APPENDIX L

USFWS PROGRAMMATIC BIOLOGICAL OPINION

This page intentionally left blank

United States Department of the Interior

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

IN REPLY REFER TO:
81420-08-F-0621

AUG 12 2008

Ms. Jane Hicks
Chief, Regulatory Division
(Attn: Paula Gill)
U.S. Army Corps of Engineers
1455 Market Street, 16th Floor
San Francisco, California 94103-139

Subject: Formal Endangered Species Consultation on the Proposed South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 Actions, Alameda, Santa Clara, and San Mateo Counties, California (Corps File Numbers 07-27703S and 08-00103S)

Dear Ms. Hicks:

This is in response to the U.S. Army Corps of Engineers' (Corps) letters, dated December 13, 2007 and April 15, 2008, requesting formal U.S. Fish and Wildlife Service (Service) section 7 consultation to allow for the proposed implementation of the project-level Phase 1 actions (Phase 1 actions) and the operation and maintenance of the South Bay salt pond levees, as part of the South Bay Salt Pond Restoration Project Long-term Plan (SBSP Project), Alameda, Santa Clara, and San Mateo Counties, California. We received your letters in this office on December 14, 2007 and April 16, 2008, respectively. This document includes the Service's programmatic biological opinion (PBO) for the SBSP Project and the project-level biological opinion for the Phase 1 actions (Phase 1 BO). At issue are the effects of the proposed action on the endangered California clapper rail (*Rallus longirostris obsoletus*) (clapper rail), endangered salt marsh harvest mouse (*Reithrodontomys raviventris raviventris*) (harvest mouse), threatened Pacific coast population of the western snowy plover (*Charadrius alexandrinus nivosus*) (snowy plover), endangered California least tern (*Sternula antillarum browni*) (least tern), and endangered California brown pelican (*Pelecanus occidentalis californicus*) (brown pelican). 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).

The proposed action is not likely to destroy or adversely modify critical habitat for snowy

plovers since no critical habitat is located within the proposed action area. No critical habitat has been proposed or designated for clapper rails, harvest mice, or least terns, therefore, none will be destroyed or adversely modified. We have determined that the proposed action is not likely to adversely affect the endangered vernal pool tadpole shrimp (*Lepidurus Packardi)* and designated critical habitat, endangered California tiger salamander (central population) (*Ambystoma californiense)* and designated critical habitat, and endangered Contra Costa goldfields (*Lasthenia conjugens*) and designated critical habitat. The proposed action would not occur in vernal pool habitats that support these species, and the proposed action could implement measures to avoid and minimize any construction-related disturbance. We understand that you have made a "no effect" determination for other listed species that are known to occur in the region, but are absent from the action area (Service 2008). Listed anadromous and marine species that fall under the jurisdiction of National Marine Fisheries Service (NMFS) will be evaluated in their biological opinion on the proposed action.

This biological opinion is based on information provided in: (1) the July 2008 *Programmatic Biological Assessment for the South Bay Salt Pond Restoration Project* (Programmatic BA) (Service 2008a); (2) the July 2008 *Phase 1 Biological Assessments for the South Bay Salt Pond Restoration Project* (Phase 1 BAs) (Service 2008b-i); (3) the *South Bay Salt Pond Restoration Project/Final Environmental Impact Statement/Environmental Impact Report* (Final EIS/EIR) (Service and California Department of Fish and Game (CDFG) 2007); (4) miscellaneous correspondence and electronic mail concerning the proposed action between representatives of the Service, CDFG, biological consultants for the proposed action, and interested parties; (5) relevant published and unpublished studies, and communications on the distribution and abundance of the clapper rail, harvest mouse, least tern, snowy plover, and brown pelican; and (6) additional information available to the Service.

Consultation Process

The lead Federal agency for implementing the proposed action is the Service (San Francisco Bay National Wildlife Refuge (SFBNWR)). This section 7 consultation has been triggered by four Federal actions: 1) the U.S. Army Corps of Engineers (Corps) propose to issue a 404 Permit under the Clean Water Act to the Service (SFBNWR) for construction of the Phase 1 actions; 2) the Corps propose to extend an existing 404 Permit for the Service (SFBNWR) to conduct operations and maintenance (O&M) on all South San Francisco Bay (South Bay) salt ponds located within the proposed action area; 3) the Service (SFBNWR) (with CDFG) propose to implement the proposed action; and 4) the Service (SFBNWR) propose to issue a Special Use Permit to Pacific Gas and Electric (PG&E) to conduct O&M on all South Bay salt ponds located within the proposed action area. Therefore, this biological opinion satisfies formal intra-Service section 7 consultation as well as formal section 7 consultation with the Corps. The State of California's Resources Agency is an applicant for the purposes of this consultation, and represents CDFG. Both the Service and NMFS will evaluate effects on listed fish and wildlife and issue biological opinions for those species under each agencies respective administration.

The proposed action features a two-tiered approach to ensure compliance with the Act as well as the California Endangered Species Act (CESA). This biological opinion is both a programmatic biological opinion covering the 50-year SBSP Project as well as a project-level biological

opinion covering the specific components and implementation of the Phase 1 actions.

Programmatic Compliance

The Service used the Programmatic BA's biological information to conduct a program-level evaluation of the 50-year SBSP Project. This biological opinion on the programmatic SBSP Project will not exempt the prohibition against take of listed species. Rather, as discussed below, take authorization for entities implementing the project-level Phase 1 actions will follow a compliance process that will tier from the programmatic consultation.

Project Level Compliance

Because the Programmatic BA did not provide the specificity of detail needed to authorize take of listed species under the Act, entities implementing Phase 1 actions will develop tiered biological assessments that will be submitted independently over time. A specific action will be adequately defined when sufficient detail exists about the nature, scope, location, timing, and impacts of the action; and any additional site-specific biological data is available. Future project-level actions (Phase 2 and beyond) will be evaluated in tiered consultations and will be consistent with the proposed action's objectives and will be based on the data, information, and analysis, and conservation measures in the Final EIS/EIR and this biological opinion.

Because information in the Phase 1 BAs has already been adequately defined, this biological opinion includes the analysis of the Phase 1 actions. Individual biological assessments were developed for the Phase 1 actions to provide the level of detail necessary to evaluate affects on each listed species and to quantify the amount and extent of incidental take associated with site-specific actions. The Phase 1 BAs identified listed species likely to be present within each action area and specified measures necessary to avoid and minimize adverse effects on listed species, consistent with the conservation measures described in this biological opinion. The Phase 1 actions include:

1. Ravenswood Pond SF2 Restoration Action
2. Alviso Pond A6 Restoration Action
3. Alviso Ponds A5, A7 and A8 Restoration Action
4. Alviso Ponds A16 and A17 Restoration Action
5. Eden Landing Ponds E8A, E8X, and E9 Restoration Action
6. Eden Landing Ponds E12 and E13 Restoration Action
7. Operations and Maintenance Activities for the Service and CDFG within the SBSP Project Area
8. Operations and Maintenance Activities for PG&E within the South Bay Salt Pond SBSP Project Area

Introduction

The SBSP Project 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 South Bay while providing for flood management and wildlife-oriented public

access and recreation within formerly-owned Cargill Corporation Inc. (Cargill) salt ponds. The SBSP Project is intended to be implemented in several phases over a 50-year timeframe. The first phase of restoration, known as Phase 1, is proposed to be implemented between 2008 and 2010 and the remaining phases will be described and occur later in time. The Service (SFBNWR) and CDFG currently own and manage the land in the SBSP Project area. The Service (SFBNWR) owns and manages the Ravenswood and Alviso pond complexes and CDFG owns and manages the Eden Landing pond complex.

Background

In October 2000, Cargill proposed to consolidate its operations and sell lands and salt production rights on 61 percent of its South Bay operation area. A Framework Agreement was developed to establish a process for public acquisition of these South Bay salt ponds as well as 1,400 acres of crystallizer ponds along the Napa River. In May 2002, the Framework Agreement was signed by the Service (SFBNWR), California Resources Agency, Wildlife Conservation Board, CDFG, California State Coastal Conservancy, Cargill, and Senator Dianne Feinstein. The Framework Agreement identified the process for the public to acquire the South Bay salt ponds and 1,400 acres of crystallizer ponds along the Napa River in the North San Francisco Bay (North Bay). In December 2002, final negotiations were completed regarding the Conveyance Agreement and Phase-out Agreement, which described specific details regarding the property to be acquired and the responsibilities of Cargill for the phase-out of salt production operations. In February 2003, Cargill sold the ponds to the Service (SFBNWR) and CDFG, with the Service (SFBNWR) acquiring 9,600 acres located at the western end of Dumbarton Bridge (the Ravenswood pond complex) and along the South Bay from Mountain View to Fremont (the Alviso pond complex). CDFG acquired the remaining 5,500 acres just south of the eastern end of the San Mateo Bridge (the Eden Landing pond complex). Although the land is currently owned by the Service (SFBNWR) and CDFG, Cargill continues to manage the levees, ponds, and water control structures proposed for future South Bay salt pond activities under the Service's 1995 biological opinion (Service File Number 1-1-95-F-0047) for Cargill's salt pond operations and management.

In June 2003, the Service (SFBNWR) and CDFG prepared an Initial Stewardship Plan (ISP) that would describe the O&M of the ponds until a long-term restoration plan was developed. The ISP provided guidance on ceasing commercial salt operations, introducing tidal hydrology to ponds where feasible, maintaining existing high quality open water and wetland wildlife habitat, maintaining ponds in a restorable condition to facilitate future long-term restoration, minimizing management costs, and meeting regulatory requirements to maintain water quality standards in the South Bay. In December 2003, the Service (SFBNWR) and CDFG prepared a Draft EIS/EIR in accordance with the National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) to address the potential impacts of implementing the ISP. In March 2004 the Final EIS/EIR for the ISP was released. In March 2004, the Service issued a biological opinion for the ISP (Service File Number 1-1-03-F-0359). The biological opinion did not explicitly include operations and management activities for the ponds in the project description, however, the biological opinion acknowledged that some ponds would need to be managed under the ISP for 20+ years once transfer criteria is met. The SBSP Project will assume operations, management, and maintenance activities of all the newly acquired Cargill

ponds (including those under the ISP) as part of the proposed action, as well as the operations, management, and maintenance of new ponds created through the proposed action.

In March 2007, the Service (SFBNWR) and CDFG released a Draft EIS/EIR to evaluate the potential environmental impacts of the proposed action. Long-term restoration alternatives were developed to evaluate a range of scenarios within the three pond complexes over a 50-year timeframe. The ultimate configuration of tidal habitat and managed ponds that achieves the proposed action's objectives will likely fall between 50:50 and 90:10 (tidal habitat:managed pond) ratios. An Adaptive Management Plan (AMP) was developed to guide the planning and implementation for the proposed action and it is described in the Final EIS/EIR (Service and CDFG 2007). It is anticipated that the AMP will maximize the benefits of restoration activities for the life of the SBSP Project. The Final EIS/EIR also evaluated Phase 1 actions (proposed to be implemented between 2008 and 2010) in more detail than the long-term restoration alternatives. The proposed Phase 1 actions are common to both long-term alternatives and will include restoration and creation of a range of habitat types and provide opportunities to assess the AMP. Therefore, the Final EIS/EIR is both a programmatic EIS/EIR covering the 50-year SBSP Project as well as a project-level EIS/EIR evaluating the components and implementation of Phase 1 actions.

Project Location

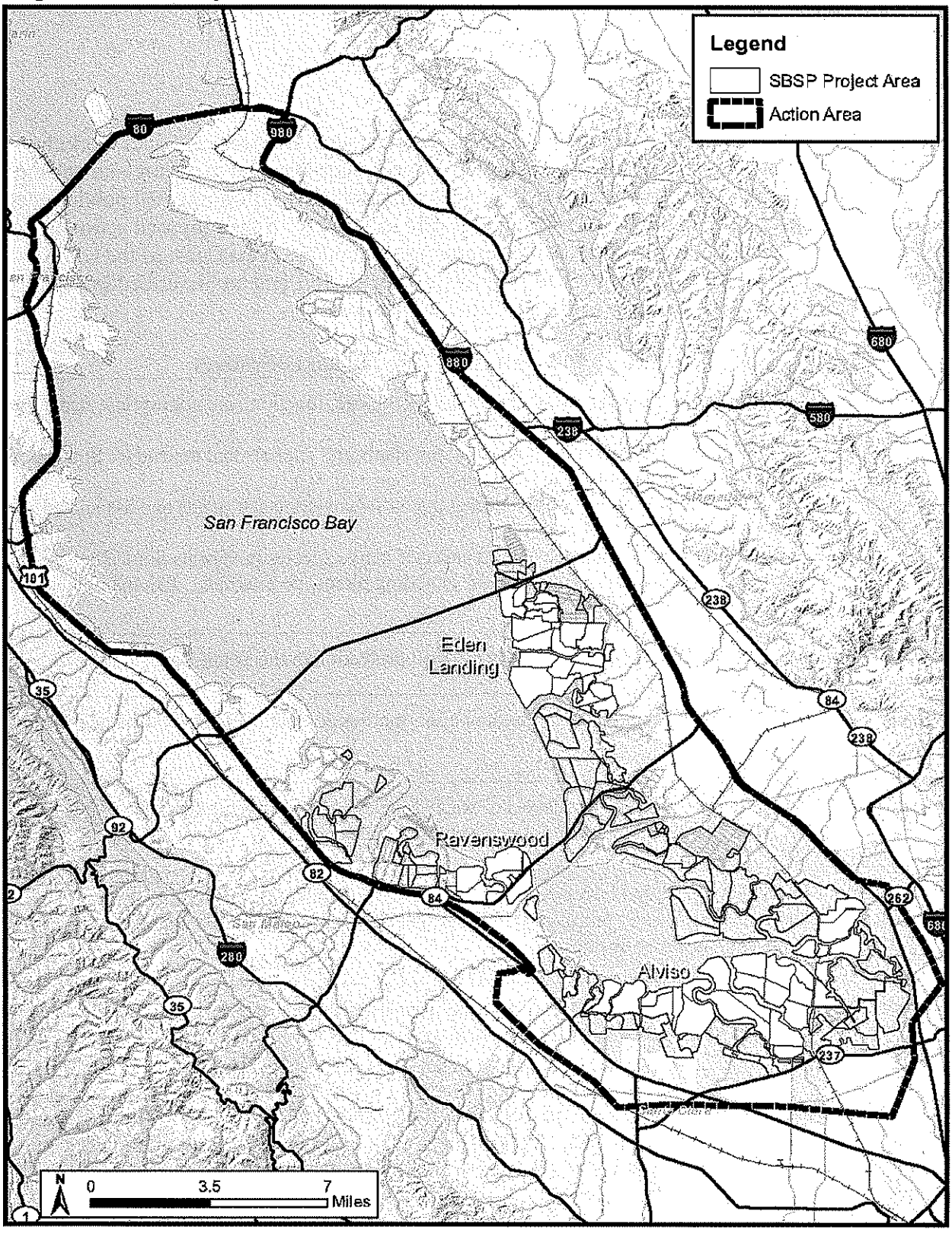
The SBSP Project is located in the South Bay in northern California and consists of approximately 15,100 acres of salt ponds and adjacent habitats within three pond complexes (Ravenswood, Alviso, and Eden Landing pond complexes) (Figure 1). The Ravenswood pond complex consists of seven ponds totaling 1,455 acres within San Mateo County. To the north of the Ravenswood complex is Redwood Creek and to the south is a portion of State Route 84 and the Union Pacific Railroad. To the east is the San Francisco Bay and the western boundary adjoins Bayfront Park in the City of Menlo Park. The Alviso pond complex consists of 25 ponds totaling 7,485 acres within Santa Clara and Alameda Counties. To the north of the Alviso pond complex is Mowry Slough and Mowry Ponds and the south is bordered by commercial and industrial land uses as well as NASA Ames Research Center and Sunnyvale Baylands Park. On the east lies Coyote Creek in San Jose and Cushing Parkway in Fremont and the pond complex is bordered on the west by the Palo Alto Baylands Nature Preserve and Charleston Slough. The Eden Landing pond complex consists of 23 ponds totaling 4,600 acres within Alameda County. The Eden Landing pond complex is located within the Eden Landing Ecological Reserve (ELER). The approach to the San Mateo Bridge forms the northern boundary of the pond complex and Alameda Creek Flood Control Channel and the Coyote Hills form the southern boundary. The ponds are east of the San Francisco Bay and west of Hayward and Union City.

Consultation History

March 1995: The Service issued a biological opinion (Service File Number 1-1-95-F-0047) to the Corps on issuance of a regional permit to Cargill to perform activities associated with solar salt production in the South Bay. This includes O&M activities on levees, ponds, and water control structures.

March 2004:	The Service issued a biological opinion to the Corps for the South Bay Salt Pond ISP (Service File Number 1-1-03-F-0359) for interim maintenance of salt ponds in the South Bay. The Service (SFBNWR) and CDFG applied for a section 404 permit from the Corps to implement the ISP until the proposed action could be implemented.
2004 – 2007:	The Service (SFBNWR) continued coordination with other Federal, State, and local agencies as well as stakeholders regarding the development of the proposed action's components for NEPA and CEQA review.
2006 –2008:	The Service (SFBNWR) continued coordination with other Federal and State agencies regarding the development of the proposed action's programmatic and project-level biological assessments.
December 2007:	The Service (SFBNWR) and CDFG released the Final EIS/EIR for the proposed action.
December 2007:	The Service received a request to initiate formal consultation on implementation of the SBSP Project (including all Phase 1 actions) from the Corps.
Jan.-July 2008:	The Service coordinated with NMFS and biological consultants for the proposed action to finalize the restoration design and plan for Phase 1 actions: Ravenswood Pond SF2; Eden Landing Ponds E8A, E8X, and E9 and E12-E13; Alviso Ponds A6, A8, and A16; CDFG and Service O&M; and PG&E O&M.
July 2008:	The Service received the Programmatic BA (Service 2008a) and the Phase 1 BAs (Service 2008b-i)

Figure 1. SBSP Project Location and Action Area



PROGRAMMATIC BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed action is a collaborative effort among federal, state, and local agencies working with scientists and the public to develop a long-term, comprehensive plan to restore and enhance wetlands in South Bay while providing for flood management and wildlife-oriented public access and recreation within the 15,100 acres of former Cargill salt ponds. If the proposed action is approved, it would be the largest wetlands restoration project on the West Coast of the United States. The six proposed action objectives are identified in Table 1 and are described in detail in the Final EIS/EIR and are summarized in the following sections.

Table 1. South Bay Salt Pond Restoration Objectives

Objective 1	Create, restore, or enhance habitats of sufficient size, function, and appropriate structure to: ▪ Promote restoration of native special-status plants and animals that depend on South Bay habitat for all or part of their life cycles. ▪ Maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees. ▪ Support increased abundance and diversity of native species in various South Bay aquatic and terrestrial ecosystem components, including plants, invertebrates, fish mammals, birds, reptiles, and amphibians.
Objective 2	Maintain or improve existing levels of flood protection in the South Bay.
Objective 3	Provide public access and recreational opportunities compatible with wildlife and habitat goals.
Objective 4	Protect or improve existing levels of water and sediment quality in the South Bay, and take into account ecological risks caused by the restoration.
Objective 5	Implement design and management measures to maintain, or improve current levels of vector management, control predation on special-status species, and manage the spread of non-native invasive species.
Objective 6	Protect the services provided by existing infrastructure (e.g., power lines, clapper railroads, and wastewater treatment plants).

The Final EIS/EIR for the proposed action evaluated three long-term alternatives with respect to tidal habitat restoration, managed ponds, flood management, and recreation and public access. The alternatives included Alternative A (No Action), Alternative B (Managed Pond Emphasis-50:50 tidal habitat:managed ponds by area), and Alternative C (Tidal Emphasis-90:10 tidal habitat:managed ponds by area). Each Alternative is identified in Table 2. The ultimate configuration of tidal habitat and managed ponds that achieves the proposed action's objectives

will likely fall between of 50:50 and 90:10 (tidal habitat:managed pond) ratios. The final mosaic combination will be guided by the AMP and implemented in adaptive steps over a 50-year period, resulting in 6,800 to 11,880 acres of tidal habitat being restored.

Table 2. Proposed Action Alternatives A, B, and C

Components	Alternative A	Alternative B	Alternative C
Tidal Habitat Restoration	Limited tidal restoration may occur from uncontrolled breaching of levees.	• 6,800 acres (50% of the proposed action area).	• 11,880 acres (90% of the proposed action area)
Managed Ponds	Current pond management would be scaled back. Many ponds would convert to seasonal habitat, filling and drying through rainfall and evaporation. Some ponds would convert to tidal habitat through uncontrolled breaching.	• 6,800 acres (50% of the proposed action area) • 20% of the managed pond area would be reconfigured for birds; the rest would have no grading or minimal grading (some island creation)	• 1,700 acres (10% of the proposed action area) • All ponds would be reconfigured to enhance foraging, roosting and nesting opportunities
Flood Management	Limited maintenance of pond levees would occur. Flooding may worsen as a result of uncontrolled breaching of levees.	• Integrated system of both coastal and fluvial flood elements: • Shoreline levees for coastal flood protection • Raise existing levee elevations where fluvial and coastal flooding occurs	• Similar to Alternative B, with differences in the actual location of levee installation/ removal
Recreation and Public Access Features	No new recreational facilities would be provided. Existing recreation opportunities may decrease as a result of uncontrolled breaching of levees.	• New recreational trails • New viewing areas • New staging areas • New field office	• Similar to Alternative B, with differences in locations of some facilities, and requirements for removal of trails

A detailed description of the long-term alternatives is located in the Final EIS/EIR for the proposed action. Implementation of the proposed action will be funded by a variety of sources, including, but not limited to grants, bonds, and appropriations, and other projects requiring mitigation within the proposed action area.

Pond Complexes

Within the South Bay, the proposed action area is divided into three main areas: Eden Landing, Alviso, and Ravenswood pond complexes (Table 3). A detailed discussion of habitats and species located within the South Bay and specifically within the proposed action pond complexes are described with the Final EIS/EIR. The Alviso pond complex contains approximately 7,400 acres of former salt ponds, 420 acres of salt marsh, 900 acres of brackish marsh, and other associated South Bay habitats. The Ravenswood pond complex contains 1,440 acres of salt ponds, with a mix of other habitats surrounding the ponds, including salt marsh (over 100 acres). The Eden Landing pond complex contains approximately 4,400 acres of salt ponds and over 700 acres of salt marsh. Of the over 18,000 acres mapped in the three pond complexes, over 13,000 acres consist of salt ponds. South Bay habitat comprises mudflat (less than 10 percent vegetated) and open water. Hardscape such as levees, ruderal upland vegetation or landscaping, unvegetated areas, and areas developed for commercial use or infrastructure, are categorized as "Other".

Table 3. Habitat Area within the Pond Complexes

HABITAT CATEGORY	COMPLEX	ACREAGE
Salt Pond*	Alviso	7,364
(Total acreage = 13,227)	Ravenswood	1,440
	Eden Landing	4,423
Marsh Habitat	Alviso	1,607
(Total acreage = 2,584)	Ravenswood	153
	Eden Landing	824
Bay Habitat	Alviso	838
(Total acreage = 1,231)	Ravenswood	283
	Eden Landing	110
Other	Alviso	617
(Total acreage = 1,228)	Ravenswood	176
	Eden Landing	435
*Note: These areas represent the actual amount of salt pond habitat contained within the existing levees of the proposed action area, and should not be confused with the 15,100 acre figure which represents the entire area purchased from Cargill and includes levees and some adjacent habitats.		

The baseline conditions, as described in the Final EIR/EIS, are the conditions that are predicted to be present once the ISP is fully operational. Therefore, the ponds that are the subject of the proposed SBSP Project are no longer salt production ponds after ISP implementation. However, because the vast majority of research that has been conducted on these ponds was performed when they were functioning as salt ponds, the term "salt pond" is used to refer to these ponds. The ponds within the proposed action area are, collectively, highly productive systems, supporting very high invertebrate biomass due to the abundance of a few key species and providing roosting, nesting, and foraging habitat for large numbers of waterbirds. However, with the exception of the birds that move in and out of the ponds, and some fish and aquatic

invertebrates that are drawn into intake ponds, the salt ponds are primarily a closed system, with virtually no export of detritus, nutrients, or energy to the tidal marsh, sloughs, mudflats, or open waters of the South Bay. Specific habitat descriptions for each of the pond complexes are described in the Final EIR/EIS. Characteristics of individual ponds selected for Phase 1 actions will be described within the project-level evaluations in the second part of this biological opinion. The following is a discussion of each of the six SBSP Project objectives:

- Ecosystem Restoration
- Flood Management
- Public Access and Recreation
- Protect Water and Sediment Quality
- Control Vectors and Nuisance Species
- Maintain Existing Infrastructure and Operations and Maintenance

Ecosystem Restoration

The Ecosystem Restoration Objective includes the creation, restoration, and/or enhancement of habitats of sufficient size, function, and appropriate structure to promote restoration of native special-status plants and animals and maintain current migratory bird species that utilize existing salt ponds and levees. Ecosystem restoration will also support increased abundance and diversity of native species in South Bay aquatic and terrestrial ecosystem components, including plants, invertebrates, fish, mammals, birds, reptiles, and amphibians. The proposed action includes a mix of restored tidal and managed pond habitats. The tidal habitat will include salt and brackish marsh, mudflats, subtidal flats and channels, marsh ecotones and upland transitional zones, salt pannes and ponds, and sloughs. For managed pond habitats, multiple options for pond reconfiguration and water regime management will be used to enhance and create ponds with a variety of depths (including vegetated ponds, salt flats, very shallow ponded areas, and deep-water areas) and salinities (e.g., ponds with salinity close to bay water as well as higher salinity brine ponds), and associated levees and islands.

General Construction Activities Associated with Ecosystem Restoration

It is anticipated that each individual restoration action will be completed in a single season (2 to 5 months), however, the timing and duration of construction will be governed by both weather conditions and the need to avoid construction in sensitive areas during certain times of the year to avoid and minimize impacts to listed species. Types of land-based construction equipment may include excavators, front-end loaders, bulldozers, forklifts, vibratory rollers, dump trucks, and water trucks. If water levels in the restoration sites are at sufficient depths for floating equipment, types of water-based equipment may include diesel-powered barges with long reach excavators or cranes outfitted with clamshell buckets and boats. Ancillary types of equipment that may be used include diesel generators, water pumps, and pile drivers. It is anticipated that dewatering and sheet piling will necessary during the construction of water control structures. Dredge-locks or coffer dams may be constructed using earth levees or sheet piling to allow access for water-based equipment within a site. When possible, amphibious excavators, vibratory pile drivers, and other less-impacting equipment will be used. Occasional delivery of

supplies and materials, such as piping, water control gates, lumber, and fuel, will be necessary. Staging areas will be temporarily established as described in the conservation measures for activities such as fueling and equipment storage. Any fill materials proposed to be used for construction of restoration sites will be stockpiled on-site and may be derived from a variety of approved sources. The stockpiling areas, though not the sources, are included within the action area for the proposed action. Ultimately, construction activities associated with ecosystem restoration and the type of equipment used will be determined by the final design of each restoration action and the conditions at the restoration site. Construction activities and methods will be detailed in the descriptions of each project-level restoration action and will include conservation measures specific to each action. The evaluations for each restoration action will tier from this PBO.

Tidal Habitat Restoration Activities

Construction activities related to tidal habitat restoration anticipated to occur include, but are not limited to, the following bullets described below. Not all of these activities may be used as part of a single habitat restoration action at a given pond or group of ponds. All construction activities related to tidal restoration will be described in detail within each of the Phase 1 action project descriptions and all future tiered action descriptions.

- Breaching sections of outboard levees
- Lowering sections of outboard levees
- Breaching internal levees
- Excavating pilot channels to sloughs through the fringe marsh outboard of outboard levee breaches
- Constructing ditch blocks in the perimeter and internal borrow ditches with material excavated from the levee breaches and lowered levees, or from other clean sediment
- Importing dredged or fill material
- Side-casting of dredge spoils into adjacent marsh
- Retrofitting infrastructure (e.g., tower footings, boardwalks, sewer lines, etc) within the project area prior to restoration
- Constructing slough channels and marsh pannes in pond bottoms, or along the tops of lowered internal levees
- Removing or abandoning existing water control structures
- Reconfiguring culvert connections
- Breaking up gypsum layer mechanically

Managed Pond Construction Activities

Construction activities related to reconfiguring managed ponds anticipated to occur include, but are not limited to, the following below. Not all of these activities may be used as part of a single action at a given pond or group of ponds. All construction activities related to managed pond reconfiguration will be described in detail within each of the Phase 1 action project descriptions and all future tiered action descriptions.

- Installing, replacing, or modifying intake/outlet water control structures with tide gates
- Installing fish screens on outboard intake/outlet water control structures as appropriate
- Constructing low berms to divide a pond into multiple cells
- Installing water control structures, such as flashboard weirs, in internal berms to regulate flow among cells
- Constructing intake and outlet canals to convey water among individual cells
- Using dredge/fill material to construct internal islands for nesting, roosting, and foraging
- Grading pond bottoms to achieve desired grades and elevations
- Improving, raising, and extending levees between managed ponds and existing or restored marshes as necessary to prevent tidal inundation of managed ponds
- Installing or operating pumps as necessary
- Excavating pilot channels to the bay through the fringe marsh outboard of new water control structures
- Improving levees around ponds to improve maintenance access and/or contain water

South Bay Salt Pond Mitigation Program

Mitigation, through habitat restoration, is used in certain instances to offset project impacts to wetland and estuarine habitats or for listed species. There are various conditions which must be met before it can be determined that mitigation is appropriate to minimize the effects of project impacts. Most importantly, a project's impacts should not compromise a species' recovery goals or jeopardize its continued existence. Under the Mitigation Program, impacts to wetland or estuarine habitat, or to listed species or their habitats that meet the appropriate conditions may be mitigated through restoration within the proposed action area. Any project that wishes to mitigate within the proposed action area is subject to the following criteria:

- Projects are subject to the review and approval of the Service, NMFS, and CDFG.
- Projects must be located south of the San Francisco Bay Bridge and within the proposed action area.
- The impacts for which mitigation is performed within the proposed action area must be located below mean high tide line.
- Projects must not conflict with any policies of the relevant regulatory agencies (i.e., Service, NMFS, Corps, CDFG, RWQCB) relating to mitigation.
- The mitigation must benefit the wetland and estuarine habitats or listed species impacted by the proposed project needing mitigation.

Mitigation on Service Land

In 1999, the Service adopted a policy that it would not allow the use of National Wildlife Refuge System lands for mitigation banks under the Clean Water Act. However, in 2004, the Service (SFBNWR) was granted an exception to this policy under the National Wildlife Refuge System and Compensatory Mitigation under the Section 10/404 Program for Refuges in the San Francisco Bay Area. Therefore, additional requirements exist for mitigation on the Don Edwards San Francisco Bay National Wildlife Refuge (Refuge) for impacts under Section 404 of the Clean Water Act and/or Section 10 of the Rivers and

Harbors Act.

- Mitigation must be approved by the Service's California Nevada Operations Office.
- Projects for which the mitigation is accepted must comply with the Section 404 (b)(1) Guidelines of the Clean Water Act.
- Mitigation must be consistent with the purposes of the Service and the mission of the National Wildlife Refuge System.
- Mitigation would result in a significant increase in natural resource benefits when compared to other appropriate, off-site mitigation options
- Mitigation plan is written to ensure there is no obligation to allow compensatory mitigation on any National Wildlife Refuge System Lands in the future.
- Projects for which the mitigation is accepted are in compliance with all applicable Federal environmental statutes including the Act, Migratory Bird Treaty Act, Marine Mammal Protection Act, Magnuson-Stevens Act, NEPA, Fish and Wildlife Coordination Act, and permits as would be required and provided by Federal, State and local governments.
- Mitigation must be consistent with and would assist in meeting the goals of, the Bay Ecosystem habitat Goals Report, prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project and applicable recovery plans for endangered species.
- Projects for which the mitigation is accepted are only public work development projects. This would limit the use of refuge lands to projects needed for the public good and would not apply to projects that may require compensatory mitigation from private entrepreneurs or developers.

Mitigation on CDFG Land

CDFG will also consider the use of CDFG lands for mitigation, when appropriate and consistent with CDFG policy and management objectives, on a case by case basis with the concurrence of permitting and resource agencies. Upon approval, projects wishing to mitigate on CDFG land would be responsible for getting approval from the regulatory agencies as part of their permitting process.

- CDFG Mitigation Requirements on existing CDFG lands:
- Mitigation applicants need to provide funding to offset the cost of acquisition which CDFG uses for other acquisition or restoration.
- Funding for planning and implementation of the mitigation actions
- Endowment for long-term stewardship which is to generate support for long-term O&M of the CDFG lands used for mitigation.
- Funding for regulatory requirements for monitoring if required

Flood Management

The Flood Management Objective includes maintaining or improving existing levels of flood protection in South Bay. Therefore, flood hazards to adjacent communities or infrastructure should not occur due to implementation of the proposed action. The proposed action will ensure

that future flood protection with the proposed action area is comparable to, or better than, current conditions.

General Construction Activities Associated with Flood Management

Each proposed restoration alternative describes provisions to manage flood hazards from both fluvial (stream) and coastal flood sources, which are described in detail in the EIS/EIR for the proposed action. A common strategy among restoration alternatives is to improve the inboard levee system (along the landward side of the ponds) to reduce the hazards of coastal flooding. Other salt pond levees include: 1) existing outboard levees (*i.e.*, bayfront and slough/creek levees adjacent to tidal waters) that were built to enclose evaporation ponds on former tidal marshes and mudflats and to protect the salt ponds from Bay inundation; 2) smaller inboard levees (*i.e.*, pond levees constructed inland along the historic Bay margin) that offer the last line of defense against flooding of low-lying, inland areas; and 3) internal levees that separate the individual salt ponds from each other. These salt pond levees were not designed, constructed, and maintained following a well-defined standard and would likely require significant improvements to provide an adequate flood protection. Construction of the inboard levee system (along the landward side of the ponds) to reduce the hazards of coastal flooding is the predominant proposed action activity associated with flood protection. For each phase of the proposed action, flood management strategies will be developed and they will be evaluated under tiered section 7 consultations under this PBO. Activities associated with flood protection may include:

- Modifying (raising or retrofitting) existing levees
- Placing fill to raise high ground areas and adding erosion protection where necessary.
- Constructing new flood protection levees
- Breaching, or setting back the existing salt pond levees, widening the channel and providing additional cross-sectional area for flow to improve floodwater conveyance
- Using regular tidal scour to enlarge the channel cross-section and increase conveyance
- Breaching slough levees to route more tidal flow through the sloughs/channels, to increase channel deepening and widening downstream of the breaches
- Removing or allowing levees on one or both sides of the channel to scour where channel scour is expected
- Relocating maintained levees to accommodate the expected channel enlargement or armoring them to ensure that they remain intact
- Providing temporary floodwater storage within the managed ponds to reduce flooding impacts
- Converting ponds to muted tidal or seasonal wetland with flood-flow diversion to increase storage of fluvial floodwaters, resulting in decreased water levels and reduced flood hazards in tributary channels

Although the proposed action is committed to ensuring that future flood protection with each individual project is equal to, or better than existing conditions, it is desirable that a comprehensive flood management strategy be developed around the entire proposed action area that would provide a consistent level of flood hazard management with flood protection

measures (levees, high ground) meeting both Federal Emergency Management Agency (FEMA) and Corps criteria.

Public Access and Recreation

The Public Access and Recreation Objective will provide public access and recreational opportunities compatible with wildlife and habitat goals. Public access and recreation, flood management, and habitat features will be developed in concert with each other to maximize the ability to manage these resources over time. Trails and other access features that are developed on existing or proposed levees would be integrated with the levee structure, without interrupting the flood control function.

Features Associated with Public Access and Recreation

The proposed public access and recreation components would include an interrelated system of trails and viewing platforms, interpretive stations, waterfowl hunting, access to and interpretation of cultural resource features, opportunities for education and interpretation, small watercraft launching points, and associated access points and parking areas. Tidal access and recreation areas would be designed to withstand periodic inundation, if appropriate, and may be in locations that would have more limited access or use, depending on tidal location and habitat requirements. Public access and recreation features would be designed to respect habitat requirements and therefore, may be seasonal or limited in the number of visitors that can be accommodated. These features are described in general below and the Final EIS/EIR describes the locations and types of features in greater detail.

- **Trails** - The trails component of the public access and recreation plan is hierarchical, with certain segments helping to complete the Bay Trail regional system, and local trail connectors that may be part of an existing local system. Where possible, new loop trails are proposed near areas where the restoration will result in the removal of existing loop trails. Trail segments will vary in size, width, surfacing and the types of users they can accommodate and when visitors will have access. Trail segments may amount to approximately 23.5 miles of new and/or improved trails. Trails may be designed to accommodate vehicular use in some locations to provide access to a staging area or launching point, or for disabled access. Trails would also provide waterfowl hunting and fishing access to areas that accommodate these activities. Trails will also provide opportunities for walking, jogging, bicycling, wildlife viewing, and nature photography. In general, trail access is considered to be less compatible with tidal habitat restoration than with managed pond restoration because, in the absence of data on public access effects on listed species, the Service must take a conservative approach to protecting listed species. Thus, tidal habitat species are currently considered sensitive to public access.

- **Access Points and Staging Areas** - Various access points and staging areas will be designated to provide access to the other features such as trails, kayak, fishing and waterfowl hunting access. Access would be designed to be as barrier-free as possible to provide access for visitors of varying abilities and would comply with the Americans with

Disabilities Act (ADA).

- **Boating** - Water-based activities such as non-motorized boating (canoes and kayaks) would be incorporated into the public access plan for hunters, anglers, and people interested in wildlife viewing.

- **Historic Features** - Historical and cultural features will be accessible as part of the larger trail network and where interpretive signage and guided or self-guided walks is appropriate. The history of landscape change in the South Bay provides a wealth of possible themes to develop as part of the public access plan. The history of the many salt works operating in the South Bay or the use of the South Bay for duck hunting are examples of themes that may be developed for interpretive and educational value. Historical as well as future landscape change would be considered in the final design of public access features.

- **Interpretive Stations** - Interpretive stations are proposed at strategic locations along the trail network within the proposed action area. These are envisioned to be of varying sizes and scope and may be interactive features that can operate independently or can be enhanced with the assistance of docents.

- **Viewing Platforms** - Viewing platforms would be located at vista points where important information about the landscape can be viewed. These may also incorporate interpretive panels or signage to link the viewer with the site location.

- **Waterfowl Hunting and Fishing** - Hunting and fishing within the proposed action area will occur for the Service (SFBNWR) and ELER, and does not include hunt programs authorized for other parcels under previous biological opinions. If these programs change in the future, the changes will be proposed to the Service, and the effects of such changes on listed species will be analyzed as specific activities tiering off this PBO. Effects to listed species cannot be greater than those already considered in the Service's biological opinion. It is likely that the Service's (SFBNWR) entire hunting program will be modified in the development of their Comprehensive Conservation Plan (CCP).

General Construction Activities Associated with Public Access and Recreation

Construction of the recreation and public access components may consist of the following activities:

- Trail construction activities may consist of grading and, for all-weather trails, gravel application. Equipment required for trail construction may include small, Bobcat-sized equipment, backhoes or front-end loaders, graders, bulldozers, asphalt placement equipment, and dump trucks. Depending on the length of trail, construction activity could take one to seven days.
- Constructing trails, including some trails designed to accommodate vehicular use, trails to provide access to a staging area or launching point, and trails for disabled access.
- Constructing interpretive stations of varying size and scope, which will include interactive

features that can operate independently or can be enhanced with the assistance of docents.

- Constructing viewing platforms at vista points where important information about the landscape can be described. Viewing platforms will be made of wood, metal, or plastic material and assembled in-place using a backhoe or excavator and hand tools. Interpretive stations will be built on-site, or will be prefabricated structures. Assembly and installation will require a backhoe or excavator and hand tools.
- Constructing non-motorized boat launching points and associated staging and parking areas for water-based activities.
- Constructing a boat launch facility for the launching of kayaks and small boats will require the building of a ramp for trailer access. Equipment required will include a backhoe or excavator, compaction equipment and a dump truck for imported fill materials.

Protect Water and Sediment Quality

The fourth objective is to protect or improve existing levels of water and sediment quality in the South Bay, and take into account ecological risks caused by the restoration. The habitats to be created by the proposed action will include a mix of managed pond and restored tidal habitats. The proposed action is designed to restore and improve water and sediment quality in the South Bay beyond the duration of the proposed action via the beneficial water quality functions of the restored tidal wetlands. The specific construction activities to achieve these beneficial water quality functions through tidal restoration have been listed under the Ecosystem Restoration Objective. More specific water and sediment quality concerns that accompany proposed action activities involve mercury mobilization, low dissolved oxygen in managed pond and releases from these ponds, and increased turbidity during construction.

Mercury-Related Activities

Sediments in some parts of the proposed action area, particularly in and along Alviso Slough, contain high levels of mercury contamination. Re-mobilization of mercury-contaminated sediments into the water column, either directly (e.g., during excavation of pilot channels) or indirectly (through increased sediment scour after a pond is opened to tidal action), can lead to exceedance of water quality objectives for mercury and result in adverse effects on South Bay biota. For mercury, the proposed action will attempt to avoid causing or contributing to mercury levels exceeding 0.2 parts per million (ppm) in large fish and 0.03 ppm in small fish, both in the project area and in the South Bay; these thresholds are driven by the total maximum daily load (TMDL) plan for mercury in the San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006). The Bay mercury TMDL also requires that activities avoid release of sediments into the bay that have a median mercury concentration greater than 0.2 ppm, and that existing water quality objectives (0.025 – 0.050 µg/L) for mercury be attained.

To help ensure that these objectives are met, testing of sediments within ponds to be opened to tidal action, and within sloughs and marshes that may scour following breaching of a pond, for mercury concentrations will be conducted, primarily along Alviso Slough.

A mercury monitoring study is currently underway to ensure that mercury impacts on biota are

minimized during restoration. This study focuses on the Alviso area where mercury levels are known to be high, but also includes sampling sites elsewhere in the South Bay. This study is measuring mercury levels in the sediment, water column, and various sentinel species; measuring the bioavailability of inorganic mercury in sediments; measuring mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. This study will increase the understanding of mercury cycling within the proposed action area and will inform future management decisions to further minimize mercury exposure.

Monitoring of mercury cycling during Phase 1 restoration and management activities will also provide information on management or restoration activities that are desirable, or that are to be avoided, in areas of high mercury concentrations. Decisions regarding restoration or management activities involving breaching and scour in a particular area will be made only after the sediments to be mobilized by such activities are tested for mercury levels, and in the context of the results of ongoing and future studies regarding the effects of mercury. Once it is determined the nature and scope of these studies, they will be evaluated and tiered under this PBO.

Other activities will be implemented as adaptive management actions if monitoring of mercury levels indicates unacceptable levels in sediments, the water column, or tissues. These activities may include:

- Adding an upper layer of clean sediment within managed ponds to decrease mercury concentrations in re-suspended sediments
- Placing berms or islands within ponds to decrease fetch length and decrease wind-driven resuspension of sediments
- Removal of mercury-contaminated sediments from areas of particularly high concentrations, or areas where mercury-laden sediments are being scoured and resuspended.

Activities Related to Low Dissolved Oxygen

Changes in water flow/residence time and increased algal productivity could reduce dissolved oxygen (DO) levels in managed ponds and discharges from these ponds to sloughs and to the South Bay. DO is depleted in pond and marsh environments by respiration and chemical and microbial aerobic processes. DO is replenished in the system through photosynthesis and oxygen transfer from the atmosphere, termed reaeration. Microbial degradation of organic matter in pond and marsh sediments can be a significant oxygen demand in the system. This sediment oxygen demand is dependent on the amount of organic matter available to decay. Death of algae and aquatic organisms contributes to the organic matter supply. Respiration may be a significant oxygen demand if algae and organism populations are large. Algae are net oxygen consumers at night, when wind-driven re-aeration is also low. This creates periods of low DO. DO is then replenished during the day when the algae photosynthesize instead of respiring and wind-driven re-aeration increases. Waters flowing slowly through a pond will not be as well mixed as faster moving waters. Stagnant conditions lead to anoxic waters as oxygen demands exceed re-aeration. Significant impacts as a result of low DO will include depressed species diversity, fish kills and death of other aquatic organisms, and odor problems.

For water discharges from the proposed action area, the goal is to avoid discharges that result in DO less than 5 mg/L in the South Bay, which is established by the regional water quality regulations. Within managed ponds in the proposed action area, where lower DO levels are expected to occur more commonly, the goal will be to avoid DO levels less than 2 mg/L. Several activities will be undertaken to prevent DO levels in managed ponds and releases from these ponds from becoming too low or increase DO levels when monitoring indicates that they are too low. These activities include:

- Decreasing the hydraulic residence time to counter algal growth and increase re-aeration
- Altering levee configurations to increase wind-driven re-aeration and/or improve pond circulation
- Decreasing water depth to counter sediment oxygen demand
- Installing baffles to re-direct flow from low-DO areas or discharge water from high-DO areas
- Installing passive or active re-aeration systems

Control Vectors and Nuisance Species

The proposed action will implement design and management measures to maintain or improve current levels of vector management, control predation on special-status species, and manage the spread of non-native invasive plant species. Vector control is incorporated into the proposed action primarily through the design and restoration of well-drained tidal marshes, as described previously for the Ecosystem Restoration Objective. Any residual mosquito control needs will be addressed by mosquito abatement districts under separate authorization; such mosquito control is not covered under this PBO. The activities for predator management and management of non-native invasive plant species are listed under the sub-headings below.

Control of Predation on Special-Status/Sensitive Species

Predation by a number of both native and non-native predator species impacts populations of special-status and sensitive species in the South Bay. The level of impact to a species by a particular predator varies by site, depending largely upon the local predator population level, habitat conditions, and surrounding landscape features. Some of the most common predators include: 1) non-native mammals such as red foxes (*Vulpes vulpes*), Norway rats (*Rattus norvegicus*), roof rats (*Rattus rattus*), and feral and domestic cats (*Felis catus*); 2) native mammals such as gray foxes (*Urocyon cinereoargenteus*), striped skunks (*Mephitis mephitis*) and raccoons (*Procyon lotor*); and 3) native birds such as California gulls (*Larus californicus*), northern harriers (*Circus cyaneus*), common ravens (*Corvus corax*), and American crows (*Corvus brachyrhynchos*). Other less common predator species may have either localized or larger scale impacts to certain special-status or sensitive species.

Predator management by California Wildlife Services, USDA-APHIS for protection of special-status and sensitive species already occurs in a large portion of the proposed action area, including an ongoing mammalian predator management program on the Service (SFBNWR) and

ELER (Foerster and Takekawa 1991), and focused removal of avian predators to protect snowy plovers on ELER (CDFG 2000). Predator management activities on the SFBNWR are limited to control of mammalian species, as authorized by the San Francisco Bay National Wildlife Refuge Predator Management Plan and Environmental Assessment (Foerster and Takekawa 1991). Predator management will continue on an as-needed basis to protect listed species, such as snowy plovers, clapper rails, harvest mice, and least tern colonies from predators. When the Service (SFBNWR) develops the revised CCP, the predator management program will be expanded to include both avian and mammalian predator species. The Service (SFBNWR) is scheduled to conduct the CCP process beginning in 2008. Until then, predator monitoring and management will continue under their current authorities and the proposed action will continue coordination with Wildlife Services to focus predator control in priority listed species habitats to reduce high levels of predation. Although these activities will continue during and post-implementation of the proposed action, they will not be covered under this PBO.

Manage the Spread of Non-native Invasive Species

A number of non-native plant species occur within the proposed action area, some of which have been identified as invasive or potentially invasive. Vegetation management activities will focus on detection and removal of invasive plant species that threaten native habitats and/or alter special-status species or migratory bird habitat. Current management focus is on several species of cordgrass (*Spartina spp.*) and perennial pepperweed (*Lepidium latifolium*). Although the growth of invasive *Spartina* is limited to salt and brackish marsh habitats, pepperweed grows in a wider variety of wetland types and in certain habitats.

The proposed action is operating under the assumption that invasive *Spartina*, including non-native smooth cordgrass (*S. alterniflora*) and its hybrids, will be controlled by the Invasive *Spartina* Project. All invasive *Spartina* control work, including monitoring and spraying as needed, will be performed under the existing Invasive *Spartina* Project Biological Opinion (Service File Number 81420-2008-F-1546) and future amendments to this authorization, until the Invasive *Spartina* Project is completed.

Control of perennial pepperweed is currently occurring only on a small-scale, experimental basis along levees. No large-scale control program yet exists to facilitate effective long-term control. Breaching of levees and subsequent increases in tidal prism could reduce the amount of brackish marsh habitat available for colonization by pepperweed. Monitoring new establishment of pepperweed will involve activities that will be covered under the Phase 1 BO in the second part of this biological opinion. These activities may include walking on levees and in marshes, driving motor vehicles on levees and roads, and boating in the South Bay and in sloughs and channels. If, over time, other non-native invasive species are detected within the proposed action area, the threat to the ecosystem will be assessed and management activities will be implemented according to the adaptive management process.

Protect Existing Infrastructure and Operation and Maintenance

The proposed action will restore a substantial portion of the 15,100-acre restoration area to tidal marsh, and will therefore contribute to changes in water levels, tidal flows, and sedimentation

patterns in the South Bay, the tidal sloughs, and the ponds over the 50-year life of the proposed action. The protection of existing infrastructure is being achieved through project design, which will minimize changes that will potentially affect the operation and management of existing utilities (e.g., electrical transmission lines and sub-stations, gas pipelines, storm drains, pump stations, and wastewater treatment plant outfalls) located within the proposed action area. Activities related to infrastructure protection such as accessing infrastructure via foot, boat, helicopter or vehicles (both light vehicles and heavy equipment) for visual inspections or surveys of levees, towers, outfalls, etc are being covered under the Phase 1 BO in the second part of this biological opinion. Such inspections will be brief at any given location, and are expected to occur no more than once per year.

The proposed action would involve O&M activities associated with Ecosystem Restoration, Flood Management, and Recreation and Public Access. O&M activities would occur periodically over the 50-year planning horizon and include activities for all South Bay salt ponds, including O&M of Phase 1 actions and future actions. O&M would include activities such as the replacement and/or repairs of water control structures, and maintenance of existing and new levees. O&M would be covered by the existing Corps Permit #19009S98 which was issued by the Corps in November 1995 to Cargill for certain structures. The portions of the permit covering lands which are part of the proposed action were transferred to Service (SFBNWR) and CDFG in May 2003. All O&M activities for ponds in the South Bay salt pond complex are addressed in two separate descriptions: 1) O&M activities to be performed by the Service (SFBNWR) and CDFG; and 2) O&M activities to be performed by PG&E on their infrastructure (by way of a Special Use permit issued by the Service (SFBNWR)). Changes in operations and maintenance of PG&E infrastructure resulting from the proposed action, as well as the activities required to protect PG&E infrastructure (raising tower footings, raising boardwalks, building boat blocks) prior to restoration actions. These activities are covered under the Phase 1 BO in the second part of this biological opinion.

Other Projects and Programs

Moffett Federal Airfield (Moffett) is a restricted use Federal airfield owned by the National Aeronautics and Space Administration (NASA) to meet the needs of NASA, other agencies, and other NASA Ames Research Center authorized users. The California Air National Guard's 129th Rescue Wing (129 RQW) is based at Moffett and operates C-130 aircraft and HH-60 helicopters, in addition to aircraft operations by NASA and other authorized users of the airfield.

The north end of the runways at Moffett is located within 10,000 feet (a critical phase of flight area) to the proposed action area (Alviso Ponds A2E, AB2, and A3W). Data complied over many years by NASA and others show wildlife-aircraft collisions occur with greater frequency at low altitudes, along shorelines, and areas favorable for wildlife habitat. These types of collisions have resulted in fatalities and the loss of an aircraft shortly after take-off when it struck a flock of birds. Therefore, the Service has been coordinating with the California Air National Guard regarding the control of wildlife hazardous to 129 RQW flight activities over and around the proposed action area. As Alviso Ponds A2E, AB2, and A3W are restored (Phase 2 - after 2010), listed species may be attracted to habitat within 10,000 feet of the north end of the runways. This may pose hazards to aircraft operating to and from Moffett. Therefore, the Service will

continue to coordinate with the California Air National Guard to ensure that their needs for wildlife control are met while complying with the Act. The Service anticipates that the California Air National Guard's wildlife control plan may require section 7 consultation if their wildlife control plan may affect listed species. If so, this consultation would be a project-level consultation which would tier under this PBO.

Conservation Measures

The following conservation measures will be implemented as part of the proposed action to further reduce or avoid adverse effects on the clapper rail, harvest mouse, snowy plover and critical habitat, least tern, and the brown pelican during the 50-year life of the project. These conservation measures are expected to be implemented in a manner and to an extent sufficient to sustain Act, and CESA compliance. Additionally, all project-level actions proposed to be implemented under the programmatic action will implement these conservation measures as appropriate and feasible for each project-level action (Phase 1 actions and future actions). However, the precise conservation measures that will apply to avoid or minimize a specific action's adverse effects will depend on the location and timing of the action, as well as the current status, distribution, and needs of the affected species and habitats. Implementation of these conservation measures as necessary is a key component in determining effects to listed species and a key component in the determination made for listed species in this biological opinion.

As the proposed action develops new information about implementation, the Service (SFBNWR) and CDFG may revise the conservation measures as necessary, consistent with the Act and CESA. However, the Service will not approve revisions to the conservation measures that would cause or allow an increase in incidental take of a listed species or critical habitat designated under the Act that was not considered in this biological opinion. Any revisions to conservation measures that are consistent with the PBO can be incorporated without re-initiating section 7 consultation.

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

2. To minimize or avoid the loss of individual clapper rails, activities within or adjacent to tidal marsh areas will be avoided during the clapper rail breeding season from February 1 through August 31 each year unless surveys are conducted to determine clapper rail locations and clapper rail territories can be avoided, or the marsh is determined to be unsuitable clapper rail breeding habitat by a qualified biologist. If breeding 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 clapper rail calling center and any activity area is greater than 200 feet, then it may proceed at that location within the breeding season. *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed

during the clapper rail breeding season in areas within or adjacent to clapper rail breeding habitat with approval of the Service and CDFG under the supervision of a qualified biologist.

3. To minimize or avoid the loss of individual harvest mice from any excavation, fill, or construction activities in suitable habitat within tidal marsh areas, vegetation removal will be limited to the minimum amount necessary to permit the activity to occur. Sufficient pickleweed habitat, as determined by a Service-approved biologist, will remain adjacent to the activity area to provide refugia for displaced harvest mice. Silt fences will be erected adjacent to construction areas to define and isolate potential harvest mouse habitat.

4. To minimize or avoid the loss of individual snowy plovers, no activities will be performed within at least 600 feet of an active snowy plover nest during the snowy plover breeding season, 1 March through 14 September (or as determined through surveys). Vehicles driving on levees and pedestrians walking on boardwalks or levees should remain at least 300 feet away from snowy plover nests and broods. In addition, personnel that must stop at a specific site for brief inspections, maintenance, or monitoring activities should remain 600 feet away from snowy plover nests and broods. *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the snowy plover breeding season in areas within or adjacent to snowy plover breeding habitat with approval of the Service and CDFG under the supervision of a qualified biologist. If snowy plover chicks are present and are foraging along any levee that will be accessed by vehicles (e.g., for construction, inspection, or access), vehicle use will be under the supervision of a qualified biologist (to ensure that no chicks are present within the path of the vehicle).

5. Water-level manipulation (e.g., for management) within ponds that contain suitable snowy plover habitat will not be performed unless surveys are conducted to determine whether they are present during the breeding season (1 March through 14 September). If snowy plovers are present, any addition of water to the pond will be monitored closely to ensure that no nests are flooded.

6. No activities will be performed within 300 feet of an active least tern nest during the least tern breeding season, 15 April to 15 August (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 Service and CDFG under the supervision of a qualified biologist.

7. Water-level manipulation (e.g., for management) within ponds known to contain nesting least terns will be monitored closely to ensure that no nests are flooded during the least tern breeding season (15 April to 15 August) unless surveys demonstrate that nesting least terns are absent.

8. For each project-level activity, the supervising construction personnel will participate in a

Service-approved worker environmental awareness program. Under this program, construction personnel shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the animal or destruction of its habitat is a violation of the Act. Prior to construction activities, a qualified biologist approved by the Service shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. The awareness program will apply to construction occurring within or adjacent to tidal marsh or slough habitat and within or adjacent to managed pond habitat. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. A Service representative shall be appointed who will be the contact source for any employee or contractor who might encounter a listed species. The representative(s) shall be identified during the environmental awareness program. The representative's name and telephone number shall be provided to the Service and CDFG prior to the initiation of any activities.

9. To avoid or minimize potential adverse effects from public access and recreation features constructed near tidal marsh, trails adjacent to some nesting areas for sensitive bird species will be closed during the breeding season. Public trails within 300 feet of suitable snowy plover or least tern nesting habitat will be closed during the breeding season. In addition, if trails are to be open during the breeding season of these species, viewing platforms, kiosks, benches, boat ramps, interpretive displays, restrooms, and other focal areas for public use will be located a minimum of 600 feet from suitable nesting habitat. The locations of trail segments to be closed, and the periods of closure, will depend on whether sensitive bird species, such as snowy plovers or least terns, are nesting in certain areas in a given year, and whether nesting areas are located in close proximity to the trails. Decisions on whether to close a particular trail segment will be made early in the breeding season (and possibly later in the season as conditions change) following surveys for nesting birds within a given pond adjacent to a trail.

10. Interpretive signage prohibiting access to areas that are closed to the public, and indicating the importance of protection of sensitive biological resources, will be placed in key locations, such as along trails near sensitive habitats, at boat launches, and near the mouths of sloughs that are closed to boating access. Interpretive signage at boat launches will describe areas that are closed to boating access and describe measures to be implemented to avoid impacts to harbor seals, clapper rails, and other sensitive wildlife.

11. In order to minimize potential effects on salt marsh habitat and associated species (clapper rail and harvest mouse), hunters will not be allowed to construct new permanent blinds in marsh areas. Wildlife managers may close certain ponds to hunting if deemed necessary to protect important habitat for snowy plovers.

12. If brown pelican observations increase substantially on any ELER ponds during the hunting season, the potential for disturbance may be reevaluated and the hunting program may be modified to avoid any impacts.

13. Dogs are restricted to designated trails, and designated hunting areas during the waterfowl season. Dogs must be on a leash at all times other than dogs used for hunting in designated hunting areas. In designated hunting areas, dogs may be off leash only for hunting during waterfowl season and must be under voice control at all times.

14. To reduce potential impacts from infestation by non-native *Spartina*, pepperweed, and other invasive, non-native plant species, all equipment (including personal gear) will be cleaned of soil, seeds, and plant material prior to arriving on site to prevent introduction of undesirable plant species. Equipment and personal gear will be subject to inspection. All infestations occurring within the wetlands would be controlled and removed to the extent feasible without substantially hindering or harming the establishment of native vegetation in the restored wetlands.

15. A hazardous spill plan will be developed prior to construction of each action. The plan will describe what actions will be taken in the event of a spill. The plan will also incorporate preventative 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 and notify appropriate authorities, and mitigate damage as appropriate. Containers for storage, transportation, and disposal of contaminated absorbent materials will be provided on the project site.

16. Project sites will be maintained trash-free and food refuse will be contained in secure bins and removed daily.

17. Any large wood, native vegetation, and weed-free topsoil displaced by construction will be stockpiled for use during site restoration.

18. Vehicles driving on levees to access the South Bay, tidal sloughs, or channels for construction or monitoring activities will travel at speeds no greater than 10 mph to minimize noise and dust disturbance.

19. A stormwater management 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 (i.e., 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 due to increased mobilization of sediments.

20. All clean fill material proposed for upland and wetland placement will meet the qualifications set forth in the Regional Water Quality Control Board's (RWQCB) waste discharge requirements (Tentative Order), approved with respect to chemical and biological suitability for uplands and wetlands by the Dredged Material Management Office (DMMO). If the above-mentioned thresholds are not attained and the material is

approved for use by the RWQCB, consultation will be reinitiated to analyze the potential effects of the contaminated material to listed species.

21. The restored tidal marsh wetlands would be monitored for possible infestation by non-native cordgrass and other invasive, non-native plant species. If any invasive, non-native plant species are found, a qualified botanist would recommend specific measures to control the spread of non-native plant species. All infestations within the restored tidal marsh wetlands would be controlled and removed in coordination with the current eradication program for *Spartina* being implemented within San Francisco Bay without substantially hindering prepared or harming the establishment of native vegetation in the restored wetlands.

22. The Service (SFBNWR), in coordination with NMFS and CDFG, will continue to develop a Monitoring and Adaptive Management Plan to determine the rate of tidal wetland restoration and quantity and quality of the wetlands established. A draft plan in nearly complete and would be finalized by the end of Phase 1. The monitoring program would be designed to determine whether tidal marsh is developing at the estimated rate of development. Monitoring of the development of the restored areas is intended to enable the Service, NMFS, and CDFG, to assess the success of habitat development and make decisions regarding corrective measures if necessary.

23. The Service (SFBNWR) and CDFG will provide access to their facilities, cooperate with designated managers of the predator control program and each provide 1/3 of the cost of the predator control program to control predators on restoration areas, mitigation areas, and at key locations throughout the Project Area. In the event that predators are controlled to a point that only a maintenance program is indicated, the dollar contribution portion of this conservation measure would be eliminated

Action Area

The action area is defined in 50 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." Restoration actions and on-going operations and maintenance activities include a number of actions that may occur throughout the South Bay. As a result, the action area for the SBSP Project encompasses:

- Three pond complexes (Eden Landing, Alviso, and Ravenswood) and the neighboring sloughs (Mt. Eden Creek, North Creek, Old Alameda Creek, Alameda Creek Flood Control Channel, Mud Slough, Coyote Creek, Alviso Slough, Guadalupe Slough, Stevens Creek, Mountain View Slough, Charleston Slough, and Ravenswood Slough).
- Recreation areas within those complexes, portions of the Bay Trail, Alameda Creek Regional Trail, Don Edwards Environmental Education Center, and the Alviso Marina County Park, as well as the associated staging areas, parking lots and access points near the three pond complexes
- San Francisco Bay south of the Bay Bridge, where indirect effects of the proposed action on bathymetry and salinity may occur

- Portions of San Francisco Bay and associated wetlands and channels south of the Bay Bridge, up to the mean high tide line, where projects that may use the proposed action for mitigation can be located
- Portions of San Francisco Bay that may be traversed by water-based equipment that may be used for dredging or other actions that require water access
- Any other areas in the vicinity of on-going maintenance and operations that may be directly or indirectly affected by noise, dust, or other factors resulting from associated operations

Applied studies will be conducted in concert with the AMP. The applied studies implemented as part of the proposed action will either be performed within the Action Area defined above, or will be performed in such a way that there will be no effect to listed or candidate species, or critical habitat.

STATUS OF THE SPECIES AND ENVIRONMENTAL BASELINE

California Clapper Rail

The clapper rail was federally listed as endangered in 1970 (35 FR 16047). Critical Habitat has not been proposed or designated. This subspecies is one of three subspecies in California listed as endangered under the Endangered Species Act (Act). The other subspecies include the light-footed clapper rail (*R. l. levipes*), which is found in tidal marshes in southern California and northwestern Baja California, and the Yuma clapper rail (*R. l. yumanensis*), which is restricted to the Colorado River basin. A detailed account of the taxonomy, ecology, and biology of the clapper rail is presented in the *Salt Marsh Harvest Mouse & California Clapper Rail Recovery Plan* (Service 1984) (Recovery Plan) and the references cited therein. The clapper rail is a fully protected species under California law (See California Fish and Game Code Section 3511).

The clapper rail is endemic to tidally influenced salt and brackish marshes of California. Historically, the clapper rail occurred in tidal marshes along California's coast from Morro Bay, San Luis Obispo County, to Humboldt Bay, Humboldt County. Currently, clapper rails are known to occur in tidal marshes in the San Francisco Estuary (Estuary) (San Francisco, San Pablo, Grizzly, Suisun and Honker bays).

The clapper rail is distinguishable from other clapper rails by its large body size of 13 to 19 in. from bill to tail, and weighs approximately 8.8 to12.3 oz. It has an orange bill, a rufous breast, black and white barred flanks, and white under tail 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).

Clapper rails are typically found in the intertidal zone and sloughs of salt and brackish marshes dominated by pickleweed (*Salicornia virginica*), Pacific cordgrass (*Spartina foliosa*), gumplant (*Grindelia stricta* var. *angustifolia*), saltgrass (*Distichlis spicata*), jaumea (*Jaumea carnosa*), and adjacent upland refugia. They may also occupy habitats with other vegetative components, which include, but are not limited to, bulrush (*Scirpus americanus* and *S. maritimus*), cattails

(*Typha* spp.), and Baltic rush (*Juncus balticus*).

Evens and Page (1983) concluded from research in a northern San Francisco Bay marsh that the clapper rail breeding season, including pair bonding and nest construction, may begin as early as February. Field observations in South Bay marshes suggest that pair formation also occurs in February in some areas (J. Takekawa, pers. comm.). The end of the breeding season is typically defined as the end of August, which corresponds with the time when eggs laid during renesting attempts have hatched and young are mobile. Harvey (1988) and Foerster *et al.* (1990) reported mean clutch sizes of 7.27 and 7.47 eggs for clapper rails, respectively. The clapper rail builds a bowl shaped platform nest of marsh vegetation and detritus (DeGroot 1927, Harvey 1988, Foerster *et al.* 1990). The clapper rail typically feeds on benthic invertebrates, but its diet is wide ranging, and includes seeds, and occasionally small mammals such as the harvest mouse.

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 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.

A number of factors influencing remaining tidal marshes limit their habitat values for clapper rails. Much of the east San Francisco Bay shoreline from San Leandro to Dumbarton Bridge is rapidly eroding, and many marshes along this shoreline could lose their clapper rail populations in the future, if they have not already. In addition, an estimated 600 acres of former salt marsh along Coyote Creek, Alviso Slough, and Guadalupe Slough, have been converted to fresh- and brackish-water vegetation due to large-volume freshwater discharge from wastewater facilities in the South Bay and are now of lower quality for clapper rails. This conversion has at least temporarily stabilized as a result of the drought since the early 1990s.

In addition, the introduction of non-native, invasive plant species such as *Spartina* and its hybrids into tidal wetlands within the Estuary is potentially impacting clapper rails by drastically changing the structure and function of tidal marshes in the estuary. Invasive *Spartina* chokes tidal creeks, changing the hydrology of the marsh and reducing the amount of foraging habitat within tidal channels, as well as replacing much of the native diverse tidal marsh vegetation. Other invasive plant species such as perennial pepperweed and glasswort (*Salsola soda*) also have the potential to alter the marsh landscape, making it less suitable as clapper rail habitat.

Throughout the Estuary, the remaining clapper rail population is impacted by a suite of mammalian and avian predators. At least 12 native and 3 non-native predator species are known to prey on various life stages of the clapper rail (Albertson 1995). Artificially high local populations of native predators, especially raccoons, skunks, and 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 clapper rails near residential areas and landfills (Albertson 1995). Non-native Norway rats have long been known to be effective predators of clapper rail nests (DeGroot 1927, Harvey 1988, Foerster *et al.* 1990). According to Harvey (1980) and Foerster *et al.* (1990), predators, especially rats, accounted for 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 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).

Hunting intensity and efficiency by many avian predators is increased by the presence of electric power transmission lines, which cross tidal marshes and provide otherwise-limited hunting perches (J. Takekawa, pers. comm.). In addition, both red-tailed hawks and common ravens nest on transmission towers. Common raven populations have recently increased dramatically within the Estuary and evidence of clapper rail egg predation by this species has been detected (J. Albertson, pers. comm.).

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, 1957) and Fisler (1965) observed heightened predator activity in marshes coinciding with extreme high tides. Evens and Page (1986) also documented the susceptibility of black clapper rails (*Laterallus jamaicensis coturniculus*) to predation during extreme high tides. More recently, clapper rail predation was noted in west Marin during extreme high tides in 2005 (G. Downard, 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 South Bay since 1986 has had a profound effect on clapper rail populations. As a result of the rapid decline and almost complete elimination of clapper rail populations in certain marshes, the San Francisco Bay National Wildlife Refuge implemented a predator management plan in 1991 (Foerster and Takekawa 1991) with an ultimate goal of increasing clapper rail population levels and nesting success through management of red fox predation. This program was successful in increasing the South Bay clapper rail populations from an all-time low.

Mercury accumulation in eggs is perhaps the most significant contaminant problem affecting 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 clapper rail eggs throughout the Estuary.

The clapper rail was listed as endangered primarily as a result of habitat loss. The factors described above have contributed to the more recent population reduction, which has occurred since the mid-1980s. Although many factors are at work, predation by native and non-native predators, in conjunction with historic habitat loss and fragmentation are the current known primary threats. With historic populations at Humboldt Bay, Elkhorn Slough, and Morro Bay now extirpated, the Estuary represents the last stronghold and breeding population of this subspecies.

Dispersal or movements by clapper rails in California occurs between and outside of marshes (Orr 1939; Zembal *et al.* 1985; San Francisco Bay Bird Observatory [SFBBO] 1986; Page and Evens 1987; Albertson 1995). Eddleman (1989) identified movements by Yuma clapper rails outside of their territories as juvenile dispersal; dispersal by an unmated individual bird; and shifts in home ranges after the breeding, in the winter, and during high water periods; and attributed these movements to a search for more suitable habitat where territories, mates, food, or safe refuge were better available. Juvenile dispersal apparently constitutes the main type of long-distance movements by light-footed clapper rails, while adult birds tend to stay within territories once they are established (Zembal and Massey 1988, Zembal *et al.* 1989, Ledig 1990; Zembal 1990, Zembal 1994, Zembal *et al.* 1996, Zembal *et al.* 1997, Zembal *et al.* 1998). Similarly, clapper rails tend to stay within established territories or home ranges year-round (SFBBO 1986; Albertson 1995). Zembal and Massey (1988) noted that 3 of 6 radio-tagged light-footed clapper rails that moved extensively were preyed upon within a relatively short period of time. By comparison, seven other birds that remained sedentary within established territories were not preyed upon during the telemetry period.

Clapper rails vary in their sensitivity to human disturbance, both individually and between marshes. Certain types of disturbances have occurred within or adjacent to some marsh areas for a long time and certain clapper rails appear to have habituated or become tolerant of these disturbances, while others appear to habituate over time or are unable to habituate to these disturbances at all. For example, certain clapper rails in the Palo Alto Baylands Nature Preserve appear to be somewhat tolerant of the relatively common pedestrian traffic on the public boardwalk that dissects the marsh. Clapper rail nests have been documented within 10 ft of trails in Elsie Romer and Cogswell marshes in Alameda County, and within 65 ft of a busy street near White Slough (Solano County).

In contrast, Albertson (1995) documented a clapper rail abandoning its territory in Laumeister Marsh in the South Bay, shortly after a repair crew worked on a nearby transmission tower. The bird did not establish a stable territory within the duration of the breeding season, but eventually moved closer to its original home range several months after the disturbance. As a result of this territorial abandonment, the opportunity for successful reproduction during the breeding season was eliminated (J. Takekawa, pers. comm.). Clapper rails in Laumeister Marsh have little contact with people, and are apparently quite sensitive to human-related disturbance.

Evens and Page (1983) documented 4 clapper rail breeding territories along the Greenbrae boardwalk in the Corte Madera Ecological Preserve. In 1993, no clapper rail breeding territories were discovered along the boardwalk even though clapper rail habitat conditions remained unchanged (J. Garcia, pers. comm.). This territorial abandonment is attributed to an increase in domestic and feral dogs and cats along the boardwalk resulting from new residents moving into nearby residential areas since 1983 (J. Garcia, pers. comm.).

Clapper rail reactions to disturbance may vary with season, however both breeding and non-breeding seasons are critical times. 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 clapper rails' vulnerability to predators. During high tides,

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 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 marsh species that depend on this habitat for refuge during high tides.

On numerous occasions at the Corte Madera Ecological Preserve, clapper rails have been observed seeking refuge from unrestrained dogs entering tidal marshes from adjacent levees with public access (J. Garcia, pers. comm.). These disturbances have occurred despite the presence of signs notifying users that they are entering sensitive wildlife species areas and that pets must be under restraint while in the preserve area. Similarly, along the Redwood Shores Peninsula in San Mateo County, fences and signs installed to prevent access into areas with listed species habitat have been repeatedly vandalized and people continue to enter the prohibited areas beyond the fences and signs (Popper and Bennett 2005).

A population viability analysis under development for clapper rails identified changes in adult survivorship as the factor with the largest influence on population growth rates (M. Johnson, pers. comm.). Another model also indicates that adult survivorship of clapper rails is the primary demographic variable for maintaining a stable population or causing the population to either increase or decline (Foin *et al.* 1997). These models indicate that survival of adult birds has the strongest effect on the perpetuation or extinction of the overall population.

Although Gill (1978) may have overestimated the total clapper rail population in the mid-1970s at 4,200 to 5,900 birds, surveys conducted by CDFG and the Service estimated that the clapper rail population was approximately 1,500 birds in the mid-1980s (Harvey 1988). A conservative estimate of the population in North San Francisco, San Pablo, and Suisun Bays, was 195 to 282 pairs based on a synoptic survey conducted in 1992-93 (Collins *et al.* 1994). In 2004, Avocet Research Associates conducted surveys within San Pablo Bay and estimated about 200 pairs of clapper rails in that area. These surveys did not include some marshes in north Central San Francisco Bay and Suisun Bay that were surveyed in 1992-93. Between the surveys conducted in 1992-93 and 2004, several population centers in San Pablo Bay have declined precipitously. The population in the White Slough tidal marshes on the west side of the Napa River declined from an estimated 16 to 23 pairs as recent as 2000, to an estimated 2 to 5 pairs in 2002, and 3 to 5 pairs in 2004, while the population in the Sonoma Creek marshes declined from 13 pairs in 1992 to no pairs in 2001 and 2004 (Avocet Research Associates 2004).

In 1988, the total clapper rail population was estimated to be 700 individuals, with 400 to 500 clapper rails in South Bay (Foerster 1989). The total clapper rail population reached an estimated all-time historical low of about 500 birds in 1991, with about 300 clapper rails in the South Bay (Service unpubl. data). In response to predator management, the South Bay clapper rail population rebounded from this lowest population estimate to an estimated 650 to 700 individuals in 1997-98 (Service unpubl. data). Subsequently, the South Bay population declined again the following year to about 500 individuals and remained at that level through early 2002 (Service unpubl. data). However, the South Bay population declined further in 2002-2003 and

was estimated to be 400 to 500 individuals (Service unpubl. data), which represented the lowest estimated population level in this area since the late 1980's and early 1990's. The South Bay population apparently increased slightly in 2004 with the population estimated at 500 individuals (Service unpubl. data).

Both winter and breeding season surveys suggest that there is substantial annual variability in local distribution and abundance of clapper rails in the South Bay. For example, at one of the sites where clapper rails were found in brackish marshes in Guadalupe Slough (discussed above), no clapper rails were found during protocol-level surveys the year before (H. T. Harvey & Associates 1990a; H. T. Harvey & Associates 1990b; H. T. Harvey & Associates 1991).

Breeding-season surveys of South Bay marshes for clapper rails through the early 1990's, summarized by Foin et al. (1997), indicated that the most substantial populations of clapper rails in the South Bay were, predictably, in the largest sections of tidal salt marsh: at Mowry Marsh and Dumbarton Marsh (in the East Bay between the Dumbarton Bridge and Mowry Slough), at the Faber/Laumeister Tracts and other marshes in the Palo Alto/East Palo Alto area, and at Greco Island in Redwood City. Mean counts from these areas include 68 birds at Mowry Marsh, 57 at Faber-Laumeister, and 44 at Dumbarton (Foin et al. 1997). Nest searches by Refuge personnel detected 40 nests in the Faber/Laumeister Tracts, 33 on Greco Island, and 13 in North Mowry Marsh in 1992 (Keldsen 1997). Clapper rails occurred in many other marshes as well, including Ideal Marsh (adjacent to Cargill pond N5), Calaveras Marsh (adjacent to Cargill Ponds M2 and M3), and Triangle Marsh in Alviso. Other surveys have also documented clapper rails in southern Whale's Tail Marsh, adjacent to the Eden Landing salt ponds (J. Krause, pers. comm.). Clapper rails have been found to occasionally use salt pond dredge locks as high-tide refugia (Wetlands Research Associates 1994b). Although site-specific surveys have not been conducted in all suitable habitat for clapper rails in the South Bay, this species is likely to occur in tidal salt marsh habitats in a number of additional areas as well.

Although clapper rails are typically found in tidal salt marshes, they have also been documented in brackish marshes in the South Bay. Breeding-season surveys conducted in marshes bordering Coyote Creek in 1989 documented breeding clapper rails in a wide variety of plant associations. Surveys conducted during the 1990 breeding season (H. T. Harvey & Associates 1990b) and winter season (H. T. Harvey & Associates (1990a) found a number of clapper rails occupying salt/brackish transitional marshes and several brackish, alkali bulrush-dominated (*Scirpus robustus*) marshes, including Warm Springs Marsh (immediately east of Pond A19) and the marshes along upper Coyote Slough even farther east. In addition, clapper rails were found in nearly pure stands of alkali bulrush along Guadalupe Slough in 1990 and 1991 (H. T. Harvey & Associates 1990a; H. T. Harvey & Associates 1990b; H. T. Harvey & Associates 1991). 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 clapper rails.

On rare occasions, clapper rails have been recorded even further upstream, in brackish/freshwater transition marshes, particularly during the non-breeding season. In the Alviso/Sunnyvale area, such individuals have been recorded along upper Alviso Slough near the Gold Street bridge (on 14 February 1997; S. Terrill, pers. obs.), in nontidal freshwater ponds

between Calabazas and San Tomas Aquino Creeks north of Highway 237 in Sunnyvale (on 16 August 1998; S. Rottenborn, pers. obs.), and along Artesian Slough near the Environmental Education Center in January 1999 and January to February 2001 (Santa Clara County Bird Data unpubl.).

Salt Marsh Harvest Mouse

The harvest mouse was federally listed as endangered in 1970 (35 FR 16047). Critical Habitat has not been proposed or designated. A detailed account of the taxonomy, ecology, and biology of the harvest mouse is presented in the Recovery Plan (Service 1984) and the references cited therein. The harvest mouse is a fully protected species under California law (See California Fish and Game Code Section 4700).

The harvest mouse is a rodent endemic to the salt and brackish marshes of the Estuary and adjacent tidally influenced areas. The harvest mouse closely resembles the western harvest mouse (*R. megalotis*). The harvest mouse typically weighs about 0.35 oz, has a head and body length ranging from 2.7 to 2.9 in, a tail length ranging from 2.6 to 3.2 in, and a hind foot length of about 0.7 in (Fisler 1965). As stated in the recovery plan, the harvest mouse, when compared to the western harvest mouse, has darker ears, belly and back, and a slightly thicker, less pointed and unicolored tail. The harvest mouse is further distinguished taxonomically into the northern and southern subspecies, *R. raviventris halicoetes* and *R. raviventris raviventris*, respectively. Of the two subspecies, *R. r. halicoetes* more closely resembles *R. megalotis*, and can be difficult to differentiate in the field; body color and color of ventral hairs as well as the thickness and shape of the tail have been used to distinguish the two.

As described by Fisler (1965), male harvest mice are reproductively active from April through September, but may appear active throughout the year. Females are reproductively active from March to November, and have a mean litter size of approximately four offspring.

The harvest mouse has evolved to a life in tidal marshes. Specifically, they have evolved to depend mainly on dense pickleweed as their primary cover and food source and may utilize a broader source of food and cover that includes saltgrass and other vegetation typically found in the salt and brackish marshes of this region. In natural systems, harvest mice can be found in the middle tidal marsh and upland transition zones. Upland refugia is an essential habitat component during high tide events. Harvest mice are highly dependent on cover, and open areas as small as 33 ft wide may act as barriers to movement (Shellhammer 1978, as cited in Service 1984). The harvest mouse does not burrow. It has been noted that the northern subspecies may build nests of loose grasses.

The historic range of the species included tidal marshes within the San Francisco and San Pablo Bays, east to the Collinsville-Antioch areas. Agriculture and urbanization has claimed much of the former historic tidal marshes, resulting in a 79 percent reduction in the amount of tidal marshes in these areas (Goals Project 1999). At present, the distribution of the northern subspecies occurs along Suisun and San Pablo Bays north of Point Pinole in Contra Costa County, and Point Pedro in Marin County. The southern subspecies is found in marshes in Corte Madera, Richmond, and South Bay mostly south of the San Mateo Bridge (Highway 92).

Historically, the marshes in San Francisco Bay were a complex mosaic of vegetation zones, generally consisting of low marsh adjacent to mudflats dominated by cordgrass, high marsh plains dominated by pickleweed, and broad transitions of peripheral halophytes (salt-tolerant plants that cannot tolerate as much inundation by the tides) into upland habitats, with narrower transitional zones on natural levees along larger channels within the marshes. Most of the tidal marshes around the Bay and especially in the South Bay were eliminated, and those remaining have lost the upper portion of their pickleweed zones as well as the higher zone of peripheral halophytes (Shellhammer 1982; Shellhammer and Duke 2004). For example, detailed mapping by H.T. Harvey & Associates for the proposed action reveals that pickleweed dominated habitat and peripheral halophyte habitat comprise only 92 and 13 acres respectively, within the 1,600-acre Ravenswood Complex, 638 and 58 acres, respectively, within the 5,500-acre Eden Landing Complex, and 275 and 113 acres, respectively, within the 8,000-acre Alviso Complex; much of the peripheral halophyte acreage in the Alviso Complex, however, is adjacent to little used brackish vegetation. Most of the tidal salt marshes in the South Bay are small, isolated strip-like marshes along backshores against levees or other hardened structures that promote predation, inhibit further high marsh development, and are threatened by sea level rise (Shellhammer 1989). Similarly, most of the marshes do not have higher order tidal channels within them and hence lack a pattern of natural levees supporting shrubs such as gum plant, and other peripheral halophytes, within them that might act as escape cover for mice within the marshes. Shellhammer and Duke (2004) note that most of the marshes of the South Bay are de facto corridors, likely not wide enough to support viable populations but wide enough to function as dispersal corridors.

Recent mapping is also documenting the fragmentation of the habitat. For example, sections of bare, rip-rapped bayfront levees more than 3,500 feet long separate appropriate pickleweed dominated habitat in the Ravenswood Complex. A similar gap of approximately 3,600 feet occurs in the Eden Landing area, between the Alameda Creek Flood Control Channel and the pickleweed-dominated habitat at the "Whale's Tail" marsh near Old Alameda Creek. Cover-dependent harvest mice are unlikely to move long distances over bare areas, and thus, isolation of suitable habitat may lead to genetic isolation of populations. While they are known to swim well, especially in comparison with western harvest mice, they have not been documented to move more than 13.1 to 16.4 feet across water or more than 16.4 feet over bare ground (Bias 1994; Geissel et al. 1988). The maximum movement through brackish or fresh water vegetation is reported in H.T. Harvey & Associates (Shellhammer 1982), in which two harvest mice moved several hundred feet along a levee side-slope at the upper edge of a brackish marsh. Based on this information, Shellhammer and Duke (2004) have hypothesized that barren areas of land more than 16.4 feet wide, reaches of water more than 42 feet wide, and brackish or freshwater marsh more than 820 feet wide act as barriers to movement of the southern subspecies of the harvest mouse, and hence barriers to gene flow. Areas of bare ground, water, or fresh/brackish marsh less than or equal to these distances may act as filters, reducing the movement of this species (and hence the rate of gene flow) between populations or between portions of a semi-fragmented population. The isolation of populations has contributed to the decline of the species (Shellhammer and Duke 2004) and could lead to local extinctions due to demographic processes or genetic "death." Based on their assessment of potential barriers in the South Bay, Shellhammer and Duke (2004) estimated that there were potentially 25 separate populations of

harvest mice in the South Bay as of 2002 (not including mice that might be present in very small patches of pickleweed).

Habitat degradation has also occurred as a result of the conversion of existing tidal salt marsh to brackish or even freshwater marsh over the past four decades. Within the Alviso Complex, the combination of treated effluent discharge, sedimentation that has reduced the tidal prism, and freshwater flows from rivers and streams (especially in high-rainfall years) has created conditions too fresh for pickleweed to compete and survive (H. T. Harvey & Associates 1994; 1997b; 1998; 1999; 2000; 2001; 2002; 2003; Shellhammer 1982; Shellhammer et al. 1988; Shellhammer et al. 1982). Traditionally the brackish species alkali bulrush was considered to have little habitat value in either tidal or diked situations in the South Bay because surveys in the 1960s and 1970s found no harvest mice. However, the habitat value of brackish marsh needs reexamination after recent results in the South Bay and Suisun Marsh. Trapping in harvest mouse preserves in the range of the northern subspecies in the Suisun Bay by Barthman-Thompson of CDFG in 2005 showed that harvest mice do use other species of bulrush and cattail in the area. In the summer of 2006, several harvest mice were captured in stands of pure alkali bulrush in the brackish Warm Springs Marsh of the South Bay. Preliminary results from a number of harvest mouse trapping projects (most of which were done in the Suisun Bay) suggest that monocultures of peppergrass (*Lepidium virginicum*), which dominate large areas of brackish marsh in the South Bay, are not used by harvest mice.

As a result of habitat loss, degradation, and fragmentation, harvest mouse populations are low. A database for all salt marsh studies carried out in the South Bay, including the entire project area, was compiled by H. Shellhammer at H.T. Harvey and Associates (Shellhammer and Duke 2004). Trapping records from permits issued by the Service and CDFG were reviewed and compiled. The database, which includes 198 trapping projects (estimated 95 percent of all such projects and studies) representing 134,204 trap nights (TN) completed through 2003, shows that 37 percent of all trapping projects (73 of 198, or 49,481 TN of a total of 134,204 TN) captured no harvest mice. The average capture efficiency (C.E., or total effort in TN divided by the number of mice captured) of all trapping projects was 0.013. In terms of unit effort, it took an average of 79 TN to capture one harvest mouse. Approximately 64 percent of the projects in which at least one harvest mouse was captured (153 of 198) had a capture efficiency equal to or less than 0.019, or it took 77 TN to capture a single harvest mouse. There were few projects in which numerous harvest mice were captured (*i.e.*, in 8 projects was there a C.E. of 0.06 or more).

Despite the species' low populations, the harvest mouse is known to rapidly colonize restored areas. This species quickly moves into areas of appropriate habitat from nearby inhabited areas as has been shown in numerous trapping projects' reports. A representative sample of those studies in the South Bay area include H. T. Harvey and Associates (1984a; 1985a; 1985b; 1985c; 1987; 1996; 1997a).

Harvest mice may be affected by mercury and polychlorinated biphenyls (PCBs) in the intertidal zone. Clark *et al.* (1992) found that harvest mice were captured only at sites where concentrations of mercury or PCBs were below specific levels in house mice (*Mus musculus*). Their results seem to suggest a southern source of mercury contamination, with mercury an order of magnitude higher in livers of house mice at Calaveras Point than at any other point measured

in the San Francisco Bay.

Western Snowy Plover

The snowy plover is a small pale shorebird that nests on beaches and salt pans in western North America. The Service listed the coastal population of the snowy plover as a threatened species in 1993 (58 FR 12864) because of a decline in the breeding population, loss of breeding habitat, and increased depredation by non-native predators. The Service designated Critical Habitat for the snowy plover in 2005 (70 FR 56969). A final recovery plan was released in 2007 (Service 2007). This recovery plan contains additional information on the biology and ecology of this species.

Snowy plovers nest on barren to sparsely vegetated beaches, salt flats, dredge spoils, levees, river bars, and salt evaporation ponds (Page *et al.* 1995). Many snowy plovers overwinter in these same areas. In the South Bay, snowy plovers nest on low, barren to sparsely vegetated dry salt ponds as well as on levees and islands, and at pond edges (Page *et al.* 2000); they preferentially use light-colored substrates such as salt flats (Feeney and Maffei 1991; Marriott 2003). Nesting areas are located near water, where prey (usually brine flies and other insects) are abundant. In some areas, snowy plovers nest within dry salt ponds; in other areas where ponds typically hold water through the summer (*e.g.*, the Newark salt ponds), nests are located primarily on levees and pond edges. Often, nests are located near disruptive objects such as rocks or surface irregularities, and may be constructed in depressions created by footprints and vehicles (Marriott 2003; Page *et al.* 1995). Nests consist of a depression scratched into the substrate sometimes lined with shell fragments, salt crystals, plant debris, fish bones, exoskeletons, and pebbles or similar local materials (Page *et al.* 2000; Page *et al.* 1995).

The breeding season of the snowy plover in California, from nest initiation to fledging of chicks, is considered to be 1 March to 31 September. Unlike sandy beach habitat, salt pan habitat used for nesting in the San Francisco Bay takes some time to dry after rains. For this reason, nesting habitat within salt ponds may not be available in March or early April, typically the beginning of the breeding season. During years of late rains, nesting habitat may not become available until well into the breeding season (e.g. late April or May; Hannon and Clayton 1995). The snowy plover is opportunistic, capable of moving around among potential breeding areas and breeding where conditions are suitable. The abundance and distribution of snowy plovers in the South Bay shifts annually, and is also dynamic within a given nesting season. Early in each breeding season, many ponds may not be suitable for nesting due to late rains creating muddy substrates, and nesting may be concentrated at a few ponds with suitable conditions. Later in the season, as more ponds dry out and become available for nesting, snowy plovers may be more dispersed among many nesting locations, and nest in lower densities. In 1990 nest density at four Oliver/Eden Landing ponds averaged 1 nest/6.3 acres, with a range of 1 nest per 3.1 to 14.2 acres (Feeney and Maffei 1991). In 2006, nest density on four ponds in the South Bay averaged 1 nest/74 acres with a range of 1 nest per 13 to 417 acres (San Francisco Bay Bird Observatory (SFBBO), unpub. data). In 2006, these numbers reflect large areas of ponds not used by snowy plovers probably due to water on the surface of the pond, and to a low number of plovers scattered over a large area.

Snowy plovers consume flies, beetles, crabs, polychaete worms, amphipods, sand hoppers, moths, grasshoppers, small crustaceans, mollusks, and plant seeds (Page *et al.* 1995). They forage by pursuing their prey on foot, picking from the surface or probing in sand and loose soils, and will charge dense aggregations of flies, snapping their bill at those flushed (Purdue 1976, Page *et al.* 1995). Within the San Francisco Bay Area, snowy plovers forage on brine flies and brine shrimp (Feeney and Maffei 1991, Page *et al. 2000*). Exposed mudflats, the open water on salt ponds, historic channels, and excavated "borrow ditches" provide foraging areas in the South Bay. Brine flies are usually found in greatest densities at the shallow margins of salt ponds or puddles.

Degradation and use of habitat for human activities has been largely responsible for the decline in the snowy plover breeding population (Page *et al.* 1995). Other important threats to the snowy plover are mammalian and avian predators, and human disturbance (Page *et al.* 1995). Human disturbance (including disturbance from domestic dogs) can lead to nest abandonment or direct trampling of eggs or chicks. In addition, because young chicks are dependent on adults for protection, human disturbance resulting in the separation of chicks from adults can lead to the death of the chicks. Precocial chicks feed themselves but require the protection of an adult for brooding and evasion of predators (Page *et al.* 1995). Additional pressures include oiling, entanglement in fishing line, striking objects, and shooting; in the South Bay, the use and maintenance of levee roads for access to salt ponds, tidal flats and marsh also causes disturbances to nesting snowy plovers.

Non-native predators, such as red fox, have had major negative effects on snowy plover populations in California; for example, in the South Bay, two snowy plover nests were known to have been depredated by red foxes in 1993 and 1994 in the Coyote Hills and Dumbarton areas (Harding *et al.* 1998), and such events have probably occurred much more frequently than is known. Efforts to curtail nest depredation by mammalian predators through a predator management program have greatly enhanced nesting success by snowy plovers on the Central Coast of California (Neuman *et al.* 2004). In the South Bay, no strong increase in nest success was noted between 1991 and 1996, after a predator management plan was implemented, except at a few nests where exclosures were used (Harding *et al.* 1998). Overall nest success in the South Bay has been fairly high in some recent years, with 80 percent nest success in 2001 (n = 78 nests) and 58 percent in 2006 (n = 81 nests, Robinson *et al.* 2006). However, predation levels have dramatically increased over the past four years, from 5 percent in 2004 (n = 59 nests) to 41 percent in 2007 (n = 84 nests) largely due to avian predation (Strong *et al.* 2004, SFBBO, unpub. data). Fledging success is unknown, and may be far less due to avian predators.

Avian predators, particularly corvids (crows and ravens), are increasingly becoming an issue for snowy plover reproductive success (Wilson 2004). American crows (*Corvus brachyrhynchos*) and common ravens are adept at finding snowy plover nests and preying on eggs. Corvid numbers are increasing throughout California, at least partially in response to increased availability of food from anthropogenic sources, such as garbage dumps (Boarman and Heinrich 1999, Verbeek and Caffrey 2002). Other avian predators, including loggerhead shrikes (*Lanius ludovicianus*), American kestrels (*Falco sparverius*), and northern harriers (*Circus cyaneus*) have been documented taking snowy plover chicks, and in some areas, have dramatically reduced fledging success (K. Neuman, pers. comm.).

Some snowy plovers remain in their coastal breeding areas year-round while other individuals are migratory. In San Francisco Bay, higher numbers in winter indicate that snowy plovers from the Great Basin population probably move into the area for the winter. At the same time, some individuals that nest in the San Francisco Bay Area probably migrate south as far as Mexico (Service 2007). There is overlap between the San Francisco Bay population and the adjacent coastal nesting population. Birds banded at Monterey Bay and Oregon have been seen in the San Francisco Bay (Feeney and Maffei 1991). It is not known whether this species nested inside San Francisco Bay before conversion of salt marsh to salt evaporation ponds. However, these ponds have provided suitable nesting and foraging habitat since the beginning of the 20th century (Grinnell *et al.* 1918). Within San Francisco Bay, snowy plovers were noted to be a common nester in this area by 1918 (Page and Stenzel 1981).

Window surveys along the Pacific Coast indicate that the numbers of breeding snowy plovers have ranged from a low of 976 in 2000 to a high of 1,904 in 2004; in 2006 1,723 plovers were counted along the Pacific Coast (Service 2007). In 1977, nesting snowy plovers in the San Francisco Bay accounted for 22 percent of all snowy plovers counted along the coast; in 2006 only 6 percent of the snowy plovers along the entire Pacific Coast were counted in the San Francisco Bay. Nearly all of the San Francisco Bay nesting occurs south of State Route 92 (San Mateo Bridge) in the South Bay (Page and Stenzel 1981, Page *et al.* 1991, Service 2007).

Within the proposed action area, the highest numbers of nesting snowy plovers occur at Eden Landing where snowy plovers have recently been focused in Ponds E6A and E6B in 2003 and 2004 (Strong and Dakin 2004; Strong *et al.* 2004) and in B8A, B12 and B14 in 2007 (SFBBO unpub. data). Numbers of nests in the Eden Landing ponds have ranged from 10 nests in 1999 (Casady 1999) to 84 nests in 2007 (SFBBO unpub. data), although nest finding effort has not been consistent throughout this time period.

Low numbers of breeding snowy plovers also occur in the Ravenswood Complex, in the Warm Springs Complex, and in the Alviso Complex. The Ravenswood ponds were used irregularly for nesting (e.g., 13 nests found during the 2003 breeding season, most of them in RSF2; (Strong and Dakin 2004); 7 nests in 2007, most in R1 (SFBBO unpub. data)). High counts here during the 2004 nesting season included 53 birds at R2, 23 at SF2, and 18 at R1 (Strong *et al.* 2004). At Warm Springs, Pond A22 was used, with more than 10 adults found during the 2003 nesting season, and a high count of 32 snowy plovers at A22 in 2004 (Strong *et al.* 2004). Low densities of snowy plovers have been recorded during the breeding season, sometimes with nests or chicks, at some other Alviso salt ponds, primarily at A6 and A8 (Ryan and Parkin 1998; Strong 2004). Pond A6 has since been occupied by a colony of approximately 20,000 California Gulls. Snowy plovers also nested in the late 1990s in Alviso Pond A3N and in a small impoundment immediately east of Pond A12 in 2006 (B. Bousman, pers. comm.).

Outside the proposed action area, snowy plovers also breed in Cargill ponds near the east end of the Dumbarton Bridge (*e.g.*, N2, N3), and north of the San Mateo Bridge in managed ponds in Hayward. The Oliver Salt Ponds, relatively small ponds adjacent to Eden Landing on either side of the east end of the San Mateo Bridge, have been used regularly for nesting, although not in recent years. In 1989, Feeney and Maffei (1991) found 29 nests here, and 152 individual snowy

plovers during the nesting season. To the south, in 1995, Hannon and Clayton (1995) found 90 nests in the Newark Ponds near the Dumbarton Bridge. The Patterson ponds, between Ponds N4A and N1A, have also been used regularly by nesting snowy plovers, at least up until 2001, when eight nests were found here (Marriott and Schelin 2001); no nests have been found here since then probably due to vegetation encroachment on the ponds. Page *et al.* (1979) and Rigney and Rigney (1981) also provide census information for Cargill ponds between Eden Landing and Warm Springs, but current data on the number of snowy plovers breeding in these ponds are not available. Due to limited habitat in these areas it is doubtful that large numbers of plovers use these areas. Marriott and Schelin (2001) surveyed the Newark ponds and found no nests, and they noted that levee over-topping by Cargill in 2000 had diminished the suitability of levees in these ponds for snowy plover nesting.

Western Snowy Plover Critical Habitat

Critical habitat for the Pacific coast population of the western snowy plover was designated on September 29, 2005, (70 FR 56969). In determining which areas to designate as critical habitat, the Service considers those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protection (50 CFR §424.12). Such physical and biological features include, but are not limited to, 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 (or development) of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

This final rule establishes approximately 12,145 acres within 32 Critical Habitat units in Washington, Oregon, and California based on three primary constituent elements: (1) Sparsely vegetated areas above daily high tides (such as sandy beaches, dune systems immediately inland of an active beach face, salt flats, seasonally exposed gravel bars, dredge spoil sites, artificial salt ponds and adjoining levees) that are relatively undisturbed by the presence of humans, pets, vehicles or human-attracted predators (essential for reproduction, food, shelter from predators, protection from disturbance, and space for growth and normal behavior); (2) Sparsely vegetated sandy beach, mud flats, gravel bars or artificial salt ponds subject to daily tidal inundation but not currently under water, that support small invertebrates such as crabs, worms, flies, beetles, sand hoppers, clams, and ostracods (essential for food); and (3) Surf or tide-cast organic debris such as seaweed or driftwood located on open substrates such as those mentioned above (essential to support small invertebrates for food, and to provide shelter from predators and weather for reproduction).

The Service has excluded six units bordering the South Bay totaling 1,847 acres. Snowy plover habitat in this region consists primarily of artificial salt ponds and associated levees, much of which is under the management of the Service and CDFG as part of the proposed action. The protections provided under section 7 of the Act largely overlap with protections resulting from critical habitat designation. By excluding the six units from critical habitat designation, the Service avoids restricting the flexibility for the development of the salt pond management plan which might otherwise establish habitat managed for plovers in other locations. The six

excluded San Francisco Bay units were chosen based on recent high usage of those areas by plovers, although the plovers have demonstrated a willingness to travel relatively large distances within the Bay area to nest wherever habitat is most appropriate. Because plover habitat in the area can easily be created or removed in different areas by drying or flooding particular ponds, the management planners currently have the flexibility to move plover habitat to wherever it would be most advantageous in light of the conservation needs of the population and of other threatened and endangered species present in the Bay area. By designating critical habitat according to the current locations of essential habitat features, the Service would tend to lock the current management scheme into place for the designated units, thereby reducing management flexibility for other listed species and targeted ecosystems that are included as part of the proposed action. Because the proposed action planning process is a collaborative effort involving cooperation and input from numerous stakeholders such as landowners, public land managers, and the general public, it allows the best information and local knowledge to be brought to the table, and may encourage a sense of commitment to the snowy plover's continuing well-being. Therefore, critical habitat is not designated in the proposed action area, and would not provide as great a benefit to the species as the positive management measures in this plan.

California Least Tern

The least tern was federally protected as endangered on 13 October 1970 (35 FR 16047). A detailed account of the taxonomy, ecology, and biology of the least tern is presented in the approved Recovery Plan for this species (Service 1980). Supplemental or updated information is provided in the Service's 16 July 1993, Biological Opinion on the Federal Aviation Administration's authorization for proposed facilities improvements at San Diego International Airport, California, which is hereby incorporated by reference.

Least terns search for prey by hovering over shallow to deep waters in bays, lagoons, estuaries, river and creek mouths, marshes, lakes and offshore and diving to the surface. Least terns feed primarily on small surface-swimming, nonspiny fish (2.0–9.0 cm long with body <1.5 cm deep), but also shrimp and other invertebrates; more than 50 fish species documented as prey throughout their range (Thompson *et.al.* 1997).

Population declines of the least tern are possibly due to the use of organochlorine pesticides, loss of nesting habitat, and disturbance on the nesting grounds by humans. Least terns require large open areas of sand or gravel with little vegetation for nesting and will use filled or graded lands as well as airports if no other habitat is available. Nesting areas must be located near open water to maintain adults and young throughout the nesting season. Conservation efforts for the least tern include protection of nesting sites, predator management, and vegetation control (Feeney 2000).

Currently, the breeding colony at Alameda Point is one of the most important breeding colonies in the state. In 2005, this colony had 424 breeding pairs (Marschalek 2006). This total is up considerably from prior decades: 128 pairs were found in 1993, and only 70 pairs nested in 1982 (Collins 1994). Least terns typically arrive at Alameda Point in mid to late April, but have arrived as early as 6 April, and depart in mid to late August each year. Hatchlings are typically fed from June through mid-August. Since 1977, the majority of nesting activities have occurred

in the 4-acre, fenced "traditional" colony site on the western end of Alameda Point, but prior to 1987, least tern nesting also occurred in other areas at Alameda Point outside the traditional site area. Furthermore, least terns have moved their young to various locations within the buffer zone surrounding the main colony site during several breeding seasons (and on one occasion as far as about 4,000 feet northwest of the main colony site), apparently to avoid predator pressure at the main colony site. While at the Alameda Point during the breeding season, least terns forage for fish in the open water offshore of the western end of Alameda Point, which contains extensive, generally productive foraging habitat areas. Foraging intensity has varied between different offshore areas, but has occurred in the Oakland Harbor, Seaplane Lagoon at Alameda Point, and areas southeast, south, and west of the traditional least tern colony site. During the breeding season, least terns are central-place foragers, that is, they return regularly to the nest from their foraging trips. Most foraging activity occurs within 2 miles of the nesting site (Atwood and Minsky 1983). Having foraging places near their nests is beneficial to least terns because it reduces the energy cost of flying to the feeding site and reduces the time needed to bring a load of fish back to the nest.

According to Caffrey (1995), the least tern breeding site at the Alameda Point has played a significant role in recent increases in the number of least terns throughout California. The Alameda Point site is consistently one of the most successful sites in California. Between 1987 and 1994, the Alameda Point site supported 5 to 6 percent of the statewide breeding population out of 35 to 40 sites each year, but produced an average of 10.6 percent of the total number of fledglings produced statewide in each of those years. By consistently producing large numbers of fledglings each year, the colony has added large numbers of potential new breeding birds to the statewide population. Therefore, this site is considered to be one of the most important "source" populations in California serving to balance out losses at many "sink" locations throughout the State.

Least terns also nested in 2000 and 2001 at Albany (near Alameda), with up to 12 pairs in 2000. At Pittsburg, on Suisun Bay, 13 pairs nested in 2001 and 8 pairs nested in 2003. Historically, small numbers of birds have nested at the Oakland International Airport (last reported in 1995), Bay Farm Island (last reported 1975), Bair Island (last reported 1984), Port Chicago (last reported in 1988), the Bay Bridge Sand Spit (one-time attempt in 1985), and Tern Island (one-time attempt in 1990, USGS Preliminary data, unpub.).

In addition, salt ponds in the South Bay have been used for sporadic and limited nesting attempts. These include attempts on levees at Ponds E10/E11 at Eden Landing (last reported 1985), Ponds N5/N7 (last reported 1983) and N1A in the Newark salt ponds, and Pond R3 in the Ravenswood Complex (Hurt 2004; Wetlands Research Associates 1994a). In the South Bay, recent breeding has occurred at Hayward Regional Shoreline, where 59 pairs nested in 2008 (45 of the 59 nests produced chicks). Of the 109 eggs laid at the site, 81 chicks have been produced. A total of 68 chicks have been observed on the site (age classes: twelve chicks at 1 to 5 days old, twenty-seven chicks at 5 to 10 days old, and twenty-three chicks at 10 to 17 days) and six fledglings. Currently, 55 to 100 least terns have been observed flying around the colony with the highest numbers observed during high tide events. Wildlife Services Specialists and staff are closely monitoring predators and will continue managing gulls, and prevent California gulls from negatively affecting the reproductive success of the tern colony. A total of two dead chicks have

been found, three depredated eggs and two chicks presumed taken by aerial predators (American crow and California gull).

Least terns also nested at Pond E8A within the SBSP restoration project in the Eden Landing Complex, where several pairs nested in 2007; this site was largely abandoned for unknown reasons. These Eden Landing birds were observed foraging both in a borrow ditch within Pond E8A and in Old Alameda Creek (C. Robinson, pers. comm.).

The Alameda Point site currently represents nearly the entire San Francisco Bay Area population, and is the northernmost of least tern breeding colonies by about 178 miles. Because of its northern location, the Alameda Point site is relatively unaffected during El Niño years when many southern California sites experience pronounced breeding failure resulting from limited food availability. In the most recent previous El Niño year, 1992, the Alameda Point site supported 6 percent of the statewide number of breeding pairs, but produced 16 percent of the total statewide number of fledglings. The 1998 season was another El Niño year, one of the most severe recorded, and least tern breeding at NAS Alameda was less successful. Only 90 young fledged, more than a 70 percent reduction from 1997. Observations of delayed breeding, reduced fish catch, and the highest non-predator mortality of young ever observed (about 50 percent, L. Collins, pers. comm.) suggest food limitation and associated problems as a cause.

The major cause of breeding failure at many least tern colony sites in California has been documented as predation on eggs, chicks, fledglings, and adults (Caffrey 1995). A wide variety of predators has been documented to prey upon least terns, including most gull species and 22 other avian species, 14 mammalian species, and some species of snakes, crabs, ants, and spiders. In addition to direct loss or mortality of eggs and individuals, avian and mammalian predators can cause least tern adults to abandon breeding sites prior to completion of nesting activities. While many least tern breeding colony sites have been plagued by high predation pressure, the Alameda Point generally has been less affected by predation threats than many other sites throughout California (Caffrey 1995).

Currently, least terns use the proposed action area primarily as a post-breeding staging area from about late June through late August, prior to their southward migration. Here, both adult and juvenile least terns roost on salt pond levees (both outboard levees and interior levees between ponds) posts, and boardwalks, and forage both in the salt ponds and over the open waters of the San Francisco Bay. At the Alameda Point, least terns forage primarily on silversides (*e.g.*, topsmelt [*Atherinops affinis*]), northern anchovies (*Engraulis mordax nanus*), Pacific herring (*Clupea pallasi*), and surfperches (*Hyperprosopon* spp.) (Elliott *et al.* 2004). Although data are unavailable regarding diet during the post-fledging period in the South Bay, diet is likely similar.

In recent years, the main post-breeding staging area for least terns in the South Bay has been in the complex of salt ponds immediately north of Moffett Field (Ponds AB1, A2E, and AB2). For example, 276 least terns were seen in these 3 ponds on 27 July 2004 (S. Rottenborn, pers. obs.). This site is used predictably for roosting and foraging by both adult and juvenile least terns in July and August every year, with typical counts of 20 to 100 birds. Least terns have also been recorded at a number of other ponds in the project area, including A1, A2E, A3N, A3W, A4, A5, A7, A9, A10, A11, A14, (Hurt 2004, Marschalek 2006, J. Krause pers. comm., USGS

Preliminary data, unpub.). Ravenswood ponds, particularly R1, are used occasionally for foraging and roosting, with counts of 96 terns in July 2002 (Hurt 2004), 42 in July 2003, and 110 in July 2004 (USGS Preliminary Data, unpub.). Eden Landing Ponds are also used irregularly for foraging including E2, E4, E5, E8A, E9, E10, and E11. Approximately 305 least terns were observed at pond E8A in August 2006, and several dozen were seen foraging in shallow San Francisco Bay waters immediately adjacent to E2 in July 2004, (USGS Preliminary Data, unpub.). Least terns also forage heavily in adjacent open San Francisco Bay waters. For example, 50 of 58 least terns observed foraging in the proposed action area on 14 July 2004 were doing so over the San Francisco Bay, with only 8 individuals actively foraging in salt ponds (S. Rottenborn, pers. obs.). However, the relative importance of salt ponds versus San Francisco Bay waters for foraging by least terns in the South Bay is largely unknown.

California Brown Pelican

The brown pelican was listed as endangered on 13 October 1970 (35 FR 16047). A detailed account of the taxonomy, ecology, and biology of the brown pelican is presented in the approved Recovery Plan for this species (Service 1983). Supplemental or updated information is provided in the Service's 17 September 1996, Biological Opinion on the U.S. Bureau of Land Management's authorization for the construction of the proposed Bal'diyaka Interpretative Center in Coos Bay, Oregon, which is hereby incorporated by reference.

Brown pelicans were threatened with extinction in the 1970's due to the use of the pesticide dichloro-diphenyl-trichloroethane (DDT). This chemical gets into the food chain and affects the bird's calcium metabolism, resulting in thin-shelled eggs that break during incubation. DDT use was banned in the United States in 1972, and the brown pelican is recovering from the chemical contamination. However, DDT is still manufactured for export and its effects in the environment linger. Food availability is now the major cause of concern. The Pacific mackerel (*Scomber japonicus*), Pacific sardine (*Sardinops sagax*), and the northern anchovy are important food for the brown pelican, especially during the breeding season. By the early 1900s commercial over-harvesting of these fish had resulted in less food availability during this critical time. In 1985, the brown pelican was delisted in the Southeastern United States as recovered, but west coast populations did not recover as quickly, and have remained fairly stable since 1985 (Shields 2002).

The brown pelican nests colonially on islands from Mexico to Florida; in California pelicans breed on the California Channel Islands, and at the Salton Sea. Nesting season begins in early spring, approximately January to May (Anderson and Gress 1983; Shields 2002). Much of the post-breeding dispersal occurs northward (as far north as Canada), and by June, many post-breeding birds are present in central California. Local abundance in central California usually peaks from August to October (Briggs *et al.* 1987; Jaques 1994). Although a small number of non-breeding birds may be found locally year-round, most brown pelicans return to their southern breeding grounds by January. Brown pelicans feed on northern anchovies and other small fishes, which they capture by plunge-diving. Brown pelicans require secure night-roosts, free of terrestrial predators (Ainley 2000, Jaques 1994).

Brown pelicans are typically less abundant inside San Francisco Bay than along the immediate

cost, although counts of more than 1,000 individuals have been recorded as far south in the San Francisco Bay as the Alameda Point area. Several hundred brown pelicans typically occur in the San Francisco Bay during summer and fall, but numbers are variable. In years when high numbers do not breed, such as El Niño years, thousands of brown pelicans occur throughout the year in the San Francisco Bay area (Ainley 2000). The largest roost in the San Francisco Bay area is located on Breakwater Island at the proposed Alameda Point, which peaks in numbers from June to August. On June 2004, 3,307 brown pelicans were counted at this roost (Hurt 2006).

Post-breeding dispersants typically begin to arrive in the South Bay in June and July, with most individuals departing by late fall. However, a few may also be found in the South Bay in winter and spring as well (Santa Clara County Bird data unpub.). Although information on daily activity patterns, habitat use, and key foraging areas of brown pelicans in the South Bay is limited, this species uses salt ponds both for foraging (which takes place in the less saline ponds supporting fish) and for roosting (on levees between ponds).

EFFECTS OF THE 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 most significant effects of the proposed action on the harvest mouse, clapper rail, snowy plover, least tern, and brown pelican are potential beneficial effects on the extent and quality of habitat being restored for these species. As a result, it is important that the evolution of habitats in the South Bay over the 50-year duration be described. Habitat evolution will first be described generally (i.e., in terms of the extent of different types of habitats over the duration of the project). Then, proposed action effects, including habitat evolution/alteration as a result of restoration activities as well as potential adverse effects will be described individually for each of the listed species that are the subject of this PBO.

Habitat Evolution

Overview of Habitat Evolution

The habitats to be created by the proposed action include a mix of managed pond habitats and restored tidal habitats. Tidal habitat to be created by this project includes tidal salt and brackish

marsh, tidal mudflat, subtidal flats and channels, marsh ecotones and upland transitional zones, salt pans and ponds. Multiple options for pond reconfiguration and water regime management will be used to enhance and create ponds with a variety of depths (including salt flats, very shallow ponded areas, and deep-water areas) and salinities (e.g., ponds with salinity close to bay water as well as higher salinity brine ponds), and associated levees and islands.

When tidal action is restored to a subsided pond site through a deliberate or accidental levee breach, physical processes are set in motion that dictate the rate and manner in which the site will evolve. These sedimentary processes have been described in conceptual models of youthful salt marsh development (Allen 1990; Orr et al. 2003) and are different from the processes, dominated by sea-level rise, which created the extensive transgressive ancient marshes of the South Bay.

In a restoring marsh, flood tides carry in suspended estuarine sediments that deposit in the wave-protected slack waters of the flooded site. Ebb tidal currents are insufficient to resuspend deposited muds, except in the locations of nascent tidal channels. As sediment accumulates, large areas of intertidal mudflats form. As they rise in elevation, the period of tidal-water inundation decreases and rate of sedimentation declines.

Once tidal mudflats reach a high enough elevation relative to the tidal frame, pioneer plant colonization can occur. Initial establishment usually occurs by seed or from plant fragments. Colonization becomes progressively more rapid through lateral vegetative expansion from the pioneer plants and continued deposition of seeds and plant fragments. Sites that have relatively high initial elevations will therefore reach colonization elevation more quickly than more deeply subsided sites.

In the San Francisco Bay, Pacific cordgrass (*Spartina foliosa*) is typically the first vegetation to colonize an accreting mudflat and dominates the low marsh. In the fresher parts of the San Francisco Bay bulrushes (*Scirpus maritimus* and *S. californicus*) will be the pioneer vegetation and will colonize lower in the tidal frame. Once mudflat colonization occurs, a vegetated marsh plain forms through lateral expansion of roots and rhizomes from established plants on the mudflat, and from plants along the site perimeter. The presence of vegetation contributes to the slow build-up of the marsh plain through sediment trapping and organic accumulation (Eisma and Dijkema 1997). Once vegetation is established, organic material will accumulate within the marsh both above ground as surface litter and below ground, through the decay of roots, rhizomes, and tubers, in the form of peat. As the vegetated marsh plain rises within the tidal frame, estuarine sediment accretion slows exponentially until a marsh plain forms at an elevation around mean higher high water (MHHW) (Atwater et al. 1979). As tidal inundation decreases, soil salinities increase and pickleweed (*Salicornia virginica*) out competes cordgrass to form the characteristic salt marsh plains of the San Francisco Bay.

The rate at which the mudflat and marsh plain builds up is dependent on the amount of sediment, or suspended sediment concentration (SSC), carried into the site by the flood tide, the rate of relative sea-level rise, the tidal range, and the amount of wind-wave action that erodes deposited sediments. The higher the average SSC in the flood tide entering the site, the quicker the restored site will evolve. Long-term average annual SSCs at any point in the South Bay vary depending on position relative to the hydrodynamics of the estuary, in particular its proximity to

extensive intertidal mudflats where sediment can be resuspended by wave action (Schoellhamer 1996). Average SSCs are ultimately determined by the long-term sediment budget of the estuary, which dictates how much sediment is available to the Estuary, and the estuarine hydrodynamics that determine how it moves and where it is concentrated.

The proposed action will be implemented in a series of phases over many years, on the order of several decades. It is anticipated that each pond will be managed in a manner similar to the ISP until its implementation phase. The initial phases, including Phase 1, will include a range of habitat types – tidal habitat, enhanced managed ponds, and reconfigured managed ponds – and early experiments for adaptive management.

The phasing of tidal- and managed-pond restoration will begin with areas that are the most feasible and/or have the highest certainty of achieving the project objectives. The ultimate progression of future restoration phases, including the total number of phases for implementation, will need to consider many factors, such as maintaining consistency with anticipated future phases, and mitigating for impacts as early as possible (preferably before they occur), for example creating a tidal marsh corridor before existing marsh is lost through tidal scour. Future phases are also likely to be associated with additional interim feasibility studies associated with the Shoreline Study, as well as restoration and adaptive management actions associated with the restoration plan. The proposed action and Shoreline Study planning efforts are, and will continue to be, closely coordinated.

Because the proposed action is phased, a mosaic of habitats will be developing over the length of the project at varying intervals. For example, mudflats will accrete sediment until the marsh begins to vegetate at which time mudflat area may decrease, but newly restored areas will again be accreting sediments. The phased nature of the project will result in shifts between habitat types during the interim times scales over the length of the project. It is important to estimate habitat development and understand these interim shifts along the restoration trajectory to determine whether the project is meeting the habitat goals for target species. These interim shifts in habitat evolution are included as estimates over decadal time scales in Table 4.

Methods of Predicting Habitat Evolution

Sedimentation forecasts by Philip Williams and Associates, Ltd. (PWA) for each Alternative every ten years were modeled in 2004. However, problems with the datum used by the USGS in conveying existing bathymetry invalidated that analysis. The analysis was performed again with the correct datums, but only for Year 0 and Year 50 (PWA 2006). Below, the original decadal analysis was used as a relative indicator of projected marsh evolution in conjunction with the final Year 50 hydrodynamic modeling as well as the Geomorphic Assessment (PWA 2006) to develop estimates of habitat development throughout the South Bay over decadal time scales (Table 4).

Table 4. Habitat Evolution over Decadal Time Scales.

Habitat Type	Year 0 (acres)	Year 10 (acres)	Year 20 (acres)	Year 30 (acres)	Year 40 (acres)	Year 50 (acres)	Year 80 (acres)
Deep Subtidal	3800	3800	3800	3900	3900	3900	-
Shallow Subtidal	13,000	13,500	14,000	14,500	14,900	15,200	-
Intertidal Mudflat (outboard)	12300	11560	10770	9980	9190	8400	-
Intertidal Mudflat (within ponds)	960	2500	2500	2200	2200	1200	0
Managed Ponds	11,790	9300	6800	4600 – 6800	2400 – 6800	1200 – 6800	1200 – 6800
Restored Tidal Marsh Habitats							
Vegetated High Marsh	0	0	624	2431	4,306	4306-5625	4306-7475
Vegetated Low Marsh	0	720	1971	2159	452-1246	452-1471	452-1150
Channels	0	115	415	715	715-912	715-1056	715-1380
Ponds and Pannes	0	125	450	775	775-988	775-1144	775-1495

Based on these two sets of modeling results, the following assumptions were used to determine the habitat evolution acreages on a decadal scale:

Breached Pond Acreage and Phasing Assumptions

- Although the proposed action's acquisition boundary comprises 15,100 acres, only approximately 13,200 acres of salt pond habitat are available for restoration. Based on detailed habitat mapping in 2004, portions of the official project area comprise existing marshes, channels, adjacent upland habitats, and infrastructure such as levees. The 13,200-acre number represents the total area within each of the ponds that is available for restoration
- Approximately 478 acres of the project area has already been restored to tidal action as part of the ISP
- Year 0 - the initiation of tidal restoration under Phase 1 includes Ponds E8A, E8X, E9, and A6 (960 acres). The Island Ponds (478 acres) were not included in this analysis because they were breached as part of the ISP. Likewise, changes to other tidal restoration sites (e.g., Cooley Landing) in the South Bay were not included in Table 4, which summarizes habitat evolution in the South Bay
- After the Phase 1 activities, the remaining acreage required to reach the 50:50 (tidal:managed pond) scenario by Year 20 was divided equally into a hypothetical Phase 2 at

Year 10 and Phase 3 at Year 20 (actual timing of these phases may vary)

- Year 10 – approximately 2,500 acres of pond will be breached
- Year 20 – The remaining 2,500 acres of pond required to achieve the 50:50 scenario will be breached
- If, after Year 20, the proposed action determines (as a result of monitoring via the AMP) that no additional tidal restoration will occur, then the habitats restored through Year 20 will simply continue to develop. This represents the low end of the range shown in Table 4. However, if the project determines that it is able to proceed along the tidal restoration staircase, the upper end of the range of the restored habitats will follow the below assumptions
- If the results of monitoring under the AMP continue to allow for progression along the staircase, the 90:10 alternative will be achieved at Year 50, with additional breaching assumed (for the sake of these habitat evolution projections) as follows:
    - Year 30 – 2,200 additional acres will be breached
    - Year 40 – 2,200 additional acres will be breached
    - Year 50 – 1,200 additional acres will be breached, achieving the 90:10 scenario and the upper range of possible habitats depicted in Table 4.
- The ponds being restored after Year 20 comprise the more subsided ponds, and therefore habitat development to tidal marsh will take longer in later phases

General Tidal Habitat Development Assumptions

- Between breaching and vegetation colonization, restored areas will be dominated by intertidal mudflats.
- It was assumed that the ponds restored in early phases are the less subsided ponds and therefore will take approximately 10 years (after breaching) to develop into low marsh and 20 years to develop into mature/high marsh.
- It was assumed that the ponds restored in later phases are the more subsided ponds and therefore will take approximately 10-20 years (after breaching) to develop into low marsh and 20-30 years to develop into mature/high marsh.
- Low marsh habitat was assumed to be approximately 10 percent of a mature marsh.
- Channel development was assumed to occur during the first 10 years and will equal approximately 12 percent of the total breached area (based on PWA's estimates).
- Marsh pond and panne habitat was assumed to occur during the first 10 years and will equal approximately 13 percent of the total breached area (based on PWA's estimates).
- At Year 50, some tidal restoration will still occur to achieve 90:10, which means that a portion of tidal marsh habitats will be newly breached and therefore still developing at that time.
- A Year 80 column has been included in Table 4 to illustrate the range of habitats inside the restored ponds once all restoration actions, including new breaches that occur at Year 50, have had time to develop.

Assumptions for Other Habitat Types

Deep Subtidal

- Deep subtidal habitat (i.e., habitat greater than 6 m below MLLW) is expected to remain relatively stable through Year 50, with a slight increase (less than 100 acres) of new habitat.

Shallow Subtidal

- Shallow subtidal habitat (i.e., habitat 0-6 meters below MLLW) is expected to increase through Year 50, with increases in habitat tapering off near the end of the 50-year proposed action duration.

Intertidal Mudflat

- The intertidal mudflat development outside of the restored ponds was modeled for Year 0 and Year 50 assuming all ponds were breached in Year 0. We used these model results as bookends and assumed a linear decrease for the interim years.
- At Year 0, intertidal mudflat within the ponds breached during Phase 1 will be equal to the breached pond acreage. An estimated 2,500 additional acres will be breached in Year 10, with 2,500 more acres in Year 20, at which time the 50:50 scenario will be reached.
- To calculate the high-end restoration trajectory, it is assumed that 2,200 acres will be breached in Year 30, and again in Year 40. The remaining 1,200 acres will be breached at Year 50.

While intertidal mudflat area outside of the ponds is expected to decrease between Year 0 and Year 50, there will be intervals within that time frame where overall intertidal mudflat area increases as new mudflat areas develop within the restored ponds. The cumulative result is a net increase in mudflat habitat from Year 0 until approximately Year 20, then a net overall decrease after Year 20 as restored tidal areas become vegetated and outboard intertidal mudflat is lost to sea level rise and vegetation colonization.

Habitat Evolution Results. The approximate acreages of key habitat types in the South Bay, by decade, are listed in Table 4. A summary of the relative extent of marsh channels expected to develop within restored marshes at Year 50, by channel order/size, appears in Table 5.

Table 5. Approximate Extent of Channels by Order in Restored Marshes at Year 50.

Channel Size	Average Width	Relative Proportion of Channels in Restored Tidal Area
1st Order	0.5 m	3.5%
2nd Order	1.5 m	5.9%
3rd Order	10 m	23.1%
4th Order	15 – 20 m	32.6%
5th Order	15 – 20 m	34.9%

California Clapper Rail and Salt Marsh Harvest Mouse

Habitat Restoration

The harvest mouse and clapper rail are both dependent on salt marsh habitats in the San Francisco Bay. These species have somewhat different habitat associations. The clapper rail is restricted to tidal salt and, to some extent, brackish marshes, where it occurs most commonly in lower-marsh habitats dominated by taller vegetation such as cordgrass, and with numerous tidal channels. The harvest mouse is found in both diked and tidal salt marsh, where it occurs more commonly in somewhat higher areas of the marsh plain that are dominated by pickleweed; this species has been recorded in brackish marsh in the South Bay (H.T. Harvey & Associates 2006). For the sake of discussion of the general effects of habitat evolution under the proposed action on these species, they are considered together since (a) both occur most commonly in tidal salt marsh, (b) attempting to predict the extent of high marsh vs. low marsh at any given time in the future will be difficult given uncertainties in sediment accretion rates, and (c) no creation of diked salt marsh (which will potentially provide habitat for the harvest mouse but not the clapper rail) is proposed under this proposed action.

Following is a prediction of how habitat for the harvest mouse and clapper rail is expected to increase over the 50-year duration of the proposed action.

Years 0-10. In the first year of project implementation, Phase 1 activities will restore full tidal action to approximately 960 acres of salt pond, as described in detail in the Phase 1 actions description below. Initially, these former ponds will be below elevations that will allow colonization by vegetation, and the former pond bottoms will provide intertidal mudflat habitat. By Year 10, enough sediment is expected to have accumulated in these former ponds that low tidal marsh vegetation will have become established throughout approximately 720 acres of the former pond area. This low tidal marsh is anticipated to be predominately vegetated with Pacific cordgrass. In addition to the vegetated low marsh, there will also be approximately 115 acres of tidal channels and approximately 125 acres of salt ponds and pannes in these restored salt marshes. All of the marshes restored in these first 10 years (Phase 1) will be salt marshes.

Use of the restored marshes by clapper rails is expected to occur as soon as enough vegetation is present to provide cover for foraging clapper rails. Even though this vegetation may not be dense and/or broad enough to provide nesting habitat for several more years, clapper rails are expected to forage on intertidal mudflats near vegetative cover. By Year 10, the cordgrass-dominated vegetation will provide cover, and possibly nesting habitat (if it is dense enough by Year 10), and the margins of the tidal channels will provide foraging habitat, at least at low tide. The harvest mouse reaches its highest densities in mature high marsh habitats with tall, thick pickleweed, and generally does not utilize low marsh habitat because it is too frequently inundated to provide permanent habitat for the harvest mouse. The cordgrass vegetation may also not provide sufficient food or cover from predators for harvest mice. The restored marsh after 10 years is not expected to provide important habitat yet for the harvest mouse because it will not yet have high marsh habitat.

Years 10-20. By Year 20, approximately 624 acres of the low marsh habitat present at year 10

will have matured to high marsh habitat, which is expected to be dominated by pickleweed. Approximately 2,500 acres of additional salt pond habitat will be opened to tidal action in year 10, and most of this will have matured to vegetated low marsh habitat by Year 20 to form a total of approximately 1,970 acres of vegetated low marsh. The amount of restored tidal channel habitat at year 20 will be approximately 415 acres, and the amount of marsh pond/panne habitat within the restored marshes will be approximately 450 acres.

The 624 acres of restored pickleweed-dominated high marsh is anticipated to constitute suitable habitat for the harvest mouse. The high fecundity of harvest mice will ensure that it will rapidly colonize the restored pickleweed marshes, so long as this species could disperse to the restored high marsh habitat and the habitat were indeed suitable. The clapper rail could utilize portions of this high quality pickleweed marsh habitat along tidal channels, and will continue to utilize restored low marsh habitat and restored tidal channels. By Year 20, the amount of restored high marsh habitat will have much more than compensated for any fringe marsh habitat lost to scour from restoration actions.

Years 20-30. By Year 30, most of the low marsh habitat present at Year 20 will have matured into pickleweed-dominated high marsh. The high marsh habitat present at year 20 will have further matured, and will likely have thick, tall, dense pickleweed, and associated late successional salt marsh plants like gumplant. This is the type of mature pickleweed marsh that is optimal habitat for the harvest mouse. A total of approximately 2,430 acres of restored high marsh in habitat at various stages of maturity will be present at this time, constituting a major increase habitat for both of these endangered species that should substantially contribute to their survival and recovery. The clapper rail could also utilize the approximately 2,160 acres of restored low marsh habitat and 715 acres of tidal channel and slough habitat available in year 30.

Whether or not more salt pond is opened to tidal action to further restore tidal marsh in Year 30 depends upon results of monitoring following the initial restoration phases. Approximately 6,600 acres of salt pond will be opened to tidal influence by Year 20. Monitoring of key habitat, species, and communities under the AMP will determine whether the conversion of salt pond habitat to tidal habitat has had unintended, adverse effects on key habitats, species, and communities. If no adverse effects have been noted, or if adaptive management actions can stall or reverse any negative trends resulting from restoration, then conversion of salt pond to tidal marsh will continue in the South Bay, potentially until 90 percent of the original salt ponds have been opened to tidal action, or until monitoring under the AMP indicates that restoration should cease to prevent impacts. If the adaptive management program indicates that further marsh restoration is to occur in Year 30, up to 2,200 acres of salt pond will be opened up to tidal action that year.

Years 30-40. By Year 40, most of the vegetated low marsh present at Year 30 will have become high marsh supporting pickleweed, for a total of approximately 4,300 acres of restored high marsh habitat in the South Bay. The high marsh present at Year 30 will have further matured, with more of it supporting dense, tall pickleweed. This high marsh habitat is expected to provide high-quality habitat for the harvest mouse.

If no further conversion of salt ponds occurred in Year 30 due to project impacts on pond-

associated species (or other impacts), the area of restored low marsh habitat will be approximately 452 acres, and the areas of tidal channels and salt ponds and pannes will be the same as in Year 30. If restoration efforts proceeded in Year 30, up to approximately 1,250 acres of restored low marsh habitat will be present in the South Bay, and up to 912 acres of tidal channel and 988 acres of marsh ponds and pannes will be present. Clapper rails will utilize these restored low marsh and tidal channel habitats in addition to portions of the restored high marsh habitats. If the adaptive management program indicates that further restoration efforts are to begin in Year 40, up to 2,200 additional acres of salt pond will be opened to tidal action in that year.

It should be noted that a fraction of the marshes restored in the Alviso Complex will be brackish rather than salt marshes. None of the marshes in Phase 1 are likely brackish, but some of the marshes restored in Years 30-50 likely will be. Because brackish marsh habitat is considered to be of lower quality for harvest mice and clapper rails, this restored marsh will have relatively lower value for these species. However, these brackish marshes will be a small fraction of the total restored marsh habitat. Furthermore, the total amount of brackish marsh in the entire South Bay at Year 50 is predicted to decline from 14 percent to 12.8 percent as a result of the increased tidal flow that will accompany the marsh restoration, so overall the fraction of salt marsh habitat available to these species will increase as a result of the project. Finally, both the harvest mouse and clapper rail have been recorded using brackish marshes in the South Bay, and thus these marshes will provide some benefit to these species.

Years 40-50. If no further tidal marsh restoration occurs beyond Year 20 (i.e., beyond the 50/50 managed pond/tidal habitats scenario), then the amount of restored high marsh in Year 50 will be the same as in Year 40, approximately 4,300 acres. This high tidal marsh habitat will have had 30 years to mature by Year 50 of the project, and so nearly all of it will likely have developed fully mature pickleweed and other late successional salt marsh plants associated with the highest quality harvest mouse habitat. Likewise, if no further marsh restoration activities took place after Year 20, the amount of low marsh habitat, tidal channel habitat, and marsh pond/panne habitat will be the same in Year 50 as in Year 30. Clapper rails will be able to utilize the restored low marshes, portions of the mature high marshes, and the tidal slough habitats.

However, if restoration efforts on as much as 90 percent of the proposed action area have proceeded up to Year 50 according, then in Year 50 there will be approximately 5,630 acres of restored high marsh, 1,470 acres of restored low marsh, 1,060 acres of restored tidal channels, and 1,140 acres of marsh ponds/pannes. Furthermore, an additional 1,200 acres of salt pond habitat will be open up to tidal action in Year 50. Any restored tidal marsh opened up in Years 30, 40, and 50 will be continuing to mature and further improve in quality for the harvest mouse. Once the tidal marsh restored under the Alternative C fully matures, which will occur by approximately year 80, there will be a total of 7,480 acres of restored high marsh, 1,150 acres of restored low marsh, 1,380 acres of restored tidal channels, and 1,500 acres of restored marsh ponds and pannes, for a total of approximately 11,500 acres of restored tidal marsh habitat. This vast amount of restored habitat for the harvest mouse and clapper rail will be expected to substantially increase South Bay populations of the species, and contribute greatly to their survival and recovery.

Habitat Loss

Over the entire 50-year life of the proposed action, approximately 220 to 250 acres (90 to 100 hectares) of fringe marsh habitat will be lost, mostly due to tidal scouring. Habitat for the clapper rail will develop quickly, and restored habitats is anticipated to outpace (and eventually far exceed) any localized loss of habitat due to scouring, excavation of pilot channels, or other activities. Mature pickleweed habitat for the harvest mouse takes longer to develop, and it is possible that it will take a decade or more for localized losses in certain areas to be offset by increases in harvest mouse habitat at that location due to tidal marsh restoration. However, lowered levees and interior levee walls within ponds opened to tidal action will be colonized rapidly by pickleweed, helping to offset the temporary loss of harvest mouse habitat in specific areas until the restored marshes achieve elevations suitable for pickleweed colonization. Eventually, the amount of habitat restored will far exceed localized, short-term losses.

In addition, the fringe marshes of the South Bay, which will be the marshes adversely affected by this short-term marsh loss, often provide the only habitat connecting the larger patches of marsh habitat that contain the "core" populations of harvest mice. The loss of these marshes in the short term before the restored marshes have matured to vegetated high marsh could temporarily reduce the connectivity between the harvest mouse populations of the South Bay. This potential is mostly offset by marshes created on lowered levees described above. By grading these areas to approximately MHHW, pickleweed will rapidly establish and broaden the strip marshes and increase the connectivity in many places.

The short-term loss of harvest mouse habitat and connectivity from fringe marsh scour will be offset by an order of magnitude in the second decade of the proposed action when the restored marsh matures to a point that it can support harvest mice. The short-term nature of the loss of connectivity suggests that it will not adversely affect the metapopulation dynamics or genetic diversity of the harvest mouse in the South Bay.

Small-scale, localized loss of habitat for the clapper rail and harvest mouse will also occur on a small scale as a result of the placement of sediment, structures, or other materials in these species' habitats, excavation of habitat, and trampling of habitat. At any one location, the extent of habitat to be impacted will be very small compared to the proposed restoration, and the total loss of clapper rail and harvest mouse habitat due to these activities is included in the above estimate of approximately 220-250 acres of fringe marsh habitat that will be lost during the life of the project.

Examples of activities that could result in the placement of sediment, structures, or other materials in clapper rail and harvest mouse habitat are as follows:

- Incidental displacement of sediment into habitat during breaching, lowering, and maintenance of sections of existing outboard levees; excavating pilot channels through fringe marsh; dredging outboard sloughs to enlarge channel and obtain borrow ditch block material; removal or replacement of existing water control structures or installation of new ones; and reconfiguration of culvert connections

- Constructing ditch blocks in the perimeter and internal borrow ditches (if harvest mouse habitat is present inside levees)
- Side-casting of dredge spoils into adjacent marsh
- Installation of new water control structures
- Installation of fish screens
- Modifying or raising levees (e.g., for flood control)
- Constructing new levees (e.g., for flood control)
- Armoring levees
- Constructing trails, viewing platforms, interpretive stations, and boat launches

Activities that could result in the loss of clapper rail and harvest mouse habitat due to excavation include the following:

- Excavating pilot channels to sloughs through the fringe marsh outboard of outboard levee breaches
- Breaching sections of outboard levees (or inboard levees if harvest mouse habitat is present inside levees)
- Widening a channel and providing additional cross-sectional area for flow to improve floodwater conveyance
- Breaching slough levees to route more tidal flow through the sloughs/channels, to increase channel deepening and widening downstream of the breaches

Examples of activities that could result in trampling of clapper rail and harvest mouse habitat by equipment or people are as follows:

- Excavation of pilot channels
- Installation, removal, replacement, or maintenance of water control structures or fish screens
- Levee breaching, maintenance, modification, or construction
- Walking through marshes or grounding boats in marshes during monitoring/research efforts
- Constructing trails, viewing platforms, interpretive stations and boat launches
- Recreational access (e.g., unauthorized access into habitat by boaters, hunters, anglers, or pedestrians)
- Placement of traps in marsh for predator control
- Lepidium control (e.g., spraying within marsh).

In addition, where harvest mouse habitat is present inside a pond to be restored to tidal action, habitat for this species will be lost due to flooding as a result of the following activities:

- Breaching levees to restore tidal action to ponds with harvest mouse habitat present inside levees
- Raising water levels in ponds with harvest mouse habitat present inside levees
- Providing temporary floodwater storage within managed ponds to reduce flooding impacts (if salt mouse habitat is present inside levees).

During any construction or excavation activities, or levee maintenance or modification, that may result in impacts to tidal marsh habitat, the limits of work will be clearly delineated to limit effects to existing clapper rail and harvest mouse habitat. Side-casting of dredged materials into tidal marsh habitat will be limited so that a minimum amount of marsh is filled. Conservation measures incorporated into the proposed action (described previously) will be implemented to minimize effects of human activity within marshes on clapper rail and harvest mouse habitat.

Direct Loss of Individuals, Nests, Eggs, and Young

All of the specific activities listed above under "Habitat Loss" have the potential to result in the direct mortality or injury of individual harvest mice (adults and young) or clapper rails (including nests, eggs, and young). Harvest mice or clapper rails may be injured or killed by crushing or smothering during the placement of sediment or other materials in suitable habitat, or by excavation of habitat. Trampling by construction equipment or people may occur during construction, monitoring, research, or recreational activities. Adult clapper rails are unlikely to be injured or killed during such activities, as they are expected to flee an area subject to such activities before injury or mortality occurs. However, these activities could destroy or damage clapper rail nests or eggs, or result in the injury or mortality of less mobile harvest mice or young clapper rails.

During any construction or excavation activities, or levee maintenance or modification, that may result in impacts to harvest mice or clapper rails, the limits of work will be clearly delineated to limit effects to these species. Conservation measures incorporated into the proposed action, including avoidance of occupied habitat during the clapper rail breeding season and minimization of work within marsh habitat will minimize effects of human activity within marshes on clapper rails and harvest mice.

Where harvest mouse habitat is present inside a pond to be restored to tidal action, individual harvest mice will be lost due to flooding when levees are breached to restore tidal action to ponds, water levels are raised during pond management, or temporary floodwater storage within managed ponds occurs to reduce flooding impacts.

Loss of individual clapper rails and harvest mice due to predation could also be exacerbated by the proposed action, at least in localized areas. The restoration of tidal marsh habitat will increase habitat for northern harriers, which prey on small mammals such as harvest mice, and are expected to prey on clapper rail chicks as well. However, because habitat for northern harriers is suitable for clapper rails and harvest mice as well, the increase in clapper rail and harvest mouse populations due to habitat restoration in a given area will outpace any adverse effects of predation by northern harriers. Local increases in predation on clapper rails and harvest mice may occur due to marsh restoration in close proximity to colonies of California gulls; electrical towers providing nesting sites for common ravens, red-tailed hawks (*Buteo jamaicensis*), peregrine falcons (*Falco peregrinus*); upland areas providing sources or predators such as cats, rats, foxes, raccoons, loggerhead shrikes (*Lanius ludovicianus*), white-tailed kites (*Elanus leucurus*), and American crows; and landfills that attract potential avian and mammalian predators. Although terrestrial pathways used by mammalian predators to access marshes will be

reduced through the breaching, lowering, and removal of levees in some areas, marshes that abut upland areas will be subject to predation by land-based predators, and avian predators will have more widespread access to clapper rails and harvest mice in restored marshes.

Breaching ponds where California gulls breed would result in the displacement of several large California gull colonies. These displaced gulls may select nesting sites in close proximity to clapper rail and harvest mouse habitat elsewhere. The displacement of gulls from areas of lower clapper rail and harvest mouse habitat quality to areas of higher habitat quality could result in increased predation pressure by gulls on these two species.

Conversely, both mammalian and avian predator control efforts are expected to increase as part of the proposed action. Currently, mammalian predators are controlled on Refuge lands, and localized avian predator control is implemented at the ELER where individual predators threaten snowy plover nesting areas. However, given the limited existing extent of salt marsh habitat for clapper rails and harvest mice, individuals of these species are concentrated in very limited areas, facilitating predation. The rate of predation of individual clapper rails and harvest mice is expected to decline during implementation of the proposed action due to increased predator control efforts and extensive tidal habitat restoration, which would reduce the concentration of individual clapper rails and harvest mice and, potentially, make it more difficult for predators to locate clapper rails and harvest mice.

Although there is some potential for clapper rails to be accidentally shot by hunters, the probability of such an occurrence is extremely low. Most hunting in the proposed action area occurs from blinds within managed ponds, where clapper rails do not occur due to a lack of vegetative cover and poor foraging habitat. Those levees that are currently open to hunting (e.g., along Ponds A5, A7, and A8N) are located in areas where few clapper rails are present due to the brackish nature of the marshes, and clapper rails rarely fly high or far enough to provide quarry for waterfowl hunters. Both the Service and CDFG law enforcement staff track the number of hunters and their harvest, and monitor for impacts to non-huntable wildlife.

With the implementation of the conservation measures described previously, the actual number of individual clapper rails and harvest mice lost due to implementation of the proposed action will be very low. Any incidental take associated with project-level activities will be identified in the tiered biological opinions.

Loss of Individuals and Reduced Reproductive Success due to Mercury Exposure

Mercury accumulation in eggs is perhaps the most significant contaminant problem affecting clapper rails in the Estuary, with the South Bay containing the highest mercury levels. Mercury is taken in by clapper rails primarily through contaminated prey. Although mercury intake is generally not acute enough to result in lethal toxosis of adults or young, mercury is extremely toxic to embryos and thus results in high levels of egg inviability and reduced clapper rail fecundity. Schwarzbach et al. (2006) found high mercury levels and low hatching success (due both to predation and, presumably, mercury) in clapper rail eggs throughout San Francisco Bay. They also suggested that mercury exposure could slow or stunt development of young, possibly increasing predation risk.

Clapper rails are currently exposed to mercury when foraging on mudflats and in sloughs with high levels of mercury contamination. The proposed action has the potential to increase the exposure of clapper rails to mercury by stirring up sediments during excavation of pilot channels in contaminated marshes, breaching levees, widening or dredging of channels, and placement of contaminated sediment in marshes (e.g., following excavation of pilot channels, during levee construction or maintenance, or during levee lowering or removal). Mercury-contaminated sediments that are currently buried too deep to adversely affect clapper rails could be mobilized by these activities, entering the food chain.

A mercury monitoring study is currently underway to ensure that mercury impacts on biota are minimized during restoration. This study focuses on the Alviso area where mercury levels are known to be high, but also includes sampling sites elsewhere in the South Bay. This study is measuring mercury levels in the sediment, water column, and various sentinel species; measuring the bioavailability of inorganic mercury in sediments; measuring mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. This study will increase the understanding of mercury cycling within the proposed action area and will inform future management decisions to further minimize mercury exposure. Monitoring of mercury cycling during Phase 1 restoration and management activities will also provide information on management or restoration activities that are desirable, or that are to be avoided, in areas of high mercury concentrations. Decisions regarding restoration or management activities involving breaching and scour in a particular area will be made only after the sediments to be mobilized by such activities are tested for mercury levels, and in the context of the results of ongoing and future studies regarding the effects of mercury.

Disturbance of Individuals, Nests, and Young

Disturbance such as loud noise or the presence and movement of people, dogs, and heavy equipment in or near clapper rail habitat may alter bird behavior in ways that result in injury, mortality, or reduced nesting success. Such disturbance could result in temporary or permanent habitat loss due to clapper rail avoidance of areas that have suitable habitat but intolerable levels of disturbance; abandonment of nests, eggs, or young by nesting pairs; a reduction in foraging efficiency if high quality foraging areas are impacted; and increased movement or flushing from cover, or altered activity patterns, that reduce energy reserves and increase predation risk.

Examples of proposed action activities that will cause such disturbance, if they occur in or near occupied clapper rail habitat, include the following:

- Installation, removal, replacement, or maintenance of water control structures, water pumps, or fish screens
- Levee breaching, maintenance, modification, or construction
- Construction of islands and levees in managed ponds
- Excavation of pilot channels and dredging of inboard and outboard channels
- Construction of trails, viewing platforms, interpretive stations, and boat launches
- Walking through marshes or grounding boats in marshes during monitoring/research efforts

for adaptive management and applied studies
- Walking and driving on levees during survey, monitoring, research, or maintenance activities
- Recreational access (e.g., authorized and unauthorized access into or near nesting and foraging habitat by boaters, hunters, anglers, or pedestrians)
- Trapping, shooting, and hazing for predator control

These activities would be disruptive to clapper rail breeding efforts if they occur in or near occupied habitat during the breeding season. Disturbance could cause short-term effects such as failure to breed, nest abandonment, lower numbers of eggs, juvenile abandonment, and overall lower juvenile survivorship. In areas where high-intensity disturbance is short-lived (e.g., during pilot channel excavation, or levee breaching or construction), successful reproduction may not occur while the disturbance is ongoing, but may resume after construction is completed. In areas where disturbance will increase permanently as a result of the proposed action (e.g., due to the construction of boat launches, or construction of trails adjacent to clapper rail habitat), some clapper rails may acclimate to the new disturbance, while others may not.

Even with the implementation of conservation measures to minimize disturbance in the tidal marsh during the breeding season, clapper rails that disperse away from disturbance may not successfully establish new breeding territories and breed. Clapper rails forced to disperse would need to either maintain existing pair bonds or develop new pair bonds and establish new breeding territories in other suitable habitat areas. The ability of these clapper rails to reestablish new breeding territories would be hampered by the fact that clapper rails maintain year-round home ranges and defend established breeding territories from intrusions by other clapper rails. Loss of any female clapper rails would be compounded by the loss of potential future progeny. Reduced survival of adult clapper rails would impact the long-term viability of the population.

Disturbance that occurs during the clapper rail non-breeding season could also result in harassment, harm, or mortality of clapper rails. Clapper rails could be forced to adjust the boundaries of their territories or to disperse to other habitat areas. Displaced individuals and their eggs or young could be subjected to injury or mortality from starvation, physiological stress, and increased predation. Clapper rails disturbed by work activities also could be subjected to predation if they increase their movements within their home range or disperse to other nearby or distant tidal wetlands.

Human activity and associated pet use will increase in areas where trails, interpretive stations, and other recreational/public access features are to be opened or improved. Interpretive displays will inform the public about the potential to disturb listed species and their habitat. The ability to manage or control potential disturbances in adjacent habitat areas from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails.

Visual and physical barriers along trails may have limited effect in deterring human or pet disturbance because they can be easily crossed. Continued dog use will be dependent upon compliance with new leash restrictions; non-compliance will result in the Refuge and ELER

removing dog-walking from recreational use. During the non-compliant period, harvest mice could be harmed, harassed, or killed by dogs.

Water-based disturbance of clapper rails will increase to some extent due to the construction of new boat launches. However, interpretive signage describing closed areas and boating procedures to avoid impacts to sensitive wildlife species, both at boat launches and at the mouths of restored sloughs that are closed to boat access, will help to minimize disturbance of clapper rails in restored and existing marshes.

Increased recreational trail use in areas where existing trails occur adjacent to clapper rail habitat could result in the flushing of clapper rails at high tides, increasing predation risk. Such disturbance will increase in areas where new trails will be opened to the public adjacent to existing clapper rail habitat, or where trails (new or existing) occur adjacent to new tidal marsh habitat.

Construction, maintenance, monitoring, recreational, and other activities will result in increased levels of disturbance to harvest mice from noise, vibrations from equipment, and construction activities. Disturbance will result in displacement of harvest mice from protective cover and their territories/home ranges (through noise and vibrations) and/or direct injury or mortality (through crushing). These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of harvest mice from their territory/home range in the areas where their habitat is destroyed. Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance to females during the period of March through November may mean abandonment or failure of the current litter. Thus, displaced harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

During any construction or excavation activities, or levee maintenance or modification, that may result in disturbance of harvest mice or clapper rails, the limits of work will be clearly delineated to limit effects to these species. Conservation measures incorporated into the proposed action, including avoidance of occupied habitat during the clapper rail breeding season, interpretive signage at the edges of sensitive habitat areas and seasonally closed trails, and enforcement of hunting regulations, will minimize effects of human disturbance on clapper rails and harvest mice.

Western Snowy Plover

Habitat Modification

Although snowy plovers in the San Francisco Bay occasionally nest on levees and islands, the majority of nests are currently found on flats within dry or partially dry ponds (Feeney and Maffei 1991, Fischer 1998). A few ponds, particularly in Eden Landing, as well as Ponds A22 and SF2, have long been used regularly for nesting by snowy plovers. In the past, such regular use resulted from the type and consistency of management of these ponds for salt production (e.g., the same ponds representing the same stage in the salt-making process provided conditions that were consistently suitable for use by nesting snowy plovers). Currently, under the ISP,

attempts are being made to manage a few ponds (e.g., Ponds E6B, E8, E8A, and E8X) with optimal breeding conditions for snowy plovers in mind. Other ponds are used more sporadically, and in any given year there may be extensive habitat in the South Bay that is ostensibly suitable for nesting but is unoccupied by the species. Without management of ponds targeted specifically for snowy plovers, the amount of suitable nesting habitat is unpredictable, given that changes in precipitation, rate of evaporation, and pond management could make any given pond unsuitable in a given year.

Restoration of tidal marsh, or increasing water levels (e.g., to manage ponds for diving ducks or other birds), in ponds that support breeding snowy plovers will reduce the overall nesting and foraging habitat available. Flooding or removal of levees and salt flats will also reduce foraging habitat for snowy plovers. However, quantifying the predicted effect of such a habitat decline on snowy plover numbers is difficult. The extent of habitat offering dry salt pans or island nesting habitat varies from year to year due to the timing and amount of precipitation (and consequently water depth) in seasonal ponds, and much seemingly suitable habitat in any given year is unoccupied by snowy plovers. As a result, a reduction in the extent of suitable habitat need not result in a decline in numbers of snowy plovers if some ponds are managed specifically (and consistently) for nesting snowy plovers.

Proposed action activities to increase densities of nesting snowy plovers within the project area are not only expected to compensate for decreases in salt pond habitat, but also to enhance conditions for breeding snowy plovers to help contribute to the species' recovery. Enhancement of managed pond habitat by targeted management for shallow water depths and the creation of artificial islands have been found to support high nesting densities of snowy plovers at the Moss Landing Wildlife Area and in evaporation basins in the San Joaquin Valley (Eyster et al. 2003, H.T. Harvey & Associates, unpublished data). As a result, the creation of nesting islands and the management of suitable water levels, nesting island conditions (e.g., through vegetation management), and predators (e.g., at Ponds E12, E13, SF2, and A16 in Phase 1 and possibly other ponds thereafter) is expected to support high densities of nesting snowy plovers. Additional ponds will be available for management as nesting snowy plover habitat, either on islands or in seasonally managed ponds. The number of ponds managed for this species, and the manner in which they are managed (e.g., with islands or salt pans), will be informed by monitoring the results of ongoing plover habitat management at Eden Landing and the outcome of Phase 1 studies. The project has also begun planning of focused restoration designed to benefit the plover based upon results reported in the Owens Valley by Point Reyes Bird Observatory. In that location, a managed pond with a series of furrows and with water moving in channels in between the furrows resulted in very high nesting success. This design may be experimented with in Phase 2 of the proposed action.

However, the effectiveness of habitat enhancement/creation and predator control in sustaining and increasing numbers of breeding snowy plovers in the South Bay cannot be predicted with certainty. For this reason, monitoring and adaptive management will be important components of the proposed action, and will be essential in ensuring that project activities result in a net benefit to snowy plovers. Snowy plover numbers, as well as some measure of reproductive success, will be determined through comprehensive, annual South Bay surveys and monitoring during the breeding season. The effects of phased restoration activities will be predicted prior to

each phase of restoration, and deviations from the projected trajectory toward achieving the proposed action's objectives regarding snowy plover numbers will be noted. If the rate of population change declines substantially from this projected trajectory, if the South Bay population declines in any given year below 2006 baseline levels, or if increases in predatory/competitive species, such as California gulls, to population or activity levels that may threaten maintaining numbers of breeding snowy plovers are noted, the adaptive management trigger will be tripped, and adaptive management actions to reverse any adverse effects on snowy plovers will be implemented.

Adaptive management actions will include the construction of additional islands, the creation of islands of a different size and/or configuration (based on an analysis of use of existing islands), adjustment of water depths, adjustment of pond management to provide more salt pan habitat, and increased levels of predator management. Other means of providing nesting habitat will also be assessed. For example, "furrowed" ponds described above, in which the pond substrate is furrowed to create small islands and ridges surrounded by shallow water, have been successful in supporting high densities of nesting snowy plovers in the Owens Valley (N. Warnock, pers. comm.); creation and management of such habitat in South Bay ponds, and comparison of nesting snowy plover densities among ponds providing different types of snowy plover nesting habitat, will allow for effective management of their habitat.

The AMP provides a mechanism to ensure that the proposed action's effects on snowy plovers and the loss of salt pond habitat are sufficiently compensated for by intensive management of the remaining managed ponds. Thus, over the life of the proposed action, any adverse effects on snowy plovers are expected to be minor and short-term, and the proposed action is expected to result in an increase in the habitat quality and population size of snowy plovers in the South Bay.

Through focused habitat restoration and existing predator management, it is expected that snowy plover numbers will achieve the draft Recovery Plan success criteria under the 50:50 managed pond/tidal habitat restoration scenario. In fact, there is potential for snowy plover numbers within the proposed action area to exceed 250 individuals under this scenario. As restoration proceeds along the adaptive management "staircase," and additional ponds are restored to tidal habitats so that the extent of managed pond habitat represents progressively less than 50 percent of the proposed action area, it is possible that the number of snowy plovers may eventually decline from their previous highs as a result of a reduction in breeding habitat acreage. However, the objective of supporting at least 250 individual breeding snowy plovers is expected to remain as restoration proceeds beyond the 50:50 scenario.

Direct Loss of Individuals, Nests, Eggs, and Young

A number of activities associated with the proposed action have the potential to cause direct mortality or injury of snowy plovers, including nests, eggs, and young. Although adult snowy plovers may forage on tidal mudflats, direct loss of adults on tidal mudflats is unlikely to occur as a result of the proposed action. Nesting, brooding, and most foraging (including virtually all foraging by chicks) in the project area occurs in shallow managed ponds and along barren or sparsely vegetated levees within and surrounding these ponds. Therefore, activities that could result in the direct loss of individual snowy plovers and their nests, eggs, and young are those

that occur within the managed ponds and on surrounding levees. Examples of activities that could result in eggs or chicks being crushed, trampled, or buried include the following activities:

- Grading and nesting island creation, management, and maintenance within reconfigured managed ponds
- Incidental displacement of sediment into nesting or foraging habitat during breaching, lowering, and maintenance of sections of existing outboard levees; removal or replacement of existing water control structures or installation of new ones; and reconfiguration of culvert connections
- Constructing ditch blocks in borrow ditches
- Constructing trails, viewing platforms, and interpretive stations
- Levee breaching, maintenance, modification, armoring, or construction
- Walking or driving along levees or through ponds during facilities inspections and maintenance, surveys, and monitoring and research efforts
- Recreational access (e.g., authorized use of levees by pedestrians, or unauthorized access into managed ponds by anglers or pedestrians)
- Vegetation and predator control within managed ponds

In addition, eggs (and possibly very small young, if they are unable to swim to terrestrial refugia) may be lost if occupied nesting habitat is flooded as a result of the following activities:

- Breaching levees to restore tidal action to ponds
- Raising water levels during pond management
- Providing temporary floodwater storage within managed ponds to reduce flooding impacts

Water levels will be closely monitored in nesting areas, and particularly close attention to water levels will be paid if water control structures are opened during the breeding season so that nests are not flooded. Nevertheless, there is some risk that nests would be flooded if monitoring of water levels is not frequent enough, or if water control structures fail and cannot be repaired before nests are flooded.

To minimize such impacts, work in and adjacent to potential snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting snowy plovers, and appropriate buffers would be provided between project activities and nesting snowy plovers.

Concentration of nesting snowy plovers in fewer locations may result in increased predation pressure (e.g., if individual gulls, corvids, foxes, or other predators key in on these locations), subject larger numbers of birds to disturbance by humans or predators at any given nesting area, and provide fewer options for nesting birds in the event that pond conditions in preferred nesting areas are unsuitable (e.g., due to high water levels in wet years).

Loss of individual snowy plovers due to predation could also be exacerbated by the proposed action, at least in localized areas. The restoration of tidal marsh habitat will increase habitat for

northern harriers, which prey on snowy plovers, and will concentrate nesting plovers in fewer locations. Management of pond habitat for high densities of nesting plovers in close proximity to colonies of California gulls; electrical towers providing nesting sites for common ravens, red-tailed hawks, peregrine falcons; upland areas providing sources or predators such as cats, rats, foxes, raccoons, loggerhead shrikes, white-tailed kites, and American crows; and landfills that attract potential avian and mammalian predators could increase the intensity of predation.

Breaching ponds where California gulls breed would result in the displacement of several large California gull colonies. These displaced gulls may select nesting sites on salt pond levees, on islands, or on salt pannes, all of which have been used as breeding habitat by snowy plovers. Due to the larger size of California gulls, and the potentially overwhelming numbers of gulls that may be prospecting for new nesting sites, snowy plovers may be displaced from currently used nesting areas. California gulls displaced to sites closer to nesting snowy plovers may also prey upon plover eggs and chicks.

Both mammalian and avian predator control efforts are expected to increase as part of the proposed action. Currently, mammalian predators are controlled on Refuge lands, and localized avian predator control is implemented at ELER where individual predators threaten snowy plover nesting areas. The need for predator control will be monitored at snowy plover nesting areas, both through monitoring of predator numbers and snowy plover breeding success, and predators will be removed as needed to maintain high snowy plover breeding success.

Loss of Individuals and Reduced Reproductive Success due to Mercury Exposure

Studies in San Diego County (Hothem and Powell 2000), at Point Reyes (Schwarzbach et al. 2005), and in the South Bay (Schwarzbach and Adelsbach 2003) have found elevated mercury levels in snowy plover eggs. At Point Reyes, high levels of mercury in unhatched eggs were thought to be a possible reason for the inviability of these eggs. In the San Diego County and South Bay studies, however, concentrations of mercury in snowy plover eggs were below known embryotoxic thresholds established for other species. Ongoing studies in the South Bay will provide more information on the magnitude and potential effects of mercury contamination on snowy plovers in the proposed action area.

Snowy plovers are currently exposed to mercury in managed ponds containing mercury-contaminated water or sediment, and to a lesser extent on intertidal mudflats where this species occasionally forages. Proposed action activities that stir up contaminated sediments, such as grading, excavation, levee construction or maintenance, or fill activities within managed ponds have the potential to increase snowy plover exposure to mercury, possibly reducing fecundity in contaminated ponds. Activities that stir up mercury-laden sediments in tidal habitats, as described above for the clapper rail and harvest mouse, are expected to have little effect on snowy plovers due to the infrequency with which snowy plovers forage in intertidal habitats in the project area.

A mercury monitoring study is currently underway to ensure that mercury impacts on biota are minimized during restoration. This study focuses on the Alviso area where mercury levels are known to be high, but also includes sampling sites elsewhere in the South Bay. This study is

measuring mercury levels in the sediment, water column, and various sentinel species; measuring the bioavailability of inorganic mercury in sediments; measuring mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. This study will increase the understanding of mercury cycling within the proposed action area and will inform future management decisions to further minimize mercury exposure. Monitoring of mercury cycling during Phase 1 restoration and management activities will also provide information on management or restoration activities that are desirable, or that are to be avoided, in areas of high mercury concentrations. Decisions regarding restoration or management activities involving breaching and scour in a particular area will be made only after the sediments to be mobilized by such activities are tested for mercury levels, and in the context of the results of ongoing and future studies regarding the effects of mercury.

Disturbance of Individuals, Nests, and Young

Disturbance such as loud noise or the presence and movement of people, dogs, and heavy equipment in or near snowy plover habitat may alter bird behavior in ways that result in injury, mortality, or reduced nesting success. Such disturbance could result in temporary or permanent habitat loss due to the avoidance of areas that have suitable habitat but intolerable levels of disturbance; abandonment of nests, eggs, or young by nesting pairs; a reduction in foraging efficiency if high quality foraging areas are impacted; and increased movement or flushing from cover, or altered activity patterns, that reduce energy reserves and increase predation risk.

Examples of proposed action activities that will cause such disturbance, if they occur in or near occupied snowy plover habitat, include the following:

- Grading and nesting island creation, management, and maintenance within reconfigured managed ponds
- Installation, removal, replacement, or maintenance of water control structures, water pumps, or fish screens
- Internal and external levee breaching, maintenance, modification, or construction
- Excavation of pilot channels and dredging of inboard and outboard channels
- Construction of trails, viewing platforms, interpretive stations, and boat launches
- Walking or driving along levees or through ponds during facilities inspections and maintenance, surveys, and monitoring and research efforts
- Recreational access (e.g., authorized use of levees by pedestrians or hunters, authorized access into managed ponds by hunters, or unauthorized access into managed ponds by boaters, hunters, anglers, or pedestrians)
- Vegetation and predator control within and near managed ponds

These activities would be highly disruptive to snowy plover breeding efforts if they occur in or near occupied habitat during the breeding season. Disturbance could cause short-term effects such as failure to breed, nest abandonment, lower numbers of eggs, juvenile abandonment, and overall lower juvenile survivorship. In areas where high-intensity disturbance is short-lived (e.g., during island or internal levee construction or replacement of water control structures), successful reproduction may not occur while the disturbance is ongoing, but may resume after

construction is completed. In areas where disturbance will increase permanently as a result of the proposed action (e.g., due to the construction of trails or interpretive stations adjacent to snowy plover habitat), some plovers may acclimate to the new disturbance, while others may not.

Even with the implementation of measures to minimize disturbance near snowy plover nesting areas during the breeding season, birds that disperse away from disturbance may not successfully establish new breeding territories and breed. Snowy plovers forced to disperse would need to either maintain existing pair bonds or develop new pair bonds and establish new breeding territories in other suitable habitat areas. Loss of any females would be compounded by the loss of potential future progeny. Reduced survival of adult snowy plovers would impact the long-term viability of the population.

Disturbance during the non-breeding season, or disturbance in or near foraging habitat during the breeding season, could reduce foraging efficiency or result in increased mortality as birds are displaced to alternative foraging areas. Displaced individuals and their eggs or young could be subjected to injury or mortality from starvation, physiological stress, and increased predation.

Human activity and associated pet use will increase in areas where trails, interpretive stations, and other recreational/public access features are to be opened or improved. Interpretive displays will inform the public about the potential to disturb listed species and their habitat. The ability to manage or control potential disturbances in adjacent habitat areas from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails.

Visual and physical barriers along trails may have limited effect in deterring human or pet disturbance because they can be easily crossed. Continued dog use will be dependent upon compliance with new leash restrictions; non-compliance will result in the Service and ELER removing dog-walking from recreational use. During the non-compliant period, snowy plovers could be harmed, harassed, or killed by dogs.

To minimize impacts, work in and adjacent to potential snowy plover nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting plovers, and appropriate buffers would be provided between proposed action activities and nesting plovers. Additional conservation measures incorporated into the proposed action (described previously), including the use of interpretive signage at the edges of sensitive habitat areas and seasonally closed trails, will minimize effects of human disturbance on snowy plovers.

California Least Tern

Habitat Modification

In the South Bay, recent breeding by least terns has occurred only at Hayward Regional Shoreline, where eight pairs nested in 2005 and 15 pairs in 2006 (Strong 2006), and at Pond E8A in the Eden Landing complex, where 5 pairs nested in 2007. Most least terns in the San

Francisco Bay Area currently nest in Alameda, and most foraging during the breeding season (e.g., to feed unfledged chicks) occurs north of the San Mateo Bridge. The action area for this Biological Opinion extends north to the Bay Bridge, and thus includes the majority of the least tern nesting areas in San Francisco Bay. However, with the exception of the 2007 colony in Pond E8A, the proposed action is expected to have little direct effect on least terns or their habitats in the immediate vicinity of their current nesting colonies, other than to increase the abundance of prey fish in the South Bay as a result of tidal habitat restoration within the SBSP footprint.

Least terns currently use the portion of the South Bay south of the San Mateo Bridge primarily as a post-breeding staging area in late summer. Here, least terns use salt ponds both for foraging (in lower-salinity ponds supporting fish) and for roosting (on levees, islands, and artificial structures such as boardwalks). Although large foraging concentrations are noted in salt ponds, this species frequently forages on the Bay as well.

If least terns do rely heavily on South Bay salt ponds for foraging habitat, the loss of this habitat due to tidal restoration would likely lead to a redistribution of foraging birds in the San Francisco Bay Area. Foraging habitat for least terns in deeper-water managed ponds is expected to decline due to the conversion of some deeper-water managed ponds to tidal or shallow-water habitats. The proportion of pond habitat managed for small migratory shorebirds and snowy plovers is likely to increase as tidal restoration increases, and shallow-water ponds managed for these shorebirds will not provide high-quality foraging habitat for least terns. Thus, foraging habitat for least terns within managed ponds is expected to decline as restoration proceeds.

However, tidal restoration is anticipated to benefit the least tern. Ponds that have been restored to tidal action, but that have not yet achieved elevations suitable for colonization by vegetation, will provide foraging habitat for least terns at high tide. The extent of subtidal habitat (which serves as potential foraging habitat for least terns throughout the tidal cycle) in tidal sloughs will increase as more ponds are restored to tidal action. Additionally, tidal marsh restoration is expected to increase fish populations in the South Bay. Tidal marsh improvements are anticipated to increase nursery areas for fish eaten by least terns and other species.

It is expected that ample roosting habitat for least terns will continue to be present on islands, levees, and boardwalks in the South Bay, regardless of the restoration alternative. It is highly unlikely that this species' Bay Area populations are limited by South Bay foraging habitat, due to the relatively low breeding abundance of the species and the extensive nature of foraging habitat. Least terns "displaced" from current South Bay foraging locations within managed ponds are expected to find alternative foraging areas, either within the South Bay or elsewhere in the Bay Area.

However, because the degree to which a reduction in foraging habitat in ponds will be offset by increases in habitat and prey abundance in the Bay and in restored sloughs is unknown, monitoring and adaptive management will be implemented to ensure that proposed action activities do not result in a net adverse effect on least terns. Monitoring of numbers of breeding least terns in the Bay Area, and least tern numbers at post-breeding staging areas, will be compared to baseline levels to determine whether (and where) any declines occur. Adaptive

management triggers will include a decline (relative to the baseline) in least tern breeding abundance in the Bay Area in any given year, as determined by annual monitoring of numbers at breeding colonies, or any substantial declines in least tern numbers at post-breeding staging areas in the South Bay, either in monthly bird survey monitoring data or in incidental reports (e.g., from birders). If either of these triggers is tripped, all available monitoring data for the South Bay, Bay Area, and entire population of least terns will be analyzed to determine whether declines are likely the result of the proposed action, or the result of factors external to the proposed action. If there is evidence to suggest that declines are the result of the proposed action (e.g., if a decline in breeding numbers is noted the year following the conversion of favored staging ponds to tidal habitats), the AMP calls for applied studies of post-breeding habitat use. Based on the results of these studies, changes in management of existing ponds (e.g., to make them shallower or deeper, or lower-salinity, in order to increase prey fish numbers and availability) and possibly adjustments in restoration design (e.g., to avoid conversion of favored ponds to tidal habitats) will be considered to reverse declines.

Thus, over the life of the proposed action, any adverse effects on least terns are expected to be minor and short-term, and there is the potential for an increase in habitat quality for postbreeding least terns in the South Bay as a result of the proposed action.

Direct Loss of Individuals, Nests, Eggs, and Young

The least tern presently nests in the immediate proposed action area at Pond E8A, where 5 pairs of least terns attempted to breed in pond E8A in 2007 and 2 nests were observed in 2008 (C. Robinson pers. comm.), although the nests were depredated soon after initiation. This species had not previously nested in the immediate proposed action area since 1983. Because least terns are nesting in proposed action ponds, and because the proposed action will create and manage large numbers of nesting islands for Forster's terns, snowy plovers, and other birds, there is potential for least terns to nest more widely in the immediate proposed action footprint in the future. The provision of nesting habitat itself is expected to offset any adverse effects on nesting terns that may occur, since only 5 pairs are nesting in a single location under baseline conditions. Nevertheless, if least terns continue to breed within managed ponds in the proposed action area, a number of activities associated with the proposed action could potentially cause direct mortality or injury of least tern nests, eggs, and young. Examples of activities that could result in eggs or chicks being crushed, trampled, or buried include the following activities:

- Grading and nesting island creation, management, and maintenance within reconfigured managed ponds
- Incidental displacement of sediment into nesting or brooding habitat during breaching, lowering, and maintenance of sections of existing outboard levees; removal or replacement of existing water control structures or installation of new ones; and reconfiguration of culvert connections
- Constructing trails, viewing platforms, and interpretive stations
- Levee breaching, maintenance, modification, armoring, or construction
- Walking or driving along levees or through ponds during facilities inspections and maintenance, surveys, and monitoring and research efforts

- Recreational access (e.g., authorized use of levees by pedestrians, or unauthorized access into managed ponds by anglers or pedestrians)
- Vegetation and predator control within managed ponds

In addition, eggs (and possibly very small young, if they are unable to swim to terrestrial refugia) may be lost if occupied nesting habitat is flooded as a result of the following activities:

- Breaching levees to restore tidal action to ponds
- Raising water levels during pond management
- Providing temporary floodwater storage within managed ponds to reduce flooding impacts

Water levels will be closely monitored in nesting areas for any waterbirds, and particularly close attention to water levels will be paid if water control structures are opened during the breeding season so that nests are not flooded. Nevertheless, there is some risk that nests would be flooded if monitoring of water levels is not frequent enough, or if water control structures fail and cannot be repaired before nests are flooded.

To minimize impacts to nesting least terns, work in and adjacent to potential least tern nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting terns, and appropriate buffers would be provided between proposed action activities and nesting terns.

Management of nesting habitat for least terns in close proximity to colonies of California gulls (*Larus californicus*); electrical towers providing nesting sites for common ravens (*Corvus corax*), red-tailed hawks (*Buteo jamaicensis*), peregrine falcons (*Falco peregrinus*); upland areas providing sources or predators such as cats, rats, foxes, raccoons (*Procyon lotor*), loggerhead shrikes (*Lanius ludovicianus*), white-tailed kites (*Elanus leucurus*), and American crows (*Corvus brachyrhynchus*); and landfills that attract potential avian and mammalian predators could result in nest predation.

Both mammalian and avian predator control efforts are expected to increase as part of the proposed action. Currently, mammalian predators are controlled on Service lands, and localized avian predator control is implemented at ELER where individual predators threaten snowy plover nesting areas. The need for predator control will be monitored at any new least tern nesting areas, both through monitoring of predator numbers and least tern breeding success, and predators will be removed as needed if predation on new colonies is deemed a problem.

Because most least terns in the Bay area currently nest outside of the immediate proposed action footprint, and juveniles are highly mobile by the time they disperse into the immediate proposed action area, most least terns nesting in the Bay area will not be subject to direct, physical loss of individuals due to construction, maintenance, monitoring, and recreational activities associated with the proposed action. However, breaching ponds where California gulls breed in the South Bay would result in the displacement of several large California gull colonies. These displaced gulls may select nesting sites in areas where least terns currently breed, such as Hayward Regional Shoreline, and possibly the Alameda colony. Due to the larger size of, and earlier

initiation of breeding by, California gulls, and the potentially overwhelming numbers of gulls that may be prospecting for new nesting sites, least terns may be displaced from currently used nesting areas if gulls invade. California gulls displaced to sites closer to nesting least terns may also prey upon least tern eggs and chicks. Whether by predation, encroachment, or both, California gulls were thought to be responsible for the failure of the least tern nesting attempt at Hayward Regional Shoreline in 2006 (Strong 2006). Annual monitoring of least tern and California gull colonies will continue, and any encroachment of California gulls into least tern nesting areas, or observed predation by gulls on least tern eggs or chicks, will be noted. If encroachment or predation on least terns by California gulls displaced by the proposed action becomes a problem, gull control will be initiated to protect nesting least terns.

In addition, predation on least terns in their post-breeding staging areas may increase if terns are concentrated in fewer managed pond roosting sites due to conversion of some existing ponds to tidal habitats. Predation by northern harriers, which occasionally take volant least terns, may increase due to the expected increase in northern harrier populations as their marsh nesting habitat increases. Nevertheless, any increases in predation of least terns due to proposed action activities are expected to be very low, and would likely be offset by improvements in tidal foraging habitat due to restoration and increased fish populations.

Loss of Individuals and Reduced Reproductive Success due to Mercury Exposure

Because fish bio-accumulate methylmercury, and least terns eat almost exclusively small fish, there is some potential for mercury mobilized by the proposed action to adversely affect least terns. Recent sampling of mercury levels in biosentinel fish in San Francisco Bay revealed that 40 percent had mercury concentrations higher than the proposed TMDL threshold (Greenfield et al. 2006). Many of the fish sampled exceeded the proposed TMDL threshold for the least tern, suggesting that mercury accumulation may already be affecting these terns. Ongoing studies in the South Bay will provide more information on the magnitude and potential effects of mercury contamination on piscivorous species, including least terns, in the proposed action area.

Least terns are currently exposed to mercury in the South Bay by foraging on fish in contaminated tidal habitats in the Bay, and in managed ponds containing mercury-contaminated water or sediment. Proposed action activities that stir up contaminated sediments, whether in tidal habitats as described above for the clapper rail and harvest mouse or managed pond habitats as described above for the snowy plover, therefore have the potential to increase least terns' exposure to mercury. Such exposure could potentially affect the development of chicks and juveniles that ingest mercury in food taken during the nestling or post-breeding period, and may affect fecundity in adults that ingest contaminated fish.

A mercury monitoring study is currently underway to ensure that mercury impacts on biota are minimized during restoration. This study focuses on the Alviso area where mercury levels are known to be high, but also includes sampling sites elsewhere in the South Bay. This study is measuring mercury levels in the sediment, water column, and various sentinel species; measuring the bioavailability of inorganic mercury in sediments; measuring mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. This study will increase the understanding of mercury cycling within the proposed action area and will inform future

management decisions to further minimize mercury exposure. Monitoring of mercury cycling during Phase 1 restoration and management activities will also provide information on management or restoration activities that are desirable, or that are to be avoided, in areas of high mercury concentrations. Decisions regarding restoration or management activities involving breaching and scour in a particular area will be made only after the sediments to be mobilized by such activities are tested for mercury levels, and in the context of the results of ongoing and future studies regarding the effects of mercury.

Disturbance of Individuals, Nests, and Young

Disturbance such as loud noise or the presence and movement of people, dogs, boats, and heavy equipment in or near least tern nesting, roosting, or foraging habitat may alter bird behavior in ways that result in injury, mortality, or reduced nesting success. Currently, because only a few pairs of least terns nest in only a single location in the immediate proposed action footprint, disturbance is expected to result in effects on relatively few nests, eggs, or chicks. However, where least terns are nesting within the proposed action footprint, disturbance could result in the abandonment of nests, eggs, or young, or increased predation on eggs or young as well.

Disturbance in post-breeding staging areas could result in temporary or permanent habitat loss due to the avoidance of suitable roosting or foraging sites that have intolerable levels of disturbance; a reduction in foraging efficiency if high quality foraging areas are impacted; and increased movement or flushing from cover, or altered activity patterns, that reduce energy reserves and increase predation risk.

Examples of proposed action activities that will cause such disturbance, if they occur in or near occupied least tern nesting, roosting, or foraging habitat, include the following:

- Grading and nesting island creation, management, and maintenance within reconfigured managed ponds
- Installation, removal, replacement, or maintenance of water control structures, water pumps, or fish screens
- Internal and external levee breaching, maintenance, modification, or construction
- Excavation of pilot channels and dredging of inboard and outboard channels
- Construction of trails, viewing platforms, interpretive stations, and boat launches
- Walking or driving along levees or through ponds during facilities inspections and maintenance, surveys, and monitoring and research efforts
- Recreational access (e.g., boating in tidal foraging habitat, authorized use of levees by pedestrians, or unauthorized access into managed ponds by anglers or pedestrians)
- Vegetation and predator control within and near managed ponds

These activities would be highly disruptive to least tern breeding efforts if they occur in or near occupied habitat during the breeding season. Disturbance could cause short-term effects such as failure to breed, nest abandonment, lower numbers of eggs, juvenile abandonment, and overall lower juvenile survivorship. In areas where high-intensity disturbance is short-lived (e.g., during island or internal levee construction or replacement of water control structures), successful

reproduction may not occur while the disturbance is ongoing, but may resume after construction is completed. In areas where disturbance will increase permanently as a result of the proposed action (e.g., due to the construction of trails or interpretive stations adjacent to least tern habitat), some terns may acclimate to the new disturbance, while others may not.

Disturbance in or near foraging habitat could reduce foraging efficiency or result in increased mortality as birds are displaced to alternative foraging areas. Displaced individuals and their eggs or young could be subjected to injury or mortality from starvation, physiological stress, and increased predation.

Human activity and associated pet use will increase in areas where trails, interpretive stations, and other recreational/public access features are to be opened or improved. Interpretive displays will inform the public about the potential to disturb listed species and their habitat. The ability to manage or control potential disturbances in adjacent habitat areas from recreational human activity may not be effectively regulated or controlled, even with the proposed conservation measures to maintain public use and activities along the developed trails.

Visual and physical barriers along trails may have limited effect in deterring human or pet disturbance because they can be easily crossed. Continued dog use will be dependent upon compliance with new leash restrictions; non-compliance will result in the Service and ELER removing dog-walking from recreational use. During the non-compliant period, least terns could be harmed, harassed, or killed by dogs if least terns are nesting within proposed action -area ponds.

To minimize impacts, work in and adjacent to potential least tern nesting habitat would be conducted outside of the nesting season to the extent practicable. If seasonal avoidance is not possible, pre-construction surveys would be conducted for nesting terns, and appropriate buffers would be provided between proposed action activities and nesting terns. Additional conservation measures incorporated into the proposed action (described previously), including the use of interpretive signage at the edges of sensitive habitat areas and seasonally closed trails, will minimize effects of human disturbance on this species.

California Brown Pelican

Habitat Modification

Brown pelicans in the South Bay forage primarily in subtidal and (at high tide) intertidal habitats, and many of the proposed action-area managed ponds are too shallow to provide suitable foraging habitat for these plunge divers. However, brown pelicans do forage in some low-salinity managed ponds with water several feet deep, and they roost in low numbers on levees within the salt ponds.

The effects of the proposed action on brown pelicans depend on the proposed action's effects on both abundance and availability of prey fish. Low-salinity salt ponds may concentrate fish, thus facilitating their capture by piscivorous birds. As a result, conversion of some low-salinity ponds to tidal habitats would reduce foraging habitat in managed ponds. However, tidal restoration is

expected to result in a considerable increase in the abundance of estuarine fish in the South Bay, and the tidal sloughs and channels that would develop in restored marshes are expected to be used by foraging brown pelicans. As a result, habitat modification resulting from the proposed action is expected to have a net benefit to the brown pelican from perspective of foraging habitat, as the minor impacts from the loss of managed ponds would be far outweighed by the increase in fish abundance and tidal foraging habitat. Alteration of roosting habitat, which consists of internal pond levees, pilings, and open Bay waters, is not expected to limit South Bay brown pelican numbers.

Direct Loss of Individuals

There is some potential for brown pelicans to be injured or killed due to entanglement in fishing line from boaters who launch from new boat launches created by this proposed action. However, any increase in entanglement of brown pelicans in fishing line due to the proposed action is expected to be minimal.

Although there is some potential for brown pelicans to be accidentally shot by hunters, the probability of such an event is extremely low. Only small numbers of brown pelicans are typically present in the South Bay during the hunting season (October-January). The brown pelican's obvious difference in size, shape, and flight behavior make it unlikely that hunters would confuse pelicans with legally hunted waterfowl. Also, brown pelicans forage most often in the early morning and evening (Shields 2002), when most hunting occurs. Because brown pelicans in the South Bay forage primarily in open Bay waters, few pelicans are expected to be foraging in managed ponds when hunters are present. Both the Service and CDFG law enforcement staff track the number of hunters and their harvest, and monitor for impacts to non-huntable wildlife.

Loss of Individuals and Reduced Reproductive Success due to Mercury Exposure

Because fish bio-accumulate methylmercury, and brown pelicans eat almost exclusively fish, there is some potential for mercury mobilized by the proposed action to adversely affect brown pelicans. Recent sampling of mercury levels in biosentinel fish in San Francisco Bay revealed that 40 percent had mercury concentrations higher than the proposed TMDL threshold (Greenfield et al. 2006). Ongoing studies in the South Bay will provide more information on the magnitude and potential effects of mercury contamination on piscivorous species, including brown pelicans, in the proposed action area.

Brown pelicans are currently exposed to mercury in the South Bay by foraging on fish in contaminated tidal habitats in the Bay, and secondarily in managed ponds containing mercury-contaminated water or sediment. Proposed action activities that stir up contaminated sediments, whether in tidal habitats as described above for the clapper rail and harvest mouse or managed pond habitats as described above for the snowy plover, therefore have the potential to increase brown pelicans' exposure to mercury. Because brown pelicans occur in the Bay Area during their nonbreeding season, and juveniles are full-grown when they reach the Bay Area, such exposure is unlikely to result in developmental abnormalities in the individuals that directly ingest fish contaminated by South Bay mercury. However, accumulation of mercury in brown

pelicans that feed in the South Bay could reduce fecundity during subsequent breeding seasons.

A mercury monitoring study is currently underway to ensure that mercury impacts on biota are minimized during restoration. This study focuses on the Alviso area where mercury levels are known to be high, but also includes sampling sites elsewhere in the South Bay. This study is measuring mercury levels in the sediment, water column, and various sentinel species; measuring the bioavailability of inorganic mercury in sediments; measuring mercury methylation across salinity gradients in managed ponds, marshes, and other habitat types. This study will increase the understanding of mercury cycling within the proposed action area and will inform future management decisions to further minimize mercury exposure. Monitoring of mercury cycling during Phase 1 restoration and management activities will also provide information on management or restoration activities that are desirable, or that are to be avoided, in areas of high mercury concentrations. Decisions regarding restoration or management activities involving breaching and scour in a particular area will be made only after the sediments to be mobilized by such activities are tested for mercury levels, and in the context of the results of ongoing and future studies regarding the effects of mercury.

Disturbance of Individuals

Disturbance such as loud noise or the presence and movement of people, dogs, boats, and heavy equipment in or near brown pelican roosting or foraging habitat may cause minor alterations of these birds' behavior. Roosting or foraging pelicans may be flushed due to proposed action - related disturbance, or may avoid suitable habitat areas due to such disturbance. Although flushing may increase the birds' energy demands, it is not expected to result in a substantial effect on any brown pelicans. Ample roosting habitat is present throughout the South Bay, and most foraging habitat within the Bay itself will remain relatively undisturbed by proposed action -related activities. Individual pelicans may be harassed (e.g., flushed from the water or from perches, such as pilings) by boaters who launch from the proposed action area, but such flushing is expected to have minimal effects on individual brown pelicans.

Interpretive signage describing closed areas and boating procedures to avoid impacts to sensitive wildlife species, both at boat launches and at the mouths of restored sloughs that are closed to boat access, will help to minimize disturbance of brown pelicans in tidal habitats. Monitoring and enforcement of hunting regulations will also determine whether modifications to hunt programs need to be made to avoid accidental shooting of brown pelicans by hunters.

Cumulative Effects of the Proposed Action

Cumulative effects include the effects of future state, tribal, local, or private actions affecting listed species and their critical habitat 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 Final EIS/EIR for the proposed action contains a detailed analysis of past, present, and reasonably foreseeable future projects within the San Francisco Bay area, and having effects

similar to those of the proposed action, were considered. Cumulative projects with which the proposed action would be evaluated in combination include related non-Federal projects such as construction projects proposed by local, regional, or state agencies in and around the proposed action area. These include other projects proposed by the CDFG within the proposed action area not covered by the proposed action (e.g., CDFG's ELER project); city and county development projects (e.g., new or expanded residential, commercial, or industrial development projects); local agency infrastructural projects (e.g., water or wastewater facilities improvements/construction, and flood protection projects); PG&E projects (e.g., transmission line/facilities construction and/or improvements); traffic signalization and roadway construction/improvement projects of local municipalities or Caltrans; and recreation-related projects proposed by local municipalities, Association of Bay Area Governments (ABAG), park districts, or other non-governmental agencies.

A number of reasonably foreseeable projects will involve tidal restoration in areas where pond-associated species such as the snowy plover do not occur. As a result, these restoration projects are expected to result in a net enhancement or increase of habitat for tidal marsh species such as the clapper rail and harvest mouse, without having the potential for net adverse effects on any listed species. Although some projects (e.g., utility, road, or development projects) may result in adverse effects to the listed species discussed in this biological opinion, it is expected that those impacts will have to be mitigated to satisfy CEQA, NEPA, and/or section 7 consultation requirements.

Because of the large geographic and temporal scale of the proposed action, this project will be the primary influence on clapper rail, harvest mouse, and snowy plover populations within the proposed action area. By comparison, other projects within the action area are expected to have much less effect on these species' populations in the South Bay. Although the proposed action will also have effects on the other listed species that are addressed in this biological opinion, actions associated with other projects and/or in other locations (e.g., at colony sites for the least tern and brown pelican) are expected to be the primary drivers of population sizes of these species in the action area.

In addition to the projects described above, climate change may also have cumulative effects on the species described in this biological opinion. The global average temperature has risen by approximately 0.6 degrees Centigrade during the 20th Century (IPCC 2001, 2007; Adger *et al.*2007). There is an international scientific consensus that most of the warning observed has been caused by human activities (IPCC 2001,2007; 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 (Anonymous 2007; Inkley *et al.* 2004; Adger *et al.*2007; Kanter 2007) likely imperils the clapper rail, least tern, snowy plover, harvest mouse, and brown pelican 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, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

CONCLUSION

After reviewing the current status of the clapper rail, least tern, snowy plover, harvest mouse, and brown pelican, the environmental baseline within the proposed action area, and the effects of the proposed action, it is the Service's biological opinion that the extent of take anticipated at the programmatic level is not likely to result in jeopardy to these species. In the absence of the conservation measures listed in the Description of the Proposed Action of this biological opinion, the effects analysis above may support a conclusion of jeopardy for some of the listed species in the action area. However, this no jeopardy determination is based upon implementation of the proposed action as described in the Final EIS/EIR and Programmatic BA for the SBSP Project.

We based this determination on the following: (1) numerous conservation measures would be implemented to minimize the adverse effects on individual clapper rails, least terns, snowy plovers, harvest mice, and brown pelicans, and their habitats; and (2) restoration actions will be implemented over a 50-year period that will result in 6,800 to 11,880 acres of tidal habitat restoration and managed ponds that support these species, and is anticipated to more than compensate for the existing habitat lost identified in this PBO.

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.

Due to the programmatic nature of this biological opinion, the project- and site-specific information necessary to determine the amount and extent of incidental take of listed species associated with the proposed action actions is incomplete. Therefore, the Service 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. Incidental take of listed and proposed species is not authorized in this PBO.

REPORTING REQUIREMENTS

The Service shall be notified within twenty-four (24) hours of the finding of any injured or dead clapper rails, least terns, snowy plovers, harvest mice, and brown pelicans, or any unanticipated harm to their habitat as a result of project activities. Any injured listed species shall be cared for by a licensed veterinarian or other qualified person such as a Refuge biologist. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. The Service contact is Chris Nagano, Deputy Assistant Field Supervisor, Endangered Species Program in the Sacramento Fish and Wildlife Office (916) 414-6600. Any dead or injured specimen shall be preserved according to standard museum practices and deposited at an appropriate academic institution approved by the Service, or with the Service's Division of Law Enforcement, 2800 Cottage Way, Room W-2928, Sacramento, California 95825 (916) 414-6660.

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 recovery actions being developed for the clapper rail, least tern, snowy plover, harvest mouse, and brown pelican.
4. Sightings of any listed or sensitive species should be reported to the California Natural Diversity Database of the CDFG. 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.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the proposed Programmatic South Bay Salt Pond Restoration Project. 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.

PHASE 1 BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

Proposed Ravenswood Pond SF2 Restoration Action

Ravenswood Pond SF2 (Pond SF2) will be reconfigured to create islands for nesting least terns and shorebirds and shallow water habitat that will be managed for shorebird foraging. The final design for the site includes three management cells (Figure 2 in the *Final Biological Assessment for the Ravenswood Pond SF2 Restoration Action* (Pond SF2 BA)). Nesting islands would be constructed in the central and eastern cells and water levels will be managed to provide optimal depths for foraging. The third, western-most cell will be managed as a seasonal wetland (open water conditions during the winter months, shallow water conditions in the spring and fall, and dry conditions during the summer months). Water control structures will be used both to manage water levels and flows into and out of Pond SF2 from the San Francisco Bay (Bay), and between cells, for shorebird foraging habitat and to meet water quality objectives. Water would flow into and out of Pond SF2 through a new water control structure comprising five 4-foot inlet culverts that will be located near the southern end of the bayfront levee between Pond SF2 and the Bay. Weirs with adjustable flashboard risers (flashboard weirs) will be used to control flow in and out of cells, and water circulation through the bay front cell in Pond SF2 would be managed to meet water quality targets at the discharge point.

Additionally, the Pond SF2 design will incorporate recreation and public access elements, including trails and interpretative displays (Figure 2 in the Pond SF2 BA). The design elements within Pond SF2 will be the subject of an applied study which will test the effects of different island spacing and shapes on use by and reproductive success of nesting birds, as well as use by roosting birds. In addition, different water management regimes will be tested to determine the best method for managing the pond for the target wildlife during both the bird breeding and non-breeding seasons. Approximately 300 to 600-foot buffers have been built in to the design to limit the impacts of recreational activities on nesting and roosting birds.

Project Location

Pond SF2 is adjacent to the Dumbarton Bridge (Highway 84) and the Bay. Pond SF2 is bordered by diked marsh to the southwest and the southeast, and a small section of upland habitat borders

the pond to the south. The northeast portion of the pond borders a narrow fringe marsh along the Bay. The north portion of the pond is bordered by a paved public access trail, an access road, and the Dumbarton Bridge, while the East Palo Alto section of University Avenue borders the west side. Pond SF2 is mostly owned by the Service and is currently managed as a seasonal pond. Cargill retains a small parcel around its Trans-bay pump in the northwest corner of the pond. In addition, the Midpeninsula Regional Open Space District owns a short section of the bayfront levee between the Highway 84 frontage road and the adjacent tidal marsh.

Proposed Design Elements

The Pond SF2 design includes the following features intended to create islands for nesting birds and shallow water habitat for shorebird foraging, as well as compatible public access features:

- Nesting islands
- Earth berms
- Pilot channels
- Water control structures
- Borrow ditch filling
- Levees
- Revegetation
- Infrastructure
- Public utilities protection
- Recreation

These features are described in more detail in the following sections.

Nesting Islands. Up to 36 nesting islands would be constructed within Pond SF2 management cells by depositing and contouring soil to form several different island designs. Material needed to construct islands will be borrowed onsite, with a minimum 20-foot bench left between the borrow area and toe of the new island (the width of the borrow area will be limited to a maximum of 80 feet from this bench). It is estimated that due to soil characteristics, the windward slope of the island may need to be 5:1 or flatter to maintain a stable slope. Currently, 18 circular islands and 18 linear islands are proposed in Pond SF2. The islands will be constructed by creating a fill height of 4.5 feet above existing grade (approximately 4 feet above the average water level assuming an average water depth of 6 inches) requiring at least two soil lifts with some wait time in between.

These islands are being designed as nesting habitat for Forster's terns (*Sterna forsteri*), Caspian terns (*Sterna caspia*), American avocets (*Recurvirostra americana*), and black-necked stilts (*Himantopus mexicanus*), modeled after existing islands currently used by these species in California's Central Valley and the Bay. Although the islands are not designed specifically for use by snowy plovers or least terns, it is possible that these species could initiate nesting on the islands. Snowy plovers have nested on the dry pond bottom of Pond SF2 for the past few years, but least tern nesting has never been documented in this pond. To avoid potential human

disturbance to nesting birds, including snowy plovers and least terns, nesting islands would not be constructed within 300 feet of a PG&E boardwalk or public use trail, or 600 feet from public access viewing platform locations.

Earth Berms. Approximately 10,000 linear feet of berms will be constructed to a crest of 8 feet North American Vertical Datum (NAVD) (approximately 2 to 5 feet above the existing grade) to create three cells in Pond SF2 by constructing low "check" berms around the cells, ranging in height from approximately 2 to 6 feet above the pond bottoms. The berms would be constructed by excavating fill material on-site. Fill placement is expected to require at least two fill lifts with wait time in between, which may require at least two construction seasons. Filter fabric use will reduce the amount of fill required to reach the finished grade. Pond bottom elevations vary by approximately 0.5 feet and slope toward the southwest corner of Pond SF2. Berms would be placed to separate higher elevation pond areas from lower elevation areas; allow water levels to vary between different cells; and create cells with similar shallow water depths over the sloping pond bottom. The berm and cell system in Pond SF2 would facilitate water flows throughout this elongated pond, which may result in improved water quality by preventing water stagnation in low elevation areas of the pond. Water depths in the central and eastern portions of Pond SF2 would be managed from approximately 2 inches to 1 foot deep to provide foraging habitat for both smaller and larger shorebirds and potentially dabbling ducks. Water would be circulated into and between cells to maintain good foraging opportunities for target bird species.

Pilot Channels. Pilot channels will be excavated to the Bay through the fringe marsh outboard of the new water control structures in the Pond SF2 levee to facilitate flow of water into and out of the pond. Each pilot channel will be about 1,000 feet in length. The invert elevation through the outboard marsh will be negative (-) 1.5 feet NAVD and the invert elevation across the mudflat will be 0.5 feet NAVD. The bottom width of the pilot channels will be approximately 40 feet through the outboard marsh and 50 feet across the mudflat. Material excavated from the pilot channels will be placed within Pond SF2 or disposed off-site. Within Pond SF2, material will be placed in the borrow ditch, inboard of the bayfront levee. Material may also be placed on the pond bed (e.g., lower elevation areas in the southern portions of the cells). Except in locations where the material may be used to construct berms or islands, material will not be placed above elevation 5.0 feet NAVD.

Water Control Structures. Water control structures for the Pond SF2 restoration will include culverts and flashboard weirs. The new Pond SF2 intake structure between the Bay and Pond SF2 will be located near the southern end of the bayfront levee. The intake structure will consist of five new 4-foot intake culverts with combination slide/flap gates on each end of the culvert. Six new 4-foot outlet culverts, with combination slide/flap gates on both ends of each culvert will be installed between the Bay and Pond SF2. Water would flow out of Pond SF2 during low tides through the outlet structure located in the northern portion of the bayfront levee. Within Pond SF2, intake and outlet canals would be created to convey flow into and out of individual cells. The canals would be located along the northwest edge of the pond and the southeast edge of the pond in portions of the deep existing borrow ditch. The seasonal wetland area will have one intake and one outlet structure. The intake structure will consist of four 4-foot long flashboard weirs while the outlet structure will consist of one culvert with a flashboard weir box on the seasonal wetland area side and a tide gate on the outlet canal side (to prevent the outlet

canal from flowing into the seasonal wetland area during high tides). In addition to the cell intake and outlet weir structures, four cell outlet culvert structures will be located where the berms cross deeper, historic channels and borrow ditches (giving a total of five of these structures including the seasonal wetland area outlet structure). These culvert structures are included to drain deeper water from these channels for periodic maintenance and as a water quality management approach. Water would be circulated through the cells in Pond SF2 at rates sufficient to meet water quality objectives. The water quality objectives for Pond SF2 would be to maintain adequate dissolved oxygen (DO) levels, salinity, and pH in the cells and at the outlet structure.

Borrow Ditch Filling. Imported fill material will be used to fill the existing borrow ditch on the east side of Pond SF2 (inboard of the bayfront levee), if and when fill material of acceptable quality is readily available. Material excavated from the pilot channels may also be placed in borrow areas. New borrow areas excavated to construct nesting islands and earth berms may also be filled. Filling these areas may create additional shallow water foraging area and improve water quality. Only borrow ditches serving as intake and outlet canals (see above) would be retained. Filling borrow ditches within the cells is expected to improve water quality by reducing the potential for water column stratification and hypoxic conditions in the bottom layer. The borrow ditches will be filled in stages through an adaptive management process, involving filling different sections of the borrow ditches to different elevations. Water quality monitoring will be conducted in borrow ditches filled to different elevations (or not filled) to evaluate the effectiveness of using borrow ditch fill to improve water quality.

Levees. Approximately 3,650 linear feet of the bayfront levee/trail from the northeast corner of the pond to the viewing platform on the southeast side of the pond will be raised and widened. Imported fill material will be used to raise the levee crest elevation to 12.5 feet NAVD (approximately 1 to 2 feet above the existing crest elevation, which has an average elevation of approximately 10.5 feet NAVD).

Revegetation. The perimeter of Pond SF2 will be actively revegetated to increase the aesthetics of the area while providing some limited habitat values and an additional buffer from anthropogenic disturbances along the trail and the adjacent highway. A symbolic post-and-cable fence will be included in the design to further minimize intrusion into the managed pond area.

This transitional zone will be actively planted with native upland grasses and high marsh species such as sea lavender (*Limonium californicum*), pickleweed (*Sarcocarnia pacifica*, formerly *Salicornia virginica*), alkali heath (*Frankenia salina*), salt grass (*Distichlis spicata*), and marsh gumplant (*Grindelia stricta* var. *angustifolia*). Measures would be taken to favor the growth of native species and limit the competitive advantage of invasive species, such as pepperweed (*Lepidium latifolium*), Russian thistle (*Salsola soda*), stinkwort (*Dittrichia graveolens*) and fennel (*Foeniculum vulgare*), which could otherwise thrive. These measures could include amending the soils or other steps, such as mulching which helps to define the planting areas and suppress weed growth. Establishing native vegetation in this area would also reduce the potential seed source of the non-native invasive species, which is important for the long-term vegetation maintenance of the constructed nesting islands within Pond SF2.

Installation and irrigation detailed design of these elements will be developed with the intention of having volunteers perform the installation. Coordination with volunteer organizations such as Save the Bay is currently underway to ensure project success. Additional species and project elements may arise out of future coordination.

Infrastructure. *Cargill Salt Division.* Cargill's existing 36-inch siphon between Ponds SF2 and R2 to the north, and a pipe that runs along the northwest edge of Pond SF2, connecting the siphon to the Transbay Pipeline will remain. This section of connecting pipe is buried on the edge of the Pond SF2, in the shoulder of the existing bike trail and levee, and daylights at the northeast corner of the pond before connecting to the Transbay Pipeline. The Transbay Pipeline connects the West Bay (Redwood City) salt ponds to Cargill's Newark plant in the East Bay. Cargill expects to decommission the West Bay salt ponds and these pipes in approximately 5 years. To allow Cargill access for pipeline maintenance at the Transbay Pipeline, the proposed action would create a bermed area in the northeast corner of the pond. The proposed action is not expected to affect Cargill's access to the siphon and buried pipe. Once Cargill's operations are decommissioned, the existing siphon may be reconfigured to provide tidal flow between Pond SF2 and Ravenswood Slough.

PG&E. The proposed action is not expected to affect PG&E's access to the existing PG&E power towers because the restoration includes maintaining the area with the towers and boardwalk as seasonal wetland. A section of the existing PG&E boardwalk, approximately 35 feet in length, will be modified to construct the seasonal wetland ditch and allow access over the ditch.

Recreation. Recreation activities include upgrading the existing Bay Trail spur along the bayside of Pond SF2, installing chemical toilets enclosed in an all-weather shelter and an informational kiosk with adjacent seating at the Pond SF2 trailhead, construction of two viewing platforms and interpretative stations along the upgraded Bay Trail spur, and construction of the Bayfront Park (City of Menlo Park) viewing area located at the high elevation point in the northeastern corner of Bayfront Park.

The public access and recreation plan for this area includes an upgrade of the existing Bay Trail spur along the bay front of Pond SF2, and the construction of two viewing platforms and interpretive stations along this trail that describe the restoration process of developing a managed pond as well as the relationship to the Bay and future tidal marsh restoration in this location (Figure 2 in the Pond SF2 BA). The rehabilitated trail will be incorporated within the existing levee and the process will involve regrading and resurfacing for Americans with Disabilities Act (ADA) compliance. The trail follows an existing levee that would be rehabilitated to provide a width of 6 to 8 feet of compacted earth, allowing multi-use but excluding equestrians. The viewing platforms would be raised above the existing grade of the levee trail to allow visitors a panoramic view of the Bay and the large expanse of adjacent managed ponds.

The existing piles of discarded materials and unused or broken structures around Pond SF2 would be removed to visually enhance the area, and transitional plantings between the highway corridor and the adjacent restoration lands would be provided (see *Revegetation* above). In addition, a low fence will be built before revegetation on the levee to provide an additional

buffer for wildlife against recreation and vehicle traffic along Highway 84 and University Avenue, the northern and western perimeters of Pond SF2.

Pond SF2 Viewing Platform East. The first viewing platform is located at the eastern edge of Pond SF2, off the rehabilitated levee trail at the edge of the pond. Providing views towards the managed pond in the west and the Bay in the east, the platform is located close to the levee edge over the pond to allow vehicular traffic to pass. To minimize impacts to the pond the platform will be raised 4 feet above the existing grade of the levee. The platform is accessed by an ADA-compliant ramp and a set of stairs, which are configured to minimize circulation areas while maximizing useable gathering space and viewing edges. A railing system will be designed for safety and to facilitate a comfortable birding experience. The use of cable wires provides more un-interrupted views and makes the structure appear lighter and thus less intrusive in the relatively open landscape.

An interpretive station and seating is also provided. The interpretive station follows the design prototype being used at Eden Landing and Alviso with a view portal, educational symbols and storyboarding, and be constructed of a combination of wood and steel and sized based on the site location. The station will describe the process of developing and maintaining a managed pond, as well as the value of this management to native wildlife and the relationship to future SBSP Project tidal marsh restoration.

Pond SF2 Viewing Platform South. The second viewing platform is located at the southern edge of Pond SF2, off the rehabilitated levee trail on its pond edge. The platform is strategically located to be at the transition between the managed pond and tidal habitats. The platform is similar in design and configuration to that at the eastern edge and incorporates all of the same amenities and interpretive opportunities.

Access for Construction

Access to Pond SF2 for both workers and equipment will be off of Highway 84. Equipment will be transported to the site on trucks via existing levee roads. Water-based access will be through the Bay. However, since high site elevations may preclude the use of floating equipment for many construction activities, construction of temporary earth embankments may be required to allow pond access for land-based heavy equipment for construction of internal site features such as islands and berms.

Construction Process

Equipment and personnel to be used during construction will generally be as described in the PBO. Due to the location of the Pond SF2 restoration project, construction methods, equipment, and access are more constrained than at a typical construction site. To assist with construction access and methods, Pond SF2 may be drained prior to construction. Draining the pond may incrementally consolidate the surface mud, increasing workability for fill operations. The use of traditional construction equipment is not expected to be feasible for the construction of berms and nesting islands within the ponds. Low-ground pressure equipment and mats and/or amphibious construction equipment are expected to be required. Site observations indicate that,

due to the relatively high elevation of the site and low summer water levels, the thickness of desiccated, firm surface mud is greater than typical in some other former salt ponds. This indicates that special, low ground pressure equipment on mats may be able to work effectively. However, we presume amphibious equipment will likely be used. Marine construction equipment such as shallow-draft barges will be allowed within the pond, but may not be feasible because the high elevation of the pond may limit the water level and draft in the pond. Marine equipment is expected to be required to excavate the pilot channels.

Islands and berms will be the primary earthwork components of the Pond SF2 restoration. Borrow material varies in this location and is not always optimal for earthwork construction. If pond draining and drying are insufficient, borrow material may have a high water content. Due to this and other soil characteristics, material may be prone to slumping during construction. Therefore, material will need to be placed in a minimum of two lifts, with wait time in-between. Cargill has achieved approximately 18 inches per lift in previous, similar island and levee construction. Any new island and berm heights will need to be over-built 20 percent or more to allow for settling after construction.

Culvert pipe water control structures in existing levees will be installed by cutting a trench in the levee. Culvert pipes will be placed directly onto bay mud to eliminate a possible source of piping and soil loss experience in some ISP structures. Construction of inlet and outlet structures will be accomplished using traditional land-based construction equipment. Backfill will be compacted in lifts. Wood headwalls and wingwalls on either side of the levee will be supported by wood piles. Sheetpile cofferdams will be needed on the bay side of the structures. The need for limited dewatering is anticipated while the trench is open. The presence of a granular Bay sediment layer (i.e., sand layer) near the invert elevation of the culverts will require further consideration in final design.

Pre-cast concrete flashboard weirs will be placed in new berms within Pond SF2. Cell water control structures will likely require amphibious equipment or barges for construction. Construction may take place in the "wet" without dewatering. Compaction of fill material will likely not be possible. The contractor will determine whether flashboard weirs are placed first and the berm built around them, or vice versa.

Construction Preparation

- Water control will be necessary to drain the site for land-based equipment and/or maintain depth for floating equipment.
- Equipment will be transported to the site on trucks via existing levee roads or sloughs (see access section).
- Sheet pile will be installed around the water control structure locations and construction area will be de-watered with portable pumps.

Design Element Construction Details

- Construct low check berms to create a series of three cells. Check berms will range in height from approximately 2 to 5 feet. The berms will be constructed by excavating fill

material on-site.

- Install water control structures, such as flashboard weirs, in the berms to regulate flow into and out of the cells.
- Install new intake/outlet water control structures with tide gates between the Bay and Pond SF2.
- Install simple water control structures, such as flashboard risers, in the check berms to convey water in and out of cells.
- Construct intake and outlet canals to convey water to and from individual cells.
- Construct up to 36 nesting islands (18 circular and 18 linear, varying in density) within two cells. Each island will be approximately 3 feet high and have a surface area of approximately 15,000 square feet. The islands will be constructed using fill material excavated from the windward side of the islands.
- Construct viewing platforms between 5 to 10 feet above the existing grade of the levee using steel and recycled wood with ramps and railings as needed.
- Construct a fence along the western and northern borders of the pond to create a buffer for wildlife from recreation and vehicle traffic.
- Raise and widen bayfront levee/trail as a levee maintenance measure and to improve the levee surface for a public access trail.
- Revegetate the northern perimeter of Pond SF2, along the slope between the trail and the intake canal, with native high marsh vegetation.
- Manage water levels to provide an average depth of 6 to 12 inches, though with some deeper areas around islands, in borrow ditches, and in other portions of the pond.

Construction Schedule

Restoration construction is expected to occur over two seasons within a 24-month period, unless an additional construction period is required to place additional soil for berms and/or islands. The construction schedule and duration will be determined as the design elements are finalized. Nesting birds in the area will be the primary factor that will dictate the window of time during which construction may occur. Unless measures are implemented to prevent sensitive species from nesting in the project area, the timing of construction (construction window) will avoid impacts to nesting listed species, such as snowy plovers, and other sensitive species, including terns, avocets, and stilts.

Snowy plovers may move around during the breeding season, and can have two broods per season, occasionally having chicks into August or early September. In general the snowy plover breeding season extends from 1 March through 14 September. If the pond needs to be dry during work, some sort of hazing, beginning prior to nesting, may be employed to try to prevent nesting. Once the pond is dry, pre-construction surveys will be performed before work begins to make sure that no snowy plovers (or other nesting birds, such as recurvirostrids) will be disturbed. Using disturbance-free buffers (600 feet) around active nests might be acceptable if there are few nests (allowing the work to occur outside the buffers). After the snowy plovers have chicks, work on portions of the pond can be performed as long as the chicks are able to move well away from the work area and safely forage (possibly with some monitoring to ensure that the snowy plovers stay away from the work area).

Construction activities in the seasonal wetland area will occur between September 20 and February 1. Inundating the pond between February 1 and September 20 can occur only if pre-construction surveys (and monitoring, if snowy plovers are detected within the pond) determine that no snowy plovers are actively nesting within the pond (i.e., there are no nests with eggs) and all young have fledged. Start dates between February 1 and September 1 for construction activities that do not involve inundating the pond will be allowed only if pre-construction surveys and monitoring determine that no snowy plovers are actively nesting within the pond and all young have fledged, or that active nest sites with eggs are located more than 600 feet from the construction site. After the snowy plovers have chicks, work in specific portions of the pond, not involving inundating the pond, can be performed as long as the chicks are able to move well away from the work area and safely forage (possibly with some monitoring to ensure that the snowy plovers stay away from the work area).

Most nesting Forster's terns, avocets, and stilts typically finish nesting by August 1 in most years, but a few late pairs may have young through August. Construction activities in tern, avocet, and stilt nesting areas will generally occur between September 1 and February 1. Inundating the pond between February 1 and September 1 (during the nesting season) can occur only if pre-construction surveys determine that no terns, avocets, or stilts are actively nesting within the pond and all young have fledged, or if it is determined (in consultation with the Service and CDFG) that inundation will not adversely affect any terns, avocets, or stilts that are nesting on existing islands within the pond. Start dates between February 1 and September 1 for construction activities that do not involve inundating the pond will be allowed only if pre-construction surveys determine that no terns, avocets, or stilts are actively nesting within the pond and all young have fledged, or that active nest sites are located more than 300 feet from the construction site.

Phase 1 Applied Studies

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key uncertainties related to ecosystem restoration. Specific applied studies that may be conducted in Pond SF2 include studies to test the effects of island density, shape, and distribution on bird nesting use and reproductive success. Additional studies may be performed to study the effectiveness of management approaches to control vegetation encroachment on the nesting islands and shallow water foraging areas and to control mammalian and avian predation on listed species. Additional applied studies will be implemented as part of Phase 1 to look at the potential impacts of landside public access on birds or other target species within Pond SF2.

SF2 Action Area

The action area for Pond SF2 activities includes: (1) Pond SF2 and adjacent outboard marshes and mudflats; (2) access roads adjacent to the Dumbarton Bridge; (3) diked marsh to the southwest and southeast of Pond SF2; (4) portions of Bay that will be affected by discharge of water or sediment from Pond SF2 during construction and pond operation or that will be traversed by water-based equipment accessing Pond SF2; (5) and any other areas in the immediate vicinity of Pond SF2 that could be directly or indirectly affected by noise, dust, or

other factors resulting from the proposed action.

Proposed Eden Landing Pond E12-E13 Restoration Action

Eden Landing Ponds E12 and E13 (Pond E12 and E13) will be reconfigured and managed to create 230 acres of high quality shallow water foraging areas at varying salinities, as well as six nesting and roosting islands (Figure 2 in the Pond E12 and 13 BA). This will include the operation of a new water pump, installation of four new water control structures, development of an internal water circulation system using a series of small levees (berms) and small flashboard weirs, and the construction of six nesting and roosting islands. Ponds E12 and E13 will be divided into seven total cells, with six cells in tandem managed for progressively increasing salinity levels in each paired set of cells. Of the six cells, two cells will be managed to maintain low salinity levels (approximately 20 to 40 parts per thousand (ppt) similar to Bay salinity levels; two cells will be managed to maintain moderate salinity levels (approximately 40 to 80 ppt); and the remaining two cells will be managed to maintain high salinity levels (approximately 80 to 120 ppt) during the dry season. Salinities of these ponds will decrease in the rainy season depending upon the amount and timing of rainfall. However, these same general salinity ranges will continue to be the targets throughout the year. The water depths within each cell will be managed to provide optimal shallow water habitat for shorebird foraging. One island will be constructed in each of the six cells to create habitat for nesting birds. The seventh cell is a muted tidal mixing basin designed to reduce water salinities prior to discharge. Consistent with the adaptive management approach of the SBSP Project, Ponds E12 and E13 allow for multiple flow paths and management flexibility.

In addition, trails and viewing areas will be constructed around these ponds (Figure 3 in the Pond E12 and 13 BA). Both year-round and seasonal trails will link to the Bay Trail spine segment that will be constructed as part of an earlier Eden Landing Ecological Reserve (ELER) Restoration Project, a separate project which borders the northern perimeter of the pond complex. This segment connects the Bay Trail spine from the north along Highway 92 and the Hayward Regional Shoreline (East Bay Regional Parks District) to the east and south towards Union City and Coyote Hills Regional Park. The historic Oliver Salt Works will be accessible to the public by the new trail, and will be open year-round. A viewing platform with an interpretive station will be designed to tell the history of the salt works at this location, explain how salt is produced, and explain the salt work's cultural, economic, and social linkage to the greater Bay Area.

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key project uncertainties related to ecosystem restoration. Additional studies and future research projects may be conducted as the results of monitoring and initial applied studies indicate areas that are in need of future research. The primary design criteria for Ponds E12 and E13 was to test the effects of salinity (low, moderate, or high) on shorebird species composition and density utilizing the ponds, on foraging behavior by these birds, and on the species composition and density of the prey on which these shorebirds feed. Other applied studies will test the effects of trail use on shorebirds using Pond E12 and E13 foraging habitats.

Project Location

Ponds E12 and E13 are part of the ELER, which is owned and managed by CDFG. ELER is located to the south of Highway 92 (and the San Mateo Bridge) in Hayward, on the east side of the Bay. Pond E12 is bordered on the south by Pond E13 and on the north and east by Mount Eden Creek. Pond E13 is bordered by Pond E12 to the north, Mount Eden Creek to the west and pond E14 to the south. Both of these ponds are currently managed as seasonal ponds.

Proposed Design Elements

The Pond E12 and E13 design includes the following features intended to create shallow water foraging habitat for migratory shorebirds, with a range of salinities, and six islands for nesting and roosting waterbird habitat:

- Earth berms
- Islands
- Levees
- Water control structures
- Pilot channel
- Recreation

These features are described in more detail in the following sections.

Earth Berms. Earth berms (small levees) will be constructed in Ponds E12 and E13 to create a distribution canal, six managed cells (three in each pond), a discharge mixing basin, and to segregate the historic Oliver Salt Works area (Figure 2a in the Pond E8A-E9-E8X BA). As part of the Ponds E8A, E8X, and E9 restoration (see *Proposed Eden Landing Pond E8A-E8X-E9 Restoration Action* below), the first lift of the east-west berm between Pond E12 and E13 will be built to facilitate snowy plover management during construction. Berm design may vary slightly between berms along the distribution channel and those between cells. One berm along the distribution channel will be approximately 10 feet wide in order to provide vehicle access, while other berm sections may be up to 6 feet wide to allow ATV access. Material needed to construct the berms will be borrowed onsite, with a minimum 10-foot bench between the borrow area and toe of the new berm. The berms will range in height from approximately 2 to 6 feet. It is estimated that berm side slopes will also need to be 5:1 or flatter. Due to possible berm settlement, maintenance may be required in 5 to 10 years.

Nesting Islands. One island will be created in each of the six cells to provide nesting and roosting waterbird habitat. Nesting islands are expected to be used by avocets, stilts, Forster's terns, snowy plovers, and possibly least terns. Each island will be approximately 3 feet high, 300 feet long, and 50 feet wide. The islands will be constructed using fill material (on-site borrow) excavated from the windward side of the islands. Water depths will be deeper on the windward side and shallower on the leeward side of the islands to provide shallow water foraging habitat that is sheltered from the wind. To isolate islands from recreational trails and land-based predators, they will be at least 300 feet from outboard levees, 100 feet from internal berms, and

600 feet from the public viewing platforms and the kayak launch site.

Levees. In total, three miles of new trail may be constructed along existing levees as part of the Phase 1 public access plan at ELER. As part of the Pond E8A, E8X, and E9 actions, the existing levee between Pond E13 and Pond E14 will be re-constructed along its original alignment (see *Proposed Eden Landing Pond E8A-E8X-E9 Restoration Action* below). The levee will be improved, widened, and resurfaced to create a maintenance road, public access trail, and emergency vehicle access as part of Pond E12 and E13 restoration. The existing levee around the rest of Ponds E12 and E13 are adequate for vehicle access and recreational use. All of the trails proposed at ELER for Phase 1 actions will be 6 to 8 feet wide on an existing managed pond levee, and will have firm and stable, hardened surfacing to allow for hikers, wheelchairs and cyclists.

Water Control Structures and Pilot Channel. Water levels and flows in Ponds E12 and E13 will be managed using passive water control structures, such as concrete "rice-box" type weirs or slide flap and weir structures, with supplemental pumping as needed. The elevation of the ponds gently slopes from east to west and averages 5.7 feet NAVD, which is approximately 1.3 feet below mean higher high water (MHHW). As Ponds E12 and E13 are high in elevation relative to the tides, the potential for gravity flows into the ponds is limited, especially during neap tides when high tides are below MHHW. Gravity flows will occur through new intake structures located between Mount Eden Creek and Pond E12, and between the northern extension of Pond E8X and Pond E13. The structures are still in design, but conservatively may consist of up to five new 4-foot intake culverts with combination slide/flap gates on each end of the culvert. Water from Mount Eden Creek and the pump forebay will flow into the low salinity cells. The existing Pond E13 and E14 culverts will be replaced with new water control structures with combination slide/flap gates, as it will provide overflow and/or storage capacity (if necessary) from Ponds E12 and E13.

The narrow northern extension of Pond E8X, along the eastern edge of Pond E14 will connect Ponds E12 and E13 to North Creek. The existing pump house will be fashioned with a new pump which could be used to pump water into Ponds E12 and E13 from the narrow northern extension of Pond E8X and the ELER marsh area to the east to supplement gravity as needed. The northern extension of Pond E8X will likely silt in and become vegetated if restored to tidal action; therefore, as part of Ponds E8A, E8X, and E9 restoration actions, a new culvert with tide gates will be installed between Pond E8X and the northern extension to create a managed forebay (see *Proposed Eden Landing Pond E8A-E9-E8X Restoration Action*). This pump forebay will limit tidal sedimentation and provide storage for both passive flows into Pond E13 and pumping into Ponds E12 and E13. Pond E14, located immediately south of Pond E13, may be used to provide additional storage for gravity flows and pumping into Ponds E12 and E13. Pond E14 is currently managed as a seasonal pond and is connected to Pond E13, the northern extension of Pond E8X, and Pond E9 by existing culverts.

As part of the Phase 1 actions at ELER, the existing culverts will be replaced with new culverts with adjustable tide gates. Pond E14 may be managed adaptively to provide seasonal or year-round pond habitat. Within Ponds E12 and E13, earth berms will be constructed to separate the ponds into six cells (see *Berms* above). Passive water control structures, such as flashboard

weirs, will be used to maintain water depths ranging from approximately 2 inches to 1 foot, with an average depth of less than 6 inches, to provide shorebird foraging habitat. The shallowest areas will support smaller *Calidris* sandpipers (such as western sandpipers, *C. mauri*) and the deeper areas will support larger shorebirds. Gaps will be excavated through the existing remnant structures (wood fences separating former salt crystallizer cells) to improve circulation within the cells.

A water distribution canal will be constructed (see *Berms* above) between Ponds E12 and E13, with water control structures connecting the canal to each of the six cells, the historic salt works, and the discharge mixing basin. This distribution canal will allow bay salinity water to be pumped directly into any cell in order to dilute the higher salinity water as needed to maintain salinity targets. The canal will be created by constructing a new earth berm south of the existing borrow ditch between Ponds E12 and E13 and rebuilding the remnant levee north of the borrow ditch as needed. Part of the berm (first lift) will be built as part of the Ponds E8A, E8X, and E9 restoration, prior to Pond E12 and E13 actions, to segregate Pond E12 from E13. This will enable Pond E12 to be managed for snowy plovers during Ponds E8A, E8X, and E9 restoration actions.

The discharge mixing basin will allow managers to reduce salinity levels of water discharged from the six cells, by mixing with lower salinity water from the distribution canal. Also, the mixing basin will allow for adequate water quality parameters, including DO, to be met prior to discharge into Mount Eden Creek. The structures between the salinity cells and the mixing basin will be culverts with weir boxes and flap gates. Water will be discharged through a new outlet structure that will be installed in the Pond E13/Mount Eden Creek levee. This structure will consist of eight new 4-foot outlet culverts, with combination slide/flap gates on both ends of each culvert.

Pilot Channel. A pilot channel will be excavated through the Mount Eden Creek outboard marsh to facilitate flow. The pilot channel will be approximately 220 feet long and will have side slopes of 3:1, with a depth of approximately 8 feet. The pilot channel top width will be approximately 150 feet. The pilot channel will be excavated by either land- or water-based equipment. Excavated material will be strategically placed in nearby borrow ditches.

Recreation. Currently, no regular public access (except for restricted hunting) is allowed at the ELER. Phase 1 restoration plans for the Pond E12 and E13 project include recreational access for hikers, cyclists, kayakers and wheelchairs.

Trails. Approximately 3 miles of new year-round and seasonal trails may be constructed along existing levees as part of the Phase 1 public access plan at ELER. The existing managed pond levee between Pond E13 and Pond E14 will be improved, widened, and resurfaced to create a maintenance road, public access trail, and emergency vehicle access. The existing levee around the rest of Ponds E12 and E13 are adequate for vehicle access and recreational use. All of the trails proposed at ELER will be on an existing managed pond levees to allow for hikers, wheelchairs and cyclists. Decomposed granite surfacing will be incorporated into the existing gravel surface to create a firm and stable trail surface approximately 6 feet wide. Fencing will be installed where appropriate to prevent human

disturbance to sensitive habitat areas. Dogs (*Canis lupis familiaris*) are not permitted at the reserve except for waterfowl hunting and as per CDFG regulations. The trails will be open to the public during typical hours of operation, from sun up to sun down and will include amenities along the trail such as seating.

The proposed 0.80-mile year-round trail is located along the existing levee at the north end of Pond E12, and connects the ELER staging area with the historic Oliver Salt Works Complex. The 1.50-mile year-round shoreline trail, connects the salt works with the Bay, along the southern edge of Mount Eden Creek, and will be incorporated into the existing levee. The trail will terminate at the Pond E9 breach with a viewing area (see *Shoreline Viewing Area* below). A spur trail off the main trail will provide access to the Archimedes viewing area between Ponds E13 and E14. The proposed 1.5 mile seasonal loop trail will be located along the Pond E12 and E13 levee. This trail will be subject to closure depending on the presence/absence of sensitive species during the nesting season. It will connect the historic Oliver Salt Works Complex with the Archimedes viewing area looping between Ponds E13 and E14.

Kayak Launch Site. A kayak launch area in Mount Eden Creek will be located off the main spur trail from the staging area in the northern portion of the pond complex (Figure 3 in the Pond E12 and E13 BA). A turnaround and drop-off zone will allow temporary vehicular access to the launch area. The design incorporates an 8-foot wide launch ramp and a 10-foot wide floating dock, and an ADA-compliant ramp during portions of high tide that provides access to the dock. The launch will be in an area of reduced vegetative cover with a vertical drop of approximately 6.5 feet between the existing levee and the water elevation at low tide. Interpretive signs will be incorporated at the site, as well as a seating area and launch preparation space.

Saltworks Viewing Platform. Access to the Oliver Salt Works viewing platform will be located at the northwestern edge of Pond E12, and will be situated into the salt works remains to provide uninterrupted views of the foundation remains. The platform is designed to have a long and narrow gangplank style walk which will split into easterly and westerly directions over the salt works. The platform will be elevated 3 feet above the levee trail and will be accessed by an ADA-compliant ramp. Three interpretive stations will be implemented into the platform, along with benches. The railings will be designed to provide for a comfortable bird-watching experience, while ensuring safety. Two separate viewing areas will be created at the ends of the east/west platform at different elevations and will have canopy structures placed overhead to provide shade.

Archimedes Viewing Area. A viewing area will be located on the seasonal levee trail between Ponds E13 and E14, overlooking the remains of the Archimedes screws in pond E14. The viewing area will be built at the elevation of the levee and extend into Pond E12 and E13, providing views of the Oliver Salt Works to the north and Archimedes screws to the south. Interpretive stations and seating will be provided.

Shoreline Viewing Area. A viewing area will be located at the terminus of the year-round shoreline trail, approximately 1.5 miles from the staging area. The viewing area will be an

extension of the levee surface, drawing users up slightly from the existing levee elevation and providing panoramic views of the Bay and the newly breached mouth of Mount Eden Creek, which is part of the Pond E8A, E8X, and E9 restoration action. An interpretive station and seating will be located at the site.

Access for Construction

Access to the Pond E12 and E13 site for both workers and equipment will be either off Highway 92 to the Clawiter Road exit just east of the San Mateo Bridge or from Interstate 880 to the Industrial Parkway exit, proceeding west on Industrial Parkway to Arden then Clawiter Road to the ELER gate. Water based access will be through Mount Eden Creek if the creek depth allows for the equipment draft. At water access locations, hydraulic dredging may be used for pilot channel excavation

A staging area will be constructed to store and refuel construction equipment. Staging will take place in the vicinity of the proposed parking area at the north end of Pond E12 near the entry point from Eden Landing Road. Conservation measures will be followed to enclose fueling areas and limit construction impacts, in accordance with State and County requirements, and conservation measures listed in the PBO for the SBSP Project.

Construction Process

Equipment to be used and personnel requirements for the construction will generally be as described in the PBO. Due to the location of Pond E12 and E13, construction methods, equipment, and access are more constrained than at a typical construction site. Prior to construction in the Ponds E8A, E8X, or E9, a berm will be built between Pond E12 and E13 to allow for independent water management. Water control during construction will be implemented with existing and portable water pumps, which will be necessary to allow for land- and water-based equipment access. During construction, conservation practices such as silt fence, Environmentally Sensitive Area fence, and fiber rolls will be used to keep construction equipment in designated areas and prevent impacts to areas not in the designated construction zone.

Islands, berms, and levees will be the primary earthwork components of the Pond E12 and E13 restoration. It is expected that multiple lifts, beginning during the Pond E8A, E8X, E9 restoration, will be required for earthen structures. The removal of existing water control structures and installation of new structures will also be a primary component of the restoration process. Culvert pipes will be installed by cutting a trench in the levees. Culverts will be placed directly onto bay mud to eliminate a possible source of piping and soil loss experience in some ISP structures. Backfill will be compacted in lifts. Construction of inlet and outlet structures will be accomplished using traditional land-based equipment. The Mount Eden Creek pilot channel will be excavated using water- or land-based equipment and the material will be used for restoration features, such as berms. Wood headwalls and wingwalls on either side of the levee will be supported by wood piles. Sheetpile cofferdams will be needed on the bay side of structures, as well as areas on the pond side of structures that are flooded. The need for de-watering is anticipated while the trench is open.

Culverts and/or weirs will be placed in new berms within Ponds E12 and E13. Cell water control structures will likely require amphibious equipment or barges for construction. Construction may take place in the "wet" without dewatering. This may be required to eliminate snowy plovers from nesting near construction sites.

Construction preparation

- Water control will be necessary to drain the site for land-based equipment and/or maintain depth for floating equipment.
- Equipment will be transported to the site on trucks via existing levee roads or sloughs (see *Access* above).

Design element construction details

- If it is determined that construction cannot be completed outside the snowy plover breeding season, Ponds E12, E13, and E14 to be flooded prior to snowy plover nesting season (1 March to 15 September) to preclude snowy plovers from nesting in or near construction areas.
- The check berms between cells will range in height from approximately 2 to 6 feet, with side slopes will also need to be 5:1 or flatter.
- Each of the six nesting islands will be approximately 3 feet high, 300 feet long, and 50 feet wide.
- A new pump will be installed in the existing pump house.
- The Mount Eden Creek pilot channel will be 220 feet long and will have side slopes of 3:1, with a depth of approximately 8 feet.
- Water control structures, such as flashboard or concrete "rice-box" weirs, will maintain water depths ranging from approximately 2 inches to 1 foot, with an average depth of less than 6 inches, to provide shorebird foraging habitat.
- Approximately 3 miles of trails may be built on existing levee; the trails will have firm and stable trail surfaces and will be approximately 6 to 8 feet in width.
- The Oliver Salt Works viewing platform will be raised 3 feet above the existing levee grade and will have three interpretive stations. The railings will be designed to provide for a comfortable bird-watching experience, while ensuring safety. Two separate viewing areas will be created at the ends of the east/west platform elevations and will have canopy structures placed overhead to provide shade.
- The kayak launch will have an 8-foot wide launch ramp and a 10-foot wide floating dock, and an ADA-compliant ramp during portions of high tide that provides access to the dock.

Construction Schedule

The contractor will be allowed to select the construction schedule and sequencing within the restrictions specified by permits. The construction schedule may depend on weather conditions and contractor's preferences. At this time, construction of the Pond E12 and E13 berm is

scheduled in 2009 as part of the Pond E8A, E8X, E9 action (see *Proposed Eden Landing Pond E8A-E8X-E9 Restoration Action* below). This berm will be used to segregate Pond E12 from E13 to provide snowy plovers with nesting habitat during Pond E8A, E8X, E9 construction. The first lift for nesting islands and other berms in Ponds E12 and E13 are expected to occur in the dry season of 2010, but could begin sooner if local borrow is used, or if work is able to be done during the 2009 rainy season. The second lift for the earth berms and islands, and installation of water control structures, is expected to occur in the dry season of 2011. Construction of the trails, viewing platforms, kayak launch, and other public access components is expected to occur in 2011 or later.

As required by permits, the timing of construction (construction window) will avoid impacts to listed species, such as clapper rails, snowy plovers, and least terns, and other sensitive species including nesting birds such as avocets and stilts. Construction activities will be conducted outside the breeding season (March 1 to September 15) if practicable. If the contractor determines that work outside the plover nesting season is not possible, Ponds E12, E13, and E14 will be shallowly inundated prior to March, when snowy plover nesting selection is expected to occur, to preclude snowy plovers from nesting on the pond beds in or near the project site. Inundating ponds can occur only if pre-construction surveys determine that no snowy plovers, or other birds, are actively nesting within the pond and all young have fledged, or if it is determined (in consultation with the Service and CDFG) that inundation will not adversely affect any birds that are nesting on existing islands within the ponds. In either scenario, pre-construction surveys will confirm the presence or absence of snowy plovers in the area. If snowy plovers are located in a pond or on a levee, a 600-foot buffer will be maintained around any plover nests or chicks. Using disturbance-free buffers around active nests might be acceptable if there are few nests (allowing the work to occur outside the buffers). After the snowy plovers have chicks, work on portions of the pond can be performed as long as the chicks are able to move well away from the work area and safely forage (possibly with some monitoring to ensure that the snowy plovers stay away from the work area).

Phase 1 Applied Studies

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key project uncertainties related to ecosystem restoration. Specific applied studies that may be conducted in the project area could include studies to test effects of salinity on shorebird species composition and density, on foraging behavior by these birds, and on the species composition and density of the prey on which these shorebirds feed. The nesting islands may provide some information regarding nesting bird use at the different salinity levels in the pond. Phase 1 applied studies will also include research on the effect of trail use on shorebirds using the Pond E12 and E13 foraging habitats.

Pond E12 and E13 Action Area

The action area for the Pond E12 and E13 activities includes: (1) Ponds E12, E13 and E14; (2) Mount Eden Creek; (3) portions of outboard marshes; (4) staging areas north of the Pond E12 and land-based access areas, via Eden Landing Road; (5) water-based access areas for barge-supported equipment, which will include the access route for water-based equipment; and (6) any

other areas in the immediate vicinity of the project site that could be directly or indirectly affected by noise, dust, or other factors resulting from the proposed action.

Proposed Eden Landing Pond E8A-E8X-E9 Restoration Action

Eden Landing Ponds E8A, E8X, and E9 (Ponds E8A, E8X, and E9) restoration will introduce tidal action to create approximately 630 acres of tidal marsh and tidal channel habitat through levee breaching, levee lowering, and the installation of borrow ditch blocks (Figure 2a in the Pond E8A-E9-E8X BA). Tidal action will be restored to existing historic channels in the ponds by a series of outboard breaches and pilot channels, as well as internal levee breaches. An earthen levee will be constructed between Ponds E12 and E13 in order to provide habitat for snowy plovers in Pond E12, while other ponds will be flooded to dissuade snowy plovers from nesting in, and adjacent to, construction areas. Parts of levees will be lowered to create pickleweed marsh habitat, including outboard levees along Old Alameda Creek and North Creek and internal levees between Ponds E8A, E8X and E9. Depressions will be excavated in lowered internal levees to create tidal marsh pond habitat, similar to historic marsh ponds that previously existed in the area. Levee improvements will be made along the existing alignments of the Ponds E9-E8X-E14 and E13/E14 levees. The Pond E10 levee will be realigned further to the north and the Mount Eden Creek slough channel will be widened and deepened to minimize channel scour to the Pond E10 levee.

Although Ponds E8A, E8X and E9 have been diked for salt production, minimal subsidence has occurred. Because typical bed elevations of Ponds E8A, E8X, and E9 are relatively high in the tidal frame, the restoration action would likely facilitate salt marsh vegetation colonization and reoccupation of remnant tidal channels shortly after levee breaching. Over time, tidal sedimentation and the accumulation of plant biomass would raise the marsh plain to the elevation of adjacent mature marshes (approximately MHHW). The gypsum layer in Pond E8A may inhibit vegetation establishment and therefore will receive some pre-treatment to expedite marsh establishment.

Applied research studies will be implemented as part of Phase 1 of the SBSP Project to answer questions regarding key project uncertainties related to ecosystem restoration. Additional studies and future research projects may be conducted as the results of monitoring and initial applied studies indicate areas that are in need of further research. The key research questions for the pond E8A, E8X, and E9 restoration include an examination of sediment accretion in restored tidal areas, the effectiveness of marsh restoration in decreasing flood hazards, and the ecological value of tidal marsh ponds.

Project Location

The Pond E8A, E8X, and E9 complex is part of the ELER, which is owned and managed by CDFG. ELER is located to the south of Highway 92 in Hayward, on the east side of the Bay. The complex is bordered by Old Alameda Creek to the south and a tidal salt marsh (Whale's Tail Marsh) to the west. The complex is bordered by Mount Eden Creek on the northwest edge, pond E14 to the north, and North Creek to the east. Ponds E8A, E8X, and E9 are currently managed under the ISP as system ponds.

Proposed Design Elements

The Ponds E8A, E8X, and E9 design includes the following features intended to promote tidal marsh evolution:

- Levee lowering
- Earth berms
- Levee improvements
- Tidal marsh ponds
- Internal channels
- Ditch blocks
- Gypsum pre-treatment
- Water control structures
- Mount Eden Creek channel excavation
- Pilot channels
- Levee breaches (outboard and internal)

These features are described in more detail in the following sections.

Levee Lowering. Up to approximately 18,400 feet (3.5 miles) of levees may be lowered to the marsh plain elevation (MHHW or 7.0 feet NAVD). This length includes the outboard perimeter levees along Old Alameda Creek and North Creek and the internal levees between Ponds E8A, E8X, and E9. The outboard levee along Whale's Tail marsh will not be lowered; it will remain in place to limit wave transmission from the Bay into the ponds. The northwestern segment of the pond E9 levee from the Pond E9 breach to Pond E14 will not be lowered; it will be used as a portion of a public access trail (see *Proposed Eden Landing Pond E12-E13Restoration Action* above).

Material removed from levees during levee lowering will be used to construct ditch blocks, placed in borrow ditches, or used for other restoration features. In the first year of construction (Year 1), material will be excavated from the internal levees and the pond side of the outboard levees so that the outboard levees continue to prevent tidal inundation during construction. A minimum width of approximately 15 feet of the existing levee crest will be maintained in Year 1.

Levees will only be lowered to the extent necessary to provide enough fill material for the restoration of the features that are described below. Priority will be given to lowering the levees between Pond E8A and Old Alameda Creek (Pond E8A/Old Alameda Creek levee), Ponds E8A and E8X and North Creek (Ponds E8A/E8X/NC levee), Ponds E8A and E9 (Ponds E8A/E9 levee), and Ponds E9 and E8X (Ponds E9/E8X levee), respectively. Material from the Pond E8A/Old Alameda Creek and Ponds E8A/E8X/NC levees is expected to be needed for levee improvements (see *Levee Improvements* below).

Earth Berm. An earthen berm approximately 4,500 linear feet long will be constructed between Ponds E12 and E13 in order to segregate these two ponds. Over the course of Pond E8A, E8X, and E9 construction, Pond E12 will remain dry in an effort to provide some habitat for snowy

plovers, while Ponds E8A, E8X, E9, E10, E13, and E14 will be flooded to dissuade snowy plovers from nesting in, or adjacent to, project construction areas.

The Pond E12 and E13 earthen berm will be built to a height of approximately 3 feet, with side slopes of approximately 5:1. An additional lift will be required during the Ponds E12 and E13 construction process (see *Proposed Eden Landing Pond E12-E13Restoration Action* above). The berm will be built on remnant material of the old Pond E12/E13 levee, with the exception of the easternmost portion, which will connect to the existing pump house to the southeast.

Levee Improvements. *Ponds E9/E8X/E14 Levee Improvement.* The Ponds E9/E8X/E14 levee will be re-constructed along its current alignment, which is approximately 6,300 feet (1.2 miles) in length. The existing levee alignment will be maintained to take advantage of the existing levee material and soil compaction. The improved levee will be constructed over 2 years to address settlement of the weak underlying bay mud. The levee will be constructed to a crest elevation of 11 feet NAVD. Up to approximately 4 feet of fill will be placed above the existing grade. The constructed levee crest elevation will include approximately 25 percent overbuild to allow for settlement to approximately 10 feet NAVD. The outboard (Ponds E9 and E8X) side slope will be approximately 7:1 or shallower and the inboard side-slope will be approximately 4:1. The levee top width will be a minimum of 8 feet and the bottom width at the pond bed will be approximately 60 feet.

The existing levee material and underlying bay mud are very weak, soft, and wet and are expected to constrain levee construction. Low ground pressure equipment and special construction techniques are expected to be required since traditional construction equipment is not expected to be feasible during the initial stages of construction. Gypsum removed from the surface of Pond E8A and/or Pond E9 (see *Gypsum Pre-treatment* below) may be used to strengthen portions of the levee sub-grade.

Fill material will be obtained from the lowering of other levees. Fill will be placed in lifts of approximately 1 to 2 feet. Each lift will have an overbuild to allow for compaction. Lifts will be compacted to a relative compaction of at least 85 percent (of the maximum compacted density). The levee will be constructed to the design dimensions in Year 1. Approximately 0.5 feet of settlement is expected to occur between the completion of construction in Year 1 and the beginning of construction in Year 2. In Year 2, the settled levee will be raised back to the design dimensions (which also includes an overbuild).

The top of the levee may be planted with native high marsh and native grass species. The preliminary design includes planting the portion of the levee above elevation 8 feet NAVD, which is an area of approximately 5.4 acres. Planting will be performed by volunteers if possible. The project team may coordinate with Save the Bay during final design to arrange the volunteer process and effort.

Ponds E13/E14 Levee Improvement. The Ponds E13/E14 levee will be re-constructed along its current alignment, which is approximately 6,000 feet (1.1 miles) in length. The existing levee alignment will be maintained to take advantage of the existing levee material and soil compaction. The Ponds E13/E14 levee design considerations and design approach are expected

to be similar to those discussed above for the Ponds E9/E8X/E14 levee improvement.

The levee will be constructed to a crest elevation of 12 feet NAVD. Up to approximately 5.5 feet of fill will be placed above the existing grade. The constructed levee crest elevation will include approximately 20 percent overbuild to allow for settlement to approximately 11 feet NAVD. The levee slopes will be approximately 4:1. The levee top width will be a minimum of 10 feet and the bottom width at the pond bed will be approximately 55 feet.

Fill material will be obtained from the lowering of other levees (see *Levee Lowering* above). The levee will be constructed to the design dimensions in Year 1. Approximately 0.8 feet of settlement is expected to occur between the completion of construction in Year 1 and the beginning of construction in Year 2. In Year 2, the settled levee will be raised back to the design dimensions.

Pond E10 Levee Realignment. The segment of the Pond E10 levee downstream of the Pond E9 breach will be realigned by lowering the existing levee and constructing a new levee segment farther to the north (Figure 2a in the Pond E8A-E9-E8X BA). The Mount Eden Creek slough channel will be widened by excavating a portion of the lowered levee. The existing Mount Eden Creek breach will be widened and deepened by removing a portion of the remnant Pond E10 levee. The Mount Eden Creek slough channel will be deepened by dredging the channel bottom from the mudflat sill (bayward of the Mount Eden Creek breach) to the Pond E9 pilot channel (see *Mount Eden Creek Channel Excavations* below).

A new 1,020-foot segment will be constructed across the Pond E10 bed over the 2 years of construction. Fill material will be obtained by lowering the existing pond E10 levee and from the inboard side of a 1,200-foot segment of the levee in Year 1. All of the stockpiled material will be excavated in Year 1. The inner portion of the existing levee will be excavated down to near the pond bed elevation (approximately 5 feet NAVD). A minimum crest width of 10 feet at elevation 11 feet NAVD will remain during Year 1, with a slope of approximately 2:1 or shallower on the inboard (pond) side. Fill material will also be excavated by enlarging the Mount Eden Creek breach in Year 1 (see below). In Year 2, the remaining levee will be lowered down to the approximate mature marshplain elevation (MHHW or 7 feet NAVD).

Fill will be placed in lifts of approximately 1 to 2 feet. Each lift will have an overbuild to allow for compaction. Lifts will be compacted to a relative compaction of at least 85 percent (of the maximum compacted density). In Year 1 (first lift), approximately 6 feet of fill will be placed to construct the base of the levee to an elevation of approximately 10.5 feet NAVD. Due to the workability of the soils, placing more than about 6 feet of fill in Year 1 is expected to be difficult. Some levee settlement (about 1 foot) is expected between construction in Years 1 and 2. In Year 2, the levee will be raised to crest elevation 12.6 feet NAVD. This design crest elevation includes approximately 20 percent overbuild to allow for settlement, ultimately resulting in a crest elevation of approximately 11 feet NAVD. The outboard (Mount Eden Creek) side slope will vary from approximately 4:1 to 5:1. The inboard side-slope will vary from approximately 3:1 to 4:1. The levee base width will be approximately 80 to 90 feet.

Pond E10 may be drained through the existing Pond E10 water control structure to facilitate

construction. A flap gate will be temporarily installed on the Bay side of at least one of the three culverts to allow for drainage. The other culverts will be blocked to prevent intake. It is assumed that the existing flap gates on the pond side of two of the three culverts or from the Pond E9 water control structure can be removed and installed for drainage. The wood box culvert between Ponds E10 and E11 will be closed to separate the two ponds and Pond E11 will be managed via the water control structure between Pond E11 and Mount Eden Creek.

Low ground pressure equipment is expected to be required. The preliminary design includes placement of geofabric on the levee subgrade to enhance the ability to place fill.

Tidal Marsh Ponds. Eight tidal marsh ponds, in addition to the existing pond feature adjacent to Old Alameda Creek, will be excavated in the lowered levee between Ponds E8A and E9 (Figure 2a in the Pond E8A-E9-E8X BA). Four different combinations, of two ponds each, of adjacent marsh plain elevation and pond depth will be excavated from the levee. The differing pond characteristics will be used to test if constructed tidal marsh ponds will remain as ponds, or ultimately become vegetated and form higher marshes. Subsequent bird use of these tidal marsh ponds may be examined and used to inform future restoration designs. Minimum slopes (i.e., approximately 40:1 to 50:1 for 0.5-foot deep ponds and 20:1 to 25:1 for 1-foot deep ponds) are desired for pond habitat; however, if these shallow slopes are considered infeasible during construction, steeper slopes may be used to facilitate construction.

Each pond will be approximately 40 to 50 feet wide and 80 to 100 feet long, with areas of approximately 3,200 to 5,000 square feet. The top width of the lowered levee is expected to vary from approximately 100 to 120 feet. A minimum of 10 feet of lowered levee will remain around the pond excavation to provide a compacted perimeter and reduce the potential for erosion into the pond. Levee lowering material will be sidecast on the levee slopes at the pond locations to widen the perimeter. Material excavated from the ponds will be mounded on the windward (northwest) sides of the ponds. The pond bottoms will be compacted by track walking equipment over the excavated area.

Internal Levee Breaches. The existing internal levee between ponds E8A and E9 will be breached in five locations to reconnect remnant historical channels and facilitate tidal drainage (Figure 2a in the Pond E8A-E9-E8X BA). The western-most internal levee breach will reconnect the historic sinuous tidal channel between Old Alameda Creek and Mount Eden Creek and will be larger than the four other breaches, which will all have the same design dimensions. The breach excavations will extend beyond the levee toe into either the internal borrow ditch or the remnant historical channel. The western breach will have a top width of 90 feet, a bottom width of 10 feet, a bottom elevation of -3 feet NAVD, and a side slope of 4:1. The other four breaches will have top width of 50 feet, a bottom width of 3 feet, a bottom elevation of -1 foot NAVD, and a side slope of 3:1. The easternmost internal breach will involve the removal of a water control structure, which will be salvaged if possible (see *Water Control Structures* below). Material excavated from the internal levee breaches (and internal levee lowering) will be used for restoration features including internal ditch blocks.

Internal Channels. *Interior Connector Channels.* Wood structures and compacted fill will be excavated to remove channel obstructions and create four internal connector channels. Internal

connector channels will be excavated to the expected long-term equilibrium channel depth and to the width of the adjacent remnant tidal channels. Internal connector channels in Pond E9 will be excavated to approximately -4.5 feet NAVD, with widths of approximately 100 feet. In Pond E8A, channels will be excavated to approximately -2 feet NAVD, with widths of approximately 60 feet. These design dimensions are based on the width-to-depth ratio expected for South Bay tidal channels.

Interior Starter Channel. The large shallow remnant historical tidal channel west of the oxbow in Pond E8A will be excavated to deepen and widen the channel. The channel will be excavated to approximately 3.5 feet NAVD, with a top width of approximately 20 feet and a bottom width of 3 feet and side slopes of approximately 3:1. These dimensions are smaller than expected equilibrium dimensions and the channel is expected to scour over time. Excavated material will be placed on the pond bed to help expedite marsh development. Material will not be placed above MHHW (elevation 7.0 feet NAVD). Placement on the pond bed will be controlled to avoid blocking channels and destabilizing slopes and grades, and also to leave gaps where tributary channels can form.

Ditch Blocks. Borrow ditch blocks will be constructed in the internal borrow ditches on either side of the Ponds E8A/E9 levee and the western perimeter borrow ditch in Pond E9. The desired elevation of the top of the ditch blocks is MHHW (7.0 feet NAVD), which is expected to provide pickleweed marsh habitat. The amount of fill needed to achieve this elevation and account for settlement will be determined during final design. The length of the ditch blocks will extend 100 feet beyond the borrow ditch onto the pond bed. Top width will be 40 feet and side slopes will be 5:1 for slope stability. Ditch blocks will be constructed from onsite material generated from levee lowering and/or levee breaches. Additional excavation from the remnant channels will be allowed for borrow ditch block construction, if necessary.

Gypsum Pre-treatment. Portions of the hard gypsum layer in Pond E8A will be broken up using non-traditional construction equipment. The gypsum layer will be cracked, shifted, flipped over, and/or removed to expose the underlying mud and provide rooting pathways for marsh vegetation. Gypsum may be removed and placed at the base of the Pond E9-E8X/E14 levee (see *Levee Improvement* above).

The preliminary design includes gypsum pre-treatment for 100 acres of Pond E8A. The maximum area of gypsum pre-treatment will be approximately 240 acres, which includes the entire area of Pond E8A. Areas will be targeted where the gypsum is thickest and where new channel formation is desired. Gypsum in the large historical tidal channel to the west of the historical oxbow channel will be pre-treated. Gypsum pre-treatment will be controlled to avoid blocking channels and destabilizing slopes and grades.

Traditional land-based equipment is not expected to be effective in breaking the gypsum layer. Land-based equipment is expected to sink into the mud once it breaks through the gypsum layer or in areas where soft mud is not covered by a thick gypsum layer. Low ground pressure or amphibious equipment is expected to be required. Potential methods to break up the gypsum layer are to use a ripper shank, an impact hammer, or possibly a 3,000-pound dead blow weight (used in static compaction). As portions of the gypsum layer are thin or soft enough to break

under foot, running amphibious equipment over these areas may be sufficient.

The amount of time required to break up the gypsum layer depends on the layer's thickness and hardness, which is expected to vary spatially, but estimated at a production rate of approximately one acre per day.

Water Control Structures. The existing water control structures between Pond E9 and Mount Eden Creek (Pond E9 structure), Pond E8A and North Creek (Pond E8A structure), and Pond E8X and North Creek (Pond E8X structure) will be removed. The removal of the Pond E9, E8A, and E8X structures will function as breaches in the outboard levees (see *Outboard Levee Breaches* and *Pilot Channels* below) and facilitate tidal flow in the restoration project. Additionally, two internal water control structures in the Pond E8A/E9 levee will be removed and possibly salvaged. The existing structure on the western side of the Pond E9/E14 levee will be replaced.

The Pond E9 and Pond E8A culverts have combination slide/flap gates on both ends. The Pond E8X culvert has a slide/flap gate on one end and a concrete weir box on the other end. The pipes, gates, and other materials (e.g., rip-rap) from these structures will be salvaged and used for Ponds E8A, E8X, and E9 and Ponds E12 and E13 restoration project features. The Ponds E8A, E8X, and E9 restoration includes replacing the existing water control structure between Ponds E14 and E9 (Pond E14 structure). The existing Pond E14 structure consists of two 58-inch square wood box culverts with wood slide gates. This structure will be replaced with pipe culverts with combination slide/flap gates to facilitate management of Pond E14 when Pond E9 is restored to tidal inundation.

A water control structure will be installed between Pond E8X and the northern extension of Pond E8X (known as the pump forebay) for the Ponds E12 and E13 restoration (see *Proposed Eden Landing Pond E12-E13Restoration Action* above). The narrow northern extension of Pond E8X will provide a connection between North Creek and the existing pump station that will be used for the Ponds E12 and E13 restoration. The Ponds E9/E8X/E14 levee will be extended across the northern extension of Pond E8X and a new water control structure with pipe culverts and combination slide/flap gates on each end will be installed. The northern extension of Pond E8X will be used as a managed forebay to store water from Pond E8X and North Creek to be pumped into the Ponds E12 and E13 reconfigured ponds. This pump forebay will limit tidal sedimentation and provide storage for both passive flows into Pond E13 and pumping into Ponds E12 and E13.

For the new Pond E14 and Pond E8X forebay structures, new pipes in, addition to the salvaged pipes, may be required to extend through the Pond E9-E8X/E14 levee.

Mount Eden Creek Channel Excavations. *Mount Eden Creek Breach Enlargement.* In Year 1, the southern extension of the remnant Pond E10 levee on the north side of the existing Mount Eden Creek breach will be excavated to widen and deepen the breach. The levee will be excavated down to the equilibrium Mount Eden Creek channel depth (-6.5 feet NAVD) and a 3:1 slope will be excavated from the top of the levee to the toe of excavation. The breach will be widened by approximately 110 feet at MHHW.

Mount Eden Creek Channel Widening. After lowering the existing Pond E10 levee in Year 2, material will be excavated from the outboard side of the lowered levee to widen the Mount Eden Creek channel by approximately 25 feet. Material will be excavated down to approximately 3.5 feet NAVD and will be placed on the inboard side of the lowered levee to backfill the area up to marsh plain elevation. A width of approximately 20 feet of the lowered levee will not be excavated to allow for construction access during channel widening.

Mount Eden Creek Channel Deepening. The Mount Eden Creek channel will be deepened by approximately 8 feet by dredging the channel bottom to approximately -6.5 feet NAVD. The channel width will be approximately 25 feet at the bottom and 60 feet at mean lower low water (MLLW), with side slopes of approximately 3:1. Channel dredging will extend approximately 150 feet outboard of the Mount Eden Creek breach through the mudflat sill. The mudflat channel will be dredged to approximately -1 foot NAVD (i.e., below MLLW or -0.75 feet NAVD), with a channel bottom width of approximately 50 feet and side slopes of 3:1. Bucket and/or hydraulic dredging techniques will be used. Dredge material will be placed in either Pond E10 or Pond E9. Material may be placed in the borrow ditches and on the pond bed. In Pond E9 and the portion of Pond E10 that will be breached to tidal action, material will not be placed above MHHW (elevation 7.0 feet NAVD). Placement will be controlled to avoid destabilizing slopes and grades. In the case of hydraulic dredging, the spoils would be pumped into the pond to locations that would avoid excessive turbidity after restoration.

Outboard Levee Breaches and Pilot Channels. Eight breaches through outboard levees will be excavated at locations of major remnant historical tidal channels to facilitate tidal drainage (Figure 2a in the Pond E8A, E8X, and E9 BA). Two of the breaches will result from the removal of water control structures (see *Water Control Structures* above). At the breaches, pilot channels will be excavated through the outboard marsh to the adjacent sloughs. The breach dimensions are based on the long-term equilibrium channel dimensions expected once the restored site fills with sediment and develops mature vegetated marsh. These dimensions are adjusted to give a trapezoidal breach cross section with side slopes of approximately 3:1 to 5:1 and a minimum bottom width of 4 feet.

The pilot channels will be excavated, with side slopes of 3:1, to the depth of the breach (long-term equilibrium depth). The pilot channel widths will be approximately 60 to 80 percent of the breach width at MHHW (long-term equilibrium width). Marsh vegetation will be excavated down to the root zone over the long-term equilibrium width to reduce the resistance to pilot channel bank erosion; construction equipment will be allowed to operate within this width. The pilot channel for the breach from Pond E9 to Mount Eden Creek (Pond E9 breach) will be constructed by enlarging the existing ditch at this location.

Material excavated from the outboard levee breaches and pilot channels will be used for restoration features, such as ditch blocks, but will not be allowed to completely block and isolate any portion of the borrow ditch channel due to possible fish entrainment. In breach locations where there is no borrow ditch, material will be placed on the pond bed to help expedite marsh development. Material will not be placed above MHHW (elevation 7.0 feet NAVD). Placement on the pond bed will be controlled to avoid blocking channels and destabilizing slopes and

grades.

For shorter pilot channels (up to approximately 30 feet long), the pilot channels are expected to be within the reach of an excavator operating on the levee. However, at the Pond E9 breach to Mount Eden Creek, the existing ditch between the water control structure and Mount Eden Creek will be enlarged to accommodate the increased tidal prism. This longer pilot channel will require re-handling the excavated material or hydraulic dredging. Material re-handling will involve transporting materials from the excavation site via truck to areas where the materials are ultimately placed. In the case of hydraulic dredging, the dredge slurry would be pumped into the pond to locations that would avoid excessive filling of remnant channels and turbidity after restoration.

Access for Construction

Land access is anticipated for construction; however, the preliminary design allows for both land and water access. The land access route to Ponds E8A, E8X, and E9 will be via a combination of Clawiter Road and Eden Landing Road, across the Mount Eden Creek Bridge, and along the Ponds E12/E13/E14 levees. The land access route may require grading and widening improvements for construction access. The Mount Eden Creek Bridge is intended to provide access for maintenance and construction equipment. Heavy vehicles will avoid crossing the Mount Eden Creek Bridge and water control structures in the levees along access routes if the vehicle exceeds the weight bearing capacity of the structure. If this is not possible, engineer-approved precautions will be taken to avoid damaging the structure.

Water access will be at the Pond E9 breach and/or at the western breach of Pond E8A. The dimensions of Old Alameda Creek and Mount Eden Creek may limit or preclude barge access. At water access locations, hydraulic dredging will be used to excavate pilot channels and establish water access channels. Excavation for water access will exceed the dimensions and extent of Mount Eden Creek dredging and pilot channel excavation, with water access channel widths of up to 150 feet, depths of up to 8 feet, and side slopes of up to 3:1, unless otherwise specified. Excavation of the Mount Eden Creek channel, the existing lowered levee along the southern bank of Mount Eden Creek, and a channel across the mudflat from the Bay to the existing Mount Eden Creek breach would provide water access. Additional excavation of the Pond E9 pilot channel will also occur. Any structure built to provide water access (e.g., dock, piles, etc.) will be temporary and will be removed.

A staging area will be constructed to store and refuel construction equipment. The staging area will be located either at the Eden Landing Road entrance or on a portion of the pond levees that is within an acceptable distance from sensitive species and their habitats. Conservation measures as described in the PBO will be followed to enclose fueling areas and limit construction impacts, in accordance with State and County requirements.

Construction Process

Equipment and personnel to be used during construction will generally be as described in the PBO. Due to the location of Pond E8A, E8X, and E9 restoration, construction methods,

equipment, and access are more constrained than at a typical construction site. Low ground pressure equipment and mats and/or amphibious construction equipment are expected to be required. During construction, conservation measures such as silt fence, Environmentally Sensitive Area fence, and fiber rolls will be used to keep construction equipment in designated areas and prevent impacts to areas not in the designated construction zone.

The primary earthwork components of Pond E8A, E8X, and E9 restoration include the lowering of levees, levee improvements, berm building, excavation of marsh ponds, ditch block, and tidal channels, and levee breaching. The removal of existing water control structures and installation of new structures will also be a primary component of the restoration process. Culvert pipe water control structures will be installed by cutting a trench in the levee. Culvert pipes will be placed directly onto Bay mud to eliminate a possible source of piping and soil loss experienced in some ISP structures. Construction of inlet and outlet structures will be accomplished using traditional land-based construction equipment. Backfill will be compacted in lifts. Wood headwalls and wingwalls on either side of the levee will be supported by wood piles. Sheetpile cofferdams will be needed on the bay side of structures, as well as areas on the pond side of structures that are flooded. The need for limited dewatering is anticipated while the trench is open.

Construction preparation

- Water control will be necessary to drain the site for land-based equipment and/or maintain depth for floating equipment.
- Equipment will be transported to the site on trucks via existing levee roads or sloughs (see *Access for Construction* above).

Design element construction details

- During the snowy plover non-breeding season (i.e., mid-September to late February, unless surveys confirm the absence of nesting snowy plovers from Ponds E12 and E13), a berm will be constructed between Ponds E12 and E13 to segregate Pond E12. The berm will be approximately 3 feet high with side slopes of 5:1.
- Prior to the snowy plover breeding season (March 1), Ponds E13, E14, E8A, E8X, and E9 will be flooded to prevent snowy plovers from nesting in these ponds during construction.
- The Pond E9/E8X/E14 levee will be reconstructed to a crest elevation of 11 feet NAVD, with a top width of 8 feet and a bottom width of 60 feet. The outboard (Ponds E9 and E8X) side slope will be approximately 7:1 and the inboard slope will be 4:1.
- The Pond E13/E14 levee will be improved along its current alignment. It will be constructed to a crest elevation of 12 feet NAVD, up to approximately 5.5 feet above the existing grade.
- Five internal breaches will be excavated in the ponds to reconnect remnant historical channels and facilitated tidal drainage. The western breach will have a top width of 90 feet, a bottom width of 10 feet, a bottom elevation of -3 feet NAVD, and a side slope of 4:1. The other four breaches will have top width of 50 feet, a bottom width of 3 feet, a bottom elevation of -1 feet NAVD, and a side slope of 3:1.

- Approximately 1.5 miles of the internal levees between Ponds E8A, E8X, and E9 will be lowered to the marsh plain elevation of 7.0 feet NAVD.
- Eight tidal marsh ponds will be excavated in the lowered Pond E8A/E9 levee. Each pond will be 40-50 feet wide, 80-100 feet long, with areas of 3,200-5,000 square feet.
- Internal connector channels will be excavated to the width of expected long-term equilibrium channel depths. In Pond E9, channels will be excavated to -4.5 feet NAVD, with widths of 100 feet. In Pond E8A, channels will be excavated to -2 feet NAVD, with widths of 60 feet.
- Borrow ditch blocks will be constructed in internal borrow ditches at an elevation of 7.0 feet NAVD. Top width will be 40 feet and side slopes will be 5:1.
- Approximately 100 to 240 acres of hard gypsum in Pond E8A will be mechanically broken using low ground pressure or amphibious equipment.
- Pond E9, Pond E8A, and Pond E8X water control structures will be removed.
- Pond E14 water control structure will be replaced with four 48-inch pipe culverts that will be salvaged from the Pond E9 structure; additional new pipes may be required.
- A water control structure will be installed between Pond E8X and the northern extension of E8X (forebay), which will serve as a connector between North Creek and Ponds E12 and E13. Existing Pond E8A and E8X pipe sections will be used for this structure; additional new pipes may be required.
- A new segment, approximately 1,020 feet long, of the Pond E10 levee will be realigned approximately 350 feet to the north at a height of 11 feet NAVD and a levee top width of 15 feet.
- The Mount Eden Creek channel will be deepened by approximately 8 feet to -6.5 feet NAVD. The channel width will be approximately 25 feet at the bottom and 60 feet at MLLW, with side slopes of approximately 3:1.
- The Mount Eden Creek mudflat channel will be dredged to approximately -1 feet NAVD, with a channel bottom width of approximately 50 feet and side slopes of 3:1.
- The Mount Eden Creek breach will be enlarged to -6.5 feet NAVD, with side slopes of 3:1. The breach will be approximately 11 feet at MHHW.
- Approximately 2.0 miles of outboard levee will be lowered to the marsh plain elevation of 7.0 feet NAVD, including the perimeters levees along Old Alameda Creek and North Creek. These excavations will be accomplished over two seasons.
- Pilot channels will be excavated to the depth of the levee breach. The channel side slopes will be 3:1 and the width will be approximately 60 to 80 percent of the breach width at MHHW.
- Eight outboard levee breaches will be excavated to long-term equilibrium. The breaches will have trapezoidal cross sections with side slopes of 3:1 to 5:1 and a minimum bottom width of 4 feet.

Construction Schedule

The contractor will be allowed to select the construction schedule and sequencing within the restrictions specified by this Phase 1 BO, the PBO, and other permits. The construction schedule may depend on weather conditions and the contractor's preferences. At this time, construction is scheduled to begin in July 2009 and may extend into 2012 or 2013. The preliminary design

assumes that construction can occur during the summer bird nesting season, when the weather is dry, within restrictions specified below and by permit conditions. The construction schedule and sequence described below will be refined during the final design.

The snowy plover breeding season extends from March 1 through September 15. During the snowy plover non-breeding season (i.e., mid-September to late February, unless surveys confirm the absence of nesting snowy plovers from Ponds E12 and E13), a berm will be constructed between Ponds E12 and E13 to segregate Pond E12. Pond E12 will be drained to provide snowy plover nesting habitat while Ponds E8A, E8X, E9, E10, E13, and E14 will remain shallowly inundated during construction to discourage snowy plovers and other birds from nesting on the pond beds and allow for construction of the levee improvements during the summer season. The ponds will be inundated prior to March, when snowy plover nest selection is expected to occur. To achieve this for Ponds E8A, E9, E8X, and E13, the ponds will likely not be drained after the wet season and pond water levels will be managed by taking in bay water via the existing Pond E9 water control structure. The berm proposed for the distribution canal between Ponds E12 and E13 will be built at the beginning of construction (e.g., July 2008). Pond E12 would be drained using the Pond E12 and E13 pump, a temporary pump, or a new water control structure. The new Pond E14 water control structures will be installed prior to or during construction of the Ponds E9/E8X/E14 and Ponds E14/E13 levee improvements to facilitate water management during construction.

Mobilization for the levee improvements would likely occur in March. Vehicles will need to be allowed to traverse the Pond E12 levee during the snowy plover nesting season for access and delivery of materials. Pre-construction surveys or monitoring of the locations of nesting snowy plovers will be performed before work begins to ensure that no plovers (or other nesting birds) will be disturbed. Using disturbance-free buffers around active nests might be acceptable if there are few nests (allowing the work to occur outside the 600-foot buffers). After the snowy plovers have chicks, work on portions of the pond could be performed as long as the chicks are able to move well away from the work area and safely forage (possibly with some monitoring to ensure that the snowy plovers stay away from the work area and that access is not endangering chicks).

The preliminary design assumes that construction of the Ponds E9/E8X/E14 and Ponds E13/E14 levee improvements and lowering of the Pond E8A/E9 and North Creek levees will begin as soon after the wet season as possible (after March 15 in most years). As the ponds will be inundated, initial fill placement for the levee improvements will occur below water. Construction equipment will traverse the levees between Pond E9, Whale's Tail Marsh, and North Creek during the clapper rail nesting season (i.e., February 1 to August 31). Levee lowering along Old Alameda Creek will not occur during the early and middle portions of the nesting season so as to avoid disturbing active clapper rail nests, unless surveys are conducted and determine that no rails are present along the north side of the creek within 700 feet of the construction area, or within 200 feet on the south side of the creek. If surveys indicate the presence of clapper rails, or if surveys are not conducted, lowering of this levee will not occur before mid-July. However, because the majority of clapper rail nests in the Bay have hatched by mid-July (Joy Albertson, USFWS, pers. comm.), levee lowering along Old Alameda Creek will occur beginning July 15. Up to half of the material from the Old Alameda Creek and North Creek levees will be excavated in Year 1 (from the inner portion of the levees).

Gypsum pre-treatment and construction of internal connector channels may be performed using amphibious equipment during the summer when the ponds are wet. Alternatively, these activities may be performed after the ponds are drained, which would occur in late summer or fall after monitoring has determined that snowy plover nesting has been completed for the year. Similarly, ditch blocks and levee breaches could be constructed when the ponds are wet or dry. The first soil lift for the new Pond E10 levee would ideally occur after Pond E10 is drained (e.g., fall of Year 1), but could occur when the pond is wet.

Phase 1 Applied Studies

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key SBSP Project uncertainties related to ecosystem restoration. Specific applied studies that may be conducted in the project area could include studies to test the rate of sediment accretion in restored tidal areas, the effectiveness in decreasing flood hazard along Old Alameda Creek, and the formation of pond and panne habitats in tidal marsh to provide long-term habitat for shorebirds and waterfowl.

Pond E8A-E8X-E9 Action Area

The action area for the Ponds E8A, E8X, and E9 restoration activities includes: (1) Ponds E8A, E8X, E9, E10, E12, E13, and E14; (2) Old Alameda Creek, North Creek and Mount Eden Creek; (3) the outboard marshes and water-based access areas for barge-supported equipment, which will include the access route for water-based equipment; and (4) any other areas in the immediate vicinity of the project site that could be directly or indirectly affected by noise, dust, or other factors resulting from the proposed action.

Proposed Alviso Pond A6 Restoration Action

Alviso Pond A6 (Pond A6) will be restored to tidal habitat by breaching and lowering the outboard levee, excavating pilot channels through the fringe marsh outboard of the breaches, and constructing ditch blocks in the perimeter borrow ditch (Figure 2 in the Pond A6 BA). Since the time Pond A6 was leveed to create a salt pond, it has subsided by approximately 5 feet to an average elevation of 2.3 feet NAVD. The elevation of Pond A6 is below mean tide level (3.3 feet NAVD) and below the elevation at which marsh vegetation colonizes emerging mudflats. Pond A6 restoration would initially create large areas of emergent mudflat habitat. Over time, tidal channel and vegetated salt marsh habitats are expected to develop in Pond A6 as tidal channels reform and as sediment accumulates and vegetation establishes on the emerging mudflats.

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key SBSP Project uncertainties related to ecosystem restoration. The key research questions for Pond A6 and the associated applied studies activities include the rate of sediment accretion following restoration of tidal action and the impacts of California gulls (*Larus californicus*) on nesting birds and other key species.

Project Location

Pond A6 is located in the Bay and is bordered by Coyote Creek to the north, Alviso Slough to the east, Alviso Ponds A5 and A7 to the south, and Guadalupe Slough to the west. Pond A6 is owned by the Service and is part of the SFBNWR.

Proposed Design Elements

The Pond A6 design includes the following features:

- Outboard levee breaches
- Pilot channels
- Levee lowering
- Internal levee breaches
- Ditch blocks
- PG&E boardwalk

In addition, four short segments of new PG&E boardwalk and a pad for laydown of PG&E equipment that may be transported to the site via helicopter are proposed as part of this proposed action. These are described in more detail in the following sections.

Outboard Levee Breaches and Pilot Channels. Breaches through the outboard levee and pilot channels through the outboard marsh will be excavated at the locations of the four major remnant historic tidal channels (Figure 2 in the Pond A6 BA). The breach locations are:

- Alviso Slough north breach (LB-AN)
- Alviso Slough south breach (LB-AS)
- Guadalupe Slough north breach (LB-GN)
- Guadalupe Slough south breach (LB-GS)

Breach dimensions are based on the predicted channel dimensions once the restored site fills with sediment and develops mature vegetated marsh. These dimensions are adjusted to give a trapezoidal breach cross section with side slopes of 4:1 to 5:1 and a minimum bottom width of 10 feet. On the inboard side of the levee, the breach excavation will extend to the levee toe and meet the existing grade in the borrow ditch. Most of the breach excavations will be 30 feet wide at the top of the levee and 5 feet deep below the top of the levee (0.7 feet NAVD invert elevation). Two of the breaches will be larger, with top widths of 80 to 100 feet and depths of 8 feet (-2.3 feet NAVD invert elevation). Additional excavation from the borrow ditch and remnant channel will be allowed for borrow ditch block construction.

The pilot channels will be excavated to the depth of the breach (long-term equilibrium depth), with side slopes of 3:1. The pilot channel widths will be approximately 60 percent to 80 percent of the breach width at MHHW (long-term equilibrium width). Internal pilot channels will be excavated to 0.7 feet NAVD ± 0.5 feet and have widths at the pond bed of approximately 15 to 20 feet. The pilot channel widths will be approximately 60 percent to 80 percent of the breach

width at MHHW (long-term equilibrium width). Marsh vegetation will be excavated down to the root zone which will reduce the resistance to pilot channel bank erosion. Construction equipment will be allowed to operate within this width.

Material excavated from the levee breaches will be used to construct ditch blocks at LB-AN and LB-GN. At LB-AS and LB-GS, excavated material will be placed in the borrow ditch, but will not be allowed to block the borrow ditch channel. Excess earth and other material generated from excavation will be disposed within Pond A6 up to an elevation not to exceed 7.5 feet NAVD (MHHW). Excess earth disposal will be controlled to avoid blocking channels and destabilizing slopes and grades.

The pilot channels may be dredged hydraulically; if so, the spoils would be pumped into the pond to locations that would avoid excessive filling of remnant channels and turbidity after restoration. Pilot channel excavation material will not be side-cast on the adjacent marsh plain. For the Pond A6 pilot channels, the area between the top of the pilot channel excavation and the long-term equilibrium channel width is insufficient for placement of side-cast material.

Levee Lowering. Up to approximately 2,200 feet of the levee between Pond A6 and Guadalupe Slough (Guadalupe Slough levee) will be lowered to the marshplain elevation (MHHW or 7.5 feet NAVD) by excavating the levee. Levee lowering will occur between LB-GN and LB-GS levee breaches. Up to approximately 1,300 feet of the Alviso Slough levee will be lowered adjacent to LB-AN levee breach. Material generated from lowering these levees will be used to construct the ditch blocks. Additionally, up to approximately 150 feet of the Alviso Slough levee will be lowered adjacent to LB-AS levee breach to provide high tide conveyance (Figure 2 in the Pond A6 BA).

Material generated from levee lowering of Alviso Slough and Guadalupe Slough may be side-cast into the borrow ditch, but blocking of the borrow ditch will not be allowed in locations other than the ditch blocks.

Other portions of the Pond A6 outboard levees will not be lowered. Portions of the levee that remain high may continue to provide nesting habitat for California gulls and are expected to limit wave action. The bayfront levee between Pond A6 and Coyote Creek is expected to limit wave action at the Pond A6 south levee until the bayfront levee completely erodes. The Alviso Slough levee is expected to limit wave action at the Pond A9 levee east of Alviso Slough (i.e., opposite Pond A6). Increased wave action is expected across the lowered portion of the Alviso Slough levee, which may result in the need for more frequent maintenance on the Pond A9 levee.

Internal Levee Breaches and Internal Borrow Ditch Block. In anticipation of SBSP Phase 1 activities at Pond A6 (but part of a separately approved project to raise the electrical towers), PG&E has already breached the existing low internal levee and an access road in several locations to reconnect remnant historic channels. The breach excavations extend beyond the levee toe into either the internal borrow ditch or the remnant historic channel. Internal pilot channels were excavated to connect IB-4 to the remnant channel and to connect the remnant channel between IB-3 and IB-4 (Figure 2 in the Pond A6 BA).

As part of the SBSP Phase 1 project, excavated material will be placed in the internal borrow ditch to restrict water flow through the borrow ditch. For IB-8 and IB-11, earth can be side-cast onto the pond bed at least 10 feet from channels. A larger internal ditch block, similar to ditch blocks at LB-GN and LB-AN, will be constructed with material from IB-4 and the internal pilot channel by lowering a portion of the internal levee down to the pond bed. Other portions of the internal levee will not be lowered because the internal levee is at the appropriate elevation to provide vegetated marsh habitat. The new PG&E access road is at a similar elevation and is expected to provide marsh habitat over time, and therefore does not need to be removed. At locations where the road crosses artificial borrow ditches, culverts will be removed and the ditch will be back-filled to block flow in the ditch.

Outboard Breach Ditch Blocks. Two borrow ditch blocks, will be constructed at both LB-AN and LB-GN. The desired elevation of the top of the ditch blocks is MHHW (7.5 feet NAVD). At this elevation, the ditch blocks are expected to rapidly provide pickleweed marsh habitat. The fill elevation needed to practically achieve this elevation and account for settlement will be determined during final design. The length of the ditch blocks will extend 100 feet beyond the borrow ditch onto the pond bed. Top width will be 20 feet and side slopes will be 5:1 for slope stability. The ditch blocks will be spaced far enough apart to allow for the maximum potential channel width expected due to channel scour.

Ditch blocks will be constructed from onsite material generated from levee breaches and/or levee lowering. Some material has been excavated from the internal remnant historic channels by PG&E. Due to the depth and width of the borrow ditches, the desired ditch block dimensions are relatively large. The design dimensions were limited based on available earth within a reasonable haul distance.

PG&E Boardwalk. PG&E completed construction of new tower footings in 2007 to raise the footings to above the tide level by adding concrete prior to restoration of Pond A6. PG&E performed the tower raising work under a separate permit process, in coordination with the Service.

As part of Phase 1 of the SBSP Project, four new segments of boardwalk will be constructed to allow access to PG&E's electrical transmission towers and to provide access to two platforms that will be constructed by PG&E. These 40 x 40-foot platforms will be used for laydown of materials transported to the site by helicopter. The new boardwalk segments include a 40-foot extension of the existing boardwalk into Guadalupe Slough, a 100-foot extension of the existing boardwalk into Coyote Slough, and two 100-foot boardwalk segments extending perpendicular from the existing boardwalk within Pond A6 to the new platforms. In addition to the 100-foot extension of the existing boardwalk into Coyote Slough, the existing 200-foot long boardwalk at this location may need to be rebuilt.

The boardwalks will be supported by two 4 x 4-inch supports for every 10 feet of boardwalk constructed. No fill material will be used during construction. All of the boardwalk material below the water line (i.e., supports and sways) will be plastic, and untreated lumber will be used for the headers and boardwalk planks.

Access for Construction

Land and water access will be allowed for construction. Land access to the Pond A6 site for both workers and equipment will be off of Highway 237 via a combination of North First, Hope, Mill, Gold, and Elizabeth Streets. The land access route will depend on the timing of the Pond A8 Phase 1 action. If Pond A6 restoration is constructed before implementation of the Pond A8 Phase 1 action (see *Proposed Alviso Pond A8 Restoration Action* below), the existing access route along the "Hoxie Highway" (the dirt access road through Pond A8), Pond A8/A5 levee, and Pond A5/A7 levee will be used. The Pond A8 Phase 1 action will establish a new access route along the Pond A8 south levee and the Pond A5/Guadalupe Slough levee. This access route will be used if the Pond A8 Phase 1 action is implemented before the Pond A6 restoration. Both land access routes may require grading and widening improvements for construction access. Heavy vehicles will avoid crossing water control structures in the levees along access routes if the vehicle exceeds the weight bearing capacity of the structure. If this is not possible, engineer-approved precautions will be taken to avoid damaging the structures; these precautions will be specified in final design. The construction contractor shall be responsible for repairing any damages resulting from their operations.

Water access will be allowed at each breach location. Alviso Slough and Guadalupe Slough possess sufficient dimensions to provide limited barge access. If the new Alviso marina, a proposed project at the Alviso Marina County Park (Santa Clara Valley Water District {SCVWD)), is completed before the commencement of restoration activities at Pond A8, barges may be able to embark from that location, and traverse the intervening reach of Alviso Slough to reach the site. Otherwise, they will depart from the deepwater port at Redwood City and traverse the intervening access route through the Bay. Hydraulic dredging at the pilot channel locations may occur to excavate the pilot channels and establish water access channels. Excavation for water access will be allowed to exceed the pilot channel excavation dimensions, with water access channel widths of up to 150 feet, depths of up to 8 feet, and side slopes of up to 3:1, unless otherwise specified. Any structure built to provide water access (e.g., dock, piles, etc.) will be removed after construction is complete.

A staging area will be constructed to store and refuel construction equipment. The staging area will be located on a portion of the Pond A5 and Pond A7 levees and may be enlarged using fill material. A second or alternative staging area may be located at the Gold Street entrance to the pond complex. A berm will be constructed to enclose fueling areas, in accordance with State and County requirements.

Construction Process

Equipment and personnel used during construction will generally be as described in the PBO. Due to the location of the Pond A6 restoration project, construction methods, equipment, and access are more constrained than at a typical construction site. To assist with construction access and methods, water in Pond A6 may be drained for land-based equipment or maintained for floating equipment.

The lowering of outboard levees, excavation of pilot channels, and the breaching of outboard levees will be the primary earthwork components of the Pond A6 restoration. The outboard levees along Guadalupe and Alviso Slough will be lowered to the elevation of MHHW to create pickleweed marsh habitat. Borrow ditch blocks will be constructed with excavated materials from the lowered levees.

Construction Preparation

- The PG&E boardwalks and platforms will be constructed.
- Water control will be necessary to drain the site for land-based equipment and/or maintain depth for floating equipment.
- Equipment will be transported to the site on trucks via existing levee roads or sloughs (see *Access for Construction* above).

Design Element Construction Details

- Up to approximately 2,200 feet of the levee between Pond A6 and Guadalupe Slough (Guadalupe Slough levee) will be lowered to the marshplain elevation (MHHW or 7.5 feet NAVD).
- Up to approximately 1,300 feet of the Alviso Slough levee will be lowered adjacent to LB-AN.
- Most of the breach excavations will be 30 feet wide at the top of the levee and 5 feet deep below the top of the levee (0.7 feet NAVD invert elevation).
- Two of the breaches will be larger, with top widths of 80 to 100 feet and depths of 8 feet (-2.3 feet NAVD invert elevation).
- Internal pilot channels will be excavated to 0.7 feet NAVD ± 0.5 feet and have widths at the pond bed of approximately 15 to 20 feet.
- Breach dimensions will have a trapezoidal cross section with side slopes of 4:1 to 5:1 and a minimum bottom width of 10 feet.
- The pilot channels will be excavated to the depth of the breach, with side slopes of 3:1.
- The pilot channel widths will be approximately 60 percent to 80 percent of the breach width at MHHW (long-term equilibrium width).
- Two borrow ditch blocks will be constructed at both LB-AN and LB-GN. The desired elevation of the top of the ditch blocks is MHHW (7.5 feet NAVD).
- The length of the ditch blocks will extend 100 feet beyond the borrow ditch onto the pond bed. Top width will be 20 feet and side slopes will be 5:1 for slope stability.

Construction Schedule

Restoration construction is expected to occur over 2 to 3 seasons within a 24 to 36-month period. Unless measures are implemented to prevent sensitive species from nesting in the project area, the timing of construction (construction window) will avoid impacts to special-status species, such as clapper rails, and other sensitive species, including nesting birds such as California gulls.

Snowy plovers breed in Pond A8, including areas in close proximity to the "Hoxie Highway"

(i.e., the levee through Pond A8). The snowy plover breeding season extends from 1 March through 14 September. During this period, the "Hoxie Highway" will not be used for accessing Pond A6 unless pre-activity surveys or ongoing monitoring by Service staff or others has confirmed that no nesting snowy plovers are present.

Gulls are expected to be finished nesting (or nearly so) by August 1. Construction work prior to breaching will be allowed when the gulls have chicks and they are mobile enough to move away from the disturbance (e.g., if the chicks can move further down a levee or out into the pond away from the disturbance). Due to inter-annual variability of California gull nesting, breaching and inundating Pond A6 will not be allowed before September 1 without first conducting pre-construction surveys to check that all chicks are mobile.

There is virtually no breeding habitat for clapper rails around Pond A6 due to the narrowness of the outboard marsh. An abbreviated call-count survey protocol will be conducted to confirm the absence of clapper rails prior to any construction or excavation work that will take place during the breeding season (i.e., February 1 to August 31). If these surveys indicate the presence of clapper rails, construction activities between February 1 and August 31 will be allowed only at a distance greater than 700 feet from clapper rails in adjacent marsh areas and a distance greater than 200 feet from clapper rails across a major slough channel from the construction site (i.e., the opposite side of Guadalupe Slough or Alviso Slough). Otherwise, such construction and excavation activities will take place during the non-breeding season.

Phase 1 Applied Studies

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key SBSP Project uncertainties related to ecosystem restoration. Additional studies and future research projects may be conducted as the results of monitoring and initial applied studies indicate areas that are in need of further research. The key research questions for Pond A6 and the associated applied studies activities include the rate of sediment accretion and the impacts of gulls on nesting birds and other key species.

Pond A6 Action Area

The action area for the Pond A6 restoration activities includes: (1) Pond A6; (2) the lowermost reaches of Alviso Slough and Guadalupe Slough; (3) Ponds A5 and A7, and outboard marshes adjacent to Pond A6; (4) staging areas on a portion of the Pond A5 and Pond A7 levees, and possibly at the Gold Street entrance to the pond complex; (5) land-based access areas, which will include either the "Hoxie Highway" through Pond A8, the Pond A8/A5 levee, and the Pond A5/A7 levee, or a new access route along the Pond A8 south levee and the Pond A5/Guadalupe Slough levee, as described under *Access for Construction* above, areas that will be traversed by water-based equipment accessing Pond A6; (6) any other Bay locations within the action area for the larger programmatic action area where California gulls, displaced from construction activities and/or tidal inundation in Pond A6, could take up residence, thus potentially affecting listed species in other areas; and (7) any other areas in the immediate vicinity of Pond A6 that could be directly or indirectly affected by noise, dust, or other factors resulting from the project.

Proposed Alviso Pond A8 Restoration Action

The proposed Alviso Pond A8 (Pond A8) restoration action will introduce muted tidal action to create approximately 1,400 acres of shallow subtidal habitat in Ponds A5, A7, and A8 through the construction of a 40-foot notch at the southern end of Pond A8, and modified management of existing water control structures on Ponds A5 and A7 (Figure 2 in the Pond A8 BA). Pond A8 is often referred to in two sections: A8N (north) and A8S (south), and is divided by the "Hoxie Highway". Water levels in Pond A8N (409 acres) would exceed elevations of internal levees and spill into adjacent Ponds A5, A7, and A8S (1,023 acres), modifying the existing hydrologic regime in these ponds as well. Water levels during the tidal cycle would fluctuate evenly across all the ponds, but depths would vary due to differences in bed elevations. Depths would generally exceed those at which the ponds are presently managed (less than 1 foot in most areas) over the majority of the project site. The expected 1-foot increase in water depths will also require improvements to the small levee around the sump inlet pond (a.k.a., "donut") in Pond A4.

Assuming a 40-foot wide notch operation, water levels (though not depths) would be nearly uniform across Ponds A8, A5, and A7 and fluctuate approximately 0.5 feet about a mean elevation of approximately 4 feet NAVD. During periods when Pond A8 is subject to muted tidal action, flow across the notch will not be obstructed by gates or other structural elements. Partial restoration of tidal prism in these ponds will promote channel scour and increase salinity along Alviso Slough. The expected potential increases in channel width and salinity, and likely increase in salt marsh dominated vegetation over the existing freshwater marsh dominated vegetation, will improve navigation access in Alviso Slough in a sustainable fashion.

Operations of the existing Ponds A5 and A7 water control structures will be intake-only during the summer. During the winter, when salmonids are most likely to be present in Alviso Slough, 2-way flows through these structures will be maintained to reduce fish entrainment by allowing any fish that enter the ponds to exit through these structures.

Exchange between Pond A8 and Alviso Slough will be managed as needed during the wet season to maintain flood storage capacity presently offered by the ponds and avoid fish entrainment by eliminating tidal exchange during this period. This will be implemented by reducing the open notch width or completely eliminating tidal exchange at the Pond A8 notch. Initially, the notch would be closed February to May to avoid fish entrapment. Pending monitoring data (i.e., if monitoring indicates that fish entrainment is not a problem) notch operations could be adjusted to allow for additional bays to be opened year-round. Tidal exchange during the summer and fall months will be initially limited by opening only one of the several "bays" in the notch. Additional bays would be opened subsequently if monitoring confirms that tidal scour does not threaten to erode downstream levees.

Restoration of tidal action at Pond A8 is designed to be reversible so that in the event that unacceptable ecological impacts begin to occur, such as an increase in mercury bioavailability, tidal exchange in Pond A8 can be eliminated to prevent long-term adverse impacts, and water management at Ponds A5 and A7 can revert to ISP operations. If unacceptable long-term ecological impacts do not occur in the Pond A8 project, the next phase may be initiated, which

would involve introducing a larger tidal prism to the site, ultimately leading to the creation of fully tidal marsh habitat. However, this Phase 1 BO only pertains to the muted tidal conditions that will be introduced as part of Phase 1 activities.

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key project uncertainties related to ecosystem restoration. Additional studies and future research projects may be conducted as the results of monitoring and initial applied studies indicate areas that are in need of further research. The key research questions for Pond A8 and the associated area include assessment of mercury levels in sentinel species found in both ponded and tidal marsh habitat, and fish entrainment studies associated with the water management regime and configuration of the ponds.

Project Location

Pond A8 is located at the upstream end of Alviso Slough near the community of Alviso. Tidal marsh, mostly brackish, borders the outboard northern and eastern edges of Pond A8, the northern edge of Pond A7, and the southern edge of Pond A5. Ponds A5 and A7 border the western edge of Pond A8, and private property on a former landfill borders the southern edge of Pond A8. Pond A8 is currently managed as a seasonal pond, and Ponds A5 and A7 are operated as managed ponds. Ponds A5, A7, and A8 are owned by the Service (Figure 2 in the Pond A5, A7, and A8 BA). Pond A4, where a levee surrounding the sump inlet pond will be raised by 1-2 feet, is located on the southwest side of Guadalupe Slough, southwest of Pond A8. Pond A4 is owned by the SCVWD.

Proposed Design Elements

The Pond A8 design includes the following features:

- Armored notch
- Outboard pilot channel
- Infrastructure modification and protection
- Levee improvements

These features are described in more detail in the following sections.

Armored Notch. Muted tidal connection would be provided by construction of an armored notch through the perimeter levee that separates Pond A8 and upper Alviso Slough. Earth excavated to construct the notch would be placed within Pond A8 or used for maintenance of nearby levees. This structure would be designed to allow the width of the notch (i.e., the opening that allows water to flow in and out of the pond) to be adjustable, with a maximum width of approximately 40 feet. The depth of the notch would extend to approximately 1 foot above the average bed elevation of Pond A8 (-0.5 feet NAVD). The size of this structure has been selected to maximize the potential volume of water exchange between the slough and the pond while controlling water levels within the pond. Due to structural considerations, the notch would consist of eight 5-foot bays that can be opened and closed independently, allowing tidal exchange between the Pond A8 and Alviso Slough to be adjusted based on monitoring data.

Flow through the notch would occur during both flood and ebb tides. Operations of the existing Ponds A5 and A7 water control structures will be intake-only during the summer. During the winter, when salmonids are most likely to be present in Alviso Slough, 2-way flows through these structures will be maintained to reduce fish entrainment by allowing any fish that enter the ponds to exit through these structures. In combination with management of the Ponds A5 and A7 culverts as "flood only" culverts in the summer, the notch would enable ebb-dominated tidal asymmetry within the ponds to limit pond water levels while maximizing tidal prism in Alviso Slough. Concrete armoring of the sides and bottom of the notch structure would be required to prevent unintentional widening and/or deepening of the notch.

Water exchange would be limited, and tidal range within the three ponds would be muted during the dry summer and fall months. Water level fluctuation in the ponds over a tidal cycle would be small (approximately 0.5 feet) compared to the range of tidal change in the slough (over 8 feet).

Water levels in Pond A8N (409 acres) would exceed elevations of internal levees and spill into adjacent Ponds A5, A7, and A8S (1,023 acres), modifying the existing hydrologic regime in these ponds as well. Water levels during the tidal cycle would fluctuate evenly across all the ponds, but depths would vary due to differences in bed elevations. Depths would generally exceed those at which the ponds are presently managed (less than 1 foot in most areas) over the majority of the project site.

The 2-way (ebb and flood) flows across the open notch would minimize the potential for fish trapping inside the pond. When Pond A8 is subject to muted tidal action (see below for a discussion of the seasonality of notch closure), flow across the notch would not be obstructed by gates or other structural elements.

From modeling the Pond A8 action (during summer time when there would be no upstream flow), the estimated tidal prism increase during ebb and flood tides would be about 400 acre-feet. This 400 acre-feet would be exchanged between high-low to high-high water (during flood tides) and high-high to low-low water (during ebb tides). However, there may be a substantial difference in the duration of these flows between flood tides (about 4.8 hours) and ebb tides (8.4 hours). Assuming that 400 acre-feet is conveyed evenly across the 4.8 and 8.4 hour durations, the estimated flow rates of the "diverted" water differ for water into (approximately 1,000 cubic feet per second (cfs)) and out of (approximately 575 cfs) Pond A8.

These flows into and out of Pond A8 are on the same order of magnitude of the peak flow of a typical winter storm (approximately 2,600 cfs), but still ¼ to ½ of the stream flow total. Based on USGS gauge data (from 1930 through 1997), the average annual peak instantaneous flow is 2,600 cfs (mode) and 3,500 cfs (mean); the Corps established the 2-year peak instantaneous flow as 2,300 cfs. After a typical winter storm, the percentage of stream flow that is diverted into Pond A8 greatly increases over the modeled summer flows.

Partial restoration of tidal prism in these ponds would promote channel scour and increase salinity along Alviso Slough by shifting the tidal influence of the Bay farther upstream. The expected potential increases in channel width would improve navigation access in a sustainable fashion, which is a key objective of the Alviso Slough Restoration Project (a separate project

under consideration by the SCVWD that may implement dredging and/or vegetation removal in the slough to improve navigation).

Exchange between Pond A8 and Alviso Slough will be managed as needed during the wet season to maintain flood storage capacity presently offered by the ponds and avoid fish entrapment by eliminating tidal exchange during this period, when salmonids are most likely to be present in Alviso Slough. This will be implemented by reducing the width or completely eliminating tidal exchange at the Pond A8 notch. Initially, the notch would be closed February to May in order to avoid fish entrapment. Pending monitoring data, notch operations could be adjusted to allow for additional bays to be opened year-round. Tidal exchange during the summer and fall months will initially be limited to only one of the "bays' in the notch. Additional bays would be opened subsequently if monitoring confirms that tidal scour does not threaten to erode downstream levees.

Outboard Pilot Channel. An approximately 475-foot pilot channel would be excavated through the fringe freshwater marsh of Alviso Slough immediately outboard of the armored notch. This channel would facilitate tidal exchange through the notch by providing an initial flow path and removing erosion-resistant marsh vegetation so the channel can gradually enlarge through tidal scour. The top width of the constructed pilot channel will be over-excavated to approximately 130 feet to minimize the erosion of sediment that may be contaminated with mercury. The depth of the pilot channel will extend through the erosion-resistant vegetation and root mass to approximately 9 feet below existing grade. Rock armor will be placed immediately adjacent to the notch to limit erosion.

Infrastructure Modification and Protection. Under existing conditions, power lines suspended by wooden piles provide electricity to the Pond A8/A7 pump. These piles and transmission lines would be removed under restoration actions since electricity will not be needed and the Pond A8 and A5/A7 interior levee would be overtopped on a daily basis. The Pond A8/A7 pump would be salvaged for other purposes. In the event that the Phase 1 implementation were reversed and pumping required for water management in Pond A8, new power lines would have to be installed. Vehicular access along the Pond A8 and A5/A7 levee, and the Pond A8N/A8S interior levee would not be maintained under these restoration actions. Vehicular access would be limited to the perimeter levees of Ponds A8S, A5 and A7.

The expected 1-foot increase in water depths will require improvements to the small levee around the sump inlet pond (a.k.a., "donut") in Pond A4. The SCVWD periodically uses this sump to convey water from Pond A4 to Pond A5 via a siphon under Guadalupe Slough. Under baseline conditions, freeboard in the Pond A4 sump inlet pond is minimal, and increasing the elevations of the receiving water in Pond A5 will require the levee surrounding the sump to be increased by 1 to 2 feet.

As part of the Phase 1 construction, a nested monitoring well (one well location with three well casings inside) at Pond A7 will need to be properly abandoned. This work will be contracted out to a qualified drilling contractor. Depending upon well diameter and well depth, the typically accepted monitoring well destruction methods are to either drill down over the existing well to the total depth of the original boring and backfill the borehole with an approved sealing material,

or to pressure grout the well in place.

Levee Improvements. Some portions of the existing levees along the southern perimeter of Pond A8S will be improved to provide alternative vehicle access to Ponds A5, A6, and A7, since the flooding of Pond A8 will eliminate access through the "Hoxie Highway." In addition, as mentioned above, the Pond A4 'donut' levee will need to be raised to prevent overtopping.

Access for Construction

Land access to the Pond A8 site for both workers and equipment will be off of Highway 237 via a combination of North First, Hope, Mill, Gold, and Elizabeth Streets. Land access to the Pond A4 site for both workers and equipment will be off of Highway 237 via East Caribbean Drive. Water based access will be through Alviso and Guadalupe Sloughs. If the new Alviso marina, a proposed project at the Alviso Marina County Park, is completed before the commencement of restoration activities at Pond A8, barges may be able to embark from that location. Otherwise, they will depart from the deepwater port at Redwood City and traverse the intervening access route through Bay.

A construction staging area will be located at the Gold Street entrance to the pond complex and a berm will be constructed to enclose fueling areas, in accordance with State and County requirements.

Construction Process

Equipment and personnel to be used during construction will generally be as described in the PBO. Due to the location of Pond A8, construction methods, equipment, and access are more constrained than at a typical construction site. During construction, conservation measures such as silt fence, Environmentally Sensitive Area fence, and fiber rolls will be used to keep construction equipment in designated areas and prevent impacts to areas not in the designated construction zone.

Existing water control structures in Ponds A5 and A7 will remain, with their management being altered to intake-only during the summer with a return to 2-way flows in the winter. Electrical lines and wooden power line poles will be removed in Pond A8N.

Construction Preparation

- Prior to March 1 (the beginning of the snowy plover nesting season) during the year in which construction occurs, Ponds A8N and A8S will be flooded to a depth adequate to prevent snowy plovers from nesting in areas where they will be disturbed by construction activities. These water levels will be maintained throughout the duration of construction or the duration of the snowy plover breeding season, whichever is shorter.
- Equipment will be transported to the site on trucks via existing levee roads or sloughs (see *Access for Construction* above).

- Sheet pile will be installed around the water control structure locations and the construction area will be dewatered with portable pumps.

Design Element Construction Details

- The depth of the notch would extend to approximately 1 foot above the average bed elevation of Pond A8 (-0.5 feet NAVD).
- The notch would consist of eight 5-foot bays that can be opened and closed independently.
- An approximately 475-foot long pilot channel would be excavated through the fringing freshwater marsh of Alviso Slough immediately outboard of the armored notch.
- The top width of the constructed pilot channel will be over-excavated to approximately 130 feet and its depth would extend through the vegetation and root mass (approximately 9 feet).
- Rock armor will be placed in the pilot channel near the notch to limit erosion.
- Some portions of the existing levees along the southern perimeter of Pond A8S will be improved to provide alternative vehicle access.
- The Pond A4 'donut' levee will be raised to prevent overtopping.

Phase 1 Applied Studies

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key project uncertainties related to ecosystem restoration. Additional studies and future research projects may be conducted as the results of monitoring and initial applied studies indicate areas that are in need of further research. The key research questions for Pond A8 and the associated area include assessment of mercury levels in sentinel species found in both ponded and tidal marsh habitat, and fish entrainment studies associated with the water management regime and configuration of the ponds.

Pond A8 Action Area

The action area for the Pond A8 restoration area includes: (1) Ponds A5, A7, and A8; (2) a portion of Pond A4, where the small ring levee surrounding the sump will be raised; (3) Alviso Slough and Guadalupe Sloughs and associated outboard marshes; (4) land based access areas, including access via Highway 237 and North First, Hope, Mill, Gold, Elizabeth and East Caribbean Streets; (5) an equipment staging area at the Gold Street entrance; (6) areas that will be traversed by water-based equipment accessing Pond A8; and (7) any other areas in the immediate vicinity of Pond A8 that could be directly or indirectly affected by noise, dust, or other factors resulting from the proposed action.

Proposed Alviso Pond A16 Restoration Action Description

Alviso Pond A16 (Pond A16) will be reconfigured to create islands for nesting birds and shallow water habitat for foraging shorebirds (Figure 2 in the Pond A16 BA). Water in Pond A16 will be managed with three new water control structures (including a new intake structure between

Coyote Creek and Pond A17, where water will enter the Pond A16-A17 system), and development of an internal water circulation system using a series of berms and control structures such as flashboard weirs. In addition, a viewing platform and two interpretive stations will be constructed at Pond A16. Buffers between nesting islands and outboard levees have been built into the design to limit the impacts of recreational activities on nesting and roosting birds.

The design elements within Pond A16 will be the subject of an applied study which will test the effects of different island spacing and shapes on use by, and reproductive success of, nesting and roosting birds. In addition, different water management regimes will be tested to determine the best method for managing the pond for the target wildlife during the breeding and non-breeding seasons. The effects of public access on bird use of, and reproductive success on, nesting islands will also be studied.

Project Location

Pond A16 is located in the Bay and is bordered by Pond A17 and Coyote Creek to the north; Artesian Slough to the east; New Chicago Marsh and the Refuge's Environmental Education Center (EEC) to the south; and the New Chicago Marsh intake channel, Union Pacific Railroad (UPRR), and Alviso Ponds A15 and A13 to the west. Pond A16 is owned by the Service.

Proposed Design Elements

The Pond A16 design includes the following features intended to create islands for nesting birds and shallow water habitat for foraging shorebirds, as well as to allow public access and interpretive public education at this site:

- Nesting islands
- Earth berms
- Water control structures
- Borrow ditch filling
- Recreation

These features are described in more detail in the following sections.

Nesting Islands. Up to 50 circular and linear nesting islands will be constructed within Pond A16 to provide bird nesting habitat. Material needed to construct islands will be borrowed onsite, from the windward side of the islands, with a minimum 10-foot bench between the borrow area and toe of the new island. It is estimated that due to soil characteristics, side slopes will need to be 5:1 or flatter to construct stable islands. Currently 25 circular islands and 25 linear islands are proposed in Pond A16. Each island will be approximately 3 feet high, have a surface area of approximately 15,000 square feet, and a minimum distance of 100 feet from other islands. To isolate islands from recreational trails and land-based predators, they will be at least 300 feet from outboard levees, 100 feet from internal berms, and 600 feet from the public viewing platform.

The nesting islands are expected to settle over time due to the weak and soft condition of the Bay mud. Maintenance is expected to be required within about 5 to 10 years to raise the nesting islands, unless the lower, subsided nesting island elevations are used successfully by nesting birds.

In locations where the borrow areas for the nesting islands are near historic channels in the cells, the borrow areas will be excavated to connect to these channels. This is expected to facilitate circulation within these borrow areas. In other locations, connections will not be excavated to borrow areas except to facilitate construction access.

Earth Berms. Earth berms will be constructed in Pond A16 to divide the pond into three cells. Berm design may vary slightly for berms along the intake canal, outlet canal, and those between cells. As with islands, material needed to construct the berms will be borrowed onsite, with a minimum 10-foot bench between the borrow area and toe of the new berm. The berms will range in height from approximately 2 to 6 feet. It is estimated that berm side slopes will also need to be 5:1 or flatter. As discussed for the nesting islands, maintenance is expected to be required within about 5 to 10 years to raise the berms due to settling of the material.

Water Control Structures. Water control structures for Pond A16 restoration will include culverts and flashboard weirs. The water control structures are designed to achieve an average cell water depth of approximately 6 inches (range: 2 inches to 1 foot), provide adequate flushing for bird habitat and water quality objectives, prevent salmonid entrapment, and minimize manual management while increasing management flexibility. The preliminary design includes the water control structures described below.

Pond A17 intake structure. Water will enter the Pond A16-A17 system through a new Pond A17 intake structure between Coyote Creek and Pond A17. This structure will consist of two new 4-foot intake culverts with combination slide/flap gates on each end (i.e., on both sides of the culverts), in addition to the single existing 4-foot culvert with combination slide/flap gates. The culverts will have trash racks on the Coyote Creek side.

A pilot channel will be excavated from Coyote Creek to the structure through the existing fringe marsh. The preliminary design includes a 20-foot long trapezoidal pilot channel with 3:1 side slopes. The channel is anticipated to have a 75-foot top width and a 28-foot bottom width. The channel will be excavated to a depth of approximately 7.5 feet below the adjacent marsh plain; the channel bottom will be about 1 foot below the culvert invert.

The currently proposed location of the intake structure is the northwest corner of Pond A17, near the western end of the levee between Coyote Creek and Pond A17; however, the final location of this structure, and the potential for flow to the structure to cause scour at the Coyote Creek railroad bridge, are still being evaluated. The outboard marsh is narrowest in this location, therefore installing the culvert in this location will reduce the area of outboard marsh excavation required for the pilot channel.

Pond A16 intake structure. Three new 4-foot intake culverts, with combination slide/flap gates on the ends of each will be added between Pond A17 and Pond A16. This structure will be

located in the existing channel cut between the ponds. The new Pond A16 intake structure is recommended to provide flexibility and ease of managing water levels in Pond A17.

The existing channel cut between Ponds A17 and A16 could remain open without installing culverts; however, Pond A17 water levels would need to be managed by adjusting the Pond A16 cell intake structures (multiple weirs as discussed below). As the restoration will increase flows between Ponds A17 and A16, measures would be required to reduce scour of the levees along the existing channel cut, such as enlarging or armoring the channel. Hydraulic modeling indicates that the existing channel would need to be enlarged to twice the existing dimensions. The option of leaving the channel cut between Ponds A16 and A17 open (and possibly widening it), rather than installing new Pond A16 intake culverts in this channel, will be further evaluated as the design progresses.

Cell intake and outlet structures. Weirs with adjustable flashboard risers (flashboard weirs) will be used to control flow in and out of cells. Each cell in Pond A16 will have two intake and two outlet structures, each consisting of multiple 4-foot wide weirs. Cell 1 will have two 4-foot wide flashboard weirs per intake and outlet structure, and Cells 2 and 3 will have three 4-foot wide flashboard weirs per intake and outlet structure. Additional flashboard weirs may be included and buried in the adjacent berm to provide stability.

In addition, Cells 2 and 3 will have "auxiliary" structures to provide management flexibility for seasonal operations and intermittent management (e.g., draining). Some cell outlet structures will be located where deeper historic channels and borrow ditches cross the berms. These structures will include culverts to flush deeper water from these channels. These culvert structures will also have flashboard weirs to control flows and water levels. Similar structures will connect the intake canal to the outlet canal in two locations.

Pond A16 outlet structure. Six new 4-foot outlet culverts, with combination slide/flap gates on both ends of each culvert, will be added between Pond A16 and Artesian Slough. This new structure will be located to the south of the existing outlet culvert, which is a single 4-foot outlet culvert with combination slide/flap gates. A pilot channel will be excavated through the existing fringe marsh from the structure to the Artesian Slough side channel along the southeastern edge of Pond A16. The preliminary design includes a 50-foot long trapezoidal channel with 3:1 side slopes. The channel is anticipated to have a 105-foot top width and a 48-foot bottom width. The channel will be excavated to a depth of approximately 9.5 feet below the adjacent marsh plain; the channel bottom will be about 1 foot below the culvert invert.

Borrow Ditch Filling. Imported fill material will be used to fill the borrow ditches, if and when fill material of acceptable quality is readily available. Filling the borrow ditches is expected to improve water quality by reducing the potential for water column stratification and hypoxic conditions in the bottom layer. The borrow ditches will be filled in stages through an adaptive management process. This process will require different sections of the borrow ditch to be filled to varying elevations in stages. The section of the borrow ditch used as the Pond A16 intake canal will be filled first to improve cell intake water quality. Water quality monitoring in sections of the borrow ditches, with different fill elevations (or no fill), will determine the effectiveness of, and need for, additional borrow ditch fill in the pond. Borrow ditches provide

island-nesting birds with some protection against mammalian predators, and thus, filling these ditches could increase predation risk for these birds to some extent. However, predator control will be implemented in conjunction with the SBSP Project, and predation problems noted at Pond A16 will be addressed appropriately.

Approximate fill elevations and volumes are based on neat line quantity estimates and do not include the effect of settlement of underlying Bay mud, which is expected to decrease fill elevations over time. The fill elevations are intended to decrease borrow ditch depths while maintaining the hydraulic function of the intake and outlet canals and berm stability (i.e., not filling the intake canal borrow ditch above the elevation of the pond bed). Determining the optimal amount of fill will require additional analysis, and a review of the trade-offs between improving water quality and maintaining the canals as deterrents to access of nesting islands by mammalian predators. Stage order and fill elevations may change due to adaptive management and fill availability.

Recreation. The recreational features within the Alviso pond complex would be managed by the Service as part of the current public access program. Currently, the Service allows pedestrian and bicycle access (no dogs) on the Alviso Slough Trail, including the levees around A16 and A17. Phase 1 will continue to allow the same public access around these ponds. However, studies of the effects of public access on use of islands by nesting birds, and reproductive success of nesting birds, will be conducted, and results of those studies will be used to determine whether periodic closures of trail segments to protect sensitive wildlife are needed.

The public access and recreation plan for Pond A16 includes a proposed viewing platform and two interpretive stations that would be accessible from the existing levee along the Pond A16 and Artesian (Mallard) Slough levee trail network that currently encircles Ponds A16 and A17. These recreational features would be accessed from the EEC, or possibly from the trail network originating at the Alviso Marina County Park. The interpretive stations would be located at strategic locations along this existing trail network to provide visitors with unique viewing, birding and educational opportunities, as well as information about the transformation of Pond A16 as a managed pond. These interpretative stations will be constructed of a combination of wood and steel and sized based on the site location. A portion of the levee will need to be resurfaced to provide a firm and stable surface to conform to ADA standards.

Pond A16 Viewing Platform. The Pond A16 viewing platform would be installed at the southern edge of Pond A16, approximately 0.75 mile from the existing EEC boardwalk, allowing visitors relatively easy access to this station. The platform would be raised between 5 and 10 feet above the existing grade of the levee, allowing visitors to overlook the managed pond restoration in Pond A16. An interpretive station would be incorporated into the design of the viewing platform. The year-round trail from the EEC to the viewing platform will be incorporated into the levee along the southern edge of Pond A16 and will bisect Pond A16 and New Chicago Marsh. The platform would be constructed of steel and recycled plastic and accessed by an ADA-compliant ramp and a set of stairs, which are configured to minimize circulation areas while maximizing useable gathering and viewing space. A railing will be designed to provide a safety edge and to facilitate a comfortable birding experience. An interpretive station and seating is integrated into the platform.

Pond A16 Interpretive Station. A second interpretive station would be located adjacent to the freshwater marsh area along the eastern edge of the pond, approximately 0.8 mile from the existing boardwalk. The exact location of the station will be based on field conditions of the site. The interpretive station would be adjacent to the existing trail and would augment information provided at the other station.

Access for Construction

The land access route for both workers and equipment will be via Zanker Road, off Highway 237, and through the EEC entrance to the Pond A16 levees. The levees may require grading and widening improvements for construction access. The water access route to the site will be from the Bay via Coyote Creek, Artesian Slough, and/or the ponds to the north of Pond A16. Water access from the Bay is constrained by the UPRR railroad bridges. The Coyote Creek Bridge can no longer be opened, however the Mud Slough Bridge can be opened to provide barge access. From Mud Slough, barge access to the site will be allowed through the Island Pond A20 dredge lock, borrow ditch, and breach to Coyote Creek, if the contractor determines that this is possible. This route was used by Cargill prior to breaching the Island Ponds. Small modular barges may be assembled after being transported to the site. Small barges may also be launched at the San Jose boat ramp in Artesian Slough. Amphibious equipment may access the site through the ponds to the west of the UPRR and the road crossing the UPRR between Ponds A15 and A16. This road may require grading and widening improvements for access.

Water access to the Pond A16 site may occur at the new Pond A17 intake structure, new Pond A16 outlet structure, and the existing Pond A16 and Pond A17 dredge locks. Hydraulic dredging at the structure locations will be used to excavate the pilot channels and establish water access channels. Excavation for water access may exceed the pilot channel excavation dimensions, with water access channel widths of up to 150 feet, depths of up to 8 feet, and side slopes of up to 3:1, unless otherwise specified. Any structure built to provide water access (e.g., dock, piles, etc.) will be removed as part of demobilization.

A staging area will be constructed to store and refuel construction equipment. The staging area will be located on a portion of the Ponds A16 and A17 levees and may be enlarged using fill material. A second or alternative staging area may be located near the EEC.

Construction Process

Equipment and personnel to be used during construction will generally be as described in the PBO. Due to the location of the Pond A16 restoration project, construction methods, equipment, and access are more constrained than at a typical construction site. To assist with construction access and methods, Pond A16 will be drained prior to construction. Draining the ponds will incrementally consolidate the surface mud, increasing workability for fill operations. It is expected that this will not allow sufficient drying of the pond bottom for the use of conventional construction equipment or even low ground pressure equipment. If reconnaissance prior to construction bidding shows that sufficient drying is unlikely to take place by the start of construction, then it is anticipated that the ponds will be inundated and amphibious and/or water-

based (marine) construction equipment will be required.

Islands and berms will be the primary earthwork components of Pond A16 restoration. Borrow material varies in this location and is not always optimal for earthwork construction. If draining and drying are insufficient, borrow material may have a high water content. Due to this and other soil characteristics, material may be prone to slumping during construction. Islands and berms will require a minimum of two lifts, with wait time in between, to achieve the desired elevation. Cargill has achieved approximately 18 inches per lift in previous island and levee construction. Construction of the existing Pond A16 islands was done in-the-wet. New island and berm heights will need to be over-built 20 percent or more to allow for settlement after construction.

Culvert pipe water control structures in existing and new levees will be installed by cutting a trench in the levee. Culvert pipes will be placed on a layer of rock base over a geofabric layer between the underlying Bay mud and the rock. Backfill will be compacted in lifts. Wood headwalls and wingwalls on either side of the levee will be supported by wood piles. Sheetpile cofferdams will probably be needed on the creek and slough sides of the Pond A17 intake structure and Pond A16 outlet structure. The need for limited dewatering is anticipated while the trench is open. The fish screen at the Pond A17 intake structure will be placed close enough to the existing levee so that it can be removed for maintenance with a backhoe. Pre-cast concrete flashboard weirs will be placed in new berms within Pond A16. The contractor will determine whether flashboard weirs are placed first and the berm built around them, or vice versa.

Construction Preparation

- Water control will be necessary to drain the site for land-based equipment and/or maintain depth for floating equipment.
- Equipment will be transported to the site on trucks via existing levee roads or sloughs (see *Access for Construction*).
- Sheet pile will be installed around the water control structure locations and the construction areas will be de-watered with portable pumps.

Design Element Construction Details

- Low check berms will be constructed to create a series of three cells. Check berms will range in height from approximately 2 to 6 feet. The berms will be constructed by excavating fill material on-site.
- Water control structures, such as flashboard weirs, will be installed in the berms to regulate flow into and out of the cells.
- New intake/outlet water control structures with tide gates will be installed (or existing water control structures will be modified) between Coyote Creek and Pond A17, and between Pond A16 and Artesian Slough.
- Intake and outlet canals will be created in Pond A16 to convey flow in and out of individual cells. The canals will be located around the perimeter of the cells in portions of the deep existing borrow ditch and remnant tidal channels in Pond A16.

- Intake and outlet canals will be constructed to convey water to and from individual cells.
- A fish screen will be installed on the existing Pond A17 culvert and any new Pond A17 culverts if required by NMFS.
- Up to 50 nesting islands (25 circular and 25 linear) will be constructed within the four cells. Each island will be approximately three feet high and have a surface area of approximately 15,000 square feet. The islands will be constructed using fill material excavated from the windward side of the islands.
- Water levels will be managed to provide an average depth of approximately 6 inches, with depths ranging from approximately 2 inches to 1 foot though with some deeper areas around islands, in borrow ditches, and in other portions of the pond.
- A viewing platform will be constructed in the southwestern corner of Pond A16. The platform will be raised above the existing grade of the levee 5 to 10 feet and will be constructed of steel and recycled wood with ramps and railings as needed.
- An additional interpretive station will be located on the eastern edge of Pond A16 in a central location, approximately 0.8 mile from the existing boardwalk.

Construction Schedule

Construction at Pond A16 is expected to occur over 2 to 3 seasons within a 24 to 36 month period. Unless measures are implemented to prevent sensitive species from nesting in the proposed action area, the timing of construction (construction window) will avoid impacts to listed species, such as snowy plovers, and other sensitive species, including nesting birds such as Forster's terns, avocets, and stilts that currently nest on existing island in Pond A16.

Construction can start at the beginning of the dry season if nesting is prevented. Nesting may be prevented by hazing or by removing the existing islands prior to the breeding season. Regardless, when the pond is drained for construction, it may serve as nesting habitat for some species, most likely including gulls, terns, avocets, stilts, and potentially snowy plovers. Therefore, the construction windows and/or pre-construction surveys for nesting gulls, Forster's terns, avocets, stilts, and snowy plovers will be implemented.

If the pond needs to be dry during work, hazing, beginning prior to nesting, may be employed to try to prevent nesting. Once the pond is dry, pre-construction surveys will be performed before work begins to make sure that no snowy plovers (or other nesting birds) will be disturbed. Using disturbance-free buffers around active nests might be acceptable if there are few nests (allowing the work to occur outside the 600-foot buffers). After the snowy plovers have chicks, work on portions of the pond can be performed as long as the chicks are able to move well away from the work area and safely forage (possibly with some monitoring to ensure that the snowy plovers stay away from the work area). If construction occurs with amphibious or floating equipment, then the pond may be flooded to prevent nesting in the pond bottom prior to construction. In this case, a combination of hazing prior to nesting, pre-construction surveys, and/or buffers around existing nests would be implemented with respect to the possibility of nesting on the existing islands, or these islands would be removed prior to the breeding season.

After construction has been completed, inundation of the pond during the snowy plover nesting season of March 1 to September 15 (which encompasses the nesting season of other potential pond-breeding birds) can occur only if pre-construction surveys (and monitoring, if snowy plovers are detected within the pond) determine that no snowy plovers are actively nesting within the pond (i.e., there are no nests with eggs) and all young have fledged. Start dates between September 20 and February 1 for construction activities that do not involve inundating the pond will be allowed only if pre-construction surveys and monitoring determine that no snowy plovers are actively nesting within the pond and all young have fledged, or that active nest sites with eggs are located more than 600 feet from the construction site. After the snowy plovers have chicks, work in specific portions of the pond, not involving inundating the pond, can be performed as long as the chicks are able to move well away from the work area and safely forage (with some monitoring to ensure that the snowy plovers stay away from the work area). These same considerations will be made for other waterbirds, including Forster's terns, avocets, and stilts, that may breed in Pond A16. These species are finished nesting by August 1 in most years, but a few late pairs may have young through August.

An abbreviated call-count survey protocol (e.g., two surveys using tape playbacks during the February to mid-March primary calling period) will be conducted to confirm the absence of clapper rails prior to any construction or excavation work that will take place along Coyote Slough during the breeding season (i.e., February 1 to August 31). If these surveys indicate the presence of clapper rails, construction activities between February 1 and August 31 will be allowed only at a distance greater than 700 feet from clapper rails in adjacent marsh areas and a distance greater than 200 feet from clapper rails across a major slough channel from the construction site. Otherwise, such construction and excavation activities will take place during the non-breeding season.

Phase 1 Applied Studies

A number of applied research studies will be implemented as part of Phase 1 to answer questions regarding key project uncertainties related to ecosystem restoration. Specific applied studies that may be conducted in Pond A16 include studies to test the effects of island density, shape and distribution on bird nesting use and reproductive success. As part of Phase 1, applied studies will be implemented to examine the potential impacts of landside public access on birds or other target species within Pond A16. Additional studies may be performed to study the effectiveness of management approaches to control vegetation encroachment on the nesting islands and shallow water foraging areas and to control mammalian and avian predation on waterbirds.

Pond A16 Action Area

The Pond A16 action area includes: (1) Ponds A16 and A17; (2) the adjacent reaches of Artesian Slough and Coyote Creek; (3) outboard fresh and brackish marshes, adjacent portions of New Chicago Marsh and Triangle Marsh; and (4) staging areas on Pond A16 and A17 levees (Figure 2 in the Pond A16 BA). Water access may be gained from Mud Slough via the Island Pond A20 dredge lock, a borrow ditch and breach to Coyote Creek, from Pond A15, from the road crossing between Ponds A15 and A16, or via the City of San Jose boat ramp at Alviso Slough. Land access to Pond A16 levees may also occur from Highway 237, Zanker Road, and the EEC. The

action area also includes portions of the Bay that will be affected by discharge of water or sediment from Pond A16 during construction and pond operation or that will be traversed by water-based equipment accessing Pond A16, and any other areas in the immediate vicinity of Pond A16 that could be directly or indirectly affected by noise, dust, or other factors resulting from the proposed action.

Proposed Operations and Maintenance Activities for the Service and CDFG

On-going O&M activities will be performed periodically for all SBSP Project facilities, including reconfigured and managed ponds, recreational/public access facilities, and (less frequently) tidal habitat restorations. Operations, management, and maintenance activities are currently being performed in a manner partially described in the 1995 biological opinion issued to Cargill (Service File Number 1-1-95-F-0047) but the operations of the former salt ponds were changed when ownership was transferred to the Service and CDFG. A new operational plan was developed, termed the ISP, and most of the infrastructure was put in place to implement that plan. Since that time the operation of water management within the ponds has changed somewhat, and will continue to change in response to conditions. Additionally, a series of ponds (the Phase 1 actions) are variously changing to tidal or more intensively managed, therefore water management and operations are also changing. Levees, ponds, and water control structures will be routinely operated and maintained according to the best management practices described herein.

The scope of this Phase 1 BO includes the on-going O&M for all the ponds and the adjoining habitats that are within the programmatic SBSP Project area and attempts to capture all current and future actions that may occur as part of ISP and Phase 1 activities. Levees need to be maintained for flood protection and habitat protection purposes, water control structures require maintenance for proper operation, trails will need to be maintained, inlet and outlet channels through tidal marsh to these structures require periodic dredging, trash racks and fish screens need to be cleaned, islands created for nesting and roosting habitat will need periodic vegetation control and rebuilding with sediment, and the Service and CDFG will need to respond to emergency situations. Each of these activities will require access (by land and/or water), staging areas, and storage areas.

Project Location

The O&M aspects of the project include the entire SBSP Project area located in the Bay in Northern California within San Mateo, Santa Clara, and Alameda Counties. A detailed description of the SBSP Project area is discussed in the PBO and is hereby incorporated by reference.

Operation and Maintenance of the SBSP Project

Water Management Operations. Since 2004, the ponds within the SBSP Project area have been managed to provide habitat values while the long-term restoration plan is being developed. Bay waters have continued to be circulated through water control structures and existing levees have been maintained. Additionally, some ponds have been managed for bird or other wildlife

habitat as seasonal ponds, which fill with rain water in the winter, and which dry through evaporation in the summer months. Other ponds have been operated as high salinity ponds. The Island Ponds (Ponds A19, A20 and A21) in the Alviso pond complex were breached to tidal action in March 2006. The detailed design for the restoration was completed by SCVWD and included two breaches to Pond A19, one breach to Pond A20, and two breaches to Pond A21. All breaches were on the south side of the ponds, connecting the ponds to Coyote Creek.

Phase 1 restoration actions will directly impact the design and management of Ponds A5, A6, A7, A8, A16, A17, SF2, E8A, E8X, E9, E12, E13, and E14. Most of the remaining ponds are managed to maintain open water conditions. Without the introduction of Bay water, these ponds will dry down during the summer and become seasonal ponds in the winter, which will significantly reduce open water habitat heavily utilized by migratory and resident birds. Subsequent sections describe the operations of each pond system in more detail.

Alviso Complex. Below is a description of how the Service will operate ponds within the Alviso Slough complex of the SBSP Restoration Project area. To maximize water circulation patterns within ponds, the Refuge generally plans to operate all ponds that are unaffected by Phase 1 actions as directional systems, as described below. Each of the water control structures in these directional systems will be operated in a 1-way fashion, with water entering through the intake in one pond, then flowing through the entire system until exiting through a 1-way outlet in another pond. However, some systems, particularly Pond A3W, may occasionally be operated as 2-way, muted tidal systems in order to aid water quality within the systems. Additionally, flows may be reversed, for 2-4 week durations, during winter or summer months to flush out sediment that accreted in trash racks and other water control structures.

Alviso System A2W. The intake Pond A1 receives water at its northwesterly end from Charleston Slough via an existing 60-inch gate structure. From Pond A1, a 72-inch siphon that runs under Mountain View Slough transfers water to Pond A2W. The outlet Pond A2W discharges pond water at its northerly end to the Bay through a 48-inch gate structure.

Alviso System A3W. The intake Pond AB1 receives water from the Bay via a 36-inch gate structure and from a 48-inch culvert. The outlet Pond A3W discharges pond water through three 48-inch gates to Guadalupe Slough near the Sunnyvale Water Pollution Control Plant (WPCP) outfall. The normal flow in this system follows two routes. One route is from AB1 to A2E to A3W. The second route is from AB1 to AB2 and then to A3W. To improve water quality and maintain desired water levels, the outlet at A3W will occasionally be operated in a 2-way fashion. This system also includes pond A3N, which operates as a seasonal pond.

Alviso System A5. The intake at Pond A5 receives water from Guadalupe Slough through two 48-inch gate structures; and occasionally from Pond A4 (owned by the Santa Clara Valley Water District) through a siphon under Guadalupe Slough. From Pond A5 water is routed to Pond A7. The outlet at Pond A7 discharges water through two 48-inch gate structures to Alviso Slough. Over the past few years, Pond A8 has been operated as a seasonal pond. Restoration actions will introduce muted tidal action to this pond complex through the construction of a 40-foot notch at the southeastern end of Pond A8, and modified management of existing water control structures

on Ponds A5 and A7. Water levels will be nearly uniform across Ponds A8, A5, and A7 and fluctuate approximately 0.5 feet about a mean elevation of approximately 4 feet NAVD. Operations of the existing Ponds A5 and A7 water control structures will be intake-only during the summer. During the winter, when salmonids are most likely to be present in Alviso Slough, continuous flow through these structures will be maintained to reduce fish entrainment by allowing any fish that enter the ponds to exit through these structures. Exchange between Pond A8 and Alviso Slough will be managed as needed during the wet season to maintain flood storage capacity presently offered by the ponds and avoid fish entrainment by eliminating tidal exchange during this period. Initially, the notch will be closed February to May to avoid potential fish entrapment. Pending monitoring data (i.e., if monitoring indicates that fish entrainment is not a problem) notch operations could be adjusted to allow for additional bays to be opened year-round. Tidal exchange during the summer and fall months will be initially limited by opening only one of the several "bays" in the notch. Additional bays will be opened subsequently if monitoring confirms that tidal scour does not threaten to erode downstream levees. Restoration of tidal action at Pond A8 is designed to be reversible so that in the event that unacceptable ecological impacts begin to occur, such as an increase in mercury bioavailability, tidal exchange in Pond A8 can be eliminated to prevent long-term adverse impacts, and water management at Ponds A5 and A7 can revert to ISP operations.

Alviso Pond A6. Pond A6 is operated as a seasonal pond, with no inlet or outlet structures. During Phase 1 of the SBSP Project, Pond A6 will be restored to full tidal action.

Alviso System A14. This system consists of seven ponds. The Pond A9 intake receives water from Alviso Slough through two 48-inch gates. The outlet at Pond A14 discharges water through two 48-inch gate structures into Coyote Creek. The route of flow through this system is from A9 to A10 to A11 to A14. Over the past few years, Ponds A12, A13, and A15 have been operated as batch ponds to maintain higher salinity levels, although there is seasonal variation in water levels and salinity in this pond complex. To avoid potential salmonid entrainment, this system does not intake water from the Alviso Slough between December and April. The intake structure at Pond A9 will be closed during the winter to avoid entraining migrating salmonids, resulting in relatively small discharge from this system in these months.

Alviso System A16. This consists of two ponds (A17 and A16) that are operated under continuous flow, with intake water from Pond A17 entering from Coyote Creek through a 48-inch gate and discharge entering Artesian Slough through a 48-inch gate structure. To avoid potential salmonid entrainment in winter, flows are reversed with water entering the A16 structure and discharge occurring at A17. Under Phase 1 implementation, Pond A16 will be reconfigured to create islands for nesting birds and shallow water habitat for foraging shorebirds. Water in Pond A16 will be managed with three new water control structures (including a new intake structure between Coyote Creek and Pond A17, where water will enter the A16/A17 system), and an internal water circulation system using a series of berms and control structures such as flashboard weirs. Water control structures will allow for an average cell water depth of approximately 6 inches (range 2 inches to 1 foot), provide flushing for bird habitat and water quality objectives, and a fish screen will be installed to prevent salmonid entrainment.

Ravenswood Complex Operations. Below is a description of how the Service will operate

ponds within the Ravenswood complex of the SBSP Project area.

Ravenswood System R1, R2, R3, R4, R5 and S5. The Ravenswood ponds on the north side of Highway 84 have been managed as seasonal ponds during ISP operations, with rainfall as the only source of water, and allowing the ponds to dry seasonally. In particularly dry summers, water is taken in from the bay through existing water control structures to Pond R1 to cover the pond bottom to prevent blowing dust from causing air quality concerns. This management is expected to continue for the foreseeable future. Alternatively, water control systems may be installed to allow interim management. If so, the goal will be to reduce pond salinities for the following 3 years, and subsequently operate the ponds as five separate sub-systems, as follows:

1. Operate Ponds R1, R2, and R3 as independent single pond systems each with inlet/outlet structures; and
2. Operate Ponds S5, R5, and R4 as a system, taking in Bay water through Pond S5, then to Pond R5 and discharging through Pond R4.

These scenarios would require the construction of new water control structures. Water control structures in Ponds R1, R2, and R3 would be 2-way, with gravity intake flows at high tide and outflows occurring at low tide. The Ponds S5, R5, and R4 would be operated as a 1-way, continuous flow system.

Ravenswood System SF2. Pond SF2 is currently managed as a seasonal pond. Pond SF2 will be reconfigured to create islands for nesting and roosting birds and shallow water habitat for shorebird foraging. The pond will include two management cells within which water levels will be managed to provide optimal depths for shorebird foraging, and nesting islands will be constructed within both cells. The third, western-most cell will be managed as a seasonal wetland. Water control structures will be used both to manage water levels and flows into and out of Pond SF2 from the Bay, and between cells, for shorebird foraging habitat and to meet water quality objectives. Water will flow into and out of Pond SF2 through a new water control structure comprising up to six 4-foot inlet culverts that will be located near the southern end of the bayfront levee. Weirs with adjustable flashboard risers (flashboard weirs) will be used to control flow in and out of cells, and water circulation through the bay front cell in Pond SF2 will be managed to meet water quality targets at the discharge point.

Eden Landing Complex Operations. Below is a description of how the CDFG will operate ponds within the ELER complex of the SBSP Project footprint.

Eden Landing Systems E2 and E2C. The E2 system consists of four ponds, and the E2C system consists of eight ponds. In 2005, CDFG linked these systems together. The objective of system E2-E2C is to maintain year-round open water habitat in Ponds E1, E2, E6, E5, and E2C and winter open water habitat in all of the Ponds (E1, E2, E7, E4, E6, E5, E2C, E1C, E4C, E5C, and E6C). Pond E3C, owned by Cargill, is still part of the E2C system and will be operated as year-round open water habitat until it is decoupled from circulation patterns. In the Pond E2 system, the intake pond E1 receives water from Old Alameda Creek through four 48-inch gates. A 30,000 gallon per minute (gpm) pump could also provide supplemental intake, although it is rarely used due to high electricity costs, except to perform monthly preventative maintenance.

During the winter months, the inflow from Pond E1 circulates through Ponds E7, E6, E5, E4, and E2 before discharging to the Bay. Two 48-inch gates allow supplemental intake to Pond E2. In the summer months, CDFG intakes water at Pond E1 and transfers water from Pond E1 to Pond E2, while operating Pond E2 under muted tidal conditions. During the summer and fall, CDFG links systems E2 and E2C by routing water from Ponds E7 or E4 to Ponds E6 and E5 to make up for evaporation losses, or system E2 and E2C are linked during seasonal transition to begin re-flooding dry ponds in the E2C system (Ponds E6C, E4C, E5C, and E1C).

As described above, CDFG operates Ponds E6 and E5 as batch ponds allowing Ponds E6 and E5 to have low salinity in the spring and increased salinity during the summer months. The high salinity waters in Ponds E6 and E5 are routed, in the winter months, to Ponds E4 or E6C and diluted before reaching discharge locations. In the E2C system, CDFG operates Pond E2C under muted tidal conditions (intake and discharge at the same structure) to Alameda Flood Control Channel.

CDFG operates Ponds E6C, E4C, E5C, and E1C as seasonal ponds with open water conditions during the winter months, shallow water conditions in the spring and fall, and dry conditions during the summer months. To moderate salinity levels and improve dissolved oxygen levels in the E2C system, CDFG increases intake volumes at E2C by periodically draining pond waters to adjacent seasonal ponds (primarily E5C, although E4C and E1C may begin to flood as E5C gets deeper) to improve turnover of pond system waters.

Eden Landing System E6A. This system consists of Ponds E6A, E6B, and E8. The ponds in this system are managed seasonally, with varying salinities typically ranging from low to medium levels. During the summer months, each pond can be operated independently or in series to allow intake to provide breeding habitat and shallow water foraging habitat for the snowy plover. In other words, during the summer months, CDFG operates this system to enhance seasonal ponding via limited intake at Pond E6A. During the fall, CDFG will begin to fill the ponds with water so it can operate these ponds as open water habitat during the winter months, with Pond E6A operating under muted tidal conditions, or as flow through ponds in series.

Eden Landing System E8A. This system consists of Ponds E9, E8A, E8X, E12, E13, and E14. Currently, operating conditions change depending on the season. During the summer months, Pond E9 operates under muted tidal conditions (i.e., it receives and discharges water through four 48-inch gates from Mount Eden Creek), while during the winter months, the normal route of flow in this system is from Pond E9 to Pond E8A then to Old Alameda Creek. Typically, Pond E8A will be dry during the summer months with circulation flow occurring in borrow ditches that comprise about 10 percent of its area. Ponds E12, E13, and E14 operate as seasonal ponds. Pond E8X is very small and is operated to provide shallow water and mudflat habitat for waterbirds. The quantity of intake at Pond E9 has improved with the restoration in November 2006 of tidal action to Mt. Eden Creek. The discharge culvert in the northeast corner of Pond E8A also acts as a supplemental intake during the summer when muted tidal intake/discharge operations are used to minimize adverse water quality conditions. To moderate salinity levels and improve dissolved oxygen levels in the pond E8A system, CDFG has increased intake volumes at Pond E9 and periodically drained intake waters to adjacent seasonal ponds (Ponds E13 and E14, or E12 as needed) to improve turnover of pond system waters.

As part of Phase 1 actions, Ponds E8A, E8X, and E9 will be opened to tidal action through levee breaching and levee lowering. Tidal action will be restored to existing historic channels in the ponds by a series of outboard breaches and pilot channels, as well as internal levee breaches. Ponds E12 and E13 will be reconfigured into a managed pond with six cells of varying salinity for shorebird foraging habitat, as well as a discharge mixing basin. Of the six cells, two cells will be managed to maintain low salinity levels (approximately 20 to 40 ppt) similar to Bay salinity levels; two cells will be managed to maintain moderate salinity levels (approximately 40 to 80 ppt); and the remaining two cells will be managed to maintain high salinity levels (approximately 80 to 120 ppt) during the summer evaporation season. The water from the higher salinity cells will be routed to the discharge/mixing basin which will have sufficient intake to dilute pond water to salinity suitable for discharge. The water depths within each cell will be managed to provide optimal shallow water habitat for shorebird foraging. Water levels and flows in Ponds E12 and E13 will be managed using passive water control structures, such as culverts and/or flashboard weirs with gravity flows driven by the tides, and supplemental pumping as needed. Water levels and flows in Ponds E12 and E13 will be managed using passive water control structures, such as culverts and/or flashboard weirs with gravity flows driven by the tides, and supplemental pumping as needed.

Eden Landing System E11. This system consists of Ponds E10 and E11. Pond E10 is currently managed under muted tidal conditions and provides year-round open water. Pond E11 is managed as a seasonal pond. In winter both ponds are managed as open water and discharge can occur from either, or both, ponds.

Maintenance Elements. The areas within the SBSP Project require periodic maintenance. Levees and berms need to be maintained for flood protection and habitat protection purposes, water control structures and weirs require maintenance for proper operation, inlet and outlet channels through tidal marsh to these structures require periodic dredging, trash racks and fish screens need to be cleared, islands created for nesting and roosting habitat will need periodic vegetation control and rebuilding with sediment, and the Service and CDFG will need to respond to emergency situations. Each of these activities will require access (by land and/or water), staging areas, and storage areas. These are described below.

Vehicular Access. The majority of the potential actions for on-going O&M, listed below, will require the movement of vehicles on paved and dirt roads with the action area, including levee roads. In some cases, heavy equipment such as excavators will be towed on trailers to work on sites within the SBSP Project area.

Water-based Equipment Access. Access through the Bay, sloughs, and other channels will be required for water-based equipment. This equipment includes boats, floating dredges (e.g. Cargill's *Mallard*), and amphibious equipment (e.g., amphibious dredges or vegetation removal equipment). Areas affected by these actions are described in *O&M Action Area* below.

Routine Inspections. Routine inspection of the water control structures in managed ponds will be necessary to ensure that they are functioning properly. Inspection of water control structures and canals for debris or trash obstructions will be necessary to maintain desired flows. If

obstructions are found during inspection, it may be necessary to remove the obstructions either manually or mechanically to maintain flows. Routine inspection of the managed pond levees, trails and internal berms for unintentional breaching and erosion will also be necessary. If unintentional breaching or erosion occurs, the berm or levee will be repaired as needed to maintain pond operations, prevent potential tidal inundation of adjacent managed ponds, and to maintain public access along the trails. Nesting islands will also need to be periodically examined for erosion and growth of vegetation. Viewing platforms, interpretive signs, trails, gates, and fences will be inspected periodically and will be repaired and maintained as necessary to maintain function and appearance.

Dredge Locks. Use and maintenance of existing dredge locks to allow equipment to enter salt ponds for water-based levee maintenance will be required (previously part of Bay Conservation and Development Commission (BCDC) Permit No. 4-93, issued to Cargill). Maintenance of locks involves dredging of and placement of dredged material at 21 existing dredge locks within the SBSP Project area, and at any newly constructed authorized dredge locks, to allow the dredge to access the salt ponds. Advanced notification for these activities will include specific quantities of material to be dredged and placed, and drawings indicating pre-staked, designated areas for stockpiling, side casting and borrowing material will be indicated. Earthen levee material, stockpiled from the last time the lock was accessed atop the main levee will be used to dam the breach following entry. Upon dredge exit, breaching and closing levees will be completed in a similar fashion to that described above. The salt marsh muds that were excavated and sidecast in the access cut will be retrieved and placed back into the access cut and channel, closing the lock once the dredge has exited.

In order to gain access to the ponds for maintenance, there may also need to be dredging within shallow sloughs to provide up to 4 feet of clearance for access. Dredge material that cannot be placed on salt pond levees may be placed on bar mud flats or side-cast following approval in accordance with the notification procedure. Some slough dredging may also be performed near dredge locks for the purpose of obtaining additional mud to bring the access cut fills to the desired elevation following the dredge access.

Channel Maintenance. Periodically, inlet and outlet channels that allow water to flow into or out of water control channels will need to be maintained. This typically will involve dredging of any accumulated sediment that is preventing the free flow of water. Channel maintenance will also involve side-casting dredge material from the inlet/outlet channel of Pond A14 in accordance with regulatory permits. Additionally, periodic inspection and maintenance of restoration internal channels and associated infrastructure such as water control structures, weirs, internal managed pond berms and canals will be required to ensure that the ponds are operating as intended. This could include removal of accumulated sediments, repair of water control structures and weirs and placement of materials on internal levees and berms as needed to maintain ecological functions and values.

Borrow Ditches. Activities may also include dredging in existing and new borrow ditches within the ponds for the purpose of placing the dredged material on existing levees, and dredging in ponds to allow a dredge to cross a pond. This includes the placement of dredge material within the pond. Placement of dredged material within the pond could occur on the pond bottom along the side of the

dredged channel. Conversely, fill will also be placed in the borrow ditches themselves in strategic locations to re-direct water flow to enhance ecological functions and minimize low dissolved oxygen conditions.

Levee Fortification and Maintenance. Dredge material will be placed on levee tops and/or levee sides through the placement of material dredged from inside salt ponds or material imported in the minimum amount necessary to repair or protect levees (previously part of BCDC Permit No. 4-93, issued to Cargill). Levees may be serviced by a floating dredge or other methods such as a dragline, barge-mounted dredge, an aquatic excavator, or amphibious construction equipment. Disposed material may be dredged from salt ponds along the inside and top of salt pond levees to maintain levee configