United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To:
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Ms. Jane M. Hicks
Chief, Regulatory Division
Attn: David Wickens
U. S. Army Corps of Engineers
San Francisco District
1455 Market Street
San Francisco, California 94105-2197

Subject: Biological Opinion on the Proposed Suisun Marsh Habitat Management, Preservation, and Restoration Plan and the Project-Level Actions in Solano County, California

This biological opinion is in response to the U.S. Army Corps of Engineer's (Corps) May 15, 2013, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed Suisun Marsh Habitat Management, Preservation, and Restoration Plan (SMP) (Enclosure 1), Suisun, Solano County, California. This document includes a programmatic biological opinion (PBO) for the SMP and a biological opinion for the project-level actions (BO). There are three biological opinions that cover the SMP. Projects funded by the U.S. Bureau of Reclamation will be covered in the biological opinion addressed to them. A biological opinion issued to the U.S. Army Corps of Engineers (Corps) for the SMP will cover projects that fall under the Corps' Regional General Permit, their Letters of Permission, or individual permits. Finally, an intra-Service biological opinion covers the Service as a co-lead for the National Environmental Policy Act and our ultimate issuance of a Record of Decision (ROD). At issue are the effects of the proposed action on the endangered California clapper rail (*Rallus longirostris obsoletus*), endangered salt marsh harvest mouse (*Reithrodontomys raviventris raviventris*), endangered California least tern (*Sternula antillarum browni*), endangered soft bird's-beak (*Chloropyron molle ssp. molle*), designated soft bird's-beak critical habitat, endangered Suisun thistle (*Cirsium hydrophilum var. hydrophilum*), designated Suisun thistle critical habitat, threatened Delta smelt (*Hypomesus transpacificus*), and designated delta smelt critical habitat. This biological opinion is in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

This biological opinion is based on information provided in: (1) the June 1, 2012 *Suisun Marsh*

Habitat Management, Preservation, and Restoration Plan Final Biological Assessment for Terrestrial and Freshwater Species (BA) (Bureau of Reclamation (Reclamation) 2012); (2) *the Suisun Marsh Habitat Management, Preservation, and Restoration Plan Final Environmental Impact Statement/Environmental Impact Report* (Final EIS/EIR) (Reclamation *et al.* 2011); (3) miscellaneous correspondence and electronic mail concerning the proposed action between representatives of the Service, California Department of Fish and Wildlife (DFW), Reclamation, California Department of Water Resources (DWR), the Suisun Resource Conservation District (SRCD), and biological consultants for the proposed action, and interested parties; (4) relevant published and unpublished studies, and communications on the distribution and abundance of listed species; and (5) additional information available to the Service.

Consultation Process

The SMP is both a project-level plan and a programmatic action, proposed to be implemented over a 30-year timeframe. The SMP will comply with ESA through intra-Service section 7 consultations and section 7 consultations with Reclamation and the Corps. The Corps proposes to issue a Regional General Permit (RGP) for a 5-year period pursuant to Section 404 of the Clean Water Act. The RGP would permit SRCD, Reclamation, DFW, and the DWR to conduct ongoing operations and maintenance activities. To address the 30-year time frame for the SMP, the Corps proposes to renew this RGP at 5-year intervals. During the renewal process some RGP conditions could be revised in response to the adaptive management program and other new information. The Service will consult on individual tidal restoration projects through appendage to this programmatic biological opinion. The Corps likely would issue Individual Permits under Section 404 of the Clean Water Act for tidal restoration projects. For dredging conducted for levee maintenance in the SMP, the Corps proposes to issue a 10-year Letter of Permission (LOP) which could be renewed twice to address the 30-timeframe of the SMP.

Programmatic Level

The project description includes project-level actions associated with the managed wetland operations and maintenance activities to be permitted by the Corps under the RGP and LOP. Tidal restoration activities are described at the program-level. An overview of the expected outcomes of tidal restoration are presented, but specific site locations and other details are not available at this time. When sufficient detail exists about the nature, scope, location, and timing of the restoration actions, the implementing agency will provide the plans for the Service for review. If the site-specific tidal restoration plans are consistent with the SMP and Service-issued biological opinions, the Service will append the project to this PBO and provide an incidental take statement. If tidal restoration projects include elements or potential effects beyond those analyzed in this PBO, planning efforts for those projects will include site-specific consultation under the Act with the Service. To comply with the California Endangered Species Act (CESA), project-level applications for incidental take permits will be provided to DFW to address state listed species. The Service used the BA's biological information to conduct a program-level evaluation of the tidal restoration portion of the SMP.

Requirements for proposed tidal marsh restoration projects to be appended to this PBO are as follows. The proposed tidal marsh restoration project must:

- Be within the SMP area (Figure 1);
- Not exceed the acreage evaluated in the SMP; Note, this project does not preclude additional restoration activities from occurring in Suisun Marsh that are not specifically addressed in this biological opinion. Separate environmental permitting would be needed for these projects.
- Follow the SMP site selection considerations;
- Follow the conservation measures and reporting, as described in the Description of the Proposed Action below;
- Be reviewed and approved by the Service and DFW; and,
- Be reviewed by the Suisun Adaptive Management Advisory Team and the SMP Principals.

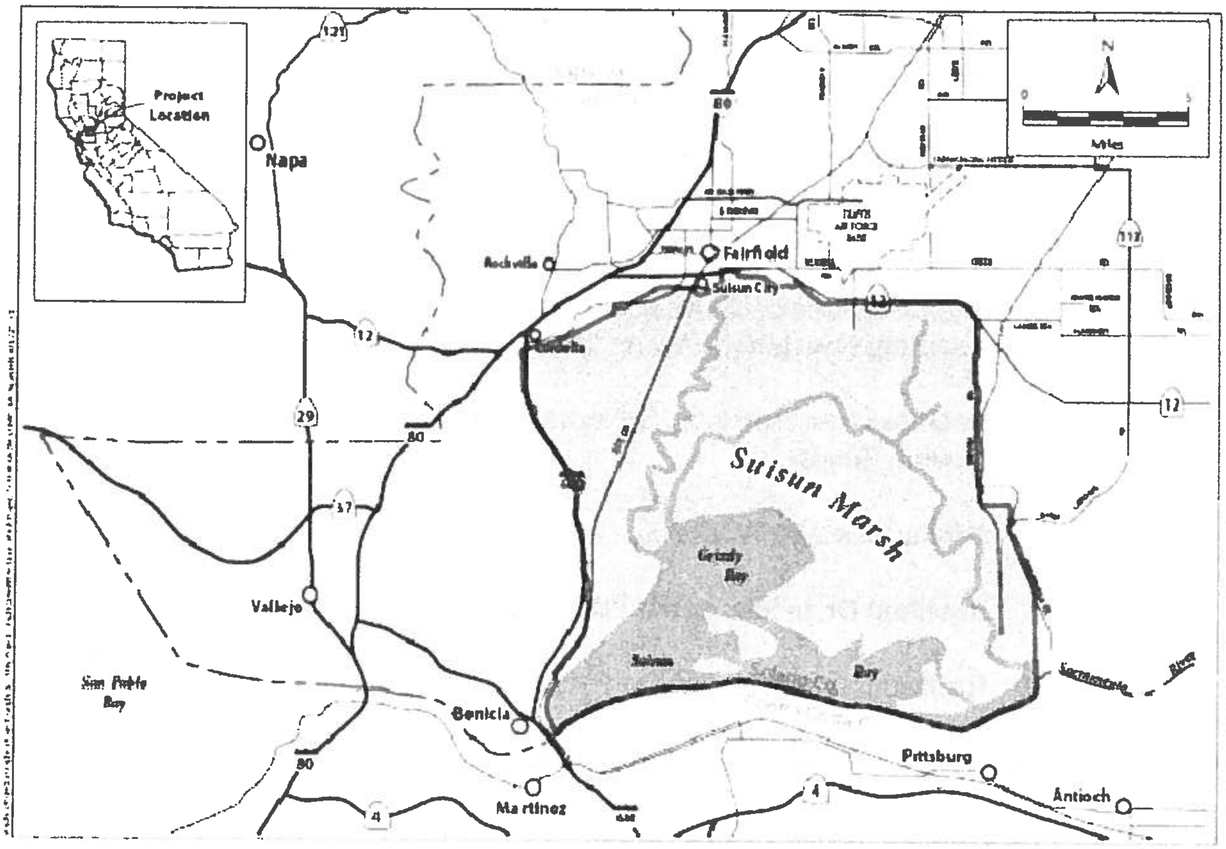

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Figure 1
Project Location

Project Level

Because information in the BA has already been adequately defined for the managed wetland operations and maintenance activities, this PBO includes the analysis of these project-level actions. The project-level actions as described provide the level of detail necessary to evaluate effects on each listed species and to quantify the amount and extent of incidental take associated with site-specific actions. Listed species likely to be present are described and specific measures necessary to avoid and minimize adverse effects to these listed species are consistent with the conservation measures described in this biological opinion. The project-level managed wetland operations and maintenance actions include:

A. Managed Wetland Operations

B. Managed Wetland Maintenance Activities

i. Currently Implemented Managed Wetland Activities

1. Repairing Existing Interior Levees
2. Coring Existing Interior Levees
3. Grading Pond Bottoms for Water Circulation
4. Creating Pond Bottom Spreader V-Ditches
5. Repairing Existing Interior Water Control Structures
6. Replacing Pipe for Existing Interior Water Control Structures or Installing New Interior Water Control Structures
7. Installing New Blinds and Relocating, Replacing, or Removing Existing Blinds
8. Discing Managed Wetlands
9. Installing Drain Pumps and Platforms
10. Replacing Riprap on Interior Levees
11. Replacing Riprap on Exterior Levees
12. Coring Existing Exterior Levees
13. Repairing Exterior Water Control Structures (Gates, Couplers, and Risers)

14. Installing or Replacing Pipe for Existing Exterior Flood or Dual-Purpose Gates

15. Installing, Repairing, or Re-Installing Water Control Bulkheads

16. Removal of Floating Debris from Pipes, Trash Racks, and Other Structures

17. Installing Alternative Bank Protection such as Brush Boxes, Biotechnical Wave Dissipaters, and Vegetation on Exterior and Interior Levees

18. Constructing Cofferdams in Managed Wetlands

19. Suisun Marsh Salinity Control Gate Repair and Maintenance

20. Roaring River Distribution System Fish Screen Cleaning

21. Installing New Fish Screen Facilities

22. Salinity Monitoring Station Maintenance, Repair, and Replacement

23. Salinity Station Relocation, Installation, and Removal

ii. Modification of Currently Implemented Activities

1. Clearing Existing Interior Ditches

2. Constructing New Interior Ditches

3. Repairing Existing Exterior Levees

iii. New Activities

1. Dredging from Tidal Sloughs as Source Material for Exterior Levee Maintenance

2. Placing New Riprap in Areas That Were Not Previously Riprapped

3. Constructing New Interior Levees for Improved Water Control and Habitat Management in the Managed Wetland Units

iv. Suisun Marsh Preservation Agreement, Preservation Agreement Implementation Fund (SMPA PAI) funded activities.

Introduction

The SMP was developed collaboratively by Federal, State, and local agencies working with scientists and the public to develop a long-term, comprehensive plan to restore and enhance wetlands in the Suisun Marsh (Marsh) while providing for flood management and wildlife-oriented public access and recreation. The SMP is intended to be implemented over a 30-year timeframe. The SMP and SMPA Team Structure is attached (Attachment 2).

The Principal Agencies are the Service; Reclamation; National Marine Fisheries Service (NMFS); DFW; DWR; Delta Stewardship Council (DSC);and SRCD, representing the interests of private landowners. The Principals have consulted with other participating charter agencies, such as the Corps, San Francisco Bay Conservation and Development Commission (BCDC), Regional Water Quality Control Board (RWQCB), and the State Water Resources Control Board (State Water Board), in developing this plan.

The SMP is a plan designed to address the various conflicts regarding use of Marsh resources, with the focus on achieving an acceptable multi-stakeholder approach to the restoration of tidal wetlands and the management of managed wetlands and their functions. The SMP addresses habitats and ecological process, public and private land use, levee system integrity, and water quality through restoration and managed wetland activities. The plan is intended to guide near-term and future actions related to restoration of tidal wetlands and managed wetland activities. Specific actions that would be implemented in the near term under the SMP include managed wetlands maintenance and enhancement activities and activities implemented under the PAI Fund.

Specifically, the SMP includes the following elements:

- Tidal restoration of 5,000 to 7,000 acres
- Continued Operation of managed wetlands
- Continued maintenance activities in managed wetlands and at water monitoring and management facilities
- New managed wetlands activities, including dredging, installing alternative bank protection, placing new riprap, and installing new fish screens
- Implementation of the SMPA PAI Fund
- Conservation measures
- Adaptive management (as described in the Suisun Marsh Habitat, Management, Preservation and Restoration Plan)

Background

Suisun Marsh is the largest contiguous brackish water marsh remaining on the west coast of North America and is a critical part of the San Francisco Bay/Sacramento–San Joaquin River Delta (Bay-Delta) estuary ecosystem. It is home to public waterfowl hunting areas and 158 private duck clubs. The Marsh encompasses more than 10 percent of California's remaining natural wetlands and serves as the resting and feeding ground for thousands of resident waterfowl as well as birds migrating on the Pacific Flyway. In addition, the Marsh provides essential habitat for more than 221 bird species, 45 mammal species, 16 reptile and amphibian species, and more than 40 fish species. Suisun Marsh supports the state's commercial and recreational salmon fishery by providing important tidal rearing areas for juvenile salmonids. Approximately 200 miles of levees in the Marsh contribute to managing salinity in the Bay-Delta.

The values of the Marsh have been recognized as important, and several agencies have been involved in its protection since the mid-1970s. In 1974 the Nejedly-Bagley-Z'Berg Suisun Marsh Preservation Act was enacted by the California Legislature to protect the Marsh from urban development. It required California Department of Fish and Game (DFG), which changed their name to California Department of Fish and Wildlife in 2013, and BCDC to develop a plan for the Marsh and called for various restrictions on development in the Marsh boundaries. In 1976, the BCDC developed the Suisun Marsh Protection Plan (SMPP), which defined and limited development within the primary and secondary management areas for the "future of the wildlife values or the area as threatened by potential residential, commercial, and industrial development."

The primary management area consists of tidal marshes, seasonal marshes, managed wetlands, and lowland grasslands within the Marsh. The secondary management area comprises upland grasslands and agricultural lands, which provide significant buffer habitat to the Marsh (Solano County 2008). The SMPP objectives are "to preserve and enhance the quality and diversity of the Suisun Marsh aquatic and wildlife habitats and to assure retention of upland areas adjacent to the Marsh in uses compatible with its protection." The SMPP calls for the preservation of Suisun Marsh, preservation of waterfowl habitat, improvement to water distribution and levee systems, and encourages agriculture that is consistent with wildlife and waterfowl, such as grazing. In 1977, the California Legislature implemented Assembly Bill (AB) 1717, the Suisun Marsh Preservation Act of 1977, which replaced the 1974 Suisun Marsh Preservation Act and called for the implementation of the SMPP, designated BCDC as the state agency with jurisdiction over the Marsh; and called for the SRCD to have the primary local responsibility for water management on privately owned lands in the Marsh. In 1984, DWR with cooperation from SRCD, DFG, and Reclamation, published the Plan of Protection for Suisun Marsh, in response to State Water Board Water Rights Decision 1485 (D-1485), Order 7. The Plan of Protection was a proposal for staged implementation of a combination of activities, including monitoring, a wetlands management program for landowners, physical facilities, and supplemental releases of State Water Project (SWP) and Central Valley Project (CVP) reservoirs. With this staged implementation approach, each action would be evaluated to determine whether subsequent actions were needed. The Initial Facilities and the Suisun Marsh Salinity Control Gates (SMSCG) were constructed and continue to be operated.

Since 1977, DFW and the SRCD have jointly held Regional General Permit 3 (RGP3) issued by the Corps. RGP3 authorizes maintenance activities within the primary management area of Suisun Marsh. Each of the past four RGP3 renewals has been issued for a 5-year period. The latest biological opinion was issued in January 2008 by NMFS. Because the SMP is addressing marsh operation, including permitting maintenance activities already authorized by the RGP3, a new biological opinion will be issued by NMFS.

In 1987, Reclamation, DWR, DFG, and SRCD signed the SMPA, which contains provisions for Reclamation and DWR to mitigate the effects of the SWP and CVP operations and other upstream diversions on Suisun Marsh channel water salinity. It required Reclamation and DWR to meet salinity standards as specified in the then-current State Water Board D-1485, set a timeline for implementing the Plan of Protection for the Suisun Marsh, and delineated monitoring and mitigation requirements.

In 2000, the CALFED Bay-Delta Program (CALFED) Record of Decision (ROD) was signed, which included the Ecosystem Restoration Program (ERP). The ERP calls for the restoration of 5,000 to 7,000 acres of tidal wetlands and the protection and enhancement of 40,000 to 50,000 acres of managed wetlands (CALFED Bay-Delta Program 2000). In 2001, the CALFED Bay-Delta Authority (CBDA) directed the formation of a charter group to develop a plan for Suisun Marsh that would balance the needs of CALFED, SMPA, and other plans by protecting and enhancing existing land uses and existing waterfowl and wildlife values, including those associated with the Pacific Flyway, endangered species, and state and federal water project supply quality. The charter group includes all local, state, and federal agencies that have jurisdiction or interest in the Marsh. However, the SMP has been developed by a subset of the charter group, the Principal Agencies.

History of Suisun Marsh Mitigation/Conservation Areas

In July 1970, a memorandum of agreement was signed by Reclamation, the Service, DWR, and DFG to complete a study of the Suisun Marsh to (1) select a water supply and marsh management plan to protect and enhance waterfowl habitat; (2) determine costs and benefits associated with the selected plan and define the responsibilities among various interests; and (3) recommend a plan of action.

With the passage of the 1974 and 1977 Suisun Marsh Preservation Act and the 1978 State Water Quality Control Plan Water Rights Decision 1485 (D1485), Reclamation and DWR were required to develop a plan to mitigate for the adverse effects of increased salinity on the Suisun Marsh from the operations of the CVP and the SWP and a portion of the adverse effects of the other upstream diversions. To meet these legislative and regulatory requirements, Reclamation prepared the 1981 Suisun Marsh Management Plan and DWR prepared the 1984 Plan of Protection for the Suisun Marsh, including an EIR. There were four key elements of both Plans: 1) Delta Outflow, 2) Physical Facilities, 3) Monitoring Program, and 4) the employment of efficient Marsh management, operation and maintenance activities of public and private managed wetlands in Suisun Marsh.

In 1978, the SRCD, DFG and DWR signed an agreement, Contract B53719, for the Initial Facilities in the Suisun Marsh to provide partial mitigation for the effects of increased salinity levels on managed wetlands in connection with developing the Suisun Marsh Plan of Protection. The Initial Facilities included the Roaring River Distribution System and Fish Screen, the Morrow Island Distribution System, and Goodyear Slough Outfall, (completed in 1981) and the Cygnus and Lower Joice Islands Units. Reclamation was unable to sign this original agreement, until the passage of Public Law 99-546 in 1986 which authorized Reclamation to participate in the SMPA. The continued operation and maintenance of these Initial Facilities was the foundation of the future implementation of 1981 Reclamation Suisun Marsh Management Plan and DWR 1984 Plan of Protection. The Plan of Protection outlined a phased approach for the construction of water conveyance facilities and establishment of a network of water quality compliance and monitoring stations to meet D1485 water quality standards.

In December of 1981, the Service completed a Section 7 Consultation (BO: AFA-SE 1-1-81-F-130) on Reclamation's 1981 Suisun Marsh Management Plan. This biological opinion (BO) addressed proposed construction of seven major water conveyance Physical Facilities to convey and deliver low salinity water throughout the Marsh, a monitoring program, managed wetlands management program, and implementation of conservation measures. The BO's Conservation Measures requirements led to the establishment of 1,000 acres of dedicated conservation areas for the salt marsh harvest mouse on DFG property in the Marsh, establishment of a Marsh wide vegetation monitoring program to ensure that preferred salt marsh harvest mouse habitat persisted on public and private managed wetlands throughout the Marsh and preferred salt marsh harvest mouse habitat did not decrease by more than 1/3 in size in any of the five established monitoring zones. The BO Conservation Measures also established salt marsh harvest mouse population surveys, California clapper rail population surveys, plus the creation of an additional 340 acres of managed wetlands (the DFG Island Slough Unit) to mitigate for the impacts of construction of the seven Physical Facilities described in the Plan of Protection. One hundred acres of the created seasonal wetlands at DFG Island Slough Unit were required to be managed as preferred salt marsh harvest mouse habitat to mitigate for the construction of the initial facilities called for in the Plan of Protection. In March of 1986, the Service completed a Section 7 Consultation with the Corps (BO: F-1-86-F-27) for the placement of dredge spoil at two sites on Van Sickle Island *(new impacts not analyzed in the 1981 BO)* as part of the construction of the Montezuma Slough Control Structure (MSCS) and associated levee maintenance. The lack of 2.2 acres of suitable salt marsh harvest mouse habitat reestablishing on the Van Sickle Island dredge disposal site required mitigation within the 100 acre Island Slough mouse area (BO: 1-1-86-F-27). The MSCS was the 1st Physical Facility proposed for construction under the Reclamation and DWR Plans.

Upon completion of the Reclamation and DWR Suisun Marsh Plans and BO, DWR, Reclamation, DFG, and SRCD began working on the completion of the SMPA, Mitigation, and Monitoring Agreements (signed 1986 and 1987). These contractual agreements are significant because they formalized each Agency's obligations and funding commitments to operate and maintain the Initial Facilities, MSCS, monitoring activities, and established a means to acquire, develop, operate, and maintain the Mitigation/Conservation Areas in the Suisun Marsh.

In 1994, the Bay Delta Accord was signed and new Delta flow standards were adopted by the SWRCB in Water Rights Order 95-6 in June 1995. In April of 1995, DWR and Reclamation stopped work on planning the Western Suisun Marsh Salinity Control Gates (the 2nd Physical Facility Proposed). Based upon the new Delta outflow objective DWR conducted salinity modeling that indicated that eastern and central Suisun Marsh salinity objectives could be met in most occasions by operating the MSCS. It was anticipated that infrequent marginal exceedences of salinity objectives may occur in the western Marsh during dry and critical water years. As a result of these developments, it was determined that the construction of the remaining six Physical Facilities originally anticipated ***would not be constructed***, although the mitigation for these facilities was developed and continues to be managed and monitored for multi-species benefits, including salt marsh harvest mouse.

In May of 2005, the SMPA Agencies (Reclamation, DWR, DFG, and SRCD) amended and updated the 1986 Suisun Marsh Preservation, Mitigation, and Monitoring Agreements. During this update, the SMPA Environmental Coordination Advisory Team (ECAT) was formally adopted within the contract with the responsibility to: (1) ensure compliance with mitigation and monitoring requirements of the Revised SMPA and related permits and biological opinions, (2) provide technical guidance and oversights of Suisun Marsh monitoring, management, and restoration programs conducted as part of the SMPA, including its Monitoring and Mitigation Agreements, and (3) include participation from other federal and State agencies, such as the Service, NMFS, and the Corps. As part of the concurrent update of the SMPA Mitigation Agreement, the SMPA Agencies also formally set aside an additional 1,500 acres of Conservation Areas (approved by the Service) for multi-species benefits in the Suisun Marsh to meet the 1981 goal of 2,500 acres of preferred salt marsh harvest mouse habitat adequately distributed throughout the Marsh (Service 1-1-07-I-1684). The updated Mitigation Agreement also identified over 2 million dollars of Phase C funding, "to be used to acquire and conserve habitat for multi-species benefits to complete the conservation measures of the 1981 Service biological opinion and contribute to the conservation of aquatic and terrestrial habitats in the Suisun Marsh. This use replaces the original intent to acquire, restore, and manage 227 acres for seasonal wetland mitigation."

Other relevant Section 7 consultations have been completed to support the renewal of Corps Regional General Permit 3 (RGP 3) for operation and maintenance activities on public and private managed wetlands in the Suisun Marsh. These past consultations have established the current RGP 3 terms and conditions, minimization and avoidance measures, work season and diversion restrictions, diversion screening requirements, construction inspections and documentation, and reporting requirements to regulatory agencies.

- Service letter May 2, 1994 – File # 1-1-94-I-841: Clapper Rail Restrictions

- Service BO, August 29, 1994 – File #1-1-94-F-20: RGP3 renewal, delta smelt, Sacramento splittail

- NMFS BO, Sept. 21, 1994 – Winter-run Chinook Salmon

- NMFS BO, Feb. 2, 2006 – Reference #151422SWR2005SR00277 for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central California Coast steelhead, Central Valley steelhead, Southern Distinct Population Segment of North American Green Sturgeon, and Essential Fish Habitat Conservation Recommendations.

- NMFS BO, Jan. 16, 2008 – Reference # 2007/07637 for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central California Coast steelhead, Central Valley steelhead, Southern Distinct Population Segment of North American Green Sturgeon, and Essential Fish Habitat Conservation Recommendations.

Consultation History

1977- 2008:	The Service issued biological opinions to the Corps on issuance of RGPs to the DFG and SRCD to perform activities associated with managed wetlands. This included operations and maintenance activities on levees and water control structures.
April 3, 1997	The Service issued biological opinion to Reclamation (1-1-96-F-84) for the Morrow Island Distribution System (MIDS) water supply ditch cleaning project, spoils placement on the adjacent managed wetlands, and future reuse of the spoils for MIDS levee improvements. The original project impacted 17 acres of managed wetland and 2 acres of uplands. The BO required 38 acres of mitigation lands to be set aside at DFW Island Slough Unit and the construction of a fish screen on MIDS.
June 13, 1997	Reclamation requested an amendment to Service BO (1-1-96-F-84) section 3) Reasonable and Prudent Measures #2 to increase the salt marsh harvest mouse mitigation acreage at DFW's Island Slough Unit from 38 acres to 57 acres. Thus increasing mitigation ratio to 3:1 upfront, thus, allowing the future dredging, placement of fill on the managed wetlands adjacent to MIDS, and removal as part of future facility maintenance.
August 28, 2000:	The CALFED ROD was signed, which established the ERP calling for the restoration of 5,000 to 7,000 acres of tidal wetlands and the protection and enhancement of 40,000 to 50,000 acres of managed wetlands for Stage 1 implementation (CALFED Bay-Delta Program 2000a).
2001-2011:	The Principal Agencies coordinated on the development of the SMP Environmental Impact Statement/Environmental Impact Report (EIS/EIR)
October 29, 2010:	The Draft EIS/EIR for the SMP was issued.

December 6, 2011:	The Final EIS/EIR for the SMP was issued.
June 8, 2012:	The Service received a request to initiate formal consultation on the SMP from Reclamation.
January 30, 2013:	The Service issued a draft biological opinion to Reclamation.
March 22, 2013:	The Service received additional conservation measures from the SRCD that were inadvertently omitted from the biological assessment.
April 2, 2013:	The Service received comments on the draft biological opinion from Reclamation, DFW, DWR, and SRCD.

BIOLOGICAL OPINION

Description of the Programmatic Proposed Action for Tidal Restoration Activities

The SMP would restore 5,000 to 7,000 acres of tidal wetlands over the 30-year planning period. This action is programmatic because the exact location, size, timing, design, and effects of each individual tidal restoration action that would make up the acres are unknown at this time.

Tidal Wetland Restoration

Tidal wetland restoration would help achieve the restoration goals established for the Marsh by the CALFED ERP Plan, San Francisco Bay Area Wetlands Ecosystem Goals Project, and the Service's Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California for the Suisun Bay Area Recovery Unit. Restoration of tidal wetlands in the Marsh would contribute to the recovery of special-status fish, wildlife, and plant species.

Tidal wetland restoration projects will be designed to accommodate sea level rise more easily than managed wetlands because the gradual elevations in tidal wetlands will not require the same level of levee maintenance and will provide an area for sediment accretion. The potential for sea level rise will be acknowledged in the site selection considerations and therefore will be a recurring consideration based on best available science for each restoration project. Administration of this criterion will recognize the dynamic nature of land and water interactions, including subsidence, sediment accretion potential, and biomass accumulation potential. This will enable project designs to be based on habitat trajectory (as opposed to current or static conditions) over the 30-year planning horizon. This approach will help minimize "sunk cost" of habitat and facility investments and help ensure that the targeted habitat type occurs as planned. In addition to site selection and project design considerations, the Adaptive Management Plan (AMP) provides a framework for adapting to sea level rise.

Benefits from individual projects would change as soil accretion increases elevations, vegetation becomes established, and vegetation communities shift over time from low marsh to high marsh conditions. Restored tidal marshes will provide different types and magnitude of benefits at any given period after restoration and at different geographic locations. Local and regional conditions will determine the salinity regime, plant communities, and rate of sedimentation. The specific actions that would be implemented as part of the tidal restoration component of the SMP are listed below.

Selecting Restoration Sites

The selection of suitable tidal restoration sites would take into consideration several factors, including land available for purchase, physical and biological site characteristics, and contribution to restoration acreage goals. It is anticipated that project proponents would consider these factors when choosing to select a restoration site based on the site-specific information available at the time of selection, although not all factors may apply. Project proponents would include Principal Agencies, such as DFW or DWR, but also possibly would include others. If a project proponent chooses, the Principal Agencies and the Adaptive Management Advisory Team (AMAT) will work collaboratively with them to select the most biologically appropriate, cost-effective, and SMP-compatible site. In addition, the AMAT may provide additional site-specific considerations.

Lands suitable for restoration of tidal wetlands would always be purchased from willing sellers by the project proponent. As opportunities present themselves, several factors would be considered for each site, as shown in Table 1. Some of the most important physical considerations are:

- location
- proximity to existing tidal habitats
- site elevation
- infrastructure
- flood liability of adjacent lands
- costs of required levee improvements and long-term maintenance

Funding sources and projects targeting specific species' biological needs also will help focus what sites to pursue. One overarching goal of restoration is to create a diverse mosaic of interconnected habitat types; therefore, the site characteristics presented in Table 1 would be considered with that goal of restoration, as well as the type of restoration that had already occurred. Restoration sites also would be selected based on their ability to contribute to the restoration acreage goals for each region shown in Table 2.

The total amount of existing managed wetlands and uplands that could be affected by tidal restoration and managed wetland activities is 52,112 acres. The Marsh has been divided into four regions based on listed species locations for purposes of this analysis. The tidal wetland restoration acreages are divided by region to achieve the total CALFED goal as described above and contribute to the Service's tidal wetlands restoration goals. The Service *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* was used to determine the goal of the percentage of restoration acreage per region. Table 2 shows the restoration goals for each region. The SMP includes the continued implementation of and increased frequency of some managed wetland activities and the implementation of new managed wetland activities on the balance of 52,112 acres that is not restored.

Table 1. Tidal Wetland Restoration Land Acquisition Considerations

Site Characteristic	Considerations
Species and Habitats	Historical geographic ranges and current populations of species Abundance of nonnative invasive species Ability to support multiple habitat types following restoration Inclusion in recovery plan Presence of listed species Connectivity to adjacent existing tidal wetlands Absence of existing or proposed industrial facilities in vicinity Presence of upland transition
Waterfowl	Existing suitability for supporting waterfowl populations Suitability for supporting waterfowl populations when restored
Recreation	Potential for recreationally important wildlife distributions and habitat use in surrounding areas Potential for, and extent of, public access Potential for disturbance to private property
Site Elevation	Amount of imported fill material and grading required Degree of subsidence and the ability to reverse subsidence through natural sedimentation and vegetation colonization/expansion (peat accumulation and sediment trapping) to promote functional, self-sustaining tidal wetlands plain elevations with natural upland transitions
Water Quality	Potential for brackish water intrusion into the Delta Potential for black water (low–dissolved oxygen) conditions Potential for adverse or beneficial effects on Delta, Suisun, and local salinity
Levees	Currents, winds, adjacent properties, extant channel networks, topography, etc., in selecting the location and size of levee breaches The extent to which the land requires flood protection levees to protect adjacent landowners Potential flood liability when tidal action is restored
Estimated Costs	Costs of acquisition and restoration Interim management costs Long-term operations and maintenance needs Cost of upgrading interior levees to exterior levees Cost of maintaining and/or rehabilitating exterior levees Costs of maintaining levee access for construction/maintenance

Site Characteristic	Considerations
Landscape Position	Potential for site to accommodate sea level rise Adjacent land uses Presence of infrastructure (e.g., transmission lines, rail lines, roads) Relative position in relation to other planned or implemented restoration sites
Cultural Resource Potential	Presence or absence of known cultural resources Location of potential restoration areas with respect to areas sensitive for the presence of buried and surface-manifested cultural resources

Table 2. Total Restoration Acreages and Percentages per Region

Region	SMP Target for Tidal Wetland Restoration*	Percentage of Existing Managed Wetlands That Would Be Restored to Tidal Wetland under the SMP
Region 1	1,000–1,500	8.4%–12.6%
Region 2	920–1,380	12.6%–18.9%
Region 3	360–540	12.1%–18.1%
Region 4	1,720–2,580	6.0%–9.0%
Total	**5,000–7,000**	

* The targets were developed for each region based on the different habitat conditions within each region to provide the range of environmental gradients necessary to contribute to the recovery of listed species. These targets complement and are consistent with the *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California*. As described in the implementation strategy in the EIS/EIR the SMP agencies will track these targets.

Note: Adjustments to the AMP may result in changes to the targets in each region.

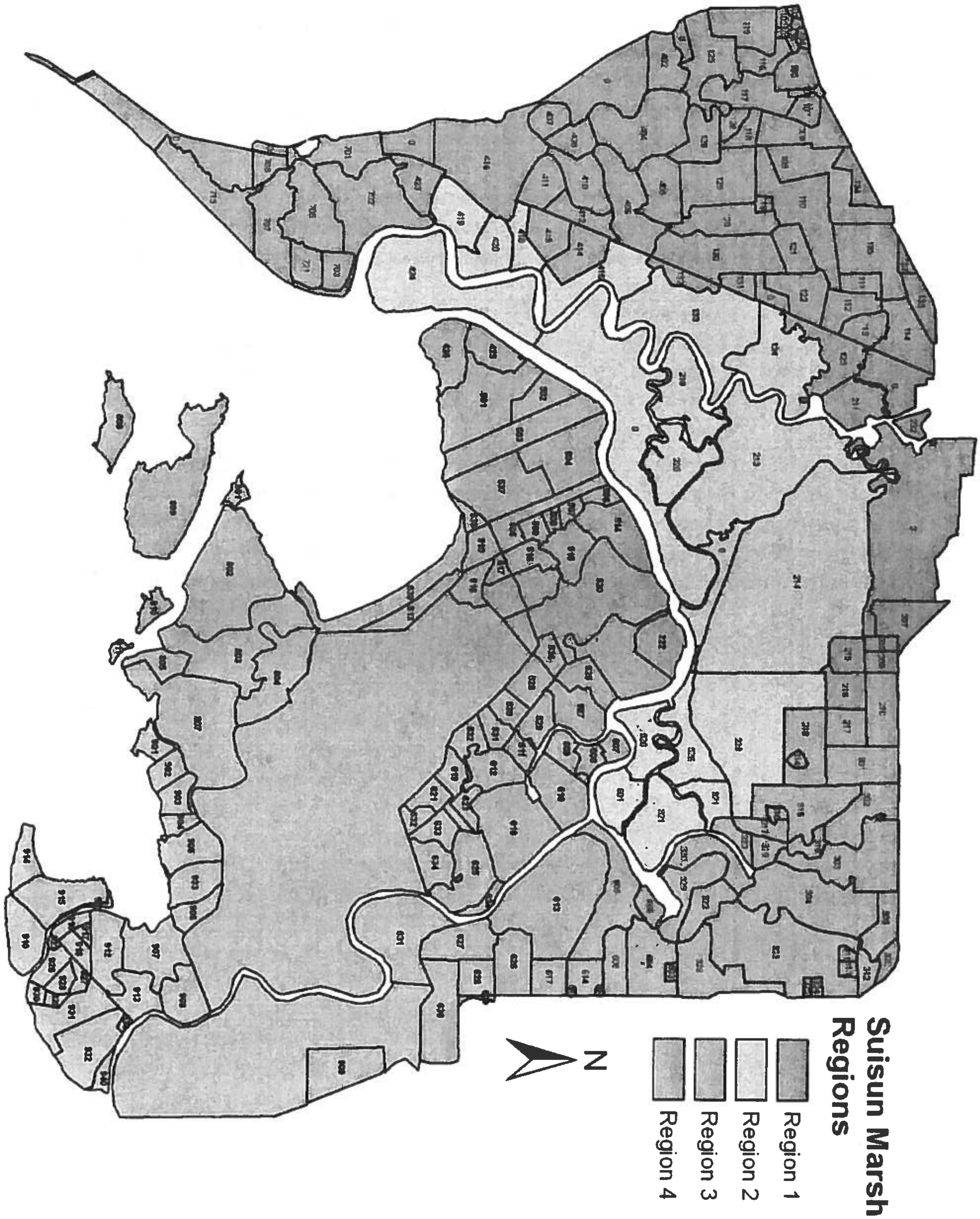


Figure 2
Regions

Moist soil management likely would be implemented during the growing season to promote the natural production of desired wetland plant species. Depending on site elevations and local salinity regime, pre-breach managed plant communities may persist following restoration of tidal action, or they may be sacrificial. Establishment of vegetation communities prior to inundation is expected to contribute suitable habitat immediately for some species, to discourage establishment of nonnative species upon inundation, to provide for early subsidence reversal, and to help capture suspended sediment once the site is restored to tidal action. Establishment of these vegetation communities is likely to increase the rate at which the tidal wetland matures, and could occur on the levees or in other areas of the restoration site.

Maintenance of levees and water control structures may also be required during the period prior to restoration of tidal action. Maintenance activities would follow the methods and approaches employed for the diked, managed wetlands. The extent of maintenance required would depend upon conditions at the time of acquisition and changes in those conditions that occur over time.

Selecting Breach Location(s) at Restoration Site

Restoration would be accomplished by breaching and/or lowering existing exterior levees to restore tidal inundation. Breaching levees would occur after ground-disturbing activities are completed and in the summer when covered fish species are not present. Depending on site-specific goals, levee modifications would be made in various ways by manipulating the opening width, depth, and/or slope angle. Breach edges may require scour protection with rock, geotextiles, or piles. Alternatively, long reaches of levee may be graded down to lower elevations—most likely between mean sea level and Mean Higher-High Water (MHHW). Material would be used to create topographic variability and encourage diverse plant communities and shallow tidal habitat. Breach location, number, and size would be chosen based on two considerations.

In general breaches on larger channels or multiple breaches would reduce the effects of the increased tidal flows on tidal elevations and velocities. If feasible based on site-specific conditions, breach locations would be located in areas that have minimal or no existing tidal wetlands on channel berms or in locations where the tidal wetland habitat value is lowest (e.g., riprap levee sections).

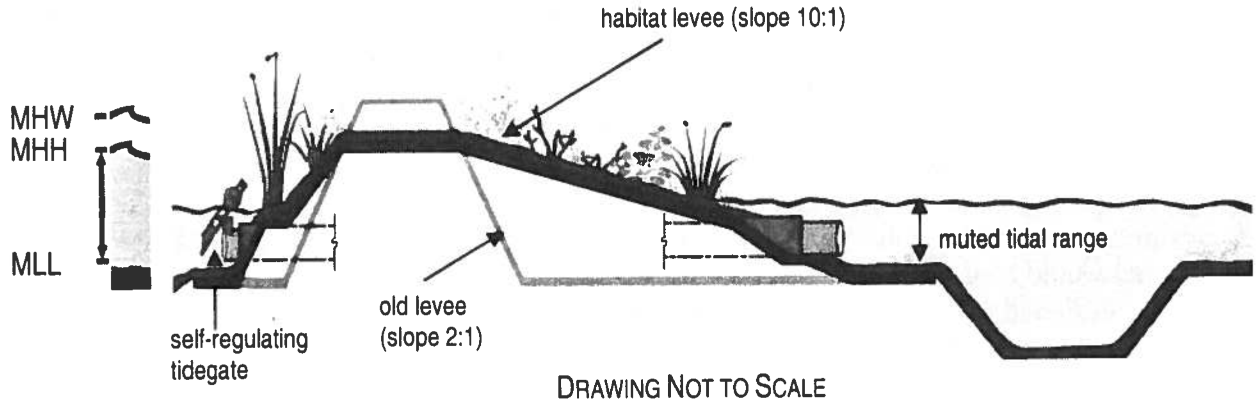
The first consideration is to maximize the ecological benefits of the restoration. Considerations would include ability to reconnect existing tidal channel networks from the site's history as a tidal marsh if those channels remain, providing suitable connectivity to the tidal source waterways, orientation relative to winds and currents to promote natural sedimentation and access to aquatic organisms, and constructability. The second consideration is to minimize upstream tidal muting, tidal elevation changes, impacts on increased salinities, slough channel scour, and hydraulic changes, and restoration projects would be designed to ensure that changes in tidal flows remain below about 1 foot per second (fps).

As part of each site-specific restoration action, project proponents would use an accurate tidal hydraulics and salinity model (e.g., the RMA Bay-Delta model) to simulate the proposed action to ensure the impacts on scour, sedimentation, salinity, and other hydraulic processes do not exceed those described in the BA for this project. This information would be used to adjust designs of restoration projects and other activities to minimize adverse impacts on tidal elevations and velocities, or other site-specific characteristics, in the restoration site and/or in Marsh channels adjacent to restoration projects; minimize salinity effects at upstream Delta locations; and potentially create benefits related to scour and sedimentation.

Upgrading or Constructing New Exterior Levees

To protect adjacent properties from an increased risk of flooding, existing exterior levees may be upgraded or new exterior levees constructed prior to breaching the levee. These new or upgraded levees would include brush boxes or other biotechnical wave dissipaters to protect the levee from wind and wave erosion.

Habitat levees that include benches or berms also may be constructed, which would provide similar wind and wave-action protection and opportunities for establishment of high marsh/upland transition habitat (Figure 2).



MHW = Mean High Water, MHH = Mean High High, MLL = Mean Low Low

Figure 3. Habitat Levee

The construction of habitat levees would depend on cost and availability of fill. Habitat levees are low, wide, gently sloping vegetated levees, which may be overtopped during storm surges without significant erosion or destabilization. Actual details of the location, number, and specifications of levees will be identified on a site-specific basis as habitat restoration projects are developed. The levee designs will be engineered appropriately at the time of the site selection. The upper substrate or upper layer of the habitat levee would be composed of non-compacted material that would be suitable for planting and establishment of marsh vegetation. The levees created as part of tidal habitat restoration will have an extension of the levee berm on the bay side (i.e., on the restoration project side). The standard section of levee (e.g. base and crown) will be composed of the compacted material, but the extended berm will have non-compacted material and will be suitable for planting and the establishment of marsh vegetation. Habitat levees are designed to allow intermittent flooding, minimize dispersal and denning of terrestrial predators, reestablish facsimiles of marsh topographic gradients, accommodate natural patterns of debris deposition and shoreline disturbance, and provide wave energy buffers (Interagency Ecological Program 2007).

Habitat levees may be planted and seeded with native marsh species and/or allowed to colonize naturally with native and naturalized species. This habitat would promote intertidal zones and mudflats that support various species that rely on a gradually transitioning marsh plain. Habitat levee design and locations would vary by site but are expected to include the widening of existing interior levees by 15 to 30 feet with a gradual slope or the construction of new interior levees or islands. Specifically, these habitat levees would be designed to create mid- and high-marsh habitat for dependent species and would be guided at least partially by information obtained through the adaptive management process. It is expected that benches or berms designed to support habitat for these species would benefit many other species.

Habitat levees would be constructed from resources available at the time of construction and may include dredged channel material collected in bays and sloughs in the action area, dredged material from outside the action area, or material excavated in the tidal restoration area or other areas of the Marsh. Habitat levees would not include challenged materials as described in the mitigation monitoring and reporting plan for the Final EIS/EIR and environmental commitments.

Protection of Other Habitat Types

The SMP is not specifically intended to restore, protect, or enhance habitats beyond existing managed wetlands and properties acquired for tidal wetland restoration. However, the Principal Agencies recognize the importance of other habitats in the Marsh. As such, when properties are restored, the specific project proponent would protect sensitive habitats that may be located within the bounds of that property. In these instances, the following actions will be implemented as appropriate and feasible.

- Protect and enhance existing tidal wetland, vernal pool, riparian, and aquatic habitat functions and values by installing fencing to enable improved grazing management.

- Maintain trees wherever feasible, which provide limited roosting and nesting habitat for raptors, herons, egrets, and other native species in the Marsh.

- Modify and/or set back existing levees to expand the floodplain and restore natural riparian processes.

- Remove and/or modify barriers to upstream fish movement/migration within the action area.

- Plant native riparian trees and shrubs to increase habitat diversity and structure.

- Identify sources of low–Dissolved Oxygen (DO) water in sloughs and bays, and where feasible, implement strategies for increasing DO concentrations in receiving waters.

- Increase natural connectivity between the shallow high productivity marsh plain habitat and adjacent nutrient-rich channels and sloughs.

A certain portion of the restored areas are expected to become tidal aquatic habitat. The percent cover of tidal aquatic habitat within existing tidal wetlands areas (Rush Ranch, Lower Joice Island, and Hill Slough) in Suisun Marsh was estimated based on existing tidal wetlands, the Integrated Regional Wetland Monitoring Pilot Project (BREACH), and geographic information systems (GIS) and site visits. The analysis demonstrated that tidal aquatic habitat accounts for an average of approximately 5 to 15 percent of the total area of established tidal wetlands. Assuming this relationship holds true for future restored tidal wetlands, under the proposed action, 5,000 to 7,000 acres would be restored and would result in an increase in tidal aquatic and open water habitat of approximately 250 to 1,050 acres. This acreage estimate does not limit the amount of restoration that could occur.

Over the 30-year SMP implementation period, it is expected that the exact habitat amount provided by restored areas would depend on the existing elevation of the site, sedimentation rates and accretion, and sea level rise. The amount of subtidal aquatic habitat is expected to decrease gradually as sediment accretes and emergent tidal vegetation is established at each restoration site. As this happens, the site would be restored to a tidal wetland. However, the rate of accretion and the rate of sea level rise will dictate the end result, and the actual timeframe for such progression depends on the site-specific conditions, but significant geomorphic changes are decadal. Locations with large subsidence and low sediment concentrations may never return to emergent marsh and instead remain as open water. Adaptive management also will be used to improve restoration designs to achieve desired results.

Implementation Strategy

The SMP would contribute to recovery of many species in the Marsh, and implementation of the entirety of the Proposed Action, including both the restoration activities and managed wetland activities, is integral to the implementation strategy. As such, both restoration and managed wetland activities would proceed simultaneously, and implementation will be planned to carefully monitor and mitigate the effects of SMP activities. The managed wetland activities would be implemented only if at least one third of the total restoration activities would be implemented in each of the 10-year increments. Therefore, it is expected that under the Proposed Action, for example, 1,600–2,300 acres in the Marsh would be restored by year 10, an additional 1,600–2,300 acres would be restored by year 20, and the full 5,000–7,000 acres would be restored by year 30. This would ensure that all actions would be implemented in a timeframe similar to that of the impacts and that restoration efforts would contribute toward recovery throughout the plan implementation period.

If these 10-year incremental SMP restoration goals are met, both the managed wetland activities and tidal restoration would continue to ensure that the SMP goals would be met. Options for addressing conditions in which these incremental goals are not met are described below. Under this strategy, the restoration and managed wetland goals would be achieved concurrently.

1. Implementing actions that apply the understandings and test hypotheses contained in the conceptual models.

2. Collecting science-based field data at implementation areas and in any other needed locations that specifically evaluate the hypotheses being tested.

3. Interpreting these data.

4. Reevaluating goals and objectives, as appropriate, updating conceptual models and hypotheses, and adjusting subsequent implementation actions and reviewing the progress of restoration and managed wetland enhancement to determine whether changes in the AMP are necessary.

This process allows for implementing tidal marsh restoration in the face of uncertainty, with an aim to reducing uncertainty over time through system monitoring. In this way, decision making simultaneously meets resource objectives and accrues information needed to improve future management. The information produced through adaptive management of the SMP will permit changes to be made that will assist in the design of future steps. Adaptive management will assist project proponents in understanding the restored system and will aid in their ability to explain their management actions to stakeholders. As such, the AMP is an important component of the implementation strategy and will be used throughout the 30-year implementation period. Adaptive management of implementing the SMP will be conducted consistent with available funding.

Reporting

To track the progress of restoration and managed wetland activities that the SMPA agencies (Reclamation, SRCD, DWR, and DFW) are implementing, those agencies will submit implementation status reports annually to DFW, NMFS, the Service, and other regulatory agencies that would describe the implemented restoration and managed wetland activities. Other project proponents will coordinate with the SMPA Principal agencies and submit required project status and monitoring reports. Additional activities, including monitoring, application of adaptive management, results of adaptive management, and any activities that are being planned, would be submitted no less frequently than every other year.

The SMPA agencies will report the status of restoration and managed wetlands in each report. In general, reports will include the following information:

1. The location, extent, and timing of land acquisition for tidal restoration.

2. The location, extent, and timing of restoration planning, protection, enhancement, restoration, or creation of tidal wetlands.

3. Status of restoration planning for acquired properties.

4. Descriptions of conservation agreements, lands acquired in fee title, interagency memorandums of agreement, and any other agreements entered into for the purposes of protecting, enhancing, or restoring tidal or managed wetlands.

5. Descriptions of the previous year's managed wetland activities, including a description of how actual impacts compare to impacts analyzed in the SMP EIS/EIR and BOs.

6. Descriptions of monitoring results, including any actions that will be implemented as a result of this information.

7. A summary of how implemented activities compare to SMP goals in terms of habitat types, managed wetland operations, acreage goals, and species composition.

If any report indicates that restoration or managed wetland targets are not being met or have the potential not to be met, the SMPA agencies along with NMFS and the Service will convene to determine how to proceed to get plan implementation on track. The mutually agreeable plan of action may include a range of potential solutions such as:

1. Changes to the manner in which the SMP is implemented.

2. Temporarily or permanently adjusting certain SMP provisions through an amendment or other process.

3. Slowing or stopping aspects of the managed wetland activities permit issuance until restoration catches up with impacts.

Programmatic Conservation Measures

The following BMPs and conservation measures will be implemented during tidal wetland restoration activities.

Standard Design Features and Construction Practices

In preparing the SMP, the Principal Agencies determined the following design features and construction practices to be potentially feasible and implementable measures to reduce or offset certain short-term, construction-related effects. These measures would be implemented at a site-specific level, as appropriate, depending on the location of construction, potential effects of the specific project, and surrounding land uses. The identified measures are:

1. Controlling construction equipment access and placement of fill to maintain acceptable loading based on the shear strength of the foundation material.

2. Minimizing degradation of wetland habitats where feasible, i.e., work will be conducted from levee crown.

3. Implementing BMPs and minimization measures to minimize water quality impacts such as temporary turbidity increases. See Erosion and Sediment Control Plan below.

4. Inspecting all equipment for oil and fuel leaks every day prior to use. Equipment with oil or fuel leaks will not be used within 100 feet of wetlands.

5. Requiring the construction contractor to remove all trash and construction debris after construction and to implement a revegetation plan for temporarily disturbed vegetation in the construction zones.

6. Maintaining waste facilities. Waste facilities include concrete wash-out facilities, chemical toilets, and hydraulic fluid containers. Waste will be removed to a proper disposal site.

Access Point/Staging Areas

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

2. Staging areas will have a stabilized entrance and exit and will be located at least 100 feet from bodies of water unless site-specific circumstances do not provide such a setback, in which case the maximum setback possible will be used. 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. An alternate site will be selected.

3. Where possible, no equipment refueling or fuel storage will take place within 100 feet of a body of water. Vehicle traffic will be confined to existing roads and the proposed access route. Ingress and egress points will be clearly identified in the field using orange construction fence. Work will not be conducted outside the designated work area.

Erosion and Sediment Control Plan

1. For projects that could result in substantial erosion, project proponents 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.

2. An erosion control plan will be developed to ensure that during rain events construction activities do not increase the levels of erosion and sedimentation. This plan will include the use of erosion control materials (baffles, fiber rolls, or hay bales; temporary containment berms) and erosion control measures such as straw application or hydroseeding with native grasses on disturbed slopes, and floating sediment booms and/or curtains to minimize any impacts that may occur from increased mobilization of sediments.

Stormwater Pollution Prevention Plan

For projects that involve grading or disturbance of more than 1 acre, a Stormwater Pollution Prevention Plan (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. The project proponents and/or their contractor(s) will develop and implement a spill prevention and control plan as part of the SWPPP to minimize effects of spills of hazardous, toxic, or petroleum substances during construction of the project. 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:

1. A description of potential pollutants to stormwater from erosion.

2. Management of dredged sediments and hazardous materials present on site during construction (including vehicle and equipment fuels).

3. Details of how the sediment and erosion control practices comply with State and Federal water quality regulations.

4. A description of potential pollutants to stormwater resulting from operation of the project.

Hazardous Materials Management Plan

1. A hazardous materials spill plan will be developed prior to construction of each action. The plan will describe the actions that will be taken in the event of a spill. The plan also will incorporate preventive measures to be implemented (such as vehicle and equipment staging, cleaning, maintenance, and refueling) and contaminant (including fuel) management and storage. In the event of a contaminant spill, work at the site immediately will cease until the contractor has contained and mitigated the spill. The contractor will immediately prevent further contamination, notify appropriate authorities,

and mitigate damage as appropriate. Adequate spill containment materials, such as oil diapers and hydrocarbon cleanup kits, will be available on site at all times. Containers for storage, transportation, and disposal of contaminated absorbent materials will be provided on the project site.

2. The project proponents and their contractors will not use any hazardous material in excess of reportable quantities, as specified in Title 40, CFR, Part 355, Subpart J, Section 355.50, unless approved in advance by the Office of Emergency Services (OES), and will provide to the OES in the annual compliance report a list of hazardous materials contained at a project site in reportable quantities.

3. For large-scale projects, the project proponents will prepare a Risk Management Plan (RMP). The RMP will be submitted to the U.S. Environmental Protection Agency and will reflect the comments of the Solano County Certified Unified Program Agency. The plan will describe procedures, protective equipment requirements, and training and contain a checklist. At least 60 days prior to the start of construction, or a lesser period of time as mutually agreed upon, the project proponents will provide the final RMP and the safety plan to the Certified Property Manager.

Biological Resources Best Management Practices

The following section outlines the potential BMPs that would be implemented to avoid or minimize impacts on biological resources. The BMPs that are implemented for each specific project would depend on the project location, potential to adversely affect biological resources, and guidance and requirements set forth by resource agencies through informal and formal consultations. Conservation measures, including an erosion and sediment control plan, SWPPP, hazardous materials management plan, spoils disposal plan, and environmental training content will be reviewed by the Service and DFW 30 days prior to construction activities starting at a restoration site. Any adverse effects on special-status species or critical habitat attributable to construction activities may require implementation of additional avoidance or mitigation measures. The Service will be consulted and additional avoidance and mitigation measures may be implemented on a site-specific basis.

General Best Management Practices

1. Native vegetation trimmed or removed on the project site will be stockpiled during work. After construction activities, when removal of temporary mats and construction-related materials and application of native seed mix have been completed, stockpiled native vegetation will be reapplied over temporarily disturbed wetlands to provide temporary soil protection and as a seed source.

2. Where vegetation removal is required, work will be conducted using hand-held tools to enable wildlife to escape. Vegetation will be cut starting at the outside edge (nearest unvegetated or disturbed areas) working toward the project limits to allow wildlife opportunity to escape toward appropriate cover.

3. Removal of vegetation in wetland habitat will be conducted with a Service-approved biologist present. This monitor will watch for special-status wildlife species and temporarily stop work if special-status species are encountered. Wildlife will be allowed to escape before work is resumed. Service-approved biologist with the appropriate qualifications to handle special-status species will be allowed to move special-status species to safe locations as permitted by the terms of their credentials.

4. Temporarily affected (restored in less than 1 year) wetlands will be restored by removing construction-related debris, and trash. Affected areas will be seeded with a certified weed-free native seed mix, as provided in the revegetation plan developed in cooperation with DFW. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.

Worker Training

1. The Service-approved biologist will provide training to field management and construction personnel on the importance of protecting environmental resources. Communication efforts and training will take place during preconstruction meetings so that construction personnel are aware of their responsibilities and the importance of compliance.

2. Construction personnel will be educated on the types of sensitive resources located in the action area and the measures required to avoid impacts on these resources. Materials covered in the training program will include environmental rules and regulations for the specific project and requirements for limiting activities to the construction right-of-way and avoiding demarcated sensitive resource areas. Training seminars will 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.
   - Conservation measures.
   - Emergency procedures.

3. If new construction personnel are added to the project, the contractor will ensure the new personnel receive the mandatory training before starting work. A representative will be appointed during the employee education program to be the contact for any employee or contractor who might inadvertently kill or injure a listed species or who finds a dead, injured, or entrapped individual. The representative's name and telephone number will be provided to the Service before the initiation of ground disturbance.

Biological Monitoring

The project proponents will provide a Service-approved biologist 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 1602; project plans [SWPPP]; and EIS/EIR mitigation measures).

1. The Service-approved biologist will determine the location of environmentally sensitive areas adjacent to each construction site based on mapping of existing land-cover types and special-status plant species. If such maps are not available, the biologist/environmental monitor will map and quantify the land-cover types and special-status plant populations in the proposed project footprint prior to construction.

2. To avoid construction-phase disturbance to sensitive habitats immediately adjacent to the action area, the Service-approved biologist will identify the boundaries of sensitive habitats and add at least a 100-foot buffer, where feasible, using orange construction barrier fencing. The fencing will be mapped on the project designs. 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 sediment off site. The sensitive habitat and erosion-control fencing will be installed before any construction activities begin and will be maintained throughout the construction period.

3. The Service-approved biologist will ensure that dredging operations avoid all sensitive habitat areas outside direct project footprint, including patches of tidal wetland along channel banks to the extent practical.

4. Plants for revegetation will come primarily from natural recruitment. Plants imported to the restoration areas will come from local stock, and to the extent possible, local nurseries. Only native plants will be used for restoration efforts.

Special-Status Plant Species Protection

1. A complete botanical survey of the action area will be completed using the Service's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (September 23, 1996) and DFG's *Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened, and Endangered Plants and Natural Communities* (May 8, 2000).

2. Special-status plant surveys required for project-specific permit compliance will be conducted for 2 years prior to initiating construction. The purpose of these surveys will be to verify whether the locations of special-status plants identified in previous surveys are extant, identify any new special-status plant occurrences, and survey any portions of the action area not previously identified. The extent of mitigation of direct loss of or indirect impacts on special-status plants will be based on these survey results.

3. Locations of special-status plants in proposed construction areas will be recorded using a global positioning system (GPS) unit and flagged.

4. If initial screening by a Service-approved biologist identifies the potential for special-status plant species to be directly or indirectly affected by a specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species.

5. Access may be restricted around restoration sites where necessary to protect special-status plant populations through appropriate management plans and the design of the tidal marsh restoration. This may include signage, buffers, seasonal restrictions, and design or no access, depending on the sensitive species in question.

6. The project proponents will oversee installation of a temporary, plastic mesh–type construction fence (Tensor Polygrid or equivalent) at least 4 feet (1.2 meters) tall around any established buffer areas to prevent encroachment by construction vehicles and personnel. A Service-approved biologist will determine the exact location of the fencing. The fencing will be strung tightly on posts set at maximum intervals of 10 feet (3 meters) and will be checked and maintained weekly until all construction is complete. The buffer zone established by the fencing will be marked by a sign stating:

   This is habitat of [the special-status species being protected], a [identify the species' status] plant species, and must not be disturbed. This species is protected by [the ESA of 1973, as amended/CESA/California Native Plant Protection Act].

7. No construction activity, including grading, will be allowed until condition number 6 is satisfied.

8. No grading, clearing, storage of equipment or machinery, or other disturbance or activity will occur until all temporary construction fencing has been inspected and approved by the qualified biologist.

9. Any special-status species observed during surveys will be reported to the Service and DFW so the observations can be added to the California Natural Diversity Database (CNDDB).

Special-Status Wildlife Species Protection

1. If individuals of listed wildlife species may be present and subject to potential injury or mortality from construction activities, a Service-approved biologist will conduct a preconstruction survey. If a listed wildlife species is discovered, construction activities will not begin in the immediate vicinity of the individual until the Service is contacted and the individual has been allowed to leave the construction area.

2. Minimum qualifications for the Service-approved biologist will be a 4-year college degree in biology or related field and 2 years of professional experience in the application of standard survey, capture, and handling methods for the species of concern. However, in the case of DFG fully protected species, no capture or handling will be done.

3. Any special-status species observed during surveys will be reported to the Service and DFW so the observations can be added to the CNDDB.

Salt Marsh Harvest Mouse

1. A Service-approved biologist, with previous salt marsh harvest mouse monitoring and surveying experience, will conduct preconstruction surveys for the mouse prior to project initiation. If a salt marsh harvest mouse is discovered, construction activities will cease in the immediate vicinity of the individual until the Service is contacted and the individual has been allowed to leave the construction area.

2. Disturbance to wetland vegetation will be avoided to the extent feasible in order to reduce potential impacts on salt marsh harvest mouse. If wetland plants cannot be avoided, it will be removed by hand (and/or by a another Service- and DFW-approved method). The Service-approved biologist will be on site to monitor all wetland vegetation removal activities.

3. The upper 6 inches of soil excavated within salt marsh harvest mouse habitat will be stockpiled separately and replaced on top of the backfilled material.

4. Vegetation will be removed using hand tools (and/or by another Service and DFW-approved method).

5. Vegetation must be cleared to bare ground.

6. Vegetation should be removed from all areas (driving roads, action area, or anywhere else that vegetation could be stepped on).

7. Work will be scheduled to avoid extreme high tides when there is potential for salt marsh harvest mouse to move to higher, drier grounds. All equipment will be staged on existing roadways away from the project site when not in use.

8. To prevent salt marsh harvest mouse from moving through the project site during construction, temporary exclusion fencing will be placed around a defined work area before construction activities start and immediately after vegetation removal. The fence should be made of a material that does not allow salt marsh harvest mouse to pass through or over, and the bottom should be buried to a depth of 2 inches so that mice cannot crawl under the fence. Any supports for the salt marsh harvest mouse exclusion fencing must be placed on the inside of the project area.

9. Prior to the start of daily construction activities during initial ground disturbance, the Service-approved biologist will inspect the salt marsh harvest mouse-proof boundary fence to ensure that it has no holes or rips and the base is still buried. The fenced area also will be inspected to ensure that no mice are trapped in it. Any mice found along and outside the fence will be closely monitored until they move away from the construction area.

10. If a salt marsh harvest mouse is discovered, construction activities will cease in the immediate vicinity of the individual until the Service is contacted and the individual has been allowed to leave the construction area.

11. A Service-approved biologist with previous salt marsh harvest mouse experience will be on site during construction activities occurring in wetlands. The biologist will document compliance with the project permit conditions and avoidance and conservation measures. The Service-approved biologist has the authority to stop project activities if any of the requirements associated with these measures is not being fulfilled. If the Service-approved biologist has requested work stoppage because of take of any of the listed species, the Service and DFG will be notified within 1 day by email or telephone.

California Clapper Rail

1. Preconstruction surveys for California clapper rail will be conducted, by a Service-approved biologist, at and adjacent to areas of potential tidal and managed wetlands habitats for California clapper rail. The surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. Survey methods will follow the protocols used by DFW during previous rail surveys in Suisun Marsh (DFG 2007) and as decribed below. The specific project proponent will implement the following survey protocols.

2. Surveys will be initiated sometime between January 15th and February 1st. A minimum of four surveys will be conducted. The survey dates will be spaced at least 2 to 3 weeks apart and will cover the time period from the date of the first survey through the end of March or mid-April. This will allow the surveys to encompass the time period when the highest frequency of calls is likely to occur.

3. Listening stations will be established at 200-meter intervals along roads, trails, and levees that will be affected by plan implementation.

4. California clapper rail vocalization recordings will be played at each station; each listening station will be occupied for a period of 10 minutes, followed by 1 minute of playing California clapper rail vocalization recordings, then followed by an additional minute of listening.

5. Surveys will be conducted at sunrise and sunset.

6. Sunrise surveys will begin 60 minutes before sunrise and conclude75 minutes after sunrise (or until presence is detected).

7. Sunset surveys will begin 75 minutes before sunset and conclude 60 minutes after sunset (or until presence is detected).

8. Surveys will not be conducted when tides are greater than 4.5 National Geodetic Vertical Datum (NGVD) or when sloughs and marshes are more than bankfull.

9. California clapper rail vocalizations will be recorded. A GPS receiver will be used to identify call location and distance. The call type, location, distance, and time will be recorded on a data sheet.

10. If California clapper rail are present in the immediate construction area, the following measures will apply during construction activities.

    A. To minimize or avoid the loss of individual California clapper rails, activities within or adjacent to California clapper rail habitat will not occur within 2 hours before or after extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge), when the marsh plain is inundated, because protective cover for California clapper rails is limited and activities could prevent them from reaching available cover.

    B. To minimize or avoid the loss of individual California clapper rails, activities within or adjacent to tidal marsh areas will be avoided during the California clapper rail breeding season from February 1 through August 31 each year unless surveys are conducted to determine California clapper rail locations and California clapper rail territories can be avoided.

    C. If breeding California clapper rails are determined to be present, activities will not occur within 700 feet of an identified calling center. If the intervening distance across a major slough channel or across a substantial barrier between the California clapper rail calling center and any activity area is greater than 200 feet, it may proceed at that location within the breeding season.

    D. *Exception:* Only inspection, maintenance, research, or monitoring activities may be performed during the California clapper rail breeding season in areas within or adjacent to California clapper rail breeding habitat with approval of the Service and DFW under the supervision of a qualified biologist.

California Least Tern

1. No activities will be performed within 300 feet of an active California least tern nest during the California least tern breeding season, April 15th to August 15th (or as determined through surveys).

2. *Exception:* Only inspection, maintenance, research, or monitoring activities may be performed during the least tern breeding season in areas within or adjacent to least tern breeding habitat with approval of the Service and DFW under the supervision of a qualified biologist.

Delta Smelt

In-water construction activities, such as levee construction and levee breaching, would occur during the in-channel work window of September 1 through November 30.

Construction Period Restrictions

Timing of restoration construction activities will depend on the type of activity, presence or absence of sensitive resources, tides, and/or water management in wetlands. In general, landside work will occur between July and September. In-water activities will be conducted during the months of September through November. Working outside this window would require additional approvals from the resource agencies. Other timing restrictions may be necessary during the hunting season, such as limiting work to days other than Saturday, Sunday, and Wednesday.

Nonnative Plant Control

The project proponents will include the following measures in the project construction specifications to minimize the potential for the introduction of new noxious weeds and the spread of weeds previously documented in the action area.

1. Use certified, weed-free, imported erosion control materials (or rice straw in upland areas).

2. Coordinate with the county agricultural commissioner and land management agencies (listed above) to ensure that the appropriate BMPs are implemented.
3. Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weeds.

4. Clean equipment at designated wash stations after leaving noxious weed infestation areas.

5. Treat isolated infestations of noxious weeds identified in the action area with Service-approved eradication methods at an appropriate time to prevent further formation of seed, and destroy viable plant parts and seed.

6. Minimize surface disturbance to the greatest extent possible.

7. Seed all disturbed areas with certified weed-free native mixes, as provided in the revegetation plan developed in cooperation with DFW. Mulch with certified weed-free mulch. Rice straw may be used to mulch upland areas.

8. Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing.

9. 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.

Description of the Project-Level Proposed Action for Managed Wetland Activities

Background

The SMP includes continued and improved operation and maintenance of the managed wetlands over the 30-year planning period. These actions are at the project level because the specific effects of the activities are known well enough to thoroughly describe and analyze.
The managed wetlands of Suisun Marsh are managed to provide wintering waterfowl habitat but also provide habitat for a variety of resident and migratory waterfowl and shorebirds and other native and special-status species.

Managed Wetland Operations

Wetland management involves diversion and subsequent draining of tidal waters into and out of managed wetlands. External levees separate managed wetlands from bays and tidal sloughs and internal levees separate adjacent managed wetlands. DFW and private landowners use various structures, such as levees, ditches, water control facilities, grading, pumps, and fish screens to manipulate the timing, duration, and depth of flooding to meet wetland management objectives. The operations schedule for managed wetlands in Suisun Marsh is driven by a number of factors, including water year type, location within the marsh, and water control facilities. Most wetland managers in Suisun Marsh begin flooding their wetlands in late September and October in preparation for the fall waterfowl migration. Because most of the wetlands are at or below mean tide elevation, gravity flow can be used, whenever possible, to fill and drain the wetlands. The wetlands are filled during flood tides when the water can flow through the water control structures into the managed wetlands, and the wetlands are drained during ebb tides when water can flow out.

To allow the managed wetlands to fill to an average depth of 8 to 12 inches, the inlet gates are opened and the drain gates are closed during initial flood-up. As such, water diversions may operate for less than 12 hours a day (during the two high tide cycles). The volume and velocity of water diversions in the wetlands vary greatly based on the location and diameter of the intake, how much the water control structure is open, and the head pressure created by the high-tide stage.

In mid-October to late January, following initial flood-up, water is circulated through wetlands by diverting from adjacent sloughs on flood tides and draining at ebb tides. Compared to the initial flood-up period, relatively small amounts of water are exchanged between the sloughs and the wetlands during circulation. Water is moved through the managed wetlands to maintain water quality and depth. Increased circulation or complete drainage can be required in October if conditions that contribute to poor water quality or high mosquito production arise. These conditions depend on the weather during the fall season and requirements of the Solano County Mosquito Abatement District. Following waterfowl season, managed wetlands are drained in February as spring flood-up begins (February and March). Delta outflow, spring weather, regulatory diversion restrictions, and drainage capabilities influence when most wetlands can be drained and re-flooded. Following spring flood-up, wetlands undergo one to two leach cycles, which consist of rapid draining and flooding to half the fall water level, to remove surface salts from the wetland soils. Once these leach cycles are complete, water is diverted only to maintain water level and to provide good water quality in the wetlands. In April, small volumes of water are diverted for circulation or wetlands are draining. Water remaining in the wetlands in June/July is drained to allow vegetative growth and routine maintenance activities during the summer work season. From July to September, water diverted into managed wetlands is to maintain water levels and water quality in permanent wetlands.

