack-Williamson Tract damaging or breaching adjacent island levees (e.g., Staten and Tyler Islands) and subsequent downstream flooding.

While the land on Grizzly Slough and McCormack-Williamson Tract is designated as prime, statewide important, or unique farmland, some of it is subject to frequent flooding and substantial portions lack adequate supply of water. The land was acquired from willing sellers, in large part, because of economic difficulties in continuing farming. However, it is still possible that the Project may cause substantial and long-term changes in the physical condition and/or natural processes of the Grizzly Slough and McCormack-Williamson Tract that may result in a loss of the land's resource qualities for agriculture where the land is categorized as prime farmland. However, despite these changes, implementation of the Project will provide an overall net benefit for agriculture by providing additional flood protection in the Project area to more valuable and viable agricultural properties.

To further this rationale, the Project includes other features specifically targeted at protection of farmland, detailed below.

Project Features for Farmland Protection

Conservation Easement Agreement on Staten Island to ensure protection of agricultural land within the Project Area. Staten Island was acquired by TNC (as a third-party landholder) in October 2001 with DWR funds, specifically for the purposes of the North Delta Project and in cooperation with CalFed. Although this Project originated from the CalFed program, it is being implemented independently with DWR as the lead agency.

As a component of the funds provided by DWR, TNC entered into an agreement providing DWR with an exclusive and perpetual conservation easement covering the entire property. The purpose of this easement is to protect the following multiple and complementary benefits:

- agricultural land preservation, including the economic viability of agricultural operations;
- wildlife habitat protection;
- protection of a floodplain area from potential inappropriate and incompatible development; and
- potential role in future flood management and water management improvements (the North Delta Project).

These multiple and complementary benefits are preserved under the easement agreement:

> Whereas, Grantor [TNC] and the Department [DWR] further acknowledge that the Department is engaging in a multi-agency planning process for designing and constructing floodway improvements in the North Delta (the "North Delta Planning Process"), pursuant to the CALFED Bay-Delta Program Programmatic Record of Decision (August 28, 2000). The Department's evaluation of alternatives for such floodway improvements in the North Delta may include use of all or a portion of Staten Island for future flood management projects or activities.

The stipulations specified in the easement agreement provide protection for the approximately 8400 acres of Staten Island farmland. This in combination with the flood protection benefits provided by the Project for several thousand acres of surrounding (adjacent to Staten Island and McCormack-Williamson Tract) farmland, will result in a net benefit to agriculture within the Project Area.

Continue Agricultural Practices on McCormack-Williamson Tract and the Grizzly Slough Property. DWR may consider managing McCormack-Williamson Tract and the Grizzly Slough property to support wildlife-friendly agricultural practices. Floodplain habitat and agriculture are often compatible land uses, and similar management efforts in the Yolo Bypass have proven successful. For example, grazing could be used not only to keep the land in agricultural production, but also to control invasive vegetation.

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described above.

Significance after Mitigation: Less than significant.

Impact LU-2: Operations-Related Impacts to adjacent farmland

Flooding of McCormack-Williamson Tract has the potential to cause seepage or even flooding on adjacent agricultural lands as a result of increased hydrostatic pressure, which could in turn reduce agricultural productivity of those adjacent lands. As addressed in Section 3.2, Flood Control and Levee Stability, mitigation has been recommended to reduce significant seepage impacts on neighboring lands to a less-than-significant level.

Additionally, restoring agricultural lands to habitat can cause adverse impacts on the agricultural productivity of adjacent lands by increasing wildlife depredation on crops and livestock. Restoration of McCormack-Williamson Tract to habitat is not expected to increase wildlife depredation on adjacent lands because the island is buffered by levees and surrounding waterways. The Grizzly Slough property, however, is not completely buffered from surrounding lands. The sloughs that border the northwest and northeast sides of the property are small and often go dry in the summer, and no buffer exists along the south side of the property except a two-lane county road. Restoration of the Grizzly Slough property, therefore, could have the potential to cause an increase in wildlife depredation on neighboring farms, resulting in reduced agricultural production value. It is assumed that any increase in wildlife depredation would be minimal, as a large portion of land to the north of the Grizzly Slough property is already under management as wildlife habitat. This impact would therefore be less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact LU-3: Inconsistency with Agricultural Objectives of Local, Regional, and State Plans.

Alternative 1-A would involve the conversion of McCormack-Williamson Tract and the Grizzly Slough property (both considered prime farmland by the California Department of Conservation) to natural preserves, with the conversion of McCormack-Williamson Tract also functioning to reduce flood risk to adjacent agricultural properties.

Although DPC supports conservation enhancement of natural resources in the Delta, this action on McCormack-Williamson Tract might be considered inconsistent with the DPC's Land Use and Resource Management Plan for the Primary Zone of the Delta. (See: environmental policy P-1 and agricultural policy P-1, listed in Attachment 5.1-1 that direct the priority land use of areas of prime soil to be agriculture.) DWR will consult with DPC to assure there is no conflict.

McCormack-Williamson Tract and the Grizzly Slough property are both located in Sacramento County. Alternative 1-A is consistent with the County of Sacramento General Plan Farmland and Agricultural Resource Protection's goal to "protect permanent crops and other agricultural investments from catastrophic flooding." However, the County of Sacramento General Plan Agricultural Element also contains an "Encroachment by Natural Resource Preserves" section, which calls for the County to balance farmland protection in concert with habitat preservation so as to maintain the County's multiple natural resource values. Applicable policies are:

> AG-9 The County shall balance the protection of prime farmlands and farmlands with intensive agricultural investments with the preservation of natural habitat realized by the establishment of environmental mitigation banks and sites, wildlife refuges and other natural resource preserves so as to protect farmland and to conserve associated habitat values.
>
> AG-10 […] natural resource preserves adjacent to prime farmland or land with intensive agricultural investments shall not disrupt or disturb standard farming practices.
>
> AG-13 Initiate intergovernmental agreements with State and Federal wildlife management authorities in order to mitigate loss of prime farmland or land with intensive agricultural investment due to natural habitat conversion.

At the time of publication of this EIR, the Sacramento County Planning and Community Development Department had not been involved in any land use decisions relevant to the Project. Policy AG-9 would be satisfied by DWR's coordination with Sacramento County's Planning department.

Project effects related to policy AG-10 are discussed above under Impact LU-2. As described above, the project is developed to minimize the impact as recommended in Section 3.2, Flood Control and Levee Stability, to reduce significant seepage impacts on neighboring agricultural lands to a less-than-significant level, and any increases in wildlife depredation are expected to be minimal.

Policy AG-13 would be satisfied with implementation of the project modifications discussed under Impact LU-1.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact LU-4: Conflict with General Plan Designations or Zoning.

Alternative 1-A would involve the conversion of McCormack-Williamson Tract and the Grizzly Slough property (both considered prime farmland by the California Department of Conservation) to natural preserves. These lands are designated "Agriculture" in the County of Sacramento General Plan. However, an overlying designation of RCA has also been applied to both properties. The intent of the RCA was to identify significant natural resources (habitat and peat soils conservation areas) in the County that deserve protection, and to develop programs and incentives to assist landowners with resource protection and enhancement. The conversion of agricultural land to habitat proposed in Alternative 1-A is consistent with the RCA. DWR will coordinate its plans with the County.

This impact is therefore considered less than significant, as the changes in land use associated with Alternative 1-A are consistent with the RCA designation applied to McCormack-Williamson Tract and the Grizzly Slough property in the County of Sacramento General Plan.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

Four components under Alternative 1-A would require in-channel construction activities that could temporarily disrupt recreational boating, personal watercraft use, and fishing in the area. These components are:

- degradation of the southwest levee on McCormack-Williamson Tract, which is located on the east side of Dead Horse Cut;
- reinforcement of the Dead Horse Island east levee, which is located on the west side of Dead Horse Cut;
- breaching the Mokelumne River levee on McCormack-Williamson Tract; and
- degradation of the east levee on McCormack-Williamson Tract, which is located on the west side of Lost Slough.

Dead Horse Cut is a popular recreational boating channel, connecting the Wimpy's/New Hope marina complex with the Delta Cross Channel and the Delta Meadows and Snodgrass Slough nature areas (see Figure 2-9 in Chapter 2, "Project Description"). The stretch of the Mokelumne River near the proposed breach location is also a popular channel for recreational boating and personal watercraft use. Lost Slough, in the vicinity of the levee identified for degradation, is a little-used backwater. Temporary disruption to recreational boating would result from the presence of construction vehicles, equipment, temporary cofferdams, and personnel in and adjacent to Dead Horse Cut, the Mokelumne River, and Lost Slough, as well as temporary construction effects on channel water quality (i.e., increased turbidity from suspended materials) during levee degradation.

This impact is considered less than significant because the disruption of recreational boating in the area would be temporary and because DWR will implement the environmental commitment described in Chapter 2, "Project Description," to reduce construction-related effects on recreational boating. This environmental commitment includes measures to ensure that:

- levee degradation will occur in a manner that allows boating access through half the channel cross section at all times;
- construction will not occur during major summer holiday periods;
- warning signs and buoys will be posted at, upstream of, and downstream of all construction equipment, sites, and activities; and
- adequate warning will be provided regarding activities and equipment in construction sites.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-2: Temporary Disruption of Recreational Boating Activities during Dredging Operations.

Proposed optional dredging activities on the mainstem Mokelumne River and South Fork Mokelumne River could temporarily disrupt boating access, personal watercraft use, and fishing during operation of dredging equipment from a barge. Boating and other recreational access would be restricted in the dredged area while equipment is operating, which could result in delays in or loss of recreational opportunities on the mainstem and South Fork Mokelumne River.

This impact is considered less than significant because the disruption of recreational boating in the area would be temporary and because DWR will implement the environmental commitment described in Chapter 2, "Project Description," to reduce construction-related effects on recreational boating. This environmental commitment includes measures to ensure that:

- construction will not occur during major summer holiday periods;
- warning signs and buoys will be placed at, upstream of, and downstream of all construction equipment, sites, and activities;
- adequate warning will be provided regarding activities and equipment in construction sites; and
- signs describing alternate boating routes will be posted in convenient locations when boating access is restricted.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-3: Long-Term Increase in Recreational Boating Opportunities.

Degradation of the southwest levee on McCormack-Williamson Tract would create approximately 335 acres of tidal perennial aquatic habitat on the southern end of the island. This new, shallow tidal habitat would be open to non-motorized boating, and could be easily accessed from the existing Delta Meadows boat ramp. This impact is considered beneficial, as it would provide an increase in safe and convenient non-motorized recreational boating opportunities in the North Delta area.

Determination of Significance: Beneficial.

Impact REC-4: Upgrade of Recreational Facilities at the Delta Meadows Property.

Optional measures are proposed to enhance the recreational facilities at the Delta Meadows property. The Delta Meadows property has the potential to offer a wealth of recreation opportunities—it is considered one of the last remaining areas of the northern Delta that exhibits remnants of the natural conditions that existed prior to settlement. However, parking is very limited and only available on either side of the narrow access road to the boat launch. Additionally, the boat launch can be unusable in the summer months, as water levels often drop below the bottom of the boat launch ramp; land-based recreation opportunities (e.g., hiking and interpretive trails) are limited; and there are no restroom facilities.

Optional measures proposed to enhance the Delta Meadows property include:

- an upgrade of the boat launch facility, making it functional year-round;
- improvements to provide additional, safer, and more convenient parking;
- addition of hiking trails and interpretational signage; and
- construction of public restrooms.

However, as described in the Setting section, DPR currently has no general plan for the Delta Meadows property, and no upgrades can be constructed until a general plan is adopted. DWR may assist DPR in facilitating the drafting and adoption of a general plan. Assistance with completion of a general plan and implementation of the above-described optional recreational enhancements is considered a beneficial impact, as it would improve and increase multiple types of recreational opportunities in the North Delta area and complements DPC recreation and access policy P-9.

Determination of Significance: Beneficial.

Impact REC-5: Increased Public Awareness of Recreational Facilities and Public Access Points.

As a component of the proposed local marina and recreation outreach program, DWR would coordinate with the California Department of Parks and Recreation and the DPC to promote public awareness of recreational opportunities in the North Delta area. Increased public awareness of existing recreational opportunities and public access points is considered a beneficial impact, as it would increase potential use of existing facilities and reduce unsanctioned recreational use (e.g., trespassing on private property to fish), and because it complements DPC recreation and access policy P-1.

Determination of Significance: Beneficial.

Economic Effects

Loss of Agricultural Production.
Implementation of Alternative 1-A would reduce existing agricultural operations on McCormack-Williamson Tract and on the Grizzly Slough property, resulting in the loss of an estimated 38 direct and indirect jobs in Sacramento and San Joaquin Counties, and a loss of an estimated $1,302,503 per year in total personal income. The greatest job losses would be experienced by farmworkers and workers in the agricultural services sectors (e.g., farm equipment, seed, fertilizers, pesticides, gasoline). Some long-term land management jobs may be created through implementation of Alternative 1-A, but the employment created by land management needs would be relatively small compared to the loss of agricultural employment.

According to the IMPLAN model, personal income in Sacramento and San Joaquin Counties is expected to total approximately $55 billion in 2006, and jobs are expected to total approximately 1,014,000. The estimated loss in income would total less than 0.003% of total personal income in Sacramento and San Joaquin Counties, and the estimated loss in jobs would be less than 0.004% of total employment in the same area.

Temporary Disruption of Local Businesses during Project Construction.
No direct impacts on local businesses would occur under Alternative 1-A. However, indirect effects on local marinas, restaurants, and other businesses associated with recreational activity may occur during Project construction as a result of increased travel times for boaters. Although travel time is expected to increase slightly because of posted speed limit reductions around in-water construction areas, the additional time is not expected to substantially reduce the number of boats passing through the construction sites, nor is it expected to substantially change the travel time to and from businesses, as DWR will implement the environmental commitment described in Chapter 2, “Project Description,” to minimize construction-related effects on recreational boating. This environmental commitment includes measures to ensure that:

- levee degradation will occur in a manner that allows boating access through half the channel cross section at all times and
- construction will not occur during major summer holiday periods.

Based on this analysis, no substantial change in business activity related to boating or other water-dependent recreation activities are expected to occur.

Temporary Increase in Employment and Income in the Local Area during Project Construction.
Construction of Alternative 1-A components would temporarily increase employment and personal income in Sacramento and San Joaquin Counties. Employment during the construction period is estimated to increase by 164 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $16,200,000, spread over 2 years. These estimates take into account both direct and indirect/induced changes in employment and personal income resulting from Project construction.

Project construction would benefit the local economy by temporarily increasing employment and personal income. However, those changes would be very small relative to the total economic activity occurring in the Sacramento and San Joaquin Counties. Construction-related employment would represent a small fraction of total employment and personal income levels. The impact on employment is considered beneficial.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations

- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact LU-1: Loss of Farmland.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described above.

Significance after Mitigation: Less than significant.

Impact LU-2: Operations-Related Effects on Agricultural Production.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact LU-3: Inconsistency with Agricultural Objectives of Local, Regional, and State Plans.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact LU-4: Conflict with General Plan Designations or Zoning.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

This impact would be the same as described under Alternative 1-A, except it would not include impacts from breaching the Mokelumne River levee on McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-2: Temporary Disruption of Recreational Boating Activities during Dredging Operations.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-4: Upgrade of Recreational Facilities at the Delta Meadows Property.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Beneficial.

Impact REC-5: Increased Public Awareness of Recreational Facilities and Public Access Points.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Beneficial.

Economic Effects

The economic effects would be the same as described under Alternative 1-A, with slight differences in anticipated increased employment and personal income. Employment during the construction period under Alternative 1-B is estimated to increase by 273 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $27,000,000, spread over 2 years.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This section summarizes the impacts and mitigation for Alternative 1-C.

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact LU-1: Loss of Farmland.

The environmental impact is the same as described under Alternative 1-A.

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described above.

Significance after Mitigation: Less than significant.

Impact LU-2: Operations-Related Impacts to Adjacent Farmland.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact LU-3: Inconsistency with Agricultural Objectives of Local, Regional, and State Plans.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact LU-4: Conflict with General Plan Designations or Zoning.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

This impact would be the same as described under Alternative 1-B.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-2: Temporary Disruption of Recreational Boating Activities during Dredging Operations.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-4: Upgrade of Recreational Facilities at the Delta Meadows Property.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Beneficial.

Impact REC-5: Increased Public Awareness of Recreational Facilities and Public Access Points.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Beneficial.

Economic Effects

The economic effects would be the same as described under Alternative 1-A, with slight differences in anticipated increased employment and personal income. Employment during the construction period under Alternative 1-C is estimated to increase by 502 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $50,000,000, spread over 2 years.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

This section summarizes the impacts and mitigation for Alternative 2-A.

Impact LU-1: Loss of Prime Farmland.

Under Alternative 2-A, a detention levee would be constructed on Staten Island so that a portion of the island could be used to detain peak flows during large flood events. According to the Staten Island purchase agreement, inundation of the detention basin may occur no more frequently than once every 10 years. The land in this detention basin would continue to be farmed between flood events, so no large-scale loss of farmland associated with Alternative 2-A would occur.

Very conservative estimates show that approximately 194 acres of prime farmland on Staten Island would be permanently altered in order to accommodate levee setbacks and the detention levee although some of this could still continue to be used for agricultural purposes. Table 5.1-6 below puts the loss of farmland and prime farmland associated with Alternative 2-A in context with the farmland and prime farmland in the rest of San Joaquin County, as well as into context with the other alternatives .

Table 5.1-6. Farmland and Prime Farmland Lost under Alternative 2-A Compared with Other Alternatives

	Total Acres of Farmland Lost[1]	Total Acres of Farmland in County	Percent Loss of Farmland	Total Acres Prime Farmland in County	Percent Loss of Prime Farmland
Alternatives 1-A, 1-B, and 1-C[2]	1,773	391,524	0.45%	111,984	1.58%
Alternative 2-A[3]	194	775,114	0.03%	415,527	0.05%
Alternative 2-B[3]	198	775,114	0.03%	415,527	0.05%
Alternative 2-C[3]	156	775,114	0.02%	415,527	0.04%

[1] All farmland lost under all alternatives is considered prime farmland by the California Department of Conservation.

[2] Sacramento County.

[3] San Joaquin County.

As described in the Assessment Methods section, The California Department of Conservation's LESA model was used as one tool to analyze the significance of agricultural land alteration for this alternative (194 acres). The LESA analysis for Alternative 2-A resulted in a final score of 74.5 (24.5 land evaluation points and 50 site assessment points) for Staten Island, which is above the LESA thresholds for significance. (The LESA score sheets are included in Attachment 5.1-2.). This score would indicate that, according to the model, the project might have a potentially significant impact on the agricultural environment. Other qualitative analyses were used to supplement the use of the model and to more fully analyze the potential significance of the impact on the environment. These include the factors discussed in the next paragraph. .

The implementation of the Project would benefit the surrounding agricultural land by increasing local flood protection. Additionally, Alternative 2-A uses a multifunctional solution that provides increased flood protection to the North Delta region while still allowing the continuation of farming in the detention basin. A very small amount of land will actually be physically altered (up to 194 acres out of a total 8,400 farmable acres on Staten Island—approximately 2%), Any potential impact this might cause would be offset by implementation of project features for farmland protection in LU-1 for Alternative 1-A.

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described under Alternative 1-A.

Significance after Mitigation: Less than significant.

Impact LU-2: Operations-Related Impacts to Adjacent Farmland

Storage of floodwater on Staten Island has the potential to cause seepage or even flooding on adjacent agricultural lands as a result of increased hydrostatic pressure. As addressed in Section 3.2, Flood Control and Levee Stability, mitigation has been recommended to reduce significant seepage impacts on neighboring lands to a less-than-significant level. This impact is therefore considered less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

This impact is similar to Impact REC-1 described under Alternative 1-A. Three components under Alternative 2-A would require in-channel construction activities that could temporarily disrupt recreational boating, personal watercraft use, and fishing in the area. These components are:

- degradation of the northern levee on Staten Island, which is adjacent to the North Fork Mokelumne River;
- retrofit or replacement of the Millers Ferry Bridge, which spans the South Fork Mokelumne River; and
- retrofit or replacement of the New Hope Bridge, which spans the North Fork Mokelumne River.

The stretches of the North Fork Mokelumne River and the South Fork Mokelumne River in the Project area are popular channels for recreational boating and personal watercraft use given their proximity to the Wimpy’s/New Hope marina complex and the Walnut Grove marina.

The impacts associated with degradation of the Staten Island north levee would be the same as described for Impact REC-1 under Alternative 1-A.

If DWR chooses to implement the optional retrofit or replacement of Millers Ferry Bridge concurrently with the retrofit or replacement of the New Hope Bridge, construction activities could completely block all boat and personal watercraft traffic on both the North Fork and South Fork Mokelumne Rivers. DWR will implement the environmental commitment described in Chapter 2, “Project Description,” to reduce construction-related effects on recreational boating; however, simultaneous blocked passage on both the North Fork and South Fork Mokelumne Rivers is considered a significant impact on recreation in the Project area as it would necessitate extremely lengthy detours for recreational boat traffic. Implementation of Mitigation Measure REC-1, described below, would reduce this impact to a less-than-significant level.

Determination of Significance: Significant.

Mitigation Measure REC-1: Implement a Bridge Construction Phasing Schedule.
If DWR chooses to retrofit and replace both the Millers Ferry Bridge and the New Hope Bridge, a bridge construction phasing schedule will be implemented to ensure that passage for boats and other recreational watercraft is available past at least one bridge location at all times.

Significance after Mitigation: Less than significant.

Impact REC-6: Occasional Temporary Loss of Wildlife-Viewing Opportunities.

For many years, Staten Island has been managed to provide a significant winter foraging area for the greater sandhill crane (a threatened species under federal law) and numerous other avian species. Staten Island is known among birders to be a prime viewing location for the greater sandhill crane and other migratory waterfowl during the late fall and winter months, and attracts visitors every year. During flooding periods when the Staten Island detention basin is full, DWR would restrict access to the island for public safety reasons, and this wildlife-viewing opportunity would be temporarily lost.

This impact is considered less than significant as the Staten Island purchase agreement stipulates that flooding of the detention basin should not occur more often than once every 10 years.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-7: Long-Term Improvements in Wildlife-Viewing Opportunities.

As described in Impact REC-6, Staten Island is known among birders to be a prime viewing location for the greater sandhill crane and other migratory waterfowl during the late fall and winter months. Presently, however, no formal facilities exist on Staten Island to accommodate visitors. Construction of a wildlife viewing area and associated infrastructure (parking area, interpretive trail loop, and restrooms) on Staten Island would enhance the migratory waterfowl-viewing experience on Staten Island as well as encourage new users to visit the facility. It also complements DPC recreation and access policies P-6 and P-9 and meets the recreation objectives of the San Joaquin General Plan as described above in the Regulatory Setting section. Improvements in wildlife-viewing opportunities on Staten Island are considered a beneficial impact.

Determination of Significance: Beneficial.

Economic Effects

Loss of Agricultural Production.

Implementation of Alternative 2-A would require that approximately 194 acres of farmland be taken out of production to accommodate levee setbacks and the detention levee. This lost agricultural production would result in the loss of an estimated four direct and indirect jobs in Sacramento and San Joaquin Counties, and a loss of an estimated $47,309 per year in total personal income. The greatest job losses would be experienced by farmworkers and workers in the agricultural services sectors (e.g. farm equipment, seed, fertilizers, pesticides, gasoline). Some long-term land management jobs may be created through implementation of Alternative 2-A, but it is unknown at this time how many jobs would be created.

According to the IMPLAN model, personal income in Sacramento and San Joaquin Counties is expected to total approximately $55 billion in 2006, and jobs are expected to total approximately 1,014,000. The estimated loss in income would total less than 0.00009% of total personal income in Sacramento and San Joaquin Counties, and the estimated loss in jobs would be less than 0.0004% of total employment in the same area.

Temporary Disruption of Local Businesses during Project Construction.

This effect would be the same as described under Alternative 1-A.

Temporary Increase in Employment and Income in the Local Area during Project Construction.

This effect would be the same as described under Alternative 1-A, with slight differences in anticipated increased employment and personal income. Employment during the construction period under Alternative 2-A is estimated to increase by 516 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $77,000,000, spread over 3 years.

Occasional Temporary Loss of Agricultural Production.

Under Alternative 2-A, a detention levee would be constructed on Staten Island so that a portion of the island could be used to detain peak flows during large flood events. The land in this detention basin would continue to be farmed after construction of the detention levee, but loss of agricultural production may occur in this area during the growing season following inundation events if the water cannot be drained off the island in time to meet growing season planting timeframes.

During the years when late floodwater detention makes agricultural production in the detention area infeasible, an estimated 54 direct and indirect jobs in Sacramento and San Joaquin Counties would be lost in that year, and an estimated $620,391 in total personal income would be lost in that year. The greatest job losses would be experienced by farmworkers and workers in the agricultural services sector (e.g., farm equipment, seed, fertilizers, pesticides, gasoline).

According to the IMPLAN model, personal income in Sacramento and San Joaquin Counties is expected to total approximately $55 billion in 2006, and jobs are expected to total approximately 1,014,000. The estimated loss in income for any year that agricultural production would be infeasible in the detention basin area would total less than 0.002% of total personal income in Sacramento and San Joaquin Counties, and the estimated loss in jobs would be less than 0.006% of total employment in the same area. Additionally, according to the Staten Island purchase agreement, inundation of the detention basin may occur no more frequently than once every 10 years.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

This section summarizes the impacts and mitigation for Alternative 2-B.

Impact LU-1: Loss of Prime Farmland.

Under Alternative 2-B, a detention levee would be constructed on Staten Island so that a portion of the island could be used to detain peak flows during large flood events. According to the Staten Island purchase agreement, inundation of the detention basin may occur no more frequently than once every 10 years. The land in this detention basin would continue to be farmed between flood events, so no large-scale loss of farmland associated with Alternative 2-B would occur.

Very conservative estimates show that approximately 198 acres of prime farmland could be removed from agricultural production under Alternative 2-B to allow for levee setbacks and the detention levee. Table 5.1-7 below puts the loss of farmland and prime farmland associated with Alternative 2-B in context with the farmland and prime farmland in the rest of San Joaquin County, as well as into context with the other alternatives (please refer to Impact ECON-1 for a discussion of the economic impact of farmland loss associated with this alternative).

Table 5.1-7. Farmland and Prime Farmland Lost under Alternative 2-B Compared with Other Alternatives

	Total Acres of Farmland Lost[1]	Total Acres of Farmland in County	Percent Loss of Farmland	Total Acres Prime Farmland in County	Percent Loss of Prime Farmland
Alternatives 1-A, 1-B, and 1-C[2]	1,773	391,524	0.45%	111,984	1.58%
Alternative 2-A[3]	194	775,114	0.03%	415,527	0.05%
Alternative 2-B[3]	198	775,114	0.03%	415,527	0.05%
Alternative 2-C[3]	156	775,114	0.02%	415,527	0.04%

[1] All farmland lost under all alternatives is considered prime farmland by the California Department of Conservation.

[2] Sacramento County.

[3] San Joaquin County.

This impact is the same as described under Alternative 2-A.except that the LESA analysis for Alternative 2-B resulted in a final score of 74.9 (24.9 land evaluation points and 50 site assessment points) for Staten Island. In addition, a mitigation measure recommending the implementation of seepage control measures has been incorporated as part of the Flood Control analysis (Section 3.2).

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described above.

Significance after Mitigation: Less than significant.

Impact LU-2: Operations-Related Effects on Agricultural Production.

The environmental impact would be the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

This impact is the same as Impact REC-1 described under Alternative 2-A, except that the levee degradation will take place at a location on Staten Island farther downstream along the North Fork Mokelumne River.

Determination of Significance: Significant.

Mitigation Measure REC-1: Implement a Bridge Construction Phasing Schedule.

Significance after Mitigation: Less than significant.

Impact REC-6: Occasional Temporary Loss of Wildlife-Viewing Opportunities.

This impact is the same as impact REC-6 described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-7: Long-Term Improvement in Wildlife-Viewing Opportunities.

This impact is the same as impact REC-7 described under Alternative 2-A.

Determination of Significance: Beneficial.

Economic Effects

Loss of Agricultural Production.
The environmental impact is the same as described under Alternative 2-A (with a loss of 198 acres of farmland).

Temporary Disruption of Local Businesses during Project Construction.
This effect would be the same as described under Alternative 1-A.

Temporary Increase in Employment and Income in the Local Area during Project Construction.
This effect would be the same as described under Alternative 1-A, with slight differences in anticipated increased employment and personal income. Employment during the construction period under Alternative 2-B is estimated to increase by 692 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $104,000,000, spread over 3 years.

Occasional Temporary Loss of Agricultural Production.
The effect would be the same as described under Alternative 2-A, with slight differences in anticipated temporary loss of employment and personal income. Under Alternative 2-B, an estimated 34 direct and indirect jobs in Sacramento and San Joaquin Counties would be lost and an estimated $394,238 in total personal income would be lost in any year when late floodwater detention makes agricultural production in the detention area infeasible. The estimated loss in income would total less than 0.001% of total personal income in Sacramento and San Joaquin Counties, and the estimated loss in jobs would be less than 0.004% of total employment in the same area in any given year.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station

- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

This section summarizes the impacts and mitigation for Alternative 2-C.

Impact LU-1: Loss of Prime Farmland.

Under Alternative 2-C, a detention levee would be constructed on Staten Island so that a portion of the island could be used to detain peak flows during large flood events. According to the Staten Island purchase agreement, inundation of the detention basin may occur no more frequently than once every 10 years. The land in this detention basin would continue to be farmed between flood events, so no large-scale loss of farmland associated with Alternative 2-C would occur.

Very conservative estimates show that approximately 156 acres of prime farmland could be altered under Alternative 2-C to allow for levee setbacks and the detention levee. Table 5.1-8 below puts the loss of farmland and prime farmland associated with Alternative 2-C in context with the farmland and prime farmland in the rest of San Joaquin County, as well as into context with the other alternatives (please refer to Impact ECON-1 for a discussion of the economic impact of farmland loss associated with this alternative).

Table 5.1-8. Farmland and Prime Farmland Lost under Alternative 2-C Compared with Other Alternatives

	Total Acres of Farmland Lost[1]	Total Acres of Farmland in County	Percent Loss of Farmland	Total Acres Prime Farmland in County	Percent Loss of Prime Farmland
Alternatives 1-A, 1-B, and 1-C[2]	1,773	391,524	0.45%	111,984	1.58%
Alternative 2-A[3]	194	775,114	0.03%	415,527	0.05%
Alternative 2-B[3]	198	775,114	0.03%	415,527	0.05%
Alternative 2-C[3]	156	775,114	0.02%	415,527	0.04%

[1] All farmland lost under all alternatives is considered prime farmland by the California Department of Conservation.

[2] Sacramento County.

[3] San Joaquin County.

This impact is the same as described under Alternative 2-A.except that the LESA analysis for Alternative 2-C resulted in a final score of 73.4 (24.9 land evaluation points and 48.5 site assessment points) for Staten Island. Similar to the previous Alternatives, implementation of the Project would benefit the surrounding agricultural land by increasing local flood protection. Additionally, this alternative uses a multifunctional solution that provides increased flood protection for the North Delta region while still allowing the land in the detention basin to continue to be farmed. In essence, the land in the detention basin is doing two jobs

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described above.

Significance after Mitigation: Less than significant.

Impact LU-2: Operations-Related Effects on Agricultural Production.

This impact would be the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

This impact is the same as Impact REC-1 described under Alternative 2-A, except that the levee degradation will take place on the Staten Island levee adjacent to the South Fork Mokelumne River.

Determination of Significance: Significant.

Mitigation Measure REC-1: Implement a Bridge Construction Phasing Schedule.

Significance after Mitigation: Less than significant.

Impact REC-6: Occasional Temporary Loss of Wildlife-Viewing Opportunities.

This impact is the same as impact REC-6 described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact REC-7: Long-Term Improvement in Wildlife-Viewing Opportunities.

This impact is the same as impact REC-7 described under Alternative 2-A.

Determination of Significance: Beneficial.

Economic Effects

Permanent Loss of Agricultural Production.
This effect is the same as described under Alternative 2-A, with slight differences in anticipated loss of employment and personal income. Lost agricultural production under Alternative 2-C would result in the loss of an estimated three direct and indirect jobs in Sacramento and San Joaquin Counties, and a loss of an estimated $39,424 per year in total personal income. The estimated loss in income would total less than 0.00008% of total personal income in Sacramento and San Joaquin Counties, and the estimated loss in jobs would be less than 0.0003% of total employment in the same area.

Temporary Disruption of Local Businesses during Project Construction.
This effect would be the same as described under Alternative 1-A.

Temporary Increase in Employment and Income in the Local Area during Project Construction.
This effect would be the same as described under Alternative 1-A, with slight differences in anticipated increased employment and personal income. Employment during the construction period under Alternative 2-C is estimated to increase by 656 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $98,364,330, spread over 3 years.

Occasional Temporary Loss of Agricultural Production.
The effect would be the same as described under Alternative 2-B.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River

- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

This section summarizes the impacts and mitigation for Alternative 2-D.

Impact LU-1: Loss Prime Farmland.

At the time of the publication of this EIR, no decision had been made regarding how many miles of levees would be modified (set back) under Alternative 2-D. Specific area limits would be established during the detailed engineering process. Site-specific conditions vary, but the majority of lands adjacent to the levees that may be modified are almost all considered prime farmland by the California Department of Conservation. Depending on the design process and existing conditions, these setback levees could encroach upon land in agricultural production anywhere from 15 feet to 100 feet or more. This means that for each mile of levees modified, 12 or more acres of farmland could be altered.

Determination of Significance: Potentially significant; less than significant if the project features for farmland protection are adopted.

Mitigation: As described above.

Significance after Mitigation: Less than significant.

Impact REC-1: Temporary Disruption of Recreational Boating Activities during Construction.

This impact is similar to Impact REC-1 described under Alternative 1-A. There would be construction impacts caused by modification of levees to increase channel capacity along the mainstem and South Fork Mokelumne Rivers. Two components under Alternative 2-D would require in-channel construction activities that could temporarily disrupt recreational boating, personal watercraft use, and fishing in the area. These components are:

- retrofit or replacement of the Millers Ferry Bridge, which spans the South Fork Mokelumne River; and
- retrofit or replacement of the New Hope Bridge, which spans the North Fork Mokelumne River.

The stretches of the North Fork Mokelumne River and the South Fork Mokelumne River in the Project area are popular channels for recreational boating and personal watercraft use given their proximity to the Wimpy's/New Hope marina complex and the Walnut Grove marina.

If DWR chooses to implement the optional retrofit or replacement of Millers Ferry Bridge concurrently with the retrofit or replacement of the New Hope Bridge, construction activities could completely block all boat and personal watercraft traffic on both the North Fork and South Fork Mokelumne Rivers. DWR will implement the environmental commitment described in Chapter 2, "Project Description," to reduce construction-related effects on recreational boating; however, simultaneous blocked passage on both the North Fork and South Fork Mokelumne Rivers is considered a significant impact on recreation in the Project area as it would necessitate extremely lengthy detours for recreational boat traffic. Implementation of Mitigation Measure REC-1would reduce this impact to a less-than-significant level.

Determination of Significance: Significant.

Mitigation Measure REC-1: Implement a Bridge Construction Phasing Schedule.

Significance after Mitigation: Less than significant.

Impact REC-2: Temporary Disruption of Recreational Boating Activities during Dredging Operations.

This impact would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Economic Effects

Temporary Disruption of Local Businesses during Project Construction.
This effect would be the same as described under Alternative 1-A.

Temporary Increase in Employment and Income in the Local Area during Project Construction.
This effect would be the same as described under Alternative 1-A, with slight differences in anticipated increased employment and personal income. Employment during the construction period under Alternative 2-D is estimated to increase by 326 jobs. Total personal income associated with construction-related expenditures (salaries and purchases of equipment and supplies) is estimated to total $49,000,000, spread over 3 years.

5.2 Population, Housing, and Environmental Justice

Analysis Summary

Constructing and operating any of the project alternatives would result in a less-than-significant impact on population and housing. Because most of the project area consists of agricultural lands, the alternatives would not result in a disproportionate impact on minority or low-income communities.

Introduction

This section describes the existing environmental conditions and impacts on population and housing or a disproportionate project-related effect on minority or low-income communities. The analysis of environmental justice includes identifying low-income and minority populations that could be affected by the project and assessing whether these populations, if present, would incur disproportionate adverse human health or environmental effects compared to the rest of the population.

Sources of Information

The following key sources of information were used in the preparation of this section:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000.
- South Delta EIR, October 2005.
- Delta Land Use Plan Housing Element.
- U.S. Census Bureau.

Assessment Methods

This section describes the assessment methods and approach used to analyze the impacts on population and housing and environmental justice.

The methodology of assessing impacts on housing is based on the questions listed in Appendix G of the State CEQA guidelines and information gathered from the U.S. Census Bureau. The assessment was made for each alternative by comparing the existing baseline to with/project conditions to determine whether a substantial number of housing units would be lost or need to be relocated.

The environmental justice analysis was based on the methods outlined in EPA's Environmental Justice Guidance (U.S. Environmental Protection Agency 1998). The EPA's Environmental Justice Guidance states that

> Minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent, or (b) the population percentage of the affected areas is meaningfully greater than the minority population percentage in the general population or other appropriate unit of analysis.

Demographic data for each Census Tract Block Group were compared to demographic data from the next highest unit of analysis, the county, to determine whether that specific area had a "meaningfully greater" percentage of minority or low-income population.

Demographic information was gathered for the local block groups and Sacramento and San Joaquin Counties. The impacts of Project alternatives were analyzed by comparing census data from the local block groups with data from each county. Primary data for the environmental justice analysis include race, income, and origin from the 2000 Census. The characteristics that were used were:

- percent of minority population,
- percent of persons of Hispanic origin, and
- percent of population below the poverty line.

To ensure that the study area minority populations are adequately identified, census data were also gathered for Hispanic origin. *Hispanic* is considered an origin, not a race, by the U.S. Census Bureau. An origin can be viewed as the heritage, nationality group, lineage, or country of birth of the person or the person's parents or ancestors before their arrival in the United States (U.S. Census Bureau 2003). People that identify their origin as Spanish, Hispanic, or Latino may be of any race.

The U.S. Census Bureau poverty threshold is defined as a single person with an income below $8,840, or a family of four with an income below $16,588.

Physical Setting/Affected Environment

Sacramento County

Tables 5.2-1 through 5.2-3 show Sacramento County's racial characteristics, Hispanic population, and population falling below the poverty level.

Economic characteristics estimated in 2003 indicated that the median household income was $46,296. Of the total county population of 1.2 million, 14% were below the poverty level.

In 2003, Sacramento County had approximately 503,000 housing units, 4.9% of which were vacant. Of the total housing units, 72% were in single-unit structures, 25% were in multi-unit structures, and 3% were mobile homes.

Table 5.2-1. Project Area/Sacramento County Race Characteristics 2000

Race	Project Study Area	Percent Study Area	County of Sacramento	Percent County of Sacramento
White alone	259	55.0	783,240	64.0
Black or African American alone	5	1.0	121,804	10.0
American Indian and Alaska Native alone	4	0.8	13,359	1.0
Asian alone	35	7.5	134,899	11.0
Native Hawaiian and Other Pacific Islander alone	0	0.0	7,264	0.6
Some other race alone	139	30.0	91,541	7.5
Two or more races	25	5.0	71,392	6.0
Minority Subtotal	208	44.0	440,359	36.1
Total Population	467	100	1,223,499	100

Source: U.S. Census Bureau 2000.

Table 5.2-2. Project Area/Sacramento County Hispanic Origin 2000

	Hispanic in Origin	Total Population	Percent Hispanic
Project Study Area	161	467	34
County of Sacramento	195,890	1,223,499	16

Source: U.S. Census Bureau 2003.

Table 5.2-3. Project Area/Sacramento County People Living in Poverty Status 1999

	Population Living in 1999 below Poverty Level	Population	Percent of Population Living below 1999 Poverty Level
Block Group	80	467	17
County of Sacramento	169,784	1,201,917	14

Source: U.S. Census Bureau.

Population and housing in Sacramento County are expected to increase over the next 20 years. Most growth is expected to occur in the city of Sacramento and on the outskirts of other larger cities. Rural areas in Sacramento County are expected to see minimal amounts of growth. The Sacramento General Plan Housing Element discourages population growth in rural areas. (Sacramento County 2006.)

San Joaquin County

San Joaquin County population and economic data are being sourced from the U.S. Census Bureau's 2000 Census. These data were used to determine the existing conditions for Sacramento County demographic information. More recent information is available, but it would not match up with the local data. Tables 5.2-4 through 5.2-6 indicate San Joaquin County's race, Hispanic, and poverty populations and levels.

In 2000, there were approximately 42,000 housing units in unincorporated areas, about 22% of housing units countywide. In the unincorporated portion of the county, about 80% of the housing stock consisted of single family units, 12% mobile homes, 2% each two-family and multifamily units, and the remainder other types of housing units. The U.S. Census Bureau reported an estimated 211,678 housing units for the year 2004.

Economic characteristics estimated in 2003 indicated that the median household income was $42,749. Of the total county population of 568,000, nearly 18% were below the poverty level.

Table 5.2-4. Project Area/San Joaquin County Race Characteristics 2000

Race	Project Study Area	Percent Study Area	County of San Joaquin	Percent County of San Joaquin
White alone	1,157	73.0	327,607	58.0
Black or African American alone	13	0.8	37,689	6.6
American Indian and Alaska Native alone	0	0	6,377	1.0
Asian alone	12	0.8	64,283	11.0
Native Hawaiian and Other Pacific Islander alone	0	0	1,955	0.3
Some other race alone	291	18.0	91,613	16.0
Two or more races	103	6.5	34,074	6.0
Minority Subtotal	419	26.1	235,991	40.9
Total Population	1,576	100	567,598	100

Source: U.S. Census Bureau 2000.

Table 5.2-5. Project Area/San Joaquin County Hispanic Origin 2000

	Hispanic in Origin	Total Population	Percent Hispanic
Project Study Area	483	1,576	30
County of San Joaquin	172,073	563,598	30

Source: U.S. Census Bureau 2003.

Table 5.2-6. Project Area/San Joaquin County People Living in Poverty Status 1999

	Population Living in 1999 below Poverty Level	Population	Percent of Population Living below 1999 Poverty Level
Block Group	288	1,555	18.5
County of San Joaquin	97,105	547,298	17.7

Source: U.S. Census Bureau 2000.

Population and housing in San Joaquin County are expected to increase over the next 20 years. However, this is forecasted to happen mainly in major cities and on the outskirts of larger cities. Rural areas in San Joaquin County are expected to see minimal amounts of growth. The San Joaquin General Plan Housing Element discourages population growth in rural areas (San Joaquin County 2004). San Joaquin County also does not encourage the complete range of urban services and does not encourage expansion in any way.

Local

Block Groups from the U.S. Census Bureau's 2000 Census were used to produce a more precise account for local existing conditions. Two tracts make up the project vicinity. Block groups do not cross county lines, so there are distinct designations for Sacramento and San Joaquin Counties. A description of each Block Group demographics is presented below.

Block Group 1, Census Tract 96.05, Sacramento County, California

The Block Group in Sacramento County is bounded by the Sacramento/San Joaquin County Line and includes all of the McCormack-Williamson Tract, Dead Horse Island, and areas north of McCormack-Williamson Tract. The project site makes up a very small piece of these statistics because it has few residents in. As of the 2000 Census, Block Group 1 in Sacramento County had 467 people. Of these, 259 people (55%) considered themselves to be white alone, and 161 people (34%) considered themselves Hispanic or Latino. The remaining population was composed of other races. Tables 5.2-1 through 5.2-3 indicate Sacramento County's race, Hispanic, and poverty populations and levels.

Block Group 1, Census Tract 40.01, San Joaquin County, California

The Block Group in San Joaquin County is bounded by the Sacramento/ San Joaquin County line and includes all of Staten Island and areas to the east and southeast of Staten Island. The project site makes up a very small piece of these statistics because it has few residents. As of the 2000 Census, Block Group 1 in San Joaquin County had 1,576 people. Of these, 974 (62%) considered themselves to be white alone, and 483 (30%) Hispanic or Latino. The remaining population was of other races. Tables 5.2-4 through 5.2-6 indicate San Joaquin County's race, Hispanic, and poverty populations and levels.

Project Site

Housing and population in the project site are minimal. The project site includes the McCormack-Williamson Tract, Dead Horse Island, and Staten Island. These pieces of land are zoned primarily for agricultural use. Population and housing adjacent to the project site include New Hope Marina and Walnut Grove.

The McCormack-Williamson Tract has few residences and structures. A multi-family farmworker residence (the two-story wood-frame type commonly used for housing migrant farmworkers) and associated farm outbuildings (sheds) are present. This structure is vacant and in a dilapidated state. Farmworkers reside in trailers around the deserted residence. Agricultural fields and a communication tower make up the land use.

Dead Horse Island has one residential structure and two agricultural structures in the southwestern corner of the island. The land use is designated as agriculture.

Staten Island comprises the majority of the population and housing on the project site. The land use is agricultural and structures are located to maximize agricultural benefits. All structures on Staten Island are in the northern half of the island. The major concentration of residences and agricultural structures is along the western riverbank across from Tyler Island and is referred to as the Headquarters. Other residences and agricultural structures are spread out along Staten Island Road. Eleven residential structures and approximately 17 agricultural structures are present on Staten Island.

Regulatory Setting and Significance Criteria

Regulatory Setting

This section summarizes plans, policies, guidelines, and other regulations specific to the resource topic that may factor into determining impacts.

The San Joaquin County and Sacramento County General Plans have policies addressing rural communities and housing. Sections of the general plans addressing housing related to the Project are detailed below. The policies are marked *S* or *SJ* for Sacramento County or San Joaquin County, respectively.

- Rural communities shall:
  - a. Be planned to have minimal growth, mainly infill development, with expansion discouraged (SJ);
  - b. Be planned to serve the immediate needs of the community's residents or the surrounding agricultural community (SJ);
  - c. Housing and Neighborhood Preservation
    - Policy 3) Permitted non-residential uses and activities shall be compatibly integrated into the neighborhoods they serve (SJ).
    - Policy HE-1) The County shall maintain an adequate supply of residential and agricultural-residential zoned land to accommodate projected housing needs. (S)
    - Policy HE-28) Support mechanisms to prevent the loss of housing by demolition, conversion to other uses, long-term vacancy, arson, vandalism, or malicious mischief, and support programs that return vacant housing to residential use. (S)
  - d. Housing Affordability and Availability
    - Policy 11) The County shall accommodate its share of regional housing needs for all income levels through adequate sites in a manner consistent with the County's General Plan (SJ)
    - Policy 12) The County shall encourage the provision of units available for sale or rent to low and moderate income households (SJ)

Executive Order (EO) 12898, Environmental Justice, includes the requirement 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.

Following EO 12898, the State of California passed its own series of environmental justice regulations in 2001. These laws and regulations defined environmental justice as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies." An Environmental Justice Subcommittee is in place as part of the Bay-Delta Public Advisory Committee that addresses the environmental justice within the program.

Significance Criteria

Housing and population significance thresholds in this section are based on Appendix G of the State CEQA Guidelines. Impacts on housing and population are considered significant if the Project would:

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

Environmental justice significance thresholds in this section are based on the CALFED Programmatic EIR/EIS (2000). These thresholds take both the human health risks and environmental effects into account. Environmental justice health impacts are considered significant if the Project would result in:

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

Environmental justice issues are considered pursuant to Federal Executive Order 12898. Environmental justice impacts are considered significant if the Project would result in:

- an impact on the natural or physical environment that adversely affects a minority or low-income population;
- an adverse effect on minority and low-income populations that appreciably exceeds or is likely to appreciably exceed the effect on the general population or other appropriate comparison group; or

- a minority or low-income population affected by cumulative or multiple adverse exposures to environmental hazards.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Existing land uses in the Project area would continue. There would be no change in the regional demand for housing compared to existing conditions. As reported in the San Joaquin and Sacramento County General Plans, the North Delta region experiences little population and housing growth. Population growth is controlled by the agricultural land use and lack of infrastructure mandated by the County's General Plans. Population growth rates similar to existing conditions would continue. Development would continue in accordance with the County's General Plan. The Project vicinity would continue to face threats and damage from flooding.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property

- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property (*optional*)

Impact POP-1: Displacement of Housing.

Alternative 1-A would require the removal of one freestanding vacant farmworker residence and surrounding sheds and the relocation of house trailers used by farmworkers. The structures are located near the southeast levee in the central portion of McCormack-Williamson Tract (see Figure 2-1). The structures would be removed. The house trailers are portable and would be relocated. Impacts on housing would be avoided because the house trailers would be relocated.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-2: Displacement of People.

Implementing Alternative 1-A would result in the displacement of only a small number of persons living on McCormack-Williamson Tract because most of the area is agricultural land. The project would not result in a substantial increase in population because the area would be used for flood control and environmental restoration.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-3: Disproportionate Impacts on Low-Income or Minority Populations.

The minority population in the San Joaquin Block Group is 15% greater than the San Joaquin County average, and the Sacramento Block Group has 18% more persons of Hispanic origin than the Sacramento County average. The total minority and low-income population in the block groups is very small compared to the total population of the block groups and counties. Constructing and operating the project is not expected to result in a disproportionate effect on low income or minority communities because only a few persons would be directly affected.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact POP-1: Displacement of Housing.

Impacts on housing would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-2: Displacement of People.

Impacts on the local population would be as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-3: Disproportionate Impacts on Low-Income or Minority Populations.

These impacts would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhance

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property (*optional*)

Impact POP-1: Displacement of Housing.

Impacts on housing would be the same as under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-2: Displacement of People.

Impacts on the local population would be the as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-3: Disproportionate Impacts on Low-Income or Minority Populations.

These impacts would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee

- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact POP-1: Displacement of Housing.

Alternative 2-A would result in the displacement of residential and agricultural structures. The affected structures include a grain-drying facility, a grain elevator and silo, four residential structures, six sheds, seven propane tanks, and five outbuildings. These structures would be reconstructed in the Headquarters area of Staten Island (Figure 2-22), where the majority of the residential and agricultural structures on the island are located. The replacement structures would be constructed before removing the existing structures to ensure that the supply of housing will not change as a result of the Project.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-2: Displacement of People.

Residents living on Staten Island that would be affected by Alternative 2-A would be relocated to the Staten Island Headquarters area as explained for Impact POP-1 above. New residential structures would be constructed before removing existing structures. The impact on the local population would be minimized as a result of constructing replacement housing.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-3: Disproportionate Impacts on Low-Income or Minority Populations.

These impacts are the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact POP-1: Displacement of Housing.

Alternative 2-B would require moving the Staten Island Headquarters area that has the majority of the island's residential and agricultural structures to a site north of the detention basin zone. Seven residential structures, nine outbuildings, nine propane tanks, a boathouse, two grain-storage tanks, a fertilizer tank, and six sheds would be removed (Figure 2-29). Replacement structures would be constructed before removing the existing structures.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-2: Displacement of People.

Residents living in the Staten Island Headquarters area that would be affected by Alternative 2-A would be relocated to a site north of the detention basin zone as explained for Impact POP-1. New residential structures would be constructed before removing the existing structures. The impact on the local population would be minimized as a result of constructing this replacement housing.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-3: Disproportionate Impacts on Low-Income or Minority Populations.

These impacts would be the same as described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge

- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact POP-1: Displacement of Housing.

Alternative 2-C would require the relocation of two affected homes along Staten Island Road to the Headquarters area on the west bank of Staten Island. Three residences, three propane tanks, two sheds, and two outbuildings would be removed (Figure 2-22). The new residential structures would be constructed before removing existing structures.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-2: Displacement of People.

Residents living in the Staten Island Headquarters area that would be affected by Alternative 2-C would be relocated as explained for Impact POP-1. New residential structures would be constructed before removing the existing structures. The impact on the local population would be minimized as a result of constructing this replacement housing.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact POP-3: Disproportionate Impacts on Low-Income or Minority Populations.

These impacts would be the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Raising

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

Alternative 2-D would have no impact on population or housing.

5.3 Utilities and Public Services

Analysis Summary

The Project results in less-than-significant impacts on utilities and public services that serve the Project area. Utilities evaluated in this EIR are natural gas, storm- and wastewater drainage, solid waste, and communications. Public services evaluated are police and fire protection. Impacts on utilities and public services were considered less than significant for each alternative

Introduction

This section provides background information and assesses impacts on utilities and public services in the Project area for each alternative. Utilities evaluated in this EIR are natural gas, storm and wastewater drainage, solid waste, and communications. Public services evaluated in the EIR include police and fire protection. Disruption of these services or the need to increase these services has the potential to result in a significant impact. The impacts on electric power use are evaluated in Section 5.4, Power Production and Energy.

Sources of Information

The following key sources of information were used in the preparation of this section:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000.
- South Delta Improvements Program EIR, 2005.
- Delta Land Use Plan, Utilities.
- Communications with utility representatives (documented in Chapter 8, “References”).

Assessment Methods

Impacts on utilities and public services were evaluated by comparing the existing infrastructure and service levels to with-Project conditions for each alternative. The following process was completed in order to determine whether impacts on utilities and public services would be considered significant:

- review of relevant documents to obtain information regarding known public services and utilities in the Project vicinity (listed under Sources of Information),
- analysis of geographic map research to determine locations of existing utilities and public services for Project alternatives, and
- telephone calls and email correspondence to area utility/service providers.

Physical Setting/Affected Environment

Electric Power Transmission

Electricity for the Project site is provided by The Pacific Gas and Electric Company (PG&E). Power transmission facilities have developed parallel to the population growth of various communities surrounding the Delta. PG&E and the Western Area Power Administration have developed power transmission lines across the Delta islands and waterways. Many electrical corridors are within the periphery of the Delta upland areas and include several natural gas-fired plants. However, power-generating facilities are absent from the Project vicinity as well as throughout the central Delta.

PG&E operates electrical transmission lines through the McCormack-Williamson Tract and through Staten Island. The transmission lines are aboveground and are typically 11-kV to 12-kV lines. On the McCormack-Williamson Tract, the power lines run across the island and eventually connect to the New Hope Tract. Staten Island's electrical lines run along Walnut Grove Road and then down along Staten Island Road. These overhead lines traverse the road and connect to individual structures via 2-kV lines. Lines run from the north end of Staten Island to the southern end of Staten Island, where they veer southeast and exit at the southeast corner of Staten Island near Terminous. Two large metal towers, one at each end of the main line, provide the height and support needed to suspend the line across the Mokelumne River to provide service to additional housing.

The Sacramento Municipal Utility District (SMUD) is the electric utility provider for the McCormack-Williamson Tract. However, the only structure that uses the electrical services is the radio transmission tower.

Natural Gas

Natural gas fields occur throughout the Project vicinity. Natural gas is transported to and from these fields through a network of pipelines, some of which run through the Project area. These pipelines are owned and operated by multiple companies. These pipelines are usually 6- to 8-inch high-pressure gas lines that are not accessible to individual users. Natural gas pipelines are located on both the McCormack-Williamson Tract and Staten Island. Staten Island has a high-pressure gas line that crosses the island along Staten Island Road. In addition, Staten Island has several existing easements for gas wells and pipelines. Twelve separate gas equipment areas were documented in the Staten Island Easement Documentation Report (2004).

Neither PG&E nor SMUD provides natural gas to the residences and businesses in the Project area. Propane is delivered by tanker trucks to users on an as-needed basis and is stored in individual propane tanks.

Stormwater and Drainage

Stormwater drainage networks consist of both natural and human-made conveyance systems to collect, convey, and store runoff resulting from a storm event. Flood control districts manage most stormwater drainage systems in urban areas and in some rural areas. Staten Island has a complex irrigation system, with approximately 9 miles of permanent irrigation canal that run adjacent to Staten Island Road, and terminate at the discharge pumping stations at the southern end of Staten Island.

Impervious surfaces in the South Delta are limited to roads, other small sections of pavement, and rural residential or agricultural structures. Stormwater in the North Delta agricultural area is drained primarily by overland flow into man-made ditches, natural drainage swales, and watercourses that discharge into waterways.

Wastewater

Wastewater treatment in Sacramento and San Joaquin Counties is divided into urban and rural service based on geography. Urban areas are serviced by collection and wastewater treatment facilities; in agricultural areas, septic tanks are acceptable means of wastewater treatment. Properties in the Project area are serviced by individual septic tanks.

Solid Waste Disposal

Solid waste disposal is provided and governed by the San Joaquin County Solid Waste Management Plan. This plan defines the programs for recycling, resource recovery, and disposal. Solid waste currently is disposed of at eight landfill sites in San Joaquin County (four are residential and four are commercial/industrial solid waste). Three of the County's landfills are expected to reach capacity within the planning horizon of their General Plan. The County has objectives that will help prolong the life of these facilities.

The County's trash services provide solid waste disposal to Staten Island residents. Solid waste pickup is classified into the "Central Valley A" area. In this area, trash is taken from residences and businesses to the Central Valley Transfer Station and then to the North County Landfill. The Central Valley

Transfer Station is privately owned and has a capacity of 1,700 tons per day. The North County Landfill is a class three landfill with a capacity of 825 tons per day. This landfill is expected to cease operations in 2035.

Communications

SBC COMMUNICATIONS INC. and Verizon provide communication services in the Project vicinity. SBC provides its services through underground fiber trunk lines and overhead lines attached to poles. The communication lines are typically aligned parallel to roadways and then traverse the roadways to supply individual service units.

A network of various telephone companies, cellular communication companies, and cable companies also serves the region. New service to specific sites is accomplished on a case-by-case basis.

Radio station KCRA leases land on the northwest corner of the McCormack-Williamson Tract for a radio communication tower.

Fire Services

Fire services in the Project vicinity are provided through mutual aid agreements. The Counties of Sacramento and San Joaquin each provide fire services. The Project site is served by the Thornton Fire Department, the closest responder to the site. The City of Thornton is east of the Project site and has access via Walnut Grove–Thornton Road. Estimated service times are based on the severity of the call and roadway conditions. Emergency services from Thornton are approximately 6–7 minutes. They receive about three calls per year for emergency service for Staten Island.

Roadway conditions can play a large role in the response times to Staten Island. The New Hope Bridge is the main link between the Thornton Fire Department and Staten Island. This bridge is jointly owned by Sacramento County and San Joaquin County. Millers Ferry Bridge is a swing bridge. In the event that the swing bridge is open, emergency response is slowed. When an emergency occurs, efforts are made to allow emergency response to take priority.

Other stations in the immediate area are Station Numbers 95 and 96 out of Walnut Grove. These are volunteer fire departments that have stations on both sides of the Sacramento River. Station Number 96 offers land, sea, and air response modes. The Walnut Grove Fire District does not have mutual aid agreements with San Joaquin County, meaning Staten Island. In the event that fire services are required, but are unable to be met, the Woodbridge Fire Department would respond to emergencies on Staten Island. However, the Woodbridge Fire Department is not to be used for station coverage.

The Woodbridge Fire District is also a first-responder to many of the river's rescue calls and has numerous personnel trained in flood rescue and several individuals certified in swift water rescue.

Police Services

The Sacramento County Sheriff's Department and the San Joaquin County Sheriff's Department provide police protection services to the North Delta. The calls for police service are prioritized by the severity of the crime and the status. This priority places life before property. Because of the uninhabited nature of the area, no police stations are in the Project vicinity. Response times to the area depend on call priority and the location of the nearest patrol car to the incident. The landscape in the Delta region comprises many islands that can be time-consuming to cross, as there are drawbridges and swing bridges in the region that can slow down response times. The Millers Ferry Bridge has the potential to reduce response times to the Project area when its swing bridge is open. The San Joaquin Sheriff's Department has jurisdiction over the Mokelumne River's waterways. The Sheriff's Department maintains a Swift Water Rescue (SWR) Unit and the Search & Rescue Delta Unit that is responsible for conducting swift water rescues for the approximate two calls per year. The Sheriff's Department has been committed to patrolling the Mokelumne River during the summer months and on weekends. When the Sheriff's Department is not patrolling, local fire departments respond to service calls.

Regulatory Setting and Significance Criteria

Regulatory Setting

This section summarizes any plans, policies, guidelines, or other regulations specific to the resource topic that may factor into determining impacts.

Wastewater

The Public Facilities Element of the Sacramento County General Plan and the Community Development Element of the San Joaquin County General Plan maintain policies for wastewater treatment facilities. The policies below relate to the Project in terms of relocating utility structures. The policy numbers appear before each policy.

Sacramento County

Policy PF-13 Public sewer systems shall not extend service into agricultural-residential areas outside the urban policy area unless the Environmental Health Department determines that there exists significant environmental or health risks created by private disposal systems serving existing development and no feasible alternative to public sewer service.

San Joaquin County

Policy 2) The following shall be minimum requirements for wastewater treatment facilities for the approval of tentative subdivision maps for new development…

Rural Communities	Septic System
Agricultural Areas	Septic System

Solid Waste

State

At the state level, management of solid waste is governed by regulation established by the CIWMB, which delegates local permitting, enforcement, and inspection responsibilities to Local Enforcement Agencies. In 1997, some of the regulations adopted by the State Water Quality Control Board (State Water Board) pertaining to landfills (Title 23, Chapter 15) were incorporated with CIWMB regulations (Title 14) to form Title 27 of the California Code of Regulations.

AB 939—California Integrated Waste Management Act

In 1989, the Legislature adopted the California Integrated Waste Management Act of 1989 (AB 939), which established an integrated waste management hierarchy that consists of the following in order of importance: source reduction, recycling, composting, and land disposal of solid waste. The law also required that each County prepare a new Integrated Waste Management Plan. The Act further required each city to prepare a Source Reduction and Recycling Element (SRRE) by July 1, 1991. AB 939 also requires cities and counties to prepare SRREs in their General Plan. Senate Bill (SB) 2202 made a number of changes to the municipal solid waste diversion requirements under the Integrated Waste Management Act. These changes included a revision to the statutory requirement for 50% diversion of solid waste to clarify that local governments shall continue to divert 50% of all solid waste on and after January 1, 2000.

San Joaquin County

Solid waste management and disposal are governed by the San Joaquin County Solid Waste Management Plan. This program defines programs for recycling, resource recovery, and disposal. As a policy of the San Joaquin County General Plan, solid waste disposal facilities shall not cause contamination of surface water or groundwater, as measured by state standards. In addition, all development shall be consistent with the County's Waste Management Plans.

Sacramento County

Policy PF-19) Develop recycling programs to be included in the County Integrated Waste Management Plan in order to meet the requirements of AB 939.

Objective: Collection, recycling, composting, transfer and disposal activities are funded primarily through customer service fees, facility-tipping fees, permit fees, etc. charged to private collectors, and monthly collection service charges on county residents. Fees are adjusted for any new recycling efforts, or other programs to cover the additional costs. Any new facilities and programs are financed through rate structures and tipping fees.

Electricity

State

The energy consumption of new buildings in California is regulated by State Building Energy Efficiency Standards, Title 24. These are contained in the California Code of Regulations, Title 24, Part 2, Chapter 2-53. Enforcement of the regulations is addressed in the California Code of Regulations, Title 20, Chapter 2, Subchapter 4, Article 1. Title 24 applies to all new construction of both residential and nonresidential buildings, and regulates energy consumed for heating, cooling, ventilation, water heating, and lighting. Title 24 is the minimum requirement for energy efficiency. Not all cost-effective efficiency is necessarily installed in projects.

The installation of housing and agricultural structures will be subject to Title 24 for energy efficiency standards.

San Joaquin County

Policy 23) The County shall promote energy efficiency in new residential construction through the implementation of state building standards and local subdivision and zoning standards.

Utility Corridors

San Joaquin County

Policy 1) The environmental assessment of new or expanded utility lines shall address the potential adverse impacts on development as a result of a rupture or malfunction, and shall identify mitigation measures to be adopted by the utility to safeguard against such accidents and to respond in the event of an accident.

Significance Criteria

Significance criteria for identifying impacts on utilities and public services are based on the CALFED Programmatic EIR/EIS and the State CEQA Guidelines Appendix G. Utilities and public services impacts are based on the displacement or modification of facilities and services because of either water-related facility development or economic stimulation. Utility and public service impacts are considered significant if implementation of the Project would:

- require the construction or expansion of electrical or natural gas transmission or distribution facilities;
- require the construction or expansion of a water conveyance or wastewater treatment facility or require new or expanded water supply entitlements;
- require the construction of new or expanded stormwater drainage facilities;
- require the construction or expansion of wastewater treatment facilities;
- cause the capacity of a solid waste landfill to be reached sooner than it would without the Project;
- require the construction or expansion of communications facilities (telephone, cell, cable, satellite dish);
- adversely affect public utility facilities that are located underground or aboveground along the local roadways form Project construction activities;
- create an increased need for new fire protection, police protection, or ambulance services or adversely affect existing emergency response times or facilities; or
- intersect with major infrastructure components, such as bridges or overpasses, requiring relocation of the components.

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term and cumulative effects of the CALFED Program.

The programmatic mitigation measures relevant to the Project are listed below:

1. Site project facilities and transmission infrastructure to avoid existing infrastructure.
2. Construct overpasses, small bridges, or other structures to accommodate existing infrastructure.
3. Coordinate construction activities with utility providers.
4. Design and operate facilities to minimize the amount of energy required and to maximize the amount of energy created.
5. Design project facilities to avoid or minimize their effect on existing infrastructure.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

With the implementation of the No Project alternative, in the short-term, the continuation of existing conditions would prevail. Implementation of the No Project Alternative would result in no construction activities, and the levees in the Project site would continue to operate under their current conditions. The Project vicinity would continue to face the existing threats from flooding.

No change would result in the regional demand for electricity, natural gas, or communications facilities compared to existing conditions. There would also be no change in local or regional water treatment systems, and no changes to north Delta agricultural diversions would occur. Stormwater, wastewater, and solid waste disposal services would remain unchanged in the Project vicinity, and there would be minimal change in the need for police or fire protection or ambulance services in the north Delta region compared to existing conditions, dependent on population trends. Potential for damage to utility lines and for delays in public services from flooding would continue.

According to the San Joaquin and Sacramento County General Plans, future urban development will result in the need for additional public services and utilities to serve the increased populations. However, development in rural settings is expected to grow at a much slower rate than the urban areas. Public services and utilities needed to support the growth planned for the counties are addressed in each county’s general plan. Future service provisions in the counties would not be affected by implementing the No Project Alternative.

Planned urban development and its required infrastructure would continue to be installed in accordance with each county’s general plan. Over the 20-year planning period, the anticipated minimal increase in population (See Section 6.2) would be faced with an increased threat of damage to utility systems and public safety concerns corresponding to increased impacts of flooding from levee failures. Emergency service response times will suffer from continued levee failures.

The No Project Alternative has the potential to significantly affect utilities and emergency public services. In the event that there is a severe flood or a levee failure, significant impacts would occur. Underground and aboveground utilities would have the potential to be destroyed, resulting in the interrupted service to residents. This impact is worsened by the increase in response times that have the potential to occur in the event that roadways are made impassable.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PUB-1: Increase in Use of Energy.

Construction of the proposed new levees and demolition of the proposed old levees and weirs would require the use of heavy equipment such as scrapers and bulldozers that use diesel fuels. Dredging would require the use of heavy equipment such as barges, cranes, and pumps that use diesel fuels as well. A slight increase in energy would be required to relocate existing structures such as pipelines and aboveground transmission lines to new locations outside the intertidal zones. However, construction activities are short-term and would not require a significant amount of energy to complete. The Project would not result in a substantial long-term permanent increase in energy use. Retrofitting the pump station would require minimal amounts of energy. The siphon only needs to be retrofitted to accommodate the new purpose.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in the Capacity of Local Solid Waste Landfills.

Excavation during construction would generate the greatest amount of waste material. The majority of the waste from earthmoving activities would be disposed of on site and used for new levee construction, as long as it is clean waste material. The small amount of waste that may require landfill disposal is not expected to substantially decrease the existing lifespan of landfills in the Project vicinity.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services.

Implementation of Alternative 1-A would create large spans of intertidal habitat. To create this intertidal habitat, utilities would need to be relocated outside the intertidal zones to avoid significant adverse effects. Above- and below-ground utilities exist among different service providers. These utilities include electrical, communication, natural gas, and septic tanks. Relocation of these utilities would require consultation with the service provider, removal or dismantling of the utility lines, and then reconstruction of the lines in their new locations. The electrical, telephone, and gas lines that run across the McCormack Williamson Tract provide service to consumers outside the Project area. Removing these utilities potentially would disrupt services to residences and businesses in the Project area. The CALFED Programmatic ROD requires that all project-specific actions follow mitigation measures that help to reduce impacts on utility infrastructure. Implementing CALFED ROD Mitigation Measures 3 and 5 would ensure that disruption to local utility services would be avoided. The measures require that construction activities be coordinated with utility providers and that the Project impacts on utilities be avoided or minimized. The measures would ensure that utility services are not disrupted as a result of Project construction or operation.

Underground utilities in the Project area that cross below the Mokelumne and South Fork Mokelumne Rivers could be affected by dredging activities. An environmental commitment to locate and avoid all underground utilities during dredging operations is described in Chapter 2, “Project Description.” This environmental commitment would avoid any impacts on utilities attributable to dredging.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-4: Increase in Emergency Service Response Times.

A small number of farm workers are living in trailers on the McCormack-Williamson Tract that have the potential to require emergency services. Implementation of the Project would change the land use from agricultural to conservation, eliminating the farming and the one remaining vacant home from the area. Relocation of the workers would reduce the need for emergency services.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PUB-1: Increase in Use of Energy.

Energy required for the construction of levees and weirs is discussed under Alternative 1-A. See the corresponding impact for a discussion.

Retrofitting the agricultural siphon and pump station would be required to allow drainage of the tract before summer. The retrofitting would require minimal amounts of energy usage in addition to the energy usage discussed under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in Capacity of Local Solid Waste Landfills.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-4: Increase in Emergency Service Response Times.

Impacts on emergency response times are the same as under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PUB-1: Increase in Use of Energy.

Impacts from construction of the levees for Alternative 1-C would be the same as under Alternative 1-A, except that the amount of soil imported would increase. This soil transfer would increase energy use for fuels and dredging actions. Dredging may be accomplished through either land- or water-based transfers. A determination on which option is best for the Project will be determined at a later time. However, construction activities are short-term, and would not require significant amounts of energy usage. No substantial increase in energy use would occur.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in the Capacity of Local Solid Waste Landfills.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-4: Increase in Emergency Service Response Times.

Impacts on emergency response times are the same as under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee

- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PUB-1: Increase in Use of Energy.

Constructing levees, weirs, and other Project elements would require the use of heavy equipment. This equipment would most likely be scrapers and bulldozers that use diesel fuels.

Retrofitting the pump station would require minimal amounts of energy. The siphon only needs to be retrofitted to accommodate the new purpose.

The replacement or retrofitting of the Millers Ferry and the New Hope Bridge would require energy for construction. Cranes and other heavy machinery would be required to construct these components. Construction activities are short-term and would not require substantial amounts of energy use. No long-term permanent increase in energy use would occur.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in Capacity of Local Solid Waste Landfills.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services.

Alternative 2-A would create a large detention basin that would be filled with water during the wet seasons. Relocation of utilities including electrical, communication, natural gas, or septic tanks outside the detention zones would be required. Above and below ground utilities exist among different service providers. Relocation of these utilities would require consultation with the service provider, dismantling/deconstruction of the existing utility line and construction of the new lines. The electrical, telephone, and gas lines that run across Staten Island extend to customers outside the Project area. The removal process has the potential to temporarily disrupt utility service to these clients. Propane tanks would also be removed and relocated.

The new detention basin would require that electric lines that run along Staten Island Road be relocated to continue to provide services to residents south of the Project site.

The CALFED Programmatic ROD requires that all Project-specific actions follow mitigation measures that help to reduce impacts on utility infrastructure. Implementing CALFED mitigation measures “3” and “5” would ensure that disruption to local utility services would be avoided. There measures require that construction activities be coordinated with utility providers and that the Project impacts on utilities be avoided or minimized. The measures would ensure that utility services are not disrupted as a result of Project construction or operation.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-4: Increase in Emergency Service Response Times.

Emergency service response times may increase during construction of the levees and retrofitting or replacement of the bridges. Constructing the levees and detention basins would require the realignment of the Walnut Grove–Thornton and Staten Island Roads. The existing Walnut Grove–Thornton Road is expected to remain open for use during construction; therefore, there should be, at worst, minimal disruption in traffic patterns or emergency vehicle access. Emergency service access to the residents on Staten Island would be provided by construction detours. As referenced in the Project description, the temporary route would be paved, striped, and signed. This route may be in use for up to 45 days. The temporary increase in response time attributable to construction of the levees and detention basins is expected to be only a couple of minutes. In the event that emergency services are required, construction equipment would comply by moving to allow the fastest response possible.

Construction activities for the Millers Ferry and the New Hope Bridges would temporarily increase response times to the residents on Staten Island. The

Millers Ferry Bridge would not result in significant impacts on emergency response as the closest responder for fire and medical service is stationed in Thornton. However, police protection would have the potential to be affected if the closest responder to the Project site is on the Walnut Grove side of the Millers Ferry Bridge.

The construction activities for the New Hope Bridge would result in potential impacts. The closure of the bridge would reroute the Thornton Fire Department's response to the Project site. The increased distance for response would be approximately 12 miles, requiring the Thornton Fire Department to travel to Twin Cities Road and then down to Staten Island.

The retrofitting or replacement of the Millers Ferry and the New Hope Bridges has the potential to increase response times. The City of Walnut Grove has a volunteer fire department that responds to emergencies. This fire department does not have a mutual aid agreement with the San Joaquin County fire departments. They would respond in the event that there was a need, but this fire station is not to be used for station coverage.

The Project description allows for the bridge construction to be staged to ensure that access is maintained to Staten Island and Dead Horse Island residents.

This alternative has the potential to impact the existing roadway infrastructure and emergency vehicle response times during flood events. As depicted in the Project description, the Walnut Grove–Thornton Road is integrated with the inlet weir; the roadway would be closed to all traffic when water is overflowing the weir. Staten Island residents would have access across the Millers Ferry Bridge to get off the island during storm events. The New Hope Bridge would be barricaded and no access allowed. During periods of detention basin operation (which is designed to be less frequent than the 10-year flood event), the west levee of Staten Island that would be improved to provide temporary access would be used for temporary access during flood events. This would minimally increase response times.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PUB-1: Increase in Use of Energy.

Impacts are the same as under Alternative 2-A, except for the addition of the optional recreational area. Please see corresponding impact for discussion.

The proposed recreational area would include a new parking facility and a restroom. This restroom would require wastewater services and electricity. Infrastructure would need to be provided to supply these facilities. Construction of the facilities would require a temporary increase in energy, and the operation of the facilities would require a permanent increase in energy.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in Capacity of Local Solid Waste Landfills.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services.

This impact would be the same as described for Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-4: Increase in Emergency Service Response Times.

Impacts on emergency response times are similar to those found in Alternative 2-A discussion. The detention basin in Alternative 2-B is on the west side of the island. All structures would be moved to outside the detention basin zone and would be accessible by roadways during both construction and operational periods.

Impacts caused by bridgework remain the same. See the corresponding impact under Alternative 2-A for a discussion.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee

- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PUB-1: Increase in Use of Energy.

This impact is the same as described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in Capacity of Local Solid Waste Landfills.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services.

This impact would be the same as described under Alternative 2-A.

Impact PUB-4: Increase in Emergency Service Response Times.

Impacts on emergency response times are similar to those found under Alternative 2-B. The difference between the two alternatives involves the utilities that need to be removed to allow for the new detention basin. The detention basin in Alternative 2-C is on the east side of the island. All structures would be removed outside the detention basin zone and would be accessible by roadways.

Impacts caused by bridgework remain the same. See the corresponding impact under Alternative 2-A for a discussion.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact PUB-1: Increase in Use of Energy.

Dredging activities would be of longer duration than under Alternative 1-A, but do not require substantial amounts of energy use. The replacement or retrofitting of the Millers Ferry or the New Hope Bridge would require energy for construction. Cranes and other heavy machinery would be required to construct these components. Construction activities are short-term and would not require substantial amounts of energy use. No long-term permanent increase in energy use would occur.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-2: Reduction in Capacity of Local Solid Waste Landfills.

This impact is the same as described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PUB-3: Disruption of Utility Services.

There are underground utilities in the project area crossing below the Mokelumne and South Fork Mokelumne Rivers that could be affected by dredging activities. An environmental commitment to locate and avoid all underground utilities during dredging operations is described in Chapter 2, “Project Description.” This environmental commitment would avoid any impacts on utilities attributable to dredging.

Determination of Significance: No impact.

Mitigation: None required.

Impact PUB-4: Increase in Emergency Service Response Times.

Emergency service response times may increase during retrofitting or replacement of the bridges. Construction activities for the Millers Ferry and the New Hope Bridges would temporarily increase response times to the residents on Staten Island. The Millers Ferry Bridge would not result in significant impacts on emergency response as the closest responder for fire and medical service is stationed in Thornton. However, police protection would have the potential to be affected if the closest responder to the Project site is on the Walnut Grove side of the Millers Ferry Bridge.

The construction activities for the New Hope Bridge would result in potential impacts. The closure of the bridge would reroute the Thornton Fire Department’s response to the Project site. The increased distance for response would be approximately 12 miles, requiring the Thornton Fire Department to travel to Twin Cities Road and then down to Staten Island.

The Project description allows for the bridge construction to be staged to ensure that access is maintained to Staten Island and Dead Horse Island residents.

This alternative has the potential to affect the existing roadway infrastructure and emergency vehicle response times during flood events. Staten Island Residents would have access across the Millers Ferry Bridge to get off the island during storm events. The New Hope Bridge would be barricaded and no access allowed. During periods of detention basin operation (which is designed to be less frequent than the 10-year flood event), the west levee of Staten Island that would be improved to provide temporary access would be used for temporary access during flood events. This would minimally increase response times.

Determination of Significance: Less than significant.

Mitigation: None required.

5.4 Power Production and Energy

Analysis Summary

Minor amounts of electrical energy would be required to operate pumping stations on McCormack-Williamson Tract and Staten Island. Because the amount of electrical energy that would be required to operate any of the alternatives being considered in this document would be so minor compared to the amount of electrical energy that is generated and used by the power providers, impacts are considered less than significant, and no mitigation measures are necessary.

Introduction

Electric power would be required to operate several key project facilities, primarily those required to drain flooded detention areas on McCormack-Williamson Tract and Staten Island and for habitat irrigation on McCormack-Williamson Tract. This section evaluates the ability of local power providers to serve this Project need. In addition, this section considers the overall energy use by the Project to evaluate the potential for inefficient, wasteful, or unnecessary consumption of nonrenewable resources.

Sources of Information

The following key sources of information were used in the preparation of this section:

- CALFED Bay-Delta Program draft programmatic environmental impact statement/environmental impact report. July, 2000.
- Pacific Gas & Electric Company. Information regarding Pacific Gas & Electric Company. Accessed online at <http://www.pge.com>, 2006
- Sacramento Municipal Utility District. Information regarding Sacramento Municipal Utility District. Accessed online at <http://www.smud.org>, 2006.

Assessment Methods

For this analysis, anticipated power use by the various Project elements was compared to the amount of electrical power generated by the suppliers to assess the need for additional power production facilities to serve the Project need.

Physical Setting/Affected Environment

Electric power use in the Project area is primarily for agricultural purposes, including the diversion of water from the Mokelumne River and other waterways into interior farms and internal distribution of water within these farms.

In the Sacramento County portion of the Project area, SMUD provides electric power. SMUD also serves part of Placer County, a 900-square-mile service area comprising more than 1,200,000 people. It is an independent, customer-owned utility established in 1923 pursuant to the California Municipal Utility District Act by a vote of the electorate. SMUD's primary activity is the generation, transmission, distribution, and sale of electric power from hydroelectric, cogeneration, combustion turbine, wind turbine, and solar photovoltaic resources. SMUD also purchases power from other utilities. The SMUD system has 10 transmission bulk substations, 500 circuit miles of transmission lines, and 9,885 circuit miles of distribution lines.

In the San Joaquin County portion of the project area, electric power is provided by PG&E. PG&E was established in 1905 and provides gas and electric service to millions of people in California. Sources of electricity include hydroelectricity and nuclear power. It operates the largest utility hydroelectric system in the United States, with 68 powerhouses and 174 dams between Redding and Bakersfield. It owns thousands of miles of power lines and gas pipeline.

Major facilities associated with SWP and CVP power production and use, such as those described in the CALFED Programmatic EIS/EIR, are not directly related to electric power use in the Project area. Hydrologic changes associated with the Project, which occur primarily during flood events, are not expected to affect power production and use by SWP or CVP facilities.

Regulatory Setting and Significance Criteria

Regulatory Setting

No specific regulations govern local power use by farmers and other users in the Project area. Hookups to electric power are provided by the utilities, and electric bills are paid by the consumers.

Significance Criteria

An alternative would result in a significant impact on power production if it would:

- exceed the available capacity of electric power supplies, and thereby require or result in the construction of new electric power generation or distribution facilities or expansion of existing facilities; or

- result in the inefficient, wasteful, or unnecessary consumption of nonrenewable resources.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

Existing power use in the project area is primarily for farming. If the No Project Alternative is implemented, this use is expected to remain similar to existing conditions.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PPE-1: Change in Power Consumption.

Power consumed on McCormack-Williamson Tract is associated primarily with operation of agricultural irrigation and drainage pumps. Implementing Alternative 1-A would result in decommissioning four electric pumps with a combined rating of 121 horsepower and four pumps powered by either diesel fuel or propane with a combined rating of 322 horsepower (Tables 2-3 and 2-4). Two existing electric pumps with a combined rating of 35 horsepower would be retained but operated less frequently than under existing conditions, and two existing gasoline powered pumps with a combined rating of 10 horsepower would be retained and operated in a manner similar to existing conditions (Tables 2-3 and 2-4). Compared to existing conditions, Alternative 1-A would result in a reduction in the consumption of electricity and fossil fuels.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*

- Enhance Delta Meadows Property *(optional)*

Impact PPE-1: Change in Power Consumption.

The change in power consumption if Alternative 1-B was implemented would be similar to the change described for Alternative 1-A. Power consumption is expected to decrease because fewer electric and diesel/propane irrigation and drainage pumps would be operated.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property

- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PPE-1: Change in Power Consumption.

The change in consumption of power if Alternative 1-C is implemented would be similar to the change described for Alternative 1-A. Consumption is expected to decrease because fewer electric and diesel/propane irrigation and drainage pumps would be operated.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PPE-1: Change in Power Consumption.

Power consumed on Staten Island is primarily associated with operation of agricultural irrigation and drainage pumps. Because agricultural production is expected to continue on the island, most of these pumps would remain in operation. However, additional pumps would be required to drain the detention basin. Use of these pumps would not increase demand for electricity because they would be diesel-powered. The pumps are not expected to result in a substantial increase in the use of diesel fuel because they would be operated only after a storm event large enough to fill the detention basin (10-year event or greater) and would be operated only as long as required to drain the detention base (up to 30 days).

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PPE-1: Change in Power Consumption.

The impact on power production would be similar to that described for Alternative 2-A. Fuel consumption associated with the Alternative 2-B detention basin pumps would be less than that for Alternative 2-A because of the smaller size of the detention basin and the smaller pumps.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PPE-1: Change in Power Consumption.

The impact on power production would be similar to that described for Alternative 2-A. Fuel consumption associated with the Alternative 2-C detention basin pumps would be less than that for Alternative 2-A because of the smaller size of the detention basin and the smaller pumps. Fuel consumption associated with this alternative would be slightly less than Alternative 2-B.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*

Impact PPE-1: Change in Power Consumption.

The impact on power consumption is not expected to change with implementation of Alternative 2-D because land management activities would not change.

Determination of Significance: Less than significant.

Mitigation: None required.

5.5 Visual Resources

Analysis Summary

This section describes the existing environmental conditions and the consequences of the proposed project on visual resources and aesthetics in the project vicinity. Specifically, this section evaluates and discusses the effects of the construction and operation of the project in terms of changes to visual character and quality, visibility of proposed changes, and viewer response to and significance of those changes. Significance of impacts is determined by using significance criteria set forth in the State CEQA Guidelines.

No significant impacts on visual resources were determined in this analysis. No mitigation for visual resources impacts is required.

Introduction

Concepts and Terminology for Visual Assessment

In Webster's *New World Dictionary*, *aesthetics* is defined as "the study or theory of beauty and the psychological responses to it." Aesthetics (or visual resources) analysis is, therefore, a process to logically assess visible change and viewer response to that change.

Identification of existing conditions with regard to visual resources entails three steps:

1. Objective identification of the visual features (visual resources) of the landscape.
2. Assessment of the character and quality of those resources relative to overall regional visual character.
3. Identification of the importance to people, or sensitivity, of views of visual resources in the landscape.

Visual Quality

Visual quality is evaluated using the well-established approach to visual analysis adopted by the Federal Highway Administration (FHWA), employing the concepts of vividness, intactness, and unity (Federal Highway Administration 1983). These terms are defined below.

- **Vividness**—The visual power or memorability of landscape components as they combine in striking or distinctive visual patterns.

- **Intactness**—The visual integrity of the natural and artificial landscape and its freedom from encroaching elements. Intactness can be present in well-kept urban and rural landscapes, as well as in natural settings.
- **Unity**—The visual coherence and compositional harmony of the landscape considered as a whole; it frequently attests to the careful design of individual components in the artificial landscape.

The appearance of the landscape is described below using these criteria and descriptions of the dominance of elements of form, line, color, and texture. These elements are the basic components used to describe visual character and quality for most visual assessments (U.S. Forest Service 1974, Federal Highway Administration 1983). In addition to their use as descriptors, vividness, unity, and intactness are used more objectively as part of a rating system to assess a landscape's visual quality. This rating system includes seven categories, ranging from very low to moderate to very high. Viewer sensitivity or concern is based on the visibility of resources in the landscape, the proximity of viewers to the visual resource, the relative elevation of viewers to the visual resource, the frequency and duration of views, the number of viewers, and the types and expectations of individuals and viewer groups.

The criteria for identifying importance of views are related in part to the position of the viewer relative to the resource. An area of the landscape that is visible from a particular location (e.g., an overlook) or series of points (e.g., a road or trail) is defined as a viewshed. To identify the importance of views of a resource, a viewshed may be broken into distance zones of foreground, middleground, and background. Generally, the closer a resource is to the viewer, the more dominant it is and the greater is its importance to the viewer. Although distance zones in viewsheds may vary between different geographic regions or types of terrain, a commonly used set of criteria identifies the foreground zone as 0.4–0.8 kilometer (0.25–0.5 mile) from the viewer, the middleground zone as extending from the foreground zone to 4.8–8 kilometers (3–5 miles) from the viewer, and the background zone as extending from the middleground zone to infinity (U.S. Forest Service 1974).

Visual sensitivity also depends on the number and type of viewers and the frequency and duration of views. Generally, visual sensitivity increases with an increase in total numbers of viewers, the frequency of viewing (e.g., daily or seasonally), and the duration of views (i.e., how long a scene is viewed). Also, visual sensitivity is higher for views seen by people who are driving for pleasure; people engaging in recreational activities such as hiking, biking, or boating; and homeowners. Sensitivity tends to be lower for views seen by people driving to and from work or as part of their work (U.S. Forest Service 1974, Federal Highway Administration 1983, U.S. Soil Conservation Service 1978). Views from recreation trails and areas, scenic highways, and scenic overlooks are generally assessed as having high visual sensitivity.

Sources of Information

The following key sources of information were used in the preparation of this section:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000;
- California Department of Transportation Scenic Highway System, 2004; and
- field visits and photographic documentation.

Physical Setting/Affected Environment

Regional Visual Character

The Delta is a relatively flat and expansive area that occupies 1,100 square miles at the confluence of the Sacramento and San Joaquin Rivers. State Routes (SRs) 12 and 160 are designated scenic highways running through the region. The major population centers of the San Francisco Bay Area and the cities of Sacramento and Stockton are located in the surroundings of the Delta (San Joaquin County General Plan 1992).

As an agricultural region, the Delta is one of extensively managed landforms and waterways, largely altered from their natural state. By the end of World War I, the Delta had been transformed from a large tidal marsh into the series of channels and leveed islands visible today. Because much of the Delta's land is below sea level, miles of levees are relied on for its protection against flooding. The highly managed hydrology and topography support agriculture, recreation, and other human-influenced land uses, further taking the Delta out of a natural visual context (California Department of Water Resources 1995).

With 700 miles of interconnected waterways, the Delta is a unique resource providing recreational opportunities such as boating, swimming, fishing, water-skiing, and bird watching (San Joaquin County General Plan 1992). Many of the human-made channels have noticeable visible differences from natural water bodies. Features such as diversion structures; regular, evenly sloped and riprapped banks; minimal vegetation; and uniform, often straight, courses characterize many of the waterways.

Because of the minimal topographic variation within the Delta, views are fairly homogeneous in form, texture, and color. Foreground views are typically composed of large areas of flat agricultural land interspersed with levees, waterways, tree clusters, and occasional residential or commercial tracts. Irrigated agricultural uses separate the land protected by levees into orderly, cultivated rows and grids. On clear days, the Sierra Nevada and Coast ranges are noticeable in the eastern and western backgrounds, respectively. Mount Diablo is very visible to the southwest under most atmospheric conditions. Overhead transmission lines cross the region, as do above-surface pipelines. Electricity-generating wind turbines are visible in the Rio Vista area.

Many of the residences in the area are rural and associated with farm operations, with the exception of the population centers of Walnut Grove, Locke, Courtland, Isleton, and Rio Vista and the outlying growth areas of Discovery Bay, Stockton, and Elk Grove, which encroach into the agricultural lands at the fringes of the Delta. Rural residences tend to include clusters of buildings surrounded by mature landscaping and large trees.

Toward the northeastern edge of the Delta and in the immediate Project area, four large transmission towers dominate the view above the horizon. Because of their slender profile, they do not present a major visual obstruction or intrusion. However, at night, these transmission towers (and a lesser fifth tower) are quite visible from many miles away. Two of the large towers are illuminated for safety with slowly pulsing red strobes; the other two large towers are illuminated with quickly flashing white lights. These lights are quite attention-getting, especially contrasting against the otherwise minimally lit nighttime sky.

Despite the homogeneity of views and the obvious imprint of humans upon the landscape, the area retains an open-space character that is rural and somewhat naturalistic because of vegetative greenery of agricultural crops and stands of native plants, high visibility of numerous waterways, and the lack of permanent structures. In fact, the Delta region is enjoyed for its scenic character and quality by many recreationists by car, boat, and motorcycle. The overall quality of the region is considered high in vividness (largely because of the omnipresent views of water) and moderately high in intactness and unity.

Local Visual Character, Visibility of the Project, and Viewer Sensitivity

The North Delta’s visual character is similar to that of the region as a whole: meandering waterways dividing large flat agricultural lands, often protected by constructed levees. Foreground views from the levees are mainly of roadside vegetation and cultivated fields on the landside and open water on the waterside. Waterside views tend to attract the viewer in contrast to the agricultural fields of the landside. Visual quality ratings in the Project area are also similar: high in vividness and moderately high in intactness and unity.

Figures 5.5-1 through 5.5-20 illustrate visual conditions in the Project area.

Visibility of the project and viewer sensitivity are best categorized by viewer groups, distinguished by the activity that draws the viewer to the Project area. (i.e., the opportunity for the view).

Roadway Users

Major roadways in the area are Twin Cities Road to the north, SR 12 to the south, River Road to the west, and Walnut Grove–Thornton Road and New Hope Road running through the Project (connected via Thornton Road). I-5 runs north-south to the east of McCormack-Williamson Tract and Staten Island. Twin Cities Road and Walnut Grove–Thornton Road are major arterials between the river communities and I-5, characterized by a mix of commercial, commuter, recreation, and local traffic. New Hope Road and Thornton Road are almost exclusively local traffic.

Speeds on these roadways generally range from 35 to 55 mph, with the exception of I-5, which is posted at 70 mph. At such speeds, views are of short duration, fleeting, and unfocused, as roadway travelers tend to be looking at surrounding traffic, road signs, and their immediate surroundings within the automobile. Exceptions to this characterization are roadway travelers on New Hope Road and Walnut Grove–Thornton Road, which are affected by the Project or are directly adjacent to proposed actions.

Viewers who frequently travel along these roads, such as commercial and local roadway users, generally possess low visual sensitivity to their surroundings (residents are discussed as a separate viewer group). The passing landscape is typically not the focus of their attention. Infrequent roadway users, such as recreationists, will have only minimal visibility of the Project because of the speeds at which they are traveling, distance from the Project, and limited direct vantage points of the Project. For these reasons, roadway users are not considered to be highly sensitive to the Project.

Residents/Local Workers

Residences and businesses are found primarily along roadways as described above and along the North and South Forks of the Mokelumne River, and residences are found on Staten Island. The community of Walnut Grove lies on the western boundary of the project area. Residents living along Walnut Grove–Thornton Road, Thornton Road, New Hope Road, and River Road most likely would be affected by views of increased construction traffic. Residents living adjacent to the Mokelumne River, Staten Island Road, and New Hope Road would have direct views of construction and proposed project components on the Mokelumne River and within McCormack-Williamson Tract and Staten Island, and are generally considered to have high visual sensitivity. Workers in the area are predominantly employed at agricultural facilities and are generally not considered sensitive viewers, as outside views are inconsequential to their jobs.

Recreationists

Recreationists who will view the proposed project use the Delta for fishing, water sport activities, motor touring, and bird watching. Viewers in this category are more likely to regard the natural and built surroundings as a holistic visual experience, rather than momentary flashes of a viewshed's individual appearance. Proportionately, especially during weekdays, recreationists are a relatively insignificant subset of overall users; however, this viewer group grows greatly on weekends. Bicyclists also use many of the levee roads throughout the Delta but are not common in the northeast Delta region (the Project area).

Boaters' views are mostly short in range because of the height of the surrounding levees. Foreground views from the waterways include riprapped levees, riparian and emergent vegetation, instream islands, agricultural pumps, and occasional riverside docks and residences. Recreationists are considered to have very high visual sensitivity.

Existing Sources of Light and Glare in the Project Vicinity

Because of the extensive agricultural land use and general lack of buildings, the Project area is sparsely lit, with the notable exceptions of the transmission towers discussed above. Residences, farm buildings, commercial establishments, and other structures in the project vicinity are the primary sources of nighttime light. Waterways contribute to daytime glare.

Assessment Methods

Analysis of the visual effects of the project are based on:

- direct field observation from key vantage points such as public roadways;
- photographic documentation of key views of and from the project site, as well as regional visual context; and
- review of the project in regard to compliance with state and local ordinances and regulations and professional standards pertaining to visual quality.

With an establishment of the existing (baseline) conditions, a proposed project or other change to the landscape can be systematically evaluated for its degree of impact. The degree of impact depends both on the magnitude of change in the visual resource (i.e., visual character and quality) and on viewers' responses to and concern for those changes. This general process is similar for all established federal procedures of visual assessment (Smardon et al. 1986) and represents a suitable methodology of visual assessment for other projects and areas.

The approach for this visual assessment is adapted from FHWA's visual impact assessment system (Federal Highway Administration 1983) in combination with other established visual assessment systems. The visual impact assessment process involves identification of:

- relevant policies and concerns for protection of visual resources;
- visual resources (i.e., visual character and quality) of the region, the immediate project area, and the project site;
- important viewing locations (e.g., roads) and the general visibility of the project area and site using descriptions and photographs;
- viewer groups and their sensitivity; and
- potential impacts.

Regulatory Setting and Significance Criteria

Regulatory Setting

Federal

No federal laws or policies regarding visual resources are known to apply directly to the Project.

State

Johnston-Baker-Andal-Boatwright Delta Protection Act of 1992

At a state and local level, the Johnston-Baker-Andal-Boatwright Delta Protection Act of 1992, incorporated into Section 21080.22 and Division 19.5 of the California Public Resources Code, facilitates the recognition, preservation, and protection of Delta resources for the use and enjoyment of current and future generations. The act includes a series of findings and declarations related to the quality of the Delta environment. Protecting the unique resources of the Delta is emphasized as national, state, and local importance. It is emphasized that the protection of these resources will best be achieved through implementation of land use planning and management practices by local governments, in compliance with a comprehensive, long-term resource management plan under the act.

California Department of Transportation State Scenic Highway Program

California's Scenic Highway Program was created by the California State Legislature in 1963. Its purpose is to preserve and protect scenic highway corridors from change that would diminish the aesthetic value of lands adjacent to highways. A highway may be designated scenic depending upon how much of the natural landscape can be seen by travelers, the scenic quality of the landscape, and the extent to which development intrudes on the traveler's enjoyment of the view. The State Scenic Highway System lists highways that are either eligible for designation as scenic highways or have been so designated. The status of a state scenic highway changes from eligible to officially designated when the local jurisdiction adopts a scenic corridor protection program, applies to the Caltrans for scenic highway approval, and receives notification from Caltrans that the highway has been designated as a scenic highway. For the purpose of visual resource protection, this analysis treats eligible roadways as having the same status as officially designated roadways (California Department of Transportation 1996).

Examples of visual intrusions that would degrade scenic corridors as stipulated by Caltrans include dense and continuous development, highly reflective surfaces, parking lots not screened or landscaped, billboards, noise barriers, dominance of power lines and poles, dominance of exotic vegetation, extensive cut and fill, scarred hillsides and landscape, and exposed and unvegetated earth (California Department of Transportation 1996).

SR 160 is a designated scenic highway in the Project area but will not be affected because the proposed actions are not visible or are only minimally visible from the road.

Local

County of Sacramento General Plan

The Sacramento County General Plan includes the following objectives, goals, and policies that may apply to the visual resources analysis of the project alternatives:

Objective

Low glare external building surfaces and light fixtures that minimize reflected light and focalize illumination.

Policies

LU-22: Exterior building materials on nonresidential structures shall be composed of a minimum of 50 percent low-reflectance, non-polished finishes.

LU-23: Bare metallic surfaces such as pipes, flashing, vents and light standards on new construction shall be painted so as to minimize reflectance.

LU-24: Require overhead light fixtures to be shaded and directed away from adjacent residential areas.

LU-25: Require exterior lighting to be low-intensity and only used where necessary for safety and security purposes.

Scenic Highways Element

The Scenic Highways Element of the Sacramento County General Plan attempts to strike a balance between the goal of scenic preservation and that of minimizing vehicle miles traveled.

Goal 1: To preserve and enhance the aesthetic quality of scenic roads without encouraging unnecessary driving by personal automobile.

Objective 1: To retain designation of the River Road (State Highways 160 and 84) as an Official State Scenic Highway and to preserve and enhance its scenic qualities.

Objective 4: To strengthen the provisions of scenic corridor regulations so as to further protect the aesthetic values of the County's freeways and scenic roads. (County of Sacramento General Plan 1997)

San Joaquin County General Plan

The San Joaquin County General Plan includes the following objectives, goals, and policies that may be applicable to the visual resources analysis of the project alternatives:

Open Space

Goal: Views of waterways, hilltops, and oak groves from public land and public roadways shall be protected.

Goal: Outstanding scenic vistas shall be preserved and public access provided to them whenever possible.

Goal: Development proposals along scenic routes shall not detract from the visual and recreational experience.

Goal: Waterway development and development on Delta islands shall protect the natural beauty, the fisheries, wildlife, riparian vegetation, and the navigability of the waterway. (San Joaquin County General Plan 1992.)

Significance Criteria

In addition to the specific state and local laws, ordinances, regulations, and standards for visual resources described above, the proposed project is subject to federal and state guidelines and professional standards below.

Federal Criteria

The Federal 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material is another federal regulation considered when determining aesthetics impacts. These guidelines relate the aesthetic quality of aquatic ecosystems with the quality of life enjoyed by the general public and property owners. The 404(b)(1) Guidelines find that a dredged or fill material discharge into aquatic environments may have a potentially significant impact on aesthetic resources if it:

- mars the beauty of natural aquatic ecosystems by degrading water quality, creating distracting disposal sites, inducing inappropriate development, encouraging unplanned and incompatible human access, or by destroying vital elements that contribute to the compositional harmony or unity, visual distinctiveness, or diversity of an area;

- adversely affects the particular features, traits, or characteristics of an aquatic area that make it valuable to property owners; or
- degrades water quality, disrupts natural substrate and vegetation characteristics, denies access to or visibility of the resource, or results in changes in odor, air quality, or noise levels, thereby potentially reducing the value of an aquatic area to private property owners.

State Criteria

According to Appendix G of the State CEQA Guidelines, as amended in 1998, visual resource impacts are considered significant if a project has a "substantial, demonstrable negative aesthetic effect." Based on professional standards and practices, a project would normally be considered to have a significant impact it if would:

- conflict with adopted visual resource policies;
- substantially reduce the vividness, intactness, or unity of high-quality views; or
- introduce a substantial source of light and glare into the viewshed.

Professional Standards

According to professional standards, a project may be considered to have significant impact if it would significantly:

- conflict with local guidelines or goals related to visual quality;
- alter the existing natural viewsheds, including changes in natural terrain;
- alter the existing visual quality of the region or eliminate visual resources;
- increase light and glare in the project vicinity;
- result in backscatter light into the nighttime sky;
- result in a reduction of sunlight or introduction of shadows in community areas;
- obstruct or permanently reduce visually important features that are in Variety Classes A (high in vividness, intactness, unity) and B (moderate in vividness, intactness, unity), and can be viewed from visually sensitive areas (CALFED Bay-Delta Program 2000); or
- result in long-term (that is, persisting for 2 years or more) adverse visual changes or contrasts to the existing landscape as viewed from areas with high visual sensitivity within 3 miles (also considering how many viewing sites would be affected). (CALFED Bay-Delta Program 2000.)

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic ROD includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project specific actions. The mitigation measures address the short-term, long-term and cumulative effects of the CALFED Program.

The discussion of significant impacts and mitigation measures within this section may include a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the proposed project.

Visual Resources Programmatic Mitigation Measures

- Minimize construction activities during the peak-use recreation season.
- Avoid unnecessary ground disturbance outside the necessary construction area.
- Water areas where dust is generated, particularly along unpaved haul routes and during earth-moving activities, to reduce visual impacts caused by dust.
- Revegetate disturbed areas as soon as possible after construction.
- Locate visually obtrusive features, such as borrow pits and dredged material disposal sites, outside visually sensitive areas and observation sites.
- Select vegetation type, placement, and density to be compatible with patterns of existing vegetation where revegetation occurs in natural areas. Vegetation such as emergent marsh grasses that can tolerate period flooding and drying may be useful.
- Use native trees, bushes, shrubs and ground cover for landscaping, when appropriate, at facilities such as dams and pumping-generating plants, and along new and expanded canals and conveyance channels, in a manner that does not compromise facility safety and access.

Impacts and Mitigation of the Project Components

Alternative NP: No Project

If the No Project Alternative is selected, no construction activities associated with Project facilities would occur. The visual character of the project would remain the same. Thus, there would be no impact.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property (*optional*)

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

Construction of the proposed project would create temporary changes in the views of and from the project area. Construction activities would introduce heavy equipment and associated vehicles, including cranes, scrapers, excavators, and graders, into the viewshed of the Project. However, the Project area is subject to the continual presence of tractors, trucks, and other equipment used in agriculture under existing conditions, although of differing types and intensity.

Roadway users, residents, and local workers would have limited visibility of actions under this alternative because most actions are concentrated on the interior of McCormack-Williamson Tract. Residents located along Thornton Road and New Hope Road will experience large haul trucks driving within their viewshed during business hours in the week, similar to trucks used in the transport of agricultural crops.

Some activities under this alternative would be visible to recreationists in adjacent waterways and on the top of adjacent levees. Recreationists may be particularly sensitive to the dredging of the Mokelumne River. Recreationists using the Mokelumne River are primarily boaters, whose main activities are cruising and fishing. Cruising is a more engaged activity, while those who are fishing are less sensitive to visual change.

Because the construction is temporary in nature and largely limited to business hours during the weekdays, the impact is considered less than significant and no mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

Alternative 1-A would change the configuration of several of the levees and result in additional placement of vegetation and RSP on levees. The proposed project would also enhance recreational experiences by creating additional floodplain habitat compatible with boating and viewing wildlife. Overall, there will be substantial net increase in vegetation. Because the project components of Alternative 1-A would not alter the quality or character of the visual setting, the impact is considered less than significant (and possibly beneficial as a result of increased native vegetation) and no mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee

- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

The impacts on visual resources during construction of Alternative 1-B would be similar to those described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

The impacts on visual resources during construction of Alternative 1-B would be similar to those described under Alternative 1-A with the exception of less levee earthwork and the construction of box culvert drains and self-regulating tidal gates. These project components would be consistent with the visual character of the project area and would not substantially alter the quality of the surrounding viewsheds. Therefore, this impact is less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property (*optional*)

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

The impacts on visual resources during construction of Alternative 1-C would be similar to those described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

The impacts on visual resources during construction of Alternative 1-C would be similar to those described under Alternative 1-A, with the exception of less levee earthwork and the construction of self-regulating tidal gates and a soil subsidence reversal area. These project components would be consistent with the visual character of the project area and would not substantially alter the quality of the surrounding viewsheds.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

Construction activities for Alternative 2-A would be similar to those described in Alternative 1-A. The impacts on visual resources during construction of Alternative 2-A would be similar to those described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

Alternative 2-A would result in minor changes to the viewshed, including the construction of weirs, a detention basin and drainage pump station, the creation of borrow sites, the possible replacement of bridges, and the reconfiguration of levees in the project area. In addition, as part of Alternative 2, a wildlife viewing area will be constructed off of Staten Island Road, which would enhance recreational experiences. Although the project would bring minor new visual features into the project area, the proposed project would be consistent in character and quality with the existing setting; therefore, the impact is considered less than significant and no mitigation is required. The effects of increased riparian vegetation could be considered visually beneficial.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station

- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

The impacts on visual resources during construction of Alternative 2-B would be similar to those described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

The impacts on visual resources for Alternative 2-B would be similar to those described under Alternative 2-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir

- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

The impacts on visual resources during construction of Alternative 2-C would be similar to those described under Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

The impacts on visual resources during construction of Alternative 2-C would be similar to those described under Alternative 2-A.

Determination of Significance: Less than Significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modification

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows

- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

Impact VIS-1: Temporary Visual Change as a Result of Construction Activities.

The impacts on visual resources during construction of Alternative 2-D would be similar to those described under Alternative 1-A, including the optional dredging task.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact VIS-2: Permanent Changes in Viewshed.

Alternative 2-D would result in minor changes to the viewshed, including the increased channel capacity of the Mokelumne River, which would require dredging and the modification of levees surrounding the river, and the possible replacement of bridges. Although the project would bring minor new visual features into the project area, these project components would be consistent with the visual character of the project area and would not substantially alter the quality of the surrounding viewsheds. Therefore, this impact is less than significant. No mitigation is required.

Determination of Significance: Less than significant.

Mitigation: None required.

5.6 Public Health and Environmental Hazards

Analysis Summary

This section discusses hazardous materials that are present in the Project vicinity. It also describes the potential for wildland fires to occur, summarizes emergency response and evacuation procedures in the Project vicinity, and discusses the mosquito species and potential diseases that may occur there. This section also discusses the potential impacts on public health relative to hazardous materials, wildland fires, emergency response and evacuation, and mosquitoes that are associated with construction and operation of the alternatives and lists mitigation measures for impacts that are determined to be significant.

Hazardous substances could be released into the environment during construction, but this risk could be reduced to a less-than-significant level by preparing a Construction Waste Management Plan and following BMPs (in accordance with applicable laws and regulations) before and during construction. Exposure of people to mosquitoes could increase, especially with the development of wetlands on McCormack-Williamson Tract. Coordination with the local mosquito abatement districts and proper design would reduce this effect to a less-than-significant level. Public risk associated with wildfires is not expected to change with implementation of the project alternatives.

Introduction

Limiting the exposure of individuals to hazardous materials and wildfires, having access to emergency evacuation and response services, and reducing the spread of mosquito-borne disease improve the overall quality of life in a society. This section addresses the four issues that are considered salient to the alternatives being considered: exposure to hazardous materials and wildfires, effects on emergency response and evacuation services, and disease transmission by mosquitoes.

In the Delta, hazardous waste sites associated with agricultural production activities may include storage facilities and agricultural ponds or pits that are contaminated with fertilizers, pesticides, herbicides, or insecticides; leaking underground storage tanks that contained petroleum products and other materials; leaking or abandoned pesticide storage containers; and/or drainage water that contains fertilizers and pesticides.

As more land in the Delta has been reclaimed for agricultural uses, the potential for exposure to fires increased because of changes in land use and vegetation and increased population in the area. Reclamation of swamp lands has resulted in some slight potential for peat fires in the region.

Emergency response and evacuation programs have been in place in many locations for years, but in the past several years the importance of such services has come to the public's attention. From a public health perspective, emergency response and evacuation activities could be required as a result of many types of incidents, including hazardous materials spills or leaks, water or land contamination, contact with a utility line, or a fire.

Urban encroachment in the Delta has resulted in more frequent human exposure to mosquitoes and the likelihood of mosquito-borne disease transmission. Mosquito breeding habitat and consequent mosquito populations have been affected by land use changes in this region. Past changes in land use from marshes to agricultural land has not always resulted in a reduction in mosquito breeding habitat. Since 1900, McCormack-Williamson Tract has flooded seven times, and Staten Island has flooded twice.

Sources of Information

The following key sources of information were used in the preparation of this section:

- CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report, July 2000.
- Environmental Data Resources Inc., DataMap Area Study—North Delta Project, North Delta, California, January 2005.
- Guide to the Common Mosquitoes of California, 2003.

Physical Setting/Affected Environment

Hazardous Materials

Hazardous materials include chemicals and other substances defined as hazardous by federal and state laws and regulations. In general, these materials include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may have harmful effects on public health or the environment during their use or when released to the environment. Hazardous materials also include waste chemicals and spilled materials.

A records review was conducted to evaluate environmental conditions of potential concern in connection with the Project area and bordering properties. The Environmental Data Resources, Inc. (EDR) Report reviewed more than 120 federal, state, and local regulatory agencies' published databases. A complete listing of the records searched by EDR is included as Appendix G.

Of the 120 databases reviewed, the following 11 databases were identified as containing information within a 0.25-mile radius of the Project area.

- Emergency Response Notification System (ERNS)
- California Hazardous Material Incident Report System (CHMIRS)
- Cortese Hazardous Waste and Substances Site List (CORTESE)
- State of California Leaking Underground Storage Tank (LUST)
- Historical UST Registered Database (HIST UST)
- Sacramento County Contaminated Sites (CS)
- Aboveground Storage Tank (AST)
- California Water Resources Control Board—Waste Discharge System (CA WDS)
- California Spills, Leaks, Investigation, and Cleanup Cost-Recovery System) (CA SLIC)
- Hazardous Waste Manifest Database (HAZNET)
- Sacramento County Master List (CA ML)

In the 11 databases, seven specific sites, and 18 "orphan" sites were identified within 0.25 mile of the project area. (An orphan site is a site identified by EDR as unmappable with the information obtained from the database search.) Of the seven specific sites, five are located more than 3 miles from the Project area and are unlikely to affect the selected alternative. After more research, three of the 18 orphan sites were found to be in the immediate Project area. The remaining 15 sites are several miles away from the Project area and are unlikely to affect the selected alternative.

The five remaining sites identified by the database search are listed in Table 5.6-1.

Table 5.6-1. Potential Areas of Environmental Concern, Identified by Records Review

Site	Address	Location*	Identified Environmental Conditions	Notes
New Hope Landing	13945 W. Walnut Grove Road, Thornton, CA	Located at corner of Staten Island Road and Walnut Grove Road	HIST UST	Two historical underground storage tanks stored onsite. Unknown when tanks installed.
Mello Farms	17153 Tyler Island Road, Isleton, CA	Located on Tyler Island Road, approx. 1 mile south of the Spezia Airport	Sacramento County ML	Unknown hazardous materials stored on site.
River Delta Unified School	14181 Walnut Grove Road	Located approx. 0.25 mile west of the corner of Staten Island Road and Walnut Grove Road	HAZNET	Orphan site, site details unknown*
CGG Land Seismic	14440 Walnut Grove Road	Located approx. 0.25 mile west of the corner of Staten Island Road and Walnut Grove Road	HAZNET	Orphan site, site details unknown*
Frank Spingolo Warehouse	14531 Walnut Grove Road	Located approx. 0.25 mile west of the corner of Staten Island Road and Walnut Grove Road	LUST, Sacramento County CS	Orphan site, site details unknown*

HAZNET = Hazardous waste manifest database
HIST UST = Historical underground storage tank
LUST = Leaking underground storage tank
Sacramento County ML = Sacramento County Master List
Sacramento County CS = Sacramento County contaminated sites
* Orphaned sites were not analyzed nor site details provided by EDR.
Based on EDR Report (January 13, 2005).

Wildland Fires

Fires occurring as a result of a buildup of fuels and peat have the potential to occur in the Delta. Fire protection services are provided by various departments in the Delta area, including the Courtland Fire Protection District, the Walnut Grove Fire Protection District, the Isleton Fire Protection District, and the River Delta Fire Protection District. Volunteer firefighters are also available to respond to fire emergencies, as needed. Fire suppression in areas not under the jurisdiction of a fire protection district is the responsibility of the landowners.

Emergency Response and Evacuation

Emergency response/evacuation services to the Project area are provided by the various departments in the cities nearest to the Project area and through Sacramento County and San Joaquin County Sheriff, Fire, and Emergency Services Departments.

Mosquitoes

Several species of mosquitoes are common in California. Each species has a season when it is most active. Depending on the California region, some species may be active during most or all of the year. Each mosquito species has a range of preferred hosts, and most species feed on more than one type of host. Mosquitoes have a wide range of blood meal hosts, including reptiles, amphibians, mammals, birds, and humans. Protein from a host's blood is used by the female mosquito to produce eggs.

Mosquitoes are the primary vectors for disease in the Delta. Mosquitoes require standing water to complete their growth cycles. Any body of standing water that remains undisturbed for more than 3 days represents a potential mosquito breeding site. Typically, water bodies with poor circulation, higher temperatures, and higher organic content produce greater numbers of mosquitoes than water bodies with good circulation, lower temperatures, and lower organic content. Water bodies with water levels that slowly rise or lower produce greater numbers of mosquitoes than water bodies with water levels that are stable or that rapidly fluctuate. Mosquitoes produce year-round in the Delta, but mosquito production diminishes substantially during cooler weather.

The following mosquito species are found in Sacramento and San Joaquin Counties (Mosquito and Vector Control Association of California 2003):

- *Aedes vexans*
- *Anopheles franciscanus*
- *Anopheles freeborni*
- *Anopheles punctipennis*
- *Coquillettidia perturbans*
- *Culex apicalis*
- *Culex erythrothorax*
- *Culex pipiens/quinquefaciatus.*
- *Culex stigmatosoma*
- *Culex tarsalis*
- *Culex thriambus*
- *Culiseta incidens*
- *Culiseta inornata*
- *Culiseta particeps*
- *Aedes bicristatus*
- *Aedes dorsalis*
- *Aedes increpitus complex*
- *Aedes melanimon*
- *Aedes nigromaculis*
- *Aedes sierrensis*
- *Aedes sticticus*
- *Orthopodomyia signifera*

One other mosquito species, *Culex boharti*, is found in Sacramento County (but not San Joaquin County). Table 5.6-2 describes these mosquito species, their season of activity, preferred host, and habitat.

Table 5.6-2. Mosquitoes Found in Sacramento and San Joaquin Counties

Vector—Mosquitoes	Seasonal Activity	Preferred Host	Preferred Habitat
Aedes sp. (v*exans)*: painful and persistent biters, and known to fly many miles from their breeding sources. A vector of canine heartworm.	Active in spring and summer; attack early in the morning, at dusk, and into the evening	Mammals and birds	Shaded areas and cold woodland pools; they usually do not enter dwellings
Anopheles sp. *(franciscanis, freeborni, and punctipennis)*: persistent biters; the only mosquito that can transmit malaria to humans.	Active in spring, summer, and fall; attack at night; is a pest in the Sacramento Valley beginning in late winter until early fall	Mammals and humans	Rice fields, wetlands, duck clubs, and rain pools
Coquillettidia sp. *(perturbans):* a vector of eastern equine encephalitis.	Active in spring and summer; bite during the night but will bite in the shade if disturbed; an important pest in shallow areas with emerged aquatic vegetation	Mammals and humans	In areas of heavy emergent vegetation
Culex sp. *(apicalis, boharti, erythrothorax, pipiens/quinquefaciatus, stigmatosoma, tarsalis, and thriambus)*: weak flyers; some of these mosquitoes can transmit encephalitis viruses to humans.	Active in spring, summer, and fall; attack at dusk and after dark	Birds, mammals, humans, and amphibians *Culex boharti* is not known to bite humans	Wetlands, duck clubs, rice fields, irrigated crops, along the edges of slow streams, rock pools, isolated ponds, and hoofprints along streams and creeks
Culiseta sp. *(incidens, inornata, and particeps)*: moderately aggressive biters	Active in spring, fall, and winter; attack in the evening or in the shade during the day	Mammals and humans	Shaded areas (clean pools and streams)
Ochlerotatus sp. *(bicristatus, dorsalis, melanimon, nigromaculis, sierrensis, sticticus, and increpitus* complex*)*: painful and persistent biters; *sierrensis* can transmit the canine heartworm parasite; *melanimon* is involved in the encephalitis virus cycle.	Active in spring, summer, and fall; attack early in the morning, at dusk, and into the evening	Mammals and humans	Oak woodlands, wetlands, duck clubs, pastures, ditches, ponds, pools, densely shaded water sources
Orthopodomyia sp. *(signifera):* a vector of encephalitis.	Active in spring	Birds Not known to bite humans	Willows and cottonwoods (tree holes), in holes that contain water year-round

Sources: Alameda County Mosquito Abatement District 2004 and 2005; American Mosquito Control Association 2004; Marin/Sonoma Mosquito and Vector Control District 2005; Sacramento-Yolo Mosquito and Vector Control District 2005; Virginia Mosquito Control Association 2005.

> Mosquitoes cause more human suffering than any other organism—more than 1 million people worldwide die from mosquito-borne diseases (known as arboviruses) every year. Not only can mosquitoes carry diseases that afflict humans, but they also transmit several diseases and parasites to which dogs and horses are very susceptible. These include canine heartworm, West Nile virus, and eastern equine encephalitis[1]. Mosquito-vectored diseases include protozoan diseases such as malaria, and viruses such as dengue[2], encephalitis, and yellow fever[3] (American Mosquito Control Association 2004). Table 5.6-3 describes several mosquito-borne diseases.

Table 5.6-3. Diseases Associated with Mosquitoes

Disease Name	Description of Disease
Encephalitis	Encephalitis, also known as sleeping sickness, is caused by a virus that can cause inflammation of the brain. Severe cases can result in mental retardation, motor impairment, or death. Mosquitoes become infected while feeding on birds that harbor the virus. They can then transmit the virus to other animals. California vectors are the encephalitis mosquito *(Culex tarsalis)* and the wetlands mosquito *(Ochlerotatus melanimon)* (Sacramento-Yolo Mosquito and Vector Control District 2005). There are several virus agents of encephalitis in the northern United States: West Nile virus, eastern equine encephalitis[a], Western equine encephalitis[b], St. Louis encephalitis[c], La Crosse encephalitis[a], dengue[a] and yellow fever[a], all of which are transmitted by mosquitoes (American Mosquito Control Association 2005).
Malaria	Malaria, caused by a protozoan (a single-celled organism), attacks red blood cells. Malaria is a chills/fever/sweating flu-like illness that recurs every 2 to 3 days. The malaria parasite can cause liver and kidney damage or death. Mosquitoes become infected while feeding on other humans that harbor the parasite. California vectors are the western malaria mosquito *(Anopheles freeborni)*, the woodland malaria mosquito *(Anopheles punctipennis)*, and the coastal malaria mosquito *(Anopheles hermsi)*. Ten to 15 human cases of malaria are reported annually; most of these cases are from individuals who became infected outside of the U.S. In 1986, two residents of Yolo County were infected with the malaria parasite (locally acquired) (Sacramento-Yolo Mosquito and Vector Control District 2005).
Canine Heartworm	Canine heartworm[b] can be a life-threatening disease for canines. The disease is caused by a roundworm. Dogs and sometimes other animals such as cats, foxes, and raccoons are infected with the worm through the bite of a mosquito carrying the larvae of the worm. The young worms circulate in the bloodstream of the dog. Mosquitoes become infected when they blood feed on a sick dog. Once inside the mosquito, the young worms leave the gut of the mosquito and live in the body of the insect for 2 to 3 weeks, then they move to the mosquito's mouthparts, where they will be able to infect an animal. When the mosquito blood feeds, the infective worms are deposited on the surface of the victim's skin. They enter the skin through the wound caused by the mosquito bite. The disease in dogs and cats cannot be eliminated but it can be controlled or prevented with pills and/or injections. Some risk is present when treating dogs infected with heartworms, but death is rare; still prevention is best. Cases have been reported in all 50 states (American Mosquito Control Association 2005). About 70 species of mosquito are capable of carrying the disease (Columbia Animal Hospital 2005).

[1] Eastern equine encephalitis is not known to occur in California (American Mosquito Control Association 2004).
[2] Dengue is a serious arboviral disease with a low mortality rate. It is transmitted by *Aedes* sp. It has not been reported in California (American Mosquito Control Association 2004).
[3] Yellow fever occurs only in tropical areas of Africa and the Americas (American Mosquito Control Association 2004).

Disease Name	Description of Disease
West Nile virus	West Nile Virus has more than 70 identified viruses. It includes West Nile fever (the least severe), West Nile encephalitis (affects the brain), and West Nile meningitis (affects the brain and the membrane around it) (American Mosquito Control Association 2005). West Nile Virus, a disease transmitted to humans, birds, horses, and other animals by infected mosquitoes, is well established in all 58 counties in California. Mosquitoes get the disease from infected birds while taking blood, and can later transmit it when they bite others. West Nile virus can cause encephalitis in humans. Most infections are mild, with flu-like symptoms. Severe infections may include neck stiffness, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and rarely, death. As of January 10, 2005, 812 humans in California have been infected with the West Nile Virus, including three in Sacramento County and 3 in San Joaquin County. (Sacramento-Yolo Mosquito and Vector Control District 2005).

[a] No cases reported in California.

[b] Has been found in California.

[c] The last human case in California was 1997.

Sources: American Mosquito Control Association 2005;
Sacramento-Yolo Mosquito and Vector Control District 2005.

Regulatory Setting and Significance Criteria

Hazardous Materials

Hazardous materials are governed under the Comprehensive Environmental Response and Liability Act (CERCLA), the Clean Air Act (CAA) and the CWA. The Superfund Amendments and Reauthorization Act (SARA) amends CERCLA and governs hazardous substances. Regulations (40 CFR 68) under the CAA are designed to prevent accidental releases of hazardous materials. The Spill Prevention, Control, and Countermeasures (SPCC) program under the CWA is designed to prevent or contain the discharge or threat of discharge of oil into navigable waters or adjoining shorelines.

Other related federal laws that address hazardous materials but do not specifically address their handling, are the Resource Conservation and Recovery Act (RCRA) and the Occupational Safety and Health Act.

California laws and regulations relevant to hazardous materials handling include Health and Safety Code Section 25500 (hazardous materials), Health and Safety Code 25531 (regulated substances), and the Aboveground Petroleum Storage Act (petroleum in aboveground tanks).

Wildland Fires and Emergency Response/Evacuation

No federal, state, or local regulatory plans, policies, or guidelines were considered applicable to the evaluation of impacts of wildland fire exposure or emergency response and evacuation as a result of implementing the alternatives.

Mosquitoes

In 1915, the California State Legislature enacted the Mosquito Abatement Act, which allowed local mosquito abatement organizations to form into specific special districts. Mosquito abatement districts rely on property taxes for funding of abatement programs; changes in land use could alter the taxes collected for the districts. Two mosquito abatement districts provide mosquito abatement services in the project area: Sacramento-Yolo Mosquito and Vector Control District (S-YMVCD) and San Joaquin County Mosquito and Vector Control District (SJCMVCD).

Mosquito abatement districts use a combination of abatement procedures to control mosquitoes. As a result of concern about the cumulative effects on the environment of past abatement practices, mosquito control has shifted away from applying pesticides, kerosene, and diesel fuel since the late 1970s. Mosquito control methods currently in use include:

- biological agents, such as mosquitofish, that eat larvae;
- source reductions, such as draining the water bodies that produce mosquitoes;
- pesticides; and
- ecological manipulations of mosquito breeding habitat.

Other public health concerns related to animal-vectored disease in California include the transmission of Lyme disease by ticks, bubonic plague by fleas, and rabies by wildlife; however, none of these issues is considered a high risk to public health in the Delta.

Significance Criteria

For hazardous materials, significance criteria from the CEQA Environmental Checklist are used for determining impact significance; the alternatives would cause a significant impact if they would:

- expose the public and/or the environmental to hazardous materials, either through the routine transport, use, or disposal of hazardous materials or through accidents involving the release of hazardous materials to the environment; or

- be located on a recognized hazardous materials site and would cause the public or environment to come in contact with such materials.

For wildland fires, significance criteria from the CEQA Environmental Checklist are used for determining impact significance; the alternatives would cause a substantial adverse effect if they would:

- expose people or structures to risk of loss, injury, or death as a result of wildland fires.

For emergency response/evacuation, significance criteria from the CEQA Environmental Checklist are used for determining impact significance; the alternatives would cause a significant impact if they would:

- impede emergency response or evacuation plans.

For mosquitoes, significance criteria were adapted from the July 2000 CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report; the alternatives would cause a significant impact if they would result in:

- an increase in mosquito breeding habitat or
- a decrease in the distance between human and mosquito populations.

Impacts and Mitigation of the Project Alternatives

Alternative NP: No Project

If the No Project Alternative is selected, no construction activities associated with Project facilities would occur. Therefore, the potential for a release of hazardous materials during Project construction and the potential for encountering hazardous materials during construction would not occur. There would be no change in the incidence of wildland fires or in emergency response or evacuation times compared to existing conditions. McCormack-Williamson Tract and Staten Island would continue to flood periodically (McCormack-Williamson Tract has flooded seven times and Staten Island has flooded twice since 1900). Because agricultural production on McCormack-Williamson Tract and Staten Island would continue at existing levels, the exposure to mosquitoes and mosquito-borne diseases would not change from existing conditions. There would be no impact.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PH-1: Releases of Hazardous Materials during Construction.

Hazardous materials that may be used during project construction include fuel and lubricants for construction equipment and chemical dust suppressants.

These materials have the potential to be released into the environment during construction activities as a result of spills, leaks, rainwater runoff, or airborne (wind) dispersal. Some of these materials may generate residual wastes that must be managed on site as hazardous materials until they can be properly disposed of off site. While stored at the construction site, these wastes have the potential to be released in a manner similar to that described above.

The volume of fuel and lubricants required during construction depends on the number and types of equipment used and the duration of construction. Normal operation of equipment is not likely to generate large quantities of these materials as waste or through potential releases because these materials will be consumed for the most part during construction activities. The SWPPP and dust control plans described in the Environmental Commitments section of Chapter 2 would ensure that fuels and lubricants would be properly handled on site and dust generated during construction would be attenuated.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction.

Previous land management activities occurring on McCormack-Williamson Tract may have included the use of hazardous substances in the tract, resulting in potential residual contamination. Environmental media (such as soil, water, air, and vegetation) potentially could be adversely affected by hazardous materials, and Project construction activities may expose construction workers to such materials, posing a public health hazard.

As ground-disturbing activities associated with Project construction occur, the potential exists for contaminated soil to become airborne in the form of dust. Because it is unknown whether this material is contaminated, it is not possible to predict the amount of exposure to the environment that could occur during construction activities.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.
If evidence of contaminated materials is encountered during construction, construction will cease immediately and applicable requirements of the CERCLA and the California Code of Regulations (CCR) Title 22 regarding the disposal of waste will be implemented. In addition, a contingency plan will be prepared to address the actions that will be taken during construction in the event that unexpected contaminated soil or groundwater is discovered. The plan will include health and safety considerations, instructions on handling and disposal of wastes, reporting requirements, and emergency procedures.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Construction activities are not expected to substantially increase the potential for wildfires to occur on McCormack-Williamson Tract. Use of local roadways by construction worker vehicles and construction equipment is not expected to result in an increase in traffic that would substantially increase emergency provider response time or evacuation times in the event of an emergency. Operation of this alternative would result in the McCormack-Williamson Tract periodically flooding. However, ongoing vegetation management activities would continue, resulting in no increase in the potential for wildland fire to occur. Operation of this alternative would have no effect on emergency response or evacuation times because maintenance activities would be infrequent and would not generate substantial amounts of traffic on local roadways.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes.

If the construction or operation of the Project creates standing water[4] in shallow areas, it could increase the amount of breeding habitat for mosquitoes and thus increase the local populations of mosquitoes. This would potentially increase the risk that residents or visitors within 10 miles of McCormack-Williamson Tract would be bitten by mosquitoes, resulting in an associated increase in transmission of mosquito-borne viruses.

Implementing mosquito management environmental commitments as described in Chapter 2, "Project Description," will ensure that this impact is less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road

[4] Shallow water that stands 3 to 4 days creates mosquito breeding habitat.

- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PH-1: Releases of Hazardous Materials during Construction.

Impacts associated with Alternative 1-B would be similar to those described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction.

Impacts associated with Alternative 1-B would be similar to those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Impacts associated with Alternative 1-B would be similar to those described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes.

Impacts associated with Alternative 1-B would be similar to those described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property

- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

Impact PH-1: Releases of Hazardous Materials during Construction.

Impacts associated with Alternative 1-C would be similar to those described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction.

Impacts associated with Alternative 1-C would be similar to those described for Alternative 1-A.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Impacts associated with Alternative 1-C would be similar to those described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes

Impacts associated with Alternative 1-C would be similar to those described for Alternative 1-A.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PH-1: Releases of Hazardous Materials during Construction.

Impacts resulting from the potential release of fuels, lubricants, and dust during construction of Alternative 2-A would be similar to those described for Alternative 1-A.

Alternative 2-A may also include replacing or retrofitting Millers Ferry Bridge and the New Hope Bridge. This could result in disturbing lead-based paint materials and environmental contamination from airborne lead material.

Contamination associated with release of fuels, lubricants, and dust would be a less-than-significant impact because the SWPPP and dust control plans described in the "Environmental Commitments" section of Chapter 2 would ensure that fuels and lubricants would be properly handled on site and dust generated during construction would be attenuated.

Contamination from lead-based paint is considered significant but would be reduced to a less than significant level by incorporating mitigation.

Determination of Significance: Significant.

Mitigation Measure PH-2: Contain and Properly Dispose of Lead-Based Paint.
Prior to construction activities at either bridge, paint samples will be taken and analyzed for lead content. If the paint on the bridges contains lead, appropriately trained personnel will perform lead abatement on the bridge prior to the start of retrofitting or reconstructing the bridges.

Significance after Mitigation: Less than significant.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction.

Impacts associated with Alternative 2-A would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Impacts associated with Alternative 2-A would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes.

Impacts associated with Alternative 2-A would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PH-1: Releases of Hazardous Materials during Construction.

Impacts resulting from the potential release of hazardous materials (fuels, lubricants, and dust) during construction of Alternative 2-B would be similar to those described for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure PH-2: Contain and Properly Dispose of Lead-Based Paint.

Significance after Mitigation: Less than significant.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction.

Impacts associated with Alternative 2-B would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Impacts associated with Alternative 2-B would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes.

Impacts associated with Alternative 2-B would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no more frequently than the 10-year event while having no measurable effect on the 100-year floodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Impact PH-1: Releases of Hazardous Materials during Construction.

Impacts resulting from the potential release of hazardous materials (fuels, lubricants, and dust) during construction of Alternative 2-C would be similar to those described for Alternative 2-A.

Determination of Significance: Significant.

Mitigation Measure PH-2: Contain and Properly Dispose of Lead-Based Paint.

Significance after Mitigation: Less than significant.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction

Impacts associated with Alternative 2-C would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Impacts associated with Alternative 2-C would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes.

Impacts associated with Alternative 2-C would be similar to those described for Alternative 1-A, but the impacts would occur on Staten Island rather than on McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

Impact PH-1: Releases of Hazardous Materials during Construction.

Impacts associated with Alternative 2-D would be similar to those described for Alternative 1-A, but the impacts would be associated with only dredging and levee modifications of the South Fork Mokelumne River rather than McCormack-Williamson Tract.

Impacts resulting from the potential release of hazardous materials (fuels, lubricants, and dust) during construction of Alternative 2-D would be similar to those described for Alternative 1-A. This impact is considered to be less than significant because the SWPPP and dust control plans described in the Environmental Commitments section of Chapter 2 would ensure that fuels and lubricants would be properly handled on site and dust generated during construction would be attenuated.

Impacts associated with dredging and use of dredged material to construct new or reconstruct existing levees would be avoided by implementing a dredged materials testing and monitoring program. The dredged material testing and monitoring program, described in the Environmental Commitments section of Chapter 2 would ensure that contaminated dredged material would not be used to construct levees.

Alternative 2-D may also include replacing or retrofitting Millers Ferry Bridge and the New Hope Bridge. This could result in disturbing lead-based paint materials and environmental contamination from airborne lead material.

Contamination from lead-based paint is considered significant but would be reduced to a less-than-significant level by incorporating mitigation.

Determination of Significance: Significant.

Mitigation Measure PH-2: Contain and Properly Dispose of Lead-Based Paint.

Significance after Mitigation: Less than significant.

Impact PH-2: Potential Exposure to Currently Unidentified Contaminated Waters or Soils during Construction.

Impacts associated with Alternative 2-D would be similar to those described for Alternative 1-A, but the impacts would be associated only with levee modifications of the South Fork Mokelumne River.

Determination of Significance: Significant.

Mitigation Measure PH-1: Properly Dispose of Contaminated Materials.

Significance after Mitigation: Less than significant.

Impact PH-3: Increased Occurrence of Wildland Fires and Increased Emergency Response/Evacuation Times.

Impacts associated with Alternative 2-C would be similar to those described for Alternative 1-A, but the impacts would be associated only with dredging and levee modifications of the South Fork Mokelumne River, rather than McCormack-Williamson Tract.

Determination of Significance: Less than significant.

Mitigation: None required.

Impact PH-4: Exposure of People to Mosquitoes.

Decanting and drying dredged material could temporarily increase the amount of standing water in the Project area. This may result in a temporary increase in amount of breeding habitat for mosquitoes and in turn, increase the local populations of mosquitoes. This would potentially increase the risk that residents or visitors within 10 miles of the dredged materials drying areas would be bitten by mosquitoes and the associated risk of transmission of mosquito-borne viruses.

Implementing mosquito management environmental commitments as described in Chapter 2, "Project Description," will ensure that this impact is less than significant.

Determination of Significance: Less than significant.

Mitigation: None required.

5.7 Cultural Resources

Analysis Summary

This section summarizes the existing conditions in the Project area, including summaries of regional prehistory, ethnography, and history. Sources consulted are described, and the section provides an assessment of the environmental consequences that may result from implementation of each Project alternative.

Sources of Information

The impact assessments presented in this section are based on a review of existing information, consultation with the Native American Heritage Commission (NAHC) and interested Native Americans, and archaeological and historic architectural surveys of the Project area.

Review of Existing Information

The review of existing information included records searches at the Central California Information Center (CCIC) and the North Central Information Center (NCIC) of the California Historical Resources Information System (CHRIS). Each CHRIS information center maintains the state's database of previous cultural resource studies and known cultural resources for the counties in its jurisdiction; the CCIC maintains the database for a seven-county area that includes San Joaquin County, and the NCIC maintains the database for a six-county area that includes Sacramento County.

In addition to the state's database of previous cultural resource studies and known cultural resources, the records searches included reviews of historic topographic maps, local historical surveys and overviews, primary and secondary historical writings, and Caltrans's Historical Bridges Inventory (California Department of Parks and Recreation 1976, 1996; Hillman and Covello 1985; Owens 1991; U.S. Geological Survey 1894, 1910a, 1910b, 1910c). The records maintained by the CHRIS, including cultural resource locations and cultural resource studies containing locations of cultural resources, are not accessible to the general public but only to cultural resource professionals. Jones & Stokes also searched the California State Lands Commission's (2004) online Shipwreck Database.

Previous Cultural Resource Studies

McCormack-Williamson Tract

The records search indicates that four cultural resource studies have been conducted on McCormack-Williamson Tract, resulting in survey of approximately 7% of the tract (Gerry 1983; Maniery 1991a; Schulz and Farris 1994; West 1991). No cultural resources have been recorded previously on the McCormack-Williamson Tract portion of the Project area.

Downstream Levee Modifications, North Fork Mokelumne River

The records search indicates that three cultural resource studies have been conducted in the downstream levee modification areas along the North Fork Mokelumne River, resulting in approximately 50% survey coverage of the levee improvement areas (Nelson et al. 2003; Schulz and Farris 1994; West 1991). Ten previously recorded cultural resources are located in the levee improvement areas and are described under Physical Setting/Affected Environment.

Staten Island Detention Areas

The records search indicates that two cultural resource studies have been conducted on portions of Staten Island slated for detention areas (Nelson et al. 2003; West 1991). Although the studies combined do not amount to 100% survey coverage of the island, the investigators focused on those portions of the island that had known historic structures and areas that had reasonable potential to contain archaeological materials; in this respect, survey of Staten Island, while not exhaustive, may be considered complete according to professional cultural resource management standards. A total of 54 cultural resources (18 archaeological resources and 36 architectural resources) have been previously recorded in the proposed Staten Island detention areas. The 36 architectural resources were inventoried and evaluated for the California Register of Historical Resources (CRHR). None of the architectural resources was found to meet the criteria for inclusion in the CRHR. The 54 cultural resources previously documented are described under Physical Setting/Affected Environment.

Dredging Areas

Paterson et al. (1978) conducted a cultural resource inventory of Delta waterways, covering the North and South Forks of the Mokelumne River. The California State Lands Commission (2004) has no record of shipwrecks in North Delta waterways.

Levee Raising Areas

The proposed project would involve raising levees on a 1.5-mile stretch of Georgiana Slough, a 2-mile segment of North Fork Mokelumne River, South Fork Mokelumne River from the north-south fork east to Potato Slough and north to McCormack-Williamson Tract, and a 3-mile section of Sycamore Slough. Alternatively, all or portions of these areas may be incorporated into levee setback areas. Because of the lack of certainty regarding the footprint of levee raising and construction of levee setbacks, the analysis contained in this document relies on existing information; no new field studies were conducted.

Sycamore Slough Section. No previous cultural resource studies have been conducted along Sycamore Slough. According to historic maps, as many as 19 cultural resources may be located along project portions of Sycamore Slough levees (Schulz and Farris 1994:321–326, 328–331).

Georgiana Slough Section. Three cultural resource studies have been conducted along the project portion of Georgiana Slough, resulting in survey of 1 mile of northern levee (Schulz and Farris 1994; Shapiro and Syda 1997:Figure 4; Werner 1988). No cultural resources have been identified in this portion of the project area.

Staten Island Section. Two cultural resource studies have been conducted on the Staten Island side of the North and South Forks of the Mokelumne River levees, resulting in approximately 20% survey coverage (Nelson et al. 2003; Schulz and Farris 1994). Nelson et al. (2003:Appendix A) identified two historic archaeological sites and seven historic isolates within the estimated levee-raising footprint. These resources are described under Physical Setting/Affected Environment.

Bouldin Island Section. Small portions of the southern (Bouldin Island) levee along the South Fork Mokelumne River have been subject to cultural resource study, resulting in approximately 60% survey coverage (Billat 2001; California Department of Transportation 2001; Laylander and Silva 1999; Maniery 1988:Figure 1; Maniery and Syda 1988; Meacham 1977; Peak & Associates 1999; Schulz and Farris 1994; West 1991). Two previously recorded historic-period cultural resources are located in the levee-raising/improvements area on Bouldin Island and are described under Physical Setting/Affected Environment.

Grizzly Slough Borrow Site. DWR obtained a records search from the NCIC on February 28, 2005. The records search indicated that no recent cultural resource studies have been conducted in the Grizzly Slough borrow site, with the exception of literature reviews by Maniery (1991) and Schulz and Farris (1994). Schenck and Dawson (1929a: 308), however, conducted surveys, interviews with local residents, and excavations in the vicinity of Lodi beginning in 1912. These investigations resulted in the recording of prehistoric archaeological sites P-34-35, P-34-36, and P-34-37 (Schenck and Dawson 1929a, 1929b, 1929c, 1929d).

DWR conducted an archaeological survey of the Grizzly Slough borrow site on April 29, 2005. The majority of the borrow site was covered with dense riparian vegetation that wholly obscured the ground surface. Accordingly, DWR archaeologists surveyed areas with good ground visibility that corresponded with the mapped locations of P-34-35, P-34-36, and P-34-37. In addition, a historic residence (CO 33) once occupied the same knoll as P-34-37. The sites are described under Physical Setting/Affected Environment.

New Hope Borrow Site. The records search indicates that the New Hope borrow site was surveyed for the presence of cultural resources in 1982 and was included in two cultural resource overview studies (Farris et al. 1982; Owens 1991; Schulz and Farris 1994:149–155). The records search also indicates that four prehistoric sites (P-39-205, P-39-206, P-39-207, and P-39-264), the location data for which are poor, are located within a 0.5-mile radius of the borrow site. Plots of the site locations place them outside of the borrow site, and Farris et al. (1982) did not identify any cultural resources in the borrow site.

Dixon Borrow Site. The records search indicates that no comprehensive cultural resource inventory has been conducted in the Dixon borrow site. The borrow site has been studied, however, in part through archaeological survey, cultural resource literature reviews, and archaeological excavations (Farris et al. 1982, cited in Schulz and Farris 1994:Appendix 2; Fenenga 1939:43–46; Maniery 1991a; Schenck and Dawson 1929a:Table 1; Schulz and Farris 1994:93).

The records search indicates that two prehistoric archaeological sites are located in the borrow site: P-34-93 and P-34-276. These sites, for which there is evidence that P-34-276 is incorrectly mapped and is actually P-34-93, are described in the Physical Setting/Affected Environment.

The Delta Meadows Property (Optional). The records search indicates that three previous cultural resource studies have been conducted on the Delta Meadows property (Foster 1985, cited in Schulz and Farris 1994:80; Hathaway 1927, cited in Woodward and Evans 1992:180; Schulz and Farris 1994:15). Four previously recorded cultural resources are located in the Delta Meadows property and are discussed in the Physical Setting/Affected Environment.

Consultation with Interested Parties

On November 8, 2002, and again on July 7, 2004, Jones & Stokes requested a search of the sacred lands file and a list of Native American contacts from the NAHC. The sacred lands file search did not indicate the presence of Native American cultural resources in the project area. The NAHC also provided a list of seven Native American contacts, to whom Jones & Stokes mailed project notification letters and maps on July 12, 2004, requesting information on Native American resources and concerns relevant to the North Delta. To date, Jones & Stokes has not received a response from the letter recipients.

A DWR archaeologist consulted with the NAHC and Native Americans regarding the Grizzly Slough borrow site. The NAHC informed DWR on March 4, 2005, that the sacred lands file does not contain records of Native American cultural resources in the Project area. The NAHC provided a list of Native American contacts as well. DWR mailed consultation letters to the contacts on March 7, 2005. To date, DWR has not received a response from letter recipients. (Offermann pers. comm.)

A Jones & Stokes architectural historian also sent project notification letters to the San Joaquin County Historical Society and San Joaquin County Museum and the Sacramento River Delta Historical Society requesting information regarding cultural resources that may be located in the Project area. To date, Jones & Stokes has not received a response from the letter recipients.

Archaeological and Architectural Surveys

Jones & Stokes archaeologists surveyed McCormack-Williamson Tract on July 22, 2003, and February 14, 2005. During the 2003 survey the project area was surveyed by walking systematic parallel transects spaced 98 feet apart. A large portion of McCormack-Williamson Tract was under active cultivation. The majority of McCormack-Williamson Tract was planted in corn, tomatoes, and wheat; therefore, survey of these areas was neither permitted nor attempted. Approximately 30% of McCormack-Williamson Tract fields had been recently harvested and/or burned. Ground visibility in the burned and fallow fields was good to excellent, often exceeding 90% visibility. Archaeological survey was conducted in these areas at 98-foot intervals. Levee slopes on both islands were heavily vegetated with annual grasses and blackberry bushes. To better inspect the ground surface, 3-foot- square patches of vegetation were scraped aside with a trowel at 98-foot intervals.

In 2005, a team of three archaeologists surveyed portions of McCormack-Williamson Tract that were not available for survey in 2003. The locations of survey blocks were selected based on the presence of mapped historic waterways and water bodies as well as mapped locations of historic buildings that no longer have aboveground structures (Budd 1926; Metsker 1940; Schulz and Farris 1994:Figure 16; Shepherd 1885; Thomas Brothers 1920; U.S. Geological Survey 1910a, 1910c). Surveys were conducted by walking systematic parallel transects spaced 49–98 feet between surveyors. Ground surface visibility ranged from fair to excellent (50–100%). No cultural resources were identified as a result of the survey.

Staten Island was not subjected to additional archaeological surveys because previous cultural resource studies (Nelson et al. 2003; West 1991) of the island were adequate for the purposes of this analysis. The island is not sensitive for the presence of prehistoric archaeological sites; it is composed almost completely of peaty mucks and peat soils (McElhiney 1992)—previous researchers in the Delta have not identified prehistoric sites on these soils (CALFED Bay-Delta Program 2000:Table 7.11-1; West 1991, 1994; West and Scott 1990). The few mineral soil occurrences on the island are crevasse-splays—deposits resulting from historic-period levee failures—and are not indicative of the presence of prehistoric archaeological sites (Brown 1997:Table 1.1; Paterson et al. 1978: 3–4).

On January 27, 2005, a Jones & Stokes architectural historian conducted a field survey of Staten Island, Dead Horse Island, and McCormack-Williamson Tract. As part of the field process, buildings, structures, and linear features 50 years old or older that had not been previously recorded were inspected, photographed, and documented using written notes.

Physical Setting/Affected Environment

The physical setting/affected environment for cultural resources is discussed under eight geographic groupings: McCormack-Williamson Tract, Downstream Levee Improvements (North Fork Mokelumne River), Staten Island Detention Areas, Levee Raising Areas, Grizzly Slough borrow site, New Hope borrow site, Dixon borrow site, and Delta Meadows Property (Optional). The cultural resources section of the *CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report* (CALFED Bay-Delta Program 2000) and the *CALFED Technical Report*, *Affected Environment: Cultural Resources* (CALFED Bay-Delta Program 1998) are incorporated here by reference, including prehistoric and ethnographic setting information. Impact analyses for the proposed project require a highly specific historic setting, which is presented below.

Historic Setting

Early explorers of the North Delta region, including Pedro Fages, Juan Bautista de Anza and Gabriel Moraga, visited the Delta relatively frequently throughout the eighteenth century. The first American to travel in the area was likely Jedediah Strong Smith, who opened the Sacramento Trail in the late 1820s. Smith reported to the Hudson's Bay Company on the quantity and quality of the furs available in California. Initially, trapping in the Sacramento and San Joaquin Valleys proved very profitable, but saw less success by 1834. By 1842, the Hudson's Bay Company terminated its California operations altogether (Hoover et al. 1990).

Only a handful of ranchos existed in the Delta, and they were situated mainly to the south of the Project area in the vicinity of Roberts and Union islands. Lands in the Project area remained essentially unsettled until the well-publicized discovery of gold in 1848. (Bean and Rawls 1993.)

Following the gold rush, settlement in the Delta region increased dramatically, largely as a result of the passage of the Swamp and Overflow Act of 1850. The law transferred swamplands from the U.S. government into the control of the state of California. Following the passage of the legislation, private citizens purchased approximately 500,000 acres of newly acquired California swampland located in the Delta (and including the Project area) (CALFED Bay-Delta Program 1996).

In the early 1860s, settlers J. T. Baily and C. F. Juillard reclaimed portions of Staten Island (formerly known as Elk Island). By 1869, the Tideland Reclamation Company (Tideland) purchased a major portion of Staten Island and immediately embarked on intensive reclamation efforts throughout the rest of the island. Reclamation continued over the next 20 years through the direction of James Ben Ali Haggin, who by then served as president of Tideland. Additional landowners on the island included T. B. Valentine, L. C. McAfee, and J. Breeden. By 1900, Haggin sold off his portion of Staten Island to the Staten

Island Land Company. Staten Island Land Company retained ownership until the late 1930s, when the Towne family purchased the company and created the M&T Company. Over the next few decades the island became more corporate as individual tenancy declined. (Nelson et al. 2003; Gibbes 1869.)

In the latter part of the nineteenth century, Staten Island's jurisdiction moved from Sacramento County to San Joaquin County. As reclamation efforts continued on the island, settlers established small hamlets such as Hagginsville and Eagle Tree. Over time larger settlements in the region, including Walnut Grove, Isleton, Clarksburg, and Rio Vista, that served as trading and shipping centers for the Delta eventually eclipsed the smaller enclaves.

The McCormack-Williamson Tract was not reclaimed until the twentieth century, and the southern portion of tract actually remained swampland for many years. During the early 1900s, families such as the Glenns, McLanahans, and Earhardts became associated with the McCormack-Williamson Tract. In addition, Southern Pacific Railroad Company owned a large strip of unreclaimed land directly adjacent to Snodgrass Slough on the western edge of the tract. (Phinney 1911.)

Fertile agricultural soil and the miles of navigable channels attracted land speculators and individual farmers to the Delta region. Efforts to reclaim the land began immediately (largely through the efforts of Chinese laborers) although the process was time consuming and costly. Because of the expenses involved, larger corporations such as Tideland Reclamation Company and Staten Island Land Company commonly formed to supply the substantial capital needed to reclaim vast areas of swampland. Overall, dredging efforts during this period remained unsuccessful until the advent of improved dredging machinery in the late nineteenth century. Staten Island and the McCormack-Williamson Tract experienced repeated levee failures in the latter part of the nineteenth century, with extensive flooding and crop damage, resulting in continuous efforts to rebuild and reinforce the earthen features. (CALFED Bay-Delta Program 1996; Paterson et al. 1978; Thompson 1958.)

By the early twentieth century, reclamation benefited from technological advances that included the clamshell, hydraulic, and steam-driven dredges in addition to the mechanical ditch digger that took the place of the horse-drawn scrapers and dredges of the early period of reclamation. Steam-powered and electrical pumps also helped to drain the land. Reclamation of virgin land ended in the early 1920s, but work remained to secure already reclaimed lands (Thompson 1958).

The twentieth century also ushered in improved transportation to the Delta region. Changes included the construction of bridges and roadways on the tops of levees, and gasoline- powered (rather than steam) riverboats that plied the waterways. Prior to transportation improvements, roadways were virtually non-existent, with most local travel being accomplished by schooners or barges. Independent operators from Stockton and Sacramento (rather than large corporations of the past) operated most of these smaller workboats. Southern Pacific Railroad and Western Pacific Railroad also constructed alignments in the vicinity of the project area. These alignments not only connected the Delta to populated centers such as Sacramento and San Francisco, but also encouraged the movement of agricultural products from the Delta to outlying markets (Owens 1991; Thomas Brothers 1920).

Reclaimed lands throughout the Delta were used for agriculture and thus made it a profitable agricultural area. During the early part of the twentieth 20th century, barley, potatoes, and asparagus successfully grew on Staten Island. By 1920, asparagus, corn, and potatoes were the major crops on the island, with barley and corn continuing to flourish well into the 1950s. Other crops in the project area were celery, onions, sugar beets, and beans. Asparagus, potatoes, and corn remained the predominant crops until the 1950s, when barley and winter wheat, began to outpace them. (Nelson et al. 2003.)

Throughout the twentieth century the North Delta region continued to be used for agricultural purposes. Currently large farming corporations and some large family farms own the majority of the project area. Upkeep and maintenance continues on the levees and water system into the present. (CALFED Bay-Delta Program 1996.)

Identified Cultural Resources

The following section describes known archaeological and architectural resources located in the Project area, and their significance status when available. Additional cultural resources, not yet identified or subjected to detailed study, are likely present in the project area as well. The potential for such cultural resources to be affected by the proposed project is discussed in this section and under Impacts and Mitigation of the Project Alternatives.

McCormack-Williamson Tract

Two architectural resources 50 years old or older were identified in the McCormack-Williamson Tract. The two resources, the McCormack-Williamson Tract levee and canal system and a farm complex, were inventoried and evaluated for the CRHR as part of this project. The canal and levee system lacks integrity, and the farm complex lacks historical significance. Because of the lack of integrity and historical significance, neither property appears to be a historical resource for the purposes of CEQA.

Downstream Levee Modifications, North Fork Mokelumne River

Eleven previously recorded cultural resources are located in the downstream levee modification areas associated with project actions on McCormack-Williamson Tract: TI-1, TI-2, TI-3, TI-4, P-39-356, P-39-4423, P-39-4424, P-39-4431, P-39-4433, P-39-4434, and P-39-4436.

TI-1, TI-2, TI-3, and TI-4

Isolated finds TI-1–TI-4 consist of four refuse scatters. The scatters contain recent and historic artifacts such as glass fragments, ceramics, iron pipe, and bricks. Agricultural activities and levee maintenance have resulted in severe disturbance to these isolated finds to the extent that they "do not have sufficient integrity to warrant further consideration." (West 1991:16, 19, Figure 17.) TI 1–TI-4 do not meet the CEQA definitions of historical resource or unique archaeological resource and will not be considered further in this EIR's impact analysis.

P-39-356

P-39-356 is a historic refuse scatter of residential domestic, structural, and dietary artifacts, including artifacts indicative of Asian occupation at the site. Although flooding, plowing, and levee construction have resulted in disturbances to P-39-356, Schulz and Farris (1994) opine that the site is potentially significant and recommended test excavation at P-39-356 to determine significance. P-39-356 remains unevaluated for qualification as a historical resource or unique archaeological resource. (Nelson et al. 2003:32, 41, Table 2.)

P-39-4423 and P-39-4424

P-39-4423 and P-39-4424 are historic archaeological sites, comprising thin scatters of domestic refuse. Artifacts include glass bottle and jar fragments, ceramic fragments, bricks, window glass, Asian ceramics, and a single square nail. P-39-4423 and P-39-4424 may be associated with a historic labor camp and pump station, respectively. These resources have not been evaluated for qualification as historical resources or unique archaeological resources under CEQA. (Nelson et al. 2003:31–32.)

P-39-4431, P-39-4433, and P-39-4434

These isolates are single historic artifacts or small scatters of historic artifacts in highly disturbed contexts. P-39-4431 is a scatter of broken ceramics, possibly associated with historic Camp 15. P-39-4433 consists of clear and brown bottles and bottle shards, possibly associated with historic "new pump." P-39-4434 includes a white ironstone cup or bowl fragment and half-gallon clear glass jug, possibly associated with historic Staten Island Pump. Nelson et al. (2003:Table 1) assign these tentative historic associations on the basis of locational correspondence to features on historic maps; the isolates themselves, however, do not convey these associations in any respect other than location.

Because of this lack of meaningful association, dearth of scientific or historical information potential, and location in highly disturbed contexts, P-39-4431, P-39-4433, and P-39-4434 do not meet the criteria of historical resources or unique archaeological resources. These resources will not be considered further in this impact analysis.

P-39-4436

P-39-4436 consists of wood pilings, probably the remnant of a pier, and may be associated with the historic town of Hagginsville (Nelson et al. 2003:31–32). P-39-4436 does not appear to meet CEQA's criteria for historical resources and will not be considered further in this EIR's impact analysis.

Architectural Resources

One architectural resource, the Staten Island levee and canal system, is located in the Downstream Levee Modifications, North Fork Mokelumne River area. Because of a lack of integrity, the levee and canal system does not appear to be a historical resource for the purposes of CEQA and will not be considered further in this EIR's impact analysis.

Staten Island Detention Areas

A total of 55 cultural resources have been identified in the Staten Island detention areas, described under separate headings below.

P-39-356, P-39-4423, and P-39-4424

See the description of these resources under Downstream Levee Modifications, North Fork Mokelumne River above.

P-39-4425

P-39-4425 is a historic refuse scatter consisting of domestic and structural debris dating to ca. 1880–1914. Asian artifacts were noted at the site as well. Nelson et al. (2003:31–32, 41) collected all discernable artifacts from the site's surface as mitigation for a Ducks Unlimited wildlife levee project. Because all archaeological materials have been removed from P-39-4425, the site does not have significant information potential and does not meet the CEQA criteria for qualification as a historical resource or a unique archaeological resource (Nelson et al. 2003:Table 2). Therefore, P-39-4425 will not be considered further in this EIR's impact analysis.

P-39-4436

See the description of this resource under Downstream Levee Modifications, North Fork Mokelumne River above.

P-39-357

Historic archaeological site P-39-357 consists of a single milk glass fragment (Nelson et al. 2003:32). West (1991:15) originally recorded the site as a diffuse refuse scatter. Schulz and Farris (1994:Appendix 2) stated that the refuse scatter consisted of relatively recent (non-historic) materials. Agricultural activities likely destroyed P-39-357 (Nelson et al. 2003:33).

Nelson et al. (2003:41) recommends that P-39-357 is ineligible for listing in the NRHP because it has no significant information potential and lacks demonstrable associations with historically important events and persons. Therefore, P-39-357 does not meet the criteria of a historical resource or a unique archaeological resource and will not be considered further in this EIR's impact analysis.

P-39-4438

P-39-4438 consists of one fragment of turquoise-glazed earthenware. P-39-4438 may be associated with historic Papderdee Camp. (DeGeorgey and Tinkham 2003a:1.) P-39-4438 is situated in a highly disturbed context, possesses no significant information potential, and lacks meaningful association with historically important events and persons. Therefore P-39-4438 does not meet the criteria of a historical resource or a unique archaeological resource and will not be considered further in this EIR's impact analysis.

Historic-Period Isolates

Nine historic-period isolates (single artifacts or very sparse artifact accumulations) have been recorded in the proposed Staten Island detention areas. These consist of glass vessel fragments, ceramics, brick, and wood pilings (Nelson et al. 2003:Table 1). The historic-period isolates are summarized in Table 5.7-1 below. Isolates are very rarely considered eligible for listing in the CRHR or the NRHP, or historical resources or unique archaeological resources under CEQA. The isolates described in Table 5.7-1 are located in highly disturbed contexts, are not unique materials or classes of cultural resource, and lack scientific and historical information potential. As such, they will not be considered further in the impact analysis of this EIR.

Table 5.7-1. Historic-Period Isolates on Staten Island

Isolate and Primary Number	Resource Description
P-39-4439 (Isolate 9)	White-ware fragments and earthenware plate; likely associated with historic Camp No. 18
P-39-4431 (Isolate 11)	Ceramic scatter; likely associated with historic Camp 15
P-39-4432 (Isolate 12)	Brick, ceramic, and glass scatter; likely associated with historic Clark 3 Camp
P-39-4433 (Isolate 13)	Clear and brown bottles and bottle shards; likely associated with historic "new pump"
P-39-4434 (Isolate 14)	White ironstone cup or bowl fragment and half-gallon clear glass jug; likely associated with historic Staten Island Pump
P-39-4435 (Isolate 15)	Scatter of red brick, olive-colored bottle glass, and metal debris; likely associated with historic Hagginsville
P-39-4436 (Isolate 16)	Wood pilings
P-39-4437 (Isolate 17)	Fragment of Chinese brown stoneware
P-39-4440 (Isolate 10)	Eight wood pilings from a dock or pier; likely associated with historic Camp No. 16 or Rickie Camp

Architectural Resources

Thirty-nine architectural resources are located in the Staten Island detention areas. Nelson et al. (2003) inventoried and evaluated 36 of the 39 resources. The remaining three resources were inventoried and evaluated by Jones & Stokes.

Thirty-six of the 39 architectural resources in the Staten Island detention areas are associated with the Staten Island Ranch Headquarters (located in the northwestern portion of Staten Island near the North Fork Mokelumne River), the Staten Ranch Elevator Camp (located in the far northern section of Staten Island near the South Mokelumne River), and Camp 36 North and Camp 36 South (located in the north central part of Staten Island). None of the resources was found to be a historical resource for the purposes of CEQA (Nelson et al. 2003). Therefore, these resources are not considered further in this EIR's impact analysis. The 36 resources are summarized in Table 5.7-2 below.

Jones & Stokes addressed three of the 39 architectural resources, the Staten Island levee and canal system, New Hope Bridge, and Millers Ferry Bridge, as part of this project. As stated above, the levee and canal system does not appear to be a historical resource for the purposes of CEQA. The New Hope Bridge (Bridge no. 29C-0104) and Millers Ferry Bridge (Bridge no. 29C-0131) are listed as Category 5 bridges (not eligible for listing in the National Register of Historic Places or considered a historical resource for the purposes of CEQA) by Caltrans and therefore require no further study.

Table 5.7-2. Previously Recorded Architectural Resources in Staten Island Detention Areas

Resource Name	Resource Description	Year Built
Ranch Headquarters: Building 1	Wood frame ranch manager's house	Ca 1880
Ranch Headquarters: Building 1b	Wood frame ranch manager's pool house	Ca 1950
Ranch Headquarters: Building 1c	Wood frame ranch manager's garage	1990
Ranch Headquarters: Building 2	Foreman's house	Ca 1960
Ranch Headquarters: Building 2a	Foreman's garage	Unknown
Ranch Headquarters: Building 3	Bunkhouse	1943
Ranch Headquarters: Building 3a	Bunkhouse shower	Unknown
Ranch Headquarters: Building 4	Employee residence	1966
Ranch Headquarters: Building 4a	Prefabricated storage shed	Unknown
Ranch Headquarters: Building 5	Open bay equipment storage	1936
Ranch Headquarters: Building 6	Corrugated metal storage shed	Unknown
Ranch Headquarters: Building 7	Oil platform	Unknown
Ranch Headquarters: Building 8	Corrugated metal storage barn	Ca 1930
Ranch Headquarters: Building 9	Steel frame water tower	Unknown
Ranch Headquarters: Building 10, 11, 12	Metal storage structures	Unknown
Ranch Headquarters: Building 13	Corrugated metal machine shop	1968
Ranch Headquarters: Building 14	Wood frame equipment garage	Ca 1953
Ranch Headquarters: Building 15	Metal equipment garage	1953
Ranch Headquarters: Building 16	Wood frame employee residence	1963
Ranch Headquarters: Building 17	Wood frame barn	1936
Ranch Headquarters: Building 18	Employee residence	1963
Ranch Headquarters: Building 18a	Garage building	1970
Elevator Camp: Building 19	Metal-sided weigh house	1950

Resource Name	Resource Description	Year Built
Elevator Camp: Building 20	Bathroom/storage	1970
Elevator Camp: Building 21	Concrete grain elevator and silos	1950
Elevator Camp: Building 22	Metal corn dryer	1970
Elevator Camp: Building 23	Concrete storage barn	1964
Elevator Camp: Building 24	Wood frame employee residence	1952
Elevator Camp: Building 25	Metal storage tank	1970
Camp 36 North: Building 26	Employee residence	1960
Camp 36 North: Building 26a	Wood frame garage residence	Ca 1960
Camp 36 North: Building 27	Employee residence	Ca 1960
Camp 36 South: Building 28	Employee residence	Ca 1960
Camp 36 South: Building 28a	Wood frame poultry shed	Ca 1910

Levee Raising Area: Staten Island Section

Nelson et al. (2003:Appendix A) identified two historic archaeological sites (P-39-4419 and P-39-4420) and seven historic isolates within the estimated levee-raising footprint.

P-39-4419

Archaeological site P-39-4419 consists of wood pilings in the South Fork Mokelumne River and an associated artifact scatter 213 feet north of the river, on the edge of a cornfield. The artifact scatter consists of residential domestic debris dating between 1880 and 1914, distributed over an area 165 feet long and 82 feet wide. All artifacts are made from ceramic, glass, or milled wood. Historic documents and artifact types at the site suggest that its occupants were Asian, possibly Japanese potato farmers residing at Camp 31. (DeGeorgey and Tinkham 2003b:1–4.) This resource has not been evaluated for qualification as a historical resource or a unique archaeological resource for the purposes of CEQA.

P-39-4420

Archaeological site P-39-4420 is a refuse scatter consisting of residential and structural debris on the landward side of the South Fork Mokelumne River levee and 10 wood pilings in the river. Artifacts include ceramics, bottle glass, other glass fragments, bricks, and window glass spread over an area 354 feet long and 65 feet wide. The artifacts date to the 1880–1914 interval and many are Asian in origin, suggesting that the site occupants were Japanese farmers. (DeGeorgey and Tinkham 2003c:1–4.) This resource has not been evaluated for qualification as a historical resource or a unique archaeological resource for the purposes of CEQA.

Historic-Period Isolates

Seven historic-period isolates (P-39-4421, P-39-4422, P-39-4427, P-39-4428, P-39-4429, P-39-4430, and P-39-4438) have been identified in the Staten Island section of the levee-raising/improvements area. The isolates are described below.

P-39-4421 is a white porcelain cup fragment with hand-painted Japanese designs dating to ca. 1900. Although only one artifact was identified, crop cover was dense in the vicinity and may have obscured other archaeological materials. The find is probably associated with historic Camp 34. (DeGeorgey and Tinkham 2003d:1.)

P-39-4422 consists of five wood pilings in the South Fork Mokelumne River and a fragment of Japanese white porcelain, located at the base of the levee. P-39-4422 is likely associated with historic San Landing and Camp 29 or 30. (DeGeorgey and Tinkham 2003e:1; Paterson et al. 1978:22, 36.) P-39-4422 is situated in a highly disturbed context and possesses no information potential beyond that contained on its site record form. Therefore, P-39-4422 does not meet the criteria of a historical resource or a unique archaeological resource and is not considered further in the impact analysis of this EIR.

P-39-4427 consists of a piece of milled lumber and a fragment of amethyst-colored bottle glass. Visibility was limited by dense crop cover at the time of P-39-4427's identification that may have obscured other archaeological materials. This isolated find is probably associated with historic Camp 1. (DeGeorgey and Tinkham 2003f:1.)

P-39-4428 consists of two fragments of thick, white stoneware and two fragments of red brick. Visibility was limited by dense crop cover at the time of P-39-4428's identification that may have obscured other archaeological materials. These artifacts are likely associated with the historic Valentine's Pump. (DeGeorgey and Tinkham 2003g:1.)

P-39-4429 consists of a patinated bottle glass fragment. This isolated artifact may be associated with historic Camp 28. In addition, dense crop cover at the time that P-39-4429 was identified obscured the ground surface's visibility, possibly obscuring other archaeological materials associated with Camp 28. (DeGeorgey and Tinkham 2003h; Nelson et al. 2003:Table 1, Isolate 6.)

P-39-4430 consists of roof shingles, green tarpaper, a clear bottle base, a metal pipe, and wood fragments. This structural debris may be associated with historic Camp 25 or the Quong Lee Landing. (DeGeorgey and Tinkham 2003i:1.) This isolate is situated in a highly disturbed context and possesses no information potential beyond that contained in its site record form. Therefore, P-39-4430 does not meet the criteria of a historical resource or a unique archaeological resource and will not be considered further in this EIR's impact analysis.

P-39-4438 is the same resource discussed under Staten Island Detention Areas above.

Architectural Resources

One architectural resource, the Staten Island levee and canal system, is located in the Staten Island section of the levee-raising/improvements area. As stated above, the levee and canal system does not appear to be a historical resource for the purposes of CEQA.

Levee Raising Area: Bouldin Island Section

Two previously recorded historic-period cultural resources are located in the levee-raising/improvements area on Bouldin Island (see below).

P-39-322

P-39-322 is a historic-period refuse scatter in a plowed field 50 feet south of the South Fork Mokelumne River. The refuse scatter measures 275 feet by 110 feet and consists of brick fragments, ceramics, and bottle glass. The artifacts present suggest association with Asian farmers of the 1920s. (Bethard et al. 1989:1, 2; Maniery and Syda 1988:43.)

Maniery and Syda (1988:60) evaluated P-39-322 for inclusion in the National Register of Historic Places (NRHP), the significance criteria of which form the basis for the CRHR significance criteria; P-39-322 was deemed ineligible for listing in the NRHP because associations with historically significant events and persons cannot be reliably established (CRHR criteria 1 and 2), the artifacts present are not exceptional examples of their type and are not representative of the work of a master artisan (CRHR criterion 3), and the severely disturbed nature of the artifact deposit renders its scientific information potential very low (CRHR criterion 4). P-39-322 is not listed in a local historic resources register, and no lead agency has previously determined the site to be a historical resource for the purposes of CEQA. The lack of important historical associations, information potential, and the common nature of the site also fall short of the criteria for unique archaeological resources. As such, impacts on P-39-322 will not be considered further in this EIR.

P-39-324

P-39-324 comprises the remnant of a historic ranch property situated 50 feet south of the South Fork Mokelumne River. Extant features include a concrete foundation and pad, cast-iron bathtubs, a shed, and corral. Historic artifacts included barbed wire, structural debris, ceramics, and glass. P-39-324 is associated with George Shima's Camp 16, which was established in 1916 and used until at least World War II. (Maniery and Wilcox 1988:1–3.) This resource has not been evaluated for qualification as a historical resource or a unique archaeological resource for the purposes of CEQA.

Architectural Resources

No previously recorded architectural resources are known to be located on Bouldin Island. An architectural survey has not been conducted for this project area because of restrictions on access to private property.

Grizzly Slough Borrow Site

Two cultural resources have been identified in the Grizzly Slough borrow site: archaeological sites P-34-36 and P-34-37/CO 33.

P-34-36

Schenck and Dawson (1929b) describe P-34-36 as a partly destroyed site that yielded artifacts and human burials. DWR archaeologists were unable to locate P-34-36 during the April 2005 archaeological survey (Offermann pers. comm.). Maniery (1991:Appendix E) describes the site as partially destroyed, but bases this comment on Schenck and Dawson (1929b), not new fieldwork.

P-34-37 and CO 33

P-34-37 is described as a 3-foot-high mounded archaeological site measuring 300 feet by 80 feet and situated on a knoll (Schenck and Dawson 1929a:310; 1929c). J. K. Dawson found human bones while digging at the site at an undisclosed date (Schenck and Dawson 1929c).

Schulz and Farris (1994:343) report that a historic residence (designated CO 33) was located atop P-34-37; maps indicate that it was built as early as 1910 (U.S. Geological Survey 1910c). The residence was removed from the knoll ca. 1995 (Offermann pers. comm.).

DWR archaeologists were unable to identify prehistoric or historic archaeological material during their April 2005 survey of the location of P-34-37 and CO 33: the ground surface was completely obscured by knee-high vegetation. The mound or knoll is still evident, however, and it is highly probable that both prehistoric and historic archaeological materials remain at this location. (Offermann pers. comm.)

Architectural Resources

No previously recorded architectural resources are known to be located in the Grizzly Slough borrow site. Because of project scheduling conflicts, an architectural survey has not been conducted for this Project area to date.

New Hope Borrow Site

Architectural Resources

No previously recorded architectural resources are known to be located in the New Hope borrow site. Because of project scheduling conflicts, an architectural survey has not been conducted for this project area to date.

Dixon Borrow Site

Two previously recorded cultural resources are located in the Dixon borrow site, but these may constitute a single resource for reasons explained below.

P-34-39

This prehistoric burial and occupation site was originally recorded between 1912 and 1921, when Elmer J. Dawson excavated 15 “holes” in the site to a maximum depth of 2.5 feet (Fenenga 1939:43; Schenck and Dawson 1929a:309). P-34-39 was an elliptical mound approximately 145 feet long, 80 feet wide, and 3 feet tall; 13 human burials were removed during Dawson’s work at the site (Schenck and Dawson 1929a: 343, Table 2; Schulz and Farris 1994:Appendix 2).

Sacramento Junior College conducted more extensive excavations at P-34-39 from August 1937 to February 1938. The site had been leveled, probably through repeated plowing, by the time fieldwork commenced. The junior college’s excavation revealed that midden soils extended 5 feet below ground surface, burials were placed as deep as 6 feet below ground surface, and the site contained animal bones, shell, ash lenses, fire pits, and dart (spear or atlatl)-sized stone projectile points. Other artifacts included pestles, antler flakers, bone tools, and various marine shell beads and ornaments. An additional 90 human burials and five cremations were identified between 1937 and 1938. (Fenenga 1939:45–46.)

J. Schulz and Farris (1982), based on a surface inspection of the site, indicate that P-34-39 is larger than previous researchers posited: they give dimensions of 120 meters (394 feet) by 80 meters (262 feet). In addition, the following artifact types were observed on the surface: groundstone tool fragments, baked clay, obsidian flakes, net sinkers, and basalt flakes. Although much of the additional size may be attributed to displacement of artifacts by plowing, the sheer abundance of material on the surface of P-34-39 indicates that substantial archaeological deposits still exist below the ground surface. (J. Schulz and Farris 1982.)

P-34-276

This site is located on the same property as P-34-39 and contains artifacts similar to P-34-39. Based on J. Schulz and Farris (1982) and the P-34-276 site record (Pohorecky 1962), it appears that P-34-276 is located within the expanded boundary of P-34-39 and does not constitute a distinct site. Therefore, the impact analysis herein will address P-34-39 and P-34-276 under the rubric P-34-39.

Architectural Resources

No previously recorded architectural resources are known to be located in the Dixon borrow site. Because of project scheduling conflicts, an architectural survey has not been conducted for this project area to date.

Delta Meadows Property (Optional)

Four previously recorded cultural resources are located on the Delta Meadows property: CA-Sac-47, P-34-102, CA-Sac-76/H, and the Walnut Grove Branch Line of the Southern Pacific Railroad.

CA-Sac-47

CA-Sac-47 is a prehistoric archaeological site measuring 300 feet long and 100 feet wide with archaeological materials extending 40 inches below the ground surface (Schulz and Farris 1994:Appendix 2). The site has not been evaluated for qualification as a historical resource or a unique archaeological resource for the purposes of CEQA.

P-34-102

P-34-102 was originally described as a prehistoric mound (occupation or burial site) 120 yards by 150 yards. A subsequent site record indicates that the site is situated on a sand dune formerly adjacent to Snodgrass Slough and measured 225 feet by 150 feet. Archaeological materials extended to a depth of more than 2–3 feet. Human remains, Native American in origin, have been removed from P-34-102, along with various prehistoric and historic artifacts. (Schulz and Farris 1994:Appendix 2.) The site has not been evaluated for qualification as a historical resource or a unique archaeological resource for the purposes of CEQA.

CA-Sac-76/H

CA-Sac-76/H, the Delta Meadows Site, is a prehistoric occupation and burial site listed in the NRHP (California Office of Historic Preservation 2000:126; National Register of Historic Places 1991:65; Schulz and Farris 1994:Appendix 2). The site has not been subjected to scientific archaeological study, though excavation by non-professionals was carried out in the 1920s (Hathaway 1927, cited in Woodward and Evans 1992:180). As an NRHP-listed cultural resource, CA-Sac-76/H is a historical resource for the purposes of CEQA.

Architectural Resources

One previously recorded architectural resource, the Walnut Grove Branch Line of the Southern Pacific Railroad, is located in the Delta Meadows property. Because of project scheduling conflicts, an architectural survey of the Delta Meadows property has not been conducted to date as part of this Project.

The Walnut Grove Branch line of the Southern Pacific Railroad SPRR was previously determined by the USACE to be eligible for listing in the NRHP for innovations involved in the railroad's construction, its influence on the development of agriculture and canning and packing operations in the Delta region, and its direct causal role in the establishment of the town of Locke. The Walnut Grove Branch Line is also considered a historical resource for the purposes of CEQA. (California Office of Historic Preservation 2004:66; Sacramento County Department of Environmental Review and Assessment 2003:10-15.)

Regulatory Setting and Significance Criteria

Regulatory Setting

California Environmental Quality Act

CEQA requires that public agencies (in this case, DWR) that finance or approve public or private projects must assess the effects of the project on cultural resources. Cultural resources are defined as buildings, sites, structures, or objects, each of which may have historical, architectural, archaeological, cultural, or scientific importance. CEQA requires that if a project would result in significant effects on important cultural resources, alternative plans or mitigation measures must be considered; only significant cultural resources, however, need to be addressed. Therefore, prior to the development of mitigation measures, the importance of cultural resources must first be determined. The steps that are normally taken in a cultural resources investigation for CEQA compliance are as follows:

- Identify cultural resources.
- Evaluate the significance of resources.
- Evaluate the impacts of a project on *significant* cultural resources.
- Develop and implement measures to mitigate the impacts of the project only on *significant* resources, namely historical resources and unique archaeological resources.

The State CEQA Guidelines define three ways that a cultural resource may qualify as a historical resource for the purposes of CEQA review:

- if the resource is listed in or determined eligible for listing in the CRHR;
- if the resource is included in a local register of historical resources, as defined in Public Resources Code (PRC) 5020.1(k), or is identified as significant in an historical resource survey meeting the requirements of PRC 5024.1(g) unless the preponderance of evidence demonstrates that it is not historically or culturally significant; or
- the lead agency determines the resource to be significant as supported by substantial evidence in light of the whole record (14 CCR 15064.5[a]).

A cultural resource may be eligible for inclusion in the California Register of Historical Resources (CRHR) if it:

- is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- is associated with the lives of persons important in our past;

- embodies the distinctive characteristics of a type, period, region, or method of construction, represents the work of an important creative individual, or possesses high artistic values; or
- has yielded, or may be likely to yield, information important in prehistory or history.

In addition, CEQA distinguishes between two classes of archaeological resources: archaeological resources that meet the definition of a historical resource as above, and "unique archaeological resources." An archaeological resource is considered unique if it:

- is associated with an event or person of recognized significance in California or American history or of recognized scientific importance in prehistory;
- can provide information that is of demonstrable public interest and is useful in addressing scientifically consequential and reasonable research questions; or
- has a special or particular quality such as oldest, best example, largest, or last surviving example of its kind (PRC 21083.2).

The State CEQA Guidelines (14 CCR 15064.5[c]) state that the lead agency must treat an archaeological resource that meets the definition of a historical resource according to the provisions of PRC 21084.1, 14 CCR 15064.5, and 14 CCR 15126.4. If an archaeological resource does not meet the definition of an historical resource, but does meet the definition of a unique archaeological resource, the lead agency is obligated to treat the resource according to the provisions of PRC 21083.2 (14 CCR 15064.5[c][3]).

Significance Criteria

Impact assessments for cultural resources are based on the type of resource, a determination of whether a resource is considered significant, the type of impact, and the extent of the impact. Impacts on cultural resources are considered significant if they would adversely affect significant cultural resources. Specific actions under the Project that may adversely affect cultural resources include the modification of levees, construction of weirs, development of wetlands and other restoration features, inundation, construction of support structures and access roads, and channel dredging. Specific CEQA and CALFED significance criteria are described below.

Physical damage to or destruction of significant cultural resources, particularly archaeological sites, may affect the physical integrity of those resources and thus reduce their information or research potential (CRHR Criterion 4). Physical damage or alteration may also have deleterious effects on the characteristics of a cultural resource that convey its significant association with an important historical event, person, or architectural/design quality (CRHR Criteria 1–3).

CEQA Significance Criteria

According to the State CEQA Guidelines (14 CCR 15064.5), a project with an effect that may cause a substantial adverse change in the significance of a historic resource is a project that may have a significant effect on the environment (14 CCR 15064.5[b]). CEQA further states that a substantial adverse change in the significance of a resource means the physical demolition, destruction, relocation, or alteration of the resource or its immediate surroundings such that the significance of a historic resource would be materially impaired. Actions that would materially impair the significance of a historic resource are any actions that would demolish or adversely alter those physical characteristics of a historic resource that convey its historic significance and qualify it for inclusion in the CRHR or in a local register or survey that meets the requirements of PRC 5020.1(k) and 5024.1(g).

CALFED Programmatic Mitigation Measures

The August 2000 CALFED Programmatic Record of Decision (ROD) includes mitigation measures for agencies to consider and use where appropriate in the development and implementation of project-specific actions. The mitigation measures address the short-term, long-term, and cumulative effects of the CALFED Program.

The discussion of significant impacts and mitigation measures in this section will include a citation of one or more of the following programmatic mitigation measures used to build project-specific mitigation measures to offset significant impacts identified from implementation of the Project.

1. conduct cultural resources inventories,
2. avoid sites through project redesign,
3. map sites prior to undertaking actions that affect cultural resources,
4. conduct surface collections,
5. perform test excavations,
6. probe for potential buried sites,
7. prepare reports to document mitigation work,
8. conduct full-scale excavations of sites slated for destruction as a result of projects,
9. prepare public interpretive documents,
10. document historic structures by preparing Historic American Engineering Records of Historic American Building Surveys, and
11. conduct ethnographic studies for traditional cultural properties.

Impacts and Mitigation of the Project Alternatives

The impact analysis and mitigation measures presented in this section are based on archival research, records searches, consultation with Native Americans, and limited field surveys. Field surveys were limited for two reasons. First, some project elements, such as the Delta Meadows property enhancements and the recreation enhancements on Staten Island, are not yet developed to the design level, rendering field inventories inadvisable. Second, the levee-raising areas extend through much private property to which DWR has not gained access, preventing lawful examination of these portions of the project area. As evidenced by the Physical Setting/Affected Environment, however, sufficient data have been gathered to evaluate the significance of cultural resource impacts in lieu of 100% field inventory of the project area.

Alternative NP: No Project

No changes in existing conditions would result from implementation of Alternative NP, rendering it highly likely that catastrophic flooding would occur within the 20-year planning horizon through 2025. Such uncontrolled, catastrophic flooding has a high probability of damaging or destroying historical resources and unique archaeological resources in the North Delta (see resource descriptions in the Physical Setting/Affected Environment). In addition, based on historic flood events (see Section 4.2 of this EIR), implementation of Alternative NP would likely result in damage to or destruction of historical resources in the Point Pleasant area, Glanville Tract, Canal Ranch Tract, New Hope Tract, and Tyler Island as a result of not addressing the flood control issued identified in Chapters 1 and 2 of this EIR.

A total of 51 previously recorded cultural resources and as many as 176 unrecorded cultural resources (identified through review of historic maps but not field-verified) are present in Canal Ranch Tract, Glanville Tract, New Hope Tract, and Tyler Island (Schulz and Farris 1994:94, 101–102, 148, 154). The most likely impact mechanisms affecting these resources would be scouring and sediment deposition associated with flooding. In addition, emergency flood control and recovery efforts conducted with minimal or no environmental impact analysis have the potential to affect cultural resources in the affected areas. Such impacts would be significant under CEQA.

Alternative 1-A: Fluvial Process Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with a scientific pilot action of breaching a levee to optimize fluvial processes. The southernmost portion of the tract would be open to tidal action. As shown in Figure 2-1, Alternative 1-A includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir

- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Breach Mokelumne River Levee
- Allow Boating on Southeastern McCormack-Williamson Tract
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property (*optional*)

A total of eight potential historical resources or unique archaeological resources have been identified in areas affected by Alternative 1-A. In addition, at least 80% of the downstream levee modification areas have not been surveyed for the presence of cultural resources because of restricted property access; construction in these areas without a cultural resource survey has the potential to damage or destroy as-yet-unidentified cultural resources. These impacts are discussed below.

Impact CR-1: Destruction of Archaeological Sites P-39-324, P-39-4419, and P-39-4420 as a Result of Ground Disturbance.

Construction associated with levee modification would likely result in the destruction of historic archaeological sites P-39-324, P-39-4419, and P-39-4420. These archaeological sites have not been evaluated for qualification as historical resources or unique archaeological resources for the purposes of CEQA. The potential for subsurface archaeological deposits, and therefore information of consequence to the study of local history, is present at all three sites.

Determination of Significance: Damage to or destruction of P-34-324, P-39-4419, and P-39-4420, if DWR determines that they are historical resources or unique archaeological resources, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation

Several mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-39-324, P-39-4419, and P-39-4420, namely mitigation strategies 3–5 and 7–8. Prior to approval and final design of the downstream levee modifications, DWR will authorize qualified archaeologists to map the sites (mitigation strategy 3), conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5), and prepare a report to document the results of mitigation strategies 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether the sites are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources.

If DWR determines the sites to be non-significant, no additional mitigation is required, and this impact will be reduced to a less-than-significant level. Conversely, if DWR determines that the any or all of the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of the site(s) deemed significant (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.

Significance after Mitigation: In cases where a small portion of the sites is affected by the project, the mitigation strategies in the preceding sentences will reduce this impact to a **less-than-significant** level. In the event of major damage or complete destruction of any significant sites, the mitigation strategies described above would **reduce** the severity of the impact, though the impact would still be **significant** after mitigation.

Impact CR-2: Destruction of Unevaluated Isolated Finds.

Construction associated with levee modifications would likely result in the destruction of five previously recorded, unevaluated historic-period isolated finds (P-39-4421, P-39-4427, P-39-4428, P-39-4429, and P-39-4438). Typically isolated finds do not qualify as historical resources or unique archaeological resources for the purposes of CEQA, in large measure because of the minimal historical associations and information potential of individual or a small number of artifacts and features. The archaeologists that recorded the isolates in question, however, report that the ground surface was obscured at the time of their survey, and therefore they consider their efforts to identify archaeological materials in the isolate vicinities to be incomplete. Additional archaeological materials may be present in areas obscured by crops, particularly since because the isolates are located at or near historic camps and landings (Nelson et al. 2003:Table 1). Further work is necessary to determine whether the isolates are historical resources or unique archaeological resources.

Damage to or destruction of P-39-4421, P-39-4427, P-39-4428, P-39-4429, and P-39-4438, if DWR determines that they are historical resources or unique archaeological resources, would be a significant impact under CEQA (14 CCR 15064.5).

Determination of Significance: Significant.

Mitigation

Mitigation strategies 1 and 3, listed in the August 2000 CALFED Programmatic ROD, are feasible mitigation measures for impacts incurred on P-39-4421, P-39-4427, P-39-4428, P-39-4429, and P-39-4438. Prior to approval and final design of the downstream levee modifications, DWR will authorize qualified archaeologists to survey the isolate vicinities and map all archaeological materials identified to determine whether additional archaeological materials are present. If no additional archaeological materials are present, isolates P-39-4421, P-39-4427, P-39-4428, P-39-4429, and P-39-4438 would not qualify as historical resources or unique archaeological resources for the purposes of CEQA, and implementation of mitigation measures 1 and 3 would reduce this impact to a no-impact level.

If additional archaeological materials are identified at any or all of the isolated finds, they will be considered archaeological sites and DWR will authorize qualified archaeologists to conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5), and prepare a report to document the results of mitigation strategies 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether the sites are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources.

If DWR determines the sites to be non-significant, no additional mitigation is required and this impact will be reduced to a less-than-significant level. Conversely, if DWR determines that the any or all of the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of the site(s) deemed significant (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.

Significance after Mitigation: If DWR determines that the sites are not significant, this impact will be reduced to a **less-than-significant** level after mitigation.

For sites that qualify as historical or unique archaeological resources, impact significance after mitigation varies with the magnitude of the impact. In cases where small portions of the sites are affected by the project, the mitigation strategies under “Mitigation Measures” will reduce this impact to a **less-than-significant level**. In the event of major damage or complete destruction of any significant sites, the mitigation strategies described above would **reduce** the severity of the impact, though the impact would still be **significant**.

Impact CR-3: Destruction of Cultural Resources along Unexamined Portions of the Downstream Levees.

Cultural resource professionals have only surveyed only 20% or less of the potentially affected areas along the downstream levees. Island levees in the North Delta area are the most likely locations for prehistoric and historic-period cultural resources. Therefore, construction of the downstream levee improvements in the absence of professionally conducted cultural resource surveys has a high probability of destroying cultural resources. Because of multiple property-access prohibitions, DWR it was not feasible to conduct a cultural resources survey of potential levee modifications in support of this EIR; impact analysis therefore must be conceptual in nature, with detailed impact analyses transpiring once suitable construction detail is available.

Construction in unsurveyed areas would likely result in damage to or destruction of cultural resources that may meet the criteria of historical resources or unique archaeological resources. Damage to or destruction of historical resources and unique archaeological resources constitutes a significant impact under CEQA (14 CCR 15064.5).

Determination of Significance: Significant.

Mitigation

Because the progress in defining this project action is provisional, mitigation strategies 1 and 7 listed in the August 2000 CALFED Programmatic ROD, are feasible mitigation measures for this impact, provided no cultural resources are identified as a result. Prior to approval and final design of the downstream levee modifications, DWR will authorize qualified cultural resource specialists to survey the areas slated for improvements (mitigation strategy 1). If no cultural resources are identified in the improvement areas, implementation of mitigation strategies 1 and 7 (report preparation) will reduce this impact to a no-impact level.

If archaeological resources are identified as a result of survey work, DWR will authorize qualified archaeologists to conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5) and prepare a report to document the results of mitigation strategies 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether the sites are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources.

If DWR determines the sites to be non-significant, no additional mitigation is required and this impact will be reduced to a less-than-significant level. Conversely, if DWR determines that the any or all of the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of the site(s) deemed significant (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.

If historic architectural resources are identified as a result of survey work, DWR will authorize qualified architectural historians to conduct an oral history research to determine, in consultation with DWR, whether the resources constitute historical resources for the purposes of CEQA. The results will be documented in an evaluation report (mitigation strategy 7).

If DWR determines the historic architectural resources to be historical resources for the purposes of CEQA, DWR will authorize qualified architectural historians to document historic structures by preparing Historic American Engineering Records of Historic American Building Surveys (mitigation strategy 10), prepare public interpretive documents (mitigation strategy 9), and prepare mitigation reports (mitigation strategy 7). Options for avoidance through project design should be contemplated as well (mitigation strategy 2).

Significance after Mitigation: If no cultural resources are identified in the improvement areas, implementation of mitigation strategies 1 and 7 (report preparation) will reduce this impact to a **no-impact** level.

If any cultural resources are identified in the improvement areas, but DWR determines that they are not historical resources or unique archaeological resources, no additional mitigation is required and this impact will be reduced to a **less-than-significant** level.

If DWR determines that significant archaeological sites are present in the improvement areas, the significance of impacts would depend on the magnitude of the physical impact. In cases where small portions of the sites are affected by the project, the mitigation strategies above will reduce this impact to a **less-than-significant** level. In the event of major damage or complete destruction of any significant sites, the mitigation strategies described above would reduce the severity of the impact, though the impact would still be **significant**.

Similarly, minimal physical damage or intrusion to the setting of a significant historic building or structure will be reduced to a **less-than-significant** or **no impact** level. In the case of complete destruction, however, the mitigation strategies described above will reduce the severity of the impact, though the impact would still be **significant**.

Dixon Borrow Site

Excavation of the Dixon borrow site would result in damage to or destruction of archaeological site P-34-39 as a result of soil removal. Furthermore, the proposed alternative has the potential to damage or destroy as-yet-unidentified cultural resources in the project area.

Impact CR-4: Damage to or Destruction of Site P-34-39 as a Result of Soil Removal.

Use of the Dixon borrow site for fill dirt would result in damage to or the destruction of site P-34-39. The site, though reported on poorly, clearly has the potential to contain abundant information of significance to the study of prehistory in the Delta.

Determination of Significance: Damage to or destruction of P-34-39, if DWR determines that it is a historical resource or unique archaeological resource, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation
This impact, associated mitigation measures, and level of significance after mitigation are the same as described for Impact CR-1.

Impact CR-5: Damage to or Destruction of Cultural Resources in the Dixon Borrow Site.

Although Farris et al. (1982) surveyed a 600-feet foot-wide swath through the Dixon borrow site, this survey coverage constitutes only about 20% of the borrow site. The unexamined portion of the borrow site is likely to contain cultural resources.

Determination of Significance: Construction in unsurveyed areas would likely result in the destruction of cultural resources that may meet the criteria of historical resources or unique archaeological resources. Damage to or destruction of historical resources and unique archaeological resources constitutes a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation
This impact, associated mitigation measures, and level of significance after mitigation are the same as described for Impact CR-3.

New Hope Borrow Site

Excavation of the New Hope borrow site has the potential to damage or destroy as-yet-unidentified architectural resources in the project area.

Impact CR-6: Damage to or Destruction of Architectural Resources in the New Hope Borrow Site.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Excavate and Restore Grizzly Slough Property (Optional)

Levee breaching and regrading on the Grizzly Slough Property have the potential to damage or destroy archaeological sites P-34-36 and P-34-37 as a result of soil removal and other ground-disturbing activities. Furthermore, portions of Grizzly and Bear Slough levees have not yet been surveyed for the presence of cultural resources because of scheduling conflicts. This action has the potential to damage or destroy as-yet-unidentified cultural resources in these areas. These impacts are discussed below.

Impact CR-7: Damage to or Destruction of Archaeological Site P-34-36 as a Result of Soil Removal and Other Ground-Disturbing Activities.

Excavation at the Grizzly Slough borrow site for restoration purposes and acquisition of fill material would result in damage to or complete destruction of site P-34-36 by removal of soils that contain prehistoric and historic archaeological deposits. During DWR's April 2005 cultural resource inventory of the site vicinity, however, no archaeological materials were observed, indicating that site P-34-36 may have been destroyed or incorrectly mapped.

Determination of Significance: Damage to or destruction of P-34-36, if DWR determines that it is a historical resource or unique archaeological resource, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation

DWR archaeologists did not identify archaeological materials at the mapped location of P-34-36 as a result of the April 2005 survey. The lack of materials may represent agricultural disturbances and looting of artifacts or insufficient mapping at the time of original recordation (1929). Both scenarios leave open the possibility that buried archaeological materials are present at the mapped location of P-34-36. The lack of specificity in the original mapping suggests that presence-absence excavation to locate P-34-36 is unwarranted. Instead, DWR will map the vicinity of P-34-36 as an environmentally sensitive area on construction and design drawings. DWR will ensure that a qualified archaeologist with full stop-work authority monitors all construction activities in the vicinity of P-34-36.

Significance after Mitigation: This mitigation measure will reduce the impact described above to a **less-than-significant level**, though additional work and assessment would be required in the event of an inadvertent discovery of archaeological materials.

Impact CR-8: Damage to or Destruction of Archaeological Site P-34-37 as a Result of Grading.

Excavation for restoration purposes at the Grizzly Slough borrow site and acquisition of fill material would result in damage to or complete destruction of site P-34-37 by removal of soils that contain prehistoric and historic archaeological deposits. The presence of human remains at P-34-37 and a fairly intact mound structure indicate that the presence of archaeological deposits with significant information potential is highly probable.

Determination of Significance: Damage to or destruction of P-34-37, if DWR determines that it is a historical resource or unique archaeological resource, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation

Two mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-34-37, namely mitigation strategies 2 and 3. Prior to approval and final design of the grading of the proposed borrow site, DWR will authorize qualified archaeologists to map the site (mitigation strategy 3) and fence the site boundaries for avoidance during construction (mitigation strategy 2). DWR should task a qualified archaeologist with periodic examinations of the fencing to ensure that the barrier is not crossed and clearly delimits the site boundaries throughout the duration of grading.

Significance after Mitigation: Implementation of this mitigation measure will reduce the severity of this impact to a **no-impact** level.

Impact CR-9: Destruction of Architectural Resources along Unexamined Portions of the Grizzly and Bear Slough Levees.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Dredge South Fork Mokelumne River (Optional)

This action has the potential to damage or destroy submerged cultural resources as a result of channel dredging and dredged soil disposal. These impacts are discussed below.

Impact CR-10: Destruction of Submerged Cultural Resources as a Result of Channel Dredging.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Impact CR-11: Destruction of Cultural Resources as a Result of Dredge Spoil Disposal.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Enhance Delta Meadows Property (Optional)

Enhancement of Delta Meadows Property has the potential to damage or destroy archaeological sites CA-Sac-76/H, CA-Sac-47, and P-34-102. In addition, portions of the area affected by this alternative have not yet been surveyed for the presence of cultural resources because of scheduling conflicts. Therefore, there is the potential for damage to or destruction of as-yet-unidentified cultural resources in Delta Meadows Property. These impacts are discussed below.

Impact CR-12: Damage to or Destruction of Archaeological Site CA-Sac-76/H at the Delta Meadows Property.

Recreational enhancements of the Delta Meadows property have the potential to result in damage to or destruction of CA-Sac-76/H via ground disturbance or the placement of fill dirt. The precise mechanism of impact has not been determined at this time.

Determination of Significance: Damage to or destruction of CA-Sac-76/H would be a **significant** impact under CEQA because it is a historical resource for the purposes of CEQA (14 CCR 15064.5).

Mitigation

The full range of CALFED programmatic mitigation strategies discussed under Impact CR-5 are appropriate for the mitigation of impacts on CA-Sac-76/H. Mitigation will be developed by California Department of Parks and Recreation during preparation of the Delta Meadows specific plan document.

Significance after Mitigation: The significance of impacts after mitigation would depend upon the magnitude of the impact and which mitigation strategies are feasible. If avoidance through project design would be feasible, impact significance after mitigation would be **no impact**. The implementation of other mitigation strategies would reduce impacts to a variable degree, from a **less-than-significant** to a reduced, but **significant** level.

Impact CR-13: Damage to or Destruction of Archaeological Sites CA-Sac-47 and P-34-102.

Recreational enhancements of the Delta Meadows property have the potential to result in damage to or destruction of CA-Sac-47 and P-34-102 through ground disturbance or the placement of fill dirt. The precise mechanism of impact has not been determined at this time.

Determination of Significance: Damage to or destruction of CA-Sac-47 or P-34-102, if DWR determines that it either or both are historical resources or unique archaeological resources, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation

The full range of CALFED programmatic mitigation strategies discussed under Impact CR-8 are appropriate for the mitigation of impacts on CA-Sac-47 and P-34-102. Mitigation will be developed by California Department of Parks and Recreation during preparation of the Delta Meadows specific plan document.

Significance after Mitigation: The significance of impacts after mitigation would depend upon the magnitude of the impact and which mitigation strategies are feasible. If avoidance through project design would be feasible, impact significance after mitigation would be **no impact**. The implementation of other mitigation strategies would reduce impacts to a variable degree, from a **less-than-significant** to a reduced, but **significant** level.

Impact CR-14: Damage to or Destruction of Architectural Resources in the Delta Meadows Property Area.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Alternative 1-B: Seasonal Floodplain Optimization

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with actions to maximize floodplain habitat to benefit fish species that spawn or rear on the floodplain. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season. As shown in Figure 2-15, Alternative 1-B includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee

- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

The potential for impacts of Alternative 1-B would be the same as those for Alternative 1-A.

Alternative 1-C: Seasonal Floodplain Enhancement and Subsidence Reversal

This alternative facilitates controlled flow-through of McCormack-Williamson Tract during high stage combined with scientific pilot actions to create floodplain habitat (similar to but less than Alternative 1-B), combined with a subsidence reversal demonstration project in the lowest area of the tract. This would be accomplished by allowing controlled flooding (with some tidal action to maintain water quality) during the wet season, as well as sediment import. As shown in Figure 2-19, Alternative 1-C includes the following components:

- Degrade McCormack-Williamson Tract East Levee to Function as a Weir
- Degrade McCormack-Williamson Tract Southwest Levee to Function as a Weir
- Reinforce Dead Horse Island East Levee
- Modify Downstream Levees to Accommodate Potentially Increased Flows
- Construct Transmission Tower Protective Levee and Access Road
- Demolish Farm Residence and Infrastructure
- Enhance Landside Levee Slope and Habitat
- Modify Landform and Restore Agricultural Land to Habitat
- Modify Pump and Siphon Operations
- Construct Box Culvert Drains and Self-Regulating Tide Gates

- Construct Cross-Levee to Create Subsidence-Reversal Demonstration Area
- Import Soil for Subsidence Reversal
- Implement Local Marina and Recreation Outreach Program
- Excavate Dixon and New Hope Borrow Sites
- Excavate and Restore Grizzly Slough Property
- Dredge South Fork Mokelumne River *(optional)*
- Enhance Delta Meadows Property *(optional)*

The potential for impacts of Alternative 1-C would be the same as those for Alternative 1-A.

Alternative 2-A: North Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the northern portion of Staten Island. High stage in the river would enter the detention basin upon cresting a weir in the levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no less more frequently than the 10-year event while having no measurable effect on the 100-year eventfloodplain. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-22, Alternative 2-A includes the following components:

- Construct North Staten Inlet Weir
- Construct North Staten Interior Detention Levee
- Construct North Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levees
- Degrade Existing Staten Island North Levee
- Relocate Existing Structures
- Modify Walnut Grove–Thornton Road and Staten Island Road
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Construction of an off-channel detention basin on the northern portion of Staten Island would damage or destroy archaeological site P-39-4423. This impact is discussed below.

Impact CR-15: Damage to or Destruction of P-39-4423 as a Result of Detention Levee Construction (North Staten Island Detention).

Construction of the southern detention levee of the North Staten Island Detention option would damage or destroy historic archaeological site P-39-4423. This site has not been evaluated for significance according to the criteria of the CRHR and CEQA.

Determination of Significance: Damage to or destruction of P-39-4423, if DWR determines that it is a historical resource or unique archaeological resource, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation

Several mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-39-4423, namely mitigation strategies 2–5 and 7–8. Prior to approval and final design of the North Staten Island Detention, DWR will authorize qualified archaeologists to map the site (mitigation strategy 3), conduct surface collections and perform test excavations at the site (mitigation strategies 4 and 5), and prepare a report to document the results of 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether P-39-4423 is a historical resource or unique archaeological resource for the purposes of CEQA, or is not a significant cultural resource. If DWR determines the site to be non-significant, no additional mitigation is required. Conversely, if DWR determines that the site qualifies as a historical resource or a unique archaeological resource, DWR will cause the final design of the North Staten Island Detention to avoid the boundaries of P-39-4423 (mitigation strategy 2) or, in the event that avoidance is not feasible, authorize qualified archaeologists to conduct full-scale excavations of P-39-4423 (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of P-39-4423.

Significance after Mitigation: If DWR determines P-39-4423 to be non-significant, no additional mitigation is required and this impact will be reduced to a **less-than-significant** level.

If DWR determines that P-39-4423 is a historical resource or a unique archaeological resource, and avoidance is feasible or a small portion of P-39-4423 is affected by the project, the mitigation strategies above will reduce this impact to **no impact** or a **less-than-significant** level, respectively. In the event of major damage or complete destruction of the site, the mitigation strategies described above would reduce the severity of the impact, though the impact would still be **significant**.

Dixon Borrow Site

The impacts of excavation of the Dixon borrow site would be the same as described under Alternative 1-A.

New Hope Borrow Site

The impacts of excavation of the Dixon borrow site would be the same as described under Alternative 1-A.

Alternative 2-B: West Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the western portion of Staten Island, along the North Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no less frequently than the 10-year event while having no measurable effect on the 100-year event. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-29, Alternative 2-B includes the following components:

- Construct West Staten Inlet Weir
- Construct West Staten Interior Detention Levee
- Construct West Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island West Setback Levee
- Degrade Existing Staten Island West Levee
- Relocate Existing Structures
- Retrofit or Replace Millers Ferry Bridge
- Retrofit or Replace New Hope Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Construction of an off-channel detention basin on the western portion of Staten Island would result in the damage or destruction of archaeological sites P-39-356, P-39-4423, and P-39-4424. This impact is discussed below.

Impact CR-16: Damage to or Destruction of P-39-356, P-39-4423, and P-39-4424 as a Result of Inundation.

Inundation of the North Fork Detention option would result in damage to or destruction of historic archaeological sites P-39-356, P-39-4423, and P-39-4424. Damage or destruction of the sites would be affected through the displacement of artifacts from their archaeological contexts, further reducing P-39-356, P-39-4423, and P-39-4424's information potential. P-39-356, P-39-4423, and P-39-4424 have not been evaluated for significance according to the criteria of the CRHR and CEQA.

Determination of Significance: Damage to or destruction of P-39-356, P-39-4423, and P-39-4424, if DWR determines that they are historical resources or unique archaeological resources, would be a **significant** impact under CEQA (14 CCR 15064.5).

Mitigation

Several mitigation strategies listed in the August 2000 CALFED Programmatic ROD are feasible mitigation measures for impacts incurred on P-39-356, P-39-4423, and P-39-4424, namely mitigation strategies 3–5 and 7–8. Prior to approval and final design of the North Staten Island Detention, DWR will authorize qualified archaeologists to map the sites (mitigation strategy 3), conduct surface collections and perform test excavations at the sites (mitigation strategies 4 and 5), and prepare a report to document the results of mitigation strategies 3–5 above (mitigation strategy 7). Based on the findings of these mitigation strategies, DWR will determine whether P-39-356, P-39-4423, and P-39-4424 are historical resources or unique archaeological resources for the purposes of CEQA, or are not significant cultural resources.

If DWR determines the sites to be non-significant, no additional mitigation is required. Conversely, if DWR determines that the sites qualify as historical resources or unique archaeological resources, DWR will authorize qualified archaeologists to conduct full-scale excavations of P-39-356, P-39-4423, and P-39-4424 (mitigation strategy 8), prepare public interpretive documents (mitigation strategy 9), and prepare a report to document mitigation work (mitigation strategy 7), as appropriate to the qualities of the sites.

Significance after Mitigation: If DWR determines the sites to be non-significant, no additional mitigation is required and this impact will be reduced to a **less-than-significant** level.

If DWR determines that one or more of P-39-356, P-39-4423, or P-39-4424 are historical resources or unique archaeological resources, the significance of impacts after mitigation would depend upon the magnitude of the physical impact. In cases where small portions of the sites are affected by the project, the mitigation strategies above will reduce this impact to a **less-than-significant** level. In the event of major damage or complete destruction of the sites, the mitigation strategies described above would reduce the severity of the impact, though the impact would still be **significant**.

Dixon Borrow Site

The impacts of excavation of the Dixon borrow site would be the same as described under Alternative 1-A.

New Hope Borrow Site

The impacts of excavation of the Dixon borrow site would be the same as described under Alternative 1-A.

Alternative 2-C: East Staten Detention

This alternative provides additional capacity in the local system through construction of an off-channel detention basin on the eastern portion of Staten Island, along the South Fork Mokelumne River. High stage in the river would enter the detention basin upon cresting a weir in the levee. Habitat restoration is integrated with the construction of a setback levee. Other components are combined to protect infrastructure. Similar to all detention alternatives, this alternative is designed to capture flows no less frequently than the 10-year event while having no measurable effect on the 100-year event. The interior of the basin would continue to be farmed, consistent with current practices. As shown in Figure 2-32, Alternative 2-C includes the following components:

- Construct East Staten Inlet Weir
- Construct East Staten Interior Detention Levee
- Construct East Staten Outlet Weir
- Install Detention Basin Drainage Pump Station
- Reinforce Existing Levee
- Construct Staten Island East Setback Levee
- Degrade Existing Staten Island East Levee
- Relocate Existing Structures
- Retrofit or Replace New Hope Bridge
- Retrofit or Replace Millers Ferry Bridge *(optional)*
- Construct Wildlife Viewing Area
- Excavate Dixon and New Hope Borrow Sites

Dixon Borrow Site

The impacts of excavation of the Dixon borrow site would be the same as described under Alternative 1-A.

New Hope Borrow Site

The impacts of excavation of the Dixon borrow site would be the same as described under Alternative 1-A.

Alternative 2-D: Dredging and Levee Modifications

This alternative provides additional channel capacity by dredging the river bottom and modifying levees. As shown in Figure 2-33, Alternative 2-D includes the following components:

- Dredge South Fork Mokelumne River
- Modify Levees to Increase Channel Capacity
- Raise Downstream Levees to Accommodate Increased Flows
- Retrofit or Replace Millers Ferry Bridge (*optional*)
- Retrofit or Replace New Hope Bridge (*optional*)

Alternative 2-D has the potential to damage or destroy submerged cultural resources as a result of channel dredging and dredged soil disposal. These impacts are discussed below.

Impact CR-10: Destruction of Submerged Cultural Resources as a Result of Channel Dredging.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Impact CR-11: Destruction of Cultural Resources as a Result of Dredge Spoil Disposal.

This impact and associated mitigation measure are the same as described for Impact CR-3.

Chapter 6
Compliance with Applicable Laws, Policies, Plans, and Regulatory Framework

This chapter provides preliminary information on the major requirements for permitting and environmental review and consultation for implementation of the Project. Certain local, state, and federal regulations require issuance of permits before project implementation; other regulations require agency consultation but may not require issuance of any entitlements before project implementation. The Project's requirements for permits and environmental review and consultation may change during the EIR review process as discussions with involved agencies proceed.

Regulatory Framework

Setting

The North Delta region is a diverse mix of multiple uses, functions, and values and includes agricultural lands, water conveyance networks, wildlife habitats, recreation opportunities, and recreation-based businesses. Because of the diverse nature of the region, proposed actions within this region are often subject to compliance and conformity with multiple laws, regulations, policies, plans, and agency requirements. Agencies responsible for the management and health of specific Delta functions and values, and for corresponding regulations, often have jurisdictions that overlap geographically. Thus, some agencies have collaborated with other agencies to create focused Delta-region oversight agencies with goals and responsibilities guided and governed by plans, policies, and guidance documents.

CALFED Bay-Delta Program

The CALFED Program is a cooperative effort of more than 24 state and federal agencies with regulatory and management responsibilities in the Bay-Delta to develop and implement a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta system. The Project is a program element of the conveyance program of the Bay-Delta plan as it was initially envisioned, and is thus subject to the plan's requirements (refer to the CALFED ROD for other program elements and Chapter 1 for additional CALFED discussion), although the project has evolved to be more closely associated with flood control and ecosystem restoration.

Laws, regulations, policies, plans, and agency requirements for the Project are discussed further below and are organized by federal and state requirements collectively, federal and state requirements separately, state and regional plan consistency, and by local plan consistency and regulatory requirements.

Federal and State Requirements

Federal and State Compliance Integration

National Environmental Policy Act and California Environmental Quality Act

DWR is the Project proponent and state lead agency under CEQA. While there is presently no federal lead agency engaged in the Project, it is anticipated that a federal lead will eventually become involved. To that end, this EIR is being prepared as compatibly as possible with NEPA and with close coordination and cooperation among the federal, state, and local agencies involved. As the state lead agency, DWR is responsible for the preparation of a CEQA-compliant EIR document for this project.

Federal and state guidelines, statutes, and regulations developed by the Council on Environmental Quality (CEQ) and the OPR encourage and provide frameworks for agencies to comply with the requirements of both CEQA and NEPA concurrently. Such frameworks are summarized below.

Sections 15222 and 15226 of Chapter 3, Guidelines for Implementation of the CEQA, Title 14, CCR, state:

> If a lead agency finds that an EIS or finding of no significant impact would not be prepared by the federal agency by the time when a lead agency will need to consider an EIR or negative declaration, the lead agency should try to prepare a combined EIR-EIS or negative declaration–finding of no significant impact. To avoid the need for the federal agency to prepare a separate document for the same project, the lead agency must involve the federal agency in preparation of the joint document. This involvement is necessary because federal law generally prohibits a federal agency from using an EIR prepared by a state agency unless the federal agency was involved in the preparation of the document and State and local agencies should cooperate with federal agencies to the fullest extent possible to reduce duplication between the California Environmental Quality Act and the National Environmental Policy Act. Such cooperation should, to the fullest extent possible, include: (a) Joint planning processes, (b) Joint environmental research and studies, (c) Joint public hearings, (d) Joint environmental documents.

Under 40 CFR 1506.2, the NEPA CEQ regulations similarly encourage federal agencies to cooperate with local agencies:

> (a) Agencies authorized by law to cooperate with State agencies of statewide jurisdiction pursuant to section 102(2)(D) of the Act may do so.
>
> (b) Agencies shall cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and State and local requirements, unless the agencies are specifically barred from doing so by some other law. Except for cases covered by paragraph (a) of this section, such cooperation shall to the fullest extent possible include: (1) Joint planning processes. (2) Joint environmental research and studies. (3) Joint public hearings (except where otherwise provided by statute). (4) Joint environmental assessments.
>
> (c) Agencies shall cooperate with State and local agencies to the fullest extent possible to reduce duplication between NEPA and comparable State and local requirements, unless the agencies are specifically barred from doing so by some other law. Except for cases covered by paragraph (a) of this section, such cooperation shall to the fullest extent possible include joint environmental impact statements. In such cases one or more Federal agencies and one or more State or local agencies shall be joint lead agencies. Where State laws or local ordinances have environmental impact statement requirements in addition to but not in conflict with those in NEPA, Federal agencies shall cooperate in fulfilling these requirements as well as those of Federal laws so that one document will comply with all applicable laws.

In California, environmental review for this size and scope of project requires an EIR. The EIR records the scope of the applicant's proposal and analyzes all its known environmental effects. Project information is used by state and local permitting agencies in their evaluation of the proposed project. (OPR, Overview of the California Environmental Review and Permit Approval Process.)

Because this project is anticipated to have federal involvement, it will eventually also be subject to the requirements of NEPA. Under NEPA, the federal equivalent of the EIR is the EIS. The processes of preparation, review, and acceptance of the EIR and EIS share many similarities but differ in the following ways: oversight agencies, level of detail in discussion of alternatives, mitigation requirements, terminology, and more. Additional details about CEQA, the compliance requirements of the Project, and how NEPA standards are incorporated into the Project analysis are discussed further under the headings Federal Requirements and State Requirements in this chapter.

Bay-Delta Framework Agreement

In June 1994, state-federal cooperation for the management and regulatory responsibility in the San Francisco Bay/Sacramento–San Joaquin River Delta Estuary (Bay-Delta Estuary) was formalized with the signing of a framework agreement by the state and federal agencies involved. The framework agreement pledged that the state and federal agencies would work together in three areas of Bay-Delta management:

- water quality standards formulation,
- coordination of SWP and CVP operations with regulatory requirements, and
- long-term solutions to problems in the Bay-Delta Estuary. (2001 CALFED Bay-Delta Program History.)

Bay-Delta Accord and Water Quality Standards

In December 1994, state and federal agencies reached an agreement known as the San Francisco Bay-Delta Agreement, or Bay-Delta Accord, on water quality standards and related provisions that would remain in effect for 3 years. This agreement was based on a proposal developed by the stakeholders. Elements of the agreement include:

- springtime export limits expressed as a percentage of Delta inflow,
- regulation of the salinity gradient in the estuary so that a salt concentration of two parts per thousand (X2) is positioned where it may be more beneficial to aquatic life,
- specified springtime flows on the lower San Joaquin River to benefit Chinook salmon, and
- intermittent closure of the Delta Cross Channel gates to reduce entrainment of fish into the Delta.

A second category of provisions is intended to reconcile operational flexibility and compliance with ESA. Compliance with provisions of the ESA is intended to result in no reduction in water supply from what would be available for export under other operational requirements of the agreement. This will be accomplished in part by better monitoring for the presence of aquatic organisms of concern, faster interpretation of monitoring information, and immediate response in the operation of export facilities. This is known as *real-time monitoring*.

A third category of provisions—referred to as *Category III*—is intended to improve conditions in the Bay-Delta Estuary that are not directly related to Delta outflow. Some of these Category III measures may include screening water diversions, waste discharge control, and habitat restoration. Parties to the agreement committed to implementation and financing of such measures and estimated that a financial commitment of $60 million would be required in each of the 3 years of the agreement.

The 1994 Bay-Delta Accord is reflected in the State Water Board's *Draft Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary* dated December 1994 and the *Final Water Quality Plan,* which was adopted May 22, 1995.

The Bay-Delta Accord was extended in 1997 for 1 year, and again in 1998, to allow the CALFED Program to continue working with stakeholders to develop a long-term solution for problems in the Bay-Delta system.

The CALFED ROD expressly replaced the provisions of the Bay-Delta Accord in their entirety. The Project is a project-level component of the ROD.

Long-Term Solutions

An additional element of the Bay-Delta framework agreement called for a joint state-federal process to develop long-term solutions to problems in the Bay-Delta Estuary related to fish and wildlife, water supply reliability, natural disasters, and water quality. The intent is to develop a comprehensive and balanced plan that addresses all of the resource problems. This effort is carried out under the policy direction of the CALFED agencies.

The public has a central role in the development of a long-term solution. A group of more than 30 citizen-advisors selected from California’s agriculture, environmental, urban, business, fishing, and other interests with a stake in finding long-term solutions for the problems of the Bay-Delta Estuary was chartered under the Federal Advisory Committee Act as the Bay-Delta Advisory Council (BDAC). BDAC advised the CALFED agencies on its mission and objectives, the problems to be addressed, and proposed actions. BDAC also provided a forum for public participation and reviewed reports and other materials prepared by CALFED staff.

In 2000, the BDAC was terminated and was replaced by the Bay-Delta Public Advisory Committee (BDPAC) which was chartered in 2001. The purpose of this new committee is to provide recommendations to the Secretary of the Interior, the Governor of California, and other participating federal agencies on implementation of the CALFED ROD. This committee is expected to exist until the completion of Stage 1 of the CALFED Program in 2008 (California Bay-Delta Authority 2003).

The CALFED Program is managed by an interdisciplinary, interagency staff team and assisted by technical experts from state and federal agencies as well as consultants. The program is following a three-phase process to achieve broad agreement on long-term solutions.

First, a clear definition of the problems to be addressed and a range of solution alternatives were developed. Second, to comply with CEQA and NEPA, a program-level (or first-tier) EIS/EIR was prepared to identify impacts associated with the various alternatives. Finally, a project-level (or second-tier) EIS/EIR will be prepared for each element of the selected solution.

In the first phase (Phase I), the CALFED Program developed a range of alternatives, consisting of hundreds of actions. The program conducted meetings and workshops to obtain public input, prepared a notice of intent and notice of preparation pursuant to NEPA and CEQA, and held public scoping sessions to determine the focus and content of the EIS/EIR. The first phase concluded in September 1996 with the development of a range of alternatives for achieving long-term solutions to the problems of the Bay-Delta Estuary.

During Phase II, the program conducted a comprehensive programmatic environmental review process. A draft programmatic EIS/EIR and interim Phase II report identifying three draft alternatives and program plans were released on March 16, 1998. The release of the documents was followed by a 105-day public comment period. On June 25, 1999, CALFED again released a draft programmatic EIS/EIR followed by a 90-day comment period. The final programmatic EIS/EIR was released July 21, 2000, followed by the ROD on August 28, 2000. The ROD completed Phase II.

The CALFED Program is now in Phase III, implementation of the preferred alternative. The first 7 years of this phase is referred to as *Stage 1* and will lay the foundation for the following years. Site-specific, detailed environmental review will occur during this phase prior to the implementation of each proposed action. Implementation of the CALFED solution is expected to take 30 years.

Since the inception of the program, progress has been made in all three areas. These management efforts have included close cooperation not only among state and federal agencies, but involvement of urban and agricultural water users, fishing interests, environmental organizations, businesses, and others. These groups—the stakeholders in resources of the Bay-Delta Estuary—play an important role in the collaborative process of solving problems.

The Multi-Species Conservation Strategy

The Multi-Species Conservation Strategy (MSCS) is an approach that entities implementing CALFED actions may use to fulfill the requirements of the ESA, CESA, and the Natural Community Conservation Plan Act (NCCPA). The MSCS serves as the CALFED programmatic BA under Section 7 of the ESA and the Natural Community Conservation Plan (NCCP) under the NCCPA. In instances in which a nonfederal entity proposes to implement a CALFED action that does not require federal permits, funding, or other authorization, the MSCS can also act as a programmatic-level habitat conservation plan (HCP) under the Section 10 process.

Specifically, the MSCS:

- analyzes CALFED's effects on 244 *evaluated species* and 20 natural communities (*NCCP communities*), comprising 18 habitats and two ecologically based fish groups composed of anadromous and estuarine fish species for ESA, CESA, and NCCPA purposes;
- identifies species goals (*recovery*, *contribute to recovery*, or *maintain*) for each of the 244 evaluated species, as well as conservation measures to achieve the goals;

- identifies goals for each of the 20 NCCP communities, as well as conservation measures to achieve the goals; and
- provides for the preparation of ASIPs, which will strengthen and simplify the CALFED Program's compliance with ESA, CESA, and NCCPA.

The MSCS contains two types of conservation measures:

- measures to avoid, minimize, and compensate for adverse effects to NCCP communities and evaluated species caused by individual program actions; and
- measures to enhance NCCP communities and evaluated species that are not directly linked to adverse effects from program actions.

On February 2, 2002, Governor Davis signed SB 107, which completely repealed and replaced the NCCPA with a new NCCPA. SB 107 became effective on January 1, 2003. However, in accordance with Section 2830(c) of SB 107, the MSCS will remain in place as an approved NCCP, and DFG may authorize take of covered species pursuant to the MSCS and DFG's NCCP approval.

Action Specific Implementation Plans

The MSCS requires CALFED project proponents and lead agencies (if different from the project proponent) to coordinate preparation of ASIPs with USFWS, NOAA Fisheries, and DFG. This coordination initiates informal consultation under Section 7 of the ESA. The North Delta ASIP serves as the Project biological assessment under Section 7 of the ESA and as the North Delta NCCP under the NCCPA.

ASIPs, which are consistent with information presented in the MSCS, present the information necessary for USFWS and/or NOAA Fisheries to issue incidental take authorization under Section 7 of the ESA for six species covered under the CALFED USFWS Programmatic BO and three species covered under the CALFED NOAA Fisheries Programmatic BO, and for DFG to issue incidental take authorization under Section 2835 of the NCCPA for 25 species covered under the CALFED Programmatic NCCP Determination.

To fulfill the requirements of ESA Sections 7 and 10 and California Fish and Game Code Sections 2835 and 2081, as applicable, each ASIP must include the following:

- detailed project description of the CALFED action or group of actions to be implemented, including site-specific and operational information;
- a list of evaluated species and any other special-status species that occur in the action area;
- an analysis identifying the direct, indirect, and cumulative impacts on the evaluated species and other special-status species occurring in the action area (along with an analysis of impacts on any designated critical habitat) likely to

result from the proposed CALFED action or group of actions, as well as actions related to and dependent on the proposed action;

- measures the implementing entity will undertake to avoid, minimize, and compensate for such impacts and, as appropriate, measures to enhance the condition of NCCP communities and evaluated species, along with a discussion of: (1) a plan to monitor the impacts and the implementation and effectiveness of these measures, (2) the funding that will be made available to undertake the measures, and (3) the procedures to address changed circumstances;
- measures the implementing entity will undertake to provide commitments to cooperating landowners;
- a discussion of alternative actions the applicant considered that would not result in take, and the reasons why such alternatives are not being used;
- additional measures USFWS, NOAA Fisheries, and DFG may require as necessary or appropriate for compliance with ESA, CESA, and NCCPA; and
- a description of how and to what extent the action or group of actions addressed in the ASIP will help the CALFED Program achieve the MSCS's goals for the affected species (i.e., how the ASIP implements the MSCS).

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) in general requires federal agencies to coordinate with USFWS and state fish and game agencies whenever streams or bodies of water are controlled or modified. This coordination is intended both to promote the conservation of wildlife resources by providing equal consideration for fish and wildlife in water project planning and to provide for the development and improvement of wildlife resources in connection with water projects. Federal agencies undertaking water projects are required to include recommendations made by USFWS and state fish and game agencies in project reports, and give full consideration to these recommendations.

USFWS will provide a Coordination Act Report in accordance with the FWCA if a federal lead were to become involved in the Project.

Federal Requirements

NEPA

NEPA is the nation's broadest environmental law, applying to all federal agencies and most of the activities they manage, regulate, or fund that affect the environment. It requires federal agencies to disclose and consider the environmental implications of their proposed actions. NEPA establishes environmental policies for the nation, provides an interdisciplinary framework for federal agencies to prevent environmental damage, and contains action-forcing procedures to ensure that federal agency decision makers take environmental factors into account.

NEPA requires the preparation of an appropriate document to ensure that federal agencies accomplish the law's purposes. The President's CEQ has adopted regulations and other guidance that provide detailed procedures that federal agencies must follow to implement NEPA. The federal lead agency for the Project, when determined, would use this EIR to comply with CEQ's regulations and document NEPA compliance. This EIR is being developed to include the analysis required under NEPA to facilitate an eventual NEPA ROD.

Federal Endangered Species Act

Section 7 of the ESA requires federal agencies, in consultation with USFWS and/or NOAA Fisheries, to ensure that their 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. The required steps in the Section 7 consultation process are as follows:

- Agencies must request information from USFWS and/or NOAA Fisheries on the existence in a project area of special-status species or species proposed for listing.
- Following receipt of the USFWS/NOAA Fisheries response to this request, agencies generally prepare a BA to determine whether any special-status species or species proposed for listing are likely to be affected by a proposed action.
- Agencies must initiate formal consultation with USFWS and/or NOAA Fisheries if the proposed action may adversely affect special-status species.
- USFWS and/or NOAA Fisheries must prepare a BO to determine whether the action would jeopardize the continued existence of special-status species or adversely modify their critical habitat.
- If a finding of jeopardy or adverse modifications is made in the BO, USFWS and/or NOAA Fisheries must recommend reasonable and prudent alternatives that would avoid jeopardy, and the federal agency must modify project approval to ensure that special-status species are not jeopardized and that their critical habitat is not adversely modified (unless an exemption from this requirement is granted).

The North Delta ASIP will serve as the Project's BA under Section 7 of the ESA.

Clean Water Act Section 404, 404(b)(1) Guidelines and Section 401

Section 404

Section 404 of the CWA requires that a permit be obtained from the USACE for the discharge of dredged or fill material into "waters of the United States, including wetlands."

Waters of the United States include wetlands and lakes, rivers, streams, and their tributaries. *Wetlands* are defined for regulatory purposes, at 33 CFR 328.3 as:

> (1) All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of tide; (2) All interstate waters, including interstate wetlands; (3) All other waters such as intrastate lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce; (4) All impoundments of waters otherwise defined as waters of the United States under the definition; (5) Tributaries of waters identified in paragraphs 1–4 in this section; (6) The territorial seas; and (7) Wetlands adjacent to waters identified in paragraphs 1–6 in this section.

CWA Section 404(b) requires that the USACE process permits in compliance with guidelines developed by EPA. These guidelines (404[b][1] Guidelines) require that there be an analysis of alternatives available to meet the project purpose and need, including those that avoid and minimize discharges of dredged or fill materials in waters. Once this first test has been satisfied, the project that is permitted must be the least environmentally damaging practical alternative before the USACE may issue a permit for the proposed activity.

Actions typically subject to Section 404 requirements are those that would take place in wetlands or stream channels, including intermittent streams, even if they have been realigned. Within stream channels, a permit under Section 404 would be needed for any discharge activity below the ordinary high water mark, which is the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, or the presence of litter or debris.

The CALFED ROD for the Final Programmatic EIS/EIR includes a CWA Section 404 memorandum of understanding (MOU) signed by Reclamation, EPA, the USACE, and DWR. Under the terms of the MOU, when a project proponent applies for a Section 404 individual permit for CALFED projects, the proponent is not required to reexamine program alternatives already analyzed in the Programmatic EIS/EIR. The USACE and EPA will focus on project-level alternatives that are consistent with the Programmatic EIS/EIR when they select the least environmentally damaging practicable alternative at the time of a Section 404 permit decision.

A 404(b)(1) alternatives information package will be prepared for the Project and submitted to the USACE and EPA.

Note: Section 404 does not apply to authorities under the Rivers and Harbors Appropriation Act of 1899, except that some of the same waters may be regulated under both statutes; the USACE typically combines the permit requirements of Section 10 and Section 404 into one permitting process.

Section 401

Under CWA Section 401, applicants for a federal license or permit to conduct activities that may result in the discharge of a pollutant into waters of the United States must obtain certification from the state in which the discharge would originate or, if appropriate, from the interstate water pollution control agency with jurisdiction over affected waters at the point where the discharge would originate. Therefore, all projects that have a federal component and may affect state water quality (including projects that require federal agency approval [such as issuance of a Section 404 permit]) must also comply with CWA Section 401. In California, the authority to grant water quality certification has been delegated to the State Water Board, and applications for water quality certification under CWA Section 401 are typically processed by the RWQCB with local jurisdiction. Water quality certification requires evaluation of potential impacts in light of water quality standards and CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United States.

For purposes of this project, DWR will obtain certification from the Central Valley RWQCB under Section 401 of the CWA.

River and Harbors Appropriation Act of 1899

The River and Harbors Appropriation Act of 1899 addresses activities that involve the construction of dams, bridges, dikes, etc., across any navigable water, or placing obstructions to navigation outside established federal lines and excavating from or depositing material in such waters, require permits from the USACE. *Navigable waters* are defined in Section 329.4 of the act as:

> Those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity.

In the Corps Sacramento District, navigable waters of the United States in the project area that are subject to the requirements of the River and Harbors Appropriation Act include Sacramento River, San Joaquin River, Mokelumne River, Cosumnes River, and all waterways in the Sacramento–San Joaquin drainage basin affected by tidal action (U.S. Army Corps of Engineers 2003). Sections of the River and Harbors Act applicable to the Project are:

Section 9

Section 9 (33 USC 401) prohibits the construction of any bridge, dam, dike, or causeway across any navigable water of the United States in the absence of congressional consent and approval of the plans by the Chief of Engineers and the Secretary of the Army. Where the navigable portions of the water body lie wholly within the limits of a single state, the structure may be built under authority of the legislature of that state, if the location and plans or any modification thereof are approved by the Chief of Engineers and by the Secretary of the Army.

Section 10

Section 10 (33 USC 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. This section provides that the construction of any structure in or over any navigable water of the United States, or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters, is unlawful unless the work has been authorized by the Chief of Engineers.

Section 13

Section 13 (33 USC 407) provides that the Secretary of the Army, whenever the Chief of Engineers determines that anchorage and navigation would not be injured thereby, may permit the discharge of refuse into navigable waters. In the absence of a permit, such discharge of refuse is prohibited. While the prohibition of this section, known as the Refuse Act, is still in effect, the permit authority of the Secretary of the Army has been superseded by the permit authority provided the Administrator, EPA, and the states under Sections 402 and 405 of the CWA, respectively.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) establishes a management system for national marine and estuarine fishery resources. This legislation requires that all federal agencies consult with NOAA Fisheries regarding all actions or proposed actions permitted, funded, or undertaken that may adversely affect “essential fish habitat.” *Essential fish habitat* is defined as “waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” 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 quantity of essential fish habitat. Federal activities that occur outside of an essential fish habitat but that may, nonetheless, have an impact on essential fish habitat waters and substrate must also be considered in the consultation process.

Under the Magnuson-Stevens Act, effects on habitat managed under the Pacific Salmon Fishery Management Plan must also be considered. The Magnuson-Stevens Act states that consultation regarding essential fish habitat should be consolidated, where appropriate, with the interagency consultation, coordination, and environmental review procedures required by other federal statutes, such as NEPA, FWCA, CWA, and ESA. Essential fish habitat consultation requirements can be satisfied through concurrent environmental compliance if the lead agency provides NOAA Fisheries with timely notification of actions that may adversely affect essential fish habitat and if the notification meets requirements for essential fish habitat assessments.

If a federal lead agency were to become involved in the Project, this EIR will be used to comply with Magnuson-Stevens Act regulations.

National Historic Preservation Act

Section 106 of the NHPA requires federal agencies to evaluate the effects of their undertakings on historic properties, which are those properties eligible for listing on, or listed on, the NRHP. Implementing regulations at 36 CFR Part 800 require that federal agencies, in consultation with the SHPO, identify historic properties within the APE of the proposed project and make an assessment of adverse effects if any are identified. If the project is determined to have an adverse effect on historic properties, the federal agency is required to consult further with the SHPO and the Advisory Council on Historic Preservation (ACHP) to develop methods to resolve the adverse effects. The Section 106 process has four basic steps:

1. Initiation of the Section 106 process (define APE and scope of identification efforts).
2. Evaluation of historic properties.
3. Determination of adverse effects to historic properties.
4. Resolution of adverse effects to historic properties.

This EIR summarizes the efforts taken to identify cultural resources within the APE and evaluates their eligibility for listing in the NRHP (see Section 5.7 of this EIR). Consultation with the SHPO for Section 106 compliance will likely be initiated through the CWA 404 process, unless a federal lead agency were to become involved in the Project in advance of permitting efforts.

Farmland Protection Policy Act and Memoranda on Farmland Preservation

Two policies require federal agencies to include assessments of the potential effects of a proposed project on prime and unique farmland. These policies are the Farmland Protection Policy Act (FPPA) and the Memoranda on Farmland

Preservation, dated August 30, 1976, and August 11, 1980, respectively, from the CEQ. Under requirements set forth in these policies, federal agencies must determine these effects before taking any action that could result in converting designated prime or unique farmland for nonagricultural purposes. If implementing a project would adversely affect farmland preservation, the agencies must consider alternative actions to lessen those effects. Federal agencies also must ensure that their programs, to the extent practicable, are compatible with state, local, and private programs to protect farmland. NRCS is the federal agency responsible for ensuring that these laws and policies are followed.

In this EIR, the effects to agricultural lands from implementation of the Project have been assessed using methods described in Section 6.1, Land Use, Agriculture, and Recreation. Compliance with these policies would be achieved through consultation with NRCS using the information in this EIR, if a federal lead agency were to become involved in the Project.

Executive Order 11988 (Floodplain Management)

Executive Order 11988 (May 24, 1977) requires federal agencies to prepare floodplain assessments for proposed actions located in or affecting floodplains. If an agency proposes to conduct an action in a floodplain, it must consider alternatives to avoid adverse effects and incompatible development in the floodplain. If the only practicable alternative involves siting in a floodplain, the agency must minimize potential harm to or in the floodplain and explain why the action is proposed in the floodplain.

The Project elements are being integrated into the existing comprehensive flood control system of the Delta.

Executive Order 11990 (Protection of Wetlands)

Executive Order 11990 (May 24, 1977) requires federal agencies to prepare wetland assessments for proposed actions located in or affecting wetlands. Agencies must avoid undertaking new construction in wetlands unless no practicable alternative is available and the proposed action includes all practicable measures to minimize harm to wetlands. Section 4.1 of this EIR, Vegetation and Wetlands, describes impacts on wetlands and mitigation measures for reducing significant impacts.

Executive Order 12898 (Environmental Justice)

Executive Order 12898 (February 11, 1994) requires federal agencies to identify and address adverse human health or environmental effects of federal programs, policies, and activities that could be disproportionately high on minority and low-income populations. Federal agencies must ensure that federal programs or activities do not directly or indirectly result in discrimination on the basis of race, color, or national origin. Federal agencies must provide opportunities for input into the NEPA process by affected communities and must evaluate the potentially significant and adverse environmental effects of proposed actions on minority and low-income communities during environmental document preparation. Even if a proposed federal project would not result in significant adverse impacts on minority and low-income populations, the environmental document must describe how Executive Order 12898 was addressed during the NEPA process. Environmental justice issues are discussed in Section 5.2 of this EIR.

Executive Order 13007 (Indian Sacred Sites) and April 29, 1994, Executive Memorandum

Executive Order 13007 (May 24, 1996) requires federal agencies with land management responsibilities to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites. Among other things, federal agencies must provide reasonable notice of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites. The agencies must comply with the April 29, 1994, Executive Memorandum, *Government-to-Government Relations with Native American Tribal Governments*.

Based on the analysis, no sacred sites would be adversely affected by the implementation of the Project.

Federal Clean Air Act

The federal Clean Air Act (CAA) was enacted to protect and enhance the nation’s air quality in order to promote public health and welfare and the productive capacity of the nation’s population. The CAA requires an evaluation of any federal action to determine its potential impact on air quality in the project region. California has a corresponding law, which also must be considered during the EIR process.

For specific projects, federal agencies must coordinate with the appropriate air quality management district as well as with EPA. This coordination would determine whether the project conforms to the CAA and the State Implementation Plan (SIP).

Section 176 of the CAA prohibits federal agencies from engaging in or supporting in any way an action or activity that does not conform to an applicable SIP. Actions and activities must conform to a SIP’s purpose of eliminating or reducing the severity and number of violations of the national ambient air quality standards and in attaining those standards expeditiously. EPA promulgated conformity regulations (codified in 40 CFR 93.150 *et seq.*).

The potential air quality impacts of the Project are discussed in Section 3.9 of this EIR.

Federal Water Project Recreation Act

The Federal Water Project Recreation Act requires federal agencies with authority to approve water projects to include recreation development as a condition of approving permits. Recreation development must be considered along with any navigation, flood control, reclamation, hydroelectric, or multipurpose water resource project. The act states that,

> consideration should be given to opportunities for outdoor recreation and fish and wildlife enhancement whenever any such project can reasonably serve either or both purposes consistently.

Compliance with the act is achieved through the documentation of the consideration of recreation opportunities in USACE reports and NEPA documents. In this EIR, DWR has taken into consideration–and addressed–outdoor recreation and fish and wildlife enhancement in the North Delta region. Recreation elements have been designed into the Project through proposed wildlife viewing areas, a public outreach program, improving a boat launch facility, and coordinating with local marinas.

State Requirements

California Environmental Quality Act

CEQA requires state and local agencies to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. The environmental review required imposes both procedural and substantive requirements. At a minimum, an initial review of the project and its environmental effects must be conducted. CEQA's primary objectives are to:

- disclose to decision makers and the public the significant environmental effects of proposed activities,
- identify ways to avoid or reduce environmental damage,
- prevent environmental damage by requiring implementation of feasible alternatives or mitigation measures,
- disclose to the public reasons for agency approval of projects with significant environmental effects,
- foster interagency coordination in the review of projects, and

- enhance public participation in the planning process.

CEQA applies to all discretionary activities proposed to be carried out or approved by California public agencies, including state, regional, county, and local agencies, unless an exemption applies. The act requires that public agencies comply with both procedural and substantive requirements. Procedural requirements include the preparation of the appropriate public notices (including notices of preparation), scoping documents, alternatives, environmental documents (including mitigation measures, mitigation monitoring plans, responses to comments, findings, and statements of overriding considerations), completion of agency consultation and State Clearinghouse review, and provisions for legal enforcement and citizen access to the courts.

CEQA's substantive provisions require agencies to address environmental impacts disclosed in an appropriate document. When avoiding or minimizing environmental damage is not feasible, CEQA requires agencies to prepare a written statement of overriding considerations when they decide to approve a project that will cause one or more significant effects on the environment that cannot be mitigated. CEQA establishes a series of action-forcing procedures to ensure that agencies accomplish the purposes of the law. In addition, under the direction of CEQA, the California Resources Agency has adopted regulations, known as the State CEQA Guidelines, which provide detailed procedures that agencies must follow to implement the law. DWR would use this EIR to comply with state CEQA requirements.

California Endangered Species Act

CESA requires a state lead agency to consult formally with DFG when a proposed action may affect state-listed endangered or threatened species. The provisions of the ESA and CESA will often be activated simultaneously. The assessment of Project effects on species listed under both the ESA and CESA is addressed in USFWS's and NOAA Fisheries' BOs. However, for those species listed only under CESA, DWR must formally consult with DFG, and DFG must issue a BO separate from USFWS's BO. The preparation of an ASIP serves to comply with Section 2081 of the CESA and Section 2835 of the NCCPA. The ASIP will be distributed subsequent to the EIR during the public review period.

Natural Community Conservation Planning Act

The NCCPA (California Fish and Game Code Section 2800 *et seq.*) was enacted to form a basis for broad-based planning to provide for effective protection and conservation of the state's wildlife heritage, while continuing to allow appropriate development and growth. The purpose of natural community conservation planning is to sustain and restore those species and their habitat identified by DFG that are necessary to maintain the continued viability of biological communities affected by human changes to the landscape. An NCCP identifies and provides for those measures necessary to conserve and manage natural biological diversity within the plan area while allowing compatible use of the land. DFG may authorize the take of any identified species, including listed and non-special-status species, pursuant to Section 2835 of the NCCPA, if the conservation and management of such species is provided for in an NCCP approved by DFG. For the Project, an ASIP has been prepared to serve as the equivalent of an NCCP. Pursuant to the NCCPA, DFG, as a responsible agency and trustee agency, may rely on the EIR and the ASIP to authorize take of covered species identified in the ASIP. DFG has been actively involved in the development of the Project.

Section 1602 of the California Fish and Game Code

DFG regulates work that will substantially affect resources associated with rivers, streams, and lakes in California, pursuant to Fish and Game Code Sections 1600 to 1607. Any action from a public project that substantially diverts or obstructs the natural flow or changes the bed, channel, or bank of any river, stream, or lake, or uses material from a streambed must be previously authorized by DFG in a Lake or Streambed Alteration Agreement under Section 1602 of the Fish and Game Code. This requirement may in some cases apply to any work undertaken within the 100-year floodplain of a body of water or its tributaries, including intermittent streams and desert washes. As a general rule, however, it applies to any work done within the annual high-water mark of a wash, stream, or lake that contains or once contained fish and wildlife, or that supports or once supported riparian vegetation.

Major activities associated with the Project that require 1602 authorization and a Streambed Alteration Agreement include the modification and setting back of the existing levees and dredging. These actions would result in the alteration of the flow within water bodies and occur within the annual high-water mark of water bodies that contain wildlife and support riparian vegetation.

Porter-Cologne Water Quality Control Act of 1969

In 1967, the Porter-Cologne Act established the State Water Board and nine RWQCBs as the primary state agencies with regulatory authority over California water quality and appropriative surface water rights allocations. Under this act (and the CWA), the state is required to adopt a water quality control policy and WDRs to be implemented by the State Water Board and nine RWQCBs. The State Water Board also establishes WQCPs and statewide plans. The RWQCBs carry out State Water Board policies and procedures throughout the state.

WQCPs, also known as basin plans, designate beneficial uses for specific surface water and groundwater resources and establish water quality objectives to protect those uses. WQCPs and water resource management plans relevant to the Project include the WQCP for the Sacramento and San Joaquin River Basins, San

Francisco Bay Basin WQCP, Inland Surface Waters Plan, the Enclosed Bays and Estuaries Plan, and the Delta Plan. Delta-specific beneficial uses protected through water quality objectives are municipal and domestic water supply, agricultural supply, industrial supply (process and service), recreation (water contact and non-contact), freshwater habitat (warm- and coldwater), fish migration (warm- and coldwater), fish spawning (warmwater fish), wildlife habitat, and navigation. The basin plans define surface water quality objectives for several parameters, including suspended material, turbidity, pH, DO, chlorides, flow, bacteria, temperature, salinity, toxicity, ammonia, and sulfides.

The Project has the potential to affect water quality in surface water or groundwater in the Central Valley region and the San Francisco Bay region, which are governed by the Central Valley RWQCB and the San Francisco Bay RWQCB, respectively. Each Project alternative considered in this EIR was analyzed for compliance with the water quality objectives set forth in the applicable WQCPs. Section 4.4 of this EIR describes Project water quality compliance specific to these basin plans.

Water Use Efficiency

The California Constitution prohibits the waste or unreasonable use of water. Further, Water Code Section 275 directs DWR and the State Water Board to “take all appropriate proceedings or actions before executive, legislative, or judicial agencies to prevent waste or unreasonable use of water.” Several legislative acts have been adopted to develop efficient use of water in the state:

- Urban Water Management Planning Act of 1985,
- Water Conservation in Landscaping Act of 1992,
- Agricultural Water Management Planning Act,
- Agricultural Water Suppliers Efficient Management Practices Act of 1990,
- Water Recycling Act of 1991, and
- Agricultural Water Conservation and Management Act of 1992.

The purpose of the Project is to address flood control and ecosystem restoration issues; thus, the proposed action would not result in the waste or unreasonable use of water.

Public Trust Doctrine

When planning and allocating water resources, the State of California is required to consider the public trust and preserve for the public interest the uses protected by the trust. The public trust doctrine embodies the principle that certain resources, including water, belong to all and, thus, are held in trust by the state for future generations.

In common law, the public trust doctrine protects navigation, commerce, and fisheries uses in navigable waterways. However, the courts have expanded the doctrine's application to include protecting tideland, wildlife, recreation, and other public trust resources in their natural state for recreational, ecological, and habitat purposes as they affect birds and marine life in navigable waters. *The National Audubon Society v. Superior Court of Alpine County* (1983) 33 Cal 3d 419 decision extended the public trust doctrine's limitations on private rights to appropriative water rights, and also ruled that longstanding water rights could be subject to reconsideration and could possibly be curtailed. The doctrine, however, generally requires the court and the State Water Board to perform a balancing test to weigh the potential value to society of a proposed or existing diversion against its impact on trust resources.

The 1986 Rancanelli decision applied the public trust doctrine to decisions by the State Water Board and held that this doctrine must be applied by the State Water Board in balancing all the competing interests in the uses of Bay-Delta waters (*United States v. State Water Resources Control Board* [1986] 182 Cal. App. 3d 82).

The Project is consistent with the public trust doctrine, as its primary goals include a balance between ecosystem restoration and improved flood control.

Davis-Dolwig Act

The Davis-Dolwig Act declares that recreation and fish and wildlife enhancement are among the purposes of state water projects. It specifies that costs for recreation and fish and wildlife enhancement not be included in prices, rates, and charges for water and power to urban and agricultural users. Under the Davis-Dolwig Act, land for recreation and fish and wildlife enhancement must be planned and initiated at the same time as any other land acquisition for the project. Implementation of the Project would include the construction of recreation facilities such as wildlife viewing areas, trails, restrooms, and upgrading boat launch facilities and signage. Therefore, the Project would be consistent with this act.

State and Regional Plan Consistency

San Francisco Estuary Project's Comprehensive Conservation and Management Plan

The San Francisco Estuary Project (SFEP) was established by EPA in 1987 because of growing public concern related to the health of the bay and the Delta. SFEP is jointly sponsored by EPA and the State of California and is part of the National Estuary Program. The National Estuary Program was created by Congress in response to growing public concern over the decline of the nation's estuaries. The program's purpose is to protect and improve the water quality and natural resources of estuaries throughout the country by addressing the environmental problems specific to each. As directed by Section 320 of the CWA, representatives of each estuary in the National Estuary Program must develop a Comprehensive Conservation and Management Plan (CCMP).

The primary focus of the SFEP CCMP is to "restore and maintain the chemical, physical, and biological integrity of the bay and Delta." The CCMP provides a thorough implementation strategy describing 145 actions to protect the Bay-Delta Estuary. Ten program areas are identified in the CCMP. For each program area, the CCMP presents a problem statement, discusses existing management, identifies program area goals, recommends approaches, and states objectives and actions specific to the program. With regard to wetlands, the CCMP focuses on the restoration and ultimate enhancement of ecological productivity and habitat value. SFEP defines the estuary as the waters of San Francisco Bay, San Pablo Bay, Suisun Bay, and the Sacramento–San Joaquin River Delta. The proposed project boundaries include these waters, their watersheds, and lands in the Delta as delineated by Section 12220 of the State Water Code. Implementation of the Project would be consistent with this program as it would assist DWR in improving water quality in the North Delta.

Area of Origin

During the years when the SWP and CVP were being developed, area of origin legislation was enacted to protect local northern California supplies from being depleted. County of origin statutes provide for the reservation of water supplies for counties in which the water originates when, in the judgment of the State Water Board, an application for the assignment or release from priority of a state water right filing would deprive the county of necessary water for present and future development. The Project will have little effect on water supplies for north-of-Delta users; therefore, this project is consistent with the area of origin legislation (see Section 4.5, Water Supply and Management, for more detail).

Delta Protection Act of 1959

The Delta Protection Act, enacted in 1959 (not to be confused with the Delta Protection Act of 1992, which relates to land use), declares that the maintenance of an adequate water supply in the Delta—to maintain and expand agriculture, industry, urban, and recreational development in the Delta area and provide a common source of fresh water for export to areas of water deficiency—is necessary for the peace, health, safety, and welfare of the people of the state, subject to the county of origin and watershed protection laws. The act requires the SWP and the CVP to provide an adequate water supply for water users in the Delta through salinity control or through substitute supplies in lieu of salinity control. In 1984, additional area of origin protections were enacted to prohibit the export of groundwater from the Sacramento River and the Delta basins unless export is in compliance with local groundwater plans. Water Code Section 1245 also holds municipalities liable for economic damages resulting from their diversion of water from a watershed. (Bulletin 160-93.) Implementation of the Project would improve water quality and is therefore consistent with the Delta Protection Act of 1959.

Land Use and Resource Management Plan for the Primary Zone of the Delta

The Delta Protection Act of 1992 (Public Resources Code Section 29760 *et. seq*.) requires the Delta Protection Commission to prepare and adopt and thereafter review and maintain a comprehensive long-term resource management plan for land uses within the Primary Zone of the Delta (resource management plan). The goals of the plan as set out in the act are to

> protect, maintain, and where possible, enhance and restore the overall quality of the Delta environment, including but not limited to agriculture, wildlife habitat, and recreational activities; assure orderly, balanced conservation and development of Delta land resources and improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety.

Also pursuant to the act, to the extent that any of the requirements specified in this land use and resource management plan are in conflict, nothing in this plan shall deny the right of the landowner to continue the agricultural use of the land (Delta Protection Commission 1995).

The commission adopted the plan on February 23, 1995, and provided it to the five counties within its jurisdiction to incorporate into their general plans and zoning codes. The Counties will then carry out the plan through their day-to-day activities. The Project will minimize and mitigate, to the extent possible, any impacts to land uses in the area. In addition, the Project will increase water supply reliability for North Delta water users and irrigated farmlands. Therefore, this project is consistent with the land use and resource management plan (see Section 6.1, Land Use, Agriculture, and Recreation, in this EIR for more detail).

Delta Protection Commission

The DPC is a state agency created in 1993 to address concerns that increasing pressures for residential, residential/recreation, and commercial/industrial users would continue to encroach into the Delta, an area of statewide agricultural significance. The commission is charged with preparation of the regional plan (mentioned previously) for the heart of the Delta, which includes portions of Solano, Yolo, Sacramento, San Joaquin, and Contra Costa Counties. The Project is consistent with this regional plan.

The DPC has appeal authority over local government actions. Thus, if any person believes a local government has taken an action, or approved a project, that is not in conformance with the act and plan, that local government action can be appealed to the commission. The appeal "suspends" the local permit, allowing the commission the opportunity to review the action. If the commission finds the local government action to be in conformance with the act and plan, the action can go forward. If the commission finds the local government action is not in conformance with the act and plan, the commission will forward its findings to the local government for further review. In 1999, the sunset date of the commission was extended to January 1, 2010.

Clean Water Act, Section 303(d)

Under CWA Section 303(d), the RWQCB and the State Water Board list water bodies as impaired when not in compliance with designated water quality objectives and standards. A TMDL program must be prepared for waters identified by the state as impaired. A TMDL is a quantitative assessment of a problem that affects water quality. The problem can include the presence of a pollutant, such as a heavy metal or a pesticide, or a change in the physical property of the water, such as DO or temperature. A TMDL specifies the allowable load of pollutants from individual sources to ensure compliance with water quality standards. Once the allowable load and existing source loads have been determined, reductions in allowable loads are allocated to individual pollutant sources.

The currently applicable basin plan chronic water quality standard for nickel in San Francisco Bay north of the South San Francisco Bay segment is 7.1 mg/l total recoverable nickel (San Francisco Bay Regional Water Quality Control Board 1995, p. 3 to 9). The state's analysis of available data found that this standard has been exceeded 102 times since 1993 (Strauss 2003a). The state erroneously applied the dissolved nickel criterion in assessing the data and reached the conclusion that the bay meets the nickel standards based on the application of an inapplicable standard. EPA identified the Sacramento–San Joaquin Delta (portion in San Francisco Bay Region) segment for inclusion on the 2002 Section 303(d) list based on the state's analysis of available nickel data in comparison with the applicable basin plan objective. EPA established a low-priority ranking for this listing as the state is in the process of developing site-specific water quality standards for nickel that will likely be attained. Therefore, it is most reasonable to proceed with water quality standards modification that will likely prevent the need to complete a nickel TMDL for the bay (Strauss pers. comm.a and b). Implementation of the Project would assist DWR in meeting these standards.

Water Rights

The State of California recognizes riparian and appropriative surface water rights. Riparian rights are correlative entitlements to water that are held by owners of land bordering natural watercourses. California requires a statement of diversion and use of natural flows on adjacent riparian land under a riparian right. Appropriative water rights allow the diversion of a specified amount of water from a source for reasonable and beneficial use during all or a portion of the year. In California, previously issued appropriative water rights are superior to and take precedence over newly granted rights. The State Water Board has authority to issue permits to grant appropriative water rights. The Project is consistent with current water rights.

Local Plan Consistency and Regulatory Requirements

In addition to the federal and state regulatory and local plan requirements, the Project may be subject to certain zoning or other ordinances and general plans of the Sacramento and San Joaquin Counties. Such regulatory requirements may include compliance with general plan elements, grading permits, and compliance with Williamson Act land programs. For more discussion on local plans and requirements applicable to the Project, refer to the Regulatory Setting part of the specific resource sections of interest within this document.

Chapter 7

Growth-Inducing and Cumulative Impacts

7.1 Introduction

The chapter evaluates the growth-inducing and cumulative impacts that potentially would occur as a result of the Project. The analysis of growth-inducing impacts assesses the construction and operation stages of the Project. The cumulative impact assessment discusses each resource topic evaluated in the EIR.

7.2 Growth-Inducing Impacts

CEQA Requirements

Section 21100(b)(5) of CEQA requires an EIR to discuss how a proposed project, if implemented, may induce growth and the impacts of that induced growth (see also State CEQA Guidelines Section 15126). CEQA requires the EIR to specifically discuss "the ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment" (State CEQA Guidelines Section 15126.2[d]).

Evaluation of the growth-inducing effects of the Project is based on a qualitative analysis of the direct effects of constructing and operating the Project, and the indirect effects that could result from changes in protection from flood events. This evaluation of potential growth-inducing impacts addresses whether the project would directly or indirectly: foster economic, population, or housing growth; remove obstacles to growth; increase population growth that would tax community service facilities; or encourage or facilitate other activities that cause significant environmental effects.

Background

According to the California Department of Finance, over the next 20 years (the Project's planning horizon) California's population is expected to increase from

37 million people to between 44 and 48 million people. The Central Valley leads the state in new home construction because of the abundance and relatively low cost of available land (in contrast to coastal population centers). Sacramento and San Joaquin Counties in particular are experiencing high rates of growth because of their proximity to jobs in the Bay Area and the state capital.

To an extent, the North Delta region is experiencing some corresponding development pressure as well. The Sacramento Area Council of Governments' "Preferred Blueprint Scenario," which outlines the organization's vision for growth in the Sacramento region through 2050, estimates that 1,600 new residential units will be built in and around the town of Locke over the next 50 years. To the immediate east and northeast of the Project, the City of Galt and City of Elk Grove are experiencing growth rates among the highest in the nation.

However, most of the North Delta Project area is located within the Delta Primary Zone (described in detail in Section 5.1, Land Use, Recreation, and Economics), which is under the jurisdiction of the DPC. The DPC was established in 1992 by the Delta Protection Act in recognition of the threats to the Primary Zone of the Delta from potential urban and suburban encroachment and the need to protect the area for agriculture. The stated goal of the DPC is to

> protect, maintain, and where possible, enhance and restore the overall quality of the Delta environment, including but not limited to agriculture, wildlife habitat, and recreational activities; assure orderly, balanced conservation and development of Delta land resources and improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety.

Thus, the DPC actively seeks to limit growth and the conversion of agricultural lands in the Delta Primary Zone.

Growth-Inducing Impacts

Construction

A discussion of changes in employment during construction of the Project is provided in Section 5.1, Land Use, Recreation, and Economics. Constructing the Project alternatives would increase direct and indirect employment over the 2-year construction period. Increases in employment would range from 164 to 692 jobs for Alternatives 1-A and 2-C, respectively.

The temporary increase in employment is not expected to result in growth-inducing effects because this increase represents a very small percentage of total employment in Sacramento and San Joaquin Counties. In addition, because most construction workers would be hired from the local labor pool, demand for housing or other services would not increase.

Operation

DWR has developed explicit goals and designed the Project so as not to increase the level of flood protection and foster growth. A project with a flood control component, such as the North Delta Project, could have the potential to induce growth if it were to provide a level of flood protection to the extent that the 100-year floodplain could be reduced and consequently made available to development, if floodplain status were the dominant barrier to growth. The Project, however, is a local flood damage reduction project that seeks to control damage from high flows and reduce the risk to existing facilities in the North Delta area. It has been specifically designed so that it does not change the 100-year floodplain (refer to Chapter 1 for a more detailed discussion of the purpose, need, and objectives of the Project).

The Group I alternatives function to mute the surge effect, described in Chapter 1, that occurs when the McCormack-Williamson Tract levees fail in flood conditions, which can be damaging to local infrastructure. These alternatives do not, however, provide any significant reduction in stage that would affect the 100-year floodplain.

Alternatives 2-A, 2-B, and 2-C are designed to reduce the peak flows greater than the 10-year flood event to provide localized stage reduction and reduce the risk of levee failure in the Project area. Alternative 2-D would involve localized dredging to provide additional conveyance capacity for floodflows. None of these alternatives proposes modifications substantial enough to change the 100-year-floodplain designation. Therefore, the Project would not result in direct or indirect growth-inducing impacts.

7.3 Cumulative Impacts

State CEQA Guidelines and NEPA regulations require that the cumulative impacts of a proposed project be addressed in an EIS/EIR. While this document is not a joint EIS/EIR, the cumulative impacts are presented in a manner consistent with NEPA standards should a federal lead agency become engaged in the Project. The cumulative impact analysis determines the combined effect of the Project and other closely related, reasonably foreseeable, projects. This chapter introduces the methods used to evaluate cumulative effects and identifies cumulative impacts. The projects considered in the cumulative analysis are categorized and described at the end of Chapter 1.

Approach to Cumulative Impact Analysis

Legal Requirements

State CEQA Guidelines and NEPA regulations require that the cumulative impacts of a proposed project be addressed in an EIS/EIR when the cumulative impacts are expected to be significant and, under CEQA, when the project's incremental effect is cumulatively considerable (Guidelines 15130[a], 40 CFR 1508.25[a][2]). Cumulative impacts are impacts on the environment that result from the incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions (Guidelines 15355[b], 40 CFR 1508.7). Such impacts can result from individually minor but collectively significant actions taking place over time.

Section 15130 of the State CEQA Guidelines states that the discussion of cumulative impacts need not provide as much detail as the discussion of effects attributable to the project alone. The level of detail should be guided by what is practical and reasonable.

Methods

According to the State CEQA Guidelines (Section 15130), an adequate discussion of significant cumulative impacts should contain the following elements:

- an analysis of related future projects or planned development that would affect resources in the project area similar to those affected by the proposed project;
- a summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating where that information is available; and
- a reasonable analysis of the cumulative impacts of the relevant projects. An EIR shall examine reasonable, feasible options for mitigating or avoiding the project's contribution to any significant cumulative effects.

To identify the related projects, the State CEQA Guidelines (15130[b]) recommend either the "list" or "projection" approach. This analysis uses the list approach, which entails listing past, present, and probable future projects producing related or cumulative impacts, including, if necessary, those projects outside the control of the lead agency. As the projects considered in this section are still largely in the planning stages, a qualitative approach was taken to this analysis.

Although NEPA does not provide specific guidance as to how to conduct a cumulative impact assessment, Reclamation's NEPA Handbook states that an EIS should

> identify associated actions (past, present, or future) which, when viewed with the proposed or alternative actions, may have cumulative significant impacts. Future cumulative impacts should not be speculative but should be based on known long-range plans, regulations, or operating agreements.
>
> —Bureau of Reclamation Draft NEPA Handbook, pp. 8–18.

The following criteria were used to identify those projects or actions that may contribute to cumulative impacts:

- Is the action under active consideration?
- Does the action have recently completed project-level environmental documentation, or are other environmental documents in some stage of active completion (e.g., public draft EIR)?
- Does the action, in combination with the Project, have the potential to affect the same resources?

Cumulative Effects

Implementation of the Project with other projects occurring at the same time in the Delta has the potential to create and contribute to cumulative impacts on the environment. The following discussion presents these impacts by resource.

Hydrology and Hydraulics

In combination with the South Sacramento Streams Project, the Project is anticipated to provide localized flood damage reduction in the Project area and in the communities in the southern part of the county, including Meadowview and the city of Elk Grove. However, it is not expected that the cumulative effect of these projects would substantially change the hydrology and hydraulic characteristics upstream or downstream of the immediate planning areas.

Additional local flood damage reduction would occur if Sacramento County pursues the construction of a Cosumnes River Dry Dam. As described in Chapter 1, a dry dam could reduce peak floodflows in the Cosumnes River by approximately two-thirds. The cumulative effect of the dry dam, the Project, and the South Sacramento Streams Project would provide a substantial reduction in flood damage in the project area and lower Cosumnes River watershed.

Flood Control and Levee Stability

See Hydrology and Hydraulics, above.

Geomorphology and Sediment Transport

All of the proposed alternatives affect the sediment storage and export characteristics of the Project area to some degree. In general, with the exception of the Mid-Mokelumne adjacent to the McCormack-Williamson Tract, the entire region is a zone of sediment storage, which is to be expected given the reduction of stream gradient from the upper Mokelumne and Cosumnes River systems to the Project area.

The computed change in reach-averaged sediment characteristics for each alternative is an expected response of the river system's sediment balance. If an alternative results in sediment deposition within a reach, generally the adjacent downstream reach adjusts to the lower inflowing sediment load through decreased deposition, or potentially scour, occurring in the downstream reach. Conversely, if an alternative results in scour within a reach, generally the adjacent downstream reach adjusts to the increased inflowing sediment load through decreased scour, or potentially deposition, occurring in the downstream reach.

Alternatives 1-B and 1-C have the least cumulative impacts on changes to the sediment regime of any of the Project alternatives. These alternatives have the least impact on the hydrodynamics of flood conditions, and hence the least impact on the resultant sedimentation dynamics. The other alternatives entail a greater degree of channel and floodplain modification, and thus change the flood and sedimentation characteristics of the Project reaches to a greater extent. None of the proposed alternatives is projected to drastically change the sediment characteristics of the Project area to the point that management activities beyond those already implemented in the region would require significant modification. Site-specific bank erosion control activities will likely be required in the future in response to continuing bank and bed scour. Limited dredging activity has been reported on some of the reaches in the Project area, and such activity would likely continue in response to continued sediment deposition in the area.

Water Supply and Water Quality

The Project is not anticipated to result in substantial changes in water supply and water quality in and of itself, although reducing irrigated agriculture as proposed by the Project will reduce water use and slightly improve water quality by reducing runoff. Further, while the project is intended to improve floodflow conveyance, the timing of these events (in the winter and spring) should be off-cycle and not coincide with water supply conveyance needs (in the summer). In combination, however, with DCC Re-Operation, the Project may result in water-supply and -quality benefits for water routed through the Delta for delivery via the CVP and SWP.

Geology, Seismicity, and Soils

No cumulative impacts on geological resources are associated with any alternatives in Group I. Implementation of the Project in combination with other CALFED Actions (as presented in Section 3.7, Geology and Soils) and other local and regional projects could contribute to regional impacts and hazards associated with geology, seismicity, and soils. As described in Section 3.7, the effect of the Project alternatives is related primarily to localized Project impacts or seismic hazards in the vicinity of McCormack-Williamson Tract. These impacts include the potential for structural damage as a result of fault rupture, ground shaking, liquefaction, development on expansive soils; accelerated runoff, erosion, and sedimentation from construction activities; and localized subsidence from placement of material on peat soils. Most of the impacts are mitigated by incorporating standard construction and structural measures into Project design and construction.

Other CALFED actions such as the Storage and Conveyance Program located in the same area as the Project, and other local projects, have the potential to contribute to similar types of geology, seismicity, and soils effects. Projects that could contribute most directly to these cumulative impacts include the Banks Pumping Expansion to 10,300 cfs, In-Delta Storage Project, Mountain House New Town, and River Islands Development. These cumulative impacts would result from construction activities and development of additional structures that may be subject to geologic, seismic, or soil erosion damage and could be reduced by implementing measures similar to those described for the Project. Although these combined impacts could be cumulatively considerable, implementing the measures identified for the Project in Section 3.7 would reduce the Project's contribution to these cumulative impacts to a level below the "cumulatively considerable" threshold. Therefore, the Project's contribution to these impacts is considered less than significant. No mitigation is required.

Air Quality

Because the air quality of the Sacramento metropolitan region is already impaired, the Project would result in a significant and unavoidable cumulative air quality impact during construction in combination with other construction projects.

Noise

Noise associated with construction activities, dredging, and pumping operations would be highly localized. Because noise-sensitive land uses are sparsely located throughout the Project area, it is unlikely that noise from these activities would have a substantial cumulative effect in association with other noise sources at any given area. Accordingly, no significant cumulative noise impacts are predicted to occur as a result of construction, dredging, and pumping activities.

Noise from trucks would not be localized and would occur on roads throughout the Project area and on roads used to access the Project area. Project-related trucking could occur on roadways where the cumulative noise from traffic exceeds local noise standards. Noise from Project-related trucking may therefore contribute to traffic noise in these situations. This would result in the Project contributing to significant and unavoidable traffic noise impacts.

Biological Resources

A number of ecosystem restoration projects are currently in operation and in the planning stages for the Delta. The Project will have a beneficial effect on fish, vegetation, and wildlife. When considered with the CALFED ERP and the other projects mentioned in Chapter 1, there is a cumulatively considerable beneficial effect on biological resources.

Land Use and Agriculture

Other projects in the vicinity of the Project could contribute to a cumulative change in land use. Projects in the immediate vicinity of the Project include improvements to the DCC and the Through-Delta Facility. Other, more localized projects also could contribute to cumulative land use changes. Generally, cumulative land use changes would involve the permanent conversion of agricultural lands to non-agricultural uses. Other land uses would not be affected by the Project. The actual amount of agricultural land that may be converted by other projects is not known. Because these totals are not known, this assessment used countywide historical data on agricultural land conversion as a method to put the estimated Project conversion in context with county conversion trends.

The Project would result in the conversion of up to 1,901 acres of agricultural land, all of which is classified by the California Department of Conservation as prime farmland. In 2002, Sacramento and San Joaquin Counties had a combined total of approximately 628,300 acres of prime farmland. The acreage of prime farmland affected by the Project represents less than 1% of the total prime farmland in both counties. Between 1998 and 2002 the combined average annual loss of prime farmland for both counties was approximately 4,700 acres per year. If this conversion rate continues, the loss of the 1,970 acres of prime farmland as a result of the Project would represent a significant proportion of this annual loss and would be cumulatively considerable. Mitigation Measure LU-1, described in Section 5.1, Land Use, Recreation, and Economics, would reduce the impact on prime farmland attributable to the Project, but would not reduce it to a less-than-significant level. Suggested Mitigation Measure LU-2 would reduce this impact to a less-than-significant level if a Group 1 alternative is selected. Recreation

The Project is designed to benefit recreation in the North Delta. Related projects in the vicinity, such as the DCC Re-Operation, Through-Delta Facility, and Stone Lakes National Wildlife Refuge Improvements, are also designed to improve boater access and other recreational opportunities in the North Delta region. There is a cumulatively considerable beneficial impact on recreation.

Population and Housing, and Environmental Justice

Implementation of the Project would not result in significant adverse impacts on housing and population. Unincorporated areas in both Sacramento County and San Joaquin County are zoned primarily for agriculture and preservation. As part of their general plans, both counties discourage the expansion of these areas. Rather, they encourage growth in cities or on the outskirts of cities, where infrastructure can be added easily.

The location of the Project is in an area that is difficult to develop because of the lack of infrastructure available to its residents. The increased amount of flood control devices in the area hampers increases in housing and population. The implementation of detention basins in the area, combined with the area being zoned for agricultural land use, reduces any potential for development. Water and sewer lines are nonexistent in the Project area. The communities of Walnut Grove and Thornton provide the only opportunities for increased housing and population, as they are the closest cities to the Project site. The Project alternatives do not contribute to cumulative population, housing, or environmental justice impacts.

Utilities and Public Service

Implementation of the Project would not result in growth-inducing impacts. Unincorporated areas in both Sacramento County and San Joaquin County are zoned primarily for agriculture and preservation. As part of their general plans, they both discourage the expansion of these areas. Rather, they encourage growth in cities or on the outskirts of cities, where infrastructure can be added easily.

The location of the Project makes development increasingly difficult because of the lack of infrastructure available to its residents. Water and sewer lines are nonexistent in the Project area. Areas surrounding the Project site are also zoned for agriculture by their county's general plan. The communities of Walnut Grove and Thornton provide the greatest potential for increased utilities as they are the closest population centers to the Project site. The Project site does not contribute to cumulative infrastructure growth.

Cumulative impacts are considered to be less than significant because of the lack of growth in the Project area, and zoning that discourages growth, and thus, utility expansion. In addition, the increased amount of flood control devices in the area hampers the increase of utility lines through the North Delta region.

Cultural Resources

Section 5.7, Cultural Resources, identifies several significant impacts on cultural resources. In particular, the proposed Project would result in significant effects on approximately 12 archaeological sites. Taken together with other Delta projects, the Project's impacts on cultural resources would contribute to cumulative effects on cultural resources. Implementation of the mitigation measures described in Section 5.7, however, would reduce the Project's contribution to these cumulative impacts to a level below the "cumulatively considerable" threshold. Therefore, the Project's contribution to cumulative impacts on cultural resources is considered less than significant.

Conclusions

There are no cumulatively considerable effects on public health and environmental hazards; power production and energy; utilities and public services; population, housing, and environmental justice; and transportation and navigation. The Project would contribute to cumulatively considerable effects on cultural resources; land use and agriculture (Group 1 alternatives only); geomorphology and sediment transport; and geology, seismicity and soils. Mitigation measures listed in the respective sections of this EIR would reduce these impacts to a less-than-significant level. Significant impacts on air quality and noise (as a result of construction-related Project activities) and land use and agriculture (Alternatives 2-A, 2-B, and 2-C only) would contribute to significant and unavoidable cumulatively considerable impacts. The water supply and quality, recreation, and ecosystem restoration improvements that are part of the Project would contribute to cumulatively beneficial impacts.

Chapter 8
References

8.1 Introduction (Chapter 1)

CALFED Bay-Delta Program. 1999. CALFED Bay-Delta Program Programmatic Record of Decision. Volume 1. Sacramento, CA. Page 50.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Department of Water Resources. 1990. Draft environmental impact report/environmental impact statement: North Delta program. November. Sacramento, CA.

Jones & Stokes. 2000. Environmental Impact Report, Environmental Impact Statement for the Lower Mokelumne River Restoration Program. May. (J&S 08059.98.) Sacramento, CA. Prepared for: Woodbridge Irrigation District.

8.2 Project Description (Chapter 2)

Aceituno, M. E. and S. J. Nicola. 1976. *Distribution and status of the Sacramento perch,* Archoplites interruptus (Girard) *in California*. California Department of Fish and Game 62(4):246–254.

Central Valley Joint Venture. 2004. *Technical guide to best management practices for mosquito control in managed wetlands*. June, p. 6–7. Sacramento, CA.

Gobalet, K. W. and T. L. Jones. 1995. Prehistoric Native American fisheries of the central California coast. *Trans. Amer. Fish. Soc*. 124:813–823.

Kliewer, J.W., Miura, T., Husbands, R.C. & Hurst, C.H. 1966. *Sex Pheromones and mating behavior of* Culiseta inornata *(Diptera:Culicidae)*. Annals of the Entomological Society of America. 59:530–532.

Leidy, R. A. 1984. Distribution and ecology of stream fishes in the San Francisco Bay drainage. *Hilgardia* 52(8): 1-175

Metzger, M. E. 2004. Publication 8125, *Managing mosquitoes in stormwater treatment devices*. University of California Division of Agriculture and Natural Resources. p. 4–7.

Miller, C., 2005. *Evaluation of stocking success of Sacramento perch using three life history stages, adult, juvenile, and larvae*. Contra Costa Mosquito & Vector Control District. Concord, CA.

Moyle, P. B. 2002. *Inland fishes of California*. 2nd edition. Berkeley: University of California Press.

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. *Fish species of special concern of California*. California Department of Fish and Game, Sacramento, CA, 2nd. Ed. 272 pp.

Sacramento-Yolo Mosquito & Vector Control District. *Sacramento-Yolo mosquito and vector control guidelines for mosquito management on wetland habitat*. Elk Grove, CA.

Sacramento-Yolo Mosquito and Vector Control District. 2002. Municipal Service Review and Sphere of Influence Update. October, p. 11. Elk Grove, CA.

Tharratt, R.C. and R.J McKechnie. 1966. Sacramento perch. pp. 373-375, In: A. Calhoun (ed.) Inland fishery management. Calif. Dept. Fish and Game. Sacramento.

U.S. Army Corps of Engineers. 1991. Hydraulic Design of Flood Control Channels. EM 1110-2-1601, Washington, DC. Available: <http://www.usace.army.mil/publications/eng-manuals/em1110-2-1601/toc.htm>. Last Accessed; November 6, 2006.

8.3 Hydrology and Hydraulics (Section 3.1)

Blake, S.H. 2001. *An Unsteady Hydraulic Surface Water Model of the Lower Cosumnes River, California, for the Investigation of Floodplain Dynamics*. MS thesis, University of California, Davis.

CALFED Bay-Delta Program. 2000e. *Final Programmatic Environmental Impact Statement/Environmental Impact Report*, July 2000.

California Department of Water Resources. 1995. *Hydrology Report (2) Low-Frequency Floods in North Delta Region*, March 1995.

California Department of Water Resources. 2006. Technical Memorandum Report: *Progress on Incorporating Climate Change into Planning and Management of California's Water Resources,* July 2006.

David Ford Consulting. 2004. Technical Memorandum—*Cosumnes and Mokelumne Watersheds Design Storm Runoff Analysis,* Prepared for Sacramento County Department of Water Resources by David Ford Consulting, January 2004.

Hammersmark, C. T. 2002. *Hydrodynamic Modeling and GIS Analysis of the Habitat Potential and Flood Control Benefits of the Restoration of a Leveed Delta Island*. MS thesis, University of California, Davis.

Jones & Stokes. 2003. *Final Report—Cosumnes River Watershed Inventory and Assessment: Phase II.*

MBK Engineers. 2003. *North Delta HEC-RAS Model Report*, Prepared for the California Department of Water Resources, May 8, 2003.

Philip Williams & Associates. 1997. *Analysis of Opportunities for Restoring a Natural Flood Regime on the Cosumnes River Floodplain*, Prepared for The Nature Conservancy, May 7, 1997.

Philip Williams & Associates. 2004a. Technical Memorandum: *The Geomorphic Setting, History and Process of the Grizzly Slough Restoration Project Site*. Prepared for the California Department of Water Resource, December 1, 2004.

Philip Williams & Associates. 2004b. *Grizzly Slough Hydrology Summary*. Prepared for the California Department of Water Resources, September 7, 2004.

State Water Resources Control Board. 2002. *Cosumnes River Task Force Plan*, State Water Resources Control Board, Sloughhouse Resource Conservation District, Natural Resource Conservation Service, June 2002.

U.S. Army Corps of Engineers. 1991. Hydraulic Design of Flood Control Channels. EM 1110-2-1601, Washington, DC. Available: <http://www.usace.army.mil/publications/eng-manuals/em1110-2-1601/toc.htm>. Last Accessed; November 6, 2006.

U.S. Army Corps of Engineers. 1992. Sacramento–San Joaquin Delta California Special Study Hydrology, February 1992.

U.S. Army Corps of Engineers. 2006. *South Sacramento Streams, Morrison Creek Stream Group, California, Feasibility-Level Hydrology,* Davis. 2006.

U.S. Department of the Interior, Bureau of Reclamation. 2003. *Draft Environmental Impact Report/Environmental Impact Statement, Freeport Regional Water Project.*

8.4 Flood Control and Levee Stability (Section 3.2)

CALFED Bay-Delta Program. 1990. Draft EIR/EIS North Delta Program, November 1990.

CALFED Bay-Delta Program. 2000. Levee System Integrity Program Plan, CALFED Final Programmatic EIS/EIR Technical Appendix, July 2000.

U.S. Army Corps of Engineers. 1992. Department of the Army. Sacramento–San Joaquin Delta, California Special Study, Office Report, Basis of Design and Cost Estimates, November 1992.

8.5 Geomorphology (Section 3.3)

Anderson, M. L. 1994. *Historic sediment loads in the Sacramento–San Joaquin Delta.* Report to Delta Planning Branch of Department of Water Resources of the State of California, University of California, Davis, p. 27.

California Department of Water Resources. 1993 (1995). Sacramento–San Joaquin River Delta Atlas. Reprinted July 1995. Sacramento, CA. p. 121.

California Department of Water Resources. 1993. *Southern Delta scour monitoring: 1991 and 1992, Sacramento, California*, p. 52.

California Department of Water Resources. 2000. *North Delta scour monitoring program: 1998–2000, Sacramento, California,* p. 39.

California Department of Water Resources. 2005. North Delta flood control and ecosystem restoration project. Updated: 2005. Available: <http://baydeltaoffice.water.ca.gov/ndelta/northdelta/index.cfm>. Accessed: January 16, 2005.

Dinehart, R. L. 2000. Bedform movement in Threemile Slough near San Joaquin River. CALFED Bay-Delta program science conference abstracts, October 3–5, 2000, Sacramento, CA, p. 234.

Gilbert, G. K. 1917. *Hydraulic mining debris in the Sierra Nevada.* U.S. Geological Survey professional paper 105.

Levi, I. I. 1957. *Dynamics of fluvial streams*. Gosenergoizdat, Moscow-Leningrad, Russia (in Russian).

Northwest Hydraulic Consultants. 2003. *Assessment of sediment budget of Sacramento San Joaquin Delta*, 36 p.

Northwest Hydraulic Consultants. 2004. *North Delta sedimentation study draft report*. Prepared for: California Department of Water Resources. September 2004.

Northwest Hydraulic Consultants. 2006. *North Delta sedimentation study*. Prepared for: California Department of Water Resources. March 2006.

Philip William & Associates. 2005. Grizzly Slough restoration project, phase 1. A collection of memoranda submitted as deliverables. Prepared for: California Department of Water Resources and California Bay-Delta Authority. November 11, 2005.

Porterfield, G. 1980. Sediment transport of streams tributary to San Francisco, San Pablo, and Suisun Bays, California, 1909–66. *Water Resources Investigations Report* 80-64. U.S. Geological Survey, Water Resources Division, Menlo Park, CA, p. 92.

Shlemon, R. J., and E. L. Begg. 1975. Late Quaternary evolution of the Sacramento–San Joaquin Delta, California. *Quaternary Studies:* pp. 259–266. R. P. Suggate and M. M. Cresswell (Eds.). Wellington: The Royal Society of New Zealand.

8.6 Water Quality (Section 3.4)

Brown, L. R. 2003. Potential effects of organic carbon production on ecosystem and drinking water quality. *San Francisco Estuary and Watershed Science*, 1 (1): Article 3.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

Central Valley Regional Water Quality Control Board. 2005. *Sacramento–San Joaquin Delta estuary TMDL for methyl and total mercury*. Draft staff report. August 2005.

Chow, A. T., F. Guo, S. Gao, and R. S. Breuer. 2005. Trihalomethane formation potential of filter isolates of electrolyte-extractable soil organic carbon. *Journal of Environmental Quality*, 34:1992–1997.

Chow, A. T., F. Guo, S. Gao, and R. S. Breuer. 2006. Trihalomethane reactivity of water- and sodium hydroxide–extractable organic carbon fractions from peat soils. *Journal of Environmental Quality*, 35:114–121.

Fujii, R. A. J. Ranalli, G. R. Aiken, and B. A. Bergamaschi. 1998. Dissolved organic carbon concentrations and compositions, and trihalomethanes formation potentials in waters from agricultural peat soils, Sacramento–San Joaquin Delta, California: Implications for drinking-water quality. *Water Resources Investigations Report* 98-4147, p. 75. U.S. Geological Survey.

Marvin-DiPasquale, M. R. Stewart, N. S. Fisher, P. Pickhardt, R. P. Mason, A. Heyes, L. Windham-Meyer. 2005. *Evaluation of mercury transformations and trophic transfer in the San Francisco Bay/Delta: identifying critical processes for the ecosystem restoration program*. Annual report of progress for project #ERP-02-P40, November 7, 2005.

Slotton, D. G., S. M. Ayers, T. H. Suchanek, R. D. Weyand, A. M. Listn, C. Asher, D. C. Nelson, and B. Johnson. 2002. *The effects of wetland restoration on the production and bioaccumulation of methylmercury in the Sacramento–San Joaquin Delta, California*. Draft final report, CALFED Bay-Delta program project, under CALFED contract 97-C05, July 1998–March 2003.

Slotton, D. G., T. H. Suchanek, and S. M. Ayers. 2000. *CALFED UC Davis Mercury Study: Year 2 Findings.* CALFED science conference, October 3–5, 2000, Sacramento, CA.

Slotton, D.G. 1991. *Mercury bioaccumulation in a newly impounded northern California reservoir* [dissertation]. University of California, Davis. Available from Peter J. Shields, University Library, Davis, CA, p. 362.

State Water Resources Control Board. 1995. *Water quality control plan for the San Francisco Bay/Sacramento–San Joaquin Delta estuary*. Adopted May 1995.

State Water Resources Control Board. 1999. National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity (General Permit). Water Quality Order 99-08-DWQ. Division of Water Quality, Sacramento, CA. Available at: <http://www.waterboards.ca.gov/stormwtr/index.html>.

Suchanek, T. H., D. E. Slotton, B. S. Johnson, S. M. Ayers, D. C. Nelson. 1999. Effects of wetlands restoration on the production of methylmercury in the San Francisco Bay-Delta system: Preliminary results. Interagency ecological program for the Sacramento–San Joaquin estuary. *IEP Newsletter* 12(3):19–24.

Yee, D., J. Collins, L. Grenier, J. Takekawa, S. Schwarzbach, D. Tsao-Melcer, I. Woo, M. Marvin-DiPasquale, J. Agee, L. Kieu, L. Windham, J. Flanders, N. Ladizinsky, S. Olund, T. Sabin, J. Evens. 2005. *Mercury and methylmercury processes in north San Francisco Bay tidal wetland ecosystems.* CALFED ERP02D-P62, annual project report 2005.

8.7 Groundwater (Section 3.6)

California Department of Water Resources. 1994. *Interim North Delta program seepage monitoring network.* Memorandum report. Geology and groundwater section. Sacramento, CA.

California Department of Water Resources. 1995. *Environmental study for the interim North Delta program.* Division of Planning and Local Assistance. Sacramento, CA.

California Department of Water Resources. 2003. *California's groundwater.* Bulletin 118—Update 2003 Sacramento, CA.

8.8 Geology, Seismicity, Soils, and Mineral Resources (Section 3.7)

Association of Bay Area Governments. 2001. *The real dirt on liquefaction: A guide to the liquefaction hazard in future earthquakes affecting the San Francisco Bay area.* Oakland, CA.

Atwater, B.F. 1982. *Geologic maps of the Sacramento–San Joaquin Delta, California*. U.S. Geological Survey MF-1401, 15 p + 21 plates.

Atwater, B.F., C.W. Hedel, and E.J. Helley. 1977. *Late Quaternary depositional history, Holocene sea-level changes, and vertical crustal movement, southern San Francisco Bay, California*. U.S. Geological Survey Professional Paper 1014, 15 p.

Burroughs, E. 1967. Rio Vista gas field: Summary of operations, California oil fields. Sacramento, California Division of Oil and Gas, v. 53, pp. 25–33.

California Department of Water Resources. 1980a. *Seismicity hazards in the Sacramento–San Joaquin Delta.* Central District, Sacramento, California, 26 p.

California Department of Water Resources. 1980b. *Subsidence of organic soils in the Sacramento–San Joaquin Delta*. Central District, Sacramento, California, 26 p.

California Department of Water Resources. 1986. *Delta subsidence investigation progress report*. Central District, Sacramento, California.

California Department of Water Resources. 1995. *Sacramento–San Joaquin Delta Atlas*. July, 121 p.

California Department of Water Resources. 2000. *Land subsidence*. Updated: March 20, 2000. Available: <http://wwwdpla.water.ca.gov/cd/groundwater/landsubsidence.html>. Accessed: January 8, 2005.

California Division of Mines and Geology. 1997. Guidelines for Evaluating and Mitigating Seismic Hazards in California. *Special Publication 117*. Sacramento, CA.

California Geological Survey. 2006. Seismic Shaking Hazards in California. Updated: February 2, 2006. Available: <http://www.consrv.ca.gov/CGS/rghm/pshamap/pshamain.html>. Accessed: April 27, 2005.

Cao, T., W. A. Bryant, B. Rowshandel, D. Branum, and C. J. Wills. 2003. *The revised 2002 California probabilistic seismic hazard maps.* Available: <http://www.consrv.ca.gov/CGS/rghm/psha/fault_parameters/pdf/2002_CA_Hazard_Maps.pdf>.

County of Sacramento. 1993. *Conservation element of the County of Sacramento general plan.* Updated: 2004. Available: <http://www. saccounty.net/general-plan/docs/pdf/GP-Elements/Conservation-Element.pdf>. Accessed: January 9, 2005.

Entrix. 1996. *Draft environmental impact report/environmental impact statement (EIR/EIS) interim south Delta program (ISDP), volumes I and II.*

Hart, E.W., and W.A. Bryant. 1997. Fault-Rupture Hazard Zones in California: Alquist-Priolo Earthquake Fault Zoning Act with index to Earthquake Fault Zone Maps. *Special Publication 42*. California Division of Mines and Geology. Sacramento, CA.

Hickman, J. (ed.). 1993. *The Jepson manual: Higher plants of California.* Berkeley, CA: University of California Press. 1400 p.

International Code Council. 1997. Uniform Building Code. Albany, NY: Delmar Publishers.

International Conference of Building Officials. 1997. *Maps of known active fault near-source zones in California and adjacent portions of Nevada: To be used with 1997 Uniform Building Code*. Whittier, CA.s

Jennings, C. W. 1994. *Fault activity map of California and adjacent areas.* California Geologic Data Map Series. California Division of Mines and Geology. Sacramento, CA.

Kearney, C. 1980. *Seismicity hazards in the Sacramento–San Joaquin Delta*. California Department of Water Resources, Central District, Sacramento, CA.

McElhiney, M.A. 1992. *Soil survey of San Joaquin County, California*. U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the Regents of the University of California (Agricultural Experiment Station) and the California Department of Conservation. Washington, DC.

Prokopovich, N.P. 1988. Tectonic subsidence in California's Sacramento–San Joaquin Delta. *Bulletin of the Association of Engineering Geologists* 25 (1): p. 140–144.

Sacramento County. 1997. *Safety element of the County of Sacramento general plan*. Updated: 1997. Available: <http://elib.cs.berkeley.edu/cgi-bin/doc_home?elib_id=2021>. Accessed: January 8, 2005.

San Joaquin County. 1992a. *San Joaquin County general plan 2010.:* Volume I: Policies/Implementation. Updated: 1992. Available: <http://elib.cs.berkeley.edu/cgi-bin/doc_home?elib_id=928>. Accessed: January 8, 2005.

San Joaquin County. 1992b. *San Joaquin County general plan 2010.* Volume III: Technical Appendices. Updated: 1992. Available: <http://elib.cs.berkeley.edu/cgi-bin/doc_home?elib_id=930 >. Accessed: January 8, 2005.

Shlemon, R. J. 1969. *Geomorphological investigation of the lower Mokelumne River area, California.*

Shlemon, R. J. and E.L. Begg. 1975. Late Quaternary evolution of the Sacramento–San Joaquin Delta, California. Pages 259–266 in R. P. Suggate and M. M. Cresswell (eds.) *Quaternary Studies*. Wellington: The Royal Society of New Zealand.

Shlemon, R.J. 1971. The Quaternary deltaic and channel system in the Central Great Valley, California. *Annals of the Association of American Geographers* 61 (3): 427–440.

Tokimatsu, K., and H.B. Seed. 1984. *Simplified procedures for the evaluation of settlements in clean sands*. Report No. UCB/BT-84/16. Earthquake Engineering Research Center. University of California, Berkeley, CA.

Tugel, A.J. 1993. *Soil survey of Sacramento County, California*. U.S. Department of Agriculture, Soil Conservation Service, in cooperation with the University of California Agricultural Experiment Station. Washington, DC.

U.S. Army Corps of Engineers. 1974. Port of Stockton to Point Edith, San Francisco Bay to Stockton, California (John F. Baldwin and Stockton Ship Channels), environmental working paper. Sacramento District.

U.S. Army Corps of Engineers. 1982. Sacramento–San Joaquin Delta California Documentation Report.

U.S. Army Corps of Engineers. 1995. *Reconnaissance investigation, western delta islands, Sacramento–San Joaquin Delta, California*. Geology and Soil Design Sections, Geotechnical Branch, Sacramento District, 10 p +plates.

Wagner, D.L., C.W. Jennings, T.L. Bedrossian, and E.J. Bortugno. 1987. Geologic map of the Sacramento quadrangle. California Division of Mines and Geology. Sacramento, CA.

8.9 Transportation and Navigation (Section 3.8)

AirNav.com. 2004. CN13—Borges–Clarksburg Airport, Clarksburg, CA. Available: <http://www.airnav.com/airport/CN13>. Last revised: November 23, 2006. Accessed: November 9, 2004.

AirNav.com. 2004. O88—Rio Vista Municipal Airport, Rio Vista, CA. Available: <http://www.airnav.com/airport/O88>. Last revised: November 23, 2006. Accessed: November 9, 2004.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Delta Chambers and Visitors Bureau. 2004. Ferries of the Delta. Available: <http://www.californiadelta.org/ferries.htm>. Accessed: December 30, 2004.

California Department of Water Resources. 1990. *Draft environmental impact report/environmental impact statement: North Delta program*. November. Sacramento, CA.

California Department of Water Resources. 1993 (1995). Sacramento–San Joaquin River Delta Atlas. Reprinted July 1995. Sacramento, CA.

County of Sacramento. 2004. Franklin Field. Available: <http://www.sacairports.org/franklin/>. Accessed: November 9, 2004.

Delta Protection Commission. 2004. Inventory of Recrational Facilities. Available: <http://www.delta.ca.gov/recinvty.asp>. Last revised: November 1997. Walnut Grove, CA. Accessed: December 27, 2004.

Jones & Stokes Associates, Inc. 1995. Environmental impact report and environmental impact statement for the Delta Wetlands project. Draft. September 11, 1995. (JSA 87-119.) Prepared for California State Water Resources Control Board, Division of Water Rights, and U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA.

8.10 Air Quality (Section 3.9)

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Air Resources Board. 2003. *Proposed amendments to the area designation criteria and area designations for State Ambient Air Quality Standards and maps of area designations for State and National Ambient Air Quality Standards.* December 5. Sacramento, CA.

California Air Resources Board. 2005. ARB Databases: Aerometric Data Analysis and Management System (ADAM). Last Revised: September 12, 2005. Available: <http://www.arb.ca.gov/html/databases.htm>. Accessed: January 9, 2006.

Energy and Environmental Analysis, Inc. 2000. *Analysis of commercial marine vessels emissions and fuel consumption data.* (EPA420-R-00-002.) February. Prepared for U.S. Environmental Protection Agency, Office of Transportation and Air Quality.

Sacramento Metropolitan Air Quality Management District. 2004. *Guide for air quality assessment in Sacramento County.* July 10. Sacramento, CA.

San Joaquin Valley Unified Air Pollution Control District. 2002. *Guide for assessing and mitigating air quality impacts.* Mobile Source/CEQA Section of the Planning Division of the San Joaquin Valley Unified Air Pollution Control District. January 10. Fresno, CA.

U.S. Environmental Protection Agency. 2006. Air Data. Last Revised: January 3, 2006. Available: <http://www.epa.gov/air/data/reports.html>. Accessed: January 9, 2006.

8.10.1 Personal Communications

Cadrett, John. CEQA Coordinator. San Joaquin Valley Unified Air Pollution Control District, Modesto, CA. June 15, 2005—telephone conversation with Shannon Hatcher regarding compliance with revised SJVAPCD Regulation VIII.

Guerra, Hector. Senior air quality planner. San Joaquin Valley Unified Air Pollution Control District. September 26, 2003—telephone conversation regarding health risk assessment procedures for diesel exhaust from construction equipment in the San Joaquin Valley Air Basin.

Stonefield, David H. Environmental engineer. U.S. Environmental Protection Agency, Ozone Policy and Strategies Group. Research Triangle Park, NC. December 17, 2004—email message to Shannon Hatcher.

8.11 Noise (Section 3.10)

California Department of Transportation. 2004. Transportation- and construction-induced vibration guidance manual. Sacramento, CA.

Environmental Science Associates. 2003. Port of Stockton West Complex Development Plan Draft Environmental Impact Report. Sacramento, CA. Prepared for Port of Stockton, Stockton, CA.

Federal Transit Administration. 1995. Transit noise and vibration impact assessment. Washington, DC.

Geier & Geier Consulting. 1997. Noise measurements of a clamshell dredge taken on September 23, 1997 to support the Oakland Harbor Navigation Improvement Project EIS. Oakland, CA.

Hoover, R. M., and R. H. Keith. 1996. *Noise control for buildings, manufacturing plants, equipment and products*. Houston, TX: Hoover & Keith, Inc.

Thalheimer, E. S. 2000. Construction noise control program and mitigation strategy at the Central Artery/Tunnel project, *Noise Control Engineering Journal*. September.

8.12 Vegetation and Wetlands (Section 4.1)

CALFED Bay-Delta Program. 2000. Multi-species conservation strategy. Technical appendix to the final programmatic EIS/EIR. Sacramento, CA.

California Department of Fish and Game. 1995. *Lilaeopsis masonii—Limosella subulata* recovery workshop summary, November 7, 1995. DFG Plant Conservation Program. Sacramento, CA.

California Department of Fish and Game. 2000. The status of rare, threatened, and endangered animals and plants of California. Sacramento, CA.

California Native Plant Society. 2001. *Inventory of rare and endangered plants of California.* Sixth edition. Rare Plant Scientific Advisory Committee, David P. Tibor, Convening Editor. Sacramento, CA: California Native Plant Society.

California Natural Diversity Database. 2004. RareFind 2, Version 2.1.2. Search of various 7.5-minute USGS quadrangles. Sacramento, CA: California Department of Fish and Game.

Coops, H., F. W. B. Van Der Brink, and G. Van Der Velde. 1996. Growth and morphological responses of four helophyte species in an experimental water-depth gradient. *Aquatic Botany* 54:11–24.

Coops, H., R. Boeters and H. Smith. 1991. Direct and indirect effects of wave attack on helophytes. *Aquatic Botany* 41:333–352.

Environmental Laboratory. 1987. *Corps of Engineers wetlands delineation manual.* (Technical Report Y-87-1.) Vicksburg, MS: U.S. Army Waterways Experiment Station.

Fiedler, P. L. and R. K. Zebell. 1993. Final report, restoration and recovery of Mason's lilaeopsis; Phase 1. San Francisco State University, Biology Department. San Francisco, CA.

Golden, M. L. and P. L. Fiedler. 1991. Final report: characterization of the habitat for *Lilaeopsis masonii* (Umbelliferae): a California state-listed rare plant species. California Department of Fish and Game Endangered Plant Program. San Francisco, CA.

Hunter, J. C., and J. A. Hart. 2003. Species composition and structure of Scirpus dominated marshes in the Sacramento-San Joaquin Delta. Page 85 in *CALFED Science Conference 2003, Advances in Science and Restoration in the Bay, Delta, and Watershed, Abstracts*. Sacramento, CA: CALFED Bay-Delta Program.

Jones & Stokes. 2004. Final preliminary delineation of waters of the United States, including wetlands, for the North Delta Improvement Project, San Joaquin and Sacramento Counties, California. April. (J&S 01-268.) Sacramento, CA. Prepared for California Department of Water Resources. Sacramento, CA.

Keddy, P. A. 2000. *Wetland ecology: principles and conservation.* Cambridge: Cambridge University Press.

May & Associates, Inc. 2003. Final special-status species surveys for The Nature Conservancy: Staten Island, San Joaquin County, California. June 2003. Walnut Grove, CA.

Simenstad, C., J. Toft, H. Higgins, J. Cordell, M. Orr, P. Williams, L. Grimaldo, Z. Hymanson and D. Reed. 2000. Sacramento/San Joaquin delta breached levee wetland study (BREACH). Preliminary report, February 2000. Wetland Ecosystem Team. University of Washington. Seattle, WA.

Thompson, J. 1957. The settlement geography of the Sacramento—San Joaquin Delta, California. Ph.D. dissertation. Stanford University. On file at California History Room, California State Library, Sacramento, CA.

Zebell, R. and P. Fiedler. 1996. Final report, restoration and recovery of *Mason's lilaeopsis*: Phase II. San Francisco State University, Biology Department. San Francisco, CA.

8.13 Fisheries and Aquatics (Section 4.2)

Adams, P. B., C. B. Grimes, J. E. Hightower, S. T. Lindley, M. L. Moser. 2002. *Status Review for North American Green Sturgeon,* Acipenser medirostris. June. Prepared for: National Marine Fisheries Service and North Carolina Cooperative Fish and Wildlife Research Unit.

Ahearn, D.S, J.H. Viers, J.F. Mount and R.A. Dahlgren. 2006 (*In Press)*. Priming the productivity pump: Flood pulse driven trends in suspended algal biomass distribution across a restored floodplain. University of California Davis.

Alderdice, D. F., and F. P. J. Velson. 1978. Relation between temperature and incubation time for eggs of Chinook salmon (*Oncorhynchus tshawytscha*). *Journal of the Fisheries Research Board of Canada*. 35:69–75.

Baker, P. T., T. P. Speed, and F. K. Ligon. 1995. Estimating the influence of temperature on the survival of Chinook salmon smolts migrating through the Sacramento–San Joaquin River Delta of California. *Canadian Journal of Fisheries and Aquatic Science* 52:855–863.

Barnhart, R. A. 1986. *Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)—steelhead.* June. (Biological Report 82 [11.60], TREL-82-4.) U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Coastal Ecology Group, Waterways Experiment Station. Slidell, LA.

Bash, J., C. Berman, and S. Bolton. 2001. Effects of Turbidity and Suspended Solids on Salmonids. November. Center for Streamside Studies, University of Washington.

Bayley, P.B. 1995. Understanding large river-floodplain ecosystems. Bioscience. Vol. 45(No. 3):pp.153–158.

BDAT. 2006. Bay Delta And Tributaries project. Available: <http://bdat.ca.gov/Php/Data_Retrieval/data_retrieval_by_category.php>. Accessed: February 2006.

BDAT. No date. *Acipenser transmontanus*. Available: <http://baydelta.water.ca.gov/Php/Data_Summaries/display_summary_data_by_species_station.php?is_common_name=&species_name=Acipenser+transmontanus>. Accessed: May 4, 2006. Last updated: November 2005.

Bennett, B. and L. Howard. 1999. Climate change and the decline of striped bass. *Interagency Ecological Program for the Sacramento–San Joaquin Estuary (IEP) Newsletter* 12(2). Fall. Sacramento, CA.

Bjornn, T. C., and D. W. Reiser. 1991. Habitat requirements of salmonids in streams, pp. 83–138. In Meehan, W. R. (ed.), *Influences of forest and rangeland management on salmonid fishes and their habitats*. American Fisheries Society Special Publication 19. Bethesda, Maryland: American Fisheries Society. 751 pp.

Bradford, M.J. 1997. An experimental study of stranding of juvenile salmonids on gravel bars and in side channels during rapid flow decreases. Regulated Rivers 13(5):94-401.

Brandes, P. L., and J. S. McLain. 2001. *Juvenile Chinook salmon abundance, distribution, and survival in the Sacramento–San Joaquin Estuary*. Fish Bulletin 179, Contributions to the Biology of Central Valley Salmonids, Volume 2. Edited by R. L. Brown. California Department of Fish and Game, Sacramento, CA.

Brandes, P.L., K. Perry, E. Chappell, J. McLain, S. Greene, R. Sitts. 2000. Delta Salmon Project Work Team Delta Juvenile Salmon Monitoring Program Review. July.

Bureau of Reclamation. No date. Central Valley Operations Office. Delta cross channel gates. Available: <http://www.usbr.gov/mp/cvo/xcgtxt.html>. Accessed: May 15, 2006.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Department of Fish and Game. 1991a. Observations on temporal and spatial variability of striped bass eggs and larvae and their food in the Sacramento–San Joaquin river system. Interagency ecological study program for the Sacramento–San Joaquin Estuary technical report 27. June.

California Department of Fish and Game. 1991b. Lower Mokelumne river fisheries management plan. November. Sacramento, CA.

California Department of Fish and Game. 1998. A status review of the spring-run Chinook salmon *(Oncorhynchus tshawytscha)* in the Sacramento River drainage. Report to the Fish and Game Commission, Candidate Species Status Report 98-01.

California Department of Fish and Game. 2000. Spring-run Chinook salmon annual report. Prepared for the California Fish and Game Commission. Habitat Conservation Division, Native Anadromous Fish and Watershed Branch. Sacramento, CA. 19 pages.

California Department of Fish and Game. 2005. State and Federally Listed Endangered and Threatened Animals of California. October 2005. The Resources Agency, Department of Fish and Game, Habitat Conservation Division, Wildlife and Habitat Data Analysis Branch, California Natural Diversity Database.

California Department of Fish and Game. 2006. DFG metadata and file information on Delta Smelt (20mm, DSLS, NBA). Available: <ftp://ftp.delta.dfg.ca.gov/Delta%20Smelt/>

California Department of Fish and Game. No date. Central Valley Bay-Delta Branch. White sturgeon in the San Francisco Bay Estuary. White sturgeon (*Acipenser transmontanus*). Available: http://www.delta.dfg.ca.gov/baydelta/monitoring/sturg.asp.>. Accessed: May 5, 2006.

California Department of Water Resources and Bureau of Reclamation. 1994. Effects of the Central Valley project and state water project on Delta smelt and Sacramento splittail. Biological Assessment. Prepared for U.S. Fish and Wildlife Service, Ecological Services, Sacramento Field Office, Sacramento, California.

California Department of Water Resources. 1995. *Sacramento–San Joaquin Delta atlas*. Last revised: August 8, 1995. Available: <http://rubicon.water.ca.gov/delta_atlas.fdr/daindex.html>. Accessed: November 11, 2002.

Cech, J. J., Jr. and S. I. Doroshov. 2004. Chapter 3: Environmental requirements, preferences, and tolerance limits of North American sturgeons. Pages 73–86 in G. T. O Lebreton et al. (eds), *Sturgeons and Paddlefish of North America*. Netherlands: Kluwer Academic Publishers.

Cech J. J., Jr., C. G. Campagna, S. J. Mitchell. 1979. Respiratory responses of largemouth bass (*Micropterus salmoides*) to environmental changes in temperature and dissolved oxygen. *Transactions of the American Fisheries Society*. 108:166–171.

Cook, L., and L.D. Buffaloe. 1998. Delta agricultural diversion evaluation summary Report, 1993–1995. Interagency Ecological Program for the San Francisco Bay/Delta Estuary Technical Report 61. Sacramento, California.

Cordone, A.J. and D.W. Kelley. 1961. The Influences of Inorganic Sediment on the Aquatic Life of Streams. April, 1961. Inland Fisheries Branch, California Department of Fish and Game. *Conservation of Wildlife Through Education*. Volume 47:Number 2.

Crain, P. K., K. M. Small, and P. B. Moyle. 2002. Survey of fish and their diets surrounding the McCormack-Williamson Tract (2000–2001).

Crain, P. K., K. Whitener, and P. B. Moyle. 2004. Use of a restored Central California floodplain by larvae of native and alien fishes. *American Fisheries Society Symposium* 39:125–140.

Cramer, S. P., and D. B. Demko. 1997. *The status of late-fall and spring Chinook salmon in the Sacramento River Basin regarding the Endangered Species Act.* Submitted to the National Marine Fisheries Service on behalf of the Association of California Water Agencies and California Urban Water Agencies. 111 pp.

Daniels, R. A., and P. B. Moyle. 1983. Life history of the splittail (Cyprinidae: *Pogonichthys macrolepidotus*) in the Sacramento–San Joaquin Estuary. *Fish Bulletin* 84:105–117.

Everest, F. H., and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. *Journal of the Fisheries Resource Board of Canada* 29(1):91–100.

Feist, B.E., J.J. Anderson, and R. Miyamoto. 1992. Potential Impacts of Pile Driving on Juvenile Pick (Oncorhynchus gorbuscha) and Chum (O. keta) Salmon Behavior and Distribution. May. University of Washington School of Fisheries and Applied Physics Laboratory.

Feyrer F., T. R. Sommer, S. C. Zeug, G. O'leary, and W. Harrell. 2004. Fish assemblages of perennial floodplain ponds of the Sacramento River, California (USA), with implications for the conservation of native fishes. Aquatic Ecology Section, California Department of Water Resources, Sacramento, CA, USA. *Fisheries Management and Ecology*. 11 (2004):335–344.

Florsheim, J. L. and J. F. Mount. 2002. Restoration of floodplain topography by sand-splay complex formation in response to intentional levee breaches, Lower Cosumnes River, California. *Geomorphology* 44 (2002):67–94.

Foss, S., and L. Miller. 2001. Growth of larval striped bass in the San Francisco Estuary. Article in *Interagency Ecological Program for the San Francisco Estuary* 14(4).

Gregory, R. S., and T. S. Northcote. 1993. Surface, planktonic, and benthic foraging by juvenile chinook salmon (*Oncorhynchus tshawytcha*) in turbid laboratory conditions. Canadian Journal of Fisheries and Aquatic Sciences 50: 223-240.

Grimaldo, L., C. Peregrin, and R. Miller. 2000. Examining the relative predation risks of juvenile Chinook salmon in shallow water habitat: the effect of submerged aquatic vegetation. Interagency Ecological Program for the San Francisco Estuary, California Department of Water Resources, Sacramento, CA. Winter 2000. *IEP Newsletter* 13(1):57–61.

Hallock, R. J. 1989. *Upper Sacramento River steelhead* Oncorynchus mykiss, *1952–1988.* A report to the U.S. Fish and Wildlife Service. September 15.

Hallock, R. J., and F. W. Fisher. 1985. *Status of the winter-run Chinook salmon (*Oncorhynchus tshawytscha*) in the Sacramento River*. (Anadromous Fisheries Branch Office Report.) Sacramento: California Department of Fish and Game.

Hallock, R. J., R. T. Elwell, and D. H. Fry. 1970. *Migrations of adult King Salmon (*Oncorhynchus tshawytscha*) in the San Joaquin Delta as demonstrated by the use of sonic tags*. California Department of Fish and Game, Fish Bulletin 151:1-192.

Healey, M.C. 1991. Life history of Chinook salmon *(Oncorhynchus tshawytscha)*. Pages 311–393 in C. Groot and L. Margolis (eds.), *Pacific Salmon Life Histories*. Vancouver, British Columbia: University of British Columbia Press.

Herren, J.R., and S.S. Kawasaki. 2001. Inventory of water diversions in four geographic areas in California's Central Valley. Pages 343–355 in R. L. Brown, editor. Contributions to the biology of Central Valley salmonids, Volume 2. California Department of Fish and Game, Fish Bulletin 179, Sacramento, CA.

Higgins, P.S., and M.J. Bradford. 1996. Evaluation of a large-scale fish salvage to reduce the impact of controlled flow reduction in a regulated river. North American Journal of Fisheries Management 16:666–673.

Holland, L.E., and M.L. Huston. 1985. Distribution and food habits of yoy fishes in a backwater lake of the upper Mississippi River. Journal of Freshwater Ecology 3:81–91.

Holland, L.E. 1986. Distribution of early life history stages of fishes in select pools of the upper Mississippi River. Hydrobiologia 136:121–130.

Jackson, T. A. 1992. Microhabitat utilization by juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in relation to stream discharges in the lower American River of California. M.S. thesis, Oregon State University. 118 pp.

Jassby A. D., and J. E. Cloern. 2000. Organic matter sources and rehabilitation of the Sacramento-San Joaquin Delta (California, USA). *Aquatic Conservation: Marine and Freshwater Ecosystems* 10:323–352. (Cited from Kimmerer).

Jones & Stokes and NHC Inc. 2003. Cosumnes River watershed inventory and assessment: Phase II. Final Report. September. (J&S 02-287.) Sacramento, CA.

Jones & Stokes Associates, Inc. 1993. *Sutter Bypass fisheries technical memorandum II: potential entrapment of juvenile Chinook salmon in the proposed gravel mining pond.* May 27, 1993. (JSA 91-272.) Sacramento, CA. Prepared for Teichert Aggregates, Sacramento, CA.

Jones & Stokes Associates Inc. 1999. Administrative draft environmental impact report/environmental impact statement for the lower Mokelumne River Restoration Program. (JSA 98-059). October. Prepared for Woodbridge Irrigation District, Woodbridge CA.

Kimmerer W. J. 2004. Open water processes of the San Francisco Estuary: from physical forcing to biological responses. *San Francisco Estuary and Watershed Science* [online serial] 2(1; February 2004):1. Available: <http://repositories.cdlib.org/jmie/sfews/vol2/iss1/art1>.

Kohlhorst, D. W., L. W. Botsford, J. S. Brennan, and G. M. Cailliet. 1991. Aspects of the structure and dynamics of an exploited Central California population of white sturgeon (Acipenser transmontanus). In: P., Williot (ed.), Acipenser: acts of the first international sturgeon symposium. October 3-6, 1989. Bordeaux, France, Cemagref-Dicova. Pp. 277–293.

Lloyd, D.S. 1987. Turbidity as a water quality standard for salmonid habitats in Alaska. North American Journal of Fisheries Management. 7:34–45.

Markham, C. 1986. *Benthic monitoring in the Sacramento–San Joaquin Delta, results from 1975 through 1981.* (Technical Report 12, WQ/BIO-4 ATR/87-12.) Interagency Ecological Study Program for the Sacramento–San Joaquin Estuary, California Department of Water Resources. Sacramento, CA.

McCullough, D.A. 1999. *A review and synthesis of effects of alterations to the water temperature regime on freshwater life stages of salmonids, with special reference to Chinook salmon*. Prepared for the U.S. Environmental Protection Agency, Region 10, Seattle, WA. Published as EPA 910-R-99-010. July 1999. 291 pp.

McEwan, D., and Jackson, T. A. 1994. *Steelhead management plan for California*. California Department Fish and Game. (Available Environmental and Technical Services Division, NMFS, 911 N.E. 11th Avenue, Room 620, Portland, OR 97232.)

McEwan, D.R. 2001. Central Valley Steelhead. California Department of Fish and Game, Fish Bulletin 179. Contributions to the Biology of Central Valley Salmonids. Ed. R.L. Brown, California Department of Water Resources. Volume 1:pp1–44.

Meehan, W.R.F., F.J. Swanson and J.R. Sedell. 1977. Influences of riparian vegetation on aquatic ecosystems with particular reference to salmonid fishes and their food supply. US Forest Service General Technical Report RM-43: 137-145.

Merz, J. E. and M. S. Saldate. 2004. Lower Mokelumne River Fish Community Survey. 1 January 1997 through 30 June 2004. East Bay Municipal Utility District. Lodi, CA.

Merz, J. E. and J. D. Setka. 2004. Riverine habitat characterization of the lower Mokelumne River, California. July. Prepared for East Bay Municipal Utility District.

Moyle, P. B., P. K. Crain, K. Whitener, and J. F. Mount. 2003. Alien fishes in natural streams: fish distribution, assemblage structure, and conservation in the Cosumnes River, California, U.S.A. *Environmental Biology of Fishes* 68:143–162, 2003. Kluwer Academic Publishers: Netherlands.

Moyle, P. B., Foley, P. J., and Yoshiyama, R. M. 1992. Status of green sturgeon, acipenser medirostris, in California. Final Report submitted to National Marine Fisheries Service. 11 p. University of California Davis.

Moyle, P. B. 2002. *Inland fishes of California*. 2nd edition. Davis, CA: University of California Press.

Moyle, P. B., J. E. Williams, and E. D. Wikramanayoke. 1989. *Fish species of special concern of California*. California Department of Fish and Game. Rancho Cordova, CA.

Moyle, P. B., P. K. Crain, and K. Whitener. 2005. Patterns in the use of a restored California floodplain by native and alien fishes. Center for Watershed Sciences and Department of Wildlife, Fish, and Conservation Biology, University of California. The Nature Conservancy. December 26.

Moyle, P. B., R. D. Baxter, T. Sommer, T. C. Foin, and S. A. Matern. 2004. Biology and population dynamics of Sacramento splittail (*Pogonichthys macrolepidotus*) in the San Francisco Estuary: a review. San Francisco Estuary and Watershed Science [online serial]. Vol. 2, Issue 2 (May 2004), Article 3. Available: <http://repositories.cdlib.org/jmie/sfews/vol2/iss2/art3>.

Moyle, P.B. and J.A. Israel. 2005. Untested assumptions: effectiveness of screening diversions for conservation of fish populations. Fisheries, 30:20-28.

Moyle, P.B. *In Press*. Patterns in the use of a restored California floodplain by native and alien fishes. University of California, Davis.

Moyle, P.B., Yoshiyama, R.M., Willians, J.E., Wikramanayake, R.M. 1995. Fish Species of Special Concern in California. Second Edition. (Final Report for Contract No. 2128IF). University of California. Davis, CA. Prepared for The Resources Agency, Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA.

Meehan, W.R. (ed.). 1991. *Influences of forest and rangeland management on salmonid fishes and their habitats*. Special Publication 19. Bethesda, MD: American Fisheries Society.

Murphy, M.L. and W.R. Meehan. 1991. Stream Ecosystems. American Fisheries Society Special Publication 19:17-46.

Myrick, C. A. and J. J. Cech,. Jr. 2001. *Temperature effects on Chinook salmon and steelhead: A review focusing on California's Central Valley populations*. White paper.

National Marine Fisheries Service. 1996a. Factors for decline: A supplement to the notice of determination for West Coast steelhead under the Endangered Species Act. Portland, OR.

National Marine Fisheries Service. 1996b. Recommendations for the recovery of the Sacramento River winter-run Chinook salmon.

National Marine Fisheries Service. 1998. A primer for federal agencies—essential fish habitat: New marine fish habitat conservation mandate for federal agencies.

Nature Conservancy of California. 2006. Cosumnes River Preserve. Last updated: April 2006. Available at: <http://www.cosumnes.org/>. Accessed: May 12, 2006.

Newman, K., and J. Rice. 1997. *Statistical model for survival of Chinook salmon smolts out-migrating through the lower Sacramento–San Joaquin system.* Technical Report 59. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. California Department of Water Resources, Sacramento, CA.

Nightingale, B., and C.A. Simenstad. 2001. Overwater Structures and Dredging Activities: Marine Issues. White Paper. Washington State Transportation Center (TRAC). Washington Dept. of Ecology. University of Washington. Seattle, WA.

Nobriga, M., and P. Cadrett. 2001. Differences among hatchery and wild steelhead: evidence from Delta fish monitoring programs. Interagency Ecological Program for the San Francisco Estuary, Sacramento, CA. IEP Newsletter 14(3):30–38.

Nobriga, M., Z. Matica, and Z. Hymanson. 2004. Evaluating entrainment vulnerability to agricultureal irrigation diversions: a comparision among open-water fishes. American Fisheries Society Symposium 39: 281-295.

Raleigh, R. F., T. Hickman, R. C. Soloman, and P. C. Nelson. 1984. *Habitat suitability information: Rainbow trout.* (Biological Report 82 [10.60].) U.S. Fish and Wildlife Service. Washington, D.C. (FWS/OBS-82/10.60 64 pp.)

Raleigh, R. F., W. J. Miller, and P. C. Nelson. 1986. *Habitat suitability index models and instream flow suitability curves: Chinook salmon*. U.S. Fish and Wildlife Service Biological Report 82(10.122). 64 pp.

Reynolds, F. L., T. Mills, R. Benthin, and A. Low. 1993. *Central Valley anadromous fisheries and associated riparian and wetlands areas protection and restoration action plan*. Draft. California Department of Fish and Game, Inland Fisheries Division. Sacramento, CA.

Rich, A. A. 1987. *Report on studies conducted by Sacramento County to determine temperatures which optimize growth and survival in juvenile Chinook salmon* (Oncorhynchus tshawytscha). Sacramento: Prepared by McDonough, Holland, and Allen, Sacramento, CA.

Schafter, R. G. 1997. White sturgeon spawning migrations and location of spawning habitat in the Sacramento River, California. *California Fish and Game* 83:45–57.

Sigler, J.W., T.C. Bjornn, and F.H. Everest. 1984. Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon. Transactions of the American Fisheries Society. 113: 142–150.

Simi, J. and C. Ruhl. 2004. Summary of Delta hydrology data. Water years 1985–2004. United States Geological Survey. Available: <http://science.calwater.ca.gov/pdf/workshops/POD/CDFG_POD_Delta_hydrology_summary_1985-2004.pdf> Accessed: May 11, 2006.

Sommer, T.R., M.L. Nobriga, B. Harrell, W. Batham, R. Kurth, and W. Kimmerer. 2000. Floodplain rearing may enhance growth and survival juvenile Chinook salmon in the Sacramento River. IEP Newsletter 13(3):26–30.

Sommer, T.R., M.L. Nobriga, W.C. Harrell, W. Batham, and W.J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: Evidence of enhanced growth and survival. *Canadian Journal of Fisheries and Aquatic Sciences* 58(2):325–333.

Sommer, T., B. Harrell, M. Nobriga, R. Brown, P. Moyle, W. Kimmerer, and L. Schemel. 2001. California's Yolo Bypass: Evidence that flood control can be compatible with fisheries, wetlands, wildlife, and agriculture. *Fisheries* 26(8):6-16.

Sommer, T.R., W.C. Harrell, and M.L. Nobriga. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. North American Journal of Fisheries Management 25:1493-1504.

Sommer, T., R. Baxter, and B. Herbold. 1997. Resilience of splittail in the Sacramento–San Joaquin Estuary. *Transactions of the American Fisheries Society* 126:961–976.

Stevens, D. E. 1989. *When do winter-run Chinook salmon smolts migrate through the Sacramento–San Joaquin Delta?* Memorandum: June 19, 1989. California Department of Fish and Game. Stockton, CA.

Swanson, C., and J. J Cech. 1995. *Environmental tolerances and requirements of Delta smelt*, hypomesus transpacifus. Final Report, Department of Water Resources. 77 pp.

Tracy, C. 1990. Memorandum: Green sturgeon meeting and comments. State of Washington Department of Fisheries 10 p.

U.S. Army Corps of Engineers and The Reclamation Bureau. 2002. Sacramento and San Joaquin River Basins comprehensive study, California. Interim report. December 20. Available: <http://www.spk.usace.army.mil/projects/civil/compstudy/docs/interimreport20021220/interimrpt-part11.pdf>. Accessed: May 18, 2006.

U.S. Fish and Wildlife Service. 1992. Shaded riverine aquatic cover of the Sacramento River system: classification as resource Category I under the F. W. S. mitigation policy. Fish and Wildlife Enhancement Field Office, Sacramento, CA

U.S. Fish and Wildlife Service. 1993. Abundance and survival of juvenile Chinook salmon in the Sacramento-San Joaquin Estuary. (1992 annual progress report.) Stockton, CA.

U.S. Fish and Wildlife Service. 1994. The relationship between instream flow, adult migration, and spawning habitat availability for fall-run Chinook salmon in the upper San Joaquin River, California. Upper San Joaquin River IFIM Report, Ecological Services. Sacramento, CA.

U.S. Fish and Wildlife Service. 1996. Sacramento–San Joaquin Delta native fishes recovery plan. U.S. Fish and Wildlife Service, Portland, OR.

U.S. Fish and Wildlife Service. 2001. Abundance and Survival of Juvenile Chinook Salmon in the Sacramento–San Joaquin Estuary. December. 1997 and 1998 Annual Progress Reports Sacramento–San Joaquin Estuary Fishery Resource Office, U.S. Fish and Wildlife Service. Stockton, CA.

U.S. Fish and Wildlife Service. No date. Delta juvenile fish monitoring program. DCC-Delta Cross Channel. Available: <http://www.delta.dfg.ca.gov/jfmp/dcc.asp>. Accessed: May 18, 2006.

Vayssieres, M., and H. Peterson. 2003. Cross-channel variability in benthic habitat. Spring 2003. Interagency Ecological Program for the San Francisco Estuary, California Department of Water Resources, Sacramento, CA. *IEP Newsletter* 16(2):51–56.

Wang, J. C. S. 1986. *Fishes of the Sacramento–San Joaquin Estuary and adjacent waters, California: A guide to the early life histories*. (FS/10-4ATR86-9.) California Department of Water Resources. Sacramento, CA. Prepared for Interagency Ecological Study Program for the Sacramento–San Joaquin Estuary, Sacramento, CA.

Wang, J. C. S., and R. L. Brown. 1993. *Observations of early life stages of Delta smelt,* Hypomesus transpacificus, *in the Sacramento–San Joaquin Estuary in 1991, with a review of its ecological status in 1988 to 1990*. Technical Report 35. November.

Waters, T.F. 1995. Sediment in streams—sources, biological effects and control. *American Fisheries Society Monograph 7*. Bethesda, MD. 251 pp.

Wilson, G. D. F. 1998. *A post-impact monitoring study of benthic fauna in areas dredged for the third parallel runway in Botany Bay*. May. Prepared for: The Federal Airports Corporation.

WRIA6 (Whidbey and Camano Islands). 2005. Multi-species salon recovery plan. Executive summary. May. Available at: <http://www.islandcounty.net/health/Envh/WRAC/TopicPapers/SalmonRecoveryPlan_ExecutiveSummary.pdf>. Accessed: May 22, 2006.

Young, P. S., and J. Cech., Jr. 1996. Environmental tolerances and requirements of splittail. *Transactions of the American Fisheries Society* 125:664–678.

Zamora, C., C. R. Kratzer, M. S. Majewski, , and D. L. Knifong. 2003. Diazinon and chlorpyrifos loads in precipitation and urban and agricultural storm runoff during January and February 2001 in the San Joaquin River Basin. U.S. Geological Survey Water-Resources Investigations Report 03-4091.

8.13.1 Personal Communications

Smith, Jim. East Bay Municipal Utility District. July 10, 2006—comments made at the Agency Review Meeting for the North DeltaFlood Control and Ecosystem Restoration Project Administrative Draft Environmental Impact Report.

8.14 Wildlife (Section 4.3)

Amaral, M.J. 1985. The Aleutian Canada Goose. Pp. 437–442, in The Audubon Wildlife Report 1985, New York. 671 pp.

Arizona Game and Fish Department. 2002. *Population trends, distribution, and monitoring protocols for the California black rail*. January. Arizona Game and Fish Department Heritage Program 2002. Prepared by Arizona Cooperative Fish and Wildlife Research Unit and the Bureau of Reclamation.

Barr, C. B. 1991. *The distribution, habitat, and status of the valley elderberry longhorn beetle* (Desmocerus californicus dimorphus). U.S. Fish and Wildlife Service. Sacramento, CA.

Beedy, E. C., and S. L. Granholm. 1985. *Discovering Sierra birds*. Yosemite Natural History Association and Sequoia Natural History Association. Yosemite National Park, CA.

Beedy, E. C., and W. J. Hamilton III. 1997. *Tricolored blackbird status update and management guidelines.* Prepared for U.S. Fish and Wildlife Service Migratory Birds and Habitat Programs and California Department of Fish and Game Bird and Mammal Conservation Program. Sacramento, CA.

Beedy, E. C., and W. J. Hamilton III. 1999. Tricolored blackbird (*Agelaius tricolor*). In *The birds of North America*, No. 423, A. Poole and F. Gill (eds.). Philadelphia, PA: Academy of Natural Sciences, and Washington, DC: American Ornithologists' Union.

Behle, W. H. 1942. Distribution and variation of horned larks (*Otocoris alpestris*) of western North America. University of California Publications in *Zoology* 46(3):205–316.

Behler, J. L., and F. W. King. 1998. *National Audubon Society field guide to North American reptiles and amphibians.* New York, NY: Alfred A. Knopf.

Brown, L., and D. Amadon. 1968. *Eagles, hawks, and falcons of the world*. Country Life Books, London. 945 pp.

CALFED Bay-Delta Program. 2000a. Multi-species conservation strategy for the CALFED Bay–Delta program. July. Sacramento, CA. Prepared by Jones & Stokes. Sacramento, CA.

CALFED Bay-Delta Program. 2000b. Final programmatic environmental impact statement/environmental impact report, CALFED Bay–Delta program. July. Sacramento, CA. Prepared for the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, U.S. Army Corps of Engineers, and California Resources Agency.

CALFED Bay-Delta Program. 2000c. Programmatic record of decision. August. Sacramento, CA.

California Department of Fish and Game. 1994. Staff report regarding mitigation for impacts to Swainson's hawks (*Buteo swainsonii*) in the Central Valley of California. Sacramento, CA.

California Department of Fish and Game. 2000. The status of rare and endangered animals and plants in California, greater sandhill crane. Sacramento, CA.

California Department of Fish and Game. 2001. Special animals list. Available: <http://www.dfg.ca.gov/hcpb/species/ssc/sscmamml/sscmamml.shtml>. Last revised May 3, 2003.

California Department of Fish and Game. 2006. Special animals. Wildlife and Habitat Data Analysis Branch. California Natural Diversity Database. Sacramento, CA.

California Natural Diversity Database. 2006. Records search of the Thornton, Isleton, Bouldin Island, and Terminous 7.5-minute U.S. Geological Survey Quadrangles. California Department of Fish and Game. Sacramento, CA.

DeHaven, R. W., F. T. Crase, and P. D. Woronecki. 1975. Breeding status of the tricolored blackbird, 1969–1972. *California Fish and Game* 61:166–180.

Gaines, D. 1992. *Birds of Yosemite and the east slope*. Lee Vining, CA: Artemisia Press.

Grinnell, J., and A. H. Miller. 1944. *The distribution of the birds of California* (Pacific Coast Avifauna Number 27). Cooper Ornithological Club. Berkeley, CA.

Hansen, G. E., and J. M. Brode. 1980. *Status of the giant garter snake*, Thamnophis couchii gigas (*Fitch*). Inland Fisheries Endangered Species Program Special Publication Report No. 80-5. California Department of Fish and Game.

Ivey, G. L., and C. P. Herziger. Unpublished. Results of sandhill crane monitoring on Staten Island, San Joaquin County, California, during winter 2002–03. Prepared for The Nature Conservancy, Cosumnes River Preserve, Galt, CA.

Ivey G. L. and C. P. Herziger. 2003. Sandhill Crane Monitoring at Staten Island, San Joaquin County, California, 2002–2003. The Nature Conservancy, Galt, CA.

Jennings, M. R., and M. P. Hayes. 1994. *Amphibian and reptile species of special concern in California.* California Department of Fish and Game. Sacramento, CA.

Littlefield, C. D., and G. L. Ivey. 2000. Conservation assessment for greater sandhill cranes wintering on the Cosumnes River floodplain and delta regions of California. February. Unpublished report.

May & Associates, Inc. 2003. Special-status species surveys for The Nature Conservancy: Staten Island, San Joaquin County, California. Prepared for The Nature Conservancy, Galt, CA.

May & Associates, Inc. 2004. Staten Island Easement Documentation Report. January. San Joaquin County, California. Great Central Valley Ecoregion / Sacramento-San Joaquin Delta. Prepared for: The Nature Conservancy.

Neff, J. A. 1937. Nesting distribution of the tricolored red-wing. *Condor* 39:61–81.

Orians, G. H. 1961. The ecology of blackbird (Agelaius) social systems. *Ecological Monographs* 31(3):282–312.

Pacific Flyway Council. 1997. *Pacific Flyway management plan for the Central Valley population of greater sandhill cranes*. Pacific Flyway Study Commission [c/o Pacific Flyway Representative U.S. Fish and Wildlife Service], Portland, OR.

Pogson, T. H., and S. M. Lindstedt. 1991. Distribution and abundance of large sandhill cranes (*Grus canadensis tabida*) wintering in California's Central Valley. *Condor* 93:266–278.

Point Reyes Bird Observatory. 2001. *Summary of work by PRBO at TNC's McCormack Williamson Tract, Cosumnes River Preserve, 2000*. Prepared for: The Nature Conservancy, Galt, CA.

Point Reyes Bird Observatory. 2004. Avian Studies of the McCormack-Williamson Tract, Cosumnes River Preserve, 2000 and 2001. January. Final Report 2000–2001 On CALFED-funded Project: McCormack-Williamson Tract Restoration Planning, Design and Monitoring Program (#01-01662V). J. K. Wood, T. Haff, and G. R. Geupel PRBO Conservation Science. Submitted to: Information Center for the Environment, University of California, Davis.

Remsen, J. V., Jr. 1978. *Bird species of special concern in California*. California Department of Fish and Game, Wildlife Management Branch. Sacramento, CA.

Rothstein, S. I., J. Verner, and E. Stevens. 1984. Radio-tracking reveals a unique diurnal pattern of spatial occurrence in the parasitic brown-headed cowbird. *Ecology* 65:77–88.

San Joaquin Council of Governments. 1999. *Draft joint environmental impact statement and environmental impact report for the approval and implementation of the San Joaquin County multi-species habitat conservation and open space plan, San Joaquin County, California.* Stockton, CA.

Stillwater Sciences. 2004. *Summary of Elderberry Survey Results McCormack-Williamson Tract*. January 27, 2004.

Thompson, J. 1957. The settlement geography of the Sacramento–San Joaquin Delta, California. Ph.D. dissertation, Stanford University. On file at California History Room, California State Library, Sacramento, CA.

U.S. Fish and Wildlife Service. 1997. Programmatic final consultation for U.S. Army Corps of Engineers 404 permitted projects with relatively small effects on the giant garter snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter and Yolo Counties, California. November. Sacramento, CA.

U.S. Fish and Wildlife Service. 1999b. Conservation guidelines for the valley elderberry longhorn beetle. July. U.S. Fish and Wildlife Service, Sacramento, California.

U.S. Fish and Wildlife Service. 2005. Species list obtained from the USFWS website for the Project, dated January 30, 2006 (Attachment 4.3-1).

Zeiner, D. C., W. F. Laudenslayer, and K. E. Mayer (eds.). 1988. *California's wildlife*. Volume I: Amphibians and reptiles. California Statewide Wildlife Habitat Relationships System. California Department of Fish and Game, Sacramento, CA.

Zeiner, D. C., W. F. Laudenslayer Jr., K. E. Mayer, and M. White (eds.). 1990a. *California's wildlife.* Volume II: Birds. California Statewide Wildlife Habitat Relationships System. California Department of Fish and Game, Sacramento, CA.

Zeiner, D., Laudenslayer, F., Mayer, K., and M. White (eds.). 1990b. *California's wildlife.* Volume III: Mammals. California Statewide Habitat Relationships System. California Department of Fish and Game. Sacramento, CA.

8.14.1 Personal Communications

Ivey, Gary. Wetlands and wildlife consultant. May & Associates. September 2002 through April 2003—conversations.

8.15 Land Use, Recreation, and Economics (Section 5.1)

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Agricultural Statistics Service. 2005. 2004 County Agricultural Commissioners' data. October 14, 2004. Sacramento, CA.

California Economic Forecast. 2005. California County Economic Forecasts: 2005–2025. September 2005. Prepared for: California Department of Transportation, Office of Transportation Economics, Division of Transportation Planning.

California Department of Food and Agriculture. 2006. California Agricultural Resource Directory 2005. Sacramento, California.

California Department of Water Resources. 1996. Land Use Mapping Data for San Joaquin County, 1996.

California Department of Water Resources. 2000. Land Use Mapping Data for Sacramento County, 2000.

County of Sacramento. 2004. Land use element of the County of Sacramento General Plan. Revised on May 2, 1997 and February 11, 2004. Adopted December 15, 1993. Sacramento, CA.

Dangerwood Group, The. 2002. Sacramento–San Joaquin Delta boating needs assessment: 2000–2020. Prepared for the California Department of Boating and Waterways. December 2002. Sacramento, CA.

San Joaquin County Development Department. 2000. General plan 2010 review. March 2000. Stockton, CA.

San Joaquin County. 1992. General plan 2010—volume 1: policies/ implementation. Adopted July 29, 1992, as amended. Stockton, CA.

U.S. Department of Agriculture, National Agricultural Statistics Service, California Field Office. 2005. 2004 County Agricultural Commissioners' Data—Summary of County Agricultural Commissioners' Reports. October. Sacramento, CA.

University of California at Berkeley Department of Agricultural and Resource Economics. 1998. The Economic Impact of Recreational Boating and Fishing in the Delta. November. Berkeley, CA.

8.15.1 Personal Communications

Morse, Peter. Planner. Sacramento County Department of Environmental Review and Assessment, Sacramento, CA. June 8, 2006—Telephone Conversation with Sara Martin (J&S).

Rodriguez, Jamie. Grizzly Slough Tenant Farmer, Galt, CA. March 20, 2006—Telephone Conversation with Matt Reeve (DWR).

Whitener, Keith (a). Director of Cosumnes and Delta Projects. The Nature Conservancy, Galt, CA. March 28, 2006—voice mail message left for Sara Martin (J&S).

Whitener, Keith (b). Director of Cosumnes and Delta Projects. The Nature Conservancy, Galt, CA. March 23, 2006—E-mail to Zaffar Eusuff (DWR).

Van Loben Sels, Topper. Area Farmer and Delta Protection Commissioner. September 19, 2007—Telephone Conversation with Matt Reeve (DWR).

8.16 Population, Housing, and Environmental Justice (Section 5.2)

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

Jones and Stokes. 2005. South Delta Improvements Program Draft Environmental Impact Statement/Environmental Impact Report. October. (J&S 02053.02.) Sacramento, CA. Prepared for the U.S. Department of the Interior Bureau of Reclamation and the California Department of Water Resources.

Sacramento County. 2006. General plan update website. Available: <http://www.saccounty.net/planning/gpupdate/gpu-index.html>.

San Joaquin County. 1992 (2004). *San Joaquin County General Plan 2010*. Volume I, Chapter IV: Community Development Volume. July 1992. Available: <http://www.co.san-joaquin.ca.us/commdev/cgi-bin/cdyn.exe?grp=planning&htm=generalplan>.

U.S. Census Bureau. 2000. American Factfinder website. Available: <http://factfinder.census.gov>.

U.S. Census Bureau. 2003. *American community survey profile 2003: Sacramento and San Joaquin County.*

U.S. Environmental Protection Agency. 1998. Final Guidance For Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analyses. April 1998.

8.17 Utilities and Public Service (Section 5.3)

California Integrated Waste Management Board. 2006. Database search on the board's website. Available: <www.ciwmb.ca.gov>.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

Jones and Stokes. 2005. South Delta Improvements Program Draft Environmental Impact Statement/Environmental Impact Report. October. (J&S 02053.02.) Sacramento, CA. Prepared for the U.S. Department of the Interior Bureau of Reclamation and the California Department of Water Resources.

Sacramento Local Agency Formation Commission. 2006. Website search. Available: <http://www.saclafco.org/>.

San Joaquin County Resource Conservation District. 2002. *Lower Mokelumne River watershed stewardship plan: emergency services and fire prevention.*

May & Associates, Inc. 2004. Staten Island Easement Documentation Report. January. San Joaquin County, California. Great Central Valley Ecoregion / Sacramento-San Joaquin Delta. Prepared for: The Nature Conservancy.

8.17.1 Personal Communications

Coomes, Harlan. Supervisor, Design Resource Center. Sacramento Municipal Utility District. 2006—telephone conversation and email.

Goins, Steve. Service specialist 3. Sacramento County Sheriff's Department. 2006—telephone conversation.

Bellestri, Anna. New business clerk. Pacific Gas & Electric Company. 2006—telephone conversation.

Crane, Sandy. Engineer and mapper. Pacific Gas & Electric Company. 2006—telephone conversation.

Okamoto, Steve. Industrial power engineer. Pacific Gas & Electric Company. 2006—telephone conversation and email.

Ralph, Ron. Engineer for San Joaquin County. Pacific Gas & Electric Company. 2006—telephone conversation.

Savale, Vic. Assistant chief. Walnut Grove Fire District. 2006—telephone conversation.

Simmons, John. Manager. Department of Transportation, County of Sacramento. 2006—email.

Tafuri, Vince. Fire chief. Thornton Rural Fire Protection District. 2006—telephone conversation.

8.18 Power Production and Energy (Section 5.4)

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

Pacific Gas and Electric Company, The. 2006. Information regarding Pacific Gas & Electric Company. Available at: <http://www.pge.com>.

Sacramento Municipal Utility District. 2006. Information regarding Sacramento Municipal Utility District. Accessed online at <http://www.smud.org>.

8.19 Visual Resources (Section 5.5)

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Department of Transportation Scenic Highway Program. Available: <http://www.dot.ca.gov/hq/LandArch/scenic_highways/scenic_hwy.htm>.

California Department of Transportation. 1996. Guidelines for the official designation of scenic highways. March. Sacramento, CA.

California Department of Water Resources. 1993 (1995). Sacramento–San Joaquin River Delta Atlas. Reprinted July 1995. Sacramento, CA.

County of Sacramento. 1997. Land use element of the County of Sacramento General Plan. Revised on May 2, 1997 and February 11, 2004. Adopted December 15, 1993. Sacramento, CA.

Federal Highway Administration. 1983. Visual impact assessment for highway projects. (Contract DOT-FH-11-9694.) Washington, D.C.

San Joaquin County. 1992. *San Joaquin County general plan 2010.:* Volume I: Policies/Implementation. Updated: 1992. Available: <http://elib.cs.berkeley.edu/cgi-bin/doc_home?elib_id=928>.

Smardon, R. C., J. F. Palmer, and J. P. Felleman. 1986. *Foundations for visual project analysis.* New York, NY: John Wiley & Sons Inc.

U.S. Forest Service. 1974. National forest landscape management volume 2, chapter 1: The visual management system (Agriculture Handbook Number 462). Washington, D.C.

U.S. Soil Conservation Service. 1978. Procedure to establish priorities in landscape architecture. (Technical Release No. 65.) Washington, D.C.

8.20 Public Health and Environmental Hazards (5.6)

Alameda County Mosquito Abatement District. 2004. Ochlerotatus mosquitoes of California. Available: <http://www.mosquitoes.org/Ochlerotatus.htm>. Accessed: December 7, 2004; Culex mosquitoes of California. Available: <http://www.mosquitoes.org/CulexCal.htm>. Accessed: December 7, 2004; Culiseta mosquitoes of California. Available: <http://www.mosquitoes.org/Culiseta.html>. Accessed: December 7, 2004; and miscellaneous mosquitoes of California. Available: <http://www.mosquitoes.org/MiscMosq.html>. Accessed: December 7, 2004, and January 13, 2005.

American Mosquito Control Association. 2005. Mosquito information: mosquito-borne diseases. Available: <http://www.mosquito.org/info/php>. Accessed: January 21, 2005.

American Mosquito Control Association. 2004. Mosquito information: mosquito adult. Available: <http://www.mosquito.org.info.php>. Accessed: July 19, 2004.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

Columbia Animal Hospital. 2005. Pet's Health—Canine Heartworm Disease. Available: <http://www.petshealth.com/dr_library/canineheartworm.html>.

Environmental Data Resources, Inc. 2005. EDR data map area study. North Delta project. North Delta, CA 95412. January 13.

Marin/Sonoma Mosquito and Vector Control District. 2005. Featured mosquitoes: western malaria mosquito (*Anopheles freeborni*). Available: <http://www.msmosquito.com/afreebor.html>. Accessed: January 21, 2005.

Mosquito and Vector Control Association of California. 2003. Guide to the Common Mosquitoes of California. III. Central Valley and Western Sierra. Sacramento, CA

Sacramento-Yolo Mosquito and Vector Control District. 2005. Common California mosquito species. Available: <http://www.fightthebite.net/vectors/index. php>. Accessed: January 21, 2005; Vector-borne diseases information. Available: <http://www.fightthebite.net/diseases>; West Nile virus information. Available: <http://www.fightthebite.net/wnv/>; California update information. Available: <http://www.fightthebite.net/wnv/latest.php>. Accessed: January 21, 2005.

Virginia Mosquito Control Association. 2005. Coquillettidia perturbans data. Available: <http://www.mosquito-va.org/coquillettidia_perturbans.htm>. Accessed: January 20, 2005.

8.21 Cultural Resources (5.7)

Bean, W., and J. J. Rawls. 1993. *California: an interpretive history* (4th ed.). New York, NY: McGraw-Hill.

Bethard, R., C. Hill, and S. Wilcox. 1989. *Archaeological site record for P-39-322*. January 13. Prepared by PAR & Associates, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

Billat, L. 2001. *Letter report regarding Nextel Communications wireless telecommunications service facilities—San Joaquin County*. Prepared by EarthTouch, LLC, Layton, UT. Prepared for California Office of Historic Preservation, Sacramento. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (Study SJ 5417).

Brown, A. G. 1997. *Alluvial geoarchaeology: floodplain archaeology and environmental change*. Cambridge, UK: Cambridge University Press.

Budd, H. B. 1926. *Map of San Joaquin County, California, and vicinity—1926*. Stockton, CA: Budd & Widdows, civil engineers. On file at California History Room, California State Library, Sacramento, CA.

CALFED Bay-Delta Program. 1996. *Draft affected environment technical report: cultural resources in the Delta region*. September 23.

CALFED Bay-Delta Program. 1998. *CALFED technical report, affected environment: cultural resources*. Draft. March.

CALFED Bay-Delta Program. 2000. CALFED Bay-Delta Program Final Programmatic Environmental Impact Statement/Environmental Impact Report. July 2000. Sacramento, CA.

California Department of Parks and Recreation. 1976. *California points of historical interest*. Sacramento, CA:

California Department of Parks and Recreation. 1996. *California historical landmarks*. Sacramento, CA:

California Department of Transportation. 2001. *Historic property survey report—negative findings: Bouldin Island passing lane*. Prepared by California Department of Transportation, District 10. Prepared for California Department of Transportation, Central Sierra Environmental Analysis Branch. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (Study SJ 4275).

California Office of Historic Preservation. 2000. *Archeological determinations of eligibility: Sacramento County.* August 30. Sacramento, CA.

California Office of Historic Preservation. 2004. *Directory of properties in the historic property data file for Sacramento County*. December 3. Sacramento, CA.

California State Lands Commission. 2004. Shipwreck database. Available: <http://shipwrecks.slc.ca.gov/ShipwrecksDatabase/Shipwrecks_Database.asp>. Accessed: December 30, 2004.

Cole, R. C., L. K. Stromberg, O. F. Bartholomew, and J. L. Retzer. 1954. *Soil survey of the Sacramento area, California*. Soil Conservation Service, U.S. Department of Agriculture.

DeGeorgey, A., and K. Tinkham. 2003a. Site record forms for P-39-4438. August 20. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003b. Site record forms for P-39-4419. August 19. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003c. Site record forms for P-39-4420. August 19. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003d. Site record forms for P-39-4421. August 19. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003e. Site record forms for P-39-4422. August 20. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003f. Site record forms for P-39-4427. August 19. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003g. Site record forms for P-39-4428. August 19. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003h. Site record forms for P-39-4429. August 20. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

DeGeorgey, A., and K. Tinkham. 2003i. Site record forms for P-39-4430. August 20. Prepared by Tremaine & Associates, Inc., Dixon, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

Farris, G. J., P. D. Schulz, and M. V. Speer. 1982. *Cultural resource evaluation of the proposed Delta Peripheral Canal.* November. On file at Cultural Resources Management Unit, California Department of Parks and Recreation, Sacramento.

Fenenga, F. F. 1939. Excavation of site C. 66. Pages 43–46 in *An introduction to the archeology of central California*, by J. B. Lillard, R. F. Heizer, and F. Fenenga. Bulletin 2, Department of Anthropology, Sacramento Junior College. Sacramento, CA.

Gerry, R. A. 1983. *Letter report regarding an archaeological survey of the KCRA transmission tower project.* October 14. Prepared by Peak & Associates, Sacramento, CA. Prepared for County of Sacramento, CA. On file at North Central Information Center, California State University, Sacramento, CA (Study 3128).

Gibbes, J. T. 1869. Map showing the lands of the Tide Land Reclamation Company. San Francisco, CA: Britton & Rey. On file at California History Room, California State Library, Sacramento, CA.

Hathaway, B. W. 1927. *Excavation work done on 23 Indian mounds in the state of California.* August. On file at North Central Information Center, California State University, Sacramento, CA.

Hillman, R. W., and L. A. Covello. 1985. *Cities and towns of San Joaquin County*. Fresno, CA: Panorama West Books.

Hoover, M. B., H. E. Rensch, E. G. Rensch, and W. N. Abeloe. 1990. *Historic spots in California* (4th ed.). Revised by D. E. Kyle. Stanford, CA: Stanford University Press.

Laylander, D., and B. A. Silva. 1999. *Negative archaeological survey report of two portions of State Route 12, San Joaquin County, California.* Prepared by California Department of Transportation. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (Study SJ 3804).

Maniery, M. L. 1988. *Cultural resources assessment of Bedford properties, Contra Costa and San Joaquin counties, California.* December 9. Prepared by PAR & Associates, Sacramento, CA. Prepared for Jones & Stokes Associates, Inc., Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

Maniery, M. L. 1991a. *Mokelumne River and tributaries, California: cultural resources summary.* February 18. Prepared by PAR Environmental Services, Inc., Sacramento, CA. Prepared for Sacramento District, U.S. Army Corps of Engineers, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (Study CCIC 217).

Maniery, M. L. 1991b. *National Register of Historic Places significance evaluation of Walnut Grove branch line railroad, Sacramento County, California.* Prepared by PAR Environmental Services, Sacramento, CA. Prepared for U.S. Army Corps of Engineers, Sacramento, CA. On file at North Central Information Center, California State University, Sacramento.

Maniery, M., and K. Syda. 1988. *Cultural resources inventory and evaluation of Delta Wetlands water storage project, Contra Costa and San Joaquin counties, California.* February 24. Prepared by PAR Environmental Services, Inc., Sacramento, CA. Prepared for Jones & Stokes Associates, Inc., Sacramento, CA. On file at Northwest Information Center, Sonoma State University, Rohnert Park, CA.

Maniery, M., and S. Wilcox. 1988. *Archaeological site record for P-39-324.* Prepared by PAR & Associates, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA.

McElhiney, M. A. 1992. *Soil survey of San Joaquin County, California*. USDA Soil Conservation Service in cooperation with the Regents of the University of California (Agricultural Experiment Station) and the California Department of Conservation. Washington, D.C.

Meacham, C. M. 1977. *An archaeological survey of a proposed bridge replacement (10 SJ-12, P.M. 4.2/5.1)*. December. Prepared by California Department of Transportation, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (SJ 751).

Metsker, C. F. 1940. *Metsker's map of Sacramento County, California.* San Francisco, CA: Metsker the Map Man. On file at California History Room, California State Library, Sacramento, CA.

National Register of Historic Places. 1991. *National Register of Historic Places, 1966–1991*. Nashville, TN: American Association for State and Local History.

Nelson, W. J., K. J. Tremaine, and C. Roland. 2003. *Cultural resources inventory report for Staten Island, San Joaquin County, California.* December. Prepared by Tremaine & Associates, Inc., Dixon, CA, and Roland-Nawi Associates, Sacramento, CA. Prepared for the Nature Conservancy, Galt, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (SJ 5356).

Owens, K. 1991. *Sacramento–San Joaquin Delta, California historical resources overview.* Draft. Prepared for U.S. Army Corps of Engineers, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (SJ 816).

Paterson, A. M., R. F. Herbert, and S. R. Wee. 1978. *Historical evaluation of the Delta waterways, report No. 2.* Prepared for the California State Lands Commission. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (CCIC 1640).

Peak & Associates. 1999. *Letter report regarding Pacific Bell wireless site SA-247-01, cultural resources assessment: 19401 W. State Highway 12, Thornton, San Joaquin County.* May. Prepared by Peak & Associates, Inc., El Dorado Hills, CA. Prepared for Quad-Knopf, Inc., Roseville, CA. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (SJ 4056).

Phinney, C. M. 1911. *Official map of the county of Sacramento.* On file at California History Room, California State Library, Sacramento, CA.

Pohorecky. 1962. *Archaeological site survey record for P-34-276.* July 4. On file at North Central Information Center, California State University, Sacramento.

Robertson, D. B. 1998. *Encyclopedia of Western railroad history, vol. 4.* Caldwell, ID: Caxton Printers, Ltd.

Sacramento County Department of Review and Assessment. 2003. *Draft environmental impact report: Sacramento Regional County Sanitation District Lower Northwest Interceptor project*. Vol. 1. February. Control Number: 98-PWE-0612. State Clearinghouse Number: 2001112085 and 2002092071. Prepared by Sacramento County Department of Environmental Review and Assessment, Sacramento, CA.

Schenck, W. E., and E. J. Dawson. 1929a. Archaeology of the northern San Joaquin Valley. In *University of California Publications in American Archaeology and Ethnology* 25(4):289–413.

Schenck, W. E., and E. J. Dawson. 1929b. *Archaeological site survey record for CA-Sac-8 (P-34-35)*. On file at North Central Information Center, California State University, Sacramento.

Schenck, W. E., and E. J. Dawson. 1929b. *Archaeological site survey record for CA-Sac-9 (P-34-36).* On file at North Central Information Center, California State University, Sacramento.

Schenck, W. E., and E. J. Dawson. 1929c. *Archaeological site survey record for CA-Sac-10 (P-34-37).* On file at North Central Information Center, California State University, Sacramento.

Schulz, J., and G. Farris. 1982. *Archeological site survey record update for P-34-39.* April 19. On file at North Central Information Center, California State University, Sacramento.

Schulz, P. D., and G. J. Farris. 1994. *Class I archeological survey, North Delta program, Sacramento and San Joaquin counties, California.* May 31. Preliminary draft. Prepared by Resource Management Division, California Department of Parks and Recreation, Sacramento. Prepared for Division of Planning, California Department of Water Resources, Sacramento.

Shapiro, W., and K. Syda. 1997. *An addendum archaeological assessment within Reclamation District 563, Sacramento County.* Part of the cultural resources inventory and evaluation for U.S. Army Corps of Engineers, Sacramento District, PL 84-99 levee rehabilitation on the Feather, Bear, Sacramento and San Joaquin rivers system, Corps water basin system designation SAC 24. November 5. Prepared by Pacific Legacy, Inc., Woodland, CA. Prepared for U.S. Army Corps of Engineers, Sacramento District, Sacramento, CA. On file at North Central Information Center, California State University, Sacramento (Study 1806).

Shepherd, F. A. 1885. *Official map of Sacramento County.* San Francisco, CA: Britton & Rey. On file at California History Room, California State Library, Sacramento, CA.

Thomas Brothers. 1920. *California, central.* San Francisco, CA: Thomas Brothers. On file at California History Room, California State Library, Sacramento, CA.

Thompson, J. 1958. *The settlement geography of the Sacramento–San Joaquin Delta, California.* Ph.D. dissertation, Stanford University. On file at California History Room, California State Library, Sacramento, CA.

U.S. Geological Survey. 1894. *1:125,000-scale Lodi sheet.* On file at North Central Information Center, California State University, Sacramento.

U.S. Geological Survey. 1910a. *7.5-minute Bruceville, California, quadrangle.* Surveyed in 1907–1908. On file at North Central Information Center, California State University, Sacramento.

U.S. Geological Survey. 1910b. *7.5-minute Isleton, California, quadrangle.* On file at North Central Information Center, California State University, Sacramento.

U.S. Geological Survey. 1910c. *7.5-minute New Hope, California, quadrangle.* On file at North Central Information Center, California State University, Sacramento.

Werner, R. H. 1988. *Cultural resources inventory and evaluation, Sacramento River bank protection project, units 42 and 43.* Prepared by Archaeological Services, Inc., Stockton, CA. On file at North Central Information Center, California State University, Sacramento.

West, G. J. 1991. *Class II archeological survey, North Delta program, Sacramento–San Joaquin Delta, California.* March. Prepared by Mid-Pacific Region, Bureau of Reclamation, Sacramento, CA. Prepared for California Department of Water Resources, Sacramento. On file at Central California Information Center, California State University, Stanislaus, Turlock, CA (CCIC 1731).

West, G. J. 1994. A Class III archeological survey of the South Delta water management program area, San Joaquin and Contra Costa counties, California. Prepared by Bureau of Reclamation, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus (Study CCIC-2391). Turlock, CA.

West, G. J., and B. G. Scott. 1990. *A Class II archeological survey of the South Delta water management program area, San Joaquin and Contra Costa counties, California.* Prepared by Bureau of Reclamation, Sacramento, CA. On file at Central California Information Center, California State University, Stanislaus (Study CCIC-1732). Turlock, CA.

Woodward, J., and N. H. Evans. 1992. *Summaries of burial collections.* August 24. Prepared by California Department of Parks and Recreation, Cultural Heritage Section, Sacramento, CA. On file at Northwest Information Center, Sonoma State University, Rohnert Park, CA (Study S-14343).

8.21.1 Personal Communications

Offermann, Janis. Senior environmental planner (archaeologist). California Department of Water Resources, Sacramento, CA. April 29, 2005—telephone conversation.

8.22 Compliance with Applicable Laws, Policies, Plans, and Regulatory Framework (Chapter 6)

CALFED Bay-Delta Program. 2001. CALFED Bay-Delta Program History. Available: <http://calwater.ca.gov/AboutCalfed/ProgramHistory.shtml>.

California Bay-Delta Authority. 2001. Guide to regulatory compliance for implementing CALFED actions, volume 2: Environmental regulatory processes. June. Sacramento, CA.

California Bay-Delta Authority. 2003. California Bay-Delta Authority Act. Available: http://www.calwater.ca.gov/AboutCalfed/AboutCALFED.shtml. Accessed: 2003.

Delta Protection Commission. 1995. Land use and resource management plan for the primary zone of the Delta. Adopted February 23, 1995. Available: <http://www.delta.ca.gov/plan.html>.

San Francisco Bay Regional Water Quality Control Board. 1995. Water Quality Control Plan for the San Francisco Bay Region. June 21, 1995. Approved by the State Water Resources Control Board July 20, 1995.

U.S. Army Corps of Engineers, Sacramento District. 2003. List of Sacramento District navigable waters of the U.S. subject to the requirements of the River and Harbors Appropriation Act. Obtained from Corps Sacramento District Regulatory Branch web site. Available: <http://www.spk.usace.army.mil/organizations/cespk-co/regulatory/ca_waterways.html>.

8.22.1 Personal Communications

Strauss, Alexis. 2003a. *Review of California's 2002 Section 303(d) water body List.* U.S. Environmental Protection Agency, Region 9. Second enclosure to letter from Alexis Strauss to Celeste Cantú, State Water Resources Control Board. June 18.

Strauss, Alexis. 2003b. *Waters added to 303(d) list for California.* U.S. Environmental Protection Agency, Region 9. First enclosure to letter from Alexis Strauss to Celeste Cantú, State Water Resources Control Board. July 25.

Chapter 9

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