Managed Wetland Maintenance Activities

The intended outcomes of the managed wetland activities described below are to maintain and improve habitat conditions for native and special-status species and minimize or avoid adverse effects of wetland operations. For managed wetlands, the optimum flood and drain cycle is 30 days. The activities described below provide a suite of tools that can be used to maintain and improve levee stability and the 30-day flood and drain cycle. The SMP assumes that managed wetlands are enhanced by improving levees and the flood and drain cycle because it allows managed wetlands to be managed as effectively as possible in providing habitat for waterfowl. Managed wetland operations and levee maintenance would be adjusted over time in response to sea level rise. Exterior levees would be designed to accommodate future sea level rise, with the flexibility to add levee height in the future. Ongoing levee maintenance would maintain levee crown elevations as needed to continue protection from flooding associated with sea level rise. Managed wetlands also will be more difficult to drain by gravity at low tide, making water management more difficult. This can be offset mainly through increased use of pumps to drain managed wetland, with some clubs continuing to be gravity-drained but with more management options to take best advantage of every low tide.

The ability of managed wetlands to improve habitat also depends on the availability of lower-salinity water. DWR/Reclamation facilities and salinity stations are used to reduce water salinity and to distribute less-saline water to managed wetlands. These facilities and stations must be maintained in order to work as intended.

Many of the managed wetland activities described below are currently occurring in the Marsh. Some of the current activities would be modified, and new activities would be conducted. Many of the current activities would qualify for the SMPA PAI Fund, which is described below. Under the SMP, many of these activities would increase in frequency, primarily because of an increase in funding provided by the PAI Fund.

Currently Implemented Managed Wetland Activities

The RGP authorizes the DFW and the private landowners represented by the SRCD to complete approved work activities and place fill material in areas subject to Corps jurisdiction. The Corps has consulted with the Service on the previous RGP. The Corps recently consulted on the previous RGP with NMFS, which includes all activities currently implemented in the managed wetlands as described in this section, and issued a biological opinion associated with the previous RGP in 2008. The new permits will also include maintenance and repair activities on DWR's and Reclamations's facilities in the Suisun Marsh.

DFW and DWR will be responsible for ensuring that all authorized work done by its personnel or on its land is done in accordance with the RGP and this BO. Landowners working under the RGP are responsible for ensuring that all work they or their contractors do is in accordance with the terms and conditions of the RGP and this BO. The SRCD is responsible for compiling annual work applications, conducting the required monitoring, and compiling required year-end summary reports.

The SRCD works closely with a Corps representative to facilitate the approval of work activity requests for Suisun Marsh. Landowners must fill out a Corps Wetlands Maintenance Application and submit the application to the SRCD with maps showing the location of the proposed work. The SRCD reviews each application for accuracy, map quality, and to be sure that the work request does not exceed annual work limits (based on ownership acreages). The SRCD compiles this information and on the first day of each month submits the monthly proposed work application report to the Corps. The Corps then has 30 days to review and verify whether the proposed work is authorized by the RGP. Upon completion of this review, the Corps issues a monthly approval letter to the SRCD. When SRCD receives the Corps approval letter, it sends written notification to the requesting landowners that they are authorized to proceed with their proposed work. At the end of the work season, SRCD compiles an actual work completed report, which reconciles the proposed work activity and what is completed on each property. In addition to compiling the landowners' work requests, DFW and SRCD are responsible for notifying landowners of seasonal restrictions (for California clapper rail, Chinook salmon, and delta smelt), monitoring diversion closures, ensuring landowner compliance with diversion restrictions, and continuing to identify and seek funding for the construction of additional fish screens. Currently California least terns forage in the project area, however if they breed in the project area, then seasonal restrictions would occur to protect nesting birds. Periodically, less than 3.5 times per year (Table 4) a landowner identifies an urgent or unforeseen event that occurs outside the monthly application and approval process (e.g., water control failure or beaver hole running water through an exterior levee). When this occurs SRCD coordinates directly with the appropriate agency, depending on the location of the event, regarding work season restrictions, scope of work to remedy the event and considerations for any species potentially affected. For example, urgent and unforeseen levee repair associated with exterior levee rat hole damage is sometimes required in California clapper rail work season restriction areas (e.g., during the end of survey season to the end of the breeding season). In these circumstances SRCD receives authorization from the appropriate agency and records the occurrence and magnitude of the event. This information is ultimately included in the annual reports.

DFW, DWR, and landowners (as represented by SRCD) currently maintain their facilities and/or properties in the Marsh by implementing the actions listed below in Tables 1a and 1b. Additionally, Reclamation contributes funding to DWR to implement operations and maintenance of facilities that mitigate the effects of the CVP/SWP, including Roaring River Distribution System (RRDS), MIDS, Goodyear Slough Outfall, salinity stations, and other facilities and/or properties.

The list below is a comprehensive description of the activities conducted by these agencies and landowners in the Marsh, although the activities each implements depend on their individual facilities, properties, and other factors. The limits for work are shown in Table 1a. All activities would be implemented by DFW, landowners (as represented by SRCD), and/or DWR except as noted. A full description of each activity is provided following Tables 1a and 1b. Table 1a presents activities that would be performed on or at interior levees and thus have no potential to affect fish or aquatic habitat, and Table 1b presents those activities that would be performed on or at exterior levees with the potential to affect fish or aquatic habitat.

Table 1a. Currently Permitted Activities in the Managed Wetlands with No Potential to Affect Fish or Aquatic Habitat

Managed Wetland Activities	Existing Annual Activities Average, Low–High	Current Corps Permitted Annual Limits
Repair existing interior levees	29,228 cy,* 9,697–54,040 cy	443,000 cy
Core existing interior levees	6,380 cy, 2,022–15,108 cy	No limit
Grade pond bottoms for water circulation	147,377 cy, 79,750–228,546 cy	1,772,000 cy
Create pond bottom spreader V-ditches	40,403 feet, 14,500–72,300 feet	1,438,000 linear feet
Repair existing interior water control structures	24, 10–37	No limit
Replace pipe for existing interior water control structures or install new interior water control structures	20, 14–38	No limit
Install new blinds and relocate, replace, or remove existing blinds	38, 23–51	5 per ownership annually
Disc managed wetlands	2,552 acres, 1,837–3,100 acres	No limit
Install drain pumps and platforms	1, 0–2	No limit
Replace riprap on interior levees	50 cy, 0–300 cy	Obtained as needed
Remove floating debris from pipes, trash racks, and other structures	20 cy, 10–50 cy	Obtained as needed
Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on and interior levees	450 feet, 300–600 feet	Obtained as needed
Construct cofferdams in managed wetlands (considered interior activity because it is in the managed wetlands)	1 unit, 0–2 unit	Obtained as needed
Construct new interior ditch; clear existing interior ditches	49,456 cy, 9,724–69,022 cy	443,000 cy

*cy = cubic yards.

Table 1b. Currently Permitted Activities in the Managed Wetlands with Potential to Affect Fish or Aquatic Habitat

Managed Wetland Activities	Existing Annual Activities Average, Low–High	Current Corps Permitted Annual Limits
Repair existing exterior levees	43,902 cy, 28,622–87,232 cy	443,000 cy
Replace riprap on exterior levees	2,435 cy, 292–7,406 cy	Limited to replacement of existing riprap
Repair exterior water control structures (gates, couplers, and risers)	17, 8–28	No limit
Install or replace pipe for existing exterior flood or dual-purpose gate	11, 1–23	50 annually Marsh-wide
Install, repair, or re-install water control bulkheads	11, 3–21	No limit
Remove floating debris from pipes, trash racks, and other structures	20 cy, 10–50 cy	Obtained as needed
Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on exterior levees	450 feet, 300–600 feet	Obtained as needed
Repair and maintain Suisun Marsh salinity control gate	1, 0–2	Obtained as needed
Clean Roaring River Distribution System fish screen	Oct daily Nov–Sept weekly	No limit
Install new fish screen facilities	2 units, 0–5 units	Obtained as needed
Repair or replace salinity monitoring station	2 stations, 0–18 stations	Obtained as needed
Relocate, install, or remove salinity station	1 station, 0–5 stations	Obtained as needed

cy = cubic yards.

The existing RGP describes limits on the volume of work activities based on the acreage of each participating parcel. The volume is regulated on a sliding scale for each activity. Table 2 shows the permitted work for levees.

Table 2. Volume of Work Allowed versus Parcel Size

Size of Individual Ownerships (Acreage)	Exterior Levees (Cubic yards)	Interior Levees (Cubic yards)
Under 50	1,000	1,000
50–249	2,000	2,000
250–499	3,000	3,000
500–749	4,000	4,000
750–999	5,000	5,000
1,000 and over	6,000	6,000

On an annual basis only a small proportion of the total permitted work is completed. Table 5 summarizes the percent of actual work completed compared to work permissible (in cubic yards) since 1995.

Table 3. Percent of Actual Work Completed versus Work Permissible

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
%	9.45	8.71	15.47	17.83	N/A	11.48	N/A	10.0	8.11	7.76	12.12

In some cases, unforeseen circumstances occur and repairs are needed. Table 6 shows activities that were performed between 2007 and 2011.

Table 4. Urgent and Unforeseen Activities by Year and Amount

Year	Repair Existing Exterior Water Control Structures (Number/Size (Diameter))	Install, Repair, or Re-Install Water Control Bulkheads (Number/Lin. Ft.)	Repair Existing Interior Water Control Structures (Number/Size (Diameter))	Clearing Existing Interior Ditches (Lin. Ft.)	Repair Interior Existing Levees (Lin. Ft.)	Repair Exterior Existing Levees (Lin. Ft.)	Grading Pond Bottoms for Water Circulation (Acreage/Yds^3)	Replace Previous Existing Riprap on Exterior Levee (Lin. Ft.)	Pipe Replacement for Existing Exterior Flood Gate (Lin. Ft.)	Pipe Replacement for Existing Exterior Drain Gate (Lin. Ft.)	Pipe Replacement for Existing Exterior Dual Purpose Gate (Lin. Ft.)
2007	1/36				1,320	400					40
2008											50
2009										50	
2010	1/48		2/36			1,240			50		40
2011		1/50; 1/130		3,000		240	2/3,000	45		50	
lin. ft. = linear feet.											

Below are descriptions of the currently permitted managed wetland activities.

<u>*Currently Permitted Activities in Managed Wetlands* (Table 1a)</u>

Repairing Existing Interior Levees

This action involves the improvement or repair of levees; it may be necessary to mow vegetation growth on levees to maintain condition and assess repair needs. Spoils from other permitted activities such as clearing interior ditches, constructing new interior ditches, or grading pond bottoms may be used for repairs, or materials may be imported. The spoils would be placed on the crown of the levee with an excavator, dozer, or box scraper.

Coring Existing Interior Levees

The coring of levees is intended to stop the flow of water through rodent holes and cracks in levees. To core a levee, typically a 2-foot-wide trench (depending on the width of the excavator bucket) is excavated in the levee crown using a long-reach excavator or backhoe, and the material is placed on the crown of the levee adjacent to the excavation site. The trench then is backfilled immediately using the material that was excavated. The material is compacted during the backfilling process to seal the levee. If a rodent hole is identified, its entire length may need to be excavated to stop the flow of water and prevent future burrowing by small mammals. Coring of levees generally is performed between July and September, and approximately 700 feet can be completed in 1 day.

Grading Pond Bottoms for Water Circulation

Water circulation can be improved by recontouring low areas and raising pond bottoms. The raising of low pond bottom areas improves circulation and drainage in the managed wetlands. To provide material for levee maintenance, material is graded from high-ground areas or pond bottoms. Grading also can be used to create or maintain swales, typically 2 feet deep with gradual slopes. This work is completed with a box scraper pulled by a low–ground pressure dozer or tractor. Work generally is done June through August. Approximately 700 cubic yards (cy) can be graded per day.

Creating Pond Bottom Spreader V-Ditches

V-ditches are 18-by-18-inch or 24-by-24-inch ditches created by pulling a V-ditch plow behind a tractor. V-ditches facilitate circulation and drainage of low areas and sinks. Occasionally, a ditch may be constructed in high areas to improve drainage by connecting an isolated wet area to other draining wet areas. Typically, these ditches silt in quickly and last only 1 to 2 years after creation. These ditches normally are created after the ponds have drained for the season, generally June through August, and 2,000 feet can be constructed per day. Spoil materials typically remain on the sides of the V-ditches, although they may be spread back into the pond bottom to further improve the low areas, or they can be flattened adjacent to the V-ditch.

Repairing Existing Interior Water Control Structures

This repair involves the replacement of component parts of pipes through interior levees (gates, stubs, or couplers) but not replacement of the pipe itself. Work is done by hand (uncoupling the old structure and re-coupling the new structure), and generally a ground crew removes the damaged structure and installs the new structure on the end of the existing pipe. This work typically is completed in the summer, when the managed wetlands are dry.

Replacing Pipe for Existing Interior Water Control Structures or Installing New Interior Water Control Structures

This activity includes the replacement of a pipe for an existing interior water control structure or the installation of a pipe for a new interior water control structure. If a new structure is being installed, the new structure is assembled on the crown of the levee, a trench is excavated laterally through the levee, the new pipe is placed in the trench, the trench is backfilled, and the fill is compacted. If a pipe is being replaced, the trench is excavated at the site of the old pipe and that pipe is removed. Similar to installing new pipe, the replacement pipe is placed in the trench and backfilled. However, when feasible, new drainage pipes would be placed where they can be consolidated or drain into an existing ditch. Occasionally, an interior ditch cannot be drained sufficiently for pipe replacement. In these instances, sheet piles may be used to retain the water temporarily until the pipe is replaced.

Many water control structures have walkways that run from the levee to the end of the pipe. These walkways include pilings, walkway boards, and handrails. These structures strengthen the gate by providing a grounded structure for frame attachment, and they provide a means by which wetland managers can access the gate for operation. Any necessary repair to these structures typically is done during pipe replacement. However, some repairs may need to be done more frequently, especially replacement of walkway boards or handrails. This work typically is completed in the summer when the managed wetlands are dry.

Installing New Blinds and Relocating, Replacing, or Removing Existing Blinds

Duck blinds are plastic, fiberglass, or metal structures (3 feet x 4 feet x 8 feet) placed in the ground to conceal the hunter. When an in-ground blind is replaced, the old blind is excavated from the ground, and a new blind is placed in the void, which can be as deep as 4 feet. This work is completed with a dozer and/or excavator. The blind is placed and secured with vertical timbers and cross timbers that are pushed into the ground adjacent to the blind and material from the pond bottom is graded to conceal the sides of the blind.

Discing Managed Wetlands

Discing is done on the landside of levees in the spring or late summer to clear problematic vegetation, reduce the production of vector mosquitoes, break up the soil for seedbed preparation, smooth excavated material, fill cracks in soil, or create fire breaks. A disc is pulled behind a tractor or dozer. Depending on the wetland management and vegetation objectives, discing can occur annually in upland areas to promote annual grasses and cereal grain production and once every 2 to 5 years in wetland areas to set back plant succession. Discing is voluntarily limited to one fifth of a property area per year (Suisun Resource Conservation District 1998).

Installing Drain Pumps and Platforms

Drain pumps are installed on wooden platforms built to support them. The pump and platform are installed on the inland side of the exterior levee. Occasionally, the pump discharge pipe would be set high in the profile of the exterior levee so that the pipe does not limit levee access but allows discharge at high tidal levels.

Replacing Riprap on Interior Levees

Riprap is replaced on interior levees in the minimum amount necessary for bank stabilization and in areas around water control structures where water flow and eddies erode the ditch bank and interior levee toe. Riprap will be placed on interior levee banks only in those areas with existing riprap. Riprap is placed on the interior levees using a long-reach excavator that is located on the levee crown. Approximately 300 feet of riprap can be placed per day. Riprap generally is replaced during July through September.

Removal of Floating Debris from Pipes, Trash Racks, and Other Structures

Floating vegetative debris and other debris, such as wood and trash, often accumulates in front of pipes, trash racks, and other structures. This debris typically is removed using a long-reach excavator. Material is disposed of outside of Suisun Marsh. Work is done annually, generally during the summer months.

Installing Alternative Bank Protection such as Brush Boxes, Biotechnical Wave Dissipaters, and Vegetation on Exterior and Interior Levees

As described above, vegetation applications, including brush boxes, may be appropriate and effective mechanisms for controlling erosion of levees. Pursuant to previous 1994 BOs from NMFS and the USFWS, and the subsequent 2008 NMFS BO, SRCD was required to employ levee maintenance methods that do not use riprap. Brush boxes use natural materials and native plants for capturing sediment to stabilize and protect exterior levees while also providing fish habitat. The installations generally are done during July through September. Brush boxes, brush bundles, and ballast buckets are placed below the mean high water mark and anchored with tree stakes. Brush boxes and brush bundles are generally dead branches that are staked into the ground or wrapped in coconut fiber. Ballast buckets are organic, biodegradable buckets planted with native wetland species such as tule (*Schoenoplectus acutus*), three-corner bulrush, and Baltic rush (*Juncus balticus*). As the technology is developed further, alternative materials or installation methods may be used. The installation of brush boxes and ballast buckets does not involve any in-water work because all work would be done at low tide. This work is done entirely by hand, reducing the sedimentation that can occur with mechanical work. After the build-up of sediment and the growth of native plants over time, the exterior levee would be stabilized and protected from further erosion, and habitat would be established for fish and the macroinvertebrates on which they feed.

Integrated vegetation solutions are desirable to provide low-maintenance "living" bank protection and wave-energy dissipation. Applications of these solutions are limited by the local channel velocities and depth, wind fetch, and exposure to wake. If the tidal hydraulic regime is suitable for the establishment of vegetation capable of resisting high channel velocities and wave energy, vegetation would be incorporated into the erosion protection design. This would reduce the future maintenance costs of erosion protection. The following criteria would be considered in determining the appropriateness of vegetation, either by itself or in combination with riprap, at each site.

- When channel velocities are low enough to prevent loss, vegetation solutions can be installed to halt erosion processes along levee slopes and natural channel bank sections.

- If channel depth on the face of the levee slope is less than 3 feet below average tide elevation (i.e., mean tide level [MTL] or mid tide), and the levee slope is less than 3:1 (H:V), vegetation solutions can be installed to halt erosion processes along levee slopes and natural channel bank sections.

- If levee slopes can provide suitable foundations, brush boxes can be installed at various elevations to create a "benched" sequence up the slope and reduce or stop erosion in areas where scallop failures have occurred.
- If shallow water, shallow slopes, benches, or shoals exists, vegetation can be installed to greatly reduce wake energy and provide a low-maintenance erosion-reduction measure.

- If fetch length is less than 1,000 feet in the direction of the predominant southeast to southwest winds during high-water conditions (e.g., winter storms, spring tides) or prevailing winds during all other times (typically from the west), vegetation solutions should be applied to the upper slope of the levee to dissipate wind-driven waves and reduce erosion potential.

Constructing Cofferdams in Managed Wetlands

Cofferdams and ditch crossings are temporary earthen structures used to cross interior ditches or prevent interior water from flowing into construction sites, in support of other permitted construction activities (e.g., exterior pipe replacement) and required Best Management Practices (BMPs). Cofferdams are constructed from material from the levee toe, pond-bottom grading, or other excavated areas in the managed wetlands. The volume of material used to transverse the ditch is limited to that required to stop the flow of water and provide adequate width to support equipment access to both sides of the ditch. During installation of a cofferdam, a long-reach excavator or dozer places or pushes material from the adjacent levee crown or field area into the ditch. Upon completion of the associated work activities, the cofferdam or crossing is excavated and removed from the ditch and the ditch is restored to its original width and depth. After the cofferdam is removed, all material is placed on the crown and backslope of the exterior levee or is spread out over the adjacent interior ditch bank or levee. An alternative to cofferdams is a sheet pile that can be pushed into the levee toe with a long-reach excavator and removed upon completion of construction. Sheet piles could be used instead of or in conjunction with cofferdams. This activity generally would be implemented in the summer months.

Currently Permitted Activities in the Managed Wetlands with Potential to Affect Fish or Aquatic Habitat (Table 1b)

Repairing Existing Exterior Levees

This action involves the improvement or repair of exterior levees; it may be necessary to mow vegetation growth on levees to maintain condition and assess repair needs. Spoils from other permitted activities such as clearing interior ditches, constructing new interior ditches, or grading pond bottoms may be used for repairs, or imported from an outside source. The spoils would be placed on the crown of the levee with an excavator, dozer, or box scraper. On rare occasions, exterior levee integrity is compromised from rodent holes, storm damage, or unanticipated overtopping of the levee crown, allowing uncontrollable tidal flows to enter the managed wetland, which can cause levee breaches. For example, from 2007 to 2011, emergency exterior levee repairs occurred only 7 times in those 4 years or approximately twice a year. Repairs totaled 1,880 linear feet of repairs and are generally limited in their length; however, one instance of interior levee repair that occurred in 2007 totaled 1,320 linear feet. If the exterior levee breach can be repaired using on-site material consistent with existing permit terms and conditions, the levee integrity is restored on the next appropriate low tide cycle (refer to managed wetlands conservation measures for additional discussion of this activity). Aggregate base rock may be placed on the crown of levees to prevent road surface degradation. Work generally would occur in late summer; in the past, however, exterior levee repairs have occurred January through July. Approximately 500 linear feet of levee can be repaired per day.

The most common practices for repairing exterior existing levees in Suisun Marsh involve the removal of accumulated silt and vegetation from water circulation ditches in managed wetlands and placement of spoil material on the crown of adjacent levees to raise the crown to its original or design height, and/or improvement of interior side slopes. Materials may be imported from an upland source within or outside the Marsh. Material may also be obtained from beneficial uses of dredged materials or from implementation of the Long-Term Management Strategy. A potential additional material source, dredging from tidal sloughs, is described below under New Activities.

Repair of existing levees typically occurs from June through September. Approximately 800 linear feet can be completed in 1 day. It is unlikely that a significant amount of levee repair material would be lost to the outboard side of an exterior levee below the mean high water line. Any material that might trickle down the outside slope of the levee from the crown probably would not affect vegetated areas and may cause only slight and very temporary turbidity.

This activity currently is limited based on acreage of each parcel protected by the exterior levee (Table 2). The proposed change is to limit work based on actual lineal footage of each exterior levee of each property owner. This change is proposed because some small-acreage properties may have significant lengths of exterior levee (e.g., a long, narrow parcel), and a large acreage property may have minimal or no exterior levees but be protected by the small property exterior levee. This administrative change would provide landowners with a more appropriate limit for maintenance of exterior levees. Placement of up to 1.5 cy of levee material per linear foot on average for annual work activities would occur. One levee segment may require no work in a given year, and a different levee segment may require 3.0 cy per linear foot because of flood damage. This would average out over the individual property's total levee system. This slight change in how permitted volumes are calculated is not expected to change the overall patterns of activities conducted in the Marsh. However, the frequency of work is expected to increase to meet the enhancement objective.

Replacing Previously Existing Riprap on Exterior Levees

Riprap is replaced on the tidal side of exterior levees in the minimum amount necessary for bank stabilization. Currently, riprap is placed on exterior levee banks only in those areas with existing riprap. Those areas that receive direct wave impacts historically have been fortified with riprap and require periodic maintenance. These are areas that experience erosion, and the replacement of riprap prevents the continued deterioration of the areas. On average, approximately five sites a year received exterior levee riprap replacement over the last 4 years. Replacement of exterior levee riprap generally is done during July through September during dry periods; however, sometimes it has to occur during large tidal changes or during unforeseen events. In the past 4 years, nine events occurred in spring to summer (April thru July); 11 events occurred in late summer to autumn (August thru October); and, two events occurred in winter (as urgent and unforeseen events). Riprap is placed on the tidal side of exterior levees using a long-reach excavator that is located on the levee crown, or by barge with a dragline or clamshell dredge. The barge method is used less frequently as it requires greater channel widths and is more expensive. The amount of exterior levee riprap placed depends on site-specific conditions; typically, however, the minimum amount of riprap is used.

Coring of Existing Exterior Levees

This activity is the same as described for interior levees.

Repairing Exterior Water Control Structures (Gates, Couplers, and Risers)

Repairing exterior water control structures involves the replacement of components of pipes through exterior levees (gates, stubs, or couplers) but does not involve the replacement of the pipe itself. All work is completed at low tide to allow access to the pipe and typically does not involve any excavation of sediments from the exterior slough. The repairs generally are done during July through September. In-water work is done by hand (uncoupling the old structure and re-coupling the new structure), and generally a ground crew lifts the damaged structure out of the water and lowers the new structure into place.

Installing or Replacing Pipe for Existing Exterior Flood or Dual-Purpose Gates

This activity is the replacement of an exterior water control structure (pipe, gates, stubs, and couplers) that is used to either flood or drain managed wetlands. There are no restrictions on the size of a draingate. For floodgates and dual-purpose gates (flood and drain) that divert water from tidal sloughs, however, the overall capacity of the diversion for that parcel may not be enlarged. In the past, water control structures typically were constructed of corrugated metal pipe. Because of the corrosive environment of the Marsh, these pipes often begin leaking and fail in 8 to 15 years. If an exterior pipe leaks, habitat management and maintenance activities would be compromised as a result of uncontrollable flooding of the managed wetland. Therefore, metal pipes typically are replaced with High-Density Polyethylene pipes.

When a pipe is replaced, a new pipe and appurtenant structures are assembled on the crown of the levee with the appropriate control structure components attached to each end of the pipe. A trench is excavated in the exterior levee over the old pipe, and the pipe is removed. All replacement activity is completed in one low tide. Replacement pipes typically are placed in the same location as the existing structure, the trench is backfilled, and the backfilled material is compacted. Either a dozer or an excavator is used to excavate the trench, and generally an excavator is used to install the replacement pipe. The backfill material is compacted with a dozer and/or excavator. Replacement of the pipes takes approximately 4 days and generally would be done March through September. The first day is mobilization of equipment and materials, the second day is assembly and preparation for installation, the third day is installation, and the fourth day is demobilization and site clean-up.

If a new drainpipe is required, it would be installed at a location where discharge channels already exist or exterior levees have minimal vegetation. The new structure is assembled on the crown of the levee, usually with a flap gate on the outside and flashboard riser or screw gate on the inside. Installation of a new drainpipe requires the same types of equipment and takes the same amount of time as replacing an old drainpipe.

Many water control structures have walkways that run from the levee to the end of the pipe. These walkways include pilings, walkway boards, and handrails. These structures strengthen the gate by providing a grounded structure for frame attachment, and they provide a means by which wetland managers can access the gate for operation. Any repair that may need to be done to these structures typically is conducted during pipe replacement. However, some repairs may need to be done more frequently, especially replacement of walkway boards or handrails.

Installing, Repairing, or Re-installing Water Control Bulkheads

Bulkheads are built to stabilize and strengthen levees exposed to highly energetic water flows or wave energy. These structures typically are installed near water control structures and prevent the erosion of soils at the toe of the levee and ditch banks. Exterior work is done at low tide and does not involve any excavation of sediments from the exterior slough. In-water work is done by hand (unbolting the old boards and/or bolting a new structure together), and generally a ground crew lifts the old boards out of the water and lowers the new boards into place. A new bulkhead may be constructed to strengthen newly excavated sections of levee and to help avoid additional turbidity after installation of exterior water controls by containing loose soils that otherwise may fall into the exterior slough. Bulkheads can be constructed from wood, or vinyl or metal sheet pile. This activity generally would be implemented in the summer months.

Remove Floating Debris from Pipes, Trash Racks and Other Structures

This activity is the same as described for interior levees.

Install Alternative Bank Protection

This activity is the same as described for interior levees.

Suisun Marsh Salinity Control Gates Repair and Maintenance

Operation of the SMSGC is covered under the Coordinated Operation of the CVP and SWP BO and therefore is not included in this analysis. However, routine maintenance and repair activities associated with these facilities are included and would be covered by permits issued by the Corps. Maintenance and repair of flashboards to the gates would occur. Flashboards are installed and removed on an annual basis by means of either a land-based crane on the banks of Montezuma Slough or a barge crane. Repairs and maintenance include servicing, replacing, and installing sections and pieces of the radial gates or boat locks, most of which are done above water from a boat or from the superstructure while sections are hoisted out of the water. This activity is conducted by DWR.

Roaring River Distribution System Fish Screen Cleaning

Operation of the RRDS is covered under the Coordinated Operation of the CVP and SWP BO and therefore is not included in this analysis. However, routine maintenance and repair activities associated with these facilities are included and would be covered by permits issued by the Corps and therefore analyzed in this BO. Specifically, the fish screens are cleaned by successively lifting each stationary vertical screen panel out of the water and pressure washing the silt and vegetation accumulation off the screens. During the flood-up season (generally August through October), this activity can be conducted up to once a day. During the rest of the year, this activity is conducted less frequently as needed. This activity is conducted by DWR.

Installing New Fish Screen Facilities

Fish screens are installed at managed wetland water intakes (flood pipes) to prevent fish from swimming or being drawn into managed wetlands. The installation of fish screens was first permitted in the 1995 RGP and has been carried forward in all subsequent RGP's. (Since 1995 16 diversions screened.) Fish screens may not be a preferred option for diversions in the Marsh because of the installation and maintenance costs compared to the number of fish protected.

Wetland effects from screening diversions to protect fish would not exceed 1,000 square feet per year or a total of 30,000 square feet over the 30-year plan period. All Suisun Marsh screens would be designed to comply with Service delta smelt approach velocities of 0.2 fps, which are well below required approach velocities for salmon (0.4 fps) (NMFS 1996a). However, variance on the approach velocity may be obtained pending Service approval.

There are many different designs for fish screens in the Delta and Suisun Marsh. Site-specific considerations, such as acreage served, diversion volume, and channel and diversion point configuration, would dictate screen design. The stainless steel conical 8-foot, 10-foot, and 12-foot fish screens have proved the most efficient design for small diversions screened in Suisun Marsh. These screens were designed to be removable from the crown of the exterior levee with a standard boom truck or excavator. This aspect of the design allows normal maintenance to be conducted in the dry, and the screens can be removed from the tidal slough and placed on a storage platform for inspection and maintenance. Normal maintenance includes power washing the screens, replacing cathartic protection (zinc or magnesium anodes), replacing cleaning brushes, and general inspection.

Typically, fish screens are installed at an existing diversion structure; therefore, there is an existing channel or basin in the tidal area and a supply ditch in the managed wetland. However, consolidation of unscreened diversions may require a new diversion location to serve multiple wetland units at one location. The fish screen platform is supported by four pilings, which are pushed into the bay mud at the toe of the exterior levee. The conical fish screen support platform and diversion pipe are placed on top of these support pilings and installed through the exterior levee. These construction methods are similar to exterior pipe replacement and bulkhead repair or installation. All other work activities for screen installation are completed at the toe of the exterior levee on the land side of the levee. These activities include water control installation, storage platform construction, and control center platform installation. This activity generally would be implemented in the summer months.

Salinity Monitoring Station Maintenance, Repair, and Replacement

Infrequent major maintenance activities do not involve work done in the water—repairs to walkways, equipment housing, or other wood, plastic, or metal structures. This also includes installation, removal, replacement, repair, or modification of monitoring instrumentation within the equipment housing. These activities are done twice per year.

Weekly maintenance activities include collecting data from the electronic equipment at the site and calibrating and cleaning the probes. With the exception of lowering the probes in the water, these activities are done above the water or adjacent to the water on the levee bank.
Periodic activities to be conducted in the water by hand include cleaning or replacement of the probe mounting equipment, resetting of water stage gauge, cleaning of probe pipes, and replacement of the dimple collar to suppress wave action. On the remaining stations with stilling wells, clearing accumulated sediment from the stilling well is done by flushing the stilling well with water pumped from the adjacent area.

Stilling well replacement and walkway/platform piling replacement includes removal by tractors and trucks operated from the existing roadway/levee and excavators or cranes operated from the roadway/levee or barge. Work generally is scheduled during the dry months of summer and fall. This activity is performed about once every 5 to 10 years at a site.

DWR gradually is moving away from using stilling wells toward using pressure transducers to measure water surface elevation. Pressure transducers (as well as the other transducers in the bundle) are suspended in the water above the bottom. This activity is conducted by DWR.

Salinity Monitoring Station Relocation, Installation, and Removal

Salinity stations need to be relocated, installed, or removed as a result of regulatory requirements, physical constraints, the need to obtain more reliable data, the data no longer being required, or for other reasons. Maintenance equipment may include trucks, bucket excavators, small cranes, boats, barges, and other equipment as required. Work generally is scheduled during the dry months, June through September.

When a salinity station is removed, it is done by hand when feasible. Otherwise, tractors and trucks operate from the existing roadway/levee and excavators or cranes operate from the roadway/levee or from barge. All components of the station are removed, including the stilling well culvert and pilings supporting the walkway, which are removed from the levee slope/river bottom. Materials from the removed station are disposed of at an approved off-site location. The total disturbance would not exceed 400 square feet. The removal of a monitoring station usually takes about 8 hours over the course of approximately 3 days.

New monitoring stations are installed on a levee when possible or in water when location on a levee is not feasible. A new station may include installation of salinity measurement equipment with equipment housing. Stations that cannot be located on the levee would require a platform to support the equipment housing, a walkway to access the platform, and pilings to support the platform and walkway. Stilling wells may be installed. Alternatively, pressure transducer equipment would be attached to structures in the water, such as pilings, to enable measurements to be taken in the water column without disturbing the substrate during installation or maintenance. The footprint for the walkway (actual fill) is less than 2 cubic feet. Installation of a monitoring station usually takes approximately 4 days, involves the use of a truck to haul equipment, and may require an excavator and small boat to install the stilling basin. The total disturbance would not exceed 50 square feet. This activity is conducted by DWR.

Modification of Currently Implemented Activities

Only three activities currently implemented would be modified under the SMP. The activities themselves—clearing existing interior ditches, constructing new interior ditches, and repairing existing exterior levees—would not change, but how the activities are administered would change. These activities would be implemented by DFW, landowners (as represented by SRCD), and/or DWR. This includes RRDS, MIDS, Goodyear Slough Outfall, and other facilities and/or properties. Table 5 identifies the modifications under the SMP.

Table 5. Modifications to Managed Wetland Activities

Managed Wetland Activities	Existing Annual Activities Average, Low–High	Current Corps Permitted Annual Limits	Modification
Clearing existing interior ditches; constructing new interior ditches	49,456 cy, 9,724–69,022	443,000 cy	Expected to be within existing annual permitted limits.
Repairing existing exterior levees	43,902 cy, 28,622–87,232	443,000 cy	Expected to be within existing annual permitted limits.

cy = cubic yards.

Clearing Existing Interior Ditches

This action removes accumulated silt and emergent vegetation and aquatic vegetation from interior ditches with an excavator to eliminate water-flow restrictions. Clearing of material from interior ditches would also include the RRDS, MIDS, and GYS areas, which are managed by DWR. These ditches are currently screened and thus prevent fish species from entering them. Ditch clearing would generally be done during the months of June through September using a long-reach excavator, harvester, or other drag method to remove sediments. Approximately 900 linear feet and 1,500 cy of material can be cleared from a typical ditch in 1 day. The DWR facilities have not been cleared for several years and DWR anticipates that the majority of their ditch clearing would be accomplished during the first few years of this activity. In years following the initial clearing, the DWR facilities would require less clearing which would become the baseline for normal annual maintenance.

Excavation within typical interior ditches and DWR ditches would be administered by SRCD to ensure that the overall quantity of material removed from interior ditches does not exceed the maximum allotment of 443,000 cy per year currently allowed under the RGP. DFG and landowners would follow the allotment schedule as provided in the existing RGP that bases the amount of material that can be removed on the size of the parcel that encompasses the ditch. The material excavated from these ditches could be spread evenly on adjacent land or used for levee repairs at an annual rate of 1.5 cy per linear foot of levee. Currently, sidecast materials may be left in place to dry for only 1 month. However, SRCD, DFW, DWR, and Reclamation propose that this period be extended to 1 year to ensure that all materials are dried before being used for an authorized activity (levee maintenance or grading) or removed to an area outside Corps jurisdiction (crown of a levee or hauled offsite to another upland area). If deposited on the levee, spoils would be moved using a dozer or box scraper. If deposited elsewhere, the material would be placed in trucks and hauled to the upland discharge location.

Excavation within the DWR facilities would be limited to an average of 1.5 cy per linear foot of DWR levee, which would amount to 3 cy per linear foot of ditch for RRDS and MIDS, which have levees on both sides. The material excavated from the DWR facilities would be placed on the crown and/or the landside slopes of the levees confining the facility or hauled offsite to an upland disposal location as described above to be stockpiled and used for other authorized activities within or outside the marsh.

Constructing New Interior Ditches

This action is performed by the removal of pond bottom material with an excavator to create a new interior ditch for improved water circulation. Approximately 600 linear feet of ditch can be constructed in 1 day, and work generally would be conducted during the months of June through August. A long-reach excavator may be used to remove the silt and spread materials evenly on adjacent land. However, spoils may be sidecast and left adjacent to the ditch for up to 1 year; then they must be used for an authorized activity (levee maintenance or grading) or removed to an area outside Corps jurisdiction (crown of a levee). Spoils are moved using a dozer or box scraper.

Similar to clearing existing ditches, sidecast materials currently may be left in place to dry for only a month. SRCD, DFW, DWR, and Reclamation propose this period be extended to a year to ensure that all materials are dried before put to beneficial use.

New Activities

New activities are activities that have not been implemented in the Marsh, or that have not been implemented in so long that they are not considered part of the existing baseline condition. These new activities would be implemented by DFW, landowners (as represented by SRCD), and/or DWR. The new activities and how they compare to existing activities are summarized in Table 6 and are described below.

Table 6. New Managed Wetland Activities

Managed Wetland Activities	Existing Annual Activities	New Activity Annual Limits
Dredging from tidal sloughs as source material for exterior levee maintenance	Currently not permitted	100,000 cy.
Placement of new riprap on interior levees	Currently not permitted	No more than 200 linear feet of new riprap would be placed annually; no more than 6,000 linear feet over the life of the 30-year plan.
Placement of new riprap on exterior levees	Currently not permitted	No more than 67 linear feet annually; no more than 2,000 linear feet over the life of the 30-year plan.
Constructing new interior levees for improved water control and habitat management in the managed wetland units	Currently not permitted	Obtain as needed.
Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on and interior levees	450 feet, 300–600 feet	Obtained as needed

cy = cubic yards

Dredging from Tidal Sloughs as Source Material for Exterior Levee Maintenance

As an alternative and/or supplement to materials from the managed wetlands, SRCD proposes reinitiating a dredging program (Appendix B). Excavated materials from the adjacent tidal sloughs comprise primarily silts and clays, significantly better material for levee integrity and long-term durability than the peaty soils from managed wetlands. Dredging is proposed in major sloughs (Suisun and Montezuma Sloughs), minor sloughs, bays, and historical dredger cuts, which are areas separated from the main channels by remnant berms resulting from previous dredging to construct the original levees. Dredging from the dredger cuts provides a secondary benefit of removing silt accumulation that impairs managed wetland drainage and tidal operations of water control structures. In many locations in the Marsh, silt accumulation has physically restricted flap gates from opening, and drainage channels have become isolated from adjacent slough channels at low tide.

The Corps will issue an RGP that continues to authorize obtaining source materials for levee maintenance from diked managed wetland areas. As a result, the primary source of material for maintenance of some levee segments will continue to be the adjacent managed wetlands or importation from outside of the Marsh.

A dredging program would be implemented to provide materials for deferred and anticipated levee maintenance needs. A total of 3 million cy of materials would be dredged from major and minor tidal sloughs and bays over the 30-year SMP implementation period. However, over time, as tidal restoration occurs, the number of exterior levees in the Marsh may decrease, thus reducing the amount of dredging required to maintain Marsh levees. Based on the tidal restoration proposed, it is expected that dredging could be reduced by 15 percent (to a total of 85,000 cy annually). This reduction would occur over time and would be concurrent with the implementation of the restoration. This activity would be performed during the dredging windows of September through November.

The annual allotment would be divided between State and private property, depending on need, and limited to 2.1 cy per linear foot of channel, based on the linear extent of exterior levees on each property or the length of dredger cut. Flexibility would be necessary in case of special conditions, such as catastrophic levee failure. The proposed volume may be reduced, in any given year, if supplemental material is available through beneficial reuse of suitable dredged materials.

Some exterior levee segments have vegetation on the levee toe that extends out into the bays and/or sloughs. Repair of levee segments with this vegetation would be avoided if the tidal berm is more than 50 feet wide. Dredging could be done within dredger cuts, which transect wide berms, and salinity stations located on the edge of such berms. Dredging from the center channel would be done to avoid emergent vegetation, and other areas with vegetation will be avoided. The approximate cubic yards and acreage of other habitat types per region proposed for dredging per year is shown in Tables 7 and 8. Minor sloughs include all sloughs except Montezuma and Suisun. Dredger cuts are small, linear channel areas isolated by or transecting a vegetated berm. These are channels that were created immediately adjacent to the toe of the exterior levees during original levee construction or are channels that run from water control structures to bays or sloughs that were previously created to facilitate water drainage.

Table 7. Proposed Dredging Volume of 100,000 Cubic Yards Distributed per Habitat Classification and Plan Region

Feature	Region 1 Volume (cy)	Region 2 Volume (cy)	Region 3 Volume (cy)	Region 4 Volume (cy)	Montezuma Slough Volume (cy)	Total Volume (cy)
Bays	0	0	100	4,000	0	4,100
Major Sloughs	2,100	10,700	0	0	16,000	28,800
Minor Sloughs	21,600	8,900	3,000	2,400	0	35,900
Dredger Cuts	6,300	2,700	4,500	10,500	7,200	31,200
Total	**30,000**	**22,300**	**7,600**	**16,900**	**23,200**	**100,000**

cy = cubic yards.

Table 8. Annual Acreage of Dredging per Habitat (acres)

Feature	Region 1	Region 2	Region 3	Region 4	Montezuma Slough	Total Acres
Bays	0	0	0.02	0.79	0	0.81
Major Sloughs	0.42	2.12	0	0	3.16	5.7
Minor Sloughs	4.28	1.76	0.61	0.48	0	7.13
Dredger Cuts	1.25	0.54	0.89	2.08	1.43	6.19
Total	**5.95**	**4.42**	**1.52**	**3.35**	**4.59**	**19.83**

Dredging would be tracked by SRCD using GIS to ensure that it does not occur more than once every 3 years in any location, and would not remove material deeper than 4 feet per dredging cycle. The actual dredging locations would be based on needed levee improvements but would be limited by region, annual limits, habitat types, and frequency in any one location as described above.

A clamshell dredge or long-reach excavator could be used to dredge in the Marsh. The long-reach excavator could dredge from the levee crown or from a barge. Clamshell dredging could take place either from a barge within the slough channel or from the top of a levee, depending on restrictions caused by vegetation on channel banks or the width of a channel. Barge clamshell dredges are not self-propelling and therefore would need a small tugboat to maneuver within the channel. From a barge, the operation would begin when the bucket assembly, attached by a boom (up to 100 feet), is lowered into the channel to collect sediments. It would scoop up to 5 cy of consolidated bay mud and deposit it on the land side of the levee or crown adjacent to the channel. In limited instances, materials may be used for exterior levee maintenance in areas not adjacent to the dredged material source. The clamshell dredge or long-reach excavator may sit atop the levee and scoop up to 5 cy of consolidated bay mud from the channel bottom, using the same method as from a barge, and deposit the dredged material on the landside backslope, crown, or the levee slope on the bay/slough side if it is devoid of vegetation.

Once material is placed on the levee crown and land side, an excavator bucket would be used to compact the material against the levee to make it as smooth as possible. After 2–3 months of drying time, the material would be disced and graded to integrate the new materials with the existing levee. Minimal materials enter the interior managed wetland or bay/slough because the materials are deliberately placed and kept on the crown and slopes of the levee.

Dredging could occur in the center of slough channels, adjacent to water control structures or culverts, in salinity station locations, in the location of the SMSCG, adjacent to fish screen structures, and in historical dredger cuts. Some exterior levee segments have vegetation growth on the levee toe that extends out into the bay and/or slough. Repair of levee segments with this vegetation would be avoided by not dredging adjacent to tidal berms more than 50 feet wide, dredging from the center channel to avoid emergent vegetation often found along levee slopes, and avoiding other areas with vegetation. Dredging in human-made dredger cuts, which are linked directly to the water control infrastructure of the managed wetlands, fish screens, and in transect-wide berms would improve drainage issues that have resulted from siltation. Siltation in some instances has restricted flap gates from opening, dammed water in the drainage channel, and clogged trash racks. This reduces the management capabilities and habitat quality on managed wetland units and reduces the effectiveness of State/Federal facilities.

Similarly, some of the 16 fish screen structures and the RRDS fish screen experience significant siltation problems. Silt is deposited around these screens, which impedes the operation of the screen and screen-cleaning brushes. Every few years a relatively small amount of material would be removed from the fish screen basins (about 20 to 100 cy each) by dredging. (This amount is included in the total 3 million cy proposed for dredging in the Marsh.) Alternative measures (trying to move silt by hand) have been ineffective. Dredging around fish screens would be done during low tide to minimize in-water work and turbidity. As the tide returns, the fish screen would be opened to allow turbid water to be drawn into the managed wetland. Dredge spoils would be placed on the crown or landside slope of the exterior levee adjacent to the fish screen. In instances where material cannot be used adjacent to the dredging site, the material may be used on other levees in Suisun Marsh.

Placing New Riprap in Areas That Were Not Previously Riprapped

Many of the areas that require riprap have been treated, and their continued maintenance is described above. This activity addresses those areas that currently do not have riprap but that may be determined in the future to require such treatment. New riprap would be placed on exterior and interior levees as described below.

Interior Levees

Up to 6,000 linear feet of new riprap could be placed over the 30-year plan period on interior levees. No more than 200 feet of new riprap would be placed annually on interior levees. This activity is needed occasionally on interior levees where the velocity of water flowing through an exterior water control structure causes scouring eddies and bank erosion of inter-levee toes. Materials would be transported to the site and placed at the site as described above for exterior levees. BMPs would be implemented to reduce the environmental effect as described in the Conservation Measures section.

Exterior Levees

Up to 2,000 linear feet of new riprap would be placed over the 30-year plan period on exterior levees. (This is in addition to the replacement of riprap described above.) No more than 67 linear feet of new riprap would be placed annually on exterior levees. Riprap is placed on the levee using a long-reach excavator or a clamshell or dragline dredge. Placement of riprap would be done from June through September. Riprap materials are transported to the site with a 10-wheel dump truck with a capacity of 16 cy or by barge with a 400-cy capacity.

New exterior levee riprap would be placed only when it has been determined that the specific conditions of each site would not support other types of erosion control. Riprap would be applied only under the following circumstances.

- Levees are exposed to channel velocities that are too high to support vegetation. Depending on soil type, it may be possible for levee material to withstand short durations that exceed 6 fps.

- Channel depth on the face of the levee slope is deeper than 3 feet below MTL and the levee slope is steeper than 3:1 (H:V); riprap would be applied to reduce erosion potential without consideration for incorporation of vegetation.

- Levee face typically is exposed to vessel wakes year-round and not located in a 5-miles per hour (mph) zone; riprap would be applied in areas where erosion persists.

- Fetch length exceeds 1,000 feet in the direction of the predominant southwest to southeast winds during high water conditions (e.g., winter storms, spring tides) or prevailing winds during all other times (typically from the west); riprap would be applied to the upper slope of the levee to dissipate wind-driven waves and reduce erosion potential.

Where new riprap is placed, integrative vegetation also would be applied where it is biologically appropriate. Additionally, BMPs would be implemented to reduce environmental effects as described in *Conservation Measures*.

Constructing New Interior Levees for Improved Water Control and Habitat Management in the Managed Wetland Units

Interior levees are embankments that allow management of water inside exterior levees on the managed wetlands. The interior levees are not exposed to tidal action. The purpose of interior levees is to isolate specific areas in the managed wetland to allow independent water control or different water elevations in those areas. The crown width of these levees is normally 10 feet or less, with a crown height of 3 feet above pond bottom, 1-foot of freeboard, and a side slope of 2:1 on both sides.

Interior levees can be constructed in numerous ways: (1) by excavating a new or existing water conveyance ditch and stacking the excavated material to create an interior levee; (2) recontouring a ponded area and pushing up material with a dozer; (3) placing material with a box scraper to create a levee from high ground or pond bottom areas; or (4) importing materials and placing with an excavator or dozer. Interior levees generally would be constructed during the summer months when managed wetlands are dry. Approximately 400 feet of levee can be constructed per day.

Project-Level Conservation Measures

The following BMPs and conservation measures will be implemented during managed wetland activities.

Standard Design Features and Construction Practices

1. When possible, drain pipes will be relocated to drain into larger receiving sloughs with good tidal circulation to avoid and minimize the degradation of water quality in receiving waters.

2. All new and/or replacement drain pipes will be located on the largest possible sloughs, or sloughs with the highest levels of tidal circulation possible, to minimize the possibility of degraded water quality conditions.

3. Management options, including vegetation management and diversion timing and location, will be pursued to avoid and minimize occurrence of low DO conditions in managed wetlands.

4. New exterior drain structures will be installed where the discharge channel already exists. The new drain will not be placed on emergent vegetation. The pipe will be installed at low tide. No in-water work is authorized.

5. Material excavated from existing spreader ditches and creation of new spreader ditches may be sidecast adjacent to the ditch. No excavated material will exceed 12 inches in height.

6. Exterior pipes will be placed below the depth of emergent vegetation.

7. Pipe replacement as well as repair, replacement, or installation of exterior water control structures will not change the existing use or diversion capacity.

8. All pipes will be pre-assembled before installation to minimize work time.

9. All material shall remain on the crown or interior side of the levee during the repair of exterior existing levees, the coring of existing exterior levees, and the installation of drain pumps and platforms.

10. All bulkheads will be in place prior to backfilling the bulkhead during installation, repair, or re-installation of water control structures.

11. Installation of drain pumps and platforms will be done entirely within the managed wetland; although discharge pipes will comply with permit terms and conditions for exterior discharge pipe installation.

12. All work to be performed on the exterior side of levees shall commence and be completed within a 6-hour period, from 3 hours prior to low tide to 3 hours after low tide.

13. Construction equipment used for projects will be checked each day prior to work and, if necessary, action will be taken to prevent fluid leaks. If leaks occur during work, Reclamation, its permittee, or the contractor will contain the spill and remove the affected soils.

14. All contractors must have a supply of erosion and pollution control materials on site to facilitate a quick response to unanticipated storm events or emergencies.

15. No in-water work will occur during the repair of existing exterior levees; the coring of existing levees; pipe replacement at the exterior flood or dual-purpose gate; pipe replacement at the existing exterior drain gate; installation, repair, or re-installation of water control bulkheads; installation of drain pumps and platforms; or installation of new exterior drain structures.

16. Emergent vegetation will not be disturbed during the following activities: repair of existing exterior levees, replacement of existing riprap on exterior levee, or installation of the new exterior drain structure.

17. No fresh concrete, cement, silts, clay, soil, or other materials will be discharged to Marsh waters.

Riprap

Riprap replacement may occur in the minimum amount necessary on the slopes of interior ditches where rock has been washed away and on exterior levees where rock previously existed and has been washed away or subsided. Riprap will not be placed directly on emergent vegetation (e.g., tules, *Scirpus* spp.). Emergent vegetation will not be uprooted during the placement of riprap, nor will it be displaced by riprap. Riprap placement on the exterior side of the levee will commence and be complete within a 6-hour period, from 3 hours prior to low tide to 3 hours following low tide.

Dredging Practices

Dredging has the potential to result in adverse environmental effects if it leads to the release of fine-grained sediments or increasing turbidity, or if it remobilizes contaminated materials. The following preliminary conservation measures will be implemented as part of the proposed dredging program to avoid and/or minimize effects on aquatic resources in Suisun Marsh.

1. All construction facilities and working platforms required for dredging operations will maintain an operating environment free of fuel spills.

2. Runoff generated on the job site will be controlled.

3. In areas that may support delta smelt and California clapper rail, dredging activities will occur only between September 1st and November 30th.

4. Removal of emergent vegetation will be avoided where feasible, although areas of vegetation may need to be disturbed during construction to provide site access, adequate volume of material for construction, and proper water flow at the site. Any unavoidable loss of emergent tidal vegetation from dredging activities in bays, major sloughs, minor sloughs, and dredger cuts will be compensated for by implementing tidal wetland restoration at a 3:1 ratio if restoration is done within one year of the loss or 2:1 if restoration is done in advance of the loss.

5. Dredging will be avoided within 200 feet of storm drain outfall and urban discharge locations, unless suitable preconstruction contaminant testing is conducted.

6. A berm will be constructed on the channel-side of the levee crown to prevent runoff into adjacent aquatic habitats.

7. Releases of discharge water from managed wetlands will be limited following dredged material placement.

8. The extent of dredging disturbance will be limited based upon slough channel habitat classification and plan region (identified in Table 2-6 of Chapter 2 of the final SMP EIS/EIR).

Biological Resources Best Management Practices

Below are conservation measures for special-status plants, birds, and fish. Any suspected take of listed species will be reported immediately to DFW and the SRCD, who will contact USFWS or NMFS, as appropriate, immediately.

Special-Status Plant Species Protection

1. A survey for soft bird's beak and Suisun thistle will be conducted by a Service-approved representative of the SRCD or DFW for all water control structure replacements except when a headwall is present and for all installation of water control structures.

2. If a soft bird's beak or Suisun thistle are found during a survey, it will be avoided and a map showing the location of the plant provided to Reclamation, the Corps and the Service no later than 7 calendar days after the survey is completed. If a federally listed threatened or endangered plant is found that cannot be avoided during the proposed work, the qualified representative of SRCD or DFW will notify the Corps immediately so it can consult with the Service.

California Clapper Rail

Authorized work may not be conducted in California clapper rail habitat between February 1st and August 31st unless the California clapper rail surveys are conducted as described in the conservation measures for California clapper rail from the PBO are followed. Figure 15 (Attached) of the final SMP EIS/EIR depicts the areas of habitat to be avoided during this time.

Fish

1. Any suspected take of listed species will be reported immediately to DFW and the SRCD, who will contact NMFS, or the Service, as appropriate, immediately. Any carcasses of protected fish will be frozen in a whirl-pak bag and retained until instructions are received from the applicable Federal agency.

2. SRCD and DFW will continue to identify and prioritize placement of water control structures that require fish screens in consultation with the Corps, NMFS, and the Service. The SRCD and DFW will seek funding to install screens at the highest-priority sites.

3. To minimize entrainment losses of fish throughout the Marsh, water control structures would be consolidated and equipped with state-of-the-art fish screens. Intakes that present the highest risk of entrainment to salmonid smolts will be given the highest priority, including intakes located on Montezuma, Suisun, and Cordelia Sloughs.

4. Any new or enlarged exterior water control structures will be screened in accordance with DFW's criteria unless DFW and the Corps determine the structure would not adversely affect any listed species and the Corps obtains concurrence for the federally listed species with that determination from the Service and/or NMFS.

5. All in-water work will be done by hand and only during low tide (within a 6-hour period, from 3 hours prior to low tide to 3 hours following low tide) when there is the least chance of affecting fish, as part of the following activities: repair, replacement, or installation of exterior water control structures; pipe replacement at the exterior flood or dual-purpose gate; pipe replacement at the existing exterior drain gate; and installation of the new exterior drain structure.

6. All levee repairs and pipe replacements will be restricted to the dry season and not done in the rain.

7. Repairs of existing exterior levees, to stop the flow of tidal waters entering into the managed wetlands, will be completed within 7 days of the breach for coverage under the SMP.

8. Fish screens will be installed on any new or enlarged water control structures.

9. No more than 1,000 square feet of wetlands throughout the Marsh per year will be filled during installation of fish screens.

10. If Reclamation, the Service, the Corps, its permittee, or the contractor identifies a project-related condition that could adversely affect delta smelt or their habitat in a manner not anticipated, Reclamation, the Service, the Corps, its permittee, or the contractor will be responsible for rectifying such changes in a timely manner.

11. If the managed wetlands are subject to uncontrolled tidal flow, dewatering of the managed wetland area will be conducted through the use of existing gravity tidal drainage gates as much as possible. DFW will be consulted to determine whether fish salvage efforts are needed prior to completely dewatering the site.

Water Diversion Restrictions

1. SRCD will notify DFW, NMFS, Reclamation, and the Corps of the starting and closing dates of duck hunting season annually at least 1 month prior to the start of the season. Landowners diverting water from designated sloughs will use no more than 25 percent of the water control structure's diversion capacity from November 1 to the last day of duck hunting season. These landowners are prohibited from diverting water from designated sloughs from February 21st to March 31st. The purpose of these diversion restrictions is to protect migrating salmonids. Table 9 describes the diversion restrictions.

Table 9. Inches of Water Discharged through Pipe for Salmonid Restriction

Diameter of Pipe (inches)	25% Open (inches)
12	3
18	4
24	6
30	7
36	9
48	12

2. Landowners diverting water from designated sloughs will use only 35 percent of the water control structure's intake capacity between April 1st and May 31st. If, during this time, two out of the three DFW 20-millimeter trawl survey sites (sites 606, 609, and 610) predict delta smelt densities greater than 20 delta smelt individuals per 10,000 cubic meters over a 2-week sampling period, all diversions from these sloughs will use only 20 percent of the water control structure's intake capacity. Survey trawls will take place at least once every 14 days between April 1st and May 31st. Table 10 determines delta smelt diversion restrictions.

Table 10. Inches of Water Discharging through Pipe for Delta Smelt Restriction

Diameter of Pipe (inches)	20% Open (inches)	35% Open (inches)
12	3	5
18	4	7
24	5	8.5
30	6	10.5
36	7	13
48	8	17

3. While diversion restrictions are in place, the SRCD and DFW will monitor gate closures. If an open gate is observed, they will immediately contact the landowner and the gate will be closed.

Construction Period Restrictions

Timing of construction activities will depend on the type of activity, presence or absence of sensitive resources, tides, and/or water management in wetlands. In general, in-water work associated with exterior levee activities will occur between September 1 and November 30, which avoids delta smelt. Additionally, most of the managed wetland activities are expected to be implemented from June to September when the wetlands are dry enough to conduct these activities. Activities may be conducted during other times of the year, depending on the potentially affected species for each site-specific case.

Hazardous Materials Management Plan

A hazardous materials spill plan will be developed for the managed wetland activities. The plan will describe the actions that will be taken in the event of a spill. The plan also will incorporate preventive measures to be implemented (such as vehicle and equipment staging, cleaning, maintenance, and refueling) and contaminant (including fuel) management and storage. In the event of a contaminant spill, work at the site will immediately cease until the contractor has contained and mitigated the spill. The contractor will immediately prevent further contamination, notify appropriate authorities, and mitigate damage as appropriate. Adequate spill containment materials, such as oil diapers and hydrocarbon cleanup kits, will be available on site at all times.

Analytical Framework for the Jeopardy Analysis

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the *Status of the Species*, which evaluates the range wide condition of the California clapper rail, salt marsh harvest mouse, California least tern, soft bird's-beak, Suisun thistle, and delta smelt, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of these species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these listed species; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the California clapper rail, salt marsh harvest mouse, California least tern, soft bird's-beak, Suisun thistle, and delta smelt; and (4) the *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on these species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the California clapper rail, salt marsh harvest mouse, California least tern, soft bird's-beak, Suisun thistle, and delta smelt, taking into account any cumulative effects, to determine if implementation of the proposed project is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these listed species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the California clapper rail, salt marsh harvest mouse, California least tern, soft bird's-beak, Suisun thistle, and delta smelt, and the role of the action area in the survival and recovery of these listed species as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.
In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the rangewide condition of designated critical habitat for soft bird's beak, Suisun thistle, and delta smelt in terms of Primary Constituent Elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat at the provincial and range-wide scale; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects* which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on soft bird's beak, Suisun thistle, and delta smelt critical habitat are evaluated in the context of the range-wide condition of the critical habitat at the provincial and range-wide scales, taking into account any cumulative effects, to determine if the range-wide critical habitat would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for soft bird's beak, Suisun thistle, and delta smelt. The analysis in this biological opinion places an emphasis on using the intended range-wide recovery function of soft bird's beak, Suisun thistle, and delta smelt critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Action Area

An action area is defined in 50 Code of Federal Regulations (CFR) § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the SMP, the action area encompasses the entire Suisun Marsh area. Suisun Marsh is located in southern Solano County, California, about 35 miles northeast of San Francisco. The Marsh is bordered on the east by the Delta, on the south by Suisun Bay, on the west by Interstate 680, and on the north by State Route 12 and the cities of Suisun and Fairfield. This area includes 7,672 acres of tidal wetlands, and 52,112 acres of managed wetlands and uplands. Figure 1 shows the location of SMP action area.

Status of the Species and Critical Habitat

<u>California Clapper Rail</u>

Listing Status: The California clapper rail was listed as endangered on October 13, 1970 (35 **FR** 16047). Critical habitat has not been designated for this species. The California clapper rail is a Fully Protected Species under California law (See California Fish and Game Code Section 3511).

Description: This subspecies is one of three subspecies in California listed as endangered under the Act. The other subspecies include the light-footed clapper rail, which is found in tidal marshes in southern California and northwestern Baja California, and the Yuma clapper rail, which is restricted to the Colorado River basin. The California clapper rail is distinguishable from other clapper rails by its large body size of 13 to 19 inches from bill to tail, and weighs approximately 8.8 to 12.3 ounces. It has an orange bill, a rufous breast, black and white barred flanks, and white undertail coverts (Albertson and Evens 2000). Clapper rails are sexually dimorphic; the males are slightly larger than females (Garcia 1995). Juveniles have a pale bill and dark plumage. Clapper rails are capable of producing several vocalizations, most common of which are a series of keks or claps (Massey and Zembal 1987).

Natural History and Distribution: The California clapper rail is endemic to tidally influenced salt and brackish marshes of California. Historically, the California clapper rail occurred in tidal marshes along California's coast from Morro Bay, San Luis Obispo County, to Humboldt Bay, Humboldt County. Currently, California clapper rails are known to occur in tidal marshes in the San Francisco Bay Estuary (Estuary) (San Francisco, San Pablo, Grizzly, and Suisun bays) (Olofson Environmental, Inc. 2011; DFG 2011). California clapper rails are typically found in the intertidal zone and sloughs of salt and brackish marshes dominated by pickleweed, Pacific cordgrass, *Grindelia*, saltgrass, jaumea, and adjacent upland refugia. They may also occupy habitats with other vegetative components, which include, but are not limited to, bulrush, cattails, and Baltic rush.

In northern San Francisco Bay, California clapper rails also occur in tidal brackish marshes that vary significantly in vegetation structure and composition, ranging from salt-brackish marsh to fresh-brackish marsh transitions (Service 2010a). Use of brackish marshes by California clapper rails is largely restricted to major sloughs and rivers of San Pablo Bay and western Suisun Marsh, and along portions of Coyote Creek in the South Bay (Service 2010a). California clapper rails were also found in nearly pure stands of alkali bulrush along Guadalupe Slough in 1990 and 1991 (H. T. Harvey & Associates 1990a, 1990b and 1991). On rare occasions, California clapper rails have been recorded even further upstream, in brackish/freshwater transition marshes, particularly during the non-breeding season. Although it has been suggested that habitat quality may be lower in brackish marshes than in salt marshes (Shuford 1993), further studies comparing reproductive success in different marsh types are necessary to determine the value of brackish marshes to California clapper rails.

The breeding period of the California clapper rail is prolonged. Pair bonding and nest building are generally initiated by mid-February. Nesting may begin as early as late February or early March (Evens and Page 1983), and extend through July in the South Bay, and into August in the North Bay (DeGroot 1927, Service unpubl. data). The end of the breeding season is typically defined as the end of August, which corresponds with the time when eggs laid during re-nesting attempts have hatched and young are mobile.

California clapper rails require an intricate network of sloughs to provide abundant invertebrate populations (Grinnell *et al.* 1918, DeGroot 1927, Harvey 1988, Collins *et al.* 1994) and escape routes from predators, particularly for vulnerable flightless young (Taylor 1894, Adams 1900, DeGroot 1927, Evens and Page 1983, Foerster *et al.* 1990, Evens and Collins 1992). In addition, the small natural berms along tidal channels with relatively tall vegetation, such as *Grindelia stricta*, provide elevated nesting substrate. Harvey (1988) and Foerster *et al.* (1990) reported mean clutch sizes of 7.27 and 7.47 eggs for California clapper rails, respectively. The California clapper rail builds a bowl shaped platform nest of marsh vegetation and detritus (DeGroot 1927; Harvey 1988; Foerster *et al.* 1990). The California clapper rail typically feeds on benthic invertebrates, but its diet is wide ranging, and includes seeds, and occasionally small mammals such as the salt marsh harvest mouse.

Dispersal or movement by clapper rails in California occurs between and outside of marshes (Orr 1939; Zembal *et al.* 1985; San Francisco Bay Bird Observatory 1986; Page and Evens 1987; Albertson 1995). Post-breeding dispersal has been documented during the fall and early winter (Lindsdale 1936, Orr 1939, Service unpubl. data, Albertson 1995). There is no clear evidence of migratory behavior in the California clapper rail. However, infrequent long distance dispersal does occur.

Threats: An estimated 40,191 acres of tidal marshes remained in 1988 of the 189,931 acres of tidal marsh that historically occurred in the Estuary; this represents a 79 percent reduction from historical conditions (Goals Project 1999). The suitability of many remaining marshes for

California clapper rails is limited, and in some cases precluded, by their small size, fragmentation, and lack of tidal channel systems and other micro-habitat features. These limitations render much of the remaining tidal marsh acreage unsuitable or of low value for the species. Habitat loss has dramatically slowed since the California clapper rail was listed in 1970, but ongoing disturbance and degradation precludes or reduces occupation of much of the remaining potential habitat by California clapper rails. Remaining habitat has been fragmented by levee systems that reduce and isolate patches of habitat, reduce/eliminate high marsh and refugial habitat, and make habitat accessible to predators and human disturbance. Habitat has been filled, subjected to many contaminants, converted to less suitable vegetation conditions by fresh wastewater discharges, and submerged by land subsidence caused by agricultural practices and groundwater overexploitation.

Loss of upper marsh vegetation has greatly reduced available habitat throughout the range of the California clapper rail. Most marshes in the South Bay are adjacent to steep earthen levees that have all but eliminated upper marsh vegetation and reduced available cover for California clapper rails during winter flood tides. In Suisun Marsh, high marsh vegetation has been eliminated by diking and livestock grazing. In addition to the problems associated with landscape alteration caused by development, California coastal wetlands are expected to be subject to the effects of global sea level rise and climate change due to global warming. The effects of past subsidence of marsh plain relative to mean tidal level, particularly in the South Bay (Atwater *et al.* 1979), are likely to be amplified by rising tidal levels.

Other than outright habitat loss due to marsh reclamation, significant historic degradation to California clapper rail habitat quality in remaining tidal marshes is caused by numerous human-caused physical and biological changes in the San Francisco Bay Estuary tidal marshes, including: construction and maintenance of dikes in tidal wetlands; replacement of tidal refugia along landward marsh edges with unbuffered urban edges; conversion of salt marsh to brackish-fresh marsh by urban fresh wastewater discharges; structural habitat change caused by non-native plant invasions (such as perennial pepperweed (*Lepidium latifolium*), ice plant, and mustard in high marsh); increased predation by avian and mammalian predators attracted by the availability of man-made structures (e.g., electrical towers, buildings, and boardwalks); increased disturbance from recreational access, including humans and dogs; reduced habitat quality and increased predation pressure from predators attracted to litter and debris; and contamination of marsh sediments, which may impact California clapper rails directly or indirectly (potential direct effects include toxicity to adults, chicks, or embryos, and potential indirect effects include reduced prey quality, quantity, and availability, and altered vegetation structure/composition for nesting and sheltering). Few of these causes of habitat degradation are independent of one another; they interact and mutually amplify (Service 2010a).

Wastewater discharges that alter natural salinity levels in tidal waters can adversely affect California clapper rail populations and other species by changing the plant composition. Since about 1970, freshwater discharges on the order of 120 million gallons/day from the San Jose Water Pollution Treatment Plant, have led to the conversion of approximately 300 acres of former salt marsh to fresh and brackish marsh at the southern end of San Francisco Bay along Coyote Creek and adjoining sloughs of the Santa Clara Valley (H.T. Harvey and Associates

1997). Marsh conversion may lower the habitat quality and carrying capacity of tidal marshes to support California clapper rails, as evidenced by lower population and nesting densities recorded in brackish marshes than salt marshes (H.T. Harvey and Associates 1989).

California clapper rails vary in their sensitivity to human disturbance, both individually and between marshes. California clapper rails have been documented nesting in areas with high levels of disturbance, including areas adjacent to trails, dikes, and roads heavily used by pedestrian and vehicular traffic (J. Didonato pers. comm., Baye *in litt.* 2008). In contrast, Albertson (1995) documented a California clapper rail abandoning its territory in the Laumeister Tract, shortly after a repair crew worked on a nearby transmission tower.

California clapper rail reactions to disturbance may vary with season; however, both breeding and non-breeding seasons are critical times. California clapper rail mortality is greatest during the winter, primarily due to predation during extreme winter high tides (Eddleman 1989; Albertson 1995). Human-related disturbance may increase the California clapper rail's vulnerability to predators. During high tides, California clapper rails and other wildlife hide within any available cover in the transition zone and high marsh. As people approach, the birds may flush and attract predators. The presence of people and their pets in or near the high marsh plain or upland areas during marsh inundation may even prevent California clapper rails from leaving the lower marsh plain to seek cover, which also leaves them vulnerable to predation (Evens and Page 1983; Evens and Page 1986). Public trails that run along a narrow marsh transition zone may be particularly hazardous to California clapper rails that depend on this habitat for refuge during high tides.

Throughout the Estuary, the remaining California clapper rail population is impacted by a suite of mammalian and avian predators and are exacerbated by at least 12 native and three non-native predator species known to prey on various life stages of the California clapper rail (Albertson 1995). Artificially high local populations of native predators, especially raccoons, skunks, and common ravens occur due to the presence of landfills and other sources of human food waste adjacent to marshes. Feral cats also represent another predation threat on adult and young California clapper rails near residential areas and landfills (Albertson 1995). Non-native Norway rats have long been known to be effective predators of California clapper rail nests (DeGroot 1927; Harvey 1988; Foerster *et al.* 1990). According to Harvey (1988) and Foerster *et al.* (1990), predators, especially rats, accounted for California clapper rail nest losses of 24 to 29 percent in certain South Bay marshes. Placement of shoreline riprap, levees, buildings, and landfills favor rat populations, which results in greater predation pressure on California clapper rails in certain marshes. Encroaching development displaces lower order predators from their natural habitat and adversely affects higher order predators, such as coyotes, which will normally limit population levels of lower order native and non-native predators, especially red foxes (Albertson 1995).

These predation impacts are exacerbated by a lack of high marsh and natural high tide cover in most remaining marshes. DeGroot (1927) noted that clapper rails were extremely vulnerable to predation by raptors during high tide events when they were forced to seek refuge in exposed locations. Similarly, Johnston (1956 and 1957) and Fisler (1965) observed heightened predator activity in marshes coinciding with extreme high tides. Evens and Page (1986) also documented the susceptibility of California black rails to predation during extreme high tides. More recently, California clapper rail predation was noted in west Marin during extreme high tides in 2005 (G. Block, pers. comm.). There is an abundance of falcons, raptors, egrets, and herons during high tides that opportunistically take advantage of prey during this vulnerable period.

The proliferation of non-native red foxes into tidal marshes of the South Bay since 1986 has had a profound effect on California clapper rail populations. As a result of the rapid decline and almost complete elimination of California clapper rail populations in certain marshes, the Don Edwards San Francisco Bay National Wildlife Refuge implemented a predator management plan in 1991 (Foerster and Takekawa 1991) with an ultimate goal of increasing California clapper rail population levels and nesting success through management of red fox predation. This program was successful in increasing the South Bay California clapper rail populations from an all-time low.

Mercury accumulation in eggs is perhaps the most significant contaminant problem affecting California clapper rails in the Estuary, with the South Bay containing the highest mercury levels. Mercury is extremely toxic to embryos and has a long biological half-life. Schwarzbach *et al.* (2006) found high mercury levels and low hatching success (due both to predation and, presumably, mercury) in California clapper rail eggs throughout the Estuary. California clapper rail habitat is also at risk of contamination due to oil spills (Baker *et al.* 2009).
Population Status and Trends: The California clapper rail population was first estimated at 4,200 to 6,000 birds between 1971-1975, of which 55 percent occurred in the South Bay and 38 percent in the Napa Marshes (Gill 1979). Although the population was estimated at only 1,500 between 1981-1987 (Harvey 1988), the difference between these two estimates is believed to be partially due to survey intensity. Breeding season density data indicate that populations remained stable during the 1970s (Gill 1979, Harvey 1988), but reached an estimated all-time historical low of about 500 birds in 1991, with about 300 California clapper rails in the South Bay (Harding *et al.* 1998). California clapper rail numbers have rebounded between 1990s and 2007. However, substantial increases in population may be difficult to achieve due to the current disjunct distribution of their habitat (Albertson and Evens 2000).

Bay-wide California clapper rail numbers in the Estuary have been declining overall since 2007, and the decline is highly correlated with efforts to eradicate invasive *Spartina* in the San Francisco Estuary. U.S. Geological Survey data suggest that Bay-wide California clapper rail call count numbers declined by as much as 50 percent between 2007 and 2011. PRBO Conservation Science conducted Estuary-wide surveys of the San Francisco Bay for California clapper rail between 2005 and 2010. Results of the 2008 survey indicated only 543 rails, compared to 938 rails detected in 2007 (PRBO Conservation Science 2009a). In both years, the South Bay accounted for the majority of California clapper rails. Between 2005 and 2008, the estimated Estuary-wide total population of California clapper rails decreased by about 21 percent (Liu *et al.* 2009). The South Bay population of California clapper rails decreased by 54 percent between 2007 and 2008 (Liu *et al.* 2009). Invasive Spartina Project (ISP) California clapper rail survey data collected at 30 sites from 2004-2010 also shows an overall decline in California clapper rails. The population increased by 25 percent between 2005 and 2006 and by 25 percent again between 2006 and 2007. Then count numbers decreased by 35 percent between 2007 and 2008, by 32 percent from 2008 to 2009 and by 13 percent from 2009 to 2010.

Data collected by ISP from 2004 to 2010 at 30 sites within the San Leandro Bay, the Hayward region, the San Francisco Peninsula, and the Newark region, showed a decline in California clapper rail numbers from 519 in 2007 to 202 in 2010. U.S. Geological Survey data suggests that, Estuary-wide California clapper rail call count numbers declined by approximately 50 percent between 2007 and 2011. According to the *California Clapper Rail Population Monitoring Report: 2005-2008*, the Estuary-wide California clapper rail population showed an overall negative trend (-20.6 percent, P <0.0001) from 2005 to 2008, which can be mostly attributed to the 57 percent decline seen in the South Bay from 2007 to 2008 (PRBO Conservation Science 2009b). This decrease in the population of California clapper rails in 2008 is highly correlated with large scale *Spartina* eradication during this period which resulted in the loss of cover. No new cover was created or enhanced for California clapper rail to offset this loss. In 2010, PRBO Conservation Science detected an increase of California clapper rails in San Pablo Bay and South San Francisco Bay, while ISP detected a decline at other locations. This difference suggests that mature marshes (surveyed by PRBO Conservation Science) which received a high degree of hybrid *Spartina* control still provided enough native habitat to support stable California clapper rail population, while young marshes (surveyed by ISP), where hybrid *Spartina* was a more significant component of marsh vegetation cover, no longer provided habitat for California clapper rails because California clapper rails in these marshes were dependent on the hybrid *Spartina* for cover. It is unknown if the increased number of California clapper rails detected at some locations is due to high breeding success or is a result of immigration from marshes where *Spartina* treatment resulted in a loss of high tide refugia habitat. In addition, high tide surveys conducted by East Bay Regional Parks District showed decreases in California clapper rail numbers in San Leandro Bay since 2007. An extreme decline on East Bay Regional Parks District land occurred at Arrowhead Marsh which decreased from 112 California clapper rails in 2007 to 35 in 2010.

Recovery Actions: The *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Draft Recovery Plan; Service 2010a) is an expansion and revision of *The California Clapper Rail and Salt Marsh Harvest Mouse Recovery Plan* (Service 1984). The Draft Recovery Plan is scheduled to be finalized in 2013. The Draft Recovery Plan features the California clapper rail along with four other endangered species. The Draft Recovery Plan identifies high priority areas for tidal marsh and ecotone restoration including restoring tidal action to many of the salt ponds and other diked baylands along San Francisco Bay. Thousands of acres of former salt ponds and other diked baylands along San Francisco Bay have been restored or are proposed to be restored to tidal action (Service file number 81420-2008-F-0621; Service 2008); however, it may take decades before many of the heavily subsided areas within the former salt ponds accumulate enough sediment to become suitable tidal marsh habitat for California clapper rails. The Don Edwards San Francisco Bay National Wildlife Refuge with assistance from the U.S. Department of Agriculture Wildlife Services currently manages mammalian and avian predators within California clapper rail habitat on its refuge lands in the South Bay and on DFW lands; however, the Predator Management Program is underfunded. The

ISP was thought to be an important recovery action, but it has not been implemented as envisioned.

Salt Marsh Harvest Mouse

The status of the salt marsh harvest mouse and information about its biology, ecology, distribution, and current threats is available in the *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Draft Recovery Plan; Service 2010a). The Draft Recovery Plan is scheduled to be finalized in 2013. The Draft Recovery Plan features the salt marsh harvest mouse along with four other endangered species. Supplemental or updated information is provided in the Service's February 2010 five-year review for the salt marsh harvest mouse (Service 2010b). The five-year review recommended the salt marsh harvest mouse remain listed as endangered due to the continuation of threats from habitat loss due to filling, diking, subsidence, changes in water salinity, non-native species invasions, sea level rise associated with global climate change, and contamination. Habitat suitability of many marshes is further limited by small size, fragmentation, and lack of other vital features such as sufficient refugial habitat. None of the recovery units have met the Draft Recovery Plan's downlisting criteria for the protection, management, and restoration of suitable tidal marsh habitat.

California Least Tern

A detailed account of the taxonomy, ecology, and biology of the California least tern is presented in the approved recovery plan for this species (Service 1985). Supplemental or updated information is provided in the Service's 2006 five-year review for the California least tern (Service 2006). In 2006, the Service recommended downlisting the status of the California least tern to threatened due to: (1) an increase in the population from 600 in 1973 to roughly 7,100 pairs in 2005 (the downlisting and delisting criteria require 1,200 pairs); (2) a near doubling in the number of California least tern colonies (there are currently 40 known nesting sites in California with 30 of those sites containing at least 20 breeding pairs); and (3) the amelioration of threats from predation, non-native plants, and human-related disturbance through intensive management of nesting sites (Service 2006).

Soft Bird's-Beak

The status of the soft bird's-beak and information about its biology, ecology, distribution, and current threats is available in the *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Draft Recovery Plan; Service 2010a). The Draft Recovery Plan is scheduled to be finalized in 2013. The Draft Recovery Plan features the soft bird's-beak along with four other endangered species. Supplemental or updated information is provided in the Service's Januray 2009 five-year review for the soft bird's-beak (Service 2009). The five-year review recommended soft bird's beak remain listed as endangered due to the continuation of threats from muting (damping) of tides and salinity, invasive non-native plants, seed predation, sea level rise predicted to result from global climate change, mosquito abatement, oil spills, and (for these small populations) random events. None of the recovery units have met the Draft Recovery Plan's downlisting criteria for the protection, management, and restoration of suitable tidal marsh habitat.

Soft Bird's-Beak Critical Habitat

The Service designated critical habitat for soft bird's-beak on April 12, 2007 (Service 2007). Critical habitat is defined in Section 3 of the Act as: (1) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection; and (2) 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. In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR 424.12(b)). The Service is required to list the known primary constituent elements together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

- Space for individual and population growth, and for normal behavior;
- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, rearing of offspring, or dispersal; and
- Generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The PCEs defined for soft bird's-beak was derived from its biological needs. Based on our current knowledge of the life history, biology, and ecology of the species, and the habitat requirements for sustaining the essential life-history functions of the species, the Service determined that the primary constituent elements essential to the conservation of the soft bird's beak are:

(1) Persistent emergent, intertidal, estuarine wetland at or above the mean high-water line (as extended directly across any intersecting channels);

(2) Rarity or absence of plants that naturally die in late spring (winter annuals); and

(3) Partially open spring canopy cover (approximately 790 nMol/m2/s) at ground level, with many small openings to facilitate seedling germination.

Five units have been designated as critical habitat for soft bird's beak in Contra Costa, Napa, and Solano Counties, California. Contra Costa, Napa, and Solano Counties have approximately 22 acres, 384 acres, and 1,870 aces of critical habitat, respectively. Common threats that may require special management considerations or protections of the PCEs for soft bird's beak in all five units include: (1) mosquito abatement activities (ditching, dredging, and chemical spray operations), which may damage the plants directly by trampling and soil disturbance, and indirectly by altering hydrologic processes and by providing relatively dry ground for additional foot and vehicular traffic; (2) general foot and offroad vehicle traffic through soft bird's beak populations that could result in their damage and loss in impacted areas; (3) increases in the proliferation of nonnative invasive plants from human-induced soil disturbances leading to the invasives outcompeting soft bird's beak; (4) control or removal of nonnative invasive plants, especially *Lepidium latifolium*, which, if not carefully managed, can damage soft bird's beak populations through the injudicious application of herbicides, by direct trampling, or through the accidental transport of invasive plant seeds to new areas; and (5) presence of *Lipographis fenestrella* (a moth) larvae that could reduce the reproductive potential of soft bird's beak through flower, fruit, and seed predation.

The Service intends to conserve the geographic areas containing the physical and biological features that are essential to the conservation of the species, through the identification of the appropriate quantity and spatial arrangement of the primary constituent elements sufficient to support the life-history functions of the species. Because not all life-history functions require all the primary constituent elements, not all areas designated as critical habitat will contain all the primary constituent elements. Please refer to the final designation of critical habitat for soft bird's beak for additional information (72 FR 18518).

Suisun Thistle

The status of Suisun thistle and information about its biology, ecology, distribution, and current threats is available in the *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Draft Recovery Plan; Service 2010a). The Draft Recovery Plan is scheduled to be finalized in 2013. The Draft Recovery Plan features Suisun thistle along with four other endangered species. Supplemental or updated information is provided in the Service's 2009 five-year review for Suisun thistle (Service 2009). In 2009, the Service recommended no change in the classification of Suisun thistle.

Suisun Thistle Critical Habitat

The Service designated critical habitat for Suisun thistle on April 12, 2007 (Service 2007). Refer to soft bird's beak critical habitat section for definition of critical habitat.

The PCEs defined for Suisun thistle was derived from its biological needs. Based on our current knowledge of the life history, biology, and ecology of the species, and the habitat requirements for sustaining the essential life-history functions of the species, the Service determined that the primary constituent elements essential to the conservation of the Suisun thistle are:

(1) Persistent emergent, intertidal, estuarine wetland at or above the mean high-water line (as extended directly across any intersecting channels);

(2) Open channels that periodically contain moving water with ocean derived salts in excess of 0.5 percent; and

(3) Gaps in surrounding vegetation to allow for seed germination and growth.

The three units designated as critical habitat for Suisun thistle comprise 2,052 acres of Solano County. Common threats that may require special management considerations or protections of the PCEs for Suisun thistle in all three units include: (1) alterations to channel water salinity and tidal regimes from the operation of the Suisun Marsh Salinity Control Gates that could affect the depth, duration, and frequency of tidal events and the degree of salinity in the channel water column; (2) mosquito abatement activities (dredging, and chemical spray operations), which may damage the plants directly by trampling and soil disturbance, and indirectly by altering hydrologic processes and by providing relatively dry ground for additional foot and vehicular traffic; (3) rooting, wallowing, trampling, and grazing impacts from livestock and feral pigs that could result in damage or loss to *C. hydrophilum* var. *hydrophilum* colonies, or in soil disturbance and compaction, leading to a disruption in natural marsh ecosystem processes; (4) the proliferation of nonnative invasive plants, especially *Lepidium latifolium*, leading to the invasives outcompeting *C. hydrophilum* var. *hydrophilum*; and (5) programs for the control or removal of non-native invasive plants, which, if not conducted carefully, can damage *C. hydrophilum* var. *hydrophilum* populations through the injudicious application of herbicides, by direct trampling, or through the accidental transport of invasive plant seeds to new areas. An additional threat that may require special management considerations or protection of the PCEs in Units 1 and 2 includes urban or residential encroachment from Suisun City to the north that could increase stormwater and wastewater runoff into these units.

The Service intends to conserve the geographic areas containing the physical and biological features that are essential to the conservation of the species, through the identification of the appropriate quantity and spatial arrangement of the primary constituent elements sufficient to support the life-history functions of the species. Because not all life-history functions require all the primary constituent elements, not all areas designated as critical habitat will contain all the primary constituent elements. Please refer to the final designation of critical habitat for Suisun thistle for additional information (72 FR 18518).

Delta Smelt

Listing status: Delta smelt was federally listed as a threatened species on March 5, 1993 (Service 1993a) due to a population decline of nearly 90 percent in a 20 year period that was likely caused by large freshwater exports as well as agricultural and urban water diversions. Critical habitat for delta smelt was designated on December 19, 1994 (Service 1994a). The Sacramento-San Joaquin Delta Native Fishes Recovery Plan was completed in 1996 (Service 1996). The 5-year Status Review determined the delta smelt threatened status should be retained and was completed on March 31, 2004 (Service 2004). A 12-month finding reclassifying the delta smelt from a threatened to an endangered species as warranted but precluded, was completed in in 2010 (Service 2010).

Description: Delta smelt are nearly translucent with a steely-blue sheen to their sides and have been characterized to have a pronounced odor reminiscent of cucumber (Moyle 2002). Although delta smelt have been recorded to reach lengths of up to 120 mm (4.7 in) (Moyle 2002), mean fork length of the delta smelt from 1975 - 1991 was measured to be 64.1 ± 0.1 mm. Since then, catch data from 1992 - 2004 showed mean fork length decreased to 54.1 ± .01 mm (Bennett 2005; Sweetnam 1999). Delta smelt are also identifiable by their relatively large eye to head size. The eye can occupy approximately 25-30 percent of their head length (Moyle 2002). Delta smelt have a small, translucent adipose fin located between the dorsal and caudal fins. Occasionally one chromatophore (a small dark spot) may be found between the mandibles, but most often there is none (Moyle 2002).

Delta smelt are small slender-bodied fish within the Osmeridae family of fishes (smelts) (Moyle 2002). The delta smelt is one of six species currently recognized in the *Hypomesus* genus (Bennett 2005). Genetic analyses have confirmed that *H. transpacificus* presently exists as a single intermixing population (Stanley *et al.* 1995; Trenham *et al.* 1998; Fisch *et al.* 2011). Within the genus, delta smelt is most closely related to surf smelt (*H. pretiosis*), a species common along the western coast of North America. Despite morphological similarities, the delta smelt is less-closely related to the wakasagi (*H. nipponensis*), an anadromous western Pacific species introduced to Central Valley reservoirs in 1959, and may be seasonally sympatric with delta smelt in the estuary (Trenham *et al.* 1998). Allozyme studies have demonstrated that wakasagi and delta smelt are genetically distinct and presumably derived from different marine ancestors (Stanley *et al.* 1995). Genetic introgression among *H. transpacificus* and *H. nipponensis* is low.

Distribution: The delta smelt is endemic to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta) in California, and is restricted to the area from San Pablo Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties (Moyle 2002). Their range extends from San Pablo Bay upstream to Verona on the Sacramento River and Mossdale on the San Joaquin River. The range of delta smelt is commonly divided into three zones: Central, North and West Zones. The Central Zone is defined as all delta smelt habitat east of the Interstate 80 Bridge over the Carquinez Strait and south of the City of Sacramento's I Street Bridge over the Sacramento River. The Central Zone contains all of the "Legal Delta", as defined by Section 12220 of the Water Code, and the entire designated critical habitat for delta smelt. The North Zone is defined as all delta smelt habitat in the Sacramento River north of the City of Sacramento's I Street Bridge over the Sacramento River. The West Zone is defined as all delta smelt habitat west of the Interstate 80 Bridge over the Carquinez Strait. The West Zone includes the Napa River, Napa Marsh, and San Pablo Bay. The delta smelt was formerly considered to be one of the most common pelagic fish in the upper Sacramento-San Joaquin Estuary (Moyle 2002).

Life History and Biology: Adult delta smelt spawn during the late winter and spring months, with most spawning occurring during April through mid-May (Moyle 2002). Spawning occurs primarily in sloughs and shallow edge areas in the Delta. Delta smelt spawning has also been recorded in Suisun Marsh and the Napa River (Moyle 2002). Most spawning occurs at temperatures between 12-18°C. Although spawning may occur at temperatures up to 22°C, hatching success of the larvae is very low (Bennett 2005).

Fecundity of females ranges from about 1,200 to 2,600 eggs, and is correlated with female size (Moyle 2002). Moyle *et al.* (1992) considered delta smelt fecundity to be "relatively low." However, based on Winemiller and Rose (1992), delta smelt fecundity is fairly high for a fish its size. In captivity, females survive after spawning and develop a second clutch of eggs (Mager *et al.* 2004); field collections of ovaries containing eggs of different size and stage indicate that this also occurs in the wild (IEP 2010). Captive delta smelt can spawn up to 4-5 times. While most adults do not survive to spawn a second season, a few (<5 percent) do (Moyle 2002; Bennett 2005). Those that do survive are typically larger (90-110 mm Standard Length [SL]) females that may contribute disproportionately to the population's egg supply (Moyle 2002 and references therein). Two-year-old females may have 3-6 times as many ova as first year spawners. Most of what is known about delta smelt spawning habitat in the wild is inferred from the location of spent females and young larvae captured in the DFG's Spring Kodiak Trawl (SKT) and 20-mm survey, respectively. In the laboratory, delta smelt spawned at night (Baskerville-Bridges *et al.* 2000; Mager *et al.* 2004). Other smelts, including marine beach spawning species and estuarine populations and the landlocked Lake Washington longfin smelt (*Spirinchus thaleichthys*), are secretive spawners, entering spawning areas during the night and leaving before dawn. If this behavior is exhibited by delta smelt, then delta smelt distribution based on the SKT, which is conducted during daylight hours in offshore habitats, may reflect general regions of spawning activity, but not actual spawning sites.

Delta smelt spawning has only been directly observed in the laboratory and eggs have not been found in the wild. Consequently, what is known about the mechanics of delta smelt spawning is derived from laboratory observations and observations of related smelt species. Delta smelt eggs are 1 mm diameter and are adhesive and negatively buoyant (Moyle 1976, 2002; Mager *et al.* 2004; Wang 1986, 2007). Laboratory observations indicate that delta smelt are broadcast spawners, discharging eggs and milt close to the bottom over substrates of sand and/or pebble in current (DWR and Reclamation 1994; Brown and Kimmerer 2001; Lindberg *et al.* 2003; Wang 2007). Spawning over gravel or sand can also aid in the oxygenation of delta smelt eggs. Eggs that may have been laid in silt or muddy substrates might get buried or smothered, preventing their oxygenation from water flow (Lindberg pers. comm. 2011). The eggs of surf smelts and other beach spawning smelts adhere to sand particles, which keeps them negatively buoyant but not immobile, as the sand may move ("tumble") with water currents and turbulence (Hay 2007). The locations in the Delta where newly hatched larvae are present, most likely indicates spawning occurrence. The 20-mm trawl has captured small (~5 mm SL) larvae in Cache Slough, the lower Sacramento River, San Joaquin River, and at the confluence of these two rivers (e.g., 20-mm trawl survey 1 in 2005). Larger larvae and juveniles (size > 23 mm SL), which are more efficiently sampled by the 20-mm trawl gear, have been captured in Cache Slough and the Sacramento Deep Water Channel in July (e.g. 20-mm trawl survey 9 in 2008). Because they are small fish inhabiting pelagic habitats with strong tidal and river currents, delta smelt larval distribution depends on both the spawning area from which they originate and the effect of transport processes caused by flows. Larval distribution is further affected by water salinity and temperature. Hydrodynamic simulations reveal that tidal action and other factors may cause substantial mixing of water with variable salinity and temperature among regions of the Delta (Monson *et al.* 2007). This could result in rapid dispersion of larvae away from spawning sites.

The triggers for and duration of delta smelt larval movement from spawning areas to rearing areas are not known. Hay (2007) noted that eulachon larvae are probably flushed into estuaries from upstream spawning areas within the first day after hatching, but downstream movement of delta smelt larvae occurs much later. Most larvae gradually move downstream toward the 2 psu isohaline (X2). X2 is scaled as the distance in kilometers from the Golden Gate Bridge (Jassby *et al.* 1995).

At all life stages, delta smelt are found in greatest abundance in the water column and usually not in close association with the shoreline. They inhabit open, surface waters of the Delta and Suisun Bay, where they presumably aggregate in loose schools where conditions are favorable (Moyle 2002). In years of moderate to high Delta outflow (above normal to wet water years), delta smelt larvae are abundant in the Napa River, Suisun Bay and Montezuma Slough, but the degree to which these larvae are produced by locally spawning fish versus the degree to which they originate upstream and are transported by tidal currents to the bay and marsh is uncertain.

Young-of-the-year delta smelt rear in the low salinity zone (LSZ) from late spring through fall and early winter. Once in the rearing area growth is rapid, and juvenile fish are 40-50 mm SL long by early August (Erkkila *et al.* 1950; Ganssle 1966; Radtke 1966). They reach adult size (55-70 mm SL) by early fall (Moyle 2002). Delta smelt growth during the fall months slows considerably (only 3-9 mm total), presumably because most of the energy ingested is being directed towards gonadal development (Erkkila *et al.* 1950; Radtke 1966).

Population Status and Trends: Channelization, conversion of Delta islands to agriculture, and water operations have substantially changed the physical appearance, water salinity, water clarity, and hydrology of the Delta. As a consequence of these changes, most life stages of the delta smelt are now distributed across a smaller area than historically (Arthur *et al.* 1996; Feyrer *et al.* 2007). Wang (1991) noted in a 1989 and 1990 study of delta smelt larval distribution that, in general, the San Joaquin River was used more intensively for spawning than the Sacramento River. Nobriga *et al.* (2008) found that delta smelt capture probabilities in the Summer Townet Survey (TNS) are highest at specific conductance levels of 1,000 to 5,000 $\mu S\ cm^{-1}$ (approximately 0.6 to 3.0 practical salinity unit [psu]). Similarly, Feyrer *et al.* (2007) found a decreasing relationship between abundance of delta smelt in the Fall Midwater Trawl (FMWT) and specific conductance during September through December. The location of the LSZ and changes in delta smelt habitat quality in the San Francisco Estuary can be indexed by changes in X2. The LSZ historically had the highest primary productivity and is where zooplankton populations (on which delta smelt feed) were historically most dense (Knutson and Orsi 1983; Orsi and Mecum 1986). However, this has not always been true since the invasion of the overbite clam (*Corbula amurensis*) (Kimmerer and Orsi 1996). The abundance of many local aquatic species has tended to increase in years when winter-spring outflow was high and X2 was pushed seaward (Jassby *et al.* 1995), implying that the quantity and quality (overall suitability) of estuarine habitat increases in years when outflows are high.

However, delta smelt is not one of the species whose abundance has statistically covaried with winter-spring freshwater flows (Stevens and Miller 1983; Moyle *et al.* 1992; Kimmerer 2002; Bennett 2005).

The distribution of juvenile delta smelt has also changed over the last several decades. During the years 1970 through 1978, delta smelt catches in the TNS survey declined rapidly to zero in the Central and South Delta and have remained near zero since. A similar shift in FMWT catches occurred after 1981 (Arthur *et al.* 1996). This portion of the Delta has also had a long-term trend increase in water clarity during July through December (Arthur *et al.* 1996; Feyrer *et al.* 2007; Nobriga *et al.* 2008).

The California Department of Fish and Game has conducted several long-term monitoring surveys that have been used to index the relative abundance of delta smelt. The 20-mm Survey has been conducted every year since 1995. This survey targets late-stage delta smelt larvae. Most sampling has occurred April-June. The TNS has been conducted nearly every year since 1959. This survey targets 38-mm striped bass, but collects similar-sized juvenile delta smelt. Most sampling has occurred June-August. The FMWT Survey has been conducted nearly every year since 1967. This survey also targets age-0 striped bass, but collects delta smelt > 40 mm in length. The FMWT samples monthly, September-December.

Early statistical assessments of delta smelt population dynamics concluded that at best, the relative abundance of the adult delta smelt population had only a very weak influence on subsequent juvenile abundance (Sweetnam and Stevens 1993). Thus, early attempts to describe abundance variation in delta smelt ignored stock-recruit effects and researchers looked for environmental variables that were directly correlated with interannual abundance variation (e.g., Stevens and Miller 1983; Moyle *et al.* 1992; Sweetnam and Stevens 1993; Herbold 1994; Jassby *et al.*1995). Because delta smelt live in a habitat that varies in size and quality with Delta outflow, the authors cited above searched for a linkage between Delta outflow (or X2) and the TNS and FMWT indices. Generally, these analyses did not find strong support for an outflow-abundance linkage. These analyses led to a prevailing conceptual model that multiple interacting factors had caused the delta smelt decline (Moyle *et al.* 1992; Bennett and Moyle 1996; Bennett 2005). It has also recently been noted that delta smelt's FMWT index is partly influenced by concurrent environmental conditions (Feyrer *et al.* 2007, 2010). This may be a partial explanation for why few analyses could consistently link springtime environmental conditions to delta smelt's fall index.

It is now recognized that delta smelt abundance plays an important role in subsequent abundance (Bennett 2005; Maunder and Deriso 2011). Bennett (2005) assessed (1) the influence of adult stock as indexed by the FMWT versus the next generation of juveniles indexed by the following calendar year's TNS; (2) the influence of the juvenile stock indexed by the TNS versus the subsequent adult stock indexed a few months later in the FMWT; (3) the influence of the FMWT on the following year's FMWT and on the FMWT two years later, and (4) he did the same for the

TNS data. He concluded that (1) two-year-old delta smelt might play an important role in delta smelt population dynamics, (2) it was not clear whether juvenile production was a density-independent or density-dependent function of adult abundance, and (3) adult production was a density-dependent function of juvenile abundance and the carrying capacity of the estuary to support this life-stage transition had declined over time. These conclusions are also supported by Maunder and Deriso (2011).

Threats

Habitat Changes: The existing physical appearance and hydrodynamics of the Delta have changed substantially from the environment in which native fish species like delta smelt evolved. The Delta once consisted of tidal marshes with networks of diffuse dendritic channels connected to floodplains of wetlands and upland areas (Moyle 2002). The in-Delta channels were further connected to drainages of larger and smaller rivers and creeks entering the Delta from the upland areas. In the absence of upstream reservoirs, freshwater inflow from smaller rivers and creeks and the Sacramento and San Joaquin Rivers were highly seasonal and more strongly and reliably affected by precipitation patterns than they are today. Consequently, variation in hydrology, salinity, turbidity, and other characteristics of the Delta aquatic ecosystem was greater in the past than it is today (Kimmerer 2002). For instance, in the early 1900s, the location of maximum salinity intrusion into the Delta during dry periods varied from Chipps Island in the lower Delta to Stockton along the San Joaquin River and Merritt Island in the Sacramento River. Operations of upstream reservoirs have reduced spring flows while releases of water for Delta water export and increased flood control storage have increased late summer and fall inflows (Knowles 2002), though Delta outflows have been tightly constrained during late summer-fall for several decades. The following is a brief description of the changes that have occurred to delta smelt's habitat that are relevant to the environmental baseline for this consultation.

There have been documented changes to the delta smelt's low-salinity zone (LSZ) habitat that have led to present-day, baseline habitat conditions. Currently available information indicates that delta smelt habitat is most suitable for the fish when low-salinity water is near 20°C, highly turbid, oxygen saturated, low in contaminants, supports high densities of calanoid copepods and mysid shrimp (Moyle *et al.* 1992; Nobriga 2002), and occurs over comparatively static 'landscapes' that support sandy beaches and bathymetric variation that enables the fish and their prey to aggregate (Hobbs *et al.* 2006). Almost every component listed above has been degraded over time (see below). The Service has determined that this accumulation of habitat change is the fundamental reason or mechanism that has caused delta smelt to decline.

The position of the LSZ, where delta smelt rear, has changed over the years. The first major change in the LSZ was the conversion of the landscape over which tides oscillate and river flows vary (Moyle and Bennett 2010). The ancestral Delta was a large tidal marsh-floodplain habitat totally approximately 700,000 acres. Most of the historic wetlands were diked and reclaimed for agriculture or other human uses by 1920. Channels were dredged deep (~12 m) to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton. These changes left Suisun Bay and the confluence of the Sacramento-San Joaquin Rivers as the largest and most bathymetrically variable places in the LSZ. This region remained a highly productive nursery for many decades (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995). However, the deepened channels created to support shipping and flood control, requires more freshwater outflow to maintain the LSZ in the large Suisun Bay and River confluence than was once required (Gartrell 2010).

The construction of the CVP and SWP not only provided water supply for urban, agricultural and industrial users, but also provided water needed to combat salinity intrusion into the Delta, which was observed by the early 20th century. California's demand for freshwater continues to increase, thus seasonal salinity intrusion perpetually reduces the temporal overlap of the LSZ (indexed by X2) within the Suisun Bay (region), especially in the fall (Feyrer *et al.* 2007, 2010). Consequently, the second major habitat change in the Delta has been in the frequency with which the LSZ is maintained in Suisun Bay for any given amount of precipitation. There was a step-decline in the LSZ in 1977 from which it has never recovered for more than a few years at a time. Based on model forecasts of climate change and water demand, this trend is expected to continue (Feyrer *et al.* 2010).

Summer and fall environmental quality has decreased overall in the Delta because outflows are lower and water transparency is higher. These changes may be due to increased upstream water diversions for flooding rice fields (Kawakami *et al.* 2008). The confluence of the Sacramento and San Joaquin Rivers has, as a result, become increasingly important as a rearing location for delta smelt, with physical environmental conditions constricting the species range to a relatively narrow area (Feyrer *et al.* 2007; Nobriga *et al.* 2008). This has increased the likelihood that most of the juvenile population is exposed to chronic and cyclic environmental stressors, or catastrophic events.

Turbidity: From 1999 to present, the Delta experienced a change in estuarine turbidity that culminated in an estuary-wide step-decline in 1999 (Schoellhamer 2011). For decades, the turbidity of the modified estuary had been sustained by very large sediment deposits resulting mainly from gold mining in the latter 19th century. Sediments continued to accumulate into the mid-20th century, keeping the water relatively turbid even as sediment loads from the Sacramento River basin declined due to dam and levee construction (Wright and Schoellhamer 2005). Delta smelt are associated with highly turbid waters; there is a negative correlation between the frequency of delta smelt occurrence in survey trawls during summer, fall and early winter and water clarity. For example, the likelihood of delta smelt occurrence in trawls at a given sampling station decreases with increasing Secchi depth (Feyrer *et al.* 2007; Nobriga *et al.* 2008). This is very consistent with behavioral observations of captive delta smelt (Nobriga and Herbold 2008). Turbid waters are thought to increase foraging efficiency (Baskerville-Bridges *et al.* 2004) and reduce the risk of predation for delta smelt.

Temperature: Temperature also affects delta smelt distribution. Swanson and Cech (1995) indicates delta smelt tolerate temperatures less than 8° C to greater than 25° C, however warmer water temperatures greater than 25° C restrict their distribution more than colder water temperatures (Nobriga and Herbold 2008). Delta smelt of all sizes are found in the main channels of the Delta and Suisun Marsh and the open waters of Suisun Bay where the waters are well oxygenated and temperatures are usually less than 25° C in summer (Nobriga *et al.* 2008). Currently, delta smelt are subjected to thermally stressful temperatures every summer.

Foraging Ecology: Delta smelt feed primarily on small planktonic crustaceans, and occasionally on insect larvae (Moyle 2002). Juvenile-stage delta smelt prey upon copepods, cladocerans, amphipods, and insect larvae (Moyle 2002). Historically, the main prey of delta smelt was the euryhaline copepod *Eurytemora affinis* and the euryhaline mysid *Neomysis mercedis*. The slightly larger *Pseudodiaptomus forbesi* has replaced *E. affinis* as a major prey source of delta smelt since its introduction into the Bay-Delta, especially in summer, when it replaces *E. affinis* in the plankton community (Moyle 2002). Another smaller copepod, *Limnoithona tetraspina*, which was introduced to the Bay-Delta in the mid-1990s, is now one of the most abundant copepods in the LSZ, but is not abundant in delta smelt diets. *Acartiella sinensis*, a calanoid copepod species that invaded the Delta at the same time as *L. tetraspina*, also occurs at high densities in Suisun Bay and in the western Delta over the last decade. Delta smelt consume these newer copepods, but *Pseudodiaptomus forbesi* remains their dominant prey (Baxter *et al.* 2008).

River flows influence estuarine salinity gradients and water residence times and thereby affect both habitat suitability for benthos and the transport of pelagic plankton upon which delta smelt feed. High tributary flow leads to lower residence time of water in the Delta, which generally results in lower plankton biomass (Kimmerer 2004). In contrast, higher residence times, which result from low tributary flows, can result in higher plankton biomass but water diversions, overbite clam grazing (Jassby *et al.* 2002) and possibly contaminants (Baxter *et al.* 2008) remove a lot of plankton biomass when residence times are high. These factors all affect food availability for planktivorous fishes that utilize the zooplankton in Delta channels. Delta smelt cannot occupy much of the Delta anymore during the summer (Nobriga *et al.* 2008). Thus, there is the potential for mismatches between regions of high zooplankton abundance in the Delta and delta smelt distribution now that the overbite clam has decimated LSZ zooplankton densities.

The delta smelt compete with and are prey for several native and introduced fish species in the Delta. The introduced Mississippi silverside (*Menidia beryllina*) may prey on delta smelt eggs and/or larvae and compete for copepod prey (Bennett and Moyle 1996; Bennett 2005). Young striped bass also use the LSZ for rearing and may compete for copepod prey and eat delta smelt. Centrarchid fishes and coded wire tagged Chinook salmon smolts released in the Delta for survival experiments since the early 1980s may potentially also prey on larval delta smelt (Brandes and McLain 2001; Nobriga and Chotkowski 2000). Studies during the early 1960s found delta smelt were only an occasional prey fish for striped bass, black crappie, and white catfish (Turner and Kelley 1966). However, delta smelt were a comparatively rare fish even then, so it is not surprising they were a rare prey.

Aquatic Macrophytes: For many decades, the Delta's waterways were turbid and growth of submerged plants was apparently unremarkable. That began to change in the mid-1980's, when the Delta was invaded by the non-native plant, *Egeria densa*, a fast-growing aquatic macrophyte that has now taken hold in many shallow habitats throughout the Delta (Brown and Michnuik 2007; Hestir 2010). *Egeria densa* and other non-native species of submerged aquatic vegetation (SAV) grow most rapidly in the summer and late fall when water temperatures are warm (>

20^0C) and outflow is relatively low (Hestir 2010). The large canopies formed by these plants have physical and biological consequences for the ecosystem (Kimmerer *et al.* 2009). First, the dense nature of SAV promotes sedimentation of particulate matter from the water column which increases water transparency. Increased water transparency leads to a loss of habitat for delta smelt (Feyrer *et al.* 2007; Nobriga *et al.* 2008). Second, dense SAV canopies provide habitat for a suite of non-native fishes that occupy the littoral and shallow habitats of the Delta, displacing native fishes (Brown and Michniuk 2007). Finally, the rise in SAV colonization over the last three decades has led to a shift in the dominant trophic pathways that fuel fish production in the Delta. Until the latter 1980s, the food web of most fishes was often dominated by mysid shrimp (Feyrer *et al.* 2003) that were subsidized by phytoplankton food sources. Now, most littoral and demeral fishes of the Delta have diets dominated by the epibenthic amphipods that eat SAV detritus or the epiphytic algae attached to SAV (Grimaldo *et al.* 2009).

Predators: Delta smelt is a rare fish and has been a rare fish (compared to other species) for at least the past several decades (Nobriga and Herbold 2008). Therefore, it has also been rare in examinations of predator stomach contents. Delta smelt were occasional prey fish for striped bass, black crappie and white catfish in the early 1960s (Turner and Kelley 1966) but went undetected in a recent study of predator stomach contents (Nobriga and Feyrer 2007). Striped bass are likely the primary predator of juvenile and adult delta smelt given their spatial overlap in pelagic habitats. Despite major declines in age-0 abundance, there remains much more biomass of striped bass in the upper estuary than delta smelt. This means it is not possible for delta smelt to support any significant proportion of the striped bass population. It is unknown whether incidental predation by striped bass (and other lesser predators) represents a substantial source of mortality for delta smelt.

Nothing is known about the historic predators of delta smelt or their possible influence on delta smelt population dynamics. Fish eggs and larvae can be opportunistically preyed upon by many invertebrate and vertebrate animals. There has always been a very long list of potential predators of delta smelt's eggs and larvae. The eggs and newly-hatched larvae of delta smelt are thought to be prey for Mississippi silversides in littoral habitats (Bennett 2005). Other potential predators of eggs and larvae of smelt in littoral habitats are yellowfin goby, centrarchids, and Chinook salmon. Potential native predators of juvenile and adult delta smelt would also have included numerous bird and fish species and this may be reflected in delta smelt's annual life-history.

The introduction of striped bass into the San Francisco Estuary in 1879 added a permanently resident, large piscivorous fish to the low-salinity zone. The LSZ is a habitat not known to have had an equivalent predator prior to the establishment of striped bass (Moyle 2002). Striped bass likely changed predation rates on delta smelt, but there are no data available to confirm this hypothesis. For many decades the estuary supported higher striped bass and delta smelt numbers than it does currently (Moyle 2002). This is evidence that delta smelt is able to successfully coexist with striped bass.

Competition: It has been hypothesized that delta smelt are adversely affected by competition from other introduced fish species that use overlapping habitats, including Mississippi silversides (Bennett and Moyle 1995), striped bass, and wakasagi (Sweetnam 1999). Laboratory studies show that delta smelt growth is inhibited when reared with Mississippi silversides (Bennett 2005) but there is no empirical evidence to support the conclusion that competition between these species is a factor that influences the abundance of delta smelt in the wild. There is some speculation that the overbite clam competes with delta smelt for copepod nauplii (Nobriga and Herbold 2008). It is unknown how intensively overbite clam grazing and delta smelt directly compete for food, but overbite clam consumption of shared prey resources does have other ecosystem consequences that appear to have affected delta smelt indirectly.

Microcystis: Large blooms of toxic blue-green algae, *M. aeruginosa*, were first detected in the Delta during the summer of 1999 (Lehman *et al.* 2005). Since then, *M. aeruginosa* has bloomed each year, forming large colonies throughout most of the Delta and increasingly down into eastern Suisun Bay. Blooms typically occur between late spring and early fall (peak in the summer) when temperatures are above 20 °C. *M. aeruginosa* can produce natural toxins that pose animal and human health risks if contacted or ingested directly. Preliminary evidence indicates that the toxins produced by local blooms are not toxic to fishes at current concentrations. However, it appears that *M. aeruginosa* is toxic to copepods that delta smelt eat (Ali Ger 2008 CALFED Science Conference). In addition, *M. aeruginosa* could out-compete diatoms for light and nutrients. Diatoms are a rich food source for zooplankton in the Delta (Mueller-Solger *et al.* 2002).

Contaminants: Contaminants can change ecosystem functions and productivity through numerous pathways. However, contaminant loading and its ecosystem effects within the Delta are not well understood. Although a number of contaminant issues were first investigated during the Pelagic Organism Decline (POD) years, concern over contaminants in the Delta is not new. There are long-standing concerns related to mercury and selenium levels in the watershed, Delta, and San Francisco Bay (Linville *et al.* 2002; Davis *et al.* 2003). Phytoplankton growth rate may, at times, be inhibited by high concentrations of herbicides (Edmunds *et al.* 1999). New evidence indicates that phytoplankton growth rate is chronically inhibited by ammonium concentrations in and upstream of Suisun Bay (Wilkerson *et al.* 2006; Dugdale *et al.* 2007). Contaminant-related toxicity to invertebrates has been noted in water and sediments from the Delta and associated watersheds (e.g., Kuivila and Foe 1995; Giddings 2000; Werner *et al.* 2000; Weston *et al.* 2004). Undiluted drainwater from agricultural drains in the San Joaquin River watershed can be acutely toxic (quickly lethal) to fish and have chronic effects on growth (Saiki *et al.* 1992).

Delta Smelt Critical Habitat

The action area for this consultation is within portions of designated delta smelt critical habitat. The Service designated critical habitat for the delta smelt on December 19, 1994 (Service 1994). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code) (Service 1994).

Conservation Role of Delta Smelt Critical Habitat: The Service's primary objective in designating critical habitat was to identify the key components of delta smelt habitat that support successful spawning, larval and juvenile transport, rearing, and adult migration. Delta smelt are endemic to the Bay-Delta and the vast majority only live one year. Thus, regardless of annual hydrology, the Delta must provide suitable habitat all year, every year. Different regions of the Delta provide different habitat conditions for different life stages, but those habitat conditions must be present when needed, and have sufficient connectivity to provide migratory pathways and the flow of energy, materials and organisms among the habitat components. The entire Delta and Suisun Bay are designated as critical habitat; over the course of a year, the entire habitat is occupied.

Description of the Primary Constituent Elements: In designating critical habitat for the delta smelt, the Service identified the following primary constituent elements (PCEs) essential to the conservation of the species:

Primary Constituent Element 1: "Physical habitat" is defined as the structural components of habitat. Because delta smelt is a pelagic fish, spawning substrate is the only known important structural component of habitat. Structural habitat also contains factors that contribute to hydrodynamic complexity in a tidal environment – tributaries, bathymetric variability, edges, eddies, breaches, cracks, crags, marshes, tules, etc. Hydrodynamic complexity provides smelt opportunity to forage, hide, rest, escape, etc. These should also be considered PCE of "physical habitat." It is possible that depth variation is an important structural characteristic of pelagic habitat that helps fish maintain position within the estuary's LSZ (Bennett *et al.* 2002; Hobbs *et al.* 2006).

Primary Constituent Element 2: "Water" is defined as water of suitable quality to support various delta smelt life stages with the abiotic elements that allow for survival and reproduction. Delta smelt inhabit open waters of the Delta and Suisun Bay. Certain conditions of temperature, turbidity, and food availability characterize suitable pelagic habitat for delta smelt and are discussed in detail in the Status of the Species/Environmental Baseline section, above. Factors such as high entrainment risk and contaminant exposure can degrade this PCE even when the basic water quality is consistent with suitable habitat.

Primary Constituent Element 3: "River flow" is defined as transport flow to facilitate spawning migrations and transport of offspring to LSZ rearing habitats. River flow includes both inflow to and outflow from the Delta, both of which influence the movement of migrating adult, larval, and juvenile delta smelt. Inflow, outflow, and Old and Middle Rivers flow influence the vulnerability of delta smelt larvae, juveniles, and adults to entrainment at Banks and Jones (refer to Status of the Species/Environmental Baseline section, above). River flow interacts with the fourth primary constituent element, salinity, by influencing the extent and location of the highly productive LSZ where delta smelt rear.

Primary Constituent Element 4: "Salinity" is defined as the LSZ nursery habitat. The LSZ is where freshwater transitions into brackish water; the LSZ is defined as 0.5-6.0 psu (parts per thousand salinity; Kimmerer 2004). The 2 psu isohaline is a specific point within the LSZ where the average daily salinity at the bottom of the water is 2 psu (Jassby *et al.* 1995). By local convention the location of the LSZ is described in terms of the distance from X2 the Golden Gate Bridge; X2 is an indicator of habitat suitability for many San Francisco Estuary organisms and is associated with variance in abundance of diverse components of the ecosystem (Jassby *et al.* 1995; Kimmerer 2002). The LSZ expands and moves downstream when river flows into the estuary are high. Similarly, it contracts and moves upstream when river flows are low. During the past 40 years, monthly average X2 has varied from as far downstream as San Pablo Bay (45 km) to as far upstream as Rio Vista on the Sacramento River (95 km). At all times of year, the location of X2 influences both the area and quality of habitat available for delta smelt to successfully complete their life cycle. In general, delta smelt habitat quality and surface area are greater when X2 is located in Suisun Bay. Both habitat quality and quantity diminish the more frequently and further the LSZ moves upstream, toward the confluence.

Overview of Delta Smelt Habitat Requirements and the Primary Constituent Elements: Delta smelt live their entire lives in the tidally-influenced fresh- and brackish waters of the San Francisco Estuary (Moyle 2002). Delta smelt are an open-water, or pelagic, species. They do not associate strongly with structure. They may use nearshore habitats for spawning (PCE #1), but free-swimming life stages mainly occupy offshore waters (PCE #2). Thus, the distribution of the population is strongly influenced by river flows through the estuary (PCE #3) because the quantity of fresh water flowing through the estuary changes the amount and location of suitable low-salinity, open-water habitat (PCE #4). This is true for all life stages. During periods of high river flow into the estuary, delta smelt distribution can transiently extend as far west as the Napa River and San Pablo Bay. Delta smelt distribution is highly constricted near the Sacramento-San Joaquin Rivers confluence during periods of low river flow into the estuary (Feyrer *et al.* 2007). In the 1994 designation of critical habitat, the best available science held that the delta smelt population was responding to variation in spring X2.

Alterations to Estuarine Bathymetry PCE # 1 (~ 1850-present): The first major change in the LSZ was the conversion of the landscape over which tides oscillate and river flows vary (Nichols *et al.* 1986). The ancestral Delta was a large tidal marsh-floodplain habitat totaling approximately 300,000 acres. Most of the wetlands were diked and reclaimed for agriculture or other human use by the 1920s. The physical habitat modifications of the Delta and Suisun Bay were mostly due to land reclamation and urbanization. Water conveyance projects and river channelization have had some influence on the regional physical habitat by armoring levees with riprap, building conveyance channels like the Delta Cross Channel, storage reservoirs like Clifton Court Forebay, and by building and operating temporary barriers in the south Delta and permanent gates and water distribution systems in Suisun Marsh.

In the 1930s to 1960s, the shipping channels were dredged deeper (~12 m) to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton. These changes left Suisun Bay and the Sacramento-San Joaquin River confluence region as the largest and most bathymetrically variable places in the LSZ. This region remained a highly productive nursery for many decades (Stevens and Miller 1983; Moyle *et al.* 1992; Jassby *et al.* 1995). However, the deeper landscape created to support shipping and flood control requires more freshwater outflow to maintain the LSZ in the large Suisun Bay/river confluence region than was once required (Gartrell 2010).

Seasonal salinity intrusion reduces the temporal overlap of the LSZ (indexed by X2) with the Suisun Bay region, especially in the fall (Feyrer *et al.* 2007, 2011). Thus, the second major change has been in the frequency with which the LSZ is maintained in Suisun Bay for any given amount of precipitation (DFG 2010). This metric showed a step-decline in 1977 from which it has never recovered for more than a few years at a time. Based on model forecasts of climate change and water demand, this trend is expected to continue (Feyrer *et al.* 2011). As such this alteration of PCE # 1 also affects the other PCEs, particularly PCE # 4. The major landscape factor affecting this interaction was the dredging of shipping channels.

Spawning delta smelt require all four PCEs, but spawners and embryos are the life stage that is believed to most require a specific structural component of habitat. Spawning delta smelt require sandy or small gravel substrates for egg deposition (Bennett 2005). The major invasive species effect on physical habitat is the dense growth of submerged aquatic vegetation in the Delta (described in more detail below). These plants carpet large areas in parts of the Delta such as Franks Tract. The vegetation beds act as mechanical filters removing turbidity and possibly other water quality components as the tides and river flows move water over them (Hestir 2010). Thus, the proliferation of submerged aquatic plants has likely also reduced the area of nearshore habitat suitable for delta smelt spawning.

Alterations to Water (PCE # 2): PCE # 2 is primarily referring to a few key water quality components (other than salinity) that influence spawning and rearing habitat suitability for delta smelt. Research to date indicates that water quality conditions are more important than physical habitat conditions for predicting where delta smelt occur (Feyrer *et al.* 2007; Nobriga *et al.* 2008) – probably because delta smelt is a pelagic fish except during its egg/embryo stage. However, the interaction of water quality and bathymetry is thought to generally affect estuarine habitat suitability (Peterson 2003) and there is evidence that delta smelt habitat is optimized when appropriate water quality conditions overlap the Suisun Bay region (Moyle *et al.* 1992; Hobbs *et al.* 2006; Feyrer *et al.* 2011). This is discussed further in the section about PCE # 4 (salinity).

Changing predation pressure (1879 to present): Nothing is known about the historical predators of delta smelt or their possible influence on delta smelt. Fish eggs and larvae can be opportunistically preyed upon by many invertebrate and vertebrate animals so there has always been a very long list of potential predators of delta smelt's eggs and larvae. Potential native predators of juvenile and adult delta smelt would also have included numerous bird and fish species and this may be reflected in delta smelt's annual life-history. Annual fish species, also known as "opportunistic strategists," are adapted to high mortality rates in the adult stage (Winemiller and Rose 1992). This high mortality is usually due to predation or highly unpredictable environmental conditions, both of which could have characterized the ancestral niche of delta smelt.

The introduction of striped bass into the San Francisco Estuary in 1879 added a permanently resident, large piscivorous fish to the low-salinity zone: a habitat that is not known to have had an equivalent predator prior to the establishment of striped bass (Moyle 2002). This likely changed predation rates on delta smelt, but there are no data available to confirm this hypothesis. For many decades the estuary supported higher striped bass and delta smelt numbers than it does currently. This is evidence that delta smelt is able to successfully coexist with striped bass.

The current influence of striped bass and other predators on delta smelt population dynamics is also not known mainly because quantitative descriptions of predator impacts on rare prey are extremely difficult to generate. Delta smelt were observed in the stomach contents of striped bass and other fishes in the 1960s (Stevens 1963; Turner and Kelley 1966), but have not been observed in more recent studies (Feyrer *et al.* 2003; Nobriga and Feyrer 2007). Predation is a common source of density-dependent mortality in fish populations (Rose *et al.* 2001). Thus, it is possible that predation was a mechanism that historically generated the density-dependence observed in delta smelt population dynamics (Bennett 2005; Maunder and Deriso 2011). Because it is generally true for fishes, the vulnerability of delta smelt to predators is influenced primarily by habitat conditions. Turbidity may be a key mediator of delta smelt's vulnerability to predators (Nobriga *et al.* 2005, 2008). Growth rates, an interactive outcome of feeding success and water temperature, are also well known to affect fishes' cumulative vulnerability to predation (Sogard 1997). Thus, predation rate is best characterized as an aspect food web function linked to PCE # 2.

Food web alterations attributable to the overbite clam (1987-present): The next major change to PCE # 2 occurred following the invasion of the estuary by overbite clam. The overbite clam was first detected in 1986 and from 1987-1990 its influence on the ecosystem became evident. Since 1987, there has been a step-decline in phytoplankton biomass (Alpine and Cloern 1992; Jassby *et al.* 2002). Phytoplankton in the LSZ is an important component of the pelagic food web that delta smelt are a part of because a key part of the diet of delta smelt's prey is phytoplankton. Not only does the overbite clam reduce food for delta smelt's prey, it can also graze directly on the larval stages of the copepods eaten by delta smelt (e.g., Kimmerer *et al.* 1994). The grazing pressure applied by the overbite clam rippled through the historical zooplankton community that fueled fishery production in the LSZ (Kimmerer *et al.* 1996; Orsi and Mecum 1996; Kimmerer 2002b; Feyrer *et al.* 2003). This major change in the way energy moved through the ecosystem has likely facilitated the numerous invasions of the estuary by suppressing the production of historically dominant zooplankton, which increases the opportunity for invasion by other species that are less dependent on high densities of LSZ phytoplankton.

The distribution and abundance of several LSZ fishes have changed since 1987 (Kimmerer 2002b; Kimmerer 2006; Rosenfield and Baxter 2007; Mac Nally *et al.* 2010). Surprisingly, the changes in phytoplankton and zooplankton production have not been as evident for delta smelt as for other organisms (Kimmerer 2002b; Kimmerer 2006; Sommer *et al.* 2007; Mac Nally *et al.* 2010). Nonetheless, delta smelt collected in the FMWT have been persistently smaller since the overbite clam invasion (Sweetnam 1999; Bennett 2005). This is evidence for reduced growth rates that could have been caused by food web changes stemming from overbite clam grazing.

The Service considers the prey density aspect of the estuarine food web to be a component of PCE # 3 ("Water"). The Central Valley Project and State Water Project entrain some food web production (about 4.5 percent on a daily average basis was attributed to all water diversions in the Delta; Jassby *et al.* 2002). However, prey densities have been most strongly affected by clam grazing (Kimmerer *et al.* 1994; Jassby *et al.* 2002). Urban wastewater input, *Microcystis* blooms, and pesticide loads may also impair the production of zooplankton eaten by delta smelt or eaten by delta smelt's prey (Wilkerson *et al.* 2006; Dugdale *et al.* 2007; Jassby 2008; Ger *et al.* 2009; Werner *et al.* 2010).

Proliferation of submerged aquatic vegetation (1980s to present): For many decades, the Delta's waterways were turbid and the growth of submerged plants was apparently unremarkable. That began to change in the mid-1980s, when the Delta was invaded by the non-native plant, *Egeria densa*, a fast-growing aquarium plant that has taken hold in many shallow habitats (Brown and Michnuik 2007; Hestir 2010). *Egeria densa* and other non-native species of submerged aquatic vegetation (SAV) grow most rapidly in the summer and late fall when water temperatures are warm (> 20^0C) and outflow is relatively low (Hestir 2010). The large canopies formed by these plants have physical and biological consequences for the ecosystem (Kimmerer *et al.* 2008). First, dense SAV promotes water transparency. Increased water transparency leads to a loss of habitat for delta smelt (Feyrer *et al.* 2007; Nobriga *et al.* 2008). Second, dense SAV canopies provide habitat for a suite of non-native fishes, including largemouth bass, which now dominate many shallow habitats of the Delta and displace native fishes (Nobriga *et al.* 2005; Brown and Michniuk 2007). Finally, SAV colonization over the last three decades has led to a shift in the dominant freshwater food web pathways that fuel fish production (Grimaldo *et al.* 2009b). It is noteworthy that SAV-dominated habitats are comparatively productive (Nobriga *et al.* 2005; Grimaldo *et al.* 2009b), but most of the productivity they generate remains in the nearshore environment and therefore does not contribute much to pelagic fish production (Grimaldo *et al.* 2009b).

Reduced turbidity (1999-present): The next major change was a change in estuarine turbidity that culminated in an estuary-wide step-decline in 1999 (Schoellhamer 2011). For decades, the turbidity of the modified estuary had been sustained by very large sediment deposits resulting mainly from gold mining in the latter 19th century. The sediments continued to accumulate into the mid-20th century, keeping the water relatively turbid even as sediment loads from the Sacramento River basin declined due to dam and levee construction (Wright and Schoellhamer 2004). The flushing of the sediment deposits may also have made the estuary deeper overall and thus a less suitable nursery from the 'static' bathymetric perspective (Schroeter 2008). Delta smelt larvae require turbidity to initiate feeding (Baskerville-Bridges *et al.* 2004), and as explained above, older fish are thought to use turbidity as cover from predators. Thus, turbidity is an aspect of PCE # 2 which is a necessary water quality aspect of delta smelt's critical habitat.

Dams and armored levees have contributed to the long-term decline in sediment load to the estuary (Wright and Schoellhamer 2004) and to the clearing of estuary water. This is a long-term effect that stemmed from building and maintaining infrastructure. Opportunities to substantively address this change are limited due to the extreme Central Valley flood and water supply risks that would result from decommissioning dams or removing levees.

Changing water temperature (present through long-term climate forecasts): Delta smelt is already subjected to thermally stressful temperatures every summer in the Delta. Water temperatures are presently above 20°C for most of the summer in core habitat areas, sometimes even exceeding the nominal lethal limit of 25°C for short periods. Coldwater fishes begin to have behavioral impairments (Marine and Cech 2004) and lose competitive abilities (Taniguchi *et al.* 1998) prior to reaching their thermal tolerance limits. Thus, the estuary can already be considered thermally stressful to delta smelt and can only become more so if temperatures warm in the coming decades.

All available regional climate change projections predict central California will be warmer still in the coming decades (Dettinger 2005). It is expected that warmer estuary temperatures will be yet another significant conservation challenge (Brown *et al.* unpublished data; Cloern *et al.* 2011). This is true because they will limit abiotic habitat suitability further than indicated by flow-based projections (e.g., Feyrer *et al.* 2011). In addition, warmer water temperatures mean that higher prey densities will be required just to maintain present-day growth rates, which are already lower than they once were (Sweetnam 1999; Bennett 2005). Water temperature is mainly affected by climate variation, both as air temperature and as flood and drought scale flow variation (Kimmerer 2004; Wagner *et al.* 2010).

Sensitivities to contaminants (ongoing): Delta smelt's spawning migration coincides with early winter rains (Sommer *et al.* 2011). This 'first-flush' of inflow to the Delta brings sediment-bound pesticides with it (Bergamaschi *et al.* 2001), and peak densities of larvae and juveniles can co-occur with numerous pesticides (Kuivila and Moon 2004). Bennett (2005) reported that about 10 percent of the delta smelt analyzed for histopathological anomalies in 1999-2000 showed evidence of deleterious contaminant exposure, but this was low compared to the 30-60 percent of these fish that appeared to be food-limited.

Delta smelt can also be exposed to other toxic substances. Recent toxicological research has provided dose-response curves for several contaminants (Connon *et al.* 2009, 2011). This research has also shown that gene expression changes and impairment of delta smelt swimming performance occur at contaminant concentrations lower than levels that cause mortality. Climatic scale flow variation (e.g., flood versus drought scale variation) affects the amount of methyl mercury (Darryl Slotton presentation) entering the ecosystem and may have some influence on the meaningful dilution of ammonium from urban wastewater inputs (Dick Dugdale presentation).

Invasive species may also affect PCE # 2 by changing contaminant dynamics. For instance, *Microcystis* blooms generate toxic compounds that can kill delta smelt prey (Ger *et al.* 2009) and accumulate in the estuarine food web (Lehman *et al.* 2010). A second example is the biomagnification of selenium in the food web by overbite clam (Stewart *et al.* 2004). This has been considered a potential issue for the clam's predators – namely sturgeon, splittail, and diving ducks (Richman and Lovvorn 2004; Stewart *et al.* 2004). However, it is not known whether this change in selenium dynamics negatively affects delta smelt and other fishes that do not directly prey on the clams.

Alterations of River Flows PCE # 3: This PCE refers to the transport flows that help guide young delta smelt from spawning habitats to rearing habitats, and to flows that guide adult delta smelt from rearing habitats to spawning habitats. Delta outflow also has some influence on delta smelt's supporting food web (Jassby *et al.* 2002; Kimmerer 2002) and it affects abiotic habitat suitability as well (Feyrer *et al.* 2007; 2011). The latter is expanded upon in the discussion of PCE # 4. The environmental driver with the strongest influence on PCE # 3 is highly dependent on the time-scale being considered. The tide has the largest influence on flow velocities and directions in delta smelt's critical habitat at very short timescales (minutes to days), whereas interannual variation in precipitation and runoff has the largest influence on flows into and through the Delta at very long timescales (years to decades), and sometimes at shorter time scales (days to weeks) during major storm events. Changes to flow regimes can have the largest influence on PCE #3 at timescales of weeks to seasons. This is particularly true during periods of low natural inflow, for instance during the fall and during droughts, and in the south Delta where Old and Middle River flows are often managed using changes in export flow rates.

Entrainment into water export diversions (1951 to present):The amount of water diverted from the estuary has generally increased over time, and most of the increase during the 1950s and 1960s was due to Central Valley Project exports, and since the latter 1960s, State Water Project exports. There are two basic potential fishery impacts that result from water diversion from the Delta: ecosystemic impacts and direct entrainment. From the ecosystemic perspective, water diversions are unnatural 'predators' because they 'consume' organisms at every trophic level in the ecosystem from phytoplankton (Jassby *et al.* 2002) to fish (Kimmerer 2008). Unlike natural predators which typically shift their prey use over time in association with changes in prey fish density (Nobriga and Feyrer 2008), fractional entrainment losses of fishes to diversions are functions of water demand (e.g., Grimaldo *et al.* 2009). Thus, water diversions not only elevate 'predation' mortality in an aquatic system, but they can do so in an atypical, density-independent manner. Diversions and fish collection facilities in the south Delta are very large structures which attract large aggregations of actual predatory fish that prey on smaller species like delta smelt before they reach the fish salvage facilities and within these facilities (Gingras 1997).

Estimated entrainment losses of delta smelt to State Water and Central Valley Projects diversions can be substantial in some years (Kimmerer 2008). Given the delta smelt's current density-independent population dynamics, even a statistically indiscernable entrainment effect on the population is likely to cause the species to continue to decline (Kimmerer 2011). The entrainment losses of delta smelt are not generally observed until they reach the early juvenile stage (~ 20-30 mm in length), but combinations of 20mm Survey distribution data and hydrodynamic modeling provide evidence that their risk of entrainment into the Project diversions can be described by any of several indices that integrate Delta inflow and export flow (Kimmerer and Nobriga 2008; Kimmerer 2008; USFWS 2008; Grimaldo *et al.* 2009).

Delta smelt entrainment losses estimated from survey data and hydrodynamics can also be substantial in some years (Kimmerer 2008), though it is possible that Kimmerer may have overestimated them (Miller 2011). Nonetheless, increasingly higher outflow (or lower X2) moves the bulk of the larval population increasingly west, which results in fewer larvae distributed in the south Delta where they are at highest risk of entrainment. At the same time, indices like the export to inflow ratio or Old and Middle River flow are useful metrics for gauging the effect of exports on the south Delta.

The risk of delta smelt entrainment into smaller agricultural irrigation diversions used mainly to irrigate crops within the Delta is also related to flow conditions. These in-Delta irrigation diversions generally have mean flow rates less than 1 cubic meter per second (Nobriga *et al.* 2004). The lower the Delta outflow, the higher the proportion of the young delta smelt population that overlaps the array of irrigation diversions in the Delta (Kimmerer and Nobriga 2008). However, the irrigation diversions are not currently considered to represent a substantial source of mortality because they individually draw small quantities of water relative to channel volumes (Nobriga *et al.* 2004).

In Suisun Marsh, water diversions are largely made to support waterfowl production. Some Suisun Marsh diversions are larger for the size of channels they are in than most of the agricultural irrigation diversions in the Delta. Based on hydrodynamic simulations, proximity to water diversions in the marsh is expected to correlate strongly with entrainment (Culberson *et al.* 2004), and substantial delta smelt losses have been reported when these diversions are not screened (Pickard 1982). Entrainment risk for delta smelt in western Suisun Marsh is considered low because the habitat surrounding the diversions is often too saline (Enos *et al.* 2007).

Salinity PCE # 4: The core delta smelt habitat is the LSZ (Moyle *et al.* 1992; Bennett 2005). The LSZ is where freshwater transitions into brackish water, and is defined as the area of the estuary where salinity ranges from 0.5-6.0 psu (parts per thousand salinity; Kimmerer 2004). This area is always moving due to tidal and river flow variation. Larval delta smelt tend to reside somewhat landward (upstream) of X2 (Dege and Brown 2004), but the center of juvenile distribution tends to be very near X2 until the fish start making spawning migrations in the winter (Feyrer *et al.* 2011; Sommer *et al.* 2011). Because of this association between the distribution of salinity in the estuary and the distribution of the delta smelt population, the tidal and river flows that comprise PCE # 3 affect PCE # 4.

The expansion and contraction of the LSZ affects the areal extent of abiotic habitat for delta smelt, both during spring (Kimmerer *et al.* 2009) and fall (Feyrer *et al.* 2007, 2011). In the spring, most delta smelt are larvae or young juveniles and the LSZ is typically maintained over the expansive Suisun Bay region. Thus, abiotic habitat "limitation" is unlikely and no consistent influence of spring X2 variation on later stage abundance estimates has been reported to date (Jassby *et al.* 1995; Bennett 2005; Kimmerer *et al.* 2009). Historical maxima in juvenile abundance according to DFG's TNS occurred in low outflow years when abiotic habitat area was comparatively low (Kimmerer 2002; Kimmerer *et al.* 2009).

In contrast, during fall delta smelt are late stage juveniles and for the past decade or more, the LSZ has been persistently constricted by low Delta outflow. Fall habitat conditions affect delta smelt distribution and the concurrent FMWT abundance index (Feyrer *et al.* 2007, 2011). However, the quantitative life cycle models developed to date have not found evidence for a year over year effect of fall LSZ location on delta smelt population dynamics (Mac Nally *et al.* 2010; Thompson *et al.* 2010; Deriso 2011).

It is now recognized that some delta smelt occur year-around in the Cache Slough region including the Sacramento River Deep Water Shipping Channel and Liberty Island (Kimmerer 2011; Miller 2011; Sommer *et al.* 2011). The latter has been a consistently available habitat only since 1997. This region is often lower in salinity than 0.6 psu – the lower formal limit of the LSZ as defined by Kimmerer (2004). Delta smelt likely use it because it is one of the most turbid habitats remaining in the Delta (Nobriga *et al.* 2005). A recent population genetic study found no evidence that delta smelt inhabiting this region are unique compared to delta smelt using the LSZ-proper (Fisch *et al.* 2011), therefore it is likely that individual delta smelt migrate between the LSZ and the Cache Slough region. This is consistent with the high summer water temperatures observed there, which might compel individual delta smelt to seek out cooler habitats within and outside the Cache Slough region.

Environmental Baseline

California Clapper Rail

There are 14 documented CNDDB occurrences of California clapper rail in the action area (CNDDB 2010). This species has been detected at several locations in Suisun Marsh, including occurrences along Suisun Slough, Cutoff Slough, Hill Slough, Goodyear Slough, Rush Ranch, and Ryer Island. Up to four clapper rails were detected in the action area during the breeding season in seven survey years from 2002 to 2008; however, eight were detected during the fall of the same years (DFG 2007; DFG 2008b [unpublished survey]). Surveys conducted by DFG in 2006 identified two clapper rail occurrences in the Marsh and three occurrences near Pt. Edith on the south side of Grizzly Bay. The two occurrences in the Marsh were from First Mallard Slough (DFG 2007). Suisun Marsh has very limited high marsh vegetation which California clapper rail requires. According to the Draft Recovery Plan, in order for California clapper rail to be downlisted within the Suisun Bay Recovery Unit, a minimum of 5,000 acres of contiguous high-quality tidal marsh habitat is required with well-developed channel systems and high-tide refugial/escape cover at the high marsh/upland transition zone and or inner-marsh of the Western Grizzly and Suisun Bays and marshes of Suisun, Hill and Cutoff Slough (Regions 3, 1, and 2).

Salt Marsh Harvest Mouse

There are 37 documented CNDDB occurrences of salt marsh harvest mouse in the Marsh (CNDDB 2010). This species has been observed in tidal wetlands and along sloughs as well as within managed wetlands. Salt marsh harvest mouse use of managed wetlands has been documented to be as high, or higher than, tidal wetland use (Sustaita et. al. 2011). Downlisting of the salt marsh harvest mouse in the Suisun Bay Recovery Unit is achievable through 1,000 or more acres of muted or tidal marsh in the Western Suisun/Hill Slough Marsh Complex (Region 1), 1,000 or more acres of muted or tidal marsh in the Suisun Slough/Cutoff Slough Marsh Complex (Region 2), 1,500 or more acres of diked or tidal marsh in the Grizzly Island Marsh Complex (Region 3), 1,000 or more acres of muted or tidal marsh in the Nurse Slough/Denverton Slough Marsh Complex (Region 4), and 500 or more acres of muted or tidal marsh in the Contra Costa County Marsh Complex (not in the SMP). Pepperweed occurrence within the action area is high. Currently, 2,500 acres of suitable habitat throughout the Marsh has been conserved as salt marsh harvest mouse habitat. The salt marsh harvest mouse Conservation Areas are Peytonia Slough; Hill Slough West Ponds 1, 2, 4, and 4A; Hill Slough East Areas 8 and 9; a portion of Joice Island, Crescent Unit, a portion of Lower Joice Island; Blacklock; and Grizzly Island Ponds 1 and 15. Mitigation areas are Island Slough Ponds 4 and 7.

California Least Tern

There is one documented CNDDB occurrence of California least tern in the action area (CNDDB 2010). A breeding colony was located on the east side of Montezuma Slough near Collinsville in 2006, at the Montezuma Wetlands dredge disposal site. After initially being sighted at Montezuma in 2005, California least terns nested at the site in 2006 and 2007. In summer 2005, approximately 15 to 20 California least terns were observed on a shell mound in Cell 3/4. The next year, California least terns nested on another shell mound in Cell 3/4. The California least terns nested successfully at the project site in 2006 and have nested each year since then. The table below presents the number of California least terns observed at the site:

	2006	2007	2008	2009	2010
nests	45	32	35	27	17
chicks	Not counted	16	24	17	20
fledglings	28	5	18	7	5

Soft Bird's-Beak

There are 11 occurrences in the action area (California Natural Diversity Database 2010). These occurrences are found in Regions 1, 2, and 4. Soft bird's-beak is thought to be limited to three general locations in Suisun Marsh: Rush Ranch, DFW's Joice Island Unit of the Grizzly Island Wildlife Management Area, and the Hills Slough marsh (DWR 2001); however, this species also occurs on Luco Slough and east of Bradmoor Island (California Natural Diversity Database 2010). The Hill Slough population accounts for more than 80% of the occurrences of this species in the action area (DWR 1999). Downlisting of soft bird's beak will be achieved if over a five year period, the median area inhabited by the species is 3,000 acres or more in the Suisun Bay Area and 1,000 acres in the San Pablo Bay Area, a total of 5,000 acres or more in the Suisun Bay Area and the San Pablo Bay Area are permanently preserved and under protective management which include existing or successfully restored tidal marsh areas with suitable habitat for the species and encompass at least 80 percent of the species. *Lepidium latifolium* populations are reduced to less than ten percent cover in Suisun Marsh, there is less than 10% total cover of other non-native perennial or non-native winter annual grass species, and natural tidal cycles are restored at Hill Slough, and the ponded area at Rush Ranch is returned to periodic tidal flooding.

Soft Bird's-Beak Critical Habitat

Three critical habitat units identified for soft bird's-beak occur in the action area. These units are Unit 2, Hill Slough Wildlife Management Area; Unit 4, Rush Ranch/Grizzly Island Wildlife

Management Area; and Unit 5, Southampton Marsh (72 FR 18528, April 12, 2007). Soft bird's-beak occurs in each of these Units.

Suisun Thistle

This species is known to exist only in Suisun Marsh and typically is found in the action area in the middle to high marsh zone along tidal channels and in irregularly flooded estuarine wetlands (DWR 2001). Three populations of Suisun thistle are known (DWR 2001), and there are four occurrences in the action area (California Natural Diversity Database 2010). One population occurs on DFW's Peytonia Slough Ecological Reserve in Region 1. The second population and the remaining occurrences are associated with the Cutoff Slough tidal marshes and DFW's Joice Island Unit of the Grizzly Island Wildlife Management Area in Region 2. Downlisting of Suisun thistle will be achieved if the median area inhabited by this species is 2,000 acres, a total of 4,000 acres or more is permanently preserved, *Lepidium latifolium* populations are reduced to less than ten percent cover in Suisun Marsh, natural tidal cycles are restored at Hill Slough, and the ponded area at Rush Ranch is returned to periodic tidal flooding.

Suisun Thistle Critical Habitat

Three critical habitat units have been identified for Suisun thistle in the action area. These units are Unit 1, Hill Slough Wildlife Management Area; Unit 2, Peytonia Slough Ecological Reserve; and Unit 3, Rush Ranch/Grizzly Island Wildlife Management Area (72 FR 18527, April 12, 2007). Suisun thistle occurs in each of these Units.

Delta Smelt

Suisun Marsh is a key habitat area for delta smelt. Mature adults and rearing juveniles have been detected in Suisun Marsh during all of the past 7 years of DFG summer kodiak trawls (DFG 2008a). Larval delta smelt surveys (20-mm survey) also are done by DFG and have taken place from 1995 to 2008. Larval delta smelt have been found every year, and numbers vary from year to year (DFG 2010). Numerous delta smelt have been captured over the years during the University of California at Davis (UC Davis) Suisun Marsh fish survey. However, their numbers have diminished over the years. The highest number caught was 230 fish in 1981, and in subsequent years (1982–2005), numbers ranged from 0 to 33 fish. In 2006, two fish were captured (Schroeter 2008 pers. comm.). They are present in most sloughs in the Marsh, with Suisun Slough having the most fish. Most adult and juvenile fish rear from January through May and September through December. There are few fish present in the Marsh from June through August. Larval smelt are present in the action area from February to June (Bay Delta and Tributaries no date) (Table 13).

Table 13. Delta Smelt Life Stage Timing in Suisun Marsh

Life Stage	Distribution	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult migration	Delta	■	■	■									■
Spawning	Delta, Suisun Marsh			■	■	■	■						
Larval and early juvenile rearing	Suisun Marsh		■	■	■	■	■						
Estuarine rearing: juveniles and adults	Suisun Marsh	■	■	■	■	■				■	■	■	■

■ Primary occurrence included in the assessment of plan impacts.

Sources: Rosenfield and Baxter 2007; Wang and Brown 1993; U.S. Fish and Wildlife Service 1996; McEwan 2001; Moyle 2002; Hallock 1989.

<u>Delta Smelt Critical Habitat</u>

Critical habitat for delta smelt was designated on December 19, 1994. Critical habitat includes all submerged land below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma Sloughs; and the existing contiguous waters contained in the Delta (59 FR 65256). Primary constituent elements are physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (59 FR 65279).

Effects of the Programmatic Proposed Action

Effects of the action are defined in 50 CFR §402.02 as "the direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline." Direct effects occur at the project site and may extend upstream or downstream based on the potential for impairing important habitat elements. Indirect effects are defined as "those that are caused by the proposed action and are later in time, but still are reasonably certain to occur." They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. Interrelated actions are "those that are part of a larger action and depend on the larger action for their justification." Interdependent actions are "those that have no independent utility apart from the action under consideration." Cumulative effects, which are discussed separately after this section, are the effects of future State, local, or private activities, not involving Federal activities that are reasonably certain to occur in the action area.

The tidal wetland restoration actions, specifically levee breaching, initially would result in the establishment of tidal open water habitat. Tidal wetland vegetation would establish as sediment accrues over time. There initially would be some impacts on managed wetland habitats. These values would be replaced as part of the restoration design and increased as tidal wetland vegetation becomes established.

Several types of monitoring would be implemented as part of tidal restoration projects under the SMP:

- Compliance monitoring would be built into project-specific permit requirements.
- Performance monitoring would identify whether project-specific actions are achieving their expected outcomes or targets.
- Mechanistic monitoring would demonstrate whether the mechanisms thought to link actions to desired outcomes are working as predicted.

Project monitoring needs to be designed to help reduce uncertainty and be measurable with observable responses to project implementation, noting that subtle differences in responses before and after project implementation are seldom detected. Tidal restoration project proponents will receive input from the Suisun Marsh Adaptive Management Advisory Team and Suisun Principals regarding project planning, design, and monitoring. In addition, it is recommended that each individual tidal restoration project seek the input of other science-based work groups to develop goals, objectives, and performance measurements for each restoration project, as applicable.

Salt Marsh Harvest Mouse

The salt marsh harvest mouse inhabits suitable vegetation communities in tidal and managed wetlands in the action area. Conversion of suitable habitat in managed wetlands to tidal wetlands would result in a temporary reduction in suitable habitat. Effects of tidal marsh restoration will be dispersed in space and time. As the restored area evolves into a functioning, vegetated tidal wetland, it is expected to provide permanent suitable and sustainable habitat for the salt marsh harvest mouse. Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period. Tidal restoration will result in localized declines in salt marsh harvest mouse numbers due to movement to adjacent habitat. The implementation of the managed wetland activities would ensure that remaining managed wetlands would continue to provide habitat for salt marsh harvest mouse between breaching levees and the establishment of fully functioning tidal wetlands. Short term effects are the temporary loss of salt marsh harvest mouse habitat as vegetation in managed marshes are flooded when levees are breached. As flooded managed marshes accrete soil and vegetation becomes established, salt marsh harvest mouse habitat will be created in a natural tidal marsh which can accommodate sea level rise providing long term beneficial effects.

Managed wetlands are susceptible to high water events which could over-top levees or lead to levee failure. Levee failure could cause catastrophic flooding which has the potential to submerge large areas, making the habitat no longer suitable for salt marsh harvest mouse. Tidal wetland restoration projects will be designed to accommodate sea level rise more easily than managed wetlands because the gradual elevations in tidal wetlands will not require the same level of levee maintenance and will provide an area for sediment accretion. The effects of rising sea levels on tidal marshes are dependent upon the relative rate of sea level rise versus rates of sedimentation and accretion of the marsh surface. Over the 30-year life of the plan, tidal wetlands will increase by 5,000 to 7,000 acres.

The proposed project may result in the harassment, harm, injury, or death of salt marsh harvest mice through the loss and degradation of their habitat from flooding and through crushing by equipment and machinery. Salt marsh harvest mouse habitat may be destroyed or fragmented by levee breaching, levee creation, and other activities that involve the movement of the soil or other material. Individual salt marsh harvest mice may also be harassed by noise and vibrations associated with levee breaching, levee creation, and construction activities within or adjacent to salt marsh habitat resulting in the disruption of feeding, sheltering, or breeding activities. Salt marsh harvest mice that are harassed may be flushed from protective cover or their territories exposing the mice to predators. Displaced salt marsh harvest mice may also have to compete for resources in occupied habitat. Disturbance to females from March to November may cause abandonment or failure of the current litter. Thus, displaced salt marsh harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Restoration activities would include the construction of habitat levees that include benches or berms, which would provide opportunities for the establishment of high marsh/upland transition habitat. Habitat levees will be planted and seeded with native marsh species and/or allowed to colonize naturally with native and naturalized species. The habitat levees would provide habitat for salt marsh harvest mouse as the remainder of the tidal wetland areas become established.

Construction activities related to tidal restoration actions 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. The non-native invasive, perennial pepperweed is common in Suisun Marsh. Perennial pepperweed establishes poor above-ground cover as it is leafless in the winter and provides little cover during high winter tides. Without suitable upland refugia cover, salt marsh harvest mice are vulnerable to predation during high tide events when the mice escape the flooded marsh to seek higher ground. Perennial pepperweed also interferes with the establishment of marsh gumplant, a tall native evergreen sub-shrub used by salt marsh harvest mice for high tide cover in the high marsh. Spreading rhizomatouslly and by seed, perennial pepperweed may also displace pickleweed and other native salt marsh vegetation essential to the salt marsh harvest mouse. As described in Tidal Wetland Restoration Conservation Measures, several measures will be implemented to avoid the spread of nonnative plants. Additionally, proposed restoration sites would be managed to promote tidal wetland vegetation so when inundation occurs, there is minimal potential to support nonnative species.

Conservation measures include monitoring activities for salt marsh harvest mouse. Before and during restoration activities, a Service-approved biologist will monitor for salt marsh harvest mouse and if it is found, construction activities will be stopped and allowed to continue once the individual has moved from the area. However, vegetation may be removed, which would affect habitat. Temporary losses of suitable habitat would be compensated for by the creation of tidal wetlands and through the restoration design and enhancement actions for managed wetlands.

California Clapper Rail

California clapper rails inhabit suitable tidal wetlands and tidal sloughs in the action area. Rails require an intricate network of *sloughs* to provide abundant invertebrate *populations* (Grinnell *et al.* 1918, DeGroot 1927, Harvey 1988, Collins *et al.* 1994) and escape routes from predators, particularly for vulnerable flightless young (Taylor 1894, Adams 1900, DeGroot 1927, Evens and Page 1983, Foerster *et al.* 1990, Evens and Collins 1992). In addition, the small natural *berms* along *tidal* channels with relatively tall vegetation, such as *Grindelia stricta* (gumplant), provide elevated nesting substrate. Restoration activities in these areas could disrupt California clapper rail breeding habitat and foraging habitat in tidal wetlands. California clapper rails do not occupy managed seasonal wetlands; therefore, flooding managed wetlands for the purpose of restoration would not affect California clapper rails.

Proposed ground disturbing activities, such as levees maintenance and dredging, may result in the harassment, harm, injury, or death of California clapper rails through the loss or degradation of their habitat, crushing by equipment and machinery, loss of breeding activity, nest abandonment, or increased risk of predation. Individual California clapper rails may be harassed by noise and vibrations associated with levee breaching, levee creation, and other construction activities within or adjacent to salt marsh habitat resulting in the disruption of feeding, sheltering, or breeding activities. California clapper rails that are harassed may be flushed from protective cover or their territories exposing the rails to predators. The level of harassment would be exacerbated if the construction activities occurred during the rail's breeding season resulting in the loss of breeding activity or if the work occurred during an extreme high tide when the California clapper rails are most likely to escape the adjacent flooded marsh plain to seek upland refugia cover along the levee. Activities including levee breaching, levee creation, and other construction activities that involve the movement of large equipment, and/or soil, could inadvertently crush and kill individual California clapper rails, nests, or young. However, it is unlikely that individual adult California clapper rails, nests, or young will be directly lost due to the proposed project. Nests, eggs, and young are unlikely to be present in areas where activities will occur.

Noise and vibrations may result in displacement of California clapper rails from protective cover and their territories. These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of California clapper rails from their territory in the areas where their habitat is destroyed. Displaced California clapper rails may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance to California clapper rails during the breeding season may disrupt breeding or cause nest abandonment resulting in the mortality of all the eggs and chicks in the nest. Thus, displaced California clapper rails may suffer from increased predation, competition, mortality, and reduced reproductive success.

Breeding would not be disturbed during construction, and impacts on breeding habitat would be minimal with implementation of the conservation measures. Construction activity, including vegetation clearing, would be limited to months outside the breeding season, and staging areas would be sited at least 100 feet from water bodies. Preconstruction surveys of suitable nesting habitat adjacent to construction areas would be performed to identify the general location of California clapper rail nest sites in the action area. No construction activities will occur within 700 feet of these locations or until after the nesting season. Additionally, breach sites and other restoration features will be designed to avoid California clapper rail habitat.

There could be a loss of foraging habitat as a result of construction-related activities throughout the Marsh. Additionally, increased scour and tidal muting that could occur as a result of restoration could result in the loss of California clapper rail foraging habitat due to a loss of tidal marsh vegetation. Regardless, restoration actions are not expected to adversely affect clapper rail because the minor and temporary loss of foraging habitat is not considered substantial given the amount of foraging habitat remaining.

Conversion of managed wetlands to tidal wetlands would result in increased California clapper rail breeding and foraging habitat. The plan includes design features that would promote the establishment of natural permanent California clapper rail habitat, including habitat levees that provide high tide refugia habitat for California clapper rails. As the restored area evolves into a functioning, vegetated tidal wetland, it is expected to provide permanent, sustainable, suitable habitat for the California clapper rails. Habitat levees also would provide refugia from high water events.

Restoration activities likely would be located throughout the Marsh and would be implemented over the 30-year plan period. It is expected that suitable adjacent areas would continue to provide habitat for California clapper rail between breaching the levee and the establishment of a fully functioning tidal wetland. The restoration of 5,000 to 7,000 acres of tidal marsh would benefit the California clapper rail by creating more habitat and is consistent with the Draft Recovery Plan which calls for more tidal wetlands in Suisun Marsh to benefit California clapper rail. Temporary disturbance to individual California clapper rails and their habitat would occur initially, but the long term effects would be increased suitable tidal marsh habitat which would benefit the entire California clapper rail population.

<u>California Least Tern</u>

California least terns are known to breed and nest at one location on the east side of Suisun Marsh, the Montezuma Wetlands dredge disposal site, and to forage in the bays, sloughs, and managed wetlands in the Marsh. The Montezuma Wetlands dredge disposal site is independently permitted and creating unique conditions to attract their presence. Preconstruction surveys would be performed to identify California least tern nest sites, and construction-related activities during the breeding season in the vicinity of active nests would be avoided as described in *Conservation Measures*. Construction activities would not significantly affect foraging habitat because open water habitat is abundant in the action area.

Conversion of suitable habitat in managed wetlands to tidal wetlands would result in an increase in suitable foraging habitat because the tidal wetland restoration areas would be subject to tidal action and therefore would be inundated permanently or more frequently than the managed wetlands. As the restored area evolves into a functioning tidal wetland, it will continue to provide suitable habitat for the California least tern.

It is unlikely that constructions activities will cause the permanent loss of California least tern habitat. Minimal loss of foraging habitat may occur, as a result of an increase in turbidity and a reduction in dissolved oxygen in areas where levee breaching occurs, thereby decreasing the availability of fish to foraging California least terns. However, these losses are expected to be temporary (lasting for about two weeks or less) and localized to the immediate vicinity of the breach. The effects of construction activities on foraging California least terns during the post-breeding season is likely to be minimal.

Construction activities may harass California least terns. Levee breaching, levee creation and, and other construction activities may temporarily disturb California least terns from roosting and foraging areas. Noise created by diesel pumps, excavators, front end loaders, bulldozers, forklifts, vibratory rollers, dump trucks, water trucks, barges, cranes, and other large equipment may also temporarily disturb individual California least terns. However, due to their highly mobile nature, ability to forage in a variety of habitats, and accessibility of a variety of roost sites, it is unlikely that these activities will cause substantial disturbance to California least terns. The proposed project is not likely to disturb any nesting California least terns or their chicks due to the proposed conservation measures. Conservation measures include worker training and a work window for activities near the known California least tern site which will minimize the potential for disturbing California least terns.

Soft Bird's-Beak and Suisun Thistle

Suisun thistle and Soft bird's-beak are known to occur in the action area. Construction activities associated with tidal wetland restoration could affect populations of both species. As described in the *Conservation Measures*, if initial screening by a Service-approved biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat. However, indirect effects related to restoration, such as scour adjacent to the breach location, could result in a loss of suitable habitat for Suisun thistle and soft bird's beak. Breach size and location would be selected to minimize effects of scour on special-status species. Additionally, restoration of tidal marshes is expected to create a range of marsh elevation habitat that would support Suisun thistle and soft bird's beak. Long term effects of the 30-year project will be increased habitat for these rare plants.

Construction activities related to tidal restoration actions 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 currently are not found in the project area, including exotic pest plant species. Construction activities also could spread exotic pest plants that already occur in the project area.

As described in *Programmatic Conservation Measures*, several measures will be implemented to avoid the spread of nonnative plants. Additionally, proposed restoration sites would be managed to promote tidal wetland vegetation so when inundation occurs, there is minimal potential to support nonnative species.

Tidal wetland restoration would occur by breaching and/or lowering exterior levees to restore tidal inundation to restoration sites. Breach locations would be chosen to minimize temporary upstream tidal muting; the implementation of restoration over a 30-year period, spreading it throughout the Marsh, and the effect of sea level rise would minimize the potential for substantial tidal muting. Although tidal muting could result in a temporary reduction in the tidal water surface elevation range, the overall acreage of tidal wetlands in the Marsh would increase substantially as a result of restoration actions and provide more suitable habitat for these species.

Suisun Thistle and Soft Bird's-Beak Critical Habitat

Critical habitat for Suisun thistle and soft bird's-beak will not be adversely modified by the programmatic proposed actions. Within Suisun Marsh there are 2,052 acres of critical habitat designated for Suisun thistle in Units 1, 2, and 3, and 1,870 acres of critical habitat designated for soft bird's-beak in Units 2, 4, and 5. As described in *Programmatic Conservation Measures*, sensitive plant species would be identified and avoided so there would be no impacts on special-status plant species, including critical habitat for Suisun thistle and soft bird's-beak. Indirect effects related to restoration, such as scour adjacent to the breach location, could result in a loss of critical habitat. Breach size and location would be selected to minimize effects of scour on special-status species habitat. Creation of tidal marsh may create additional habitat within critical habitat units for these species. PCEs will remain intact, contributing to the high conservation value of the unit as a whole, and sustaining the unit's role in the conservation and recovery of the species.

Delta Smelt

Construction activities, such as levee construction and levee breaching, would occur during the in-channel work window of September 1 through November 30. These activities could accidentally introduce contaminants into the sloughs in Suisun Marsh and Suisun Bay and could adversely affect delta smelt and their habitat.

Disturbance of sediment in and around sloughs likely would result in a release of sediments into the slough channels and possibly release of soil contaminants into the water column. Refueling, operating, and storing construction equipment and materials could result in accidental spills of pollutants such as hydraulic fluids, oil, and fuel. Pollutants entering water bodies in the action area could cause mortality or impaired growth or viability of delta smelt through direct exposure to these discharges. Indirect effects of contaminants could occur if prey organisms are killed, resulting in a reduction in food availability, or delta smelt are digesting organisms that have become contaminated. Furthermore, these pollutants could adversely affect the movement of delta smelt.

Conservation measures, 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 to minimize the potential for exposure of delta smelt and other aquatic organisms to contaminants. The Service, NMFS, and DFW will be provided these plans for review 30 days prior to construction. Compliance with water quality standards and implementation of the erosion control BMPs would ensure that turbidity and suspended sediment levels remain within regulatory limits. Potential exposure of the delta smelt population to contaminants would be minimized further by limiting construction activities to September 1 to November 30, when delta smelt are rare in Marsh sloughs.

Construction activities, such as levee construction and levee breaching, could release excess sedimentation into sloughs and Suisun Bay and could adversely affect delta smelt and their habitat. Potential impacts include avoidance of suitable habitat and mortality of prey, resulting in a decrease in food supply. Conservation measures, including the erosion and sediment control plan, SWPPP, and environmental training, will be developed and implemented before and during construction activities. The Service, NMFS, and DFW will be provided these plans for review 30 days prior to construction. Compliance with water quality standards and implementation of the erosion control BMPs would ensure that turbidity and suspended sediment levels remain within regulatory limits. Construction activities will be limited to September 1 to November 30, when delta smelt are rare in Marsh sloughs. Therefore, they would not likely be affected by short-term increases in turbidity.

Changes in channel morphology and hydraulics can result when levees are breached and changes in water circulation occur. Depending on the size and location of the breach, the sloughs in Suisun Marsh can be hydraulically affected. These changes are expected to occur for a short time until the newly opened area stabilizes, provided that BMPs and Conservation Measures are implemented. Sediment gradually would fill in the sites, raising elevations and decreasing tidal prism and associated velocities.

The majority of larval delta smelt and some juveniles in Suisun Marsh are found in Nurse, Suisun, Cordelia, Denverton, and Spring Branch Sloughs (Bay Delta and Tributaries no date). During high freshwater years, delta smelt may spawn in Suisun Marsh channels (Sweetnam 1999), as seen by the number of larval fish captured. Larvae are planktonic and move with the currents. Aasen (1999) found adult and juvenile delta smelt moved with the tides between Honker and Grizzly Bays. Levee breaching would occur from September 1 to November 30 when delta smelt larvae and juveniles are rare in Marsh sloughs. Long-term impacts of velocity changes in the sloughs as a result of levee breaching could preclude delta smelt from dispersing to rearing habitat, depending on the breach location and size.

Preliminary modeling suggested that potential project actions under all the alternatives could produce tidal velocities in excess of the sustained swimming speed of several sensitive species, including delta smelt. Prior to implementation, preliminary modeling and design of the potential breach areas would be done to assess effects on hydraulic conditions. As discussed in *Selecting Breach Location(s) at Restoration Site*, velocity changes would be addressed adaptively through modifications of breached areas. Final designs will attempt to account for potential adverse hydraulic modifications. This information will be used to modify or maintain levee breaches as needed to support fish passage and access to rearing habitat for delta smelt.

As the restored area evolves into a functioning tidal marsh, it is expected to provide indirect benefits to delta smelt through increased exports of nutrients and food to adjacent open water areas. Additionally, restoration activities likely would be located throughout the Marsh and implemented over the 30-year plan period, rather than concentrated in a small geographic area or time frame. As such, only minimal changes in delta smelt habitat in the Marsh would occur at any one time. For most cases of restoration, adjacent areas would continue to provide suitable habitat in the interim between breaching the levee and a fully functioning tidal marsh.
The overall 30-year plan is expected to benefit delta smelt by encouraging development of a more natural habitat through restoration of managed wetlands, which are inaccessible to delta smelt, to tidal wetlands.

Restoration activities that convert managed wetlands to tidal wetlands, especially those in areas with poor circulation or other conditions leading to low levels of DO, will promote increased water circulation and decrease the amount of high-sulfide water discharged from managed wetlands into sloughs. Sloughs are important habitat for delta smelt, and DO is an important determinant of habitat quality. The extent of this improvement depends on the location and design of individual restoration sites. However, it is assumed that at least some areas currently contributing to low DO will be restored, resulting in an improvement in those areas.

Benthic invertebrate composition could change if channel morphology and hydraulics change as a result of restoration. Higher velocities could occur at certain places in the channel, and if they occur, the habitat could attract and retain a modified benthic macroinvertebrate community. However, preliminary modeling suggests that the project actions would result in minimal long-term hydraulic modifications in the system, provided that BMPs are adhered to. The specific mixture and arrangement of particular hydraulic features may be altered, but the resulting conditions should be within the tolerances of the extant and endemic benthic macroinvertebrate community. As part of the Adaptive Management Plan, the appropriate level of benthic monitoring or benthic community evaluation will be conducted associated with the final site-specific breach design and anticipated influence on existing slough channel modifications from the tidal restoration actions, as needed.

The proposed restoration activities would provide increased exchange between marsh, intertidal and subtidal habitat, and the sloughs and bays in the Marsh. Algal growth rates are limited by low availability of sunlight energy (Cloern 1999). Light limitation is most severe in deeper channels where algal respiration can balance or exceed photosynthesis. Primary production is highest in shallow-water habitats (e.g., Blacklock), inundated floodplains (e.g., Yolo Bypass), and tidal sloughs (Sobczak et al. 2005). Also, fish would have increased access to higher productivity shallow-water areas such as blind channels and marsh channels.

Connectivity between the restoration sites and existing aquatic habitat is important to provide the greatest ecological value. Most of the volume in the larger Suisun Marsh sloughs (e.g., Montezuma Slough, Suisun Slough) is below the photic zone and thus dominated by heterotrophic (carbon-consuming) processes. When shallow productive habitats are hydrodynamically proximate to deep channel habitats, excess shallow habitat production can support biological production in the channels if hydrodynamic exchanges are optimal (Siegel 2008). Shallow-water marshes can function as donor habitats by exporting unconsumed phytoplankton biomass to support biological production in deep channel habitats (López et al. 2006; Cloern 2007). When the connectivity rate is optimized, production exported from shallow donor habitats subsidizes production in resource-deficient habitats like deeper sloughs (Siegel 2008). The open water associated with newly restored areas could provide nutrients and primary productivity that would enhance secondary food web production in adjacent heterotrophic habitats. Habitats that are connected support more species than disconnected ones (Zedler and Callaway 2001).

Therefore, project activities would benefit the actual or available primary productivity of the action area as a whole by increasing nutrient exchange and nutrient turnover rates. Nutrient levels would increase in an area where water quality is improved. In theory, primary production would increase, and zooplankton would respond, assuming the system is bottom-up controlled.

Delta Smelt Critical Habitat

The proposed programmatic action may include dredging that will result in the temporary loss of delta smelt critical habitat. PCEs 1 and 2 will be temporarily effected due to dredging which could change the physical structure and increase turbidity. PCEs will remain intact, contributing to the high conservation value of the unit as a whole, and sustaining the unit's role in the conservation and recovery of the species.

Effects of the Project-Level Proposed Action

Loss or Degradation of Wetland Communities and Special-Status Species in Slough Channels as a Result of Channel Dredging

Dredging could occur either from a barge in the slough channels or from the top of a exterior levee, depending on restrictions caused by vegetation on channel banks or the width and depth of a channel. Dredging would occur in the center of slough channels, adjacent to fish screens, and in historical dredger cuts. As much as possible, vegetation would be avoided by not dredging adjacent to tidal berms more than 50 feet wide, dredging from the center channel to avoid emergent vegetation often found along levee slopes, and avoiding other areas with prominent vegetation. However, some emergent vegetation may be removed. The amount of disturbance is limited per Region (see Table 13 and 14). As described in *Project-Level Conservation Measures*, any loss of emergent vegetation will be compensated for by implementing tidal wetland restoration at a 3:1 ratio if restoration is done within one year of the loss or 2:1 if restoration is done in advance of the loss.

Dredging would avoid direct impacts on tidal emergent wetlands and managed wetlands. Indirect impacts of dredging could include temporarily decreased water quality caused by turbidity. Tidal wetland vegetation would not be significantly affected by the temporary, small increase in channel water turbidity.

Loss or Degradation of Sensitive Communities and Special-Status Species as a Result of New Fish Screen Facilities

New fish screens could be constructed on existing diversion facilities and at new diversion locations. Construction activities associated with construction of new fish screen facilities could temporarily affect tidal wetlands, managed wetland habitat, and associated special-status species populations. As described in *Project-Level Conservation Measures*, several measures would be in place to identify and avoid special-status plants and sensitive habitat communities. Temporarily disturbed areas would be allowed to reestablish following completion of enhancement activities.

Loss or Disturbance of Wetlands and Special-Status Species as a Result of Placement of New Riprap

The placement of new riprap on exterior and interior levee surfaces in areas that were not previously riprapped could result in temporary and permanent effects on tidal wetland or bays and sloughs. Temporary effects could occur when accessing the location and during placement. Preconstruction surveys for special-status plant species will be performed in locations proposed for riprap placement. If special-status plants are identified, their populations will be avoided. Bank protection would be needed primarily in areas that currently do not have vegetation, and as described in, *Project-Level Conservation Measures*, sensitive plant species would be identified and avoided so there would be no impacts on special-status plant species, including critical habitat for Suisun thistle and soft bird's beak. Although riprap placement could result in permanent fill of other waters of the United States, the implementation of this bank protection activity would prevent levee breaching and the loss or degradation of managed wetlands. As described in *Project-Level Conservation Measures*, any loss of emergent vegetation will be compensated for by implementing tidal wetland restoration at a 3:1 ratio if restoration is done within one year of the loss or 2:1 if restoration is done in advance of the loss.

Loss or Disturbance of Wetlands and Special-Status Species as a Result of Construction of Alternative Bank Protection Actions

The construction of alternative bank protection (e.g., brush boxes, biotechnical wave dissipaters) on exterior and interior levee surfaces in areas that were not previously riprapped or otherwise protected could result in temporary and permanent effects on tidal wetland, bays and sloughs, and special-status species populations. Temporary effects could occur when accessing the location and during placement of alternative bank protection. However, alternative bank protection would be needed primarily in areas that currently do not have vegetation, and as described in *Conservation Measures*, sensitive species would be identified and avoided. Although alternative bank protection placement could result in permanent fill of other waters of the United States, the implementation of this bank protection activity would prevent levee breaching and the loss or degradation of managed wetlands.

Loss or Disturbance of Wetlands and Special-Status Species as a Result of DWR/Reclamation Facility Maintenance Activities

DWR/Reclamation facility maintenance activities, as described under Managed Wetland Activities, could result in temporary and permanent effects on tidal wetland, bays and sloughs, managed wetlands, and special-status species populations. Areas of temporary disturbance will be restored following completion of the maintenance activity. Sensitive species will be identified and avoided to the extent feasible. As described in, *Project-Level Conservation Measures*, sensitive plant species would be identified and avoided so there would be no impacts on special-status plant species, including critical habitat for Suisun thistle and soft bird's beak.

<u>Salt Marsh Harvest Mouse</u>

The salt marsh harvest mouse inhabits suitable vegetation communities in tidal and managed wetlands in the action area. Some of the proposed management activities would occur in managed wetlands and have the potential to temporarily disrupt suitable habitat areas.
The proposed project may result in the harassment, harm, injury, or death of salt marsh harvest mice through the loss and degradation of their habitat from flooding and through crushing by equipment and machinery. Salt marsh harvest mouse habitat may be destroyed or fragmented by managed wetland maintenance activities and other activities that involve the movement of the soil or other material during levee work. Individual salt marsh harvest mice may also be harassed by noise and vibrations associated with managed wetland maintenance activities within or adjacent to salt marsh habitat resulting in the disruption of feeding, sheltering, or breeding activities. Salt marsh harvest mice that are harassed may be flushed from protective cover or their territories exposing the mice to predators. The level of harassment would be exacerbated if the construction activities occurred during an extreme high tide or when managed wetlands are flooded, when the salt marsh harvest mice are most likely to escape the adjacent flooded marsh plain to seek upland refugia cover along the levee. As described in Managed Wetland Activities Conservation Measures, measures will be implemented to minimize the effects to salt marsh harvest mouse.

Construction activities related to managed wetland maintenance 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. The non-native invasive, perennial pepperweed is common in Suisun Marsh. Perennial pepperweed establishes poor above-ground cover as it is leafless in the winter and provides little cover during high winter tides. Without suitable upland refugia cover, salt marsh harvest mice are vulnerable to predation during high tide events when the mice escape the flooded marsh to seek higher ground. Perennial pepperweed also interferes with the establishment of marsh gumplant, a tall native evergreen sub-shrub used by salt marsh harvest mice for high tide cover in the high marsh. Spreading rhizomatously and by seed, perennial pepperweed may also displace pickleweed and other native salt marsh vegetation essential to the salt marsh harvest mouse. As described in

Managed Wetland Activities Conservation Measures, several measures will be implemented to avoid the spread of nonnative plants.

Noise and vibrations may result in displacement of salt marsh harvest mice from protective cover and their territories. These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of salt marsh harvest mice from their territory in the areas where their habitat is destroyed. Displaced salt marsh harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance to females from March to November may cause abandonment or failure of the current litter. Thus, displaced salt marsh harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Managed wetland activities would be implemented on individual parcels throughout the 30-year implementation period and would improve flood and drain capabilities and levee stability in the Marsh. The improvement of flood and drain capabilities will result in the creation or enhancement of suitable habitat in the managed wetlands for salt marsh harvest mice. Providing levee stability would minimize the potential for catastrophic loss of salt marsh harvest mouse habitat in managed wetlands. Many of these activities have been occurring for decades, and the SMP could increase their frequency, although they still would occur within the RGP limitations.

<u>California Clapper Rail</u>

California clapper rails inhabit suitable tidal wetlands and tidal sloughs in the action area. Managed wetland activities in these areas could disrupt California clapper rail habitat. Specifically, levee maintenance activities for managed wetland levees that could remove preferred tidal wetland vegetation have the potential to temporarily reduce or disturb California clapper rails habitat in tidal wetlands.

Authorized work will not be conducted in the areas shown on the California clapper rail breeding habitat maps between February 1 and August 31 (Figure 15 attached) to prevent California clappers rails from being disturbed during their breeding season. Breeding would not be disturbed during maintenance activities, and impacts on breeding habitat would be minimal with implementation of the other conservation measures.

New activities such as dredging and placement of new riprap in tidal areas have the potential to remove a minor amount of emergent vegetation. Similar to other managed wetland activities, new activities would be subject to restrictions related to breeding season and nest sites. Furthermore, any unavoidable loss of emergent tidal vegetation from dredging, maintenance at water quality monitoring and management facilities or new riprap placement activities in bays, major sloughs, minor sloughs, and dredger cuts will be compensated for by implementing tidal wetland restoration at a 3:1 ratio or 2:1 if restoration is done in advance of the loss. A relatively small amount of tidal wetlands may be lost or degraded during levee breaching, and the restoration of tidal action would restore a much greater acreage of tidal wetland habitat than would be impacted.

Maintenance activities on the crown and tidal side of the exterior levee will avoid and minimize disturbance of tidal wetland vegetation. All managed wetland activities would occur over the 30-year implementation period and throughout the Marsh, avoid nests and breeding season in applicable areas, and not substantially change the foraging habitat available to California clapper rail at any one time. Additionally, restoration actions would contribute to recovery of the California clapper rails over the 30-year implementation period by creating more tidal wetlands as opposed to managed wetlands which provide no habitat for California clapper rails.

California Least Tern

California least terns are known to breed and nest at one location on the east side of Suisun Marsh, the Montezuma Wetlands dredged material disposal site, and to forage in the bays, sloughs, and managed wetlands in the Marsh. New activities such as dredging, new riprap placement, brush boxes, and construction of new interior levees and cofferdams have minimal the potential to disrupt nest sites should work occur in the vicinity of occupied habitat. Maintenance activities would not significantly affect foraging habitat because open water habitat is abundant in the action area. Maintenance activities have the potential to affect breeding habitat. Implementation of conservation measures would decrease effects on nesting least terns. Restoration actions would contribute to recovery of California least tern over the 30-year implementation period by creating more foraging habitat for California least terns.

Suisun Thistle and Soft Bird's Beak

Managed wetland activities and the new activities intended to maintain or improve exterior levees would have the potential to affect special-status plants, including soft bird's-beak and Suisun thistle. These species occur in specific areas throughout the Marsh in mid- to high-tidal marsh areas. The most common practices for repairing exterior levees in Suisun Marsh involve the removal of accumulated silt and vegetation from water circulation ditches or pond bottom grading in managed wetlands and placement of spoil material on the crown of adjacent levees to raise the crown to its original or design height and/or improve interior side slopes. Material also is proposed to come from dredging of adjacent tidal sloughs.

It is unlikely that a significant amount of levee repair material would be lost to the outboard side of an exterior levee below the mean high water line. Any material that might trickle down the outside slope of the levee from the crown would not affect vegetated areas and may cause only slight and temporary turbidity. None of these activities would result in changes in tidal stage, flows, or erosion that would substantially affect suitable habitat. As described in *Conservation Measures*, if initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the Service-approved biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat.

Equipment operation and dredged material placement could affect tidal and managed wetland habitat and associated special-status species populations. As described in *Conservation*

Measures, if initial screening by a Service-approved biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat.

Suisun Thistle and Soft Bird's Beak Critical Habitat

Critical habitat for Suisun thistle and soft bird's-beak will not be adversely modified by the proposed project–level actions. Managed wetland activities and the new activities intended to maintain or improve exterior levees would have the potential to affect Suisun thistle and soft bird's-beak critical habitat. As described in *Project-Level Conservation Measures*, if initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a site-specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species' habitat. This will prevent PCEs from being effected. PCEs will remain intact, contributing to the high conservation value of the unit as a whole, and sustaining the unit's role in the conservation and recovery of the species.

Delta Smelt

As previously described, managed wetlands are drained seasonally during ebb tides. Results from monitoring studies indicate that, on average, salinity levels and temperature in drain water are similar to, or slightly higher than, ambient salinity and temperature, and other water quality parameters are comparable to ambient conditions (NMFS 2008). In most sloughs in Suisun Marsh, diurnal tide cycles provide adequate circulation such that large fluctuations in water quality parameters are avoided.

Wetlands in Regions 2, 3, and 4 drain into medium and large sloughs with good tidal circulation, and, therefore, only small, localized water quality changes are expected to occur in these regions. In Region 1, however, there are a few small dead-end sloughs that have little tidal exchange, and low-DO conditions periodically may occur during May, June, or October (NMFS 2008). As previously discussed, overall, few delta smelt occur in the Marsh from June through August. However, there may be late-spawning adult, larval, and early juvenile delta smelt present during the months of May and June.

Larval or juvenile delta smelt may move out into Suisun Bay in May and June through Suisun Sloughs. Dead-end tributaries to these sloughs can have low-DO conditions (NMFS2008), and fish entering these tributaries may encounter degraded water quality. Prolonged exposure to low-DO conditions could compromise metabolic rate, growth, swimming performance, and survival (NMFS 2006). Peak outmigration of juvenile smelt coincides with higher streamflow. Water quality in these sloughs would be expected to improve during high-flow events, and therefore juveniles would be less likely to be exposed to low DO conditions. Nonetheless, there is a chance that a small number of juvenile delta smelt could encounter a low DO event and could be adversely affected by poor water quality.

Modifications in Suisun Marsh wetland management have been effective in reducing or eliminating low DO events. As previously discussed, these management activities have been incorporated into the proposed project and include elimination of discharges to dead-end sloughs with minimal tidal exchange (Boynton and Peytonia Sloughs); relocation of discharges to Suisun Slough; controlling broad-leaved vegetation prior to flood-up to reduce oxygen demand during decomposition; increasing circulation to improve aerobic conditions; and rapid flooding and draining to encourage aerobic decomposition, and regional coordination of managed wetlands operations and water management.

During diversion operations in the managed wetlands, there is an increased risk of fish entrainment at unscreened water diversions in the Marsh. Initial flooding of managed wetlands begins in September or October. From October to late January, water is circulated through wetlands by diverting from adjacent sloughs. Spring leach cycle flood-up occurs in the spring (February and March) when delta smelt may occur in Suisun Marsh. Flooding of the wetlands may entrain delta smelt without necessarily causing mortality of the fish that enter the wetlands. When water is diverted onto a managed wetland, it may be retained for an extended period before it is drained. During this retention period, water quality parameters may vary and may create conditions that could cause stress or mortality of entrained delta smelt. Fish also could be exposed to increased predation in the managed wetlands. Potential stress caused by entrainment in the wetlands could result in spawning failure. Additionally, during the dewatering phase, adult delta smelt could become stranded in the wetlands and die in small pools of remaining water as water temperatures rise and DO decreases. Any eggs that may have been spawned in the wetlands could become entrapped in these pools and covered with silt and consequently suffocated or experience adverse temperature changes as water evaporates, ultimately resulting in unsuccessful hatching. Larvae, if hatched successfully, could remain entrapped in the small pools unable to reach adequate rearing grounds in Suisun Bay.

As described in *Biological Resources Best Management Practices*, such as seasonal diversion restrictions, minimization of entrainment losses of fish throughout the Marsh is part of the proposed project. Some water intakes in the Marsh, primarily in Region 3, are equipped with fish screens. These screens were designed to exclude delta smelt. No entrainment is expected at these screened diversions. At the unscreened diversion intakes, previously described seasonal diversion curtailments and restrictions (Water Diversion Restrictions) to protect delta smelt are expected to reduce entrainment. Nonetheless, diversion curtailments and restrictions may not prevent all entrainment of delta smelt.

A few of the management activities (e.g., exterior pipe replacement, riprap, and dredging) have the potential to release contaminants and sediments into slough channels. Conservation measures to prevent accidental spills or runoff of contaminants on land have been developed and will be implemented before and during construction activities, which will reduce the potential for land based activities to result in contamination of waterways. Furthermore, management activities would have few effects on fish species because of the limited area and shorter duration of management activities than restoration activities and most of the activities occur within the managed wetlands are physically isolated from tidal slough habitats.

Management activities (i.e., dredging, and fish screen installation) could remove aquatic and/or terrestrial vegetation, substrate, or other cover for delta smelt in the action area. Aquatic and other vegetation on slough banks will be avoided to the extent feasible. Removal of substrate would remove invertebrates from the area. Placement of new riprap and fish screen installation would be in small areas and of short duration. Adjacent areas would continue to provide habitat, and restoration of tidal wetlands throughout the Marsh would provide additional habitat. As discussed in *Project-Level Conservation Measures*, any loss of aquatic vegetation will be compensated by implementing tidal wetland restoration at a 3:1 ratio or a 2:1 ratio if restoration is done in advance of the loss. A relatively small amount of tidal wetlands may be lost or degraded during levee breaching, and the restoration of tidal action would restore a much greater acreage of tidal wetland habitat than would be impacted.

As discussed under Dredging from Tidal Sloughs as Source Material for Exterior Levee Maintenance, dredging would occur no more than once every 3 years in any given location of the Marsh. Dredging activities would be spread throughout the Marsh over time so that the total volume of dredging per year per region will be limited (Table 14). Table 15 below shows percentage of habitat that would be affected per year by dredging.
Dredging around fish screens would be done during low tide to minimize in-water work and minimize turbidity. Dredging would occur in the center of slough channels, adjacent to fish screen structures, and in historical dredger cuts (a small, linear channel area isolated by a vegetated berm from the major and minor slough channels, which was created immediately adjacent to the toe of the exterior levees during original levee construction and previous maintenance dredging events). Aquatic and other vegetation would be avoided to the extent feasible and any loss of aquatic/emergent vegetation will be compensated for by implementing tidal restoration at a 3:1 ratio or a 2:1 ratio if restoration is done in advance of the loss.

Table 13. Proposed Dredging Volume of 100,000 Cubic Yards Distributed per Habitat Classification and Plan Region

Feature	Region 1 Volume (cy)	Region 2 Volume(cy)	Region 3 Volume(cy)	Region 4 Volume (cy)	Montezuma Slough Volume (cy)	Total Volume (cy)
Bays	0	0	100	4,000	0	4,100
Major sloughs	2,100	10,700	0	0	16,000	28,800
Minor sloughs	21,600	8,900	3,000	2,400	0	35,900
Dredger cuts	6,300	2,700	4,500	10,500	7,200	31,200
Total	**30,000**	**22,300**	**7,600**	**16,900**	**23,200**	**100,000**

cy = cubic yards.

Table 14. Total Percent Acres per Year Affected by Dredging

Habitat	Total Acres in Action Area	Acres/Year Affected for Dredging 30,000 cy	% of Total Area Affected
Minor slough	1,108	7.1	0.6
Major slough	2,212	5.7	0.2
Bays	22,346	0.8	<0.1
Dredger cuts	151	6.1	4.0

Removal of organisms through dredging and burying of deposit feeders, suspension/deposit feeders, and suspension feeders would occur in portions of the dredging area. Removal of these organisms through dredging or disposal may cause short-term harm to fish species residing in the dredging area by limiting food resources.

Macroinvertebrate use of specific locations in Suisun Marsh is dependent on salinity, water velocity, and substrate conditions (Markmann 1986). Stable invertebrate communities require stable environmental conditions. Consistent with ecological theory, stable communities of low-mobility, long-lived species are more vulnerable to physical disturbance than short-lived species in changeable environments (National Research Council 2002). In Suisun Marsh, macroinvertebrate densities fluctuate as a result of constantly changing environmental conditions such as salinity and DO. If the natural environment has fluctuating water quality, macroinvertebrates in the habitat are likely to be resilient and dredging and disturbance would have less effect on them (Corps 1978). Benthic communities normally subjected to wave scour, high turbidity, and sediment deposition recover in a short amount of time from dredging and sediment disposal because the residents are rapidly reproducing, opportunistic species with short life cycles (Oliver et al. 1977).

Benthic invertebrate composition could change if channel morphology and hydraulics change as a result of dredging. Higher velocities could occur at certain places in the channel, and if that occurs, the habitat could attract and retain a modified benthic macroinvertebrate community. However, preliminary modeling suggests that the project actions would result in minimal long-term hydraulic modifications (Appendix E of the BA) in the system, provided that BMPs are adhered to. The specific mixture and arrangement of particular hydraulic features may be altered, but the resulting conditions should be within the tolerances of the extant and endemic benthic macroinvertebrate community. As appropriate, a site-specific benthic monitoring plan will be developed and implemented to determine effects of activities on the macroinvertebrate community.

Recolonization of sites occurs within months, although sites may be recolonized by opportunistic species that are not normally dominant at the site (Corps 1978). The current dominant species composition in the Marsh is polychaetes and bivalves (Schroeter no date), which represent Stage I species. Dredging would remove these taxa, but they should be replaced quickly by recolonization in dredged areas. Taxa would not change.

Invertebrates are expected to recolonize dredge locations within months; therefore, potential long-term impacts associated with these activities are expected to be small. Moreover, the areas of dredging and deposition at any one time are small fractions of the total area of Suisun Marsh. Thus, the influx of organisms from the surrounding undisturbed areas can be rapid. Also, because many of the species in Suisun Marsh remain reproductively active for much of the year, they can quickly colonize a newly exposed sediment surface. As a result, benthic invertebrates in Suisun Marsh can be expected to be as resilient as in other estuaries (Boesch et al. 1976).

As discussed in *Conservation Measures*, measures will be implemented to reduce the water quality effects of dredging. As shown in Table 15, only a very small area of total habitat will be affected annually. The highest percentage of habitat dredged will occur in dredger cuts, which do not provide significant fish habitat. Any unavoidable loss of emergent tidal vegetation from dredging, maintenance at water quality monitoring and management facilities, or new rip-rap placement activities in bays, major sloughs, minor sloughs, and dredger cuts will be compensated for by implementing tidal wetland restoration. A relatively small amount of tidal wetlands may be lost or degraded during levee breaching, and the restoration of tidal action would restore a much greater acreage of tidal wetland habitat than would be affected. Additionally, a benthic monitoring approach will be implemented to ensure that the impacts are not greater than what is expected. Benthic sampling will occur 30 days prior to dredging and then at specified time intervals after dredging. If the comparison of data collected prior to dredging and after dredging demonstrates that impacts are greater than what is expected, the dredging program will be modified to minimize the impacts to benthic communities.

Dredging is an activity that removes material from the benthic environment and thus would be more likely to affect benthic species. The potential for entrainment depends on many factors, including: the abundance, swimming ability (which is positively related to size), and behavioral

response of species to dredging activities; the total area dredged; the speed at which dredging is conducted; and possibly other factors.
Dredging some areas of Suisun Marsh sloughs could result in direct mortality of rearing delta smelt if individuals are present when these activities occur. Conservation measures restrict dredging to months when delta smelt are rare in the action area, thereby minimizing or eliminating potential interactions between this species and the dredging activities.

Dredging practices include conservation measures to avoid negative habitat modifications of tidal areas. More specifically, dredging would occur during months when delta smelt are rare in the Marsh and in dredger cuts and other areas that have been dredged previously for levee construction and maintenance. Dredging would take place in the center of the channels, therefore avoiding shallow water habitat and aquatic vegetation. Tidally influenced berms represent key habitat for migratory and resident species in the Marsh, and avoiding these areas would minimize the impacts of dredging to a great extent.

Delta Smelt Critical Habitat

Critical habitat for delta smelt will not be adversely modified by the proposed project–level actions. Dredging activities will temporarily affect critical habitat. Dredging activities would be spread throughout the Marsh over time so that the total volume of dredging per year per region will be limited. As discussed in *Project-level Conservation Measures*, measures will be implemented to reduce the water quality effects of dredging. Dredging would take place in the center of the channels, therefore avoiding shallow water habitat and aquatic vegetation. Management activities (i.e., dredging, and fish screen installation) could remove aquatic and/or terrestrial vegetation, substrate, or other cover for delta smelt in the action area. Aquatic and other vegetation on slough banks will be avoided to the extent feasible. Removal of substrate would remove invertebrates from the area. Placement of new riprap and fish screen installation would be in small areas and of short duration. Adjacent areas would continue to provide habitat, and restoration of tidal wetlands throughout the Marsh would provide additional habitat. As discussed in *Project-Level Conservation Measures*, any loss of aquatic vegetation will be compensated by implementing tidal wetland restoration at a 3:1 ratio or a 2:1 ratio if restoration is done in advance of the loss. A relatively small amount of tidal wetlands may be lost or degraded during levee breaching, and the restoration of tidal action would restore a much greater acreage of tidal wetland habitat than would be impacted. PCEs will remain intact, contributing to the high conservation value of the unit as a whole, and sustaining the unit's role in the conservation and recovery of the species.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act. The potential for project-generated effects to contribute to cumulative effects on listed species would arise if any additional project not involving a Federal action were to be constructed within the action area in the foreseeable future. All of the projects near the action area that are known at this time would require a permit from the Corps and would require consultation with the Service.

The global average temperature has risen by approximately 0.6 degrees Centigrade during the 20th Century (International Panel on Climate Change [IPCC] 2001, 2007a, 2007b; Adger *et al.* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (IPCC 2001, 2007a, 2007b; Adger *et al.* 2007), and that it is "very likely" that it is largely due to man-made emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007). Ongoing climate change (Inkley *et al.* 2004; Adger *et al.* 2007; Kanter 2007) likely imperils the salt marsh harvest mouse, California clapper rail, delta smelt, and California least tern, and the resources necessary for their survival, since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, diseases, and non-native competitors. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat. Sea level rise associated with climate change particularly threatens the salt marsh harvest mouse, California clapper rail, and California least tern by inundating their salt marsh and coastal habitats. Residential and urban development near the current shoreline may preclude the landward transgression of the tidal marsh with sea level rise resulting in the loss of a significant amount of habitat for the salt marsh harvest mouse, California clapper rail, and California least tern.

Conclusion

After reviewing the current status of the California clapper rail, salt marsh harvest mouse, California least tern, and delta smelt, the environmental baseline within the proposed action area, and the effects of the proposed action, it is the Service's biological opinion that the proposed programmatic and project level actions are not likely to result in jeopardy to these species.

After reviewing the current status of critical habitat for delta smelt, soft bird's beak, and Suisun thistle, the environmental baseline within the proposed action area, and the effects of the proposed action, it is the Service's biological opinion that the proposed programmatic and project level actions are not likely to result in adverse modification to these critical habitats.

We based this determination on the following: (1) numerous conservation measures would be implemented to minimize the adverse effects on individual California clapper rails, salt marsh harvest mouse, California least tern, delta smelt, soft bird's beak, and Suisun thistle, and their habitats; and (2) restoration actions will be implemented over a 30-year period that will result in 5,000 to 7,000 acres of tidal habitat restoration and managed wetland enhancements that support these species.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage

in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.
Sections 7(b)(4) and 7(o)(2) of the Act do not apply to listed plant species. However, protection of listed plants is provided to the extent that the Act requires a Federal permit for removal or reduction to possession of endangered and threatened plants from areas under Federal jurisdiction, or for any act that would remove, cut, dig up, damage, or destroy any such species on any other area in knowing violation of any regulation of any State or in the course of any violation of a State criminal trespass law.

Programmatic Biological Opinion

Due to the programmatic nature of the PBO, the tidal marsh restoration project- and site-specific information necessary to determine the amount and extent of incidental take of listed species associated with the proposed programmatic actions is incomplete. Therefore, the Corps will initiate individual section 7 consultations for actions which may affect listed and proposed species. Future biological and/or conference opinions that are tiered under this PBO will estimate, evaluate, and authorize the amount and extent of incidental take associated with project-specific actions.

Project Level Biological Opinion

The incidental take statement accompanying this biological opinion exempts take of California clapper rails, salt marsh harvest mice, California least terns, and delta smelt carried out in accordance with the following reasonable and prudent measures and terms and conditions, from the prohibitions contained in section 9 of the Act. It does not address the restrictions or requirements of other applicable laws.

The measures described below are non-discretionary, and must be implemented by the Corps and/or the project proponent(s). If the Corps: (1) fails to require to adhere to the terms and conditions of the incidental take statement; and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Conservation measures proposed by the Corps and described in the "Description of the Proposed Action" of the PBO and BO will reduce, but do not eliminate, the potential for incidental taking of California clapper rails, salt marsh harvest mouse, California least terns, and delta smelt. The Service expects that incidental take of the California clapper rail will be difficult to detect or quantify because of the reclusive nature of this species. Similarly, the Service anticipates incidental take of individual salt marsh harvest mice will be difficult to detect because of the variable, unknown size of any resident population over time, and the difficulty of finding killed or injured small mammals. The Service considers the number of salt marsh harvest mice, California clapper rails, California least terns, and delta smelt subject to harassment from noise and vibrations and human activities to be impracticable to estimate. The Service, therefore, anticipates the following levels of take as a result of implementation of the proposed project-level action.

Due to implementation of the SMP Project-level action (Tables 3a and 8), incidental take for California clapper rails, California least terns, delta smelt, and salt marsh harvest mice is expected in the form of:

1. harassment of 3 California clapper rails annually in existing California clapper rail habitat in the western marsh (see Figure 15 attached) and as habitat is restored to tidal marsh;

2. harassment of 10 delta smelt in 20.00 acres of tidal sloughs annually;

3. harassment of 2 California least terns in the eastern marsh in the Montezuma Wetlands every 10 years;

4. harassment of 100 salt marsh harvest mouse on approximately 4,000 acres annually; and

5. harm or mortality of up to two (2) salt marsh harvest mouse annually.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impact of take on the California clapper rails, salt marsh harvest mice, California least terns, and delta smelt:

1. The Corps will minimize the potential for harm, harassment, or mortality of California clapper rails, salt marsh harvest mice, California least terns, and delta smelt.

Term and Condition

To be exempt from the prohibitions of section 9 of Act, the Service must comply with the following terms and conditions, which implements the reasonable prudent measures described above. These terms and conditions are nondiscretionary.

1. The following Terms and Conditions implement Reasonable and Prudent Measure Number One (1):

a. The Corps and/or project proponents shall minimize the potential for harm, harassment, injury, and killing of California clapper rails, salt marsh harvest mice, California least terns, and delta smelt resulting from project-related activities by implementation of the Conservation Measures in this biological opinion.

b. The Corps and/or project proponents shall comply with the reporting requirements of this biological opinion, including a post-construction report outlining how the Conservation Measures were implemented for this project.

Reporting Requirements

The Service must be notified within 24 hours of the finding of any injured or dead salt marsh harvest mouse, California clapper rail, or California least tern, delta smelt or any unanticipated damage to their habitats associated with the proposed project. Injured salt marsh harvest mice, California clapper rails, California least terns, and delta smelt shall be cared by a licensed veterinarian or other qualified person, such as the Service-approved biologist for the proposed project. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. Dead animals or fish should be sealed in a zip lock bag containing a piece of paper indicating the location, date and time when it was found, and the name of the person who found it; and the bag should be frozen in a freezer in a secure location. The Service contact persons are Coast Bay/Forest Foothills Division Chief, Endangered Species Program, at the Sacramento Fish and Wildlife Office at telephone (916) 414-6600 and Resident Agent-in-Charge of the Service's Law Enforcement Division at telephone (916) 569-8444.

The Corps via the SRCD or an SMPA agency shall submit an annual post-construction compliance report to the Sacramento Fish and Wildlife Office upon completion of construction activity and at the end of the calendar year. This report shall detail (i) dates, type, size, and location that construction occurred; (ii) pertinent information concerning the success of the project in implementing the avoidance and minimization measures including photographs before, during, and after construction; (iii) an explanation of failure to implement avoidance and minimization measures, if any; (iv) known project effects on the salt marsh harvest mouse, California clapper rail, and California least tern, if any; (v) occurrences of incidental take of these listed species, if any; (vi) documentation of employee environmental education; and (vii) other pertinent information.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases. In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations. We make the following conservation recommendations:

1. Encourage or require the use of appropriate California native species in re-vegetation and habitat enhancement efforts associated with any projects authorized by the Service.

2. Facilitate additional educational programs geared toward the importance and conservation of tidal marsh and seasonal wetlands.

3. Assist the Service in implementing other recovery actions identified within most current recovery plans for the California clapper rails, salt marsh harvest mice, California least terns, and delta smelt.

4. Sightings of any listed or sensitive species should be reported to the California Natural Diversity Database of the DFW. A copy of the reporting form and a topographic map clearly marked with the location where the individuals were observed should also be provided to the Service.

5. Encourage participation of prospective permittees in a program being developed by Federal and State resource agencies to limit and reverse the spread of non-native *Lepidium* within the Marsh.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the SMP. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation. Any reinitiation of consultation would be expected to result in supplemental biological opinions, which could be appended to this PBO.

If you have any questions regarding this biological opinion on the proposed SMP and the Project-level actions, please contact Vincent Griego, or Ryan Olah, Coast Bay/Forest Foothills Division Chief, at (916) 414-6600.

Sincerely,

Roberta Gerson

for Jan C. Knight
Acting Field Supervisor

Enclosures:
1. Suisun Marsh Habitat Management, Preservation, and Restoration Plan
2. SMPA and SMP Team Structure

cc via electronic mail:
Kim Turner, Bay Delta Fish and Wildlife Office, Sacramento, California
Rebecca Victorine, Bureau of Reclamation, Sacramento, California
Steve Chappell, Suisun Resource Conservation District, Suisun, California
Dean Messer and Kristin Garrison, Department of Water Resources, Sacramento, California
Scott Wilson and Jim Star, California Department of Fish and Game, Yountville, California
Gary Stern and Dan Logan, National Marine Fisheries Service, Santa Rosa, California
Jessica Davenport and Cindy Messer, Delta Stewardship Council, Sacramento, California

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Suisun Marsh
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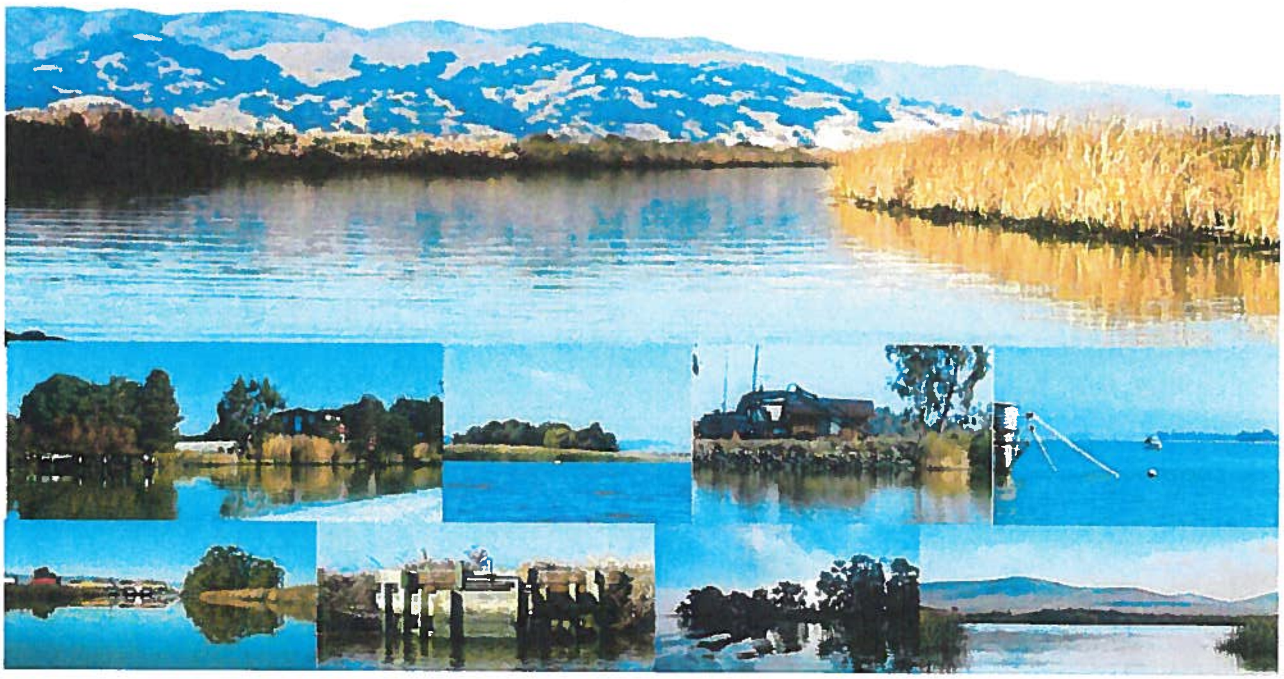

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California Department of Fish and Game

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The Suisun Marsh Habitat Management, Preservation, and Restoration Plan

Executive Summary

The Suisun Marsh Habitat Management, Preservation, and Restoration Plan, referred to from here on as the Suisun Marsh Plan (SMP), is being pursued by the Suisun Principal Agencies (or Principals), a group of agencies with primary responsibility for Suisun Marsh management, and is intended to balance the benefits of tidal wetland restoration with other habitat uses in the Marsh by evaluating alternatives that provide a politically acceptable change in Marsh-wide land uses, such as salt marsh harvest mouse habitat, managed wetlands, public use, and upland habitat. It relies on the incorporation of existing science and information developed through adaptive management. The Principals are U.S. Fish and Wildlife Service (USFWS), U.S. Department of the Interior, Bureau of Reclamation (Reclamation), California Department of Fish and Game (DFG), California Department of Water Resources (DWR), National Marine Fisheries Service (NMFS), Suisun Resource Conservation District (SRCD), and CALFED Bay-Delta Program (CALFED). The Principals have consulted with other participating agencies, such as the U.S. Army Corps of Engineers (Corps), San Francisco Bay Conservation and Development Commission (BCDC) the Regional Water Quality Control Board (RWQCB) and the State Water Resources Control Board (State Water Board), in developing this plan.

The SMP is intended to address the full range of issues in the Marsh, which are linked geographically, ecologically, and ideologically. Many of these issues have been recognized in other planning documents such CALFED Record of Decision (ROD), and the Revised Suisun Marsh Preservation Agreement. The SMP incorporates these plans and directives, while meeting the following plan objectives.

- **Habitats and Ecological Processes**—implement the CALFED Ecosystem Restoration Program Plan (ERPP) restoration target for the Suisun Marsh ecoregion of 5,000 to 7,000 acres of tidal marsh and protection and enhancement of 40,000 to 50,000 acres of managed wetlands.
- **Public and Private Land Use**—maintain the heritage of waterfowl hunting and other recreational opportunities and increase the surrounding communities' awareness of the ecological values of Suisun Marsh.
- **Levee System Integrity**—maintain and improve the Suisun Marsh levee system integrity to protect property, infrastructure, and wildlife habitats from catastrophic flooding.

- **Water Quality**—protect and, where possible improve, water quality for beneficial uses in Suisun Marsh, including estuarine, spawning, and migrating habitat uses for fish species as well as recreational uses and associated wildlife habitat.

The SMP requires that these interrelated and interdependent objectives be implemented to some extent through all SMP actions. For example, the levee system integrity objective will ensure that managed wetlands are protected from catastrophic flooding, thus contributing to meeting the portion of the habitats and ecological processes objective that addresses protection of managed wetlands. Similarly, the restoration of certain properties may help protect and/or improve water quality, and achieving the habitats and ecological processes objective also will help to achieve the private and public land use objective.

Recognizing these relationships, the SMP is proposed to contribute to meeting each of the objectives in parallel over the 30-year planning period by providing adequate restoration both to mitigate impacts related to managed wetland activities and to contribute to recovery of listed species. As such, both restoration and managed wetland activities could proceed simultaneously. An adaptive management plan is an essential component of the SMP, as it provides a mechanism to collect and use information to optimize restoration activity benefits. The SMP also includes annual reporting and tracking of progress through permitting processes.

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The Suisun Marsh Habitat Management, Preservation, and Restoration Plan

1. Introduction

The Suisun Marsh Habitat Management, Preservation, and Restoration Plan, abbreviated as the Suisun Marsh Plan (SMP), is a 30-year comprehensive plan designed to address the various conflicts regarding use of Marsh resources, with the focus on achieving an acceptable multi-stakeholder approach to the restoration of tidal wetlands and the management of managed wetlands and their functions. The SMP addresses habitats and ecological process, public and private land use, levee system integrity, and water quality through restoration and managed wetland activities. As such, the SMP is intended to be a flexible, science-based, management plan for Suisun Marsh (Marsh), consistent with the revised Suisun Marsh Preservation Agreement (SMPA) and CALFED Bay-Delta Program (CALFED). It also is intended to set the regulatory foundation for future actions.

1.1. Summary of Plan Objectives

The SMP is intended to address the full range of issues in the Marsh, which are linked geographically, ecologically, and politically. The plan objectives are:

- **Habitats and Ecological Processes**— implement the CALFED Ecosystem Restoration Program Plan (ERPP) restoration target for the Suisun Marsh ecoregion of 5,000 to 7,000 acres of tidal marsh and protection and enhancement of 40,000 to 50,000 acres of managed wetlands.
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1.2. Background

In 2000, the CALFED Bay-Delta Program (CALFED) Record of Decision (ROD) was signed, which established the Ecosystem Restoration Program (ERP) calling for the restoration of 5,000 to 7,000 acres of tidal wetlands and the protection and enhancement of 40,000 to 50,000 acres of managed wetlands for Stage 1 implementation (CALFED Bay-Delta Program 2000a). In 2001, the CALFED agencies were directed to work with key entities involved with Suisun Marsh to form a charter group to develop a plan for Suisun Marsh that would balance the needs of CALFED, the SMPA, and other plans by protecting and enhancing existing land uses and existing waterfowl and wildlife values, including those associated with the Pacific Flyway, endangered species, and state and federal water project supply quality. The charter group includes all of the local, state, and federal agencies that have jurisdiction or interest in the Marsh. However, the SMP has been developed by a subset of the charter group, the Principal Agencies.

The Principal Agencies are the U.S. Fish and Wildlife Service (USFWS); the U.S. Department of the Interior, Bureau of Reclamation (Reclamation); National Marine Fisheries Service (NMFS); California Department of Fish and Game (DFG); California Department of Water Resources (DWR); Suisun Resource Conservation District (SRCD), representing the interests of private landowners; and California Bay-Delta Authority (CBDA). The Principals have consulted with other participating charter agencies, such as the U.S. Army Corps of Engineers (Corps), the San Francisco Bay Conservation and Development Commission (BCDC), and the State Water Resources Control Board, in developing this plan.

1.3. Suisun Marsh Preservation Agreement and the Corps Regional General Permit 3

The SMPA is a contractual agreement among DFG, DWR, Reclamation, and SRCD intended to mitigate the salinity impacts in the Marsh related to State Water Project (SWP) and Central Valley Project (CVP) operations, and other upstream diversions. The SMPA was first signed in 1987 and since then has called for the development of many of the salinity control and monitoring facilities in the Marsh. In 2005, the SMPA was revised to replace the construction of additional large-scale salinity management facilities, as outlined in the 1984 Plan of Protection, with landowner-based management activities. As part of the revised SMPA, DWR and Reclamation will provide funding through the Preservation Agreement Implementation Fund (PAI Fund), which is an element of the SMP (described in detail below). Essentially, the PAI Fund is a mechanism that allows DWR and Reclamation to cost-share for certain managed wetland activities that assist landowners in meeting the desired flood and drain cycles to accommodate higher salinities applied to the managed wetlands and maintain existing habitat conditions.

The salinity management facilities and ongoing maintenance by landowners in the Marsh, including those that could be funded with the PAI Fund under the SMP, have been subject to Clean Water Act (CWA) Section 404 permitting through the Corps, and associated federal Endangered Species Act (ESA) compliance and consultation. As part of the 1981 ESA consultation with USFWS, the SMPA agencies have mitigated impacts for the implementation of the Plan of Protection and potential salt marsh harvest mouse (SMHM) habitat through the establishment of conservation and restoration areas, including the Blacklock parcel. In a letter sent to the SMPA agencies in 2007, the USFWS concurred that the completion of the restoration at Blacklock satisfied the goal of the original conservation measures for ongoing impacts on the SMHM, provided benefits to other tidal marsh-dependent species, and mitigated the current ongoing impacts related to managed wetland activities, including those that will be continued under the SMP.

Currently, many of the ongoing maintenance activities implemented in the Marsh are permitted through Corps 404 Regional General Permit (RGP) 3. RGP3 is used by DFG and other landowners (as represented by SRCD) to complete work necessary to maintain and operate managed wetlands. The SMP includes the continuation of these activities, plus an increase in frequency of these activities. Additionally, the SMP includes activities that occur in the Marsh but were not included in RGP3 (such as those activities currently conducted by DWR and Reclamation) and some activities that are new to the Marsh. These specific activities are described in this plan.

2. Plan Objectives

2.1. Habitats and Ecological Processes

The conversion of tidal wetlands as a result of diking resulted in a loss of habitat for many species, including those now listed as threatened or endangered. Development in areas surrounding the Marsh has resulted in introduction and spread of nonnative species, fish entrainment issues, and degradation of water quality. Additionally, there have been water quality effects from drainage operations in managed wetlands. While taking appropriate steps to restore the ecological values of historical tidal wetland habitat, efforts will be made to improve management of managed wetlands and to lessen adverse effects from development, nonnative species, and detrimental land use practices in the secondary management areas and adjacent metropolitan areas.

2.2. Public and Private Land Use

Managed wetlands, tidal wetlands, and uplands, whether publicly or privately owned, provide important wetlands for migratory waterfowl and other resident and migratory wetland-dependent species and opportunities for hunting, fishing, bird watching, and other recreational activities. There is a need to maintain these opportunities as well as improve public stewardship of the Marsh to ensure that the implementation of restoration and managed wetland activities is understood and valued for both public and private land uses.

2.3. Levee System Integrity

Of the more than 200 miles of exterior levees in Suisun Marsh, only about 20 miles along Suisun, Grizzly, and Honker Bays (authorized through Assembly Bill [AB] 360) receive public funding. The public funding for Suisun Marsh levees needs to be expanded from a current limit to address maintenance and improvement activities for exterior levees (levees exposed to tidal action). Additionally, as restoration actions are implemented, some interior levees will be converted to exterior levees and will require reinforcement and more maintenance, and in some instances significant upgrades. Because of current restrictions preventing dredging from sloughs and constraints on importing materials, landowners in the Marsh have maintained their exterior levees using primarily material from ditch cleaning or pond bottom grading for more than a decade, a practice that increases subsidence and potentially weakens the existing levee foundations. These factors combined have exhausted the supply of levee maintenance material in the managed wetlands and have forced maintenance to be deferred on some exterior levees, increasing the risk of catastrophic flooding.

2.4. Water Quality

Multiple factors contribute to the degradation of water quality in Suisun Marsh, including upstream diversion, reduced Sacramento–San Joaquin River Delta (Delta) outflow, state and federal water project operations and diversions, drainage practices in managed wetlands, minimal tidal exchange in dead-end sloughs, urban runoff, erosion, agricultural runoff, discharge from the Fairfield Suisun Sewer District treatment plant to Boynton Slough, and remnant contaminants such as mercury. Improvement of water quality and water quality management practices will benefit the ecological processes for all habitats, including managed and tidal wetlands.

3. Plan Elements

The Plan provides a framework for how restoration and managed wetland activities will be implemented. The Plan also addresses other SMP elements such as levee integrity, water quality, and recreation. The elements of the Plan are summarized below.

- Restoration of tidal wetlands.
- Implementation of managed wetland activities such as increased frequency of current activities in managed wetlands.
- Implementation of new managed wetlands activities, including dredging, placement of new riprap, and installation of new fish screens.
- Implementation of environmental commitments.
- Implementation of adaptive management and the SMPA PAI Fund.

Each of these Plan elements is described below.

3.1. Tidal Wetland Restoration

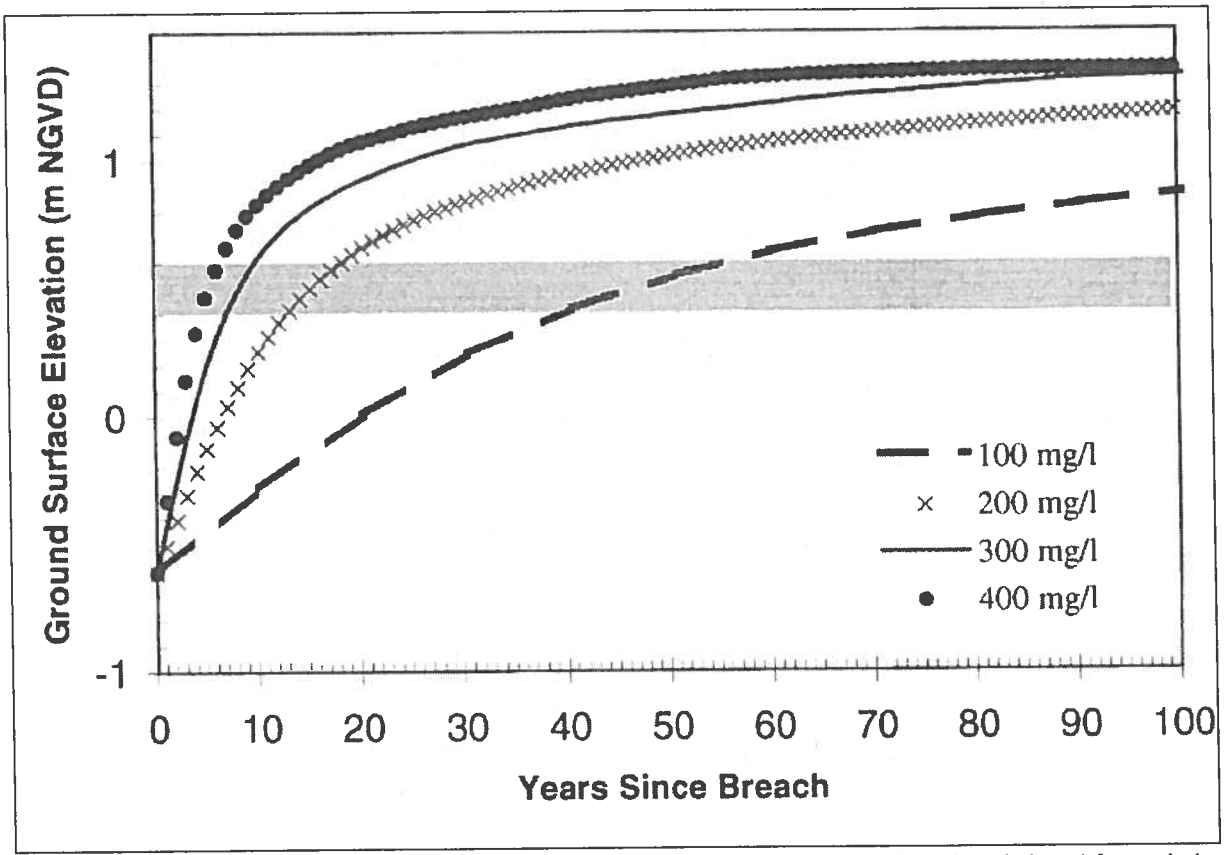
Restoration of tidal wetlands will help to achieve the restoration goals established for the Marsh by the CALFED ERPP, San Francisco Bay Area Wetlands Ecosystem Goals Project (CALFED Bay-Delta Program 2000b), and USFWS Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California for the Suisun Bay Area Recovery Unit (U.S. Fish and Wildlife Service 2010). Restoration of tidal wetlands in the Marsh will contribute to the recovery of special-status wildlife species, including small mammals (SMHM, Suisun shrew), birds (California clapper rail, California black rail, Suisun song sparrow, salt marsh common yellowthroat), and fish (salmonids, delta smelt, longfin smelt, Sacramento splittail, green sturgeon), and plants (soft bird's-beak, Suisun thistle, Delta tule pea). Tidal wetland restoration also will be designed to accommodate sea level rise more easily than managed wetlands because the gradual elevations within tidal wetlands will not require the same level of levee maintenance and will provide an area for sediment accretion.

Tidal wetlands are composed of vegetated marsh plains and intertidal and subtidal channels, all of which provide habitat to support the various life history stages of native fish and wildlife species. There are approximately 7,672 acres of tidal wetlands currently in Suisun Marsh. Vegetated tidal wetland plains provide habitat for native plant species such as soft bird's-beak and Suisun thistle and nesting and foraging habitat for bird species such as California clapper rail, California black rail, Suisun song sparrow, salt marsh common yellowthroat, and some waterfowl species. Tidal marsh plains also contribute terrestrial and benthic invertebrates to the aquatic food web. Smaller fish will use the marsh plain when it is flooded by the higher tides. Tidal marsh pannes, sometimes found within the marsh plains, provide habitat for invertebrates that, in turn, support aquatic and avian communities, and they provide roosting habitat for shorebirds and waterfowl. Channels can provide habitat for native fish species such as the delta smelt, longfin smelt, Sacramento splittail, green sturgeon, and outmigrating salmonids. Channels also support phytoplankton production; phytoplankton is a food source for aquatic species and supports benthic invertebrate production, providing a food source for fish, bird, and marine mammal species. The mudflat edges of tidal wetlands, found within channels at low tide and along open water marsh edges, provide habitat for numerous invertebrates and foraging habitat for shorebirds at low tide. Wetlands also provide critical habitat components for species generally considered strictly terrestrial, such as passerine birds (song sparrows) and raptors (short-eared owls and harriers) that feed and/or breed in wetlands and spend some time in adjacent upland habitats. Tidal wetlands along the marsh perimeter allow ecological connectivity to adjacent habitats, thereby supporting a broader range of wildlife species.

The strong salinity gradients in the Marsh, both east-west along the main axis of the estuary, and north-south from the main Suisun Bay channel to the upper reaches of the tides, provide widely differing tidal marsh conditions. Restoration activities in the Marsh will create areas of increased salt concentration. Opening and restoring areas on the west of the Marsh would draw in and capture more saline water from the Bay. This would result in fresher water being drawn from the Delta into the eastern portion of the Marsh. Assuming restoration is distributed among the four regions, more saline areas are expected to be created in the west, which would allow restored areas in the east to remain fresher. Therefore, fresher wetlands would occur in the east-southeast of the Marsh, with greater abundance of the taller tules and bulrushes. Marshes along the west would be more saline, supporting fewer tules and bulrushes and greater amounts of shorter, salt-tolerant wetland plants. While locations such as Goodyear Slough currently have tall tules and rushes, the plant communities may change overtime as salinities vary over years. Thus, between these two end points would be a broad variety of brackish marsh, with the plant communities reflecting the localized salinity regime.

The geographic position of tidal marshes in relation to Suisun Bay exerts additional factors in defining their ecological functions. Proximity to the main Suisun Bay channel connecting the Delta to San Francisco Bay affects population abundance of numerous aquatic species. Proximity to this main channel and also to the large shallow embayments in the southern Marsh also provides a significant sediment supply for marsh accretion; areas removed from these sediment sources would take far longer for natural accretion. Proximity to the edge of the Marsh links sites to adjacent uplands and in some locations to local streams, each of which has a large effect on species that could use a restored marsh; sites around the edges of the Marsh may have the potential for sea level rise resiliency, if they are able to flood adjacent uplands over time and allow marsh landward expansion. In summary, location within Suisun Marsh is a critical factor in directing the ecological functions that a particular restoration site could provide.

Strategically restoring tidal wetlands gradually would provide a range of the above habitat values depending on the initial site conditions (mainly elevation), the local and regional physical evolution drivers, and location in the Marsh. The ecosystem functions a restored site provides will change over time, with benefits to particular species increasing or decreasing with site evolution. Initially subsided sites may provide primarily subtidal aquatic habitat until the surface has accreted enough sediment for vegetation colonization; that process could take many years to decades (Figure 1) in the more subsided areas that are away from adequate sediment supply, and some locations could remain as open water indefinitely. Subtidal aquatic habitats provide many benefits to numerous species. Diving ducks would have significant foraging habitat, the extent of which varies with the tidal cycle and thus water depth. Submerged and floating aquatic vegetation would provide significant food resources for birds and fish. Phytoplankton and zooplankton production in the water column would support the food web. These areas may provide spawning substrate for some resident fish species.



Note: This plot is for the lower, saline region of the San Francisco estuary and applies to sites sheltered from wind-wave action. The shaded bar identifies the approximate Spartina colonization elevation. Prediction is based on tides at the San Francisco Presidio, no sea level rise, and 550 kilograms per cubic meter (kg/m^3) dry density of inorganics typical for San Francisco Bay. Spartina is not found within the marsh; therefore, this is used as an example to depict the relationship between breaching of levees and colonization elevation.

Source: Williams and Orr 2002.

Figure 1. Approximate Timelines of Accretion as a Function of Sediment Supply

Restoration of 5,000 to 7,000 acres of tidal wetlands will be implemented over the 30-year SMP timeframe, and benefits from individual projects would change as elevations rise, vegetation becomes established, and vegetation communities shift over time from low marsh to high marsh conditions. All restored areas are most likely to provide different types and magnitude of benefits at any given period after restoration and at different geographic locations, as local and regional conditions will determine the salinity regime, plant communities, and rate of sedimentation. Existing elevation data (LIDAR [Light Detection and Ranging]) can be used to screen potential properties considered for acquisition and restoration, followed by a more detailed topographic survey. Also, the Charter acquisition considerations shown in Table 1 will be used to screen potential sites. In the interim, a range of subtidal habitat–ecosystem functions will be provided. Additional site-specific analysis, environmental review, and permitting would occur and tier from the SMP EIS/EIR once sites have been selected.

The specific actions that will be implemented as part of the tidal restoration component of the SMP are listed below.

3.1.1. Selecting Restoration Sites

Lands suitable for restoration of tidal wetlands will be acquired only from willing sellers. As opportunities present themselves, several factors will be considered for each site, as shown in Table 1. One overarching goal of restoration is to create a diverse mosaic of interconnected habitat types.

The total amount of existing managed wetlands and uplands that could be affected by tidal restoration and managed wetland activities is 52,112 acres. Based on hydrology and facilities, the Marsh has been divided into four regions (Figure 2). The tidal wetland restoration acreages are divided by region to achieve the total CALFED goal as described above and contribute to the USFWS tidal wetlands restoration goals. The USFWS Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California[1] was used as a template in determining the goal of the percentage of restoration acreage per region (U.S. Fish and Wildlife Service 2010). Sites will be selected based on their ability to contribute to restoration goals for each region as shown in Table 2, as well as the considerations described in Table 1.

[1] <http://www.fws.gov/sacramento/ea/news_releases/2010_News_Releases/tidal_marsh_recovery.htm>.

Table 1. Tidal Wetland Restoration Land Acquisition Considerations

Site Characteristic	Considerations
Species and Habitats	• Historical geographic ranges and current populations of species. • Abundance of nonnative invasive species. • Ability to support multiple habitat types following restoration. • Inclusion in any recovery plans. • Presence of listed species. • Connectivity to adjacent existing tidal wetlands. • Absence of existing or proposed industrial facilities in vicinity. • Presence of upland transition.
Waterfowl	• Existing suitability for supporting waterfowl populations. • Suitability for supporting waterfowl populations when restored.
Recreation	• Potential for recreationally important wildlife distributions and habitat use in surrounding areas. • Potential for, and extent of, public access. • Potential for disturbance to private property.
Site Elevation	• Amount of imported fill material and grading required. • Degree of subsidence and the ability to reverse subsidence through natural sedimentation and vegetation colonization/expansion (peat accumulation and sediment trapping) to promote functional, self-sustaining tidal wetlands plain elevations with natural upland transitions.
Water Quality	• Potential for brackish water intrusion into the Delta. • Potential for black water (low dissolved oxygen) conditions. • Potential for adverse or beneficial effects on Delta, Suisun, and local salinity.
Levees	• Currents, winds, adjacent properties, extant channel networks, topography, etc., in selecting the location and size of levee breaches. • The extent to which the land requires flood protection levees to protect adjacent landowners. • Potential flood liability when tidal action is restored.
Estimated Costs	• Costs of acquisition and restoration. • Interim management costs. • Long term operations and maintenance (O&M) needs. • Cost of upgrading interior levees to exterior levees. • Cost of maintaining and/or rehabilitating exterior levees. • Costs of maintaining levee access for construction/maintenance.
Landscape Position	• Potential for site to accommodate sea level rise. • Adjacent land uses. • Presence of infrastructure such as transmission lines, rail lines, roads, etc. • Position relative to other planned or implemented restoration sites.
Cultural Resource Potential	• Presence or absence of known cultural resources. • Location of potential restoration areas with respect to areas sensitive for the presence of buried and surface-manifested cultural resources.

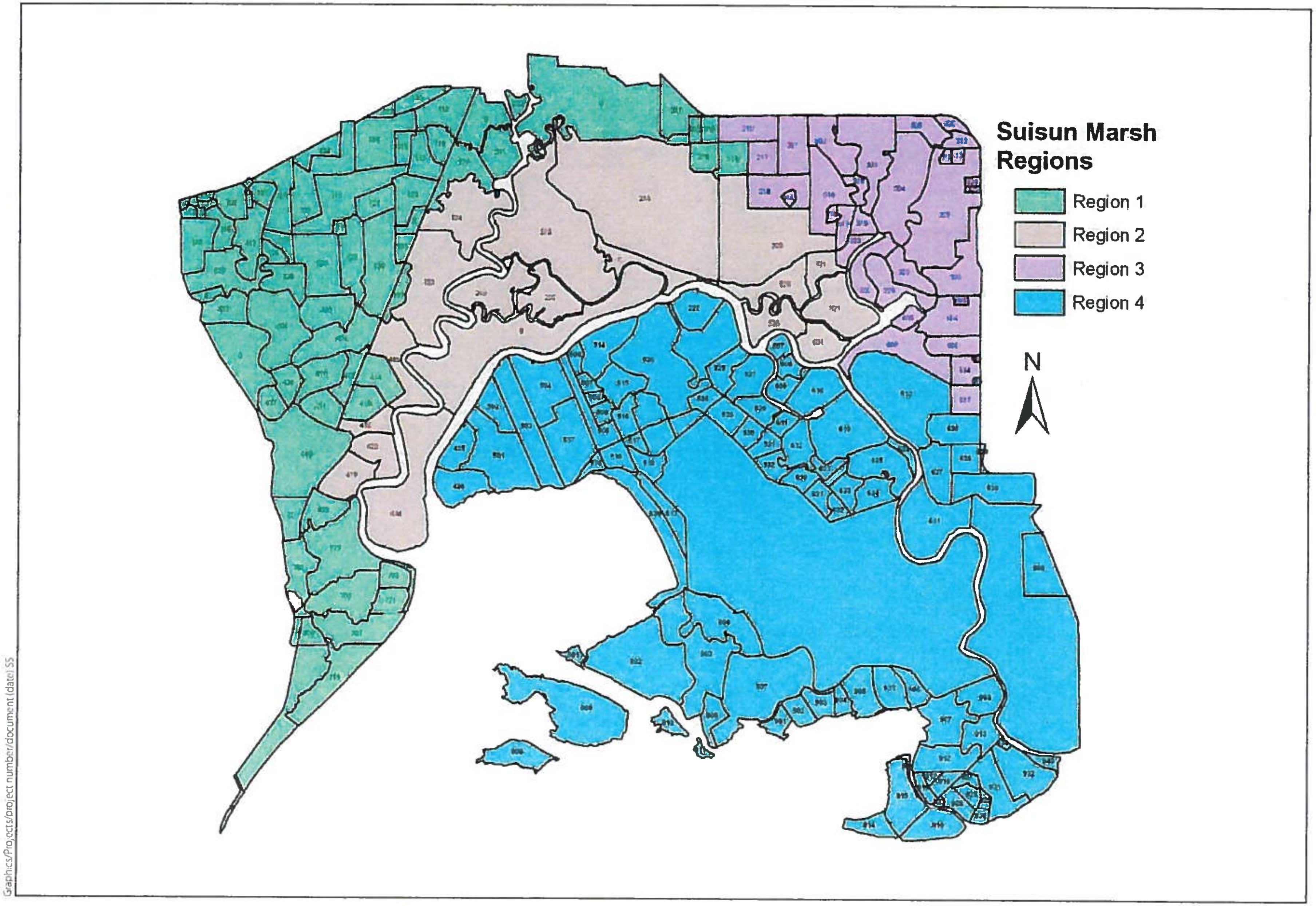


Figure 2
Suisun Marsh Regions

Table 2. Total Restorable Acres per Region and Percentage to Be Restored

Region	SMP Target for Tidal Wetland Restoration*	Percentage of Existing Managed Wetlands That Will Be Restored to Tidal Wetland under the SMP
SMP	**5,000–7,000**	
Region 1	1,000–1,500	8.4%–12.6%
Region 2	920–1,380	12.6%–18.9%
Region 3	360–540	12.1%–18.1%
Region 4	1,720–2,580	6.0%–9.0%

SMP = Suisun Marsh Habitat Management, Preservation, and Restoration Plan.

* The targets were developed for each region based on the different habitat conditions in each region to provide the range of environmental gradients necessary to contribute to the recovery of listed species. These targets complement and are consistent with the Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California. The Adaptive Management Plan will track these targets to ensure restoration benefits for listed species.

Note: Adjustments to the Adaptive Management Plan may result in changes to the targets in each region.

3.1.2. Site Preparation

Once a site has been acquired from a willing seller, the project proponent will undertake several land management activities necessary to prepare the site for restoration. These land management activities will need to occur from the time of acquisition until the time of restoration, which could last anywhere from 1 to 5 or more years.

Each restoration site will be designed to accomplish specific environmental goals by restoring historical conditions. To accomplish this, sites will need to be graded and prepared to re-create flows and hydraulic conditions. As such, ditches previously used for managed wetland flood and drain practices may be filled in with dirt, brush boxes, or other material. Depending on the timing of this activity, material removed from levees, either as breaches or grade-downs, or from grading the restoration site could be used to fill adjacent ditches. In addition to or in lieu of filling in ditches, specific restoration designs may include placement of hay bales, brush boxes, or other slow-degrading material adjacent to levee breaches that block water access to ditches and direct tidal energy into the restoration area. Additionally, restoration preparation may include digging starter channels to increase tidal water connectivity.

Moist soil management likely will be implemented during the growing season to promote the natural production of desired wetland plant species. Depending on site elevations and local salinity regime, these pre-breach managed plant communities may persist following restoration of tidal action or they may be sacrificial. Establishment of vegetation communities prior to inundation is expected to contribute to immediately providing suitable habitat to some species, to discourage establishment of nonnative species upon inundation, to provide for early subsidence reversal, and to help capture suspended sediment once the site is restored to tidal action. Establishment of these vegetation communities is likely to increase the rate at which the tidal wetland matures, and could occur on the levees or in other areas of the restoration site.

Maintenance of levees and water control structures also may be required during the period prior to restoration of tidal action. Maintenance activities will follow the methods and approaches employed for the diked, managed wetlands. The extent of maintenance required will depend on conditions at the time of acquisition and changes in those conditions that occur over time. However, structures peculiar to managed wetlands, including duck blinds and derelict pipelines, likely will be removed. Support apparatus for water control structures often requires levee excavation and pile, culvert, flashboard riser, and gate removal. The removal of water control structures will depend on the moist soil management regime prior to breaching, but their eventual removal is expected at all sites.

3.1.3. Selecting Breach Location(s) at Restoration Site

Restoration will be accomplished by breaching and/or lowering existing exterior levees to restore tidal inundation. Breaching levees would occur after ground-disturbing activities are completed and in the summer when covered fish species are not present. Depending on site-specific goals, levee modifications will be made in various ways by manipulating the opening width, depth, and/or slope angle. Breach edges may require scour protection with rock, geotextiles, or piles. Alternatively, long reaches of levee may be graded down to lower elevations—most likely between mean sea level and mean higher-high water (MHHW). Material will be used to create topographic variability and encourage diverse plant communities and shallow tidal habitat.

Breach location, number, and size will be chosen based on two considerations. The first consideration is to maximize the ecological benefits of the restoration. Considerations will include ability to reconnect existing tidal channel networks from the site's history as a tidal marsh if those channels remain, providing suitable connectivity to the tidal source waterways, orientation relative to winds and currents to promote natural sedimentation and access to aquatic organisms, and constructability. The second consideration is to minimize upstream tidal muting, tidal elevation changes, slough channel scour, and hydraulic changes, and restoration projects will be designed to ensure that changes in tidal flows remain below about 1 foot per second (fps). In general, breaches on larger channels or multiple breaches will reduce the effects of the increased tidal flows on tidal elevations and velocities. If feasible based on site-specific conditions, breach locations will be located in areas that have minimal or no existing tidal wetlands on channel berms or in locations where the tidal wetland habitat value is lowest (e.g., riprap levee sections).

As part of each site-specific restoration action, project proponents will use an accurate tidal hydraulics and salinity model (e.g., the Resource Management Associates [RMA] Bay-Delta model) to simulate the proposed action to ensure the impacts on scour, sedimentation, salinity, and other hydraulic processes do not exceed those described in the SMP Environmental Impact Statement/Environmental Impact Report (EIS/EIR). This information will be used to adjust designs of restoration projects and other activities to minimize adverse impacts on tidal elevations and velocities, or other site-specific characteristics, in the restoration site and/or in Marsh channels adjacent to restoration projects; minimize salinity effects at upstream Delta locations; and potentially create benefits related to scour and sedimentation.

3.1.4. Upgrading or Constructing New Exterior Levees

To protect adjacent properties from increased risk of flooding, existing interior levees may be upgraded or new exterior levees will be constructed prior to breaching the levee. These new or upgraded levees will include brush boxes or other biotechnical wave dissipaters to protect the levee from wind and wave erosion.

Habitat levees that include benches or berms also may be constructed, which will provide similar wind- and wave-action protection as well as opportunities for high marsh/upland transition habitat. The construction of habitat levees will depend on cost and availability of fill. Habitat levees are low, wide, gently sloping vegetated levees, which may be overtopped during storm surges with nominal eroding or destabilizing. Actual details of the location and number of levees will be identified on a site-specific basis as habitat restoration projects are developed. The levee designs will be engineered appropriately at the time of the site selection. Actual detail of each levee will also be developed on a site-specific basis once the location for the levee is selected; however, the upper substrate or upper layer of the habitat levee would be composed of non-compacted material that would be suitable for planting and establishment of marsh vegetation. The levees created as part of tidal habitat restoration will have an extension of the levee berm on the bay side (i.e., on the restoration project side). The standard section of levee (e.g., base and crown) will be composed of the compacted material, but the extended berm will have non-compacted material and will be suitable for planting and the establishment of marsh vegetation. Habitat levees are designed to allow intermittent flooding; minimize dispersal and denning of terrestrial predators; reestablish facsimiles of marsh topographic gradients; accommodate natural patterns of debris deposition and shoreline disturbance; and provide wave-energy buffers (Interagency Ecological Program 2007).

Habitat levees may be planted and seeded with native marsh species and/or allowed to colonize naturally with native and naturalized species. This habitat will promote intertidal zones and mudflats that support various species that rely on a gradually transitioning marsh plain. Habitat levee design and locations will vary by site but are expected to include the widening of existing interior levees by 15 to 30 feet with a gradual slope or the construction of new interior levees or islands. Specifically, these benches or berms will be designed to create mid and high marsh habitat for dependent species and will be guided at least partially by information obtained through the adaptive management process. It is expected that benches or berms that support habitat for these species will benefit many other species.

Habitat levees will be constructed from resources available at the time of construction and may include channel dredged material collected in bays and sloughs in the plan area, dredged material from outside the plan area, or material excavated within the tidal restoration area or other areas of the Marsh.

3.2. Implement Managed Wetland Activities on 44,000 to 46,000 Acres

The managed wetlands of Suisun Marsh are managed specifically for duck hunting activities but also provide important habitat for a variety of resident and migratory waterfowl and shorebirds and other native and special-status species; protection of these areas is a goal of many agencies and programs, including the Central Valley Joint Venture program and CALFED. These wetlands, which are managed for a diversity of wetland vegetation and other wetland wildlife food plants, are important as feeding and roosting areas for species such as geese, mallards, pintails, widgeons, and gadwalls. Managed wetlands also provide breeding habitat for shorebirds, which nest in a wide range of habitats from unvegetated wetland flats to uplands. Spring drawdowns practiced by Suisun Marsh wetland managers in conjunction with adjacent uplands provide ideal foraging conditions for migrating shorebirds.

Managed wetlands provide valuable habitat for a variety of non-waterfowl birds, mammals, reptiles, and amphibians. Birds such as Suisun song sparrow, salt marsh common yellowthroat, shorebirds, and ring-necked pheasant forage and nest in the managed wetlands. Managed wetlands support mammals such as SMHM, northern river otter, coyote, raccoon, striped skunk, black-tailed jackrabbit, common muskrat, and tule elk, as well as native reptiles and amphibians (e.g., western pond turtle, gopher snake).

Managed wetlands face challenges and constraints such as aging water management facilities, threatened and endangered species regulations, subsidence, mosquito abatement regulations, and water quality issues, including salinity. Additionally, the aging levee system, which is difficult to maintain because of a lack of appropriate levee source materials and regulatory constraints, compromises the managed wetland system.

The intended outcomes of the managed wetlands activities described below are to maintain and improve habitat conditions and minimize or avoid adverse effects of wetland operations. For managed wetlands, the optimum flood and drain cycle is 30 days. The activities described below provide a suite of tools that can be used to maintain and improve levee stability and the 30-day flood and drain cycle. As described above, the restoration and enhancement goals of the ERPP include protecting and enhancing 40,000 to 50,000 acres of managed wetlands. The SMP assumes that managed wetlands are enhanced by improving levees and the flood and drain cycle because it allows managed wetlands to be managed as effectively as possible.

The ability for managed wetlands to improve habitat is also dependent on the availability of lower-salinity water. DWR/Reclamation facilities and salinity stations are used to reduce water salinity and to distribute less saline water to managed wetlands. These facilities and stations must be maintained in order to function as intended.

Most of the managed wetland activities described below are already occurring in the Marsh. Some of the current activities will be modified, and new activities will be conducted. Many of the current activities will qualify for the SMPA PAI Fund, which is described below. Under the SMP, many of these activities will increase in frequency, primarily because of an increase in funding provided by the PAI Fund.

3.2.1. Increased Frequency of Currently Implemented Managed Wetland Activities

DFG, DWR, and landowners (as represented by SRCD) currently maintain their facilities and/or properties in the Marsh by implementing the actions listed below. Additionally, Reclamation contributes funding to DWR to implement operations and maintenance of facilities that mitigate the effects of the CVP/SWP, including Roaring River Distribution System (RRDS), Morrow Island Distribution System (MIDS), Goodyear Slough Outfall, salinity monitoring stations, and other facilities and/or properties. Table 3 gives a comprehensive description of most of the activities conducted by these agencies and landowners in the Marsh, although the activities each implements depend on their individual facilities, properties, and other factors. Some of these actions are expected to increase in frequency because of the increase in effort to support the managed wetland targets as well as the PAI Fund (described below), and to ensure continuing functionality of state/federal facilities. The current level of activity combined with the proposed new activities make up the total work needed to support managed wetland operations. Increasing the current level of work and implementing the new activities will help SRCD and DFG meet the SMP managed wetland goals related to levees and flood and drain cycles and help DWR and Reclamation meet their contractual and mitigation requirements for the effects of the SWP and CVP. All activities will be implemented by DFG, landowners (as represented by SRCD), and/or DWR except as noted. Descriptions of each activity are provided in the subsections following Table 3.

Table 3. Baseline and Proposed Change in Currently Implemented Managed Wetland Activities

Managed Wetland Activities	Annual Baseline Activities (Average, Low–High)	Current Corps Permitted Annual Limits	Anticipated Change from Baseline with SMP Implementation
Repair existing interior levees	29,228 cy, 9,697–54,040	443,000 cy	Slight increase (10% or less of annual baseline)
Repair existing exterior levees	43,902 cy, 28,622–87,232	443,000 cy	Decrease
Core existing interior levees	6,380 cy, 2,022–15,108	No limit	No change
Grade pond bottoms for water circulation	147,377 cy, 79,750–228,546	1,772,000 cy	Decrease
Create pond bottom spreader V-ditches	40,403 linear feet, 14,500–72,300	1,438,000 linear feet	No change
Repair existing interior water control structures	24, 10–37	No limit	No change
Replace pipe for existing interior water control structures or install new interior water control structures	20, 14–38	No limit	Slight increase (10% or less of annual baseline)
Install new blinds and relocate, replace, or remove existing blinds	38, 23–51	5 per ownership annually	No change
Disc managed wetlands	2,552 acres, 1,837–3,100	No limit	No change
Install drain pumps and platforms	1, 0–2	No limit	No change
Replace riprap on interior levees	50 cy, 0–300	Obtained as needed	No change
Replace riprap on exterior levees	2,435 cy, 292–7,406	Limited to replacement of existing riprap	No change
Repair exterior water control structures (gates, couplers, and risers)	17, 8–28	No limit	No change
Install or replace pipe for existing exterior flood or dual-purpose gate	11, 1–23	50 annually Marsh-wide	No change
Install, repair, or re-install water control bulkheads	11, 3–21	No limit	No change
Remove floating debris from pipes, trash racks, and other structures	20 cy, 10–50	Obtained as needed	No change
Install alternative bank protection such as brush boxes, biotechnical wave dissipaters, and vegetation on exterior and interior levees	450 ft, 300–600	Obtained as needed	No change
Construct cofferdams in managed wetlands	1 unit, 0–2	Obtained as needed	No change

Managed Wetland Activities	Annual Baseline Activities (Average, Low–High)	Current Corps Permitted Annual Limits	Anticipated Change from Baseline with SMP Implementation
Repair and maintain Suisun Marsh salinity control gate	1, 0–2	Obtained as needed	No change
Clean roaring river distribution system fish screen	Oct daily Nov–Sept weekly	No limit	No change
Install new fish screen facilities	2 units, 0–5	Obtained as needed	No change
Salinity monitoring station repair and replacement	2 stations, 0–18	Obtained as needed	No change
Relocate, install, or remove salinity station	1 station, 0–5	Obtained as needed	No change
Construct new interior ditches; clear existing interior ditches	49,456 cy, 9,724–69,022	443,000 cy	Slight increase (10% or less of annual baseline)

cy = cubic yards.

3.2.2. Repairing Existing Interior and Exterior Levees

This action involves the improvement or repair of levees by using spoils from other permitted activities such as clearing interior ditches, constructing new interior ditches, or grading pond bottoms. Vegetation growth on levees can require mowing to maintain condition and to assess repair needs. The spoils will be placed on the crown of the levee with an excavator, dozer, or box scraper. On rare occasions, exterior levee integrity is compromised (from rodent holes, storm damage, or unanticipated overtopping of the levee crown), allowing uncontrollable tidal flows to enter the managed wetland that can cause levee breaches. If the exterior levee breach can be repaired using on-site material consistent with existing permit terms and conditions, the levee integrity is restored on the next appropriate low tide cycle. See managed wetlands environmental commitments (Section 4) for additional discussion of this activity. Aggregate base rock may be placed on the crown of levees to prevent road surface degradation. Work generally will occur in late summer, and approximately 500 linear feet of levee can be repaired per day.

3.2.3. Coring Existing Interior Levees

The coring of levees is intended to stop the flow of water through rodent holes and cracks in levees. To core a levee, typically a 2-foot-wide trench (depending on the width of the excavator bucket) is excavated in the levee crown using a long-reach excavator or backhoe, and the material is placed on the crown of the levee adjacent to the excavation site. The trench then is backfilled immediately using the same material that was excavated. The material is compacted during the backfilling process to seal the levee. If a rodent hole is identified, its entire length may need to be excavated to stop the flow of water and prevent future burrowing by small mammals. Coring of levees generally is performed between July and September, and approximately 700 feet can be completed in 1 day.

3.2.4. Grading Pond Bottoms for Water Circulation

To improve water circulation by re-contouring low areas and raising pond bottoms and provide material for levee maintenance, material is graded from high-ground areas or pond bottoms. The raising of low pond bottom areas improves circulation and drainage in the managed wetlands. Grading also can include the creation or maintenance of swales, typically 2 feet deep with gradual slopes. This work is completed with a box scraper pulled by a low–ground pressure dozer or tractor. Work is generally done in June through August. Approximately 700 cubic yards can be graded per day.

3.2.5. Creating Pond Bottom Spreader V-Ditches

V-ditches are 18-by-18-inch or 24-by-24-inch ditches created by pulling a V-ditch plow behind a tractor. These V-ditches facilitate circulation and drainage of low areas and sinks. Occasionally, a ditch may be constructed in high areas to improve drainage by connecting an isolated wet area to other draining wet areas. Typically, these ditches silt in quickly and last only 1 to 2 years after creation. These ditches normally are created after the ponds have drained for the season, generally in June through August, and 2,000 feet can be constructed per day. Spoil materials typically remain on the sides of the V-ditches, although they may be spread back into the pond bottom to further improve the low areas, or they can be flattened adjacent to the V-ditch.

3.2.6. Repairing Existing Interior Water Control Structures

This repair involves the replacement of component parts of pipes through interior levees (gates, stubs, or couplers) but not replacement of the pipe itself. Work is done by hand (uncoupling the old structure and re-coupling the new structure), and generally a ground crew removes the damaged structure and installs the new structure on the end on the existing pipe. This work typically is completed in the summer, when the managed wetlands are dry.

3.2.7. Replacing Pipe for Existing Water Control Structures or Installing New Interior Water Control Structures

This activity includes the replacement of a pipe for an existing interior water control structure or the installation of a pipe for a new interior water control structure. If a new structure is being installed, the new structure is assembled on the crown of the levee, a trench is excavated laterally through the levee, the new pipe is placed in the trench, the trench is backfilled, and the fill is compacted. If a pipe is being replaced, the trench is excavated at the site of the old pipe, and that pipe is removed. Similar to installing new pipe, the replacement pipe is placed in the trench and backfilled. However, when feasible, new drainage pipes will be placed where they can be consolidated or drain into an existing ditch. Occasionally, an interior ditch cannot be drained sufficiently for pipe replacement. In these instances sheet piles may be used to retain the water temporarily until the pipe is replaced.

Many water control structures have walkways that run from the levee to the end of the pipe. These walkways include pilings, walkway boards, and handrails. These structures strengthen the gate by providing a grounded structure for frame attachment, and they provide a means by which wetland managers can access the gate for operation. Any necessary repair to these structures typically is done during pipe replacement. However, some repairs may need to be done more frequently, especially replacement of walkway boards or handrails.

This work typically is completed in the summer when the managed wetlands are dry.

3.2.8. Installing New Blinds and Relocating, Replacing, or Removing Existing Blinds

Duck blinds are plastic, fiberglass, or metal structures (3' x 4' x 8') placed in the ground to conceal the hunter. When an in-ground blind is replaced, the old blind is excavated from the ground, and a new blind is placed in the void, which can be as deep as 4 feet. This work is completed with a dozer and/or excavator. The blind is placed and secured with vertical timbers and cross timbers that are pushed into the ground adjacent to the blind. Then material from the pond bottom is graded to conceal the sides of the blind.

3.2.9. Discing Managed Wetlands

Discing is done on the landside of levees in the spring or late summer to clear problematic vegetation, reduce the production of vector mosquitoes, break up the soil for seedbed preparation, smooth excavated material, fill cracks in soil, or create fire breaks. A disc is pulled behind a tractor or dozer. Depending upon the wetland management and vegetation objectives, discing can occur annually in upland areas to promote annual grasses and cereal grain production and once every 2 to 5 years in wetland areas to set back plant succession. Discing is voluntarily limited to one fifth of a property area per year (Suisun Resource Conservation District 1998).

3.2.10. Installing Drain Pumps and Platforms

Drain pumps are installed on wooden platforms built to support them. The pump and platform are installed on the inland side of the exterior levee. Occasionally, the pump discharge pipe will be set high in the profile of the exterior levee so that the pipe does not limit levee access but allows discharge at high tidal levels.

3.2.11. Replacing Riprap on Interior Levees

Riprap is replaced on interior levees in the minimum amount necessary for bank stabilization and in areas around water control structures where water flow and eddies erode the ditch bank and interior levee toe. Riprap will be placed on interior levee banks only in those areas with existing riprap. Riprap is placed on the interior levees using a long-reach excavator that is located on the levee crown. Approximately 300 feet of riprap can be placed per day. Riprap generally is replaced during July through September.

3.2.12. Replacing Riprap on Exterior Levees

Riprap is replaced on the tidal side of exterior levees in the minimum amount necessary for bank stabilization. Riprap will be placed on exterior levee banks only in those areas with existing riprap. Those areas that receive direct wave impacts historically have been fortified with riprap and require periodic maintenance. Riprap is placed on the tidal side of exterior levees using a long-reach excavator that is located on the levee crown, or by barge with a dragline or clamshell dredge. The barge method is used less frequently, as it requires greater channel widths and depths and is more expensive. Riprap generally is replaced during July through September.

3.2.13. Coring Existing Exterior Levees

This activity is the same as described for interior levees.

3.2.14. Repairing Exterior Water Control Structures (Gates, Couplers, and Risers)

Repairing exterior water control structures involves the replacement of components of pipes through exterior levees (gates, stubs, or couplers) but does not involve the replacement of the pipe itself. All work is completed at low tide to allow access to the pipe and typically does not involve any excavation of sediments from the exterior slough. The repairs are generally done during July through September. In-water work is done by hand (uncoupling the old structure and re-coupling the new structure), and generally a ground crew lifts the damaged structure out of the water and lowers the new structure into place.

3.2.15. Installing or Replacing Pipe for Existing Exterior Flood or Dual-Purpose Gates

This activity is the replacement of an exterior water control structure (pipe, gates, stubs, and couplers) that is used to either flood or drain managed wetlands. There are no restrictions on the size of a draingate. For floodgates and dual-purpose gates (flood and drain) that divert water from tidal sloughs, however, the overall capacity of the diversion for that parcel may not be enlarged. In the past, water control structures typically were constructed of corrugated metal pipe. Because of the corrosive environment of the Marsh, these pipes often begin leaking and fail in 8 to 15 years. If an exterior pipe leaks, habitat management and maintenance activities would be compromised as a result of uncontrollable flooding of the managed wetland. Therefore, metal pipes typically are replaced with high-density polyethylene (HDPE) pipes.

When a pipe is replaced, a new pipe and appurtenant structures are assembled on the crown of the levee with the appropriate control structure components attached to each end of the pipe. A trench is excavated in the exterior levee over the old pipe, and the pipe is removed. All replacement activity is completed in one low tide. Replacement pipes typically are placed in the same location as the existing structure, the trench is backfilled, and the backfilled material is compacted. Either a dozer or an excavator is used to excavate the trench, and generally an excavator is used to install the replacement pipe. The backfill material is compacted with a dozer and/or excavator. Replacement of the pipes takes approximately 4 days and generally is done March through September. The first day is mobilization of equipment and materials, the second day is assembly and preparation for installation, the third day is installation, and the fourth day is demobilization and site clean-up.

If a new drainpipe is required, it will be installed at a location where discharge channels already exist or exterior levees have minimal vegetation. The new structure is assembled on the crown of the levee, usually with a flap gate or screw flap on the outside and flashboard riser or screw gate on the inside. Installing a new drainpipe requires the same types of equipment and takes the same amount of time as replacing an old drainpipe.

3.2.16. Installing, Repairing, or Re-installing Water Control Bulkheads

Bulkheads are built to stabilize and strengthen levees exposed to highly energetic water flows or wave energy. These structures typically are installed near water control structures and prevent the erosion of soils at the toe of the levee and ditch banks. Exterior work is done at low tide and does not involve any excavation of sediments from the exterior slough. In-water work is done by hand (unbolting the old boards and/or bolting a new structure together), and generally a ground crew lifts the old boards out of the water and lowers the new boards into place. A new bulkhead may be constructed to strengthen newly excavated sections of levee, and to help avoid additional turbidity after installation of exterior water controls by containing loose soils that otherwise may fall into the exterior slough. Bulkheads can be constructed from wood or vinyl or metal sheetpile. This activity generally will be implemented in the summer months.

3.2.17. Removal of Floating Debris from Pipes, Trash Racks, and Other Structures

Floating vegetative debris and other debris, such as wood and trash, often accumulate in front of pipes, trash racks, and other structures. This debris typically is removed using a long-reach excavator. Material is disposed of outside the Marsh. Work is done annually, generally during the summer months.

3.2.18. Installing Alternative Bank Protection such as Brush Boxes, Biotechnical Wave Dissipaters, and Vegetation on Exterior and Interior Levees

As described above, vegetation applications, including brush boxes, may be appropriate and effective mechanisms for controlling erosion of levees. Pursuant to the 1994 Biological Opinions (BOs) from NMFS and the USFWS, SRCD was required to employ levee maintenance methods that do not use riprap. Brush boxes use natural materials and native plants for capturing sediment to stabilize and protect exterior levees while also providing fish habitat. The installations generally are done during July through September.

Brush boxes, brush bundles, and ballast buckets are placed below the mean high water mark and anchored with tree stakes. Brush boxes and brush bundles are generally dead branches that are staked into the ground or wrapped in coconut fiber. Ballast buckets are organic, biodegradable buckets planted with native wetland species such as tule, three-corner bulrush, and Baltic rush. As the technology is developed further, alternative materials or installation methods may be used. The installation of brush boxes and ballast buckets does not involve any in-water work because all work will be done at low tide. This work is done entirely by hand, reducing the sedimentation that can occur with mechanical work. After the build-up of sediment and the growth of native plants over time, the exterior levee will be stabilized and protected from further erosion, and habitat will be established for fish and the macroinvertebrates on which they feed.

Integrated vegetation solutions are desirable to provide low maintenance "living" bank protection and wave-energy dissipation. Applications of these solutions are limited by the local channel velocities and depth, wind fetch, and exposure to wake. If the tidal hydraulic regime is suitable for the establishment of vegetation capable of resisting high channel velocities and wave energy, vegetation will be incorporated into the erosion protection design. This will reduce the future maintenance costs of erosion protection. The following criteria will be considered in determining the appropriateness of vegetation, either by itself or in combination with riprap, at each site.

- When channel velocities are low enough to prevent loss, vegetation solutions can be installed to halt erosion processes along levee slopes and natural channel bank sections.
- If channel depth on the face of the levee slope is less than 3 feet below mean tide level (MTL), i.e., mid tide level, and the levee slope is less than 3:1 (H:V), vegetation solutions can be installed to halt erosion processes along levee slopes and natural channel bank sections.
- If levee slopes can provide suitable foundations, brush boxes can be installed at various elevations to create a "benched" sequence up the slope and reduce or stop erosion in areas where scallop failures have occurred.
- If shallow water, shallow slopes, benches, or shoal exists, vegetation can be installed to greatly reduce wake energy and provide a low-maintenance erosion-reduction measure.
- If fetch length is less than 1,000 feet in the direction of the predominant southeast to southwest winds during high-water conditions (e.g., winter storms, spring tides), or prevailing winds during all other times (typically from the west) vegetation solutions should be applied to the upper slope of the levee to dissipate wind-driven waves and reduce erosion potential.

3.2.19. Constructing Cofferdams in Managed Wetlands

Cofferdams are temporary earthen structures used to cross interior ditches or prevent interior water from flowing into construction sites, in support of other permitted construction activities (e.g., exterior pipe replacement) and required best management practices (BMPs). Cofferdams are temporary in nature and are constructed from material from the levee toe, pond-bottom grading, or other excavated areas in the managed wetlands. The volume of material needed to transverse the ditch is limited to that required to stop the flow of water and provide adequate width to support equipment access to both sides of the ditch. During installation, a long-reach excavator or dozer places or pushes material from the adjacent levee crown or field area into the ditch. Upon completion of the associated work activities, the cofferdam or crossing is excavated and removed from the ditch, and the ditch is restored to its original width and depth. Upon removal of the cofferdam, all material is placed on the crown and backslope of the exterior levee or is spread out over the adjacent interior ditch bank or levee. An alternative to cofferdams is sheetpile that can be driven into the levee with a long-reach excavator and removed upon completion of construction. Sheetpiles could be used instead of or in conjunction with cofferdams. This activity generally will be implemented in the summer months.

3.2.20. Suisun Marsh Salinity Control Gate Repair and Maintenance

Flashboards are installed and removed on an annual basis by means of either a land-based crane on the banks of Montezuma Slough or a barge crane. Repairs and maintenance include servicing, replacing, and installing sections and pieces of the radial gates or boat locks that are connected to or associated with the entire facility. Most work is done above water from a boat or the superstructure while sections are hoisted out of the water. This activity is conducted by DWR.

3.2.21. Roaring River Distribution System Fish Screen Cleaning

The fish screens are cleaned by successively lifting each of the stationary vertical screen panels out of the water and pressure washing the silt and vegetation accumulation off of the screens. During the flood-up season (generally August through October), this activity can be conducted up to once a day. During the rest of the year, this activity is conducted less frequently on an as-needed basis. This activity is conducted by DWR.

3.2.22. Installing New Fish Screen Facilities

Fish screens are installed at managed wetland water intakes (flood pipes) to prevent fish from swimming or being drawn into managed wetlands. The installation of fish screens was permitted in the 1995 RGP (diversions are screened).

Wetland impacts from screening diversions to protect fish will not exceed 1,000 square feet per year or a total of 30,000 square feet over the 30-year plan period. All Suisun Marsh screens will be designed to comply with USFWS delta smelt approach velocities of 0.2 fps, which are well below required approach velocities for salmon.

There are many different designs for fish screens in the Delta and Suisun Marsh. Site-specific considerations, such as acreage served, diversion volume, and channel and diversion point configuration, will dictate screen design. The stainless steel conical 8-foot, 10-foot, and 12-foot fish screens have proved to be the most efficient design for small diversions screened in Suisun Marsh. These screens were designed to be removable from the crown of the exterior levee with a standard boom truck or excavator. This aspect of the design allows normal maintenance to be conducted in the dry, and the screens can be removed from the tidal slough and placed on a storage platform for inspection and maintenance. Normal maintenance includes power washing the screens, replacing cathodic protection (zinc or magnesium anodes), replacing cleaning brushes, and general inspection.

Typically, fish screens are installed at an existing diversion structure; therefore, there is an existing channel or basin in the tidal area and a supply ditch in the managed wetland. However, consolidation of unscreened diversions may require a new diversion location to serve multiple wetland units at one location. The fish screen platform is supported by four pilings that are pushed into the bay mud at the toe of the exterior levee. The conical fish screen support platform and diversion pipe are placed on top of these support pilings and installed through the exterior levee. These construction methods are similar to exterior pipe replacement and bulkhead repair or installation. All other work activities for screen installation are completed at the toe of the exterior levee on the landside of the levee. These activities include water control installation, storage platform construction, and control center platform installation. This activity generally will be implemented in the summer months.

3.2.23. Salinity Monitoring Station Maintenance, Repair, and Replacement

Infrequent major maintenance activities do not involve work done in the water. This includes repairs to walkways, equipment housing, or other wood, plastic, or metal structures. This also includes installation, removal, replacement, repair, or modification of monitoring instrumentation within the equipment housing. These activities are done twice per year.

Weekly maintenance activities include collecting data from the electronic equipment at the site and the calibration and cleaning of the probes. With the exception of lowering the probes in the water, these activities are done above the water or adjacent to the water on the levee bank.

Activities to be conducted periodically in the water by hand include cleaning or replacing the probe mounting equipment, resetting of water stage gage, cleaning probe pipes, and replacing the dimple collar to suppress wave action. On the remaining stations with stilling wells, clearing accumulated sediment from the stilling well is done by flushing the stilling well with water pumped from the adjacent area.

Stilling well replacement and walkway/platform piling replacement includes removal by tractors and trucks operated from the existing roadway/levee and excavators or cranes operated from the roadway/levee or barge. Work generally is scheduled during the dry months of summer and fall. This activity is performed by DWR about once every 5 to 10 years at a site.

DWR gradually is moving away from the use of stilling wells and moving toward using pressure transducers to measure water surface elevation. Pressure transducers (as well as the other transducers in the bundle) are suspended in the water above the bottom.

3.2.24. Salinity Station Relocation, Installation, and Removal

Salinity stations need to be relocated, installed, or removed due to regulatory requirements, physical constraints, the need to obtain more reliable data, the data no longer being required, or for other reasons. Maintenance equipment may include trucks, bucket excavators, small cranes, boats, barges, and other equipment as required. Work generally is scheduled during the dry months, June through September.

When a salinity station is removed, it is done by hand when feasible. Otherwise, tractors and trucks operated from the existing roadway/levee and excavators or cranes operated from the roadway/levee or barges are used. All components of the station will be removed. This includes the stilling well culvert, and pilings supporting the walkway will be removed from the levee slope/river bottom. Materials from the removed station are disposed of at an approved off-site location. The total disturbance will not exceed 400 square feet. The removal of a monitoring station usually takes about 8 hours over the course of approximately 3 days.

New monitoring stations are installed on a levee when possible or in water when location on a levee is not feasible. A new station may include installation of salinity measurement equipment with equipment housing. Stations that cannot be located on the levee will require a platform to support the equipment housing, a walkway to access the platform, and pilings to support the platform and walkway. Stilling wells may be installed. Alternatively, pressure transducer equipment will be attached to structures in the water, such as pilings, to enable measurements to be taken in the water column without requiring disturbance of the substrate during installation or maintenance. The footprint for the walkway (actual fill) is less than 2 cubic feet. Installation of a monitoring station usually takes approximately 4 days, involves the use of a truck to haul equipment, and may require an excavator and small boat to install the stilling basin. The total disturbance will not exceed 50 square feet. This activity is conducted by DWR.

3.3. Modification of Currently Implemented Activities

Only three activities currently implemented will be modified under the SMP. The activities themselves—clearing existing interior ditches, constructing new interior ditches, and repairing exterior levees—will not change, but how the activities are administered will change. These activities will be implemented by DFG, landowners (as represented by SRCD), and/or DWR. This includes RRDS, MIDS, Goodyear Slough Outfall, and other facilities and/or properties.

3.3.1. Clearing Existing Interior Ditches

This action is the removal of accumulated silt, emergent vegetation, and aquatic vegetation from interior ditches with an excavator to eliminate water-flow restrictions. Approximately 900 linear feet of ditch can be cleared in 1 day. The RRDS includes a square-shaped 40-acre intake area that receives water from the water control structures behind the fish screen and allows sediment to settle out of the water prior to its flowing into the RRDS ditch. Although this area is not linear like a ditch, it is similar to ditches in that it is an area with open water, boarded by levees, that may have emergent vegetation growth due to excess silt accumulation. Removal generally will be done during the months of June through September. A long-reach excavator, harvester, or other drag methods may be used to remove the material.

The material will be spread evenly on adjacent land. However, spoils also may be sidecast and left adjacent to the ditch for up to 1 year, then must be used for an authorized activity (levee maintenance or grading) or removed to an area outside Corps jurisdiction (crown of a levee). In this case, spoils are moved using a dozer or box scraper. Currently, sidecast materials may be left in place to dry for only a month. SRCD, DFG, DWR, and Reclamation propose that this period be extended to a year to ensure that all materials are dried before they are put to beneficial use.

3.3.2. Constructing New Interior Ditches

This action is the removal of pond bottom material with an excavator to create a new interior ditch for improved water circulation. Approximately 600 linear feet of ditch can be constructed in 1 day, and work generally will be conducted during the months of June through August. A long-reach excavator may be used to remove the silt and spread materials evenly on adjacent land. However, spoils may be sidecast and left adjacent to the ditch for up to 1 year; then they must be used for an authorized activity (levee maintenance or grading) or removed to an area outside Corps jurisdiction (crown of a levee). Spoils are moved using a dozer or box scraper.

Similar to clearing existing ditches, sidecast materials currently may be left in place to dry for only a month. SRCD, DFG, DWR, and Reclamation propose this period be extended to a year to ensure that all materials are dried before put to beneficial use.

3.3.3. Repairing Existing Exterior Levees

The most common practices for repairing exterior existing levees in Suisun Marsh involve the removal of accumulated silt and vegetation from water circulation ditches in managed wetlands and placement of spoil material on the crown of adjacent levees to raise the crown to its original or design height and/or improving interior side slopes. Materials may be imported from an upland source within or outside the Marsh for beneficial uses of dredged materials or from the Long-Term Management Strategy (LTMS). A potential additional material source, dredging from tidal sloughs, is described below under Section 3.4, New Activities.

Repair of existing levees typically occurs from June through September. Approximately 800 linear feet can be completed in 1 day.

It is unlikely that a significant amount of levee repair material would be lost to the outboard side of an exterior levee below the mean high water line. Any material that might trickle down the outside slope of the levee from the crown probably would not affect vegetated areas and may cause only slight and very temporary turbidity.

This activity currently is limited based on acreage of each parcel protected by the exterior levee. The change is to limit work based on actual lineal footage of each ownership. This change was proposed because some small-acreage properties may have significant lengths of exterior levee (e.g., a long, narrow parcel), and a large acreage property may have minimal or no exterior levees but be protected by the small-property exterior levee. This administrative change would provide landowners with a more appropriate limit for maintenance of exterior levees. Placement of up to 1.5 cubic yards of levee material per linear foot on average for annual work activities will occur. One levee segment may require no work in a given year, and a different levee segment may require 3.0 cubic yards per linear foot because of flood damage. This will average out over the individual properties' total levee system. This slight change in how permitted volumes are calculated is not expected to change the overall patterns of activities conducted in the Marsh. However, the frequency of work is expected to increase to meet the enhancement objective.

3.4. New Activities

New activities are activities that have not been implemented in the Marsh, or that have not been implemented in so long that they are not considered part of the existing baseline condition. These new activities will be implemented by DFG, landowners (as represented by SRCD), and/or DWR. This includes RRDS, MIDS, Goodyear Slough Outfall, and other facilities and/or properties. These new activities are described below.

3.4.1. Dredging from Tidal Sloughs as Source Material for Exterior Levee Maintenance and to Remove Sediment around Fish Screens and Other Areas

A dredging program will be implemented to provide materials for deferred and anticipated levee maintenance needs. A total of 3 million cubic yards of materials will be dredged from major and minor tidal sloughs and bays over the 30-year SMP implementation period. However, over time, as tidal restoration occurs, the number of exterior levees in the Marsh may decrease, thus reducing the amount of dredging required to maintain Marsh levees. Any reduction in dredging will occur over time and will be concurrent with the implementation of the restoration. This activity will be performed during the dredging windows of August through November.

Up to approximately 100,000 cubic yards of material will be dredged annually. However, as described above, as tidal restoration occurs the number of exterior levees in the Marsh may decrease, thus reducing the amount of dredging required to maintain Marsh levees. The annual allotment will be divided between state and private property, depending on need, and limited to 2.1 cubic yards per linear foot of channel, based on the linear extent of exterior levees on each property or the length of dredger cut. This limitation will be provided as a general guideline; however, flexibility would be necessary in case of special conditions, such as catastrophic levee failure. The proposed volume may be reduced, in any given year, if supplemental material is available through beneficial reuse of suitable dredged materials (e.g., LTMS or other operations).

Some exterior levee segments have vegetation growth on the levee toe that extends out into the bay or slough. Repair of levee segments with this vegetation will be avoided if the tidal berm is more than 50 feet wide. Dredging could be done within dredger cuts, which transect wide berms, and salinity stations located on the edge of such berms. Dredging from the center channel will be done to avoid emergent vegetation, and other areas with vegetation will be avoided. The approximate cubic yards and acreage of other habitat types per region proposed for dredging per year is shown in Tables 4 and 5. Minor sloughs include all sloughs except Montezuma and Suisun. Dredger cuts are small, linear channel areas isolated by or transecting a vegetated berm. These are channels that were created immediately adjacent to the toe of the exterior levees during original levee construction or are channels that run from water control structures to bays or sloughs that were previously created to facilitate water drainage.

Table 4. Proposed Dredging Volume of 100,000 Cubic Yards Distributed per Habitat Classification and Plan Region

	Volume (cubic yards)					
Feature	**Region 1**	**Region 2**	**Region 3**	**Region 4**	**Montezuma Slough**	**Total**
Bays	0	0	100	4,000	0	4,100
Major sloughs	2,100	10,700	0	0	16,000	28,800
Minor sloughs	21,600	8,900	3,000	2,400	0	35,900
Dredger cuts	6,300	2,700	4,500	10,500	7,200	31,200
Total	**30,000**	**22,300**	**7,600**	**16,900**	**23,200**	**100,000**

Table 5. Annual Acreage of Dredging per Habitat (acres)

Feature	**Region 1**	**Region 2**	**Region 3**	**Region 4**	**Montezuma Slough**	**Total Acres**
Bays	0	0	0.02	0.79	0	0.81
Major sloughs	0.42	2.12	0	0	3.16	5.7
Minor sloughs	4.28	1.76	0.61	0.48	0	7.13
Dredger cuts	1.25	0.54	0.89	2.08	1.43	6.19
Total	**5.95**	**4.42**	**1.52**	**3.35**	**4.59**	**19.83**

Dredging activities will be tracked by SRCD using geographic information systems (GIS) to ensure that it does not occur more than once every 3 years in any location, and would not remove material deeper than 4 feet per dredging cycle. The actual dredging locations will be based on needed levee improvements, but will be limited by region, annual limits, habitat types, and frequency in any one location as described above.

A clamshell dredge or long-reach excavator will be used to dredge in the Marsh. The long-reach excavator will dredge from the levee crown or from a barge. Clamshell dredging could take place either from a barge within the slough channel or from the top of a levee, depending on restrictions caused by vegetation on channel banks or the width of a channel. Barge clamshell dredges are not self-propelling and therefore need a small tugboat to maneuver in the channel. From a barge, the operation will begin when the bucket assembly, attached by a boom (up to 100 feet), is lowered into the channel to collect sediments. It will scoop up to 5 cubic yards of consolidated bay mud and deposit it on the land side of the levee or crown adjacent to the channel. In limited instances, materials may be used for exterior levee maintenance in areas not adjacent to the dredged material source. The clamshell dredge or long-reach excavator may sit on top of the levee and scoop up to 5 cubic yards of consolidated bay mud from the channel bottom, using the same method as from a barge, and deposit the dredged material on the landside backslope, crown, or the levee slope on the bay/slough side if it is devoid of vegetation.

Once material is placed, an excavator bucket will be used to compact the material against the levee to make it as smooth as possible. After 2–3 months of drying time, the material will be disced and graded to integrate the new materials with the existing levee. Minimal materials enter the interior managed wetland or bay/slough because the materials are deliberately placed and kept on the crown and slopes of the levee.

Dredging could occur in the center of slough channels, adjacent to water control structures or culverts, in salinity station locations, in the location of the Suisun Marsh Salinity Control Gates, adjacent to fish screen structures, and in historical dredger cuts. Some exterior levee segments have vegetation growth on the levee toe that extends out into the bay and/or slough. Repair of levee segments with this vegetation will be avoided by not dredging adjacent to tidal berms more than 50 feet wide, dredging from the center channel to avoid emergent vegetation often found along levee slopes, and avoiding other areas with vegetation. Dredging in human-made dredger cuts, which are linked directly to the water control infrastructure of the managed wetlands, fish screens, and transect-wide berms will improve drainage issues that have resulted from siltation. Siltation in some instances has restricted flap gates from opening, dammed water in the drainage channel, and clogged trash racks. This reduces the management capabilities and habitat quality on managed wetland units and reduces the effectiveness of state/federal facilities.

Similarly, some of the 16 fish screen structures and the RRDS fish screen experience significant siltation problems. Silt is deposited around these screens, which impedes the operation of the screen and screen-cleaning brushes. Every few years a relatively small amount of material will be removed from the fish screen basins (about 20 to 100 cubic yards each) by dredging. (This amount is included in the total 3 million cubic yards proposed for dredging in the Marsh.) Alternative measures (trying to move silt by hand) have been ineffective. Dredging around fish screens will be done during low tide to minimize in-water work and minimize turbidity. As the tide returns, the fish screen will be opened to allow turbidity to be drawn into the managed wetland. Dredge spoils will be placed on the crown or landside slope of the exterior levee adjacent to the fish screen. In instances where material cannot be used adjacent to the dredging site, the material may be used on other levees within Suisun Marsh, following the same environmental commitments as identified in the plan.

3.4.2. Placing New Riprap in Areas That Were Not Previously Riprapped

The levee system in Suisun Marsh is continually under the pressure of tide stage, wind fetch, eroding currents, and boat-wake damage. With sea level rise and climate change these pressures are expected to increase. Over time, protective vegetated berms and levee toes erode and expose the levee foundation to the erosive forces of wind, water, and logs. Many of the areas that require riprap have been treated, and their continued maintenance is described above. This activity addresses those areas that currently do not have riprap but that may be determined in the future to require such treatment.

This new activity will place up to 6,000 feet of new riprap over the 30-year plan period on the side slopes of interior water conveyance ditches (i.e., interior levees) and up to 2,000 feet of new riprap on the side slopes of exterior levees on newly exposed areas not previously riprapped. (This is in addition to the replacement of riprap described above.) No more than 200 linear feet of new riprap will be placed annually on the interior levees. Riprap is placed on the levee using a long-reach excavator or a clamshell or dragline dredge. Placement of riprap will be done from June through September. Riprap materials are transported to the site with a 10-wheel dump truck with a capacity of 16 cubic yards or by barge with a 400 cubic yard capacity. For interior levees, this activity is needed occasionally where the velocity of water flowing through an exterior water control structure causes scouring eddies and bank erosion of inter-levee toes.

New riprap will be placed only when it has been determined that the specific conditions of each site would not support other types of erosion control. Riprap will be applied only under the following circumstances:

- Levees exposed to channel velocities that are too high to support vegetation. Depending on soil type, it may be possible for levee material to withstand short durations that exceed 6 fps.
- Channel depth on the face of the levee slope is deeper than 3 feet below Mean Tide Level (MTL, i.e., mid tide) and the levee slope is steeper than 3:1 (H:V); riprap will be applied to reduce erosion potential without consideration for incorporation of vegetation.
- Levee face typically is exposed to vessel wakes year-round and not located in a 5 mph zone; riprap will be applied in areas where erosion persists.
- Fetch length exceeds 1,000 feet in the direction of the predominant southwest to southeast winds during high water conditions (e.g., winter storms, spring tides) or prevailing winds during all other times (typically from the west); riprap will be applied to the upper slope of the levee to dissipate wind-driven waves and reduce erosion potential.

Where new riprap is placed, integrative vegetation also will be applied where it is biologically appropriate.

If new riprap is placed on either interior or exterior levees, BMPs will be implemented to reduce the environmental effect as described below in the Environmental Commitments section.

3.4.3. Constructing New Interior Levees for Improved Water Control and Habitat Management within the Managed Wetland Units

Interior levees are embankments that allow management of water inside exterior levees on the managed wetlands. The interior levees are not exposed to tidal action. The purpose of interior levees is to isolate specific areas within the managed wetland to allow independent water control or different water elevations in those areas. The crown width of these levees is normally 10 feet or less, with a crown height of 3 feet above pond bottom, 1 foot of freeboard, and a side slope of 2:1 on both sides.

Interior levees can be constructed in numerous ways: (1) by excavating a new or existing water conveyance ditch and stacking the excavated material to create an interior levee, (2) recontouring a ponded area and pushing up material with a dozer, (3) placing material with a box scraper to create a levee from high ground or pond bottom areas, or (4) importing materials and placing with an excavator or dozer. Interior levees generally will be constructed during the summer months when managed wetlands are dry. Approximately 400 feet of levee can be constructed per day.

3.5. Preservation Agreement Implementation Fund

The SMPA PAI Fund is proposed to fund certain permitted activities to support mitigation obligations for the CVP and SWP operations. It is funded by DWR and Reclamation as part of the CVP and SWP mitigation for impacts on the Marsh, as described in the Revised SMPA. The PAI Fund will not include activities beyond what is described above for managed wetland activities, but rather will provide a funding mechanism for landowners to perform needed improvements more frequently for improved water management capabilities to fulfill Reclamation and DWR mitigation obligations. As described below, the PAI Fund applies only to specific work activities.

The PAI Fund will be part of a mitigation strategy for the effects of the CVP and SWP operations on water quality in the Marsh. The PAI Fund will contribute to the funding of some activities needed to improve managed wetland facilities operations by establishing a single cost-share funding mechanism that combines the three formerly proposed SMPA Amendment 3 actions into the PAI Fund. The type of improvement determines which cost-share program will apply. These activities will remain as distinct elements under the new PAI Fund, consistent with the objectives and guidelines of each program, cost-share requirements, and regulatory permitting compliance requirements.

The Joint-Use Facility Improvements (JUFI) program will provide funds on a 75/25 cost-share basis for infrastructure improvement to increase efficient and cooperative use of joint-use water delivery systems to managed wetlands. Joint-use facility structures may include but are not limited to interior levees, water conveyance ditches, water control structures, and permanent pumps. Funded activities include construction of new facilities and improvements to existing facilities.

The PAI Fund includes two programs: the 75/25 cost-share program and a 50/50 cost-share program. The 75/25 cost-share program will provide funds for infrastructure improvements that are necessary for the property to meet the 30-day flood and drain cycle objective for managed wetlands. Reimbursement of approved expenditures is limited to the purchase and installation of new, larger, lowered, or relocated discharge facilities to enable the individual owners to meet the 30-day flood and drain cycle. Funds made available by this program will not be used for regular maintenance or for fish screen construction.

The 50/50 cost-share program will provide funds for management and infrastructure improvements that are necessary to improve leaching and drainage efficiency of individual clubs. Eligible activities include cleaning, widening, deepening, and creating new primary and secondary ditches; adding V-ditches or drainage swales; raising elevations of pond bottom sinks; installing or improving interior water control structures; coring interior levees; offsetting electrical and fuel costs for portable and stationary pumps during spring leaching periods only; and offsetting fish screen electrical costs.

These funds, totaling $3.7 million, could be used for improvements as shown in Table 6 below.

Table 6. Improvements Funded by Preservation Agreement Implementation Fund

Activity Name	Applicable Fund
Clear existing interior ditches	JUFI, PAI Fund 50/50
Construct new interior ditches	JUFI, PAI Fund 50/50
Repair existing interior levees	JUFI
Core existing levees	JUFI, PAI Fund 50/50
Grade pond bottoms for water circulation and raising pond bottom sinks	JUFI, PAI Fund 50/50
Maintain pond bottom spreader V-ditches and swale	JUFI, PAI Fund 50/50
Repair existing interior water control structures	JUFI, PAI Fund 75/25, PAI Fund 50/50
Replace pipe for existing water control structures or installation of new interior water control structures	JUFI, PAI Fund 75/25, PAI Fund 50/50
Install drain pumps and platforms	JUFI, PAI Fund 75/25
Repair exterior water control structures (gates, couplers, and risers)	PAI Fund 75/25
Replace pipe for existing exterior flood or dual-purpose gate	PAI Fund 75/25
Install, repair, or re-install water control bulkheads	PAI Fund 75/25

3.6. Protection of Other Habitat Types

The SMP is not specifically intended to restore, protect, or enhance habitats besides existing managed wetlands and properties acquired for tidal wetlands restoration. However, the Principal Agencies recognize the importance of other habitats in the Marsh. As such, when properties are restored, the specific project proponent will protect sensitive habitats that may be located within the bounds of that property. In these instances, the following actions will be implemented as feasible.

- Protect and enhance existing tidal wetlands, vernal pool, riparian, and aquatic habitat functions and values by installing fencing to enable improved grazing management.
- Maintain trees, including nonnative eucalyptus, wherever feasible, which provide limited roosting and nesting habitat for raptors, herons, egrets, and other native species in the Marsh.
- Modify and/or set back existing levees to expand the floodplain and restore natural riparian processes.
- Remove and/or modify barriers to upstream fish movement/migration within the project area.
- Plant native riparian trees and shrubs to increase habitat diversity and structure.
- Identify sources of low–dissolved oxygen (DO) water in sloughs and bays, and where feasible, implement strategies for increasing DO concentrations in receiving waters.
- Increase natural connectivity between the shallow high productivity marsh plain habitat and adjacent nutrient rich channels and sloughs.

Of the restored areas, a certain portion is expected to become tidal aquatic habitat. The percent cover of tidal aquatic habitat within tidal wetlands areas (Rush Ranch, Lower Joice Island, and Hill Slough) in Suisun Marsh was estimated based on existing tidal wetlands, the Integrated Regional Wetland Monitoring Pilot Project (BREACH), and GIS and site visits. The analysis demonstrated that tidal aquatic habitat accounts for an average of approximately 5 to 15% of the total area of established tidal wetlands. Assuming this relationship holds true for future restored tidal wetlands, an increase of 250–1,050 acres of tidal aquatic habitat would be expected to result when the SMP is fully implemented and sites develop into fully functioning tidal marshes.

Over the 30-year SMP implementation period, it is expected that the exact habitat amount provided by restored areas will depend on the existing elevation of the site, sedimentation rates and accretion, and sea level rise. The amount of subtidal aquatic habitat is expected to decrease gradually as sediment accretes and emergent tidal vegetation is established at each restoration site. As this happens, the site will be restored to a tidal wetland. However, the rate of accretion and the rate of sea level rise will dictate the end result, and the actual timeframe for such progression depends on the site-specific conditions, but significant geomorphic changes are decadal. Locations with large subsidence and low sediment concentrations may never return to emergent marsh and instead remain as open water. Adaptive management, as described below, also will be used to improve restoration designs to achieve desired results.

4. Environmental Commitments

As part of the plan implementation, individual project proponents will incorporate certain environmental commitments and BMPs into specific projects to avoid or minimize potential impacts as applicable. Project proponents and the appropriate agencies also will coordinate planning, engineering, and design phases of the project. The environmental commitments are divided between restoration activities and managed wetland activities. For restoration activities, project proponents are defined as any state, federal, or local agency; landowner; or implementing body of a tidal restoration action in the Marsh. For managed wetland activities, the SMPA Agencies (SRCD, DFG, DWR, and/or Reclamation) are the project proponents and are responsible for implementing the environmental commitments, depending on the activity.

4.1. Restoration Environmental Commitments

The following BMPs and environmental commitments will be implemented during tidal wetland restoration activities. The environmental commitments discussed below apply to the activities described above in Section 3.1, Tidal Wetland Restoration.

4.1.1. Standard Design Features and Construction Practices

In preparing the SMP, the Principal Agencies determined the following design features and construction practices to be potentially feasible and implementable measures to reduce or mitigate certain short-term, construction-related effects. These measures will be implemented at a site-specific level, as appropriate, depending on the location of construction, potential effects of the specific project, and surrounding land uses. The identified measures are:

- Stopping work immediately if a conflict with a utility facility occurs and contacting the affected utility to (1) notify it of the conflict, (2) aid in coordinating repairs to the utility, and (3) coordinate to avoid additional conflicts in the field.
- Constructing structures in accordance with California Building Code and County General Plan Standards to resist seismic effects and to meet the implementation standards outlined in the Solano County General Plan.
- Ensuring that changes within the Suisun Marsh channels will not significantly affect navigation and emergency access by having Rio Vista and Vallejo Coast Guard Stations review plans to assess safety issues associated with changes when there is potential for in-channel work to affect access.

- Implementing BMPs to minimize any disease-carrying mosquitoes and threats to public health if it is found that project components pose a threat to public health.
- Controlling construction equipment access and placement of fill to maintain acceptable loading based on the shear strength of the foundation material.
- Minimizing degradation of wetland habitats where feasible, i.e., work will be conducted from levee crown.
- Implementing BMPs and minimization measures to minimize water quality impacts such as temporary turbidity increases. See Erosion and Sediment Control Plan below.
- Inspecting all equipment for oil and fuel leaks every day prior to use. Equipment with oil or fuel leaks will not be used within 100 feet of wetlands.
- Requiring the construction contractor to remove all trash and construction debris after construction and to implement a revegetation plan for temporarily disturbed vegetation in the construction zones.
- Maintaining waste facilities. Waste facilities include concrete wash-out facilities, chemical toilets, and hydraulic fluid containers. Waste will be removed to a proper disposal site.

4.1.2. Access Point/Staging Areas

Project proponents will establish staging areas for equipment storage and maintenance, construction materials, fuels, lubricants, solvents, and other possible contaminants in coordination with 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 unless site-specific circumstances do not provide such a setback, in which case the maximum setback possible will be used. 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. An alternate site will be selected.

Where possible, no equipment refueling or fuel storage will take place within 100 feet of a body of water. Vehicle traffic will be confined to existing roads and the proposed access route. Ingress and egress points will be clearly identified in the field using orange construction fence. Work will not be conducted outside the designated work area.

4.1.3. Erosion and Sediment Control Plan

For projects that could result in substantial erosion, project proponents 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.

An erosion control plan will be developed to ensure that during rain events construction activities do not increase the levels of erosion and sedimentation. This plan will include the use of erosion control materials (baffles, fiber rolls, or hay bales; temporary containment berms) and erosion control measures such as straw application or hydroseeding with native grasses on disturbed slopes, and floating sediment booms and/or curtains to minimize any impacts that may occur from increased mobilization of sediments.

4.1.4. Stormwater Pollution Prevention Plan

For projects that involve grading or disturbance of more than 1 acre, a stormwater pollution prevention plan (SWPPP) will be developed by a qualified engineer or erosion control specialist and implemented prior to construction. The objectives of the SWPPP will 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. The project proponents and/or their contractor(s) will develop and implement a spill prevention and control plan as part of the SWPPP to minimize effects of spills of hazardous, toxic, or petroleum substances during construction of the project. Implementation of this measure will 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 Regional Water Quality Control Board (Regional Water Board). The SWPPP will include but is not limited to:

- 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.
- A description of potential pollutants to stormwater resulting from operation of the project.

4.1.5. Noise Compliance

The project proponents and/or their contractors will comply with local noise regulations when construction activities occur near residences by limiting construction to the hours specified by Solano County. It is assumed that construction activities will occur during normal working hours, between 7:00 a.m. and 6:00 p.m., Monday through Friday, and between 8:00 a.m. and 5:00 p.m., Saturday and Sunday.

Additionally, when it is determined through site-specific analysis that construction has the potential to occur near residences, noise-reduction practices listed below will be implemented.

- Use electrically powered equipment instead of internal combustion equipment where feasible.
- Locate staging and stockpile areas and supply and construction vehicle routes as far away from sensitive receptors as possible.
- Establish and enforce construction site and haul road speed limits.
- Restrict the use of bells, whistles, alarms, and horns to safety warning purposes.
- Design equipment to conform to local noise standards.
- Locate equipment as far from sensitive receptors as possible.
- Equip all construction vehicles and equipment with appropriate mufflers and air inlet silencers.
- Restrict hours of construction to periods permitted by local ordinances.
- Locate redirected roadways away from sensitive receptors.

4.1.6. Traffic and Navigation Control Plan and Emergency Access Plan

For projects that would substantially affect traffic or navigation patterns, or could result in hazardous road or waterway conditions, the project proponents, 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 roadway and waterway systems 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, and will avoid major construction activities on days known or expected to have a significant increase in traffic as a result of events in the Marsh.

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

The traffic and navigation control plan will include but not be limited to the following actions, depending on site-specific conditions.

- 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* (2004).
- Notifying the public of road closures in the immediate vicinity of the open trenches in the construction zone and of temporary closures of recreation trails.
- 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 Solano County to monitor and repair road damage to levee roads and any other roads damaged during construction to the extent allowed by law, depending on the specific project proponent. A memorandum of understanding (MOU) may be implemented for specific restoration projects and could include the following as suggested by Solano County:
    - The restoration project will be responsible for the cost of maintaining, repairing, paving and/or reconstructing roads affected during construction, operation, and maintenance of the restoration project.
    - Repairs will be implemented to comply with the current County Road Improvement Standards, except that repairs to damaged paved sections may be made within 5 inches of asphalt concrete at the discretion of the County, while repairs to damaged gravel sections of road will replace the preexisting depth of aggregate base but not less than 12 inches in depth.
- Coordinating with the Union Pacific Railroad prior to beginning any work within the right-of-way of a rail line to ensure that the integrity of the rail line is maintained and to minimize disruptions to service.
- Coordinating with emergency service providers before construction to develop an emergency access plan for emergency vehicles into and adjacent to the construction zone; the emergency access plan will require effective traffic direction, substantially reducing the potential for disruptions to response routes.

4.1.7. Recreation Best Management Practices

The project proponents will implement measures related to recreation and recreation facilities to decrease impacts.

- Avoid nesting habitats and other sensitive areas, such as important roosting and foraging sites during critical nesting periods.

Temporary impacts on boating access may be minimized by these measures.

- Not allowing construction to occur during major summer holiday periods.
- Maintaining boat access to prime areas.
- Providing public information regarding alternate access.
- Posting warning signs and buoys in channels, upstream of and downstream of all construction equipment, sites, and activities during construction.
- Posting signs describing alternate boating routes in convenient locations when boating access is restricted.
- Minimizing water-level fluctuation during construction.

4.1.8. Mosquito Abatement Best Management Practices

As described in Section 7.8, Public Health and Environmental Hazards, the Solano County Mosquito Abatement District (SCMAD) is concerned that tidal restoration has the potential to increase mosquito production in the Marsh. However, tidal restoration will be designed to minimize such effects. To further reduce the potential for this effect to occur, SCMAD has recommended several measures to reduce the potential for the production of, and subsequent spread of diseases carried by, mosquitoes. Specific project proponents will develop site-specific plans to address mosquito production for each restoration activity based on the following recommendations, which will be implemented prior to removal or breaching of any levee or water control structure.

- Develop a management program consistent with Marsh-wide management actions for the control of mosquitoes.
- If necessary, obtain an engineering survey to locate depressions that would retain tidal water and design site restoration to promote water drainage.

4.1.9. Hazardous Materials Management Plan

A hazardous materials spill plan will be developed prior to construction of each action. The plan will describe the actions that will be taken in the event of a spill. The plan also will incorporate preventive measures to be implemented (such as vehicle and equipment staging, cleaning, maintenance, and refueling) and contaminant (including fuel) management and storage. In the event of a contaminant spill, work at the site immediately will cease until the contractor has contained and mitigated the spill. The contractor will immediately prevent further contamination, notify appropriate authorities, and mitigate damage as appropriate. Adequate spill containment materials, such as oil diapers and hydrocarbon cleanup kits, will be available on site at all times. Containers for storage, transportation, and disposal of contaminated absorbent materials will be provided on the project site.

The project proponents and their contractors will not use any hazardous material in excess of reportable quantities, as specified in Title 40 Code of Federal Regulations (CFR) Part 355, Subpart J, Section 355.50, unless approved in advance by the Office of Emergency Services (OES), and will provide to the OES in the annual compliance report a list of hazardous materials contained at a project site in reportable quantities. The reporting of hazardous materials in excess of reportable quantities of Title 40 CFR Part 355 is required annually to Solano County Environmental Health Services Division as the Solano County Certified Unified Program Agency (CUPA).

For large-scale projects, the project proponents will prepare a risk management plan (RMP). The RMP will be submitted to the U.S. Environmental Protection Agency (EPA) and will reflect the comments of the Solano County CUPA. An RMP addresses acutely hazardous materials such as chlorine gas, ammonia gas, hydrogen chloride, flammable gases. This document is required to be submitted to both the EPA and Solano County Environmental Health Services Division as the CUPA. The plan will describe procedures, protective equipment requirements, and training and contain a checklist. At least 60 days before the start of construction, or a lesser period of time mutually agreed upon, the project proponents will provide the final RMP and the safety plan to the Certified Property Manager (CPM).

4.1.10. Air Quality Best Management Practices

The following control practices will be used to offset any air quality issues that may arise (Bay Area Air Quality Management District 1999).

Basic Control Measures

The following controls will be implemented at all construction sites.

- Treat all graded surfaces to prevent nuisances from dust or spillage on roads or adjacent properties.

Enhanced Control Measures

The following measures will be implemented at construction sites greater than 4 acres in area.

- Hydroseed with native or noninvasive species appropriate to that specific location or apply (nontoxic) soil stabilizers to inactive construction areas (previously graded areas inactive for 10 days or more).
- Limit traffic speeds on unpaved roads to 15 mph.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Replant vegetation with native or noninvasive species appropriate to that specific location in disturbed areas as quickly as possible.

Additional Air Quality Best Management Practices

In addition to the above BMPs, the following measures will be required in order to further reduce construction emissions:

- Maintain properly tuned engines.
- Minimize the idling time of diesel-powered construction equipment to 2 minutes.
- Use alternative-powered (e.g., hybrid, compressed natural gas, biodiesel, electric) construction equipment.
- Use add-on control devices such as diesel oxidation catalysts or particulate filters.
- Require all contractors to use equipment that meets California Air Resources Board's most recent certification standard for off-road heavy-duty diesel engines.

4.1.11. Visual/Aesthetic Best Management Practices

For projects that have the potential to affect views or create a new source of light or glare, project proponents will identify sensitive view receptors for site-specific analysis and ensure that contractors minimize fugitive light from portable sources used for nighttime operations. Also, a visual barrier will be installed to prevent light spill from truck headlights in areas with sensitive view receptors.

4.1.12. Inadvertent Discovery of Cultural Resources

Federal and state laws and regulations outline the courses of action required in the event of inadvertent discoveries of cultural resources, including human remains. Section 106 of the National Historic Preservation Act (NHPA) allows federal agencies to plan for post-Section 106 review, or inadvertent, discoveries of cultural resources prior to authorization of a federal action or undertaking (36 CFR 800.13[a]). One avenue for planning is through a programmatic agreement (PA) (see 36 CFR 800.13[a][2]). Such PAs must define the parties responsible for action in the event of cultural resource discoveries, communication protocols, response times, and specific action items. The cultural resources analysis in the SMP EIS/EIR identifies a PA as a critical element in mitigating significant effects on cultural resources; the PA will include provisions for inadvertent discoveries.

Federal and state laws and regulations impose additional requirements specific to the discovery of human remains and associated artifacts. On federal or tribal land, human remains discoveries are subject to the Native American Grave Protection and Repatriation Act (NAGPRA). Additionally, Reclamation has specific policies for the implementation of the NAGPRA provisions (Reclamation Directives and Standards LND 07-01). For human remains discoveries on non-federal land, the requirements of the California Public Resources Code and Health and Safety Code apply, as described below. In the event that human remains are discovered inadvertently during ground-disturbing activities, the lead state or federal agency will implement the following measures. These measures also will be discussed, with explicit treatment of roles and responsibilities under the various applicable regulations, in the PA referenced previously.

- The contractor immediately will cease work within 100 feet of the find. All construction personnel will leave the area. Vehicles and equipment will be left in place until a qualified archaeologist identifies a safe path out of the area. The on-site supervisor will flag or otherwise mark the location of the find and keep all traffic away from the resource. The on-site supervisor immediately will notify the lead state or federal agency of the find.
- The lead federal agency is responsible for compliance with NAGPRA (43 CFR 10) if inadvertent discovery of Native American remains occurs on federal lands. The lead federal agency is responsible for compliance with state laws relating to the disposition of Native American burials (Public Resources Code [PRC] 5097 and California Health and Safety Code 7050.5[b]) for human remains discoveries on non-federal lands.
- If human remains of Native American origin are discovered during ground-disturbing activities on non-federal land, the lead state or federal agency must comply with state laws relating to the disposition of Native American burials, which fall within the jurisdiction of the Native American Heritage Commission (NAHC) (PRC 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, the lead state or federal agency will not allow further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:
  - the Solano County coroner has been informed and has determined that no investigation of the cause of death is required; and
  - if the remains are of Native American origin,

- the descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in PRC 5097.98; or
- the NAHC was unable to identify a descendant or the descendant failed to make a recommendation within 48 hours after being notified by the NAHC.

- If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work immediately and notify the Corps. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.
- Work is not authorized within 100 feet of archeological site CAL-SOL-13.

4.1.13. Biological Resources Best Management Practices

The following section outlines the potential BMPs that will be implemented to avoid or minimize impacts on biological resources. The BMPs that are implemented for each specific project will depend on the project location, potential to adversely affect biological resources, and guidance and requirements set forth by resource agencies through informal and formal consultations. Environmental commitments, including an erosion and sediment control plan, SWPPP, hazardous materials management plan, spoils disposal plan, and environmental training content will be reviewed by NMFS, USFWS, and DFG 30 days prior to construction activities commencing at a restoration site. Any adverse effects on special-status species, critical habitat, or essential fish habitat (EFH) attributable to construction activities may require implementation of additional avoidance or mitigation measures. NMFS, USFWS, and DFG will be consulted, and additional avoidance and mitigation measures may be implemented on a site-specific basis.

General

- No firearms (except for federal, state, or local law enforcement officers and security personnel) will be permitted at the project site to avoid harassment, killing, or injuring of wildlife.
- No pets will be permitted at the project site to avoid harassment, killing, or injuring of wildlife.
- Native vegetation trimmed or removed on the project site will be stockpiled during work. After construction activities, removal of temporary mats and construction-related materials, and application of native seed mix have been completed, stockpiled native vegetation will be reapplied over temporarily disturbed wetlands to provide temporary soil protection and as a seed source.

- Where vegetation removal is required, work will be conducted using hand-held tools to enable wildlife to escape. If any areas with pickleweed or vegetation within 50 feet of the edge of pickleweed need to be cleared for project activities, vegetation shall be removed only with non-mechanized hand tools (i.e., trowel, hoe, rake, and shovel). No motorized equipment, including weed whackers and lawn mowers, shall be used to remove this vegetation. Vegetation shall be removed under the supervision of a qualified biologist approved by DFG and USFWS. If a mouse of any species is observed within the areas being removed of vegetation, DFG and USFWS shall be notified. Vegetation removal may begin when no mice are observed and shall start at the edge farthest from the salt marsh or the poorest habitat and work its way toward the salt marsh or the better salt marsh habitat. {
- Removal of vegetation in wetland habitat will be conducted with a qualified biological monitor present. This monitor will watch for special-status wildlife species and temporarily stop work if special-status species are encountered. Wildlife will be allowed to escape before work is resumed. Monitors with the appropriate qualifications to handle special-status species will be allowed to move special-status species to safe locations as permitted by their authorizations.
- Temporarily affected wetlands will be restored by removing construction-related debris and trash. Affected areas will be seeded with a seed mix of local native wetland species.

Worker Training

Project proponents will provide training to field management and construction personnel on the importance of protecting environmental resources. Communication efforts and training will take place during preconstruction meetings so that construction personnel 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 impacts on these resources. Materials covered in the training program will include environmental rules and regulations for the specific project and requirements for limiting activities to the construction right-of-way and avoiding demarcated sensitive resources areas. Training seminars will 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.
- Emergency procedures.

If new construction personnel are added to the project, the contractor will ensure the personnel receive the mandatory training before starting work. A representative will be appointed during the employee education program to be the contact for any employee or contractor who might inadvertently kill or injure a listed species or who finds a dead, injured, or entrapped individual. The representative's name and telephone number will be provided to the USFWS before the initiation of ground disturbance.

Special-Status Plant Species Protection

A complete botanical survey of restoration areas will be completed using the USFWS's *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (September 23, 1996) (U.S. Fish and Wildlife Service 1996) and DFG's *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (November 24, 2009) (California Department of Fish and Game 2009) and/or DFG's *Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened, and Endangered Plants and Natural Communities* (May 8, 2000).

- Special-status plant surveys required for project-specific permit compliance will be conducted within 1 year prior to initiating construction. The purpose of these surveys will be to verify the locations of special-status plants identified in previous surveys are extant, identify any new special-status plant occurrences, and cover any portions of the project area not previously identified. 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 global positioning system (GPS) unit and flagged.
- If initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species.
- Access may be restricted around restoration sites where necessary to protect special-status plant populations through appropriate management plans and the design of the tidal marsh restoration. This may include signage, buffers, seasonal restrictions, and design or no access, depending on the sensitive species in question.
- The project proponents will oversee installation of a temporary, plastic mesh–type construction fence (Tensor Polygrid or equivalent) at least 1.2 meters (4 feet) tall around any established buffer areas to prevent encroachment by construction vehicles and personnel. A qualified biologist will determine the exact location of the fencing. The fencing will be strung

tightly on posts set at maximum intervals of 3 meters (10 feet) and will be checked and maintained weekly until all construction is complete. The buffer zone established by the fencing will be marked by a sign stating:

> This is habitat of *[the special-status species being protected]*, a *[identify the species' status]* plant species, and must not be disturbed. This species is protected by *[the Endangered Species Act of 1973, as amended/California Endangered Species Act/California Native Plant Protection Act]*. Violators are subject to prosecution, fines, and imprisonment.

No construction activity, including grading, will be allowed until this condition is satisfied.

- No grading, clearing, storage of equipment or machinery, or other disturbance or activity will occur until all temporary construction fencing has been inspected and approved by the qualified biologist.
- Where feasible, for stump-sprouting vegetation, construction will limit removal of woody vegetation by trimming vegetation to approximately 1 foot above ground level.

Special-Status Wildlife Species Protection

If individuals of listed wildlife species may be present and subject to potential injury or mortality from construction activities, a qualified biologist will conduct a preconstruction survey. Minimum qualifications for the qualified biologist will be a 4-year college degree in biology or related field and 2 years of professional experience in the application of standard survey, capture, and handling methods for the species of concern. However, in the case of fully protected species, no capture or handling will be done. Fully protected wildlife species are listed in Section 6.3, Wildlife. Any special-status mammal, bird, or other species observed during surveys will be reported to DFG so the observations can be added to the California Natural Diversity Database.

Mammals

Only two special-status mammal species occur in the Marsh, SMHM and Suisun shrew. Suisun shrews use habitat similar to SMHM, so any measures implemented to protect SMHM would apply to shrews. The following measures will be implemented:

- A USFWS-approved biologist, with previous SMHM monitoring and surveying experience, will identify suitable salt marsh habitat for the mouse prior to project initiation.
- Disturbance to wetland vegetation (i.e., pickleweed [*Salicornia* spp.]) will be avoided to the extent feasible in order to reduce potential impacts on SMHM habitat. If wetland vegetation (i.e., pickleweed [*Salicornia* spp.]) cannot be avoided, it will be removed by hand (and/or by another USFWS- and DFG-approved method). The USFWS-approved biologist will be on site to monitor all wetland vegetation removal activities.
- The upper 6 inches of soil excavated within SMHM habitat will be stockpiled separately and replaced on top of the backfilled material.

- Vegetation will be removed using hand tools (and/or by another USFWS- and DFG-approved method).
- In construction and staging areas where habitat is to be disturbed, vegetation must be cleared to bare ground or stubble no higher than 1 inch.
- Work will be scheduled to avoid extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge) when there is potential for SMHM to move to higher, drier grounds. All equipment will be staged on existing roadways away from the project site when not in use.
- To prevent SMHM from moving through the project site during construction, temporary exclusion fencing will be placed around a defined work area before construction activities start and immediately after vegetation removal. The fence should be made of a material that does not allow SMHM to pass through or over, and the bottom should be buried to a depth of 2 inches so that mice cannot crawl under the fence. Any supports for the SMHM exclusion fencing must be placed on the inside of the project area.
- Prior to the start of daily construction activities during initial ground disturbance, the USFWS-approved biological monitor will inspect the SMHM-proof boundary fence to ensure that it has no holes or rips and the base is still buried. The fenced area also will be inspected to ensure that no mice are trapped in it. Any mice found along and outside the fence will be closely monitored until they move away from the construction area.
- If a SMHM is discovered, construction activities will cease in the immediate vicinity of the individual until DFG and USFWS are contacted and the individual has been allowed to leave the construction area.
- A DFG- and USFWS-approved biologist with previous SMHM experience will be on site during construction activities occurring in wetlands. The biologist will document compliance with the project permit conditions and avoidance and conservation measures. The biologist has the authority to stop project activities if any of the requirements associated with these measures is not being fulfilled. If the biologist has requested work stoppage because of take of any of the listed species, the USFWS and DFG will be notified within 1 day by email or telephone.

Birds

The project proponents 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 if activities would occur during active nesting periods. Bird species using the managed wetland habitat include waterfowl, shorebirds, Suisun song sparrow, Suisun common yellowthroat, and several other resident and migratory songbirds.

- The project proponents will remove all woody and herbaceous vegetation from construction areas (earthwork areas) during the nonbreeding season (September 1–February 1) to minimize effects on nesting birds.

- During the breeding season, all vegetation subject to impact will be maintained to a height of approximately 6 inches to minimize the potential for 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, the project proponents will develop appropriate measures and coordinate with DFG to determine an acceptable buffer width.
- Inactive migratory bird nests (excluding raptors) located outside the construction areas will be preserved. If an inactive migratory bird nest is located in the area of effect, it will be removed before the start of the breeding season (approximately February 1).
- Impacts on great blue heron rookeries will be avoided; mature trees will not be removed, and nearby work will occur outside the nesting season.

Raptors

- Preconstruction surveys will be performed before and during the raptor nesting season (bimonthly, i.e., two times per month) to identify existing nests that may be used during the nesting season.
- Raptors may nest from later winter through mid-summer; therefore, multiple nesting season surveys will performed.
- DFG will be notified of all raptor nests located during the preconstruction surveys. If a raptor nest is located within the recommended buffer, the project proponents will coordinate with DFG to determine an acceptable buffer width.
- If an active raptor nest is found outside the construction areas, a buffer zone will be created around the nest tree. For special-status species, a larger buffer will be required (e.g., 0.5-mile Swainson's hawk buffer). The project proponents will coordinate with DFG prior to project implementation to determine the species-specific buffer widths.

California Clapper Rail and California Black Rail

If construction activities are necessary during the breeding season, preconstruction surveys for California clapper rail and black rail will be conducted at and adjacent to areas of potential tidal and managed wetlands habitat for California clapper rail and black rail. The surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. Survey methods will follow the protocols used by DFG during previous rail surveys in Suisun Marsh (California Department of Fish and Game 2007). The specific project proponent will implement the following survey protocols.

- Surveys should be initiated sometime between January 15 and February 1. A minimum of four surveys should be conducted. The survey dates should be spaced at least 2 to 3 weeks apart and should cover the time period from the date of the first survey through the end of March or mid-April. This will allow the surveys to encompass the time period when the highest frequency of calls is likely to occur.

- Listening stations will be established at 150-meter intervals along roads, trails, and levees that will be affected by plan implementation.
- California clapper rail and California black rail vocalization recordings will be played at each station.
- For California clapper rails, each listening station will be occupied for a period of 10 minutes, followed by 1 minute of playing California clapper rail vocalization recordings, then followed by an additional minute of listening.
- For black rails, each listening station will be occupied for 1 minute of passive listening, 1 minute of "grr" calls followed by 30 seconds of "ki-ki-krrr" calls, then followed by another 3.5 minutes or passive listening.
- Surveys will be conducted at sunrise and sunset.
- Sunrise surveys will begin 60 minutes before sunrise and conclude 75 minutes after sunrise (or until presence is detected).
- Sunset surveys will begin 75 minutes before sunset and conclude 60 minutes after sunset (or until presence is detected).
- Surveys will not be conducted when tides are greater than 4.5 National Geodetic Vertical Datum (NGVD) or when sloughs and marshes are more than bankfull.
- California clapper rail and California black rail vocalizations will be recorded. A GPS receiver will be used to identify call location and distance. The call type, location, distance, and time will be recorded on a data sheet.

If California clapper rail or black rail is present in the immediate construction area, the following measures will apply during construction activities.

- To avoid (or minimize) the loss of individual California clapper rails or black rails, activities within or adjacent to California clapper rail or black rail habitat will not occur within 2 hours before or after extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge), when the marsh plain is inundated, because protective cover for California clapper rails is limited and activities could prevent them from reaching available cover.
- To avoid (or minimize) the loss of individual California clapper rails or black rails, activities within or adjacent to tidal marsh areas will be avoided during the California clapper rail breeding season from February 1 through August 31 each year unless surveys are conducted to determine California clapper rail locations and California clapper rail and black rail territories can be avoided. Figure 3 shows the areas of known clapper rail breeding habitat.
- If breeding California clapper rails or black rails are determined to be present, activities will not occur within 700 feet of an identified calling center. If the intervening distance across a major slough channel or across a substantial barrier between the California clapper rail calling center and any

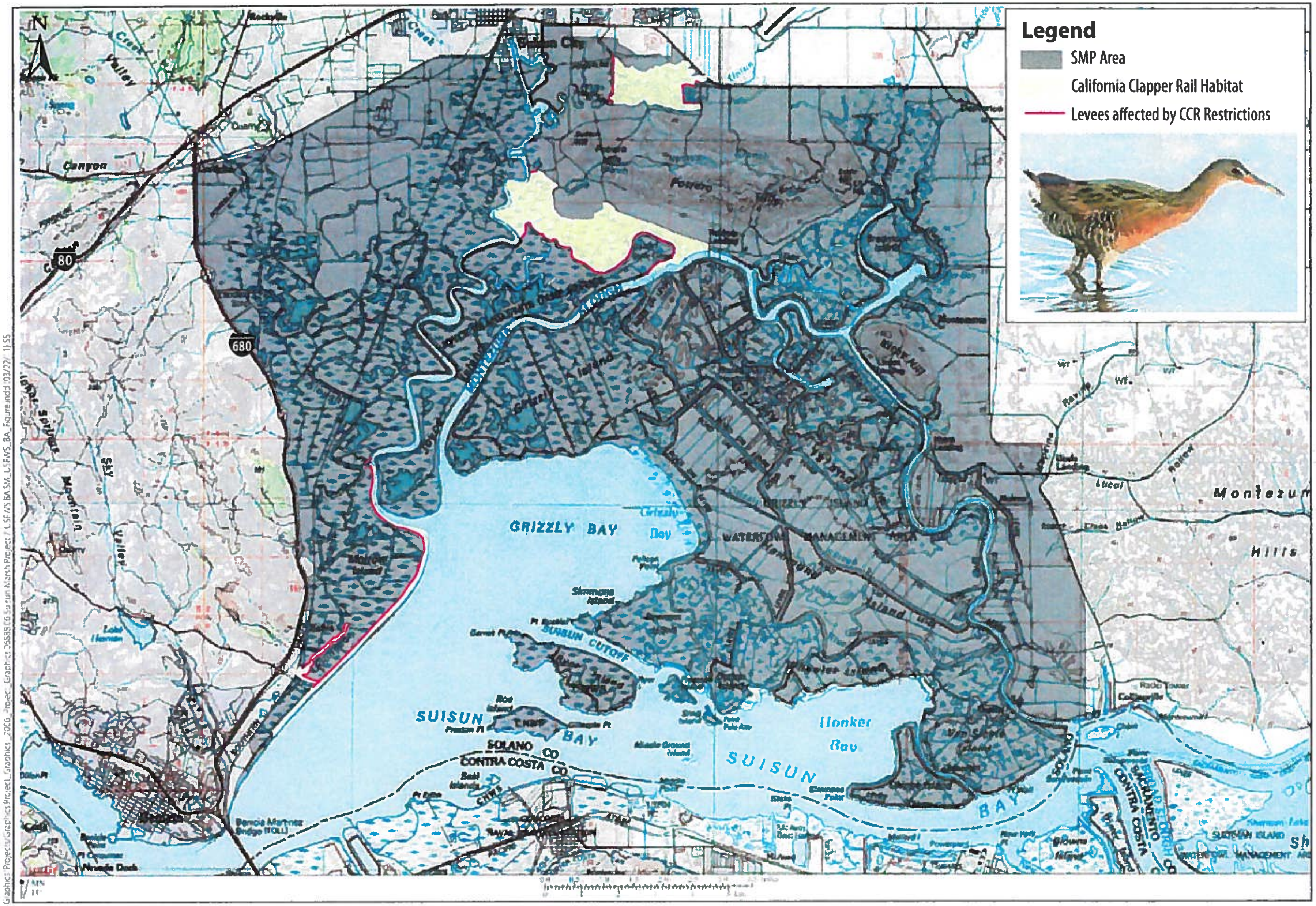


Figure 3
California Clapper Rail Habitat in Suisun Marsh

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activity area is greater than 200 feet, it may proceed at that location within the breeding season.

- *Exception:* Only inspection, maintenance, research, or monitoring activities may be performed during the California clapper rail or black rail breeding season in areas within or adjacent to California clapper rail breeding habitat with approval of the USFWS and DFG under the supervision of a qualified biologist.

California Least Tern

- No activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, April 15 to August 15 (or as determined through surveys).
- *Exception:* Only inspection, maintenance, research, or monitoring activities may be performed during the least tern breeding season in areas within or adjacent to least tern breeding habitat with approval of the USFWS and DFG under the supervision of a qualified biologist.

Biological Monitoring

- The project proponents will provide a 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 1602 and/or 2050; project plans [SWPPP]; and EIS/EIR mitigation measures).
- The biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to each construction site based on mapping of existing land cover types and special-status plant species. If such maps are not available, the biologist/environmental monitor will map and quantify the land cover types and special-status plant populations in the proposed project footprint prior to construction.
- To avoid construction-phase disturbance to sensitive habitats immediately adjacent to the project area, the monitor will identify the boundaries of sensitive habitats and add at least a 100-foot buffer, where feasible, using orange construction barrier fencing. The fencing will be mapped on the project designs. 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 sediment off site. The sensitive habitat and erosion-control fencing will be installed before any construction activities begin and will be maintained throughout the construction period.
- The biologist/environmental monitor will ensure the avoidance of all sensitive habitat areas outside direct project footprints, including patches of tidal wetland along channel banks, during dredging operations, to the extent practical.
- Plants for revegetation will come primarily from natural recruitment. Plants imported to the restoration areas will come from local stock, and to the extent

possible, local nurseries. Only native plants will be used for restoration efforts.

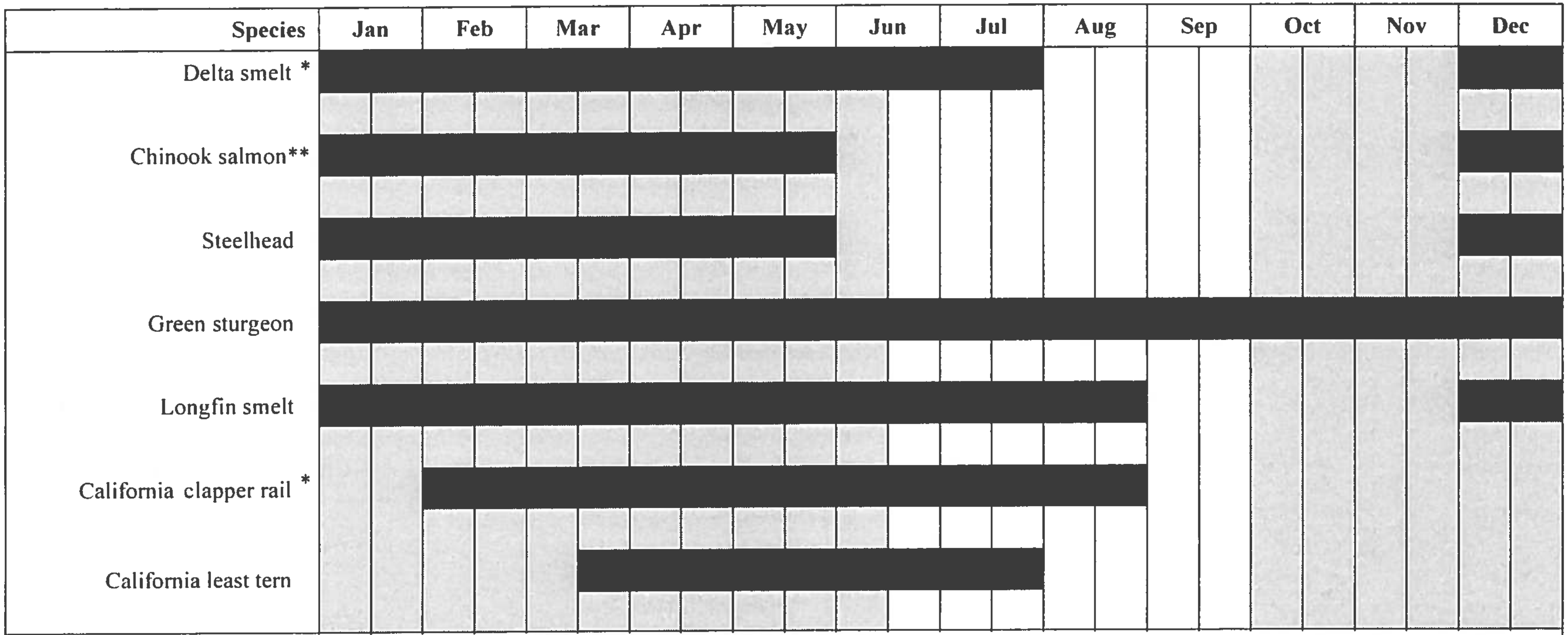
Construction Period Restrictions

Timing of restoration construction activities will depend on the type of activity, presence or absence of sensitive resources, tides, and/or water management in wetlands. In general, landside work will occur between July and September. In-water activities will be conducted during the months of August through November (Figure 4). Working outside this window will require additional approvals from the resource agencies. Other timing restrictions may be necessary during the hunting season, such as limiting work to days other than Saturday, Sunday, and Wednesday.

4.1.14. Nonnative Plant Control

The project proponents will include the following measures in the project construction specifications to minimize the potential for the introduction of new noxious weeds and the spread of weeds previously documented in the project area.

- Use certified, weed-free, imported erosion control materials (or rice straw in upland areas).
- Coordinate with the county agricultural commissioner and land management agencies to ensure that the appropriate BMPs are implemented.
- Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weeds.
- Clean equipment at designated wash stations after leaving noxious weed infestation areas.
- Treat isolated infestations of 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.
- Use certified weed-free native mixes for any restoration planting or seeding as may be necessary, 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.



Notes:

* Delta smelt and California clapper rail are present year-round in the marsh. Black represents periods of species sensitivity to construction activities.

** Chinook salmon includes spring-, winter-, fall-, and late fall–run species.

Species presence and/or period of sensitivity

Permissible time period for construction

No construction activities can occur

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Figure 4
Work Activity Windows for Sensitive Species

4.2. Managed Wetland Activities Environmental Commitments

The SMPA agencies and private landowners have been maintaining property and/or facilities in the Marsh for more than 3 decades and have operated in compliance with existing BOs from USFWS and NMFS. Implementation of the SMP will include continuation of monitoring, fish screening, and other ongoing requirements and programs. Implementation of the SMP will include submitting biological assessments to USFWS and NMFS. Terms and conditions of the revised BOs will be followed. Any adverse effects on special-status species, critical habitat, or essential fish habitat (EFH) will be addressed by the project proponent, and any additional measures will be followed in compliance with California Endangered Species Act, ESA, and EFH authorizations.

4.2.1. Standard Design Features and Construction Practices

- When possible, drain pipes will be relocated to drain into larger receiving sloughs with good tidal circulation to avoid and minimize the degradation of water quality in receiving waters.
- All new and/or replacement drain pipes will be located on the largest possible sloughs, or sloughs with the highest levels of tidal circulation possible, to minimize or lessen the possibility of degraded water quality conditions.
- Management options, including vegetation management and diversion timing and location, will be pursued to avoid and minimize occurrence of low-DO water conditions in managed wetlands.
- New exterior drain structures will be installed where the discharge channel already exists. The new drain will not be placed on emergent vegetation. The pipe will be installed at low tide. No in-water work is authorized.
- Landowners importing any material besides rock material from outside the Suisun Marsh must contact the Regional Water Board before importation. Landowners must obtain the Regional Water Board's concurrence that the imported material is acceptable before use.
- Material excavated from existing spreader ditches and creation of new spreader ditches may be sidecast adjacent to the ditch. Excavated material will be no more than 12 inches in height.
- Exterior pipes will be placed below the depth of emergent vegetation.
- Pipe replacement as well as repair, replacement, or installation of exterior water control structures will not change the existing use or diversion capacity.
- All pipes will be pre-assembled before installation to minimize work time.

- All material will remain on the crown or interior side of the levee during the repair of exterior existing levees, the coring of existing exterior levees, and the installation of drain pumps and platforms.
- All bulkheads will be in place prior to backfilling the bulkhead during installation, repair, or re-installation of water control structures.
- Installation of drain pumps and platforms will be done entirely within the managed wetland; although discharge pipes will comply with permit terms and conditions for exterior discharge pipe installation.
- All work to be performed on the exterior side of levees will commence and be completed within a 6-hour period, from 3 hours prior to low tide to 3 hours after low tide.
- Construction equipment used for projects will be checked each day prior to work and, if necessary, action will be taken to prevent fluid leaks. If leaks occur during work, the Corps, its permittee, or the contractor will contain the spill and remove the affected soils.
- All contractors must have a supply of erosion and pollution control materials on site to facilitate a quick response to unanticipated storm events or emergencies.
- No in-water work will occur during the repair of existing exterior levees; the coring of existing levees; pipe replacement at the exterior flood or dual-purpose gate; pipe replacement at the existing exterior drain gate; installation, repair, or re-installation of water control bulkheads; installation of drain pumps and platforms; or installation of new exterior drain structures.
- Emergent vegetation will not be disturbed during the following activities: repair of existing exterior levees, replacement of existing riprap on exterior levee, or installation of the new exterior drain structure.
- No fresh concrete, cement, silts, clay, soil, or other materials will be discharged to Marsh waters.

4.2.2. Reporting Requirements

Proposed work reports must be submitted to the Corps, NMFS, State Lands Commission, and Regional Water Board by the first day of each month. When the first day falls on a weekend, the report will be due the following Monday.

The SRCD will prepare an annual report that summarizes the amounts and locations of activities performed. This report will be submitted to the Corps, EPA, NMFS, USFWS, State Lands Commission, and the Regional Water Board. This report must include an estimate regarding temporarily affected wetlands and describe any additional minimization methods (i.e., replacing a metal pipe with HDPE pipe to lessen future maintenance needs).

The Corps and applicant will provide a written annual report to NMFS by December 31 of each year. The report will be submitted to the NMFS Santa

Rosa Area Office, Attention: Supervisor of Protected Resources Division, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404-6528. The report will contain, at a minimum, the following information.

i. **Project-related activities**—The report will include the type, size, and location of specific actions (on exterior pipe replacement and installation and riprap placement) undertaken; dates when specific actions began and were completed; a description of BMPs implemented to minimize project effects; photographs taken before, during, and after the activity from photo reference points; and a discussion of specific project performance or efficacy.

ii. **Unanticipated project effects**—The report will include a discussion of any unanticipated project effects or unanticipated levels of project effects on salmonids, green sturgeon, and/or critical habitat and a description of any and all measures taken to minimize those unanticipated effects as well as a statement regarding whether the unanticipated effects had any effect on ESA-listed fish or critical habitat.

iii. **Gate closures and diversion curtailment**—The report will summarize compliance monitoring for gate closures and diversion curtailments.

iv. **Observations of salmonids and green sturgeon**—The report will document observations of any salmonids or green sturgeon occurring in the action area during project actions.

A summary of the results of water quality monitoring or evaluation of the wetland management operational modifications used is no longer required. This information was previously provided by SRCD and DFG in 2008, 2009, and 2010 to NMFS.

4.2.3. Riprap

Riprap replacement may occur in the minimum amount necessary on the slopes of interior ditches where rock has been washed away and on exterior levees where rock has been washed away or subsided.

- Riprap will not be placed directly on emergent vegetation (e.g., tules, *Scirpus* spp.).
- Emergent vegetation will not be uprooted during the placement of riprap, nor will it be displaced by riprap.
- Riprap placement on the exterior side of the levee will commence and be complete within a 6-hour period, from 3 hours prior to low tide to 3 hours following low tide.

4.2.4. Dredging Practices

Dredging has the potential to result in adverse environmental effects if it leads to the release of fine-grained sediments or increasing turbidity, or if it remobilizes contaminated materials. The following preliminary environmental commitments will be implemented as part of the proposed dredging program to avoid and/or minimize effects on aquatic resources in Suisun Marsh.

- All construction facilities and working platforms required for dredging operations will maintain an operating environment free of fuel spills.
- Runoff generated on the job site will be controlled.
- Dredging activities will occur only between August 1 and November 30.
- Removal of emergent vegetation will be avoided where feasible, although areas of vegetation may need to be disturbed during construction to provide site access, adequate volume of material for construction, and proper water flow at the site. Any unavoidable loss of emergent tidal vegetation from dredging activities in bays, major sloughs, minor sloughs, and dredger cuts will be compensated for by implementing tidal wetland restoration at a 3:1 ratio or 2:1 if restoration is done in advance of the loss.
- Dredging will be avoided within 200 feet of storm drain outfall and urban discharge locations, unless suitable preconstruction contaminant testing is conducted (coordination and consulting with the Dredged Material Management Office (DMMO) relative to evaluation and placement of the materials).
- A berm will be constructed on the channel side of the levee crown to prevent runoff into adjacent aquatic habitats.
- Releases of discharge water from managed wetlands will be limited following dredged material placement.
- The extent of dredging disturbance will be limited based on slough channel habitat classification and plan region as identified in Tables 4 and 5.
- Alternate boating routes will be identified if dredging impedes navigation.

4.2.5. Biological Resources Best Management Practices

Below are environmental commitments for special-status plants, birds, and fish. Any suspected take of listed species will be reported immediately to DFG and the SRCD, who will immediately contact USFWS or NMFS. Any carcasses of listed fish will be frozen in a whirl-pak bag and retained until instructions are received from the applicable agency.

Biological Monitoring

The project proponents will monitor implementation of environmental commitments pertaining to dredging, riprap placement, or work on the water side of exterior levees that removes vegetation and will provide a biologist/ environmental monitor who will be responsible for monitoring implementation of the conditions of any state and federal permits (CWA Sections 401, 402, and

404; ESA Section 7; Fish and Game Code Section 1602 and/or 2050; project plans [SWPPP]; and EIS/EIR mitigation measures).

Plants

An on-site field inspection for special-status plants will be conducted by a USFWS-approved biologist for managed wetlands activities on the water side of exterior levees. This includes all water control structure replacement and riprap placement, except when a headwall is present; installation of exterior water control structures; alternative bank protection placement; and dredging and other facility maintenance activities that remove vegetation. Special-status plants include:

- soft bird's beak (*Cordylanthus mollis* ssp. *mollis*)
- salt marsh bird's beak (*C. maritimus* ssp. *maritimus*)
- hispid bird's beak (*C. mollis* ssp. *hispidus*)
- Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*)
- Mason's lilaeopisis (*Lilaeopsis masonii*)
- Suisun thistle (*Cirsium hydrophilum* var. *hyrdophilum*)
- Suisun Marsh aster (*Aster lentus*)
- alkali milk-vetch (*Astragalus tener*)
- heartscale (*Atriplex cordulata*)
- brittlescale (*Atriplex depressa*)
- valley spearscale (*Atriplex joaquiniana*)

If a special-status plant is found during a survey, it will be avoided, and a map showing the location of the plant will be provided to DFG, the Corps, and USFWS no later than 7 calendar days after the survey is completed. If a special-status plant cannot be avoided during the proposed work and it is not listed as threatened or endangered, the plant will be carefully transplanted to the nearest suitable habitat provided this action and the proposed transplantation site are determined by DFG to be adequate to offset any impact. If approved by DFG, a qualified representative of SRCD or DFG may conduct the transplantation. If DFG does not determine that transplantation will offset the impact, a restoration plan will be prepared and implemented, after DFG approval, that will be able to ensure that impacts on the plant population are offset. This determination by DFG will include an assessment of species distribution, the abundance in the Marsh, and the level of proposed impact.

If a federally listed threatened or endangered plant is found that cannot be avoided during the proposed work, the qualified representative of SRCD or DFG will notify the Corps immediately so it can consult with the USFWS. If determined necessary by USFWS and if a federally listed plant cannot be avoided during the proposed work, the plant will be carefully transplanted to the nearest suitable habitat provided this action and the proposed transplantation site are determined by USFWS to be adequate to offset any impact. If approved by USFWS, a qualified representative of SRCD or DFG may conduct the transplantation. If USFWS does not determine that transplantation will offset the impact, a restoration plan will be prepared and implemented, after USFWS approval, that will be able to ensure that impacts on the plant population are offset. This determination by USFWS will include an assessment of species distribution, abundance in the Marsh, and the level of proposed impact.

Birds

- Limit work in California clapper rail habitat between February 1 and August 31 unless surveys indicate that California clapper rail is not present. Figure 3 depicts the areas of habitat to be avoided during this time.
- Impacts on great blue heron and egret rookeries will be avoided and minimized by removing mature trees only outside the nesting season and maintaining a 500-foot buffer between roost sites and managed wetland activities during the nesting season.
- Managed wetland activities in the vicinity of active raptor nests will not be implemented during breeding season.

Fish

- To minimize entrainment losses of fish throughout the Marsh, water control structures will be consolidated and/or equipped with state-of-the-art fish screens when practicable and as funding allows. Intakes that present the highest risk of entrainment to salmonid smolts will be given the highest priority, including intakes located on Montezuma, Suisun, and Cordelia Sloughs.
- Any new or enlarged exterior water intakes and/or control structures will be screened in accordance with DFG's criteria unless DFG and the Corps determine that the structure would not adversely affect any listed species and the Corps obtains concurrence for any federally listed species with that determination from NMFS and/or USFWS as applicable.
- Water control structures will be installed or replaced only during low tides (within a 6-hour period, from 3 hours prior to low tide to 3 hours following low tide) when there is the least chance of affecting fish.
- SRCD and DFG will continue to identify and prioritize placement of water control structures that require fish screens in consultation with the Corps, NMFS, and the USFWS. The SRCD and DFG will seek funding to install screens at the highest-priority sites.
- Water control structures will be operated to minimize impacts on listed fish, taking into consideration seasonal timing and water quality (e.g., structures may be installed or replaced during low tides (within a 6-hour period, from 3

hours prior to low tide to 3 hours following low tide) when there is the least chance of affecting fish).

- All in-water work will be done by hand and during low tide (within a 6-hour period, from 3 hours prior to low tide to 3 hours following low tide) as part of the following activities: repair, replacement, or installation of exterior water control structures; pipe replacement at the exterior flood or dual-purpose gate; pipe replacement at the existing exterior drain gate; and installation of the new exterior drain structure.
- All levee repairs and pipe replacements will be restricted to the dry season and not done in the rain.
- Repairs of existing exterior levees, to stop the flow of tidal waters entering into the managed wetlands, will be completed within 7 days of the breach for coverage under the RGP/SMP.
- Fish screens will be installed on any new or enlarged water control structures.
- No more than 1,000 square feet of wetlands per year throughout the Marsh will be filled during installation of fish screens.
- A biologist or on-site monitor will evaluate each site during project implementation of exterior pipe replacement or riprap placement on exterior levees to document project actions for the purpose of identifying any condition that could adversely affect salmonids, green sturgeon, or their habitat. Whenever conditions are identified that could adversely affect salmonids, green sturgeon, or their habitat in a manner not described in the opinion, Reclamation, USFWS, the Corps, its permittee, or the contractor will notify a NMFS biologist immediately.
- If Reclamation, USFWS, the Corps, its permittee, or the contractor identifies a project-related condition that could adversely affect salmonids, green sturgeon, or their habitat in a manner not anticipated, the Corps, its permittee, or the contractor will be responsible for rectifying such changes in a timely manner.
- If the managed wetlands are subject to uncontrolled tidal flow, dewatering of the managed wetland area will be conducted through the use of existing gravity tidal drainage gates as much as possible. DFG will be consulted to determine whether fish salvage efforts are needed prior to completely dewatering the site.

Water Diversion Restrictions

- SRCD will notify DFG, NMFS, and the Corps of the starting and closing dates of duck hunting season annually at least 1 month prior to the start of the season. Landowners diverting water from sloughs designated by NMFS (Montezuma Slough and its tributaries, lower Nurse Slough [from the confluence with Denverton Slough to Montezuma], Denverton Slough; Cuttoff Slough [including Spring Branch Slough, first and second Mallard Branch Slough]; Suisun Slough, [from downstream of the confluence with Boynton Slough to Grizzly Bay; and Chipps Island]) will use no more than

25% of the water control structure's diversion capacity from November 1 to the last day of duck hunting season. These landowners are prohibited from diverting water from designated sloughs from February 21 to March 31. The purpose of these diversion restrictions is to protect migrating salmonids. Table 7 describes the diversion restrictions.

Table 7. Inches of Water Discharged through Pipe for Salmonid Restriction

Diameter of Pipe (inches)	25% Open (inches)
12	3
18	4
24	6
30	7
36	9
48	12

- Landowners diverting water from sloughs designated by NMFS (i.e., Montezuma Slough and its tributaries, lower Nurse Slough [from the confluence with Denverton Slough to Montezuma], Denverton Slough; Cuttoff Slough [including Spring Branch Slough, first and second Mallard Branch Slough]; Suisun Slough, [from downstream of the confluence with Boynton Slough to Grizzly Bay; and Chipps Island]) will use only 35% of the water control structure's intake capacity between April 1 and May 31. If, during this time, two out of the three DFG 20-millimeter trawl surveys sites (sites 606, 609, and 610) predict delta smelt densities greater than 20 delta smelt individuals per 10,000 cubic meters over a 2-week sampling period, all diversions from these sloughs will use only 20% of the water control structure's intake capacity. Survey trawls will take place at least once every 14 days between April 1 and May 31. Table 8 below determines delta smelt diversion restrictions.

Table 8. Inches of Water Discharging through Pipe for Delta Smelt Restriction

Diameter of Pipe (inches)	20% Open (inches)	35% Open (inches)
12	3	5
18	4	7
24	5	8.5
30	6	10.5
36	7	13
48	8	17

- While diversion restrictions are in place, SRCD and DFG will monitor gate closures. If an open gate is observed, they will immediately contact the landowner, and the gates will be brought into compliance (i.e., closed).

4.2.6. Construction Period Restrictions

Timing of construction activities will depend on the type of activity, presence or absence of sensitive resources, tides, and/or water management in wetlands. In general, in-water work associated with exterior levee activities will occur between August 1 and November 30, which avoids most of the special-status fish species. Additionally, most of the managed wetland activities are expected to be implemented from June to September when the wetlands are dry enough to conduct these activities (Figure 4). Activities may be conducted during other times of the year, depending on the potentially affected species for each site-specific case. Activities occurring during the hunting season will not occur on Saturday, Sunday, or Wednesday when such activities have a reasonable possibility of disrupting access to hunting or represent a safety concern. Furthermore, construction will not occur during major summer holiday periods, and adequate warnings signs, postings, and/or notices will be provided upstream and downstream of all construction equipment, sites, and activities to warn recreational boaters. Finally, signs describing alternate boating routes will be posted when construction activities limit and/or restrict boating access.

4.2.7. Hazardous Materials Management Plan

A hazardous materials spill plan will be developed for the managed wetland activities. The plan will describe the actions that will be taken in the event of a spill. The plan also will incorporate preventive measures to be implemented (such as vehicle and equipment staging, cleaning, maintenance, and refueling) and contaminant (including fuel) management and storage. In the event of a contaminant spill, work at the site immediately will cease until the contractor has contained and mitigated the spill. The contractor immediately will prevent further contamination, notify appropriate authorities, and mitigate damage as appropriate. Adequate spill containment materials, such as oil diapers and hydrocarbon cleanup kits, will be available on site at all times.

4.2.8. Cultural Resources

- If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work immediately and notify the Corps. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.
- Work is not authorized within 100 feet of archeological site CAL-SOL-13.

5. Plan Implementation Strategy

The SMP is predicated on the assumption that each Principal Agency will implement or approve activities in the Marsh consistent with the SMP and its own mission and jurisdictional authority. The primary components of the strategy are to:

- Implement the environmental commitments and mitigation measures in the SMP EIS/EIR and other required state and federal permit measures to ensure that resources are protected and that restoration and managed wetland goals are met simultaneously.
- Implement adaptive management to ensure impacts described in the SMP EIS/EIR are not exceeded and to improve the ecological effectiveness of restoration over the period of implementation of the SMP.
- Prepare annual reports on the status of SMP restoration and managed wetland activities.

5.1. Meeting Restoration and Managed Wetland Goals Simultaneously

The SMP will contribute to recovery of many species in the Marsh. Based on the analysis in the SMP EIS/EIR, implementation of the SMP restoration and managed wetland activities and environmental commitments will provide sufficient tidal restoration and resource protection of fish and wildlife resources to both offset potential impacts on those resources and contribute to recovery of listed species. As such, both restoration and managed wetland activities will proceed simultaneously, and implementation will be planned to carefully monitor and mitigate the effects of SMP activities.

The managed wetland activities will be implemented only if at least one third of the total restoration activities will be implemented in each of the 10-year increments. Therefore, it is expected that, for example, 1,600–2,300 acres in the Marsh will be restored by year 10, an additional 1,600–2,300 acres will be restored by year 20, and the full 5,000–7,000 acres will be restored by year 30. This will ensure that all actions will be implemented in a timeframe similar to that of the impacts and that restoration efforts will contribute toward recovery throughout the plan implementation period. If these 10-year incremental SMP restoration goals are met, both the managed wetland activities and tidal restoration will continue to ensure that the SMP goals will be met. Options for addressing conditions in which these incremental goals are not met are described below. Under this strategy, the restoration and managed wetland goals will be achieved concurrently. How the restoration acres will be applied for purposes of other regulatory permitting requirements (i.e., recovery vs. mitigation) will be specified through each permit as applicable.

5.2. Project-Specific Implementation

The SMP likely will rely on several restoration actions to meet the restoration goals. Some sites have been identified as available for restoration (e.g., Hill Slough), and other properties that have the characteristics desired for restoration are anticipated to become available for purchase (see Table 1). The SMP attempts to describe a typical restoration action in an effort to fully describe the potential impacts of the restoration element of the SMP because the SMP EIS/EIR is intended to provide as much environmental analysis as possible with the limited site-specific information relative to the 30-year plan implementation. In some site-specific instances, the project proponent will be able to rely solely on the SMP EIS/EIR for the California Environmental Quality Act (CEQA) and/or National Environmental Policy Act (NEPA) compliance, and under other circumstances, the SMP EIS/EIR may be tiered from or supplemented to disclose all potential environmental impacts. The approach for each restoration action will be determined by the specific lead agencies and will be based on the SMP EIS/EIR, project-specific design components, consideration of any new information (including that obtained through implementation of the Adaptive Management Plan [AMP]), or other factors.

The managed wetland activities will be implemented by the SMPA Agencies, including SRCD, which represents private landowners and reclamation districts in the Marsh, as described for each activity, and this EIS/EIR discloses all resulting potential impacts. As such, additional CEQA and/or NEPA documentation is not expected to be required over the 30-year plan implementation period for the management activities.

5.3. Adaptive Management

Adaptive management is essential to keeping the SMP on track toward its objectives, while avoiding and minimizing potential impacts associated with the implementation of SMP actions. The adaptive management process will use data from monitoring the effectiveness of implemented actions, research addressing uncertainties associated with the plan, and other information to inform changes to plan implementation. The adaptive management process will permit changes to be made that will assist in the design of future steps. It also will assist project proponents in understanding the restored system and will aid their ability to explain management actions to Marsh neighbors and the general public. Figure 5 depicts a diagram of the adaptive management process.

Restoration practitioners have found that, because knowledge of natural and social systems is incomplete, systems will respond in unexpected ways. Surprises are also inherent in restoration because nature is variable and unpredictable, especially at large spatial scales and over long timeframes. Adaptive management allows project proponents, Suisun Adaptive Management Advisory Team (AMAT) or the Charter Principals Group to prepare for and respond to events, ranging from unexpected changes in habitat to vandalism. When and where such events occur may not be predictable, but part of the adaptive approach is to anticipate the range of events and system responses that might occur and develop a process for dealing with them when they happen. Monitoring and adaptive management can help prevent unintended consequences of implementing actions under the SMP or, when they occur, can avoid unnecessary recurrence, help to minimize any negative impacts, and address issues before they become substantial.

The AMP (Appendix A) was prepared in accordance with the Department of Interior *Adaptive Management Technical Guide* (Williams et al. 2009) and uses the concepts of passive and active adaptive management. Through passive adaptive management, the Suisun Marsh Charter Principals Group will learn how to ensure better attainment of the SMP's objectives based on the measured success of previous actions (as indicated by effectiveness monitoring results). The SMP also will take an active adaptive management approach by encouraging project proponents to identify uncertainties applicable to their specific projects and carry out targeted studies to resolve uncertainties related to the best approaches for achieving project-specific objectives. Project proponents could design and implement experimental pilot projects to test the relative efficacy of several approaches for attaining an objective and evaluate different monitoring techniques.

The Sacramento–San Joaquin Delta Reform Act of 2009 (Act) created the Delta Stewardship Council (DSC), disbanded the CBDA, and transferred CBDA's CALFED responsibilities to the DSC. Therefore, the coordination that occurred among the Principal Agencies and CBDA staff during preparation of the SMP will be transferred to coordination with DSC staff. As the DSC generally is recognized as a clearinghouse of scientific information related to Delta planning efforts in support of the goal of improving water supply reliability and ecosystem functions, tidal restoration planning efforts during implementation of the SMP will include coordination with DSC staff.

While tidal restoration project planning and design rely ultimately on the project proponents for each project, the AMAT will provide a network of technical staff from the Principal Agencies and other agencies involved in Suisun Marsh planning issues, including the DSC, as appropriate. The SMP's adaptive management approach will involve stakeholders, including the DSC, and include periodic independent science review of SMP implementation by the Delta Science Program. An MOU among the AMAT agencies will be pursued defining the roles and responsibilities of the members with respect to achieving the SMP objectives and implementing adaptive management. The AMAT will make recommendations to the Suisun Principal Agencies as appropriate.

The SMP will occur over a 30-year implementation horizon. The SMP's adaptive management approach will allow project proponents, AMAT, or the Charter Principals Group to learn from their actions and will:

- Generate science-based information for project proponents.
- Convert information into effective management decisions.

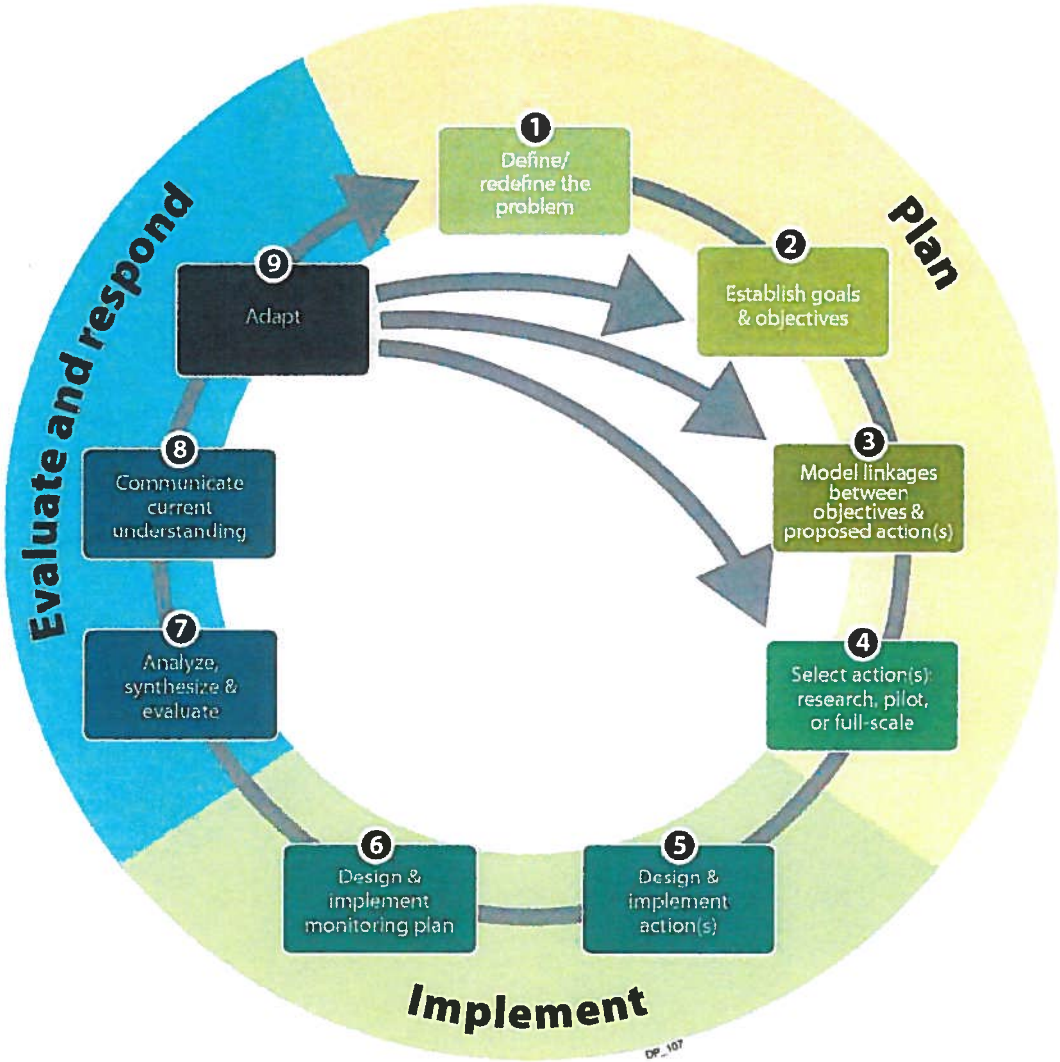

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Figure 5
Adaptive Management Process

- Involve stakeholders, including the DSC, to help provide management direction.
- Store and organize information for use by current and future decision-makers and stakeholders.
- Include periodic independence science review of plan implementation and advice using the Delta Science Program.

5.3.1. Adaptive Management Approach

Project implementation will be guided by the best available information but will be monitored and implemented with the goal of increasing understanding about the science of restoration. The opportunities for restoration and research are unknown because of the inability to predict where restoration projects will occur. As described above, the SMP is consistent with the Recovery Plan in splitting restorable acreage into specific regions in order to provide a range of environmental gradients necessary to contribute to the recovery of multiple listed species. Implementation of the SMP Mitigation Monitoring and Reporting Program (Appendix B) will inform adaptive management decision-making and tidal restoration planning efforts.

This adaptive management approach is designed to assist in achieving the SMP objectives by providing a guided approach to learning from restoration, research, monitoring and management actions, and actions that have uncertainties. Results of effectiveness monitoring may indicate that some restoration and management measures are less effective than anticipated. To address these uncertainties, the monitoring and adaptive management program will:

- Ensure impacts on benthic communities from dredging activities described and analyzed in the SMP EIS/EIR are not exceeded.
- Gage the effectiveness of restoration projects and techniques to implement SMP objectives.
- Track project-specific targets to ensure restoration benefits listed species.
- Propose alternative or modified measures as the need arises consistent with available funding.
- Be used to improve future restoration designs to achieve desired physical and ecological results.

As such, potential monitoring associated with adaptive management falls into two categories. The first category is monitoring required to ensure impacts analyzed in the EIS/EIR are not exceeded. This will be accomplished by benthic community recovery monitoring during implementation of the dredging program as described in Chapter 2 of the SMP EIS/EIR. Benthic monitoring will be implemented by the SRCD and DFG in accordance with the requirements of the USFWS and NMFS BOs on the effects of the SMP.

The other potential category of monitoring that will occur under the SMP will be based on key uncertainties and will be considered for implementation as applicable for each tidal restoration project to assess project outcomes. Currently, monitoring in the Suisun Marsh is being carried out by a number of agencies and organizations (see Section 5.4, Monitoring). This monitoring will provide additional information toward the key uncertainties.

5.3.2. Conceptual Models and Uncertainties

During preparation of the SMP, conceptual models were developed for several resource categories, including wetlands, tidal marsh and aquatic habitat, levees, scalar transport and geometry, and water quality. These conceptual models have been developed to assist projects with information regarding the current scientific understanding of the Marsh and identify uncertainties and potential actions. The models can be used to assist with selecting, designing, and predicting outcomes of project-specific design and objectives. These conceptual models include Organic Matter, Mercury, Levee, Tidal and Aquatic, and Managed Wetlands and are accessible at:

> < http://www.fws.gov/sacramento/Outreach/2010/10-29/outreach_newsroom_2010-10-29.htm >

Despite the extensive scientific information available, the SMP conceptual models identified a number of scientific uncertainties and knowledge data gaps that still exist. However, not all the uncertainties can be resolved before restoration starts. In fact, many data gaps can be addressed only by implementing restoration actions and learning from the results. Therefore, these uncertainties form the basis for potential monitoring that could apply to specific restoration projects. Each restoration project will be unique and have distinct questions appropriate for monitoring or additional scientific studies. All new information gathered will be combined with existing monitoring data for the Marsh and collected to formalize knowledge, develop expectations of future conditions and outcomes that can be tested by further monitoring, and assess the likelihood of outcomes. Conceptual models are templates for organizing information and will require revision and updating based on monitoring results and new scientific knowledge.

In addition to the resource-specific uncertainties identified in the conceptual models, climate change and changes to Delta outflow are two overarching long-term uncertainties that have been identified and may affect the Marsh. The effects of rising sea levels on tidal marshes are dependent on the relative rate of sea level rise versus rates of sedimentation and accretion of the marsh surface. Sea level rise will cause salinity levels to increase up the estuary as tides push higher up bays, rivers, and sloughs. The Suisun Bay and the Delta may become saltier. Closer study is needed of the potential amount and extent of salinity and habitat change, and the species-level effects of these changes. The maintenance of tidal marsh habitat area during sea level rise requires (1) space for tidal marshes to expand upward into adjacent habitats as sea and tide levels increase; (2) available sediment adequate to support marsh accretion rates equal to or greater than the rate of sea level rise; (3) stable erosion rates, or at least rates that do not defeat marsh accretion. The first of these requirements—room for marshes to "move up" in elevation—is especially problematic in many areas of the San Francisco Bay estuary where tidal marsh abuts a dike, levee, seawall, or other human barrier at its landward edge. The requirement for moderate erosion rates is also of concern, given that climate change and sea level rise in California are expected to be accompanied by increased storm severity and maximum wave heights. Sediment supply for marsh accretion is not yet well understood.

The SWP and CVP operations affect Suisun Marsh salinities by regulating Delta outflow through upstream reservoir storage and releases and Delta exports. Several other plans and policies are being developed that have the potential to affect the Marsh. These plans are in varying stages of development, and details on how they would affect the Marsh are limited at this time. As information is made available for these uncertainties, it will be incorporated into tidal restoration planning efforts as appropriate in the future.

5.3.3. Plan Response to Predicted Sea Level Rise

The SMP EIS/EIR evaluated the long-term alternatives for the SMP over a 30-year planning horizon, including consideration of global climate change and relative sea level rise on habitat distributions, ability to support target ecological functions, and flood hazards. Relative sea level rise—or the rate of sea level rise expected to be observed locally—is a product of global sea level rise, tectonic land movements, and local subsidence and sedimentation. The rate of global sea level rise is expected to continue along a global warming–induced trajectory, and model-based predictions of sea level rise range from low estimates of 0.18 to 0.38 meter and high estimates of 0.26 to 0.59 meter by the end of the twenty-first century (Intergovernmental Panel on Climate Change 2007). A regional study estimates that the sea level will increase in California between 12 and 17 inches (0.3 and 0.4 meter) by 2050 and between 20 and 55 inches (0.5 and 1.4 meters) by 2099 (San Francisco Bay Conservation and Development Commission 2009). More recent Ocean Protection Council (OPC) estimates are consistent with these estimates (Vermeer and Rahmstorf 2009). Although significant uncertainty exists regarding these rates, ongoing research regarding the primary factors affecting global and regional sea level rise continues to narrow the uncertainties and refine future estimates.

Looking forward, if sea level rise matches the mid-range of the Intergovernmental Panel on Climate Change (IPCC) (2007) predictions and sediment availability to the Marsh remains the same, sustainable vegetated tidal marshes are expected to develop in the tidally restored ponds within the plan's 30-year planning horizon. If higher rates of sea level rise prevail, tidally restored areas within the SMP area may persist as intertidal unvegetated mudflats or shallow open-water habitat for prolonged periods. Many tidally restored wetlands still would be expected to accrete sediment and eventually support vegetated tidal marsh, except at a slower rate, although some restorations in Suisun could remain unvegetated well into the foreseeable future.

Higher than anticipated sea level–rise rates that result in delayed or arrested marsh establishment could hinder the progression toward tidal wetlands, resulting in a mix of habitats, including managed wetlands, tidal wetlands, open-water, and subtidal aquatic habitats. Sea level rise represents only one of many uncertainties that could affect the ultimate habitat mix.

A number of features can be built into the restoration efforts to support achieving long-term ecological functions. Providing for the tidal wetland to advance "upslope" can be achieved through constructing a gradually sloping wetland/upland transition zone at interior sites and selecting restoration sites at the wetland-upland edge of Suisun that provide an elevation gradient over which tidal wetland could shift upslope as sea level rises. Promoting early emergent vegetation can help to capture sediment for marsh accretion, and it can enhance the accumulation of organic matter in the developing wetland sediments. This could be accomplished by managing lands prior to restoring tidal action to promote wetland plant biomass accumulation that reverses subsidence.

The potential for sea level rise is acknowledged in the site selection considerations and therefore will be a recurring consideration based on best available science for each restoration project. Administration of this criterion will recognize the dynamic nature of the land/water interactions, including subsidence, sediment accretion potential, and biomass accumulation potential. This will enable project designs to be based on habitat trajectory (as opposed to current or static conditions) over the 30-year planning horizon. This approach will help minimize "sunk cost" of habitat and facility investments as well as help ensure that the targeted habitat type occurs as planned. In addition to site selection and project design considerations, the AMP provides a framework for adapting to sea level rise.

Wetland operations and levee maintenance will be adjusted over time with sea level rise. Flood protection levees will be designed to accommodate future sea level rise, either with higher crown elevations at the time of initial construction or with the flexibility to add levee height in the future. Ongoing levee maintenance will maintain levee crown elevations as needed to provide continued flood protection with sea level rise. In general, raising levee crown heights requires widening the levee footprint in order to maintain levee stability. Wetlands also will be more difficult to drain by gravity at low tide, thereby reducing water management ability, which can be offset mainly through increased use of pumps for managed wetland drainage, with some clubs continuing to be gravity-drained but with greater management options to take best advantage of every low tide.

5.4. Monitoring

5.4.1. Ongoing Monitoring

Monitoring is ongoing in the Marsh to varying degrees on public and private lands and public waters. For example, the Interagency Ecological Program is composed of state and federal agencies, as well as university and private scientists, who conduct long-term monitoring and applied research in the San Francisco estuary directed toward effective management. Several ongoing monitoring programs exist in the Marsh.

- **Salt Marsh Harvest Mouse Surveys:** These surveys are conducted annually by DFG and DWR to monitor SMHM populations.
- **California Clapper Rail and Black Rail Surveys:** These surveys are conducted annually by DFG to monitor clapper rail and black rail breeding pairs.
- **Suisun Marsh Vegetation Surveys:** These surveys are conducted every 3 years by DFG to monitor vegetation changes throughout the Marsh. An aerial survey is flown every 3 years and using GIS, produces a precise vegetation map with detailed descriptions of vegetation types. This survey is used to support monitoring of SMHM and California clapper rail habitat, and can be used by private landowners to evaluate managed wetlands habitat response to management activities. Recently, this monitoring has included breach and channel network evolution for the Blacklock Tidal Restoration Project.
- **Water Quality Monitoring:** DWR maintains water quality and tide stage monitoring stations throughout the Marsh as part of the California Data Exchange Center (CDEC) monitoring network. These stations measure a variety of parameters, depending on the station, that may include precipitation, water temperature, wind speed and direction, and atmospheric pressure on an hourly basis. Data are telemetered to CDEC so tide stage can be monitored remotely.
- **Interagency Ecological Program Database:** This database contains data collected by UC Davis, DFG, and the USFWS, including fishery, benthos, nutrient, pesticide, bioassay, water-weather condition, and survey fish tag data (<http://www.water.ca.gov/iep>).
- **Blacklock Restoration Project:** This tidal restoration project has a monitoring plan that includes levee breach geometry, inundation regime monitoring, marsh surface-elevation changes/sedimentation accretion, slough network evolution, native marsh vegetation, wildlife, water quality, methyl mercury, and erosion of adjacent sloughs.
- **SRCD, DFG and Private Lands Reporting:** Annually, SRCD compiles a summary report of actual annual managed wetlands maintenance work completed under the Corps RGP3. In compliance with this permit, DFG and SRCD also conduct compliance inspections for diversion restrictions and submit report to the regulatory agencies.
- **DFG Grizzly Island Wildlife Area:** DFG conducts annual surveys for wintering waterfowl and breeding surveys for tule elk, pheasant, and waterfowl.
- **Audubon Society Christmas Bird Count:** These data are collected annually to study long-term health and status of bird populations across North America. Surveys are conducted in the Marsh every year as the

Benicia (CABE) count circle (<http://birds.audubon.org/christmas-bird-count>).

- **Tricolored Blackbird Surveys:** These surveys are carried out every 3 years during April. DFG participates in this statewide survey coordinated by Audubon California (<http://tricolor.ice.ucdavis.edu/>).
- **Solano County Mosquito Breeding Habitat Monitoring:** Adult mosquitoes are routinely monitored (7-night cycles) throughout the Solano County Mosquito Abatement District. Each week (from April through October) the samples are identified after which the findings are sent to the California Department of Health Services Vector Borne Disease Section (<http://www.solanomosquito.com/aboutus.html>).

Several other monitoring programs are being implemented that could provide useful information in the SMP adaptive management decision making process.

- **South Bay Salt Ponds Project:** USFWS is monitoring similar restoration targets and objectives.
- **Dutch Slough Restoration Project:** DWR is monitoring fish hypotheses, water quality hypotheses, and miscellaneous bio-geomorphic hypotheses.
- **Napa River Salt Marsh Restoration Project:** DFG is monitoring wildlife use of evolving tidal habitats.
- **Bay Delta and Tributaries (BDAT):** BDAT contains environmental data concerning the San Francisco Bay-Delta and provides public access to those data. More than 50 organizations contribute data voluntarily to this project. The database includes biological, water quality, and meteorological data. These can be used to gage the health of the estuary and to manage water.
- **UC Davis Fish and Invertebrate Study:** This monthly study uses multiple methods to sample fish in shallow, brackish-water habitat and has been designed since inception to monitor the status of fishes in the Marsh.
- **Time-Series Databases:** Hydrodynamics and water quality data of the California Bay-Delta Tributary collected by various agencies at more than 120 stations (mostly fixed-position stations) using the data storage system, which is suitable for time-series data and was developed by the Hydrologic Engineering Center of the Corps.
- **California Waterfowl Association:** Waterfowl nesting surveys are conducted on the Grizzly Island Wildlife Area to help monitor and assess waterfowl populations.

Information from these monitoring efforts is currently reported to the Suisun Environmental Compliance Advisory Team for use in agency planning efforts.

5.4.2. Environmental Impact Statement/ Environmental Impact Report Monitoring

As previously mentioned, because there is scientific uncertainty regarding recovery times for benthic communities, SRCD and DFG will initiate a benthic community monitoring program concurrent with the implementation of the new dredging program in accordance with the USFWS and NMFS BOs. The objectives of this monitoring are to determine benthic community richness and abundance prior to and following dredging at selected sites, with an extended post-dredging component to determine species reestablishment of disturbed areas over an appropriate period of time. The purpose of this effort is to confirm the potential impacts of dredging on benthic invertebrate communities in the vicinity of dredging activities and to make necessary adjustments to the dredging program to ensure that the anticipated effects as analyzed in the SMP EIS/EIR and BOs are not exceeded.

5.4.3. Potential Tidal Restoration Project Monitoring

Under the SMP each tidal restoration project will have its own specific objectives in support of the overall SMP tidal restoration objective of implementing 5,000 to 7,000 acres of tidal marsh restoration in the Marsh and contributing to recovery of listed species consistent with the Recovery Plan. Therefore, as applicable to project-specific objectives, project-specific monitoring will be recommended based on the previously described uncertainties during project planning and design. Project proponents will be responsible for implementing monitoring as incorporated into project planning documents. The approach for each restoration action will be determined by the specific lead agencies and will be based on the SMP EIS/EIR, project-specific design components, consideration of any new information (including that obtained through the SMP adaptive management), or other factors. Each project will create a monitoring plan that clearly identifies each monitoring activity, expected results, and responsible party for each monitoring activity.

During project monitoring planning, project proponents will (1) assemble all available data; (2) determine priorities; (3) identify focal species or suites of species, if appropriate; (4) identify performance indicators; and (5) develop monitoring protocols if none exist.

To make monitoring useful, choices of ecological attributes to monitor and how to monitor them (e.g., frequency, extent, intensity) must be linked closely to the management situation that motivates the monitoring in the first place. There are always limits on staff and funding for monitoring, and it is important to choose design protocols that will provide the most useful information within those limits. Protocol design should be based on the purposes of monitoring and the way in which monitoring data will be analyzed.

When possible, monitoring methods will be designed to collect data from multiple parameters. For example, aerial photographs or satellite images can show the extent of tidal marsh, connectivity of habitats, form and location of channels, and changes in invasive plant populations. After choosing parameters and methods, monitoring protocols must be used and, if not in existence, must be developed. These protocols must be designed to collect enough data at a scale and frequency that allow project proponents to discern spatial differences and trends through time. Monitoring will be targeted at specific mechanisms thought to underlie measures and or actions and be used to assess results. Monitoring actions will be prioritized, and considerations should include feasibility of implementation, availability of funding, and uncertainty of outcome. Capturing baseline condition information, if it is not already available, will be a component of any project-specific monitoring plan.

There are several types of monitoring that will be implemented as part of tidal restoration projects under the SMP.

- Compliance monitoring will be built into project-specific permit requirements.
- Performance monitoring will identify whether project-specific actions are achieving their expected outcomes or targets.
- Mechanistic monitoring will demonstrate whether the mechanisms thought to link actions to desired outcomes are working as predicted.

Project monitoring needs to be designed to help reduce uncertainty, be measurable with observable responses to project implementation, noting that subtle differences in responses before and after project implementation seldom are detected. Tidal restoration project proponents will receive input from the AMAT (further described in Section 5.4.1 below) and Suisun Principals regarding project planning, design, and monitoring. In addition, it is recommended that each individual tidal restoration project seek the input of other science-based work groups to develop goals, objectives, and performance measures for each restoration project, as applicable.

The following sections summarize categories for which key uncertainties have been identified (as listed in the previous section) and potential monitoring that could be recommended, as applicable, for specific tidal restoration projects.

Managed Wetland Enhancement

There is scientific uncertainty regarding the potential effects of tidal restoration on species currently using managed wetlands. As the SMP's purpose is to create an acceptable balance between protection and enhancement of managed wetlands and the species that use them, and the restoration and protection of tidal wetlands, monitoring in this category will be crucial to balanced implementation of the SMP. Monitoring in this category will be closely integrated with existing monitoring efforts in the Marsh.

Objectives of this monitoring will include gaining information related to one or more of the following key uncertainties.

- Managed wetland enhancement effects on resident and migratory wildlife species and plant populations.
- Regional waterfowl habitat availability and quality and the effects of managed wetland enhancement actions on indicators of waterfowl use.

Tidal Restoration

The expected outcome of tidal restoration is the creation of marsh habitat for endangered soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*), endangered Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*), endangered California clapper rail (*Rallus longirostris obsoletus*), and endangered SMHM (*Reithrodontomys raviventris*) which will contribute to the recovery goals in the USFWS's Suisun Bay Area Recovery Unit. There is uncertainty associated with the ways tidal restoration may change natural processes during SMP implementation. Tidal marsh development will vary depending on its location within the Marsh.

Evaluating primary productivity at a tidal restoration site attempts to determine whether a restoration project supports native fish species, including Chinook salmon, delta and longfin smelt, and other pelagic organisms by increasing the production of nutritionally valuable phytoplankton and zooplankton. An understanding of the magnitude of fish food production and release from restored tidal marshes in the Marsh is critical to determining the ability of restored intertidal marshes to aid in the recovery of pelagic species.

Objectives of this monitoring will include gaining information related to one or more of the following key uncertainties.

- Use of newly restored tidal habitats by special status plant and wildlife species.
- Tidal restoration effects on resident and migratory wildlife species and plant populations.
- Regional waterfowl habitat availability and quality and the effects of tidal restoration actions on indicators of waterfowl use.
- Producer population growth in newly restored tidal habitats.
- Nutrient cycling.
- Zooplankton growth and availability in newly restored tidal habitats.
- Native and nonnative fish habitat use and residence time in newly restored tidal habitats.

Water Quality

Multiple factors contribute to the degradation of water quality in the Marsh, including increased salinities from tidal restoration projects, some flooding and drainage practices in managed wetlands, minimal tidal exchange in dead-end sloughs, urban runoff, and naturally occurring contaminants such as mercury. Improvement of water quality and water quality management practices will benefit ecological process for all habitats, including managed and tidal wetlands.

In cooperation with regional monitoring and research efforts, sediment and water quality monitoring could be conducted at several tidal restoration project sites. Ongoing information can be used adaptively to correct long-term construction and management plans and activities associated with restoration. Water quality parameters that could be monitored include salinity, temperature, DO, and methylmercury.

Objectives of this monitoring will include gaining information related to one or more of the following key uncertainties.

- Carbon production with tidal restoration and potential for transport to Delta pumps and contribution to trihalomethane production.
- Burial or exposure of existing mercury deposits in the Marsh.
- Marsh biota exposure to mercury and reducing potential for methylmercury exposure and transport in tidal restoration site design.
- Effects of short-term pulses of methylmercury versus long-term annual concentrations.

Hydrodynamic Modeling

Hydrodynamic modeling is employed as a planning and predictive tool to investigate alternative breach options for tidal restoration projects. Hydrodynamic modeling at a planned and/or naturally occurring breach could be used as an indicator of outcome and a possible diagnostic tool to evaluate changes in tide stage, inundation regimes, or increased salinities that were not anticipated. Cross-sectional profiles of any additional natural breaches (of significant size) should be conducted where appropriate.

The previous sections describe a few examples of monitoring that could be implemented for tidal restoration projects under the SMP, based on key uncertainties identified in the conceptual models. However, this is not intended to be an all-inclusive list, and it is recognized that specific tidal restoration projects will have individual objectives and there may be monitoring for projects that is not captured here. Additional monitoring elements could include those developed for the Recovery Plan, the Bay Delta Conservation Plan Independent Science Advisors, or the DSC. In addition, uncertainties not identified here could be realized during specific tidal restoration project design, and through information learned from completed tidal restoration project monitoring. Such information will be used to update the conceptual models and this SMP adaptive management approach.

5.5. Adaptive Management Implementation

5.5.1. Roles and Responsibilities

To implement adaptive management, an effective decision-making structure must be developed to complete the loop between information from monitoring and the use of that information in decision-making. To be effective, it must be flexible and designed to be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. The following structure has been collaboratively working on Marsh issues for more than 10 years and will continue through the implementation of the SMP. The structure for decision-making is designed to achieve these functions.

- Convert information into effective management decisions.
- Incorporate independent science into plan implementation.
- Provide a forum for project development and collaboration.
- Involve the public/landowners to help provide management direction.
- Store and organize information for use by decision-makers and the public.

Suisun Marsh Charter Group Principals

The Suisun Marsh Charter Group Principal Agencies collaboratively have prepared the SMP. The Principals include agency managers from DFG, DWR, Reclamation, USFWS, and SRCD that have experience with Marsh issues, policies, and permits. The Principal agencies are ultimately responsible for decisions that are implemented regarding the SMP. Projects will be reviewed for consistency with the SMP goals and objectives. Principal agency actions related to the SMP are as follows and are further described in the SMP.

Adaptive Management Advisory Team

While project planning and design rely ultimately on the project managers for each restoration project, a network of staff from state and federal agencies will provide an interface for effective science, management, and outreach partnerships. The AMAT will be composed of technical staff from DFG, DWR, SRCD, Reclamation, USFWS, and the DSC with invitations to other entities to participate as appropriate. SRCD will be the lead of the AMAT and will convene meetings and call upon DWR, DFG, Reclamation, USFWS, and the DSC. Project proponents are encouraged to use the AMAT and their knowledge of the Marsh for project development and support and as a forum to coordinate and cooperate for the benefit of the overall restoration goals. An MOU among the

AMAT agencies will be pursued defining the roles and responsibilities of the members with respect to achieving the SMP objectives and implementing adaptive management. While retaining their existing individual land management authorities, project proponents will coordinate with the AMAT to develop project planning and design documentation, quantify specific restoration objectives and targets, and develop monitoring and research plans and schedules to assess the effectiveness of implemented actions in achieving SMP goals and objectives and addressing uncertainties associated with assumptions used to develop the plan. Coordination with the AMAT does not preclude project proponents from their regulatory due diligence. No regulatory authority has been delegated to the AMAT. Each AMAT participating agency retains its own regulatory authority. The AMAT will make recommendations to the Principals as appropriate.

The AMAT will:

- Provide access to detailed and updated conceptual models that synthesize existing knowledge of the Marsh.
- Provide access to ongoing monitoring.
- Review proponents' projects, restoration targets, and monitoring plans.
- Evaluate whether each project is contributing toward the overall SMP objectives.
- Make recommendations for project additions or changes.
- Conduct periodic reviews of project results.
- Incorporate a feedback loop that links implementation and monitoring to a decision-making process.
- Conduct periodic independent science review of plan implementation using the Delta Science Program.
- Improve restoration designs to achieve desired SMP results.
- Make recommendations to the Principal Agencies regarding implementation of the SMP.
- Submit, every other year, an implementation status report to DFG, NMFS, USFWS, and other regulatory agencies as required.

Information Management

As funding and staff become available for site-specific projects, and in accordance with permit requirements (BOs), data storage and access, including monitoring and/or GIS data, will be collected and made available to act as a link for planning future projects. The AMAT will be responsible for data storage and access, including monitoring and/or GIS data, and act as a link for all data collected. Data collected by this group also will include other relevant projects from around the Bay such as the San Francisco Bay and Napa Salt Ponds

Restoration Projects. The AMAT will ensure that monitoring data and reports are made widely available, including to the Principal Agencies.

Stakeholder Participation

Local stakeholder involvement is essential to meet the SMP objectives. Stakeholders will provide input to the AMAT to help guide restoration and adaptive management actions. The Stakeholder Group could include local public agencies, including SRCD; landowners; and other interested parties to provide ongoing, local landowner–derived input to the Principals on adaptively managing implementation of the SMP.

5.5.2. Project Success Criteria

The U.S. Department of the Interior Adaptive Management Technical Guide defines adaptive management as successful if progress is made toward achieving management goals through a learning-based (adaptive) decision process (Williams et al. 2009). It also indicates that successful adaptive management shows recognizable progress toward achieving objectives in a reasonable time frame, implements learning-based management with stakeholder involvement, and is consistent with all applicable laws and regulations. The SMP project success criteria are based on meeting the targets of restoring 5,000 to 7,000 acres of tidal wetlands habitat and protecting and enhancing 40,000 to 50,000 acres of seasonal wetland habitat.

Restoration of tidal wetlands is consistent with the *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California*. The goal of the Draft Recovery Plan is the comprehensive restoration and management of tidal marsh ecosystems in five recovery units; Suisun Bay, San Pablo Bay, the Central/South San Francisco Bay, Central Coast, and Morro Bay Recovery Units. Restoring 5,000 to 7,000 acres of tidal wetlands will aid in the recovery of the California clapper rail, SMHM, Suisun thistle, and soft bird's-beak, with the Suisun Bay Recovery Unit.

Because of the long timeframe for tidal marsh evolution and the difference in wildlife values of various types of tidal habitats, it is difficult to determine the end-point for project success. Projects related to, or tiered from, the SMP should incorporate post-construction monitoring and adaptive management to assess whether natural processes can sustain the long-term evolution of tidal marsh.

As elements and processes of managed wetland are constantly changing, adaptive management should be incorporated annually to track and determine the success of enhancement projects.

For each individual project tiered from the SMP, a clear timeline of monitoring will be developed in a manner to document results that will require a modification of the project, or identify possible new actions needed for the project to perform as intended.

5.5.3. Assessment of Monitoring Results

As monitoring data become available, the AMAT will review them for specific projects to assess how successful the individual tidal restoration projects are being at meeting their specific objectives. Also, the AMAT annually will review available monitoring data to assess progress toward achieving the overall SMP objectives. The AMAT will provide recommendations on additional monitoring needs and changes to restoration design based on review of past projects.

5.5.4. Feedback Loop and Decision-Making

Technical learning will occur over a relatively short term, during which objectives, alternatives, and other elements remain unchanged. On the other hand, learning about the decision process itself will occur through periodic revisiting of the SMP adaptive management elements over the longer term. The AMAT will act primarily as a feedback loop for new knowledge assimilated from ongoing actions and individual enhancement and restoration projects. An important role of the AMAT will be ensuring clear communication of the current understanding of existing baseline condition data to project proponents during the planning process. Also, the AMAT will provide a forum to advise project proponents of adverse conditions potentially affecting tidal restoration projects early in the planning process. As appropriate, the AMAT will advise the Principal Agencies of the need for changes to the SMP objectives and/or implementation strategy based on new information from project-specific monitoring.

As described below in Section 5.6, the SMPA agencies (Reclamation, SRCD, DWR, and DFG) will submit implementation status reports no less frequently than every other year to DFG, NMFS, and USFWS, and other regulatory agencies that will describe the implemented restoration activities, monitoring, application of adaptive management, results of adaptive management, and any activities that are being planned.

5.6. Annual Reporting

To track the progress of restoration and managed wetland activities, the SMPA agencies (Reclamation, SRCD, DWR, and DFG) will submit implementation status reports annually to DFG, NMFS, and USFWS and other regulatory agencies that will describe the implemented restoration and managed wetland activities. Additional activities, including monitoring, application of adaptive management, results of adaptive management, and any activities that are being planned, will be submitted no less frequently than every other year.

The SMPA agencies will report the status of restoration and managed wetlands in each report. Additional information will be included in the SMP Biological Assessments and BOs. In general, reports will include the following information.

- The location, extent, and timing of land acquisition for tidal restoration.
- The location, extent, and timing of restoration planning, protection, enhancement, restoration, or creation of tidal wetlands.
- Status of restoration planning for acquired properties.
- Descriptions of conservation agreements, lands acquired in fee title, interagency memorandums of agreement, or any other agreements entered into for the purposes of protecting, enhancing, or restoring tidal or managed wetlands.
- Descriptions of the previous year's managed wetland activities, including a description of how actual impacts compare to impacts analyzed in the EIS/EIR (this information can be used to determine whether additional CEQA or NEPA documentation is required for future discretionary actions).
- Descriptions of monitoring results, including any actions that will be implemented as a result of this information.
- A summary of how implemented activities compare to SMP goals in terms of habitat types, managed wetland operations, acreage goals, and species composition.

If any report indicates that restoration or managed wetland targets are not being met or have the potential not to be met, the SMPA agencies along with NMFS and USFWS will convene to determine how to proceed to get plan implementation on track. The mutually agreeable plan of action may include a range of potential solutions, including:

- Changes to the manner in which the SMP is implemented.
- Temporarily or permanently adjusting certain SMP provisions through an amendment or other process.
- Slowing or stopping aspects of the managed wetland activities permit issuance until restoration catches up with impacts.

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Appendix A

Suisun Marsh Monitoring and Adaptive Management Plan

APPENDIX A

Suisun Marsh Monitoring and Adaptive Management Plan

CONTENTS

Suisun Marsh
Monitoring and Adaptive Management Plan

I. Introduction

A. Background

Suisun Marsh (Marsh) is the largest contiguous brackish water marsh remaining on the west coast of North America and is a critical part of the San Francisco Bay/Sacramento-San Joaquin River Delta (Delta) estuary ecosystem. It encompasses more than 10% of California's remaining natural wetlands and serves as the resting and feeding ground for thousands of birds migrating on the Pacific Flyway. In addition, the Marsh consists of several habitat types that provide essential habitat for more than 221 bird species, 45 animal species, 16 reptilian and amphibian species, and the salmon fishery by providing important tidal rearing areas for juvenile fish.

Managed wetlands are the most common land cover type in the Marsh, accounting for approximately 51,416 acres, or 66.5% of the Marsh. Managed wetlands in the study area provide valuable nesting, foraging, and wintering habitat for waterfowl and shorebirds. Managed wetlands also provide nesting and foraging area for several special status species, such as salt marsh harvest mouse, Suisun shrew, California black rail, California clapper rail, western pond turtle, Suisun song sparrow, and salt marsh common yellowthroat. Managed wetlands also provide habitat for raptors, songbirds, and numerous wildlife species.

Bays and sloughs comprise approximately 25% of the Marsh. Bays and sloughs provide foraging habitat for several species of diving ducks, cormorants, grebes, and other waterfowl that are permanent residents or that winter in the Marsh. The upper reaches of the sloughs provide foraging habitat for waterfowl species, kingfishers, piscivorous birds and wading birds. Shallow freshwater aquatic areas provide rearing, escape cover, and foraging habitat for reptiles and amphibians and may be used as foraging habitat by river otters and raccoon. This habitat also provides the largest area of habitat for fish species in the Marsh. Section 6.1 of the SMP EIS/EIR contains further information on fish habitat in the Marsh.

Tidal wetlands make up approximately 7.5% of the Marsh and are divided into three zones – low marsh, middle marsh, and high marsh. The low tidal zone receives tidal inundation twice a day and provides habitat for shorebirds, California clapper rail, California black rail, other wading birds, and many fish species. Dominant plant species in the low tidal zone include hardstem bulrush and common bulrush. The middle tidal wetlands marsh provides foraging habitat for salt marsh harvest mouse and Suisun shrew, as well as common and special-status bird species, and shorebirds; this marsh zone also provides nesting and foraging habitat for Suisun song sparrow and salt marsh yellowthroat, and when inundated, for fish species. Dominant plant species in the middle tidal zone include pickleweed, saltgrass, and American bulrush. The high tidal wetland zone provides escape cover for salt marsh harvest mouse, Suisun shrew, California clapper rail during periods when the middle and low zones are inundated. The high marsh zone provides foraging and nesting habitat for special status species, such as salt marsh harvest mouse, and Suisun shrew; and provides foraging and nesting habitat for shorebirds, California clapper rail, California black rail, and other birds. Dominant plant species in the high tidal zone include saltgrass, pickleweed, annual grasses, baltic rush, and is critical habitat for special-status plant species such as, Suisun Thistle, Soft Bird's-beak, Suisun Aster, Delta Tule Pea, and Mason's Lilaeopsis. Sections 6.2 and 6.5 of the SMP EIS/EIR contain further information on tidal marsh vegetation and wildlife in the Marsh.

B. Suisun Marsh Plan Objectives

The Suisun Marsh Habitat Management, Preservation and Restoration Plan (SMP) is the result of a collaborative effort among federal, state, and local agencies working with scientists and the public to develop a plan to protect and enhance the Pacific Flyway and existing managed wetland values, natural wetland functions, tidal habitats, endangered species, water quality, and levee integrity. The SMP is a 30-year comprehensive plan that addresses habitats and ecological processes, public and private land use, levee system integrity, and water quality through tidal restoration and managed wetland activities. The SMP will guide near-term and future actions related to the various uses of the Marsh's resources with the focus on achieving an acceptable multi-stakeholder approach to the restoration of tidal wetlands and the management of managed wetlands and their functions. As such, the SMP is a flexible, science-based, management plan for the Marsh, consistent with the revised Suisun Marsh Preservation Agreement (SMPA) and California Bay-Delta Authority (CALFED) Ecosystem Restoration Program Plan (ERPP) targets for the Suisun Marsh Ecological Management Zone, which will contribute to the US Fish and Wildlife Service's (USFWS) *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California* (Recovery Plan). The SMP will set the regulatory foundation for future actions, and relies on the incorporation of existing science and information developed through adaptive management.

The SMP's purpose is to create an acceptable balance between protection and enhancement of managed wetlands, and the restoration and protection of tidal wetlands. As such, this adaptive management plan (AMP) targets multi-species benefits, rather than focusing on individual species. As described in Chapter 1 of the SMP EIS/EIR, the SMP objectives include:

- Habitats and Ecological Processes – Implement the CALFED ERPP targets for the Suisun Marsh Ecological Management Zone by restoring 5,000 to 7,000 acres of tidal marsh and protection and enhancement of 40,000 to 50,000 acres of managed wetlands. Create an acceptable balance between protection and enhancement of managed wetland habitats for waterfowl and other resident and migratory wildlife species, and restoration and protection of tidal wetland habitat and other aquatic and terrestrial habitats in the Marsh to contribute to the recovery of threatened and endangered species, improve ecological processes, and reduce stressors such as invasive species and other contaminants.

- Public and Private Land Use - Maintain the heritage of waterfowl hunting and other recreational opportunities and increase the surrounding communities' awareness of the ecological values of the Marsh. Managed wetlands and publicly owned lands in the Marsh provide important wetlands for migratory waterfowl and other wetland-dependent species and opportunities for heritage hunting, bird watching, and other recreational activities.

- Levee System Integrity – Maintain and improve Marsh levee system integrity to protect property, infrastructure, and wildlife habitats from catastrophic flooding; support tidal restoration; and maintain water quality standards in the Marsh and Delta; and

- Water Quality – Protect and, where possible, improve, water quality for beneficial uses in the Marsh. Multiple factors contribute to the degradation of water quality in the Marsh, including some flooding and drainage practices in managed wetlands, minimal tidal exchange in dead-end sloughs, urban runoff, and naturally occurring contaminants such as mercury. Improvement of water quality and water management practices will benefit the ecological process for all habitats, including managed and tidal wetlands.

C. Role of Adaptive Management

Adaptive management is the process of learning by doing and then using the results to improve management actions (Walters and Holling, 1990). Figure 1a, at the end of this document, depicts the general adaptive management process. It also involves ongoing, real-time learning and knowledge creation. In an adaptive management approach, resource management and restoration policies are viewed as scientific experiments. This concept is important because the environmental outcomes of management policies are often uncertain. To be effective, decision-making processes must be flexible and designed to be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood.

Adaptive management is essential to keeping the SMP on track toward its objectives, while avoiding and minimizing potential impacts associated with the implementation of SMP actions. The information produced through adaptive management will permit changes to be made that will assist in the design of future steps. Adaptive management will assist project proponents in understanding the restored system and will aid in their ability to explain management actions to Marsh neighbors and the general public.

Restoration practitioners have found that, because knowledge of natural and social systems is incomplete, systems will respond in unexpected ways. Surprises are also inherent in restoration because nature is variable and unpredictable, especially at large spatial scales and over long time frames. Adaptive management allows managers to prepare for and respond to events, ranging from unexpected changes in habitat to vandalism. When and where such events occur may not be predictable, but part of the adaptive approach is to anticipate the range of events and system responses that might occur and develop a process for dealing with them when it happens. Monitoring and adaptive management can help to prevent unintended consequences of implementing actions under the SMP or, when they occur, can avoid unnecessary reoccurrence, help to minimize any negative impacts and address issues before they become substantial.

The SMP will occur over a 30-year implementation horizon. The SMP's adaptive management approach will allow managers to learn from their actions and will:

- Generate science-based information for managers;
- Convert information into effective management decisions;
- Involve stakeholders to help provide management direction; and
- Store and organize information for use by current and future decision-makers and stakeholders.

This AMP has been prepared in accordance with the Department of Interior Adaptive Management Technical Guide (Williams et al. 2009) and uses the concepts of passive and active adaptive management. Through passive adaptive management, the Suisun Marsh Charter Principals Group will learn how to ensure better attainment of the SMP's objectives based on the measured success of previous actions (as indicated by effectiveness monitoring results). The SMP will also take an active adaptive management approach by encouraging project proponents to identify uncertainties applicable to their specific project and carry out targeted studies to resolve uncertainties related to the best approaches for achieving project specific objectives. Project proponents could design and implement experimental pilot projects to test the relative efficacy of several approaches for attaining an objective and evaluate different monitoring techniques.

Project implementation will be guided by the best available information, but will be monitored and implemented with the goal of increasing our understanding about the science of restoration. The opportunities for restoration and research are unknown due to the inability to predict where restoration projects will occur. As described in Chapter 1 of the SMP EIS/EIR, the SMP is consistent with the Recovery Plan in splitting restorable acreage into specific regions in order to provide a range of environmental gradients necessary to contribute to the recovery of multiple listed species. Implementation of the SMP Mitigation Monitoring and Reporting Program (Appendix F) will inform adaptive management decision making and tidal restoration planning efforts.

This AMP is designed to assist in achieving the SMP objectives by providing a guided approach to learning from restoration, research, monitoring and management actions, and actions which have uncertainties. Results of effectiveness monitoring may indicate that some restoration or management measures are less effective than anticipated. To address these uncertainties, the monitoring and adaptive management program will:

- Ensure impacts to benthic communities from dredging activities described and analyzed in the SMP EIS/EIR are not exceeded

- Gauge the effectiveness of restoration projects and techniques to implement SMP objectives

- Track project–specific targets to ensure restoration benefits listed species

- Propose alternative or modified measures as the need arises consistent with available funding and

- Be used to improve future restoration designs to achieve desired physical and ecological results;

As such, potential monitoring done under this AMP falls into two categories. The first category is monitoring required to ensure impacts analyzed in the EIS/EIR are not exceeded. Benthic community recovery monitoring during implementation of the dredging program as described in Chapter 2 of the SMP EIS/EIR is the only monitoring in this category. This benthic monitoring will be implemented by the Suisun Resource Conservation District (SRCD) and Department of Fish and Game (DFG) in accordance with the requirements of the USFWS and National Marine Fisheries Service (NMFS) Biological Opinions (Opinions) on the effects of the SMP.

The other potential category of monitoring that would occur under the SMP would be based on key uncertainties and would be considered for implementation as applicable for each tidal restoration project to assess project outcomes. Currently, monitoring in the Suisun Marsh is being carried out by a number of agencies and organizations (see Section II Monitoring). This monitoring will also provide additional information towards the key uncertainties.

D. SMP Conceptual Models and Uncertainties

During preparation of the SMP, conceptual models were developed for several resource categories, including managed wetlands, tidal marsh and aquatic habitat, levees, scalar transport and geometry, and water quality. These conceptual models have been developed to assist projects with information regarding the current scientific understanding of the Marsh, and identify uncertainties and potential actions. The models can be used to assist with selecting, designing, and predicting outcomes of project-specific design and objectives. These conceptual models include: Organic Matter, Mercury, Levee, Tidal and Aquatic, and Managed Wetlands, and are accessible at http://www.fws.gov/sacramento/ea/news_releases/2010_News_Releases/SuisunMP_EIS-EIR_DraftRelease.htm

Despite the extensive scientific information available, the SMP conceptual models identified a number of scientific uncertainties and knowledge data gaps that still exist. However, all the uncertainties cannot be resolved before restoration starts. In fact, many data gaps can only be addressed by implementing restoration actions and learning from the results. Therefore, these uncertainties form the basis for potential monitoring that could apply to specific restoration projects. Each restoration project will be unique and have distinct questions appropriate for monitoring or additional scientific studies. All new information gathered will be combined with existing monitoring data for the Marsh and collected to formalize knowledge, develop expectations of future conditions and outcomes that can be tested by further monitoring, and assess the likelihood of outcomes. Conceptual models are templates for organizing information and will require revision and updating based on monitoring results and new scientific knowledge. A list of uncertainties identified in the conceptual models that could be monitored as appropriate for specific tidal restoration projects can be found in the Attachment 1 of this AMP.

In addition to the resource-specific uncertainties identified in the conceptual models, climate change and changes to Delta outflow are two overarching long term uncertainties that have been identified and may aeffect the Marsh. The effects of rising sea levels on tidal marshes are dependent upon the relative rate of sea level rise versus rates of sedimentation and accretion of the marsh surface. Sea level rise will cause salinity levels to increase up the estuary as tides push higher up bays, rivers, and sloughs. The Suisun Bay and the Delta may become saltier. Closer study is needed of the potential amount and extent of salinity and habitat change, and the species-level effects of these changes. The maintenance of tidal marsh habitat area during sea level rise requires (1) space for tidal marshes to expand upward into adjacent habitats as sea and tide levels increase; (2) available sediment adequate to support marsh accretion rates equal to or greater than the rate of sea level rise; (3) stable erosion rates, or at least rates that do not defeat marsh accretion. The first of these requirements - room for marshes to "move up" in elevation – is especially problematic in many areas of the San Francisco Bay Estuary where tidal marsh abuts a dike, levee, seawall, or other human barrier at its landward edge. The requirement for moderate erosion rates is also of concern, given that climate change and sea level rise in California are expected to be accompanied by increased storm severity and maximum wave heights; trends that are already suggested by available data (Wilkinson 2002, Bromirski *et al.* 2004). Sediment supply for marsh accretion is not yet well understood.

The State Water Project and Central Valley Project operations affect Suisun Marsh salinities by regulating Delta outflow through upstream reservoir storage and releases and Delta exports. As described in Chapter 1 of the SMP EIS/EIR, there are several other plans and policies currently being developed that have the potential to affect the Marsh. These plans are in varying stages of development, and details on how they would affect the Marsh are limited at this time. As information is made available for these uncertainties, it will be incorporated into tidal restoration planning efforts as appropriate in the future.

II. Monitoring

A. Ongoing monitoring

Monitoring is ongoing within the Marsh to varying degrees on public and private lands, and public waters. For example, the Interagency Ecological Program is comprised of state and federal agencies, as well as university and private scientists, who conduct long-term monitoring and applied research in the San Francisco Estuary directed towards effective management. Several ongoing monitoring programs currently exist in the Marsh:

- Salt Marsh Harvest Mouse Surveys: These surveys are conducted annually by DFG and DWR to monitor salt marsh harvest mouse populations.

- California Clapper Rail and Black Rail Surveys: These surveys are conducted annually by DFG to monitor clapper rail and black rail breeding pairs.

- Suisun Marsh Vegetation Surveys: These surveys are conducted every three years by DFG to monitor vegetation changes throughout the Marsh. An aerial survey is flown every three years and using GIS, produces a precise vegetation map with detailed descriptions of vegetation types. This survey is used to support monitoring of salt marsh harvest mouse and California clapper rail habitats, and can be used by private landowners to evaluate managed wetlands habitat response to management activities. Recently, this monitoring has included breach and channel network evolution for the Blacklock Tidal Restoration Project.

- Water Quality Monitoring: DWR maintains water quality and tide stage monitoring stations throughout the Marsh as part of the California Data Exchange Center (CDEC) monitoring network. These stations measure a variety of parameters depending on the station which may include precipitation, water temperature, wind speed and direction, and atmospheric pressure on an hourly basis. Data is telemetered to CDEC so tide stage can be monitored remotely.

- Interagency Ecological Program Database: This database contains data collected by UC Davis, DFG, and the USFWS, including: fishery, benthos, nutrient, pesticide, bioassay, water-weather condition, and survey fish tag data. (http://www.water.ca.gov/iep)

- Blacklock Restoration Project: This tidal restoration project has a monitoring plan which includes levee breach geometry, inundation regime monitoring, marsh surface elevation changes/sedimentation accretion, slough network evolution, native marsh vegetation, wildlife, water quality, methyl mercury, and erosion of adjacent sloughs.

- SRCD: DFG and Private Lands Reporting: Annually, SRCD compiles a summary report of actual annual managed wetlands maintenance work completed under the US Army Corps of Engineers Regional General Permit #3. In compliance with this permit, DFG and SRCD also conduct compliance inspections for diversion restrictions and submit report to the regulatory agencies.

- DFG Grizzly Island Wildlife Area: DFG conducts annual surveys for wintering waterfowl, and breeding surveys for tule elk, pheasant, and waterfowl.

- Audubon Society Christmas Bird Count: This data is collected annually to study long-term health and status of bird populations across North America. Surveys are conducted in the Marsh every year as the Benicia (CABE) count circle. http://birds.audubon.org/christmas-bird-count

- Tricolored Blackbird Surveys: These surveys are carried out every three years during April. DFG participates in this statewide survey coordinated by Audubon California. http://tricolor.ice.ucdavis.edu/

- Solano County Mosquito Breeding Habitat Monitoring - Adult mosquitoes are routinely monitored (7 night cycles) throughout the Solano County Mosquito Abatement District. Each week (from April through October) the samples are identified after which the findings are sent to the California Department of Health Services Vector Borne Disease Section (http://www.solanomosquito.com/aboutus.html).

In addition, several other monitoring programs are currently being implemented that could provide useful information in the adaptive management decision making process:

- South Bay Salt Ponds Project: USFWS is monitoring of similar restoration targets and objectives.
- Dutch Slough Restoration Project: DWR is monitoring fish hypotheses, water quality hypotheses, and miscellaneous bio-geomorphic hypotheses.
- Napa River Salt Marsh Restoration Project: DFG is monitoring wildlife use of evolving tidal habitats.
- Bay Delta and Tributaries (BDAT): BDAT contains environmental data concerning the San Francisco Bay-Delta and provides public access to that data. Over fifty organizations contribute data voluntarily to this project. The database includes biological, water quality, and meteorological data. These can be used to gauge the health of the estuary and to manage water.
- UC Davis Fish and Invertebrate Study: This monthly study uses multiple methods to sample fish in shallow, brackish-water habitat and has been designed since inception to monitor the status of fishes in the Marsh.
- Time-Series Databases: Hydrodynamics and water quality data of the California Bay-Delta Tributary collected by various agencies at over 120 stations (mostly fixed-position stations), using the data storage system which is suitable for time-series data and was developed by the Hydrologic Engineering Center of the US Army Corps of Engineers.
- California Waterfowl Association: Waterfowl nesting surveys are conducted on the Grizzly Island Wildlife Area to help monitor and assess waterfowl populations.

Information from these monitoring efforts is currently reported to the Suisun Environmental Compliance Advisory Team for use in agency planning efforts.

B. SMP EIS/EIR Monitoring

As previously mentioned, because there is scientific uncertainty regarding recovery times for benthic communities, SRCD and DFG will initiate a benthic community monitoring program concurrent with the implementation of the new dredging program in accordance with the USFWS and NMFS Opinions. The objectives of this monitoring are to determine benthic community richness and abundance prior to and following dredging at selected sites, with an extended post dredging component to determine species reestablishment of disturbed areas over an appropriate period of time. The purpose of this effort is to confirm the potential impacts of dredging on benthic invertebrate communities in the vicinity of dredging activities and to make necessary adjustments to the dredging program to ensure that the anticipated effects as analyzed in the SMP EIS/EIR and biological opinions are not exceeded.

C. Potential Tidal Restoration Project Monitoring

Under the SMP each tidal restoration project will have its own specific objectives in support of the overall SMP tidal restoration objective of implementing 5,000 to 7,000 acres of tidal marsh restoration in the Marsh and contributing to recovery of listed species consistent with the Recovery Plan. Therefore, as applicable to project specific objectives, project specific monitoring will be recommended based on the previously described uncertainties during project planning and design. Project proponents will be responsible for implementing monitoring as incorporated into project planning documents. The approach for each restoration action will be determined by the specific lead agencies and will be based on the SMP EIS/EIR, project-specific design components, consideration of any new information (including that obtained through the implementation of the AMP), or other factors. Each project will create a monitoring plan that clearly identifies each monitoring activity, expected results, and responsible party for each monitoring activity.

During project monitoring planning, project proponents will:

- Assemble all available data
- Determine priorities
- Identify focal species or suites of species, if appropriate
- Identify performance indicators
- Develop monitoring protocols if none exist

To make monitoring useful, choices of ecological attributes to monitor and how to monitor them (frequency, extent, intensity, etc.), must be linked closely to the management situation that motivates the monitoring in the first place. There are always limits on staff and funding for monitoring, and it is important to choose design protocols that will provide the most useful information within those limits. Protocol design should be based on the purposes of monitoring and the way in which monitoring data will be analyzed.

Whenever possible, monitoring methods will be designed to collect data from multiple parameters. For example, aerial photographs or satellite images can show the extent of tidal marsh, connectivity of habitats, form and location of channels, and changes in invasive plant populations. After choosing parameters and methods, monitoring protocols must be used and, if not in existence, must be developed. These protocols must be designed to collect enough data at a scale and frequency that allows managers to discern spatial differences and trends through time. Monitoring will be targeted at specific mechanisms thought to underlie measures and or actions and be used to assess results. Monitoring actions will be prioritized, and considerations should include feasibility of implementation, availability of funding, and uncertainty of outcome. Capturing baseline condition information, if it is not already available, will be a component of any project-specific monitoring plan.

There are several types of monitoring that would be implemented as part of tidal restoration projects under the SMP:

- Compliance monitoring would be built into project-specific permit requirements

- Performance monitoring would identify whether project-specific actions are achieving their expected outcomes or targets

- Mechanistic monitoring would demonstrate whether the mechanisms thought to link actions to desired outcomes are working as predicted.

Project monitoring needs to be designed to help reduce uncertainty, be measurable with observable responses to project implementation, noting that subtle differences in responses before and after project implementation are seldom detected. Tidal restoration project proponents will receive input from the Suisun Marsh Adaptive Management Advisory Team (AMAT) (further described in Section III) and Suisun Principals regarding project planning, design, and monitoring. In addition, it is recommended that each individual tidal restoration project seek the input of other science based work groups to develop goals, objectives, and performance measures for each restoration project, as applicable.

The following sections summarize categories for which key uncertainties have been identified (as listed in the previous section), and potential monitoring that could be recommended, as applicable, for specific tidal restoration projects. Further information on these uncertainties can be found in the appendix and in the conceptual models, as previously mentioned.

1. Managed Wetland Enhancement

There is scientific uncertainty regarding the potential effects of tidal restoration on species currently utilizing managed wetlands. As the SMP's purpose is to create an acceptable balance between protection and enhancement of managed wetlands and the species that utilize them, and the restoration and protection of tidal wetlands, monitoring in this category will be crucial to balanced implementation of the SMP. Monitoring in this category will be closely integrated with existing monitoring efforts in the Marsh.

Objectives of this monitoring would include gaining information related to one or more of the following key uncertainties:

- Managed wetland enhancement effects on resident and migratory wildlife species and plant populations
- Regional waterfowl habitat availability and quality and the effects of managed wetland enhancement actions on indicators of waterfowl use

2. Tidal Restoration

The expected outcome of tidal restoration is the creation of marsh habitat for endangered soft bird's-beak (*Cordylanthus mollis ssp. mollis*), endangered Suisun thistle (*Cirsium hydrophilum var. hydrophilum*), endangered California clapper rail (*Rallus longirostris obsoletus*) (clapper rail), and endangered salt marsh harvest mouse (*Reithrodontomys raviventris*) (harvest mouse) which will contribute to the recovery goals in the US Fish and Wildlife Service's Suisun Bay Area Recovery Unit. There is uncertainty associated with the ways tidal restoration may change natural processes in unexpected ways during SMP implementation. Tidal marsh development will vary depending on its location within the Marsh.

Evaluating primary productivity at a tidal restoration site attempts to determine if a restoration project supports native fish species, including chinook salmon, delta and longfin smelt and other pelagic organisms by increasing the production of nutritionally valuable phytoplankton and zooplankton. An understanding of the magnitude of fish food production and release from restored tidal marshes in the Marsh is critical to determining the ability of restored intertidal marshes to aid in the recovery of pelagic species.

Objectives of this monitoring would include gaining information related to one or more of the following key uncertainties:

- Use of newly restored tidal habitats by special status plant and wildlife species
- Tidal restoration effects on resident and migratory wildlife species and plant populations
- Regional waterfowl habitat availability and quality and the effects of tidal restoration actions on indicators of waterfowl use
- Producer population growth in newly restored tidal habitats
- Nutrient cycling

- Zooplankton growth and availability in newly restored tidal habitats
- Native and non native fish habitat utilization and residence time in newly restored tidal habitats

3. Water Quality

Multiple factors contribute to the degradation of water quality in the Marsh, including increased salinities from tidal restoration projects, some flooding and drainage practices in managed wetlands, minimal tidal exchange in dead-end sloughs, urban runoff, and naturally occurring contaminants such as mercury. Improvement of water quality and water quality management practices will benefit ecological process for all habitats, including managed and tidal wetlands.

In cooperation with regional monitoring and research efforts, sediment and water quality monitoring could be conducted at several tidal restoration project sites. Ongoing information can be used adaptively to correct long-term construction and management plans and activities associated with restoration. Water quality parameters that could be monitored include salinity, temperature, dissolved oxygen, and methyl mercury.

Objectives of this monitoring would include gaining information related to one or more of the following key uncertainties:

- Carbon production with tidal restoration and potential for transport to Delta pumps and contribution to trihalomethane production
- Burial or exposure of existing mercury deposits in the Marsh
- Marsh biota exposure to mercury and reducing potential for methyl mercury exposure and transport in tidal restoration site design
- Effects of short term pulses of methyl mercury versus long term annual concentrations

4. Hydrodynamic Modeling

Hydrodynamic modeling is employed as a planning and predictive tool to investigate alternative breach options for tidal restoration projects. Hydrodynamic modeling at a planned and/or naturally occurring breach could be used as an indicator of outcome and a possible diagnostic tool to evaluate changes in tide stage, inundation regimes or increased salinities that where not anticipated. Cross sectional profiles of any additional natural breaches (of significant size) should be conducted where appropriate.

The previous sections describe a few examples of monitoring that could be implemented for tidal restoration projects under the SMP, based on key uncertainties identified in the conceptual models. However, this is not intended to be an all-inclusive list, and it is recognized that specific tidal restoration projects will have individual objectives and there may be monitoring for projects that is not captured here. Additional monitoring elements could include those developed for the Recovery Plan, the Bay Delta Conservation Plan Independent Science Advisors, or the Delta Stewardship Council. In addition, uncertainties not identified here could be realized during specific tidal restoration project design, and through information learned from completed tidal restoration project monitoring. Such information would be used to update the conceptual models and this AMP.

III. Adaptive Management Implementation

A. Roles and Responsibilities

To implement adaptive management, an effective decision-making structure must be developed to complete the loop between information from monitoring and the use of that information in decision-making. To be effective, decision-making processes must be flexible and designed to be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. The following structure has been collaboratively working on Marsh issues for over ten years and will continue through the implementation of the SMP. The structure for decision-making specific to the Suisun Marsh (Figure 1b at the end of this document) is designed to achieve these functions:

- Convert information into effective management decisions;
- Provide a forum for project development and collaboration;
- Involve the public/landowners to help provide management direction;
- Store and organize information for use by decision-makers and the public.

1. Suisun Marsh Charter Group Principals

The Suisun Marsh Charter Group Principal Agencies (Principals) have collaboratively prepared the SMP. The Principals include agency managers from DFG, DWR, Reclamation, USFWS, and SRCD that have experience with Marsh issues, policies, and permits. The Principal agencies are ultimately responsible for decisions that are implemented regarding the SMP. Projects will be reviewed for consistency with the SMP goals and objectives. The Principals and Adaptive Management Advisory Team (AMAT, described below) will work with agencies, such as the Regional Board and other resource agencies as appropriate, regarding marsh issues (e.g., water quality). Principal agency actions related to the SMP are as follows, and are further described in the SMP.

Principal Agencies' Actions Related to the Suisun Marsh Plan

Agency	Suisun Marsh Habitat Management, Preservation, and Restoration Plan Action
Reclamation	Implementation of Managed Wetland Activities Implementation of PAI Fund[1]
USFWS	Implementation of Restoration Issuance of Biological Opinion
DFG	Implementation of Restoration Implementation of Managed Wetland Activities Issuance of Incidental Take Permit for non–Fully Protected Species Implementation of PAI Fund
NMFS	Issuance of Biological Opinion; Issuance of Essential Fish Habitat Conservation Recommendations
DWR	Implementation of Restoration Implementation of Managed Wetland Activities Implementation of PAI Fund
SRCD	Implementation of Managed Wetland Activities Implementation of PAI Fund
CALFED	Provide Guidance for Restoration through the Science Program

Reclamation = U.S. Department of the Interior, Bureau of Reclamation.
PAI = Preservation Agreement Implementation.
USFWS = U.S. Fish and Wildlife Service.
DFG = California Department of Fish and Game.
NMFS = National Marine Fisheries Service.
DWR = California Department of Water Resources.
SRCD = Suisun Resource Conservation District.
CALFED = CALFED Bay-Delta Program.

[1] The PAI Fund is included in the Revised SMPA and is proposed to fund certain maintenance activities to support mitigation obligations for the CVP and SWP operations, and is described in Chapter 2.

2. Adaptive Management Advisory Team (AMAT)

While project planning and design relies ultimately on the project managers for each restoration project, a network of staff from state and federal agencies will provide an interface for effective science, management, and outreach partnerships. The AMAT will be comprised of technical staff from DFG, DWR, SRCD, Reclamation, and USFWS, with invitations to other entities to participate as appropriate. The AMAT is guided by the AMAT Charter (Attachment 2), the purpose of which is to:

- Summarize the SMP objectives;

- Describe how the adaptive management process will be applied in the implementation of the SMP;
- Define the mission and objectives of the AMAT;
- Describe the relationship of the AMAT to the Principals and other groups; and,
- Define the core membership and the roles and responsibilities of the AMAT.

Project proponents are encouraged to use the AMAT and their knowledge of the Marsh for project development and support and as a forum to coordinate and cooperate for the benefit of the overall restoration goals. An MOU among the AMAT agencies will be pursued defining the roles and responsibilities of the members with respect to achieving the SMP objectives and implementing adaptive management. While retaining their existing individual land management authorities, project proponents will coordinate with the AMAT to develop project planning and design documentation, quantify specific restoration objectives and targets, and develop monitoring plans and schedules. Coordination with the AMAT does not preclude project proponents from their regulatory due diligence. No regulatory authority has been delegated to the AMAT. Each AMAT participating agency retains their own regulatory authority. The AMAT will coordinate with the Suisun Principals as appropriate.

The AMAT will:

- Provide access to detailed and updated conceptual models that synthesize existing knowledge of the Marsh
- Provide access to ongoing monitoring
- Review proponents' projects, restoration targets, and monitoring plans
- Evaluate whether each project is contributing towards the overall SMP objectives
- Make recommendations for project additions or changes
- Conduct periodic reviews of project results
- Incorporate a feedback loop that links implementation and monitoring to a decision-making process

- Improve restoration designs to achieve desired SMP results
- Make recommendations to the Principal Agencies regarding implementation of the SMP
- Submit, every other year, an implementation status report to DFG, NMFS, USFWS and other regulatory agencies as required.

3. Information Management

As funding and staff become available for site specific projects, and in accordance with permit requirements (ie, biological opinions); data storage and access, including monitoring and/or GIS data, will be collected and made available to act as a link for planning future projects. The AMAT will be responsible for data storage and access, including monitoring and/or GIS data, and act as a link for all data collected. Data collected by this group will also include other relevant projects from around the Bay such as the San Francisco Bay and Napa Salt Ponds Restoration Projects. The AMAT will ensure that monitoring data and reports are made widely available, including to the Principal Agencies

4. Stakeholder Participation

Local stakeholder involvement is essential to meet the SMP objectives. Stakeholders will provide input to the AMAT to help guide restoration and adaptive management actions. The Stakeholder Group could include local public agencies, including SRCD; landowners; and other interested parties to provide on-going, local landowner-derived input to the Principals on adaptively managing implementation of the SMP.

B. Project Success Criteria

The U.S. Department of the Interior (USDOI) Adaptive Management Technical guide defines adaptive management as successful if progress is made toward achieving management goals through a learning-based (adaptive) decision process (Williams et. al. 2009). It also indicates that successful adaptive management: shows recognizable progress toward achieving objectives in a reasonable time frame, implements learning-based management with stakeholder involvement, and is consistent with all applicable laws and regulations. The SMP project success criteria is based on meeting the targets of restoring 5,000 to 7,000 acres of tidal wetlands habitat and protecting and enhancing 40,000 to 50,000 acres of seasonal wetland habitat.

Restoration of tidal wetlands is consistent with the *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California.* The goal of the *Draft*

Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California is the comprehensive restoration and management of tidal marsh ecosystems in five recovery units; Suisun Bay, San Pablo Bay, the Central/South San Francisco Bay, Central Coast, and Morro Bay Recovery Units. Restoring 5,000 to 7,000 acres of tidal wetlands will aid in the recovery of the California clapper rail, salt marsh harvest mouse, Suisun thistle, and soft bird's-beak with the Suisun Bay Recovery Unit.

Due to the long time frame for tidal marsh evolution and the difference in wildlife values of various types of tidal habitats, it is difficult to determine the end-point for project success. Projects related to, or tiered, from the SMP should incorporate post-construction monitoring and adaptive management to assess whether natural processes can sustain the long-term evolution of tidal marsh.

As elements and processes of managed wetland are constantly changing, adaptive management should be incorporated annually to track and determine the success of enhancement projects.

For each individual project tiered from the SMP a clear time line of monitoring would be developed in a manner to document results that would require a modification of the project, or identify possible new actions needed for the project to perform as intended.

C. Assessment of Monitoring Results

As it becomes available, the AMAT will review monitoring data for specific projects to assess how successful the individual tidal restoration projects are being at meeting their specific objectives. Also, the AMAT will annually review available monitoring data to assess progress towards achieving the overall SMP objectives. The AMAT will provide recommendations on additional monitoring needs and changes to restoration design based on review of past projects.

D. Feedback Loop and Decision Making

Technical learning will occur over a relatively short term, during which objectives, alternatives, and other elements remain unchanged. On the other hand, learning about the decision process itself will occur through periodic revisiting of the AMP elements over the longer term. The AMAT will primarily act as a feedback loop for new knowledge assimilated from ongoing actions and individual enhancement and restoration projects. An important role of the AMAT will be ensuring clear communication of the current understanding of existing baseline condition data to project proponents during the planning process. Also, the AMAT will provide a forum to advise project proponents of adverse conditions potentially impacting tidal restoration projects early in the planning process. As appropriate, the AMAT will advise the Principal Agencies of the need for changes to the SMP objectives and/or implementation strategy based on new information from project specific monitoring.

As described in the Implementation Strategy Section of Chapter 2 of the SMP EIS/EIR and as consistent with regulatory permits, the SMPA agencies (Reclamation, SRCD, DWR, and DFG) will submit implementation status reports no less frequently than every other year to DFG, NMFS, and USFWS, and other regulatory agencies that would describe the implemented restoration activities, monitoring, application of adaptive management, results of adaptive management, and any activities that are being planned.

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Attachment 1
SMP Conceptual Model Uncertainties

Water Quality

Methylmercury/Contaminants

Are existing mercury deposits in Suisun being buried or eroded?

Is the methyl mercury that is produced in the Marsh a source to the estuary or is the estuary a source to the Marsh?

Within the Marsh, where will the exposure of methyl mercury to biota be the highest? Managed
wetlands, marshes, channels? Which species are most at risk?

If tidal wetlands are created how can the methyl mercury exposure to biota be minimized? How can export to surrounding marshes and/or sloughs be minimized?

Do the discharges from the managed wetlands that have low dissolved oxygen readings also have high methyl mercury concentrations and can the discharges be regulated to minimize the methyl mercury concentrations?

Are there habitats in Suisun which are better mercury methylators? Can we learn something from these that will be useful in tidal marsh restoration?

Do biota respond to periodic pulses of available methyl mercury or is it the longterm annual concentration that is critical?

Document the distribution and forms of mercury within the Suisun Marsh.

What are the mercury transport mechanisms in the Marsh?

Determine the mass balance of mercury and methyl mercury in the Marsh.

The relative contribution of methyl mercury production in managed wetlands and tidal wetlands has not been determined.

What are the methyl mercury concentrations in fish in the Marsh?

What factors influence methyl mercury production in the Suisun Marsh?

Is the oxic-anoxic sediment interface in a given wetland the primary factor in methyl mercury production?

Are existing total mercury concentrations known for the given location? Is mercury speciation known?

Will implementation of the alternative result in a change in the amount of oxicanoxic interface in the sediments?

What is the toxicity of Ammonia/um to pelagic organism decline (POD) (CALFED Science Workshop 2009)?

Is implementation of the alternative likely to affect the level of activity of methylating bacteria (see Methyl Mercury Conceptual Model Table 1)?

What are the effects of pollutants on food production for wildlife?

What are the effects of managed wetland drainage water on ambient water quality?

What role do managed wetlands play in dissolved organic carbon and methelated mercury production?

What is the relationship between low dissolved oxygen events and management of wetlands?

Fish and Wildlife

What is the current use and density of species inhabiting managed wetlands?

Will enhancing current managed wetland functions aid multiple species?

Would it benefit listed species to allow wetland managers to manage specific sections of their property for them?

Would unrestricted access to water during fresh periods and saltier water later in the year benefit listed species?

What are the effects of tidal aquatic restoration on food web productivity at levels that could support fish and wildlife?

What is the waterfowl food availability and densities on managed wetlands?

What are waterfowl food preferences in Suisun?

What habitats do ducklings use and the effects of salinity on ducklings?

What are the effects of tidal restoration on waterfowl populations?

What are the Regional habitat availability effects on indicators of waterfowl use in Suisun?

Is it possible to increase the carrying capacity of managed wetlands for waterfowl under current regulatory restrictions?

Will increasing carrying capacity for wintering waterfowl on managed wetlands enhance other wildlife values?

What are the impacts of wetland management on birds nesting in wetland areas?

Evaluate the California clapper rail for effects of contaminants, connectivity, salinity, and use of dredge material to accelerate the restoration process.

Do fish screens affect foraging of waterbirds on managed wetlands?

Evaluate the Salt marsh common yellowthroat for connectivity, effects of non-native invasive plant species, inundation regime, and brown headed cowbirds.

Evaluate the Salt marsh harvest mouse for effects of other rodent species, non-native invasive plant species, connectivity, effects of contaminants, and geomorphology.

What are the effects of tidal restoration on salt marsh harvest mouse (SMHM)?

How do bat species use the Suisun Marsh?

What is the distribution of Suisun shrew on both managed and tidal wetlands of Suisun?

What impacts does wetland management have on the Suisun shrew ?

What are the impacts to wetlands by wild pigs?

What are the effects of mosquito control and management on bat populations?

What are the impacts to fish species by drain water conditions (i.e. organic matter, low DO)?

What are the impacts to fish species by unscreened diversions with current regulations on diversions?

Would additional fish-screens address potential impacts to anadromous and special status fish in the Suisun Marsh?

Is fish entrainment in managed ponds temporary (fish return to sloughs) or permanent?

What is the abundance, distribution, and detailed species composition of submerged aquatic vegetation (SAV) in Suisun Marsh?

How do waterfowl and fish use SAV in Suisun Marsh?

Explore the effects of decreased habitat connectivity in the marsh due to the SMSCG and other water control structures on aquatic species such as delta smelt, longfin smelt, splittail, and resident native species.

Investigate effects of marsh geomorphology on delta smelt and longfin smelt use of Suisun Marsh.

Determine the importance of turbidity in comparison to other water quality parameters, to longfin smelt use of Suisun Marsh.

Evaluate the importance of invertebrate community composition to delta and longfin smelt use of Suisun Marsh.

Evaluate the Central Valley fall/late-fall, Sacramento River winter-run and Central Valley spring-run Chinook salmon for habitat utilization and residence time in the marsh.

Evaluate the Central California Coast and Central Valley steelhead for habitat utilization and residence time in the marsh.

Evaluate the Green sturgeon for habitat utilization, water quality preferences and residence time in the marsh.

Research is needed on determining effects of dredging on fisheries rearing, spawning, and migration habitat in tidal sloughs.

Salinity

What is the relationship between applied water salinity and plant community composition and growth (poor water salinity)?

What is the leaching efficiency of applied water?

Is salinity the primary driver of ecological functions in the Suisun Marsh?

What is the distribution of phytoplankton with regard to salinity?

Identify which levees are most important to the protection of local and regional salinity, and what are their critical design features.

Subsidence

What is the mechanism for subsidence?

Where is subsidence occurring in the Suisun Marsh?

Specifically, where in a managed pond does subsidence take place?

How much subsidence is there and at what rate does it occur in Suisun?

What is the importance of drying ponds in August to September?

What is the re-suspension of sediment by wind and wave action?

Does the placement of mineral sediment onto peat soil cause subsidence?

How do management strategies affect soil chemistry?

What is the relationship between internal recirculation of water and sedimentation?

What is the source of sediment in internal ditches?

What are the subsidence rates in the Suisun Marsh?

Would reduced discing frequency and reflooding fallow fields to maintain a high water table slow subsidence in the Suisun Marsh?

What are the long-term trends in sediment supply into Suisun Marsh and Bay from the Delta with projected sea level rise?

Research is needed on management practices that can reduce, eliminate, or mitigate for ongoing subsidence.

Research is needed to determine the cause as well as the individual and cumulative effect of subsidence and sea level rise on levee stability.

Current and continuing studies of sea level rise should consider the associated effects on levees in Suisun Marsh. Research is needed to determine if natural geomorphic processes, such as local or regional sediment accumulation or erosion, can benefit levee program elements to an extent that will counter local or regional sea level rise.

Levees

Would the construction of new interior levees within large wetland ponds improve flooding and draining capabilities?

Would the construction of new interior levees within large wetland ponds create new habitat for multiple species?

Would dividing some ponds into smaller cells (i.e. 50 to 100 acres) reduce the need for aerial mosquito abatement?

What is the effect of future sea level rise on managed wetland levee's and management activities?

Research is needed to determine the beneficiaries for maintenance, improvements, and environmental costs of optimum designs and layouts for successful implementation. An evaluation of an incentive program that will encourage conservation practices and/or appropriate levee design and placement that can reduce overall programmatic cost, habitat impacts, and future risk is needed.

Additional research is needed as follow-up to the linkages identified by the CALFED Levee Program between the Suisun Marsh levee system configuration and water quality in the Delta. (CALFED Suisun Marsh Levees Investigation Report, March 2001)

Research on the design of levees with additional habitat features such as extended levee berms to provide opportunities to improve the level of flood protection and create needed habitat is needed. Research on the ability of dense vegetation growth on replacing the need for rip-rap is needed.

Evaluation of the potential use of newly established upland-like habitat levee areas by terrestrial vertebrate predators and what are impacts to species of concern is needed.

Additional research is needed to evaluate if larger initial environmental impacts may be offset in the long-term through reduced maintenance requirements associated with reinforced levee slopes. At the same time, research is needed to evaluate if the larger volume of material needed can be effectively supported by the existing underlying Marsh peat soils.

Research is needed in developing a strategy for utilizing dredge material collected within Suisun Marsh and from adjacent waterways as well as alternative sources.

Invasives

What are the threats posed by *Phragmites australis* in tidal marsh and adjacent shallow aquatic habitats?

What is the status of native versus non-native stands of common reed in invaded areas?

What is the potential for establishment of *Corbula* in restoration sites?

Processes

What are the causes of decline in phytoplankton biomass in Suisun?

What is the relative importance of different mechanisms relating river flow to chlorophyll concentration?

What is the ecological difference between shallow subtidal habitat from deep subtidal habitat?

How do changes in the abiotic or biotic structure of the marsh change the processes and functions of the marsh?

Do the shallow water habitats of diked wetlands provide an inundated floodplain value (e.g.Yolo bypass)?

Determine the characteristic population growth rate of producers in donor (title restoration) habitats.

Measure nutrient cycling in both high and low productivity habitats for evidence of nutrient limitation in productive habitats and possible export of reconstituted nutrients from respiration dominant habitats.

Investigate mechanical and metabolic constraints on zooplankton growth as a function of food availability.

Attachment 2
Adaptive Management Advisory Team Charter for the Suisun Marsh Habitat Management, Preservation and Restoration Plan

May 9, 2013

I. Background

The Suisun Marsh Habitat Management, Preservation and Restoration Plan (SMP) is a 30-year comprehensive plan that addresses habitats and ecological processes, public and private land use, levee system integrity, and water quality through tidal restoration and managed wetland activities. The SMP's purpose is to create an acceptable balance between protection and enhancement of managed wetlands and the restoration and protection of tidal wetlands (SMP Final EIR/EIS, Volume II, Appendix E, Page E-4).

The SMP was developed and will be overseen by the Suisun Principal Agencies (the Principals). These agencies are the U.S. Fish and Wildlife Service (USFWS); U.S. Department of Interior, Bureau of Reclamation (Reclamation); California Department of Fish and Wildlife (DFW); California Department of Water Resources (DWR); National Marine Fisheries Services (NMFS); Suisun Resource Conservation District (SRCD); and the Delta Stewardship Council (successor to the CALFED Bay-Delta Program).

Guiding Principles for SMP Implementation

1. The SMP will be implemented through the application of adaptive management.
2. The SMP Adaptive Management Plan targets multi-species benefits rather than focusing on individual species.
3. The SMP will be implemented in a manner consistent with the 1977 Suisun Marsh Preservation Act, Suisun Marsh Preservation Agreement (SMPA), the Department of Fish and Game's Ecosystem Restoration Program (ERP) *Conservation Strategy*, the U.S. Fish and Wildlife Service's *Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California*, and the Delta Stewardship Council's *Delta Plan* (expected to be adopted in 2013).

II. Purpose of the Charter

The SMP states that adaptive management is essential to keeping the SMP on track toward its objectives and minimizing potential impacts associated with the implementation of SMP actions (SMP Implementation Strategy, p. 65). The SMP Adaptive Management Plan calls for the formation of an Adaptive Management Advisory Team (AMAT). The purpose of the AMAT Charter is to:

- Summarize the SMP objectives;
- Describe how the adaptive management process will be applied in the implementation of the SMP;
- Define the mission and objectives of the AMAT;
- Describe the relationship of the AMAT to the Principals and other groups; and
- Define the core membership and the roles and responsibilities of the AMAT.

III. SMP Objectives

The SMP objectives may be summarized as follows:

1. Restore 5,000 to 7,000 acres of tidal marsh to contribute to the recovery of threatened and endangered species.
2. Protect and enhance 40,000 to 50,000 acres of managed wetlands to benefit waterfowl and other resident and migratory wildlife species.
3. Improve ecological processes and reduce stressors, such as invasive species and contaminants.
4. Maintain waterfowl hunting heritage and expand opportunities for hunting, fishing, bird watching, and other nature-oriented recreational activities.
5. Maintain and improve Marsh levee system integrity.
6. Protect and, where possible, improve water quality for beneficial uses in the Marsh.

(For the full description of the SMP objectives, see the SMP Final EIR/EIS, Volume II, Appendix E, Page E-5.)

IV. Definition of Adaptive Management in the Context of the SMP

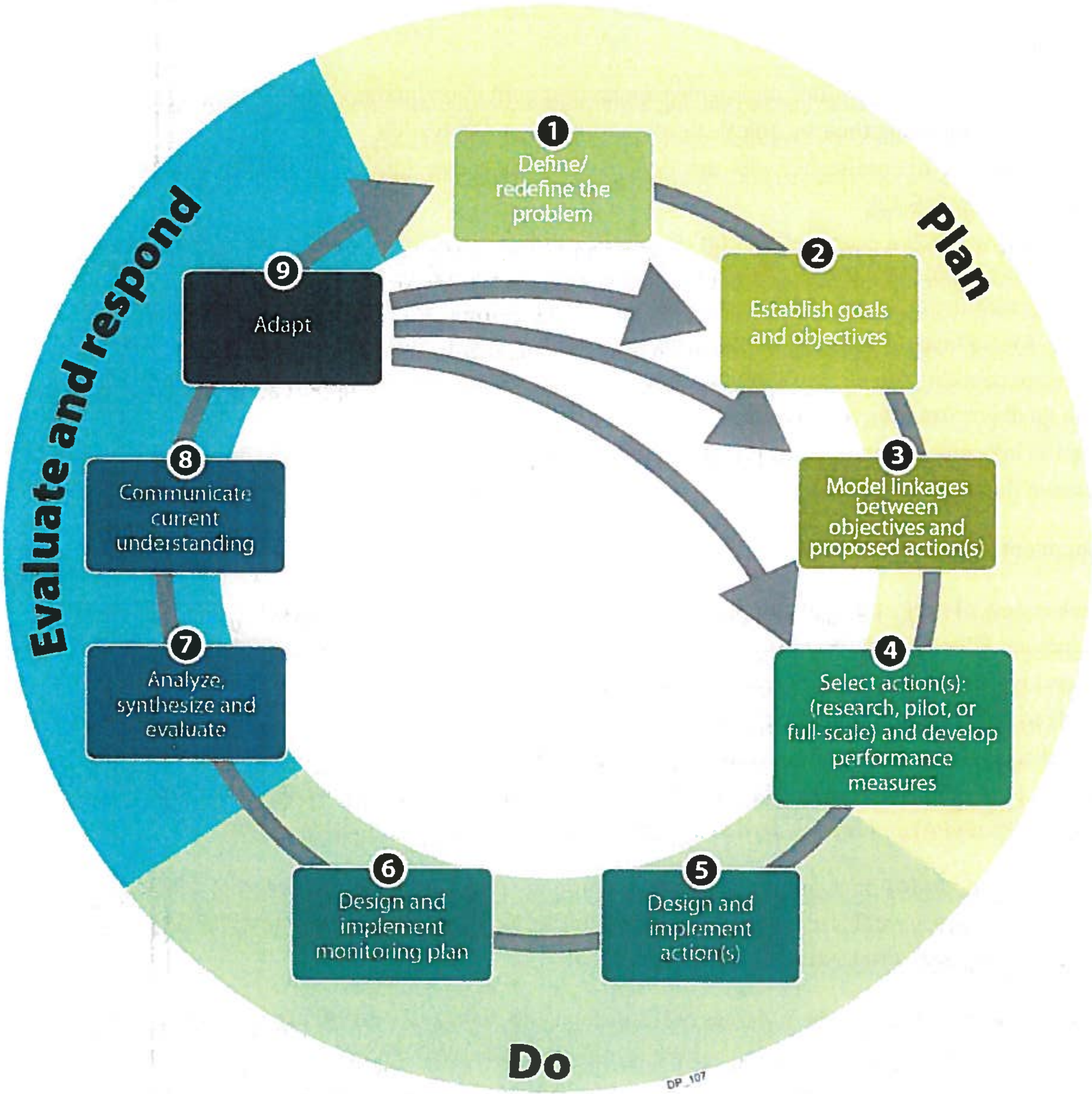
The SMP Adaptive Management Plan (SMP Implementation Strategy, Appendix A) defines adaptive management as "the process of learning by doing and then using the results to improve management actions (Walters and Holling, 1990)." The SMP Adaptive Management Plan further states that adaptive management "involves ongoing, real-time learning and knowledge creation. In an adaptive management approach, resource management and restoration policies are viewed as scientific experiments." (SMP Final EIR/EIS, Volume II, Appendix E, Page E-5)

The SMP Implementation Strategy calls for passive and active adaptive management (SMP Final EIR/EIS, Volume II, Appendix E, Page E-6), described as follows:

- Through passive adaptive management, the Principals will learn how to ensure better attainment of the SMP objectives based on monitoring the effectiveness of management actions.
- Active adaptive management will involve the Principals encouraging project proponents to carry out targeted studies to resolve uncertainties related to the best approach to achieving specific objectives.

The Principals will, where appropriate, use the adaptive management framework presented in the Draft Delta Plan. The Draft Delta Plan describes the adaptive management process as shown in Figure 1. This process will be applied, as appropriate, at both the landscape scale and the project scale.

Figure 1. A Nine-Step Adaptive Management Framework



Source: Draft Delta Plan (2012), Delta Stewardship Council, Sacramento, CA.

V. AMAT Mission Statement

The mission of the AMAT is to support the Principals in using adaptive management, including use of best available science, to achieve the SMP objectives. This will be accomplished by staffing the AMAT with technical experts who will provide guidance to project proponents and the Principals. The members of the AMAT are discussed later in Section VII below.

VI. Relationship of the AMAT to the Principals and Other Groups

The Principals will:

- Establish the AMAT by drafting and signing a memorandum of understanding among participating agencies and directing their technical staff to participate in the AMAT;
- Review projects for consistency with the SMP goals and objectives (SMP Final EIR/EIS, Volume II, Appendix E, Page E-16);
- Determine whether a proposed habitat restoration project in the Suisun Marsh can be expected to help achieve the habitat goals of the SMP based on input from the AMAT;
- Request that the agencies with responsibility for issuing permits for tidal restoration projects in the Suisun Marsh facilitate permit coordination by convening regular meetings with permit applicants ;
- Facilitate coordination of monitoring for regulatory compliance and to support adaptive management, with guidance from the AMAT; and
- Use the information, analysis and synthesis provided by the AMAT to adapt implementation to better achieve the SMP objectives.

Project proponents will:

- Seek review of project design and the adaptive management plan from the AMAT, *If the project proponent intends to tier from the SMP environmental documents and the Principals determine that the project will help achieve the objectives of the SMP*;
- Apply for all necessary permits from the regulatory agencies; and
- If applicable, request habitat mitigation credits from the appropriate groups, such as the Fisheries Agency Strategy Team (FAST), which handles habitat crediting for the Fish Restoration Program Agreement (FRPA) and the Bay Delta Conservation Plan early implementation projects.

(Coordination with the AMAT does not preclude project proponents from their regulatory due diligence. Each AMAT participating agency retains its own regulatory authority. No habitat mitigation crediting authority has been delegated to the SMP Principal Agencies or the AMAT.)

Revised SMPA Agencies. To track the progress of restoration and managed wetland activities, the Revised Suisun Marsh Preservation Agreement agencies (Reclamation, SRCD, DWR, and DFW) will submit implementation status reports no less frequently than every other year to DFW, NMFS, and USFWS, and other regulatory agencies that would describe the implemented restoration activities, monitoring, application of adaptive management, results of adaptive management, and any activities that are being planned (SMP Final EIR/EIS, Volume II, Appendix E, Page E-20).

Delta Science Program. The Delta Science Program (DSP) will support the AMAT by working with others to develop a landscape-scale conceptual model for the Suisun Marsh, building upon existing resource specific conceptual models developed for the SMP (SMP Final EIR/EIS, Volume II, Appendix E, Page E-8). The Delta Science Program will coordinate with the SMP to:

- Identify uncertainties associated with the conceptual model and assist in seek funding and in-kind contributions to accomplish studies and analysis to reduce uncertainties.
- Determine how information gained from project-specific monitoring can be used to reduce uncertainties in the landscape-scale conceptual model.
- Use the landscape-scale conceptual model to inform implementation of the SMP and serve as the repository for what is learned.

The DSP will assist project proponents by providing early consultation on project design and adaptive management plans for restoration projects that are covered actions under the Delta Plan. The DSP will also support SMP implementation through the development of the Delta Science Plan, which will be a shared plan that organizes and integrates ongoing scientific research, monitoring, analysis, and data management for the Delta science community. The Delta Science Plan will recommend approaches for an integrated monitoring approach, data management and accessibility, shared computer models, and synthesis of scientific knowledge.

ECAT. The Principals and the AMAT will coordinate with other programs with jurisdiction in or focus on the Suisun Marsh, such as the Environmental Coordination and Advisory Team (ECAT). The ECAT's responsibilities include: (1) ensuring compliance with mitigation and monitoring requirements of the Revised SMPA, related permits, and biological opinions, and (2) provide technical guidance and oversight of Suisun Marsh monitoring, management, and restoration programs conducted as part of the SMPA (page 26 RSMPA).. Monitoring data collected and reports generated by the ECAT may provide useful inputs to the performance measures that will be used to track progress toward achieving the SMP objectives.

VII. Membership, Roles and Responsibilities of the AMAT

The AMAT will be comprised of technical staff from DFG, DWR, SRCD, Reclamation, USFWS, NMFS, and the Delta Stewardship Council, with invitations to other technical experts (i.e., Delta Science Program staff) to participate as appropriate. These seven agencies serve as the Core AMAT Members and have primary responsibility for implementation of the AMAT Charter. The other technical experts may be drawn from public agencies, academia, research institutes, non-profit organizations and the private sector.

The AMAT will guide adaptive management at the landscape and project scale.

LANDSCAPE-SCALE ADAPTIVE MANAGEMENT

For the purposes of this Charter, landscape-scale adaptive management refers to adaptive management at the scale of the geographic area covered by the Suisun Marsh Plan.

Roles of the AMAT in Landscape-Scale Adaptive Management

1. **Coordinate with the Delta Science Program in its Development of a Landscape-Scale Conceptual Model for the Suisun Marsh.** During preparation of the SMP, conceptual models were developed for several resource categories, including managed wetlands, tidal marsh and aquatic habitat, levees, scalar transport and geometry, and water quality. These conceptual models have been developed to assist projects with information regarding the current scientific understanding of the Marsh, and identify

uncertainties and potential actions. The models can be used to assist with selecting, designing, and predicting outcomes of project-specific design and objectives (SMP Final EIR/EIS, Volume II, Appendix E, Page E-8). Coordinating with the AMAT and building upon the existing conceptual models, the Delta Science Program will work with others to develop and continually refine a landscape-scale conceptual model for Suisun Marsh based on the best available science (Draft Delta Plan, Ecosystem Chapter, Science Needs section). During the development of the landscape scale conceptual model, the AMAT will proceed with project review using existing conceptual models.

2. **Pursue Research to Address Key Issues.** Conduct research and pilot projects to address key issues, such as fish and wildlife recovery, subsidence reduction and reversal, and water quality, as ecologically appropriate opportunities and associated funding become available.

3. **Advise Principals in Using Performance Measures to Track Plan Implementation**. Advise the Principals in developing performance measures to track progress toward achieving the SMP objectives such as acreage of tidal marsh restored, abundance of waterfowl and listed species, water quality, etc.
   - Advise in the development of standardized monitoring protocols.
   - Advise in data management to facilitate easy access to the full range of existing monitoring data, including ECAT data.
   - Report, at a minimum, yearly to the Principals, other resource managers and stakeholders, on progress in implementing the SMP, based on the performance measures. Include a synthesis of whether the restoration projects are producing the outputs and outcomes expected and a status update on the progress made toward the SMP objectives.

4. **Advise in Adaptive Management of the Suisun Marsh Plan.** As appropriate, advise the Principals of the need for changes to the SMP objectives and/or implementation strategy based on new information (SMP Final EIR/EIS, Volume II, Appendix E, Page E-20).
   - Work with the Delta Science Program to facilitate periodic independent scientific review of SMP implementation (SMP Implementation Strategy, page 66).

PROJECT-SCALE ADAPTIVE MANAGEMENT

As described above, before the AMAT becomes involved in guiding the adaptive management of a proposed restoration project, the Principals must determine whether the project will fall under the purview of the SMP. The screening process consists of the following steps:

1. The project proponent determines whether s/he intends to use the SMP environmental documents rather than developing project-specific environmental documents.
2. The project proponent will be required to consult with the AMAT in the development of a monitoring and adaptive management plan for the project. The AMAT will also provide project design review.
3. The Principals may also request that agencies with permit authority convene a regulatory group to facilitate coordination of permit requirements for restoration projects. The group may request input

from the AMAT on monitoring parameters and adaptive management actions to include in permit conditions.

Roles of the AMAT in Restoration Projects

1. Review tidal restoration project designs and advise project proponents on how to increase chances of achieving project objectives and minimize adverse effects, based on lessons learned from ongoing and completed projects.
2. Review monitoring and adaptive management plans. Advise on the use of standardized monitoring protocols where possible. Help each project proponent develop a monitoring program tailored to the purpose of the project in order to enable evaluation of project success, and designed to address scientific uncertainties in order to help inform future restoration projects. Provide input to regulatory agencies on monitoring needed to track project performance.
3. Review project monitoring reports and evaluations of project success. Draw conclusions regarding success or failure of projects. Determine lessons learned and conditions under which those lessons are applicable for future restoration actions and updating the landscape-scale conceptual model.

VIII. AMAT Operations

The AMAT will meet quarterly, at a minimum, and it may hold additional meetings as appropriate. The AMAT will have an appointed chairperson from one of the core member agencies, as defined in Section VII above, and the position will rotate to a different agency every two years. Notes from each AMAT meeting will be prepared, and will include a summary of the meeting discussions, record any decisions made, and identify action items with schedules. The AMAT will utilize an internet-based data portal for information sharing and progress tracking.

IX. Updates to the Charter

The AMAT Charter may be updated as necessary.

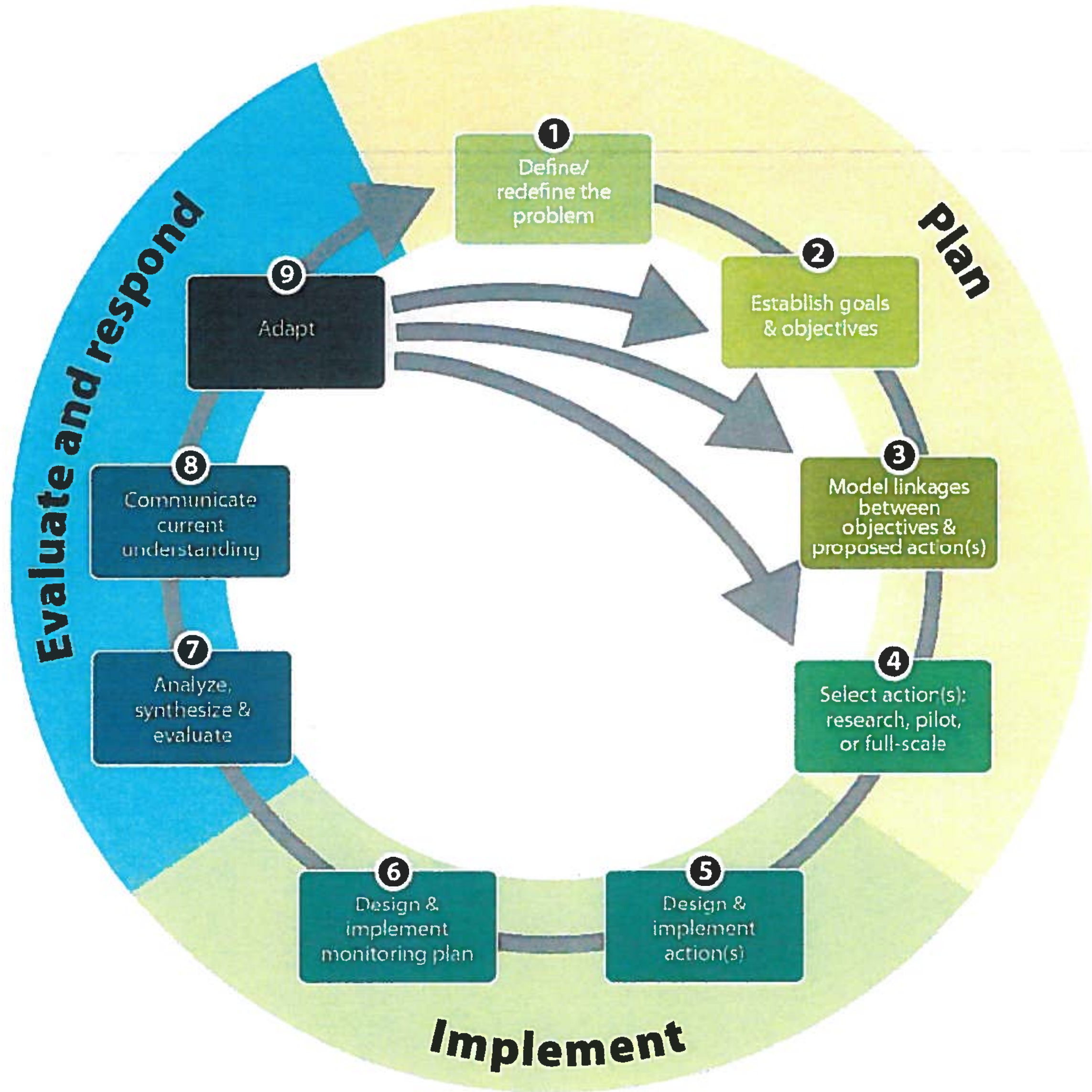


Figure 1a
General Adaptive Management Process

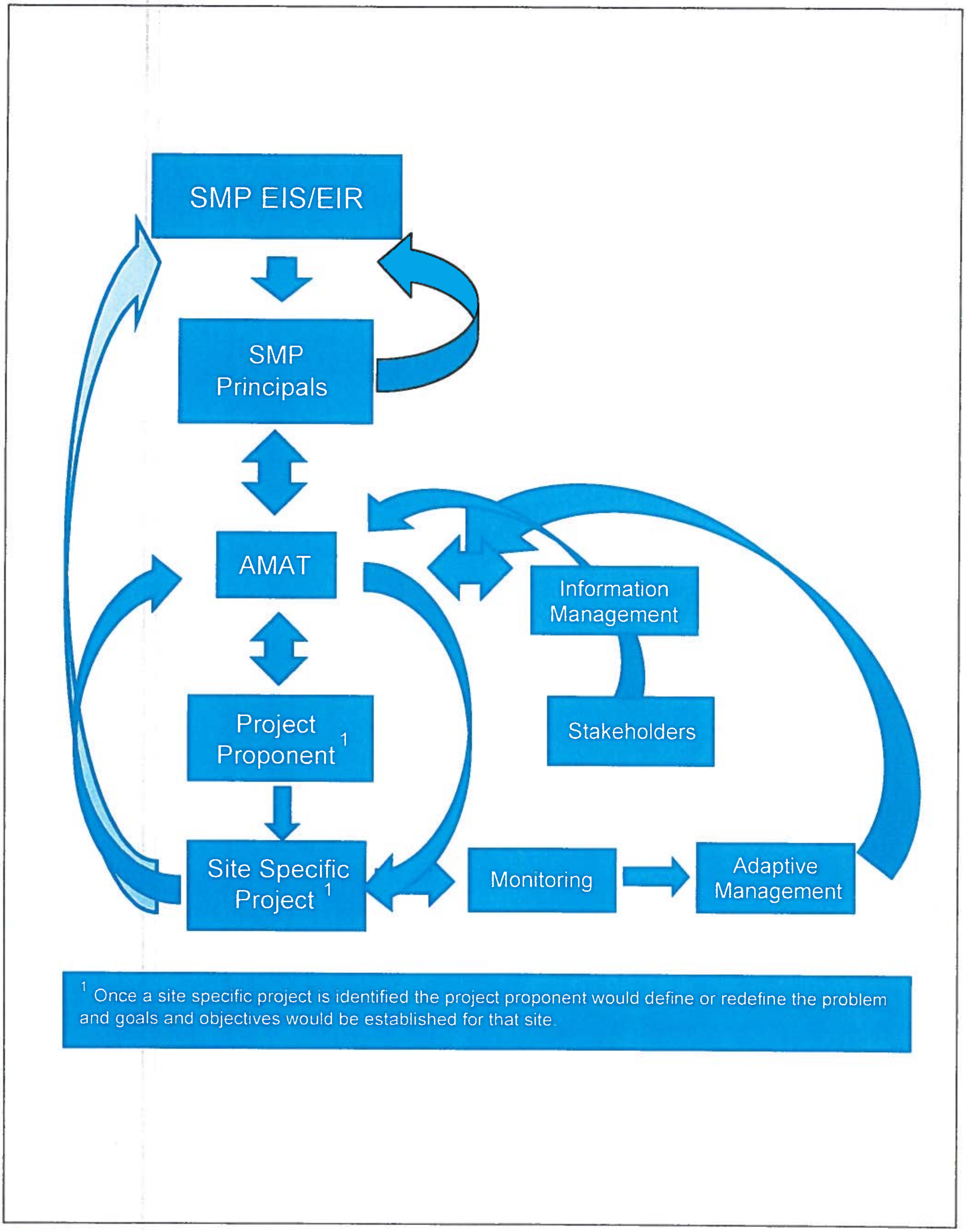


Figure 1b
Suisun Marsh Plan Adaptive Management Decision Matrix

Appendix B

Mitigation Monitoring and Reporting Program

Appendix B
Mitigation Monitoring and Reporting Program

Mitigation Monitoring and Reporting Program for the Suisun Marsh Habitat Management, Preservation, and Restoration Plan

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
General			
Implement standard design features and construction practices for restoration activities: • Construct structures in accordance with California Building Code and County General Plan Standards to resist seismic effects and to meet the implementation standards outlined in the Solano County General Plan; • Ensure that changes within the Suisun Marsh channels will not significantly affect navigation and emergency access by having Rio Vista and Vallejo Coast Guard Stations review plans to assess safety issues associated with changes when there is potential for in-channel work to affect access; • Implement Best Management Practices to minimize any disease-carrying mosquitoes and threats to public health if it is found that project components pose a threat to public health; • Control construction equipment access and placement of fill to maintain acceptable loading based on the shear strength of the foundation material; • Minimize degradation of wetland habitats where feasible, i.e., work will be conducted from levee crown; • Implementing BMPs and measures to minimize water quality impacts such as temporary turbidity increases. (see Erosion and Sediment Control Plan); • Inspect all equipment for oil and fuel leaks every day prior to use. Equipment with oil or fuel leaks will not be used within 100 feet of wetlands; • Require the construction contractor to remove all trash and construction debris after construction and to implement a revegetation plan for temporarily disturbed vegetation in the construction zones; and • Maintain waste facilities. Waste facilities include concrete wash-out facilities,, chemical toilets, and hydraulic fluid containers. Waste will be removed to a proper disposal site.	Environmental commitment	Prior to and during construction	Contractor
Establish access point/staging areas	Environmental commitment	Prior to and during construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Continue existing Best Management Practices	Environmental commitment	Prior to, during and following construction	SRCD, DWR, Reclamation, and landowners (including DFG)
Water Supply, Hydrology, and Delta Water Management			
None			
Water Quality			
Prepare and implement an Erosion and Sediment Control Plan	Environmental commitment	Prior to and during construction	Contractor
Prepare and implement a Stormwater Pollution Prevention Plan, which will include but is not limited to: • 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.	Environmental commitment	Prior to and during construction	Contractor
Prepare and implement a Hazardous Materials Management Plan	Environmental commitment	Prior to and during construction	Contractor
Geology and Groundwater			
Prepare and implement an Erosion and Sediment Control Plan	Environmental commitment	Prior to and during construction	Contractor
Prepare and implement a Stormwater Pollution Prevention Plan, which will include but is not limited to: • 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	Environmental commitment	Prior to and during construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
• a description of potential pollutants to stormwater resulting from operation of the project.			
Flood Control and Levee Stability			
Prepare and implement an Erosion and Sediment Control Plan	Environmental commitment	Prior to and during construction	Contractor
Sediment Transport			
Prepare and implement an Erosion and Sediment Control Plan	Environmental commitment	Prior to and during construction	Contractor
Transportation and Navigation			
Ensure that changes within the Suisun Marsh channels will not significantly affect navigation and emergency access by having Rio Vista and Vallejo Coast Guard Stations review plans to assess safety issues associated with changes when there is potential for in-channel work to affect access. Prepare and implement a Traffic and Navigation Control Plan and Emergency Access Plan, which will include but not be limited to the following actions, depending on site-specific conditions: • 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's) Manual of Traffic Controls for Construction and Maintenance Works Zones; • notifying the public of road closures in the immediate vicinity of the open trenches in the construction zone and of temporary closures of recreation trails; • 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 Solano County to monitor and repair road damage to levee roads and any other roads damaged during construction to the extent allowed by law, depending on the specific project proponent. An MOU may be implemented for specific restoration projects and could include the following as suggested by Solano County: o The restoration project will be responsible for the cost of maintaining, repairing, paving and/or reconstructing roads affected during construction, operation, and maintenance of the restoration project. o Repairs will be implemented to comply with the current County Road Improvement Standards, except that repairs to damaged paved sections may be made within 5 inches of	Environmental commitment	Prior to and during construction	Project proponent

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
asphalt concrete at the discretion of the County, while repairs to damaged gravel sections of road will replace the preexisting depth of aggregate base but not less than 12 inches in depth; • coordinating with the Union Pacific Railroad prior to beginning any work within the right-of-way of a rail line to ensure that the integrity of the rail line is maintained and to minimize disruptions to service; and • coordinating with emergency service providers before construction to develop an emergency access plan for emergency vehicles 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.			
Establish Access Point/Staging Areas	Environmental commitment	Prior to and during construction	Contractor
Air Quality			
Implement air quality Best Management Practices: Basic Control Measures • treat all graded surfaces to prevent nuisances from dust or spillage on roads or adjacent properties. Enhanced Control Measures The following measures will be implemented at construction sites greater than 4 acres in area: • hydroseed with native or non-invasive species appropriate to that specific location or apply (nontoxic) soil stabilizers to inactive construction areas (i.e., previously graded areas inactive for 10 days or more); • limit traffic speeds on unpaved roads to 15 mph; • install sandbags or other erosion control measures to prevent silt runoff to public roadways; and • replant vegetation with native or non-invasive species appropriate to that specific location in disturbed areas as quickly as possible. Additional Air Quality BMPs: The following measures will be required in order to further reduce construction emissions: • maintain properly tuned engines; • minimize the idling time of diesel-powered construction equipment to 2 minutes; • use alternative-powered (e.g., hybrid, compressed natural gas, biodiesel, electric) construction equipment;	Environmental commitment	Prior to, during and following construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
• use add-on control devices such as diesel oxidation catalysts or particulate filters; and • require all contractors to use equipment that meets California Air Resources Board's (CARB's) most recent certification standard for off-road heavy-duty diesel engines.			
AQ-MM-1: Limit construction activity during restoration	CEQA-triggered mitigation measure	During construction	Contractor
AQ-MM-2: Reduce construction NO_X emissions	CEQA-triggered mitigation measure	During construction	Contractor
AQ-MM-3: Implement all appropriate BAAQMD mitigation measures	CEQA-triggered mitigation measure	Prior to and during construction	Contractor
AQ-MM-4: Limit restoration and management activity	CEQA-triggered mitigation measure	During construction	Contractor
Noise			
Comply with local noise regulations by limiting construction to the hours specified by Solano County when construction activities occur near residences.	Environmental commitment	During construction	Contractor
When it is determined through site-specific analysis that construction has the potential to occur near residences, the following noise-reduction practices will be implemented: • use electrically powered equipment instead of internal combustion equipment where feasible; • locate staging and stockpile areas and supply and construction vehicle routes as far away from sensitive receptors as possible; • establish and enforce construction site and haul road speed limits; • restrict the use of bells, whistles, alarms, and horns to safety warning purposes; • design equipment to conform to local noise standards; • locate equipment as far from sensitive receptors as possible; • equip all construction vehicles and equipment with appropriate mufflers and air inlet silencers; • restrict hours of construction to periods permitted by local ordinances; and • locate redirected roadways away from sensitive receptors.	Environmental commitment	Prior to and during construction	Contractor
Climate Change			
None			

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Fish			
Prepare and implement a Stormwater Pollution Prevention Plan, which will include but is not limited to: • 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.	Environmental commitment	Prior to and during construction	Contractor
Prepare and implement a Hazardous Materials Management Plan	Environmental commitment	Prior to and during construction	Contractor
Prepare and implement and Erosion Control Plan	Environmental commitment	Prior to and during construction	Contractor
Implement and adhere to construction period restrictions. Landside work will occur between July and September. In-water activities will be conducted from August 1 to November 30. Working outside this window will require additional approvals from the resource agencies.	Environmental commitment	During construction	Contractor
Vegetation and Wetlands			
Minimize degradation of wetland habitats where feasible, i.e., work will be conducted from levee crown.	Environmental commitment	During construction	Contractor
Inspect all equipment for oil and fuel leaks every day prior to use. Equipment with oil or fuel leaks will not be used within 100 feet of wetlands.	Environmental commitment	Prior to and during construction	Contractor
Implement special-status plant species protection measures: • Perform a complete botanical survey of restoration areas using the USFWS's Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants (September 23, 1996) and DFG's Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (November 24, 2009); • Special-status plant surveys required for project-specific permit compliance will be conducted within 1 year prior to initiating construction. The purpose of these surveys will be to verify that	Environmental commitment	Prior to and during construction	Project proponent

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
the locations of special-status plants identified in previous surveys are extant, identify any new special-status plant occurrences, and cover any portions of the project area not previously identified. 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 global positioning system (GPS) unit and flagged; • If initial screening by a qualified biologist identifies the potential for special-status plant species to be directly or indirectly affected by a specific project, the biologist will establish an adequate buffer area to exclude activities that would directly remove or alter the habitat of an identified special-status plant population or result in indirect adverse effects on the species; • Access may be restricted around restoration sites where necessary to protect special-status plant populations though appropriate management plans and the design of the tidal marsh restoration. This may include signage, buffers, seasonal restrictions and design or no access depending on the sensitive species in question; • The project proponents will oversee installation of a temporary, plastic mesh–type construction fence (Tensor Polygrid or equivalent) at least 1.2 meters (4 feet) tall around any established buffer areas to prevent encroachment by construction vehicles and personnel. A qualified biologist will determine the exact location of the fencing. The fencing will be strung tightly on posts set at maximum intervals of 3 meters (10 feet) and will be checked and maintained weekly until all construction is complete. The buffer zone established by the fencing will be marked by a sign stating: *This is habitat of [the special-status species being protected], a [identify the species' status] plant species, and must not be disturbed. This species is protected by [the Endangered Species Act of 1973, as amended/California Endangered Species Act/California Native Plant Protection Act]. Violators are subject to prosecution, fines, and imprisonment.* • No construction activity, including grading, will be allowed until this condition is satisfied; • No grading, clearing, storage of equipment or machinery, or other disturbance or activity will occur until all temporary construction fencing has been inspected and approved by the qualified biologist; and • Where feasible, for stump-sprouting vegetation, construction will limit removal of woody vegetation by trimming vegetation to approximately 1 foot above ground level.			
Implement non-native plant control measures as follows: • Use certified, weed-free, imported erosion control materials (or rice straw in upland areas);	Environmental commitment	Prior to and during construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
• Coordinate with the county agricultural commissioner and land management agencies to ensure that the appropriate BMPs are implemented; • Educate construction supervisors and managers on weed identification and the importance of controlling and preventing the spread of noxious weeds; • Clean equipment at designated wash stations after leaving noxious weed infestation areas; • Treat isolated infestations of 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; • Use certified weed-free native mixes for any restoration planting or seeding as may be necessary, 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; and • Use native, noninvasive species or nonpersistent hybrids in erosion control plantings to stabilize site conditions and prevent invasive species from colonizing.			
Wildlife			
Implement general biological BMPs: • No firearms (except for federal, state, or local law enforcement officers and security personnel) will be permitted at the project site to avoid harassment, killing, or injuring of wildlife; • No pets will be permitted at the project site to avoid harassment, killing, or injuring of wildlife; • Native vegetation trimmed or removed on the project site will be stockpiled during work. After construction activities, removal of temporary mats and construction-related materials, and application of native seed mix have been completed, stockpiled native vegetation will be reapplied over temporarily disturbed wetlands to provide temporary soil protection and as a seed source; • Where vegetation removal is required, work will be conducted using hand-held tools to enable wildlife to escape. If any areas with pickleweed or vegetation within 50 feet of the edge of pickleweed need to be cleared for project activities, vegetation shall be removed only with non-mechanized hand tools (i.e., trowel, hoe, rake, and shovel). No motorized equipment, including weed whackers and lawn mowers, shall be used to remove this vegetation. Vegetation shall be removed under the supervision of a qualified biologist approved by DFG and USFWS. If a mouse of any species is observed within the areas being removed of vegetation, DFG and USFWS shall be notified. Vegetation removal may begin when no mice are observed and shall	Environmental commitment	Prior to, and during construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
start at the edge farthest from the salt marsh or the poorest habitat and work its way toward the salt marsh or the better salt marsh habitat; • Removal of vegetation in wetland habitat will be conducted with a qualified biological monitor present. This monitor will watch for special-status wildlife species and temporarily stop work if special-status species are encountered. Wildlife will be allowed to escape before work is resumed. Monitors with the appropriate qualifications to handle special-status species will be allowed to move special-status species to safe locations as permitted by their authorizations; and • Temporarily affected wetlands will be restored by removing construction-related debris, and trash. Affected areas will be seeded with a seed mix of local native wetland species.			
Prepare and implement an environmental resources worker training program. Project proponents will provide training to field management and construction personnel on the importance of protecting environmental resources. Communication efforts and training will be done during preconstruction meetings. Construction personnel will be educated on the types of sensitive resources located in the project area and the measures required to avoid impacts on these resources. Materials covered in the training program will include environmental rules and regulations for the specific project and requirements for limiting activities to the construction right-of-way and avoiding demarcated sensitive resources areas. Training seminars will 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. If new construction personnel are added to the project, the contractor will ensure that the personnel receive the mandatory training before starting work. A representative will be appointed during the employee education program to be the contact for any employee or contractor who might inadvertently kill or injure a listed species or who finds a dead, injured, or entrapped individual. The representative's name and telephone number will be provided to the USFWS before the initiation of ground disturbance.	Environmental commitment	Prior to and during construction	Project proponent

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Perform preconstruction surveys if individuals of listed wildlife species may be present and subject to potential injury or mortality from construction activities. A qualified biologist will conduct a preconstruction survey; minimum qualifications for the qualified biologist will be a 4-year college degree in biology or related field and 2 years of professional experience in the application of standard survey, capture, and handling methods for the species of concern. However, in the case of fully protected species, no capture or handling will be done. Any special-status mammal, bird or other species observed during surveys will be reported to DFG so the observations can be added to the California Natural Diversity Database.	Environmental commitment	Prior to construction	Project proponent
Implement protection measures for salt marsh harvest mouse and Suisun shrew: • A USFWS-approved biologist, with previous salt marsh harvest mouse monitoring and surveying experience, will identify suitable salt marsh habitat for the mouse prior to project initiation; • Disturbance to wetland vegetation will be avoided to the extent feasible in order to reduce potential impacts on salt marsh harvest mouse habitat. If wetland vegetation cannot be avoided, it will be removed by hand. The USFWS-approved biologist will be on site to monitor all wetland vegetation removal activities; • The upper 6 inches of soil excavated within salt marsh harvest mouse habitat will be stockpiled separately and replaced on top of the backfilled material; • Vegetation will be removed by hand using hand tools; • In construction and staging areas where habitat is to be disturbed, vegetation must be cleared to bare ground or stubble no higher than 1 inch; • Work will be scheduled to avoid extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge) when there is potential for salt marsh harvest mouse to move to higher, drier grounds. All equipment will be staged on existing roadways away from the project site when not in use; • To prevent salt marsh harvest mouse from moving through the project site during construction, temporary exclusion fencing will be placed around a defined work area before construction activities start and immediately after vegetation removal. The fence should be made of a material that does not allow salt marsh harvest mouse to pass through or over, and the bottom should be buried to a depth of 2 inches so that mice cannot crawl under the fence. Any supports for the salt marsh harvest mouse exclusion fencing must be placed on the inside of the project area; • Prior to the start of daily construction activities during initial ground disturbance, the USFWS-	Environmental commitment	Prior to and during construction	Project proponent/ contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
approved biological monitor will inspect the salt marsh harvest mouse–proof boundary fence to ensure that it has no holes or rips and the base is still buried. The fenced area also will be inspected to ensure that no mice are trapped in it. Any mice found along and outside the fence will be closely monitored until they move away from the construction area; • If a salt marsh harvest mouse is discovered, construction activities will cease in the immediate vicinity of the individual until DFG and USFWS are contacted and the individual has been allowed to leave the construction area; and • A DFG- and USFWS-approved biologist with previous salt marsh harvest mouse experience will be on site during construction activities occurring in wetlands. The biologist will document compliance with the project permit conditions and avoidance and conservation measures. The biologist has the authority to stop project activities if any of the requirements associated with these measures is not being fulfilled. If the biologist has requested work stoppage because of take of any of the listed species, the USFWS and DFG will be notified within 1 day by email or telephone.			
Implement general protection measures for bird species: • The project proponents will remove all woody and herbaceous vegetation from construction areas (earthwork areas) during the nonbreeding season (September 1–February 1) to minimize effects on nesting birds; • During the breeding season, all vegetation subject to impact will be maintained to a height of approximately 6 inches to minimize the potential for 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, the project proponents will develop appropriate measures and coordinate with DFG to determine an acceptable buffer width; • Inactive migratory bird nests (excluding raptors) located outside of the construction areas will be preserved. If an inactive migratory bird nest is located in the area of effect, it will be removed before the start of the breeding season (approximately February 1); and • Impacts on great blue heron rookeries will be avoided; mature trees will not be removed and nearby work will occur outside the nesting season.	Environmental commitment	Prior to and during construction	Contractor
Perform preconstruction surveys for raptors, adhering to the following: • Surveys will be performed before and during the raptor nesting season (bimonthly, i.e., two	Environmental commitment	Prior to construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
times per month) to identify existing nests that may be used during the nesting season; • Raptors may nest from later winter through mid-summer; therefore, multiple nesting season surveys will performed; • DFG will be notified of all raptor nests located during the preconstruction surveys. If a raptor nest is located within the recommended buffer, the project proponents will coordinate with DFG to determine an acceptable buffer width; and • If an active raptor nest is found outside the construction areas, a buffer zone will be created around the nest tree. For special-status species a larger buffer will be required (e.g., 0.5-mile Swainson's hawk buffer). The project proponents will coordinate with DFG prior to project implementation to determine the species-specific buffer widths.			
Perform preconstruction surveys for California clapper rail and California black rail if construction activities are necessary during the breeding season as follows: • Surveys will be conducted at and adjacent to areas of potential tidal and managed wetlands habitats for California clapper rail and black rail; • Surveys will focus on potential habitat that may be disturbed by construction activities during the breeding season to ensure that these species are not nesting in these locations. Survey methods will follow the protocols used by DFG during previous rail surveys in Suisun Marsh (California Department of Fish and Game 2007). The specific project proponent will implement the following survey protocols: o Surveys should be initiated sometime between January 15 and February 1. A minimum of four surveys should be conducted. The survey dates should be spaced at least 2 to 3 weeks apart and should cover the time period from the date of the first survey through the end of March or mid-April. This will allow the surveys to encompass the time period when the highest frequency of calls is likely to occur; o Listening stations will be established at 150-meter intervals along road, trails, and levees that will be affected by plan implementation; o California clapper rail and California black rail vocalization recordings will be played at each station; o For California clapper rails, each listening station will be occupied for a period of 10 minutes, followed by 1 minute of playing California clapper rail vocalization recordings, then followed by an additional minute of listening; o For black rails, each listening station will be occupied for 1 minute of passive listening, 1 minute of "grr" calls followed by 30 seconds of "ki-ki-krrr" calls, then followed by another	Environmental commitment	Prior to construction	Project proponent/ contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
3.5 minutes or passive listening; o Sunrise surveys will begin 60 minutes before sunrise and conclude75 minutes after sunrise (or until presence is detected); o Sunset surveys will begin 75 minutes before sunset and conclude 60 minutes after sunset (or until presence is detected); o Surveys will not be conducted when tides are greater than 4.5 National Geodetic Vertical Datum (NGVD) or when sloughs and marshes are more than bankfull; and o California clapper rail and California black rail vocalizations will be recorded. A GPS receiver will be used to identify call location and distance. The call type, location, distance, and time will be recorded on a data sheet. If California clapper rail or black rail is present in the immediate construction area, the following measures will apply during construction activities: • To avoid the loss of individual California clapper rails or black rails, activities within or adjacent to California clapper rail or black rail habitat will not occur within 2 hours before or after extreme high tides (6.5 feet or above, as measured at the Golden Gate Bridge), when the marsh plain is inundated, because protective cover for California clapper rails is limited and activities could prevent them from reaching available cover; • To avoid the loss of individual California clapper rails or black rails, activities within or adjacent to tidal marsh areas will be avoided during the California clapper rail breeding season from February 1 through August 31 each year unless surveys are conducted to determine California clapper rail locations and California clapper rail and black rail territories can be avoided. Figure 2–5 shows the areas of known clapper rail breeding habitat; • If breeding California clapper rails or black rails are determined to be present, activities will not occur within 700 feet of an identified calling center. If the intervening distance across a major slough channel or across a substantial barrier between the California clapper rail calling center and any activity area is greater than 200 feet, it may proceed at that location within the breeding season. • *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the California clapper rail or black rail breeding season in areas within or adjacent to California clapper rail breeding habitat with approval of the USFWS and DFG under the supervision of a qualified biologist.			

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Implement protection measures for California least tern as follows: • No activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, April 15 to August 15 (or as determined through surveys). • *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the least tern breeding season in areas within or adjacent to least tern breeding habitat with approval of the USFWS and DFG under the supervision of a qualified biologist.	Environmental commitment	During construction	Contractor
Implement biological monitoring as follows: • The project proponents will provide a biologist/environmental monitor who will be responsible for monitoring implementation of the conditions in the state and federal permits (federal Clean Water Act [CWA] Section 401, 402, and 404; ESA Section 7; Fish and Game Code Section 1602 and/or 2050; project plans [SWPPP]; and EIS/EIR mitigation measures); • The biologist/environmental monitor will determine the location of environmentally sensitive areas adjacent to each construction site based on mapping of existing land cover types and special-status plant species. If such maps are not available, the biologist/environmental monitor will map and quantify the land cover types and special-status plant populations in the proposed project footprint prior to construction; • To avoid construction-phase disturbance to sensitive habitats immediately adjacent to the project area, the monitor will identify the boundaries of sensitive habitats and add at least a 100-foot buffer, where feasible, using orange construction barrier fencing. The fencing will be mapped on the project designs. 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 sediment off site. The sensitive habitat and erosion-control fencing will be installed before any construction activities begin and will be maintained throughout the construction period; • The biologist/environmental monitor will ensure the avoidance of all sensitive habitat areas outside direct project footprints, including patches of tidal wetland along channel banks, during dredging operations, to the extent practical; and • Plants for revegetation will be accompanied by a California Nursery Stock Certificate.	Environmental commitment	Prior to and during construction	Project proponent/ contractor
Implement and adhere to construction period restrictions.	Environmental commitment	During construction	Project proponent/ contractor
Land and Water Use			
None			

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Social and Economic Conditions			
None			
Utilities and Public Services			
Stop work immediately if a conflict with a utility facility occurs and contact the affected utility to (1) notify it of the conflict, (2) aid in coordinating repairs to the utility, and (3) coordinate to avoid additional conflicts in the field.	Environmental commitment	During construction	Contractor
UTL-MM-1: Relocate or protect overhead powerlines or other utilities that could be affected by construction.	CEQA-triggered mitigation measure	Prior to construction	Contractor
UTL-MM-2: Avoid ground-disturbing activities within pipeline right-of-way.	CEQA-triggered mitigation measure	During construction	Contractor
UTL-MM-3: Relocate or upgrade utility facilities that could be damaged by inundation.	CEQA-triggered mitigation measure	Prior to inundation	Contractor
UTL-MM-4: Test and repair or replace pipelines that have the potential for failure.	CEQA-triggered mitigation measure	Prior to inundation	Contractor
Recreation Resources			
Avoid nesting habitats and other sensitive areas, such as important roosting and foraging sites during critical nesting periods.	Environmental commitment	During construction	Contractor
Construction will not occur during major summer holiday periods.	Environmental commitment	Major holiday periods	SRCD
Maintain boat access to prime areas.	Environmental commitment	During construction	Contractor
Provide public information regarding alternate access.	Environmental commitment	Prior to and during construction	Contractor
Post warning signs and buoys in channels, upstream of, and downstream of, all construction equipment, sites and activities during construction.	Environmental commitment	Prior to and during construction	Contractor
Post signs describing alternate boating routes in convenient locations when boating access is restricted.	Environmental commitment	During construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Minimize water-level fluctuation during construction.	Environmental commitment	During construction	Contractor
Power Production and Energy			
None			
Visual/Aesthetic Resources			
For projects that have the potential to affect views or create a new source of light or glare, identify sensitive view receptors for site-specific analysis and ensure that contractors minimize fugitive light from portable sources used for nighttime operations. In addition, a visual barrier will be installed to prevent light spill from truck headlights in areas with sensitive view receptors.	Environmental commitment	Prior to and during construction	Project proponent/ contractor
Cultural Resources			
Immediately cease work within 100 feet inadvertent discoveries of cultural resources, including human remains. All construction personnel will leave the area. Vehicles and equipment will be left in place until a qualified archaeologist identifies a safe path out of the area. The on-site supervisor will flag or otherwise mark the location of the find and keep all traffic away from the resource. The on-site supervisor immediately will notify the lead state or federal agency of the find.	Environmental commitment	During construction	Contractor
Comply with Native American Grave Protection and Repatriation Act (43 CFR 10) if inadvertent discovery of Native American remains occurs on federal lands.	Environmental commitment	During construction	Project proponent
Comply with state laws relating to the disposition of Native American burials (Public Resources Code [PRC] 5097 and California Health and Safety Code 7050.5[b]) for human remains discoveries on non-federal lands.	Environmental commitment	During construction	Project proponent
If human remains of Native American origin are discovered during ground-disturbing activities on non-federal land, the lead state or federal agency must comply with state laws relating to the disposition of Native American burials, which fall within the jurisdiction of the Native American Heritage Commission (NAHC) (PRC 5097). If human remains are discovered or recognized in any location other than a dedicated cemetery, the lead state or federal agency will not allow further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until: • the Solano County coroner has been informed and has determined that no investigation of the cause of death is required; and • if the remains are of Native American origin,	Environmental commitment	During construction	Project proponent/ contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
o the descendants of the deceased Native Americans have made a recommendation to the landowner or the person responsible for the excavation work for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in PRC 5097.98; or o the NAHC was unable to identify a descendant or the descendant failed to make a recommendation within 48 hours after being notified by the NAHC.			
CUL-MM-1: Document and evaluate the Montezuma Slough rural historic landscape, assess impacts, and implement mitigation measures to lessen impacts.	CEQA-triggered mitigation measure	Prior to construction	Project proponent
CUL-MM-2: Evaluate previously recorded cultural resources and fence NRHP- and CRHR-eligible resources prior to ground-disturbing activities.	CEQA-triggered mitigation measure	Prior to construction	Project proponent
CUL-MM-4: Resolve adverse effects [to known cultural resources] prior to construction.	CEQA-triggered mitigation measure	Prior to construction	Project proponent
CUL-MM-5: Conduct cultural resource inventories and evaluations and resolve any adverse effects.	CEQA-triggered mitigation measure	Prior to construction	Project proponent
Public Health and Environmental Hazards			
Prepare and implement a Hazardous Materials Management Plan	Environmental commitment	Prior to and during construction	Contractor
Prepare and implement a Stormwater Pollution Prevention Plan, which will include but is not limited to: • 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.	Environmental commitment	Prior to and during construction	Contractor
Ensure that changes within the Suisun Marsh channels will not significantly affect navigation and emergency access by having Rio Vista and Vallejo Coast Guard Stations review plans to assess safety issues associated with changes when there is potential for in-channel work to affect access.	Environmental commitment	Prior to and during construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
RESTORATION ACTIVITIES			
Develop site-specific plans to address mosquito production for each restoration activity based on the following recommendations, which would be implemented prior to removal or breaching of any levee or water control structure: 1. Develop a management program consistent with Marsh-wide management actions for the control of mosquitoes; and 2. If necessary, obtain an engineering survey to locate depressions that would retain tidal water and design site restoration to promote water drainage.	Environmental commitment	Prior to, during and following construction	Project proponent
UTL-MM-2: Avoid ground-disturbing activities within pipeline right-of-way.	CEQA-triggered mitigation measure	During construction	Contractor
UTL-MM-3: Relocate or upgrade utility facilities that could be damaged by inundation.	CEQA-triggered mitigation measure	Prior to inundation	Contractor
UTL-MM-4: Test and repair or replace pipelines that have the potential for failure.	CEQA-triggered mitigation measure	Prior to inundation	Contractor
Environmental Justice			
None			
Indian Trust Assets			
None			

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
General			
Continue existing Best Management Practices.	Environmental commitment	Prior to, during and following construction	SRCD, Landowners, DFG, Reclamation, DWR
Implement the construction period restrictions as follows: • Limit in-water work to the period between August 1 and November 30; • Most managed wetland activities are expected to be implemented from June to September when the wetlands are dry enough to conduct these activities; • Activities may be conducted during other times of the year, depending on the potentially affected species for each site-specific case; and • Activities occurring during the hunting season will not occur on Saturday, Sunday, or Wednesday when such activities have a reasonable possibility of disrupting access to hunting or represent a safety concern.	Environmental commitment	During construction	SRCD, Landowners, DFG, Reclamation, DWR
Implement standard design features and construction practices for wetland management activities: • When possible, drain pipes should be relocated to drain into larger receiving sloughs with good tidal circulation to avoid and minimize the degradation of water quality in receiving waters; • All new and/or replacementdrain pipes will be located on the largest possible sloughs, or sloughs with the highest levels of tidal circulation possible, to minimize or lessen the possibility of degraded water quality conditions; • Management options, including vegetation management and diversion timing and location, will be pursued to avoid and minimize occurrence of low dissolved oxygen (DO) water conditions in managed wetlands; • New exterior drain structures will be installed where the discharge channel already exists. The new drain will not be placed on emergent vegetation. The pipe will be installed at low tide. No in-water work is authorized; • Landowners importing any material besides rock material from outside the Suisun Marsh must contact the RWQCB before importation. Landowners must obtain the RWQCB's concurrence that the imported material is acceptable before use; • Material excavated from existing spreader ditches and creation of new spreader ditches may be sidecast adjacent to the ditch. No excavated material will be more than 12 inches high; • Exterior pipes will be placed below the depth of emergent vegetation;	Environmental commitment	Prior to and during construction	SRCD, Landowners, DFG, Reclamation, DWR

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
• Pipe replacement as well as repair, replacement, or installation of exterior water control structures will not change the existing use or diversion capacity; • All pipes will be pre-assembled before installation to minimize work time; • All material shall remain on the crown or interior side of the levee during the repair of exterior existing levees, the coring of existing exterior levees, and the installation of drain pumps and platforms; • All bulkheads will be in place prior to backfilling the bulkhead during installation, repair, or re-installation of water control structures; • Installation of drain pumps and platforms will be done entirely within the managed wetland; although discharge pipes will comply with permit terms and conditions for exterior discharge pipe installation; • All work to be performed on the exterior side of levees shall commence and be completed within a 6-hour period, from 3 hours prior to low tide to 3 hours after low tide; • Construction equipment used for projects will be checked each day prior to work and, if necessary, action will be taken to prevent fluid leaks. If leaks occur during work, the Corps, its permittee, or the contractor will contain the spill and remove the affected soils; • All contractors must have a supply of erosion and pollution control materials on site to facilitate a quick response to unanticipated storm events or emergencies; • No in-water work will occur during the repair of existing exterior levees; the coring of existing levees; pipe replacement at the exterior flood or dual-purpose gate; pipe replacement at the existing exterior drain gate; installation, repair, or re-installation of water control bulkheads; installation of drain pumps and platforms; or installation of new exterior drain structures; • Emergent vegetation will not be disturbed during the following activities: repair of existing exterior levees, replacement of existing riprap on exterior levee, or installation of the new exterior drain structure; and • No fresh concrete, cement, silts, clay, soil, or other materials will be discharged to Marsh waters.			
Prepare and submit monthly work reports to the Corps, NMFS, State Lands Commission, and the RWQCB.	Environmental commitment	During construction	SRCD, DWR, Reclamation
Prepare and submit an annual activities summary report to the Corps, U.S. Environmental Protection Agency, NMFS, USFWS, State Lands Commission, and the RWQCB.	Environmental commitment	Post-construction	SRCD, DWR, Reclamation

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Prepare and submit a written annual report to NMFS by December 31 of each year. The report shall contain, at a minimum, the following information: • Project-related activities—The report shall include the type, size, and location of specific actions (exterior pipe replacement and installation and rip rap placement) undertaken under RGP 3; dates when specific actions began and were completed; a description of BMPs implemented to minimize project effects; photographs taken before, during, and after the activity from photo reference points; and a discussion of specific project performance or efficacy; • Unanticipated project effects—The report shall include a discussion of any unanticipated project effects or unanticipated levels of project effects on salmonids, green sturgeon, and/or critical habitat and a description of any and all measures taken to minimize those unanticipated effects as well as a statement regarding whether the unanticipated effects had any effect on ESA-listed fish or critical habitat; • Gate closures and diversion curtailment—The report shall summarize compliance monitoring for gate closures and diversion curtailments; and • Observations of salmonids and green sturgeon—The report shall document observations of any salmonids or green sturgeon occurring within the action area during project actions.	Environmental commitment	Post-construction	SRCD, DWR, Reclamation
Adhere to riprap placement requirements: • Riprap will not be placed directly on emergent vegetation (e.g., tules, *Scirpus* spp.); • Emergent vegetation will not be uprooted during the placement of riprap, nor will it be displaced by riprap; and • Riprap placed on the exterior side of the levee will commence and be complete within a six-hour period, from three hours prior to low tide to three hours following low tide.	Environmental commitment	During construction	Contractor
Adhere to dredging practice requirements: • All construction facilities and working platforms required for dredging operations will maintain an operating environment free of fuel spills; • Runoff generated on the job site will be controlled; • Dredging activities will occur only between August 1 and November 30; • Removal of emergent vegetation will be avoided where feasible, although areas of vegetation may need to be disturbed during construction to provide site access, adequate volume of material for construction, and proper water flow at the site; • Dredging will be avoided within 200 feet of storm drain outfall and urban discharge locations, unless suitable preconstruction contaminant testing is conducted (coordination and consulting	Environmental commitment	During construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
with the DMMO relative to evaluation and placement of the materials); • A berm will be constructed on the channel-side of the levee crown to prevent runoff into adjacent aquatic habitats; • Releases of discharge water from managed wetlands will be limited following dredged material placement; • The extent of dredging disturbance will be limited based upon slough channel habitat classification and plan region in Table 2-6; • Alternate boating routes will be identified if dredging impedes navigation.			
Water Supply, Hydrology, and Delta Water Management			
None			
Water Quality			
Restrict levee repairs and pipe replacements to the dry season and dry days.	Environmental commitment	During construction	Landowners
Develop and implement a hazardous spill plan.	Environmental commitment	Prior to and during construction	SRCD, DFG, DWR, Reclamation, Contractor
Geology and Groundwater			
None			
Flood Control and Levee Stability			
None			
Sediment Transport			
None			
Transportation and Navigation			
None			

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Air Quality			
AQ-MM-2: Reduce construction NO_X emissions	CEQA-triggered mitigation measure	During construction	Contractor
AQ-MM-3: Implement all appropriate BAAQMD mitigation measures	CEQA-triggered mitigation measure	Prior to and during construction	Contractor
AQ-MM-4: Limit construction activity during restoration and management activities	CEQA-triggered mitigation measure	During construction	Contractor
Noise			
Comply with local noise regulations by limiting construction to the hours specified by Solano County when construction activities occur near residences.	Environmental commitment	During construction	Contractor
When it is determined through site-specific analysis that construction has the potential to occur near residences the following noise-reduction practices will be implemented: • use electrically powered equipment instead of internal combustion equipment where feasible; • locate staging and stockpile areas and supply and construction vehicle routes as far away from sensitive receptors as possible; • establish and enforce construction site and haul road speed limits; • restrict the use of bells, whistles, alarms, and horns to safety warning purposes; • design equipment to conform to local noise standards; • locate equipment as far from sensitive receptors as possible; • equip all construction vehicles and equipment with appropriate mufflers and air inlet silencers; • restrict hours of construction to periods permitted by local ordinances; and • locate redirected roadways away from sensitive receptors.	Environmental commitment	Prior to and during construction	Contractor
NZ-MM-1: Limit Noise from Pump Operations	CEQA-triggered mitigation measure	During construction	SRCD and DFG
Climate Change			
None			

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Fish			
Report any suspected take of listed fish species to DFG and the Suisun Resource Conservation District. Any carcasses of listed fish will be frozen in a whirl-pak bag and retained until instructions are received from the applicable agency.	Environmental commitment	During construction	Landowners
Consolidate and/or equip water control structures with state-of-the-art fish screens when practicable and as funding allows.	Environmental commitment	During construction of new water control structures	Landowners
Screen any new or enlarged exterior water control structures in accordance with DFG's criteria unless DFG and the Corps determine that the structure would not adversely affect any listed species and the Corps obtains concurrence for any federally listed species with that determination from NMFS or USFWS as applicable.	Environmental commitment	During construction of new or enlarged water control structures	Landowners
Install or replace water control structures only during low tides (within a six-hour period, from three hours prior to low tide to three hours following low tide) when there is the least chance of affecting fish.	Environmental commitment	During construction	Contractor
Identify and prioritize placement of water control structures that require fish screens in consultation with the Corps, NMFS, and the USFWS.	Environmental commitment	Prior to construction	SRCD and DFG
Operate water control structures to minimize impacts on listed fish, taking into consideration seasonal timing and water quality.	Environmental commitment	During operations of water control structures	Landowners
Perform all in-water work by hand and during low tide (within a six-hour period, from three hours prior to low tide to three hours following low tide) as part of the following activities: • repair, replacement, or installation of exterior water control structures; • pipe replacement at the exterior flood or dual-purpose gate; • pipe replacement at the existing exterior drain gate; and • installation of the new exterior drain structure	Environmental commitment	During construction	Landowners
Restrict levee repairs and pipe replacements to the dry season and dry days.	Environmental commitment	During construction	Landowners

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Complete repairs of existing exterior levees (to stop the flow of tidal waters entering into the managed wetlands) within 7 days of the breach for coverage under the RGP.	Environmental commitment	Within 7 days of breach	Landowners
Install fish screens on any new or enlarged water control structures.	Environmental commitment	During construction of new or enlarged water control structure	Landowners
Do not fill more than 1,000 square feet of wetlands throughout the Marsh per year during installation of fish screens.	Environmental commitment	During construction of fish screens	SRCD, DFG, DWR, Reclamation
An evaluation by a biologist or on-site monitor shall be done at each site during project implementation of exterior pipe replacement or riprap placement to document project actions for the purpose of identifying any condition that could adversely affect salmonids, green sturgeon, or their habitat. A NMFS biologist will be immediately notified whenever conditions are identified that could adversely affect salmonids, green sturgeon, or their habitat in a manner not described in the opinion.	Environmental commitment	During construction of waterside activities	Landowners
Rectify any identified project-related conditions that could adversely affect salmonids, green sturgeon, or their habitat.	Environmental commitment	Prior to or during construction	Landowners
SRCD shall notify DFG, NMFS, and the Corps of the starting and closing dates of duck hunting season annually at least 1 month prior to the start of the season. Landowners diverting water from sloughs designated by NMFS (i.e., Montezuma Slough and its tributaries lower Nurse Slough [from the confluence with Denverton Slough to Montezuma], Denverton Slough; Cuttoff Slough [including Spring Branch Slough, first and second Mallard Branch Slough]; Suisun Slough, [from downstream of the confluence with Boynton Slough to Grizzly Bay; and Chipps Island]) shall use no more than 25% of the water control structure's diversion capacity from November 1 to the last day of duck hunting season. These landowners are prohibited from diverting water from designated sloughs from February 21 to March 31.	Environmental commitment	Prior to and during hunting season	SRCD and landowners
Landowners diverting water from sloughs designated by NMFS [i.e., Montezuma Slough and its tributaries lower Nurse Slough (from the confluence with Denverton Slough to Montezuma), Denverton Slough; Cuttoff Slough (including Spring Branch Slough, first and second Mallard Branch Slough); Suisun Slough, (from downstream of the confluence with Boynton Slough to Grizzly Bay; and Chipps Island] shall use only 35% of the water control structure's intake capacity between April 1 and May 31. If, during this time, two out of the three DFG 20-millimeter trawl	Environmental commitment	Post hunting season	Landowners

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
surveys sites (sites 606, 609, and 610) predict delta smelt densities greater than 20 delta smelt individuals per 10,000 cubic meters over a 2-week sampling period, all diversions from these sloughs shall use only 20% of the water control structure's intake capacity. Survey trawls shall take place at least once every 14 days between April 1 and May 31.			
SRCD and DFG shall monitor gate closures while diversion restrictions are in place. If an open gate is observed, the landowner shall be contacted and the gates shall be brought into compliance	Environmental commitment	During periods of diversion	SRCD, DFG and landowners
If the managed wetlands are subject to uncontrolled tidal flow, dewatering of the managed wetland area will be conducted through the use of existing gravity tidal drainage gates as much as possible. DFG will be consulted to determine if fish salvage efforts are needed prior to completely dewatering of the site.	Environmental commitment	During and after breach or uncontrolled tidal flow into managed wetlands	SRCD and landowners
Limit in-water work to the period between August 1 and November 30.	Environmental commitment	During construction	SRCD, DFG, Reclamation, and DWR
Develop and implement a hazardous spill plan.	Environmental commitment	Prior to and during construction	SRCD, DFG, DWR, Reclamation, Contractor
Continue existing Best Management Practices and Biological Opinion terms and conditions.	Environmental commitment	Prior to, during and following construction	Contractor
Vegetation and Wetlands			
Report any suspected take of listed wildlife species to DFG and the Suisun Resource Conservation District.	Environmental commitment	During construction	Landowners
Conduct on-site field inspection for special-status plants for managed wetlands activities on the water side of exterior levees. Special-status plants include: • soft bird's beak (*Cordylanthus mollis* ssp. *mollis*); • salt marsh bird's beak (*C. maritimus* ssp. *maritimus*); • hispid bird's beak (*C. mollis* ssp. *hispidus*); • Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*); • Mason's lilaeopisis (*Lilaeopsis masonii*);	Environmental commitment	Prior to construction	Landowners

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
• Suisun thistle (*Cirsium hydrophilum* var. *hyrdophilum*); • Suisun Marsh aster (*Aster lentus*); • alkali milk-vetch (*Astragalus tener*); • heartscale (*Atriplex cordulata*); • brittlescale (*Atriplex depressa*); • valley spearscale (*Atriplex joaquiniana*) If a special-status plant is found during a survey, it should be avoided, and a map showing the location of the plant should be provided to DFG, the Corps, and USFWS no later than 7 calendar days after the survey is completed. If a special-status plant cannot be avoided during the proposed work and it is not listed as threatened or endangered, the plant will be carefully transplanted to the nearest suitable habitat provided this action and the proposed transplantation site are determined by DFG to be adequate to offset any impact. If approved by DFG, a qualified representative of Suisun Resource Conservation District (SRCD) or DFG may conduct the transplantation. If DFG does not determine that transplantation will offset the impact, a restoration plan will be prepared and implemented, after DFG approval, that will be able to ensure that impacts on the plant population are offset. This determination by DFG will include an assessment of species distribution, the abundance in the Marsh, and the level of proposed impact. If a federally listed threatened or endangered plant is found that cannot be avoided during the proposed work, the qualified representative of SRCD or DFG will notify the Corps immediately so it can consult with the USFWS. If determined necessary by USFWS and if a federally listed plant cannot be avoided during the proposed work, the plant will be carefully transplanted to the nearest suitable habitat provided this action and the proposed transplantation site is determined by USFWS to be adequate to offset any impact. If approved by USFWS, a qualified representative of SRCD or DFG may conduct the transplantation. If USFWS does not determine that transplantation will offset the impact, a restoration plan will be prepared and implemented, after USFWS approval, that will be able to ensure that impacts on the plant population are offset. This determination by USFWS will include an assessment of species distribution, abundance in the Marsh, and the level of proposed impact.			
Continue existing Best Management Practices and Biological Opinion terms and conditions.	Environmental commitment	Prior to, during and following construction	SRCD, DFG, DWR, and Reclamation

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Wildlife			
Limit work in California clapper rail habitat to between February 1 and August 31 unless surveys indicate that the species is not present.	Environmental commitment	During construction	Contractor
Report any suspected take of listed wildlife species to DFG and the Suisun Resource Conservation District.	Environmental commitment	Prior to, during, or following construction	Landowners
Avoid and minimize impacts on great blue heron and egret rookeries by removing mature trees only outside the nesting season and maintaining a 500-foot buffer between roost sites and managed wetland activities during nesting season.	Environmental commitment	During construction	Landowners
Do not implement managed wetland activities in the vicinity of active raptor nests during breeding season.	Environmental commitment	During active raptor breeding season	Landowners
Continue existing Best Management Practices and Biological Opinion terms and conditions.	Environmental commitment	Prior to, during and following construction	SRCD, DFG, DWR, and Reclamation
Land and Water Use			
None			
Social and Economic Conditions			
None			
Utilities and Public Services			
UTL-MM-2: Avoid ground-disturbing activities within pipeline right-of-way	CEQA-triggered mitigation measure	During construction	Contractor
Recreation Resources			
Construction will not occur during major summer holiday periods.	Environmental commitment	Major holiday periods	SRCD
In sloughs and exterior waters, place warning signs and buoys upstream of, and downstream of all construction equipment, sites, and activities.	Environmental commitment	Prior to and during construction	Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Provide adequate warning regarding activities and equipment to recreationists in construction sites by postings and/or notices.	Environmental commitment	Prior to and during construction	Contractor
Post signs describing alternate boating routes in convenient locations when boating access is restricted.	Environmental commitment	During construction	Contractor
Power Production and Energy			
None			
Visual/Aesthetic Resources			
For projects that have the potential to affect views or create a new source of light or glare, identify sensitive view receptors for site-specific analysis and ensure that contractors minimize fugitive light from portable sources used for nighttime operations. In addition, a visual barrier will be installed to prevent light spill from truck headlights in areas with sensitive view receptors.	Environmental commitment	Prior to and during construction	SRCD, DFG, DWR, and Reclamation/ contractor
Cultural Resources			
If any previously unknown historic or archeological artifacts are discovered while accomplishing the authorized work, the landowner must stop work immediately and notify the Corps. The activity is not authorized until the requirements of Section 106 of the NHPA have been satisfied.	Environmental commitment	During construction	Landowners
Work is not authorized within 100 feet of archeological site CAL-SOL-13.	Environmental commitment	During construction	Contractor
CUL-MM-6: Stop ground-disturbing activities, evaluate the significance of the discovery, and implement mitigation measures as appropriate.	CEQA-triggered mitigation measure	During construction	Contractor and landowner
CUL-MM-7: Complete NHPA Section 106 consultation and prepare and implement context study; evaluate previously recorded cultural resources and fence NRHP- and CRHR-eligible cultural resources prior to ground-disturbing activities.	CEQA-triggered mitigation measure	Prior to and during construction	Reclamation
CUL-MM-8: Complete NHPA Section 106 consultation and prepare and implement context study; conduct cultural resources inventories and evaluations and resolve any adverse effects.	CEQA-triggered mitigation measure	Prior to and during construction	Reclamation
Public Health and Environmental Hazards			
Develop and implement a hazardous spill plan.	Environmental commitment	Prior to and during construction	SRCD, DFG, DWR, Reclamation, Contractor

Mitigation Measures and Environmental Commitments	Type of Action	Implementation Schedule	Party Responsible
MANAGED WETLAND ACTIVITIES			
Environmental Justice			
None			
Indian Trust Assets			
None			

SMPA & SMP Team Structure

The Revised Suisun Marsh Preservation Agreement (Revised SMPA)

SMPA Negotiators: Agency managers able to make commitments (Regional Manager, Branch Chief, and counsel) about contract amendments, actions or funding of activities needed to achieve the original objectives of the SMPA, Amendment 3 of the SMPA commitments, and to comply with the term and conditions of the existing agreements (Revised SMPA, Mitigation and Monitoring Agreements).

Article XII. of the Revised SMPA

SMPA Coordinators – Each party (DWR, USBR, DFG, SRCD) shall appoint a representative ("Coordinator") to the SMPA Coordination Committee to review and approve, as necessary, actions and operations undertaken pursuant to the Revised SMPA.

SMPA ECAT - – Each party (DWR, USBR, DFG, SRCD) shall appoint a representative to the SMPA Environmental Coordination Advisory Team: ECAT is responsible for ensuring compliance with the SMPA mitigation and monitoring agreements and related BO's and to provide technical guidance and oversight to Suisun Marsh monitoring, management, and restoration programs conducted as part of the SMPA. Other State and federal agencies will be invited to participate (USFWS, NMFS).

SMPA Technical Committees: SMPA agency staff to support information gathering and technical analysis of negotiated item to be considered in any amendment of the SMPA.

The Suisun Marsh Management, Preservation and Restoration Plan (SMP) Implementation

SMP Principals: The following agencies are the principles: USFWS, NMFS, DWR, USBR, DFG, SRCD, DSC These agencies will be implementing the SMP as well as the Suisun Marsh Preservation Agreement (the Revised SMPA), which includes on-going operations and maintenance of the managed wetlands, and tidal restoration projects. The SMP Principles will meet at least twice per year.

SMP Regulatory Group: SMP Agencies (SRCD, DFG, DWR, USBR) will be developing permit applications to implement ongoing operation and maintenance activities of existing Suisun Marsh facilities and obtaining the permitting ability to implement the Revised SMPA PAI Fund (Preservation Agreement Implementation Fund). The Regulatory group also includes staff from Corps, BCDC, NMFS, USFWS, DSC, and RWQCB. This group will meet on an as needed basis.

SMP Adaptive Management Advisory Team: The Adaptive Management Advisory Team (AMAT) will be comprised of technical staff from DFG, DWR, SRCD, DSC, Reclamation, and USFWS, with invitations to NOAA, BCDC, RWQCB, USGS, and others as appropriate. Project proponents (FRPA, SFWCA, TNC) are encouraged to use the AMAT and their knowledge of the Marsh for project development and support and as a forum to coordinate and cooperate for the benefit of the overall restoration goals of the SMP. This team will meet at least quarterly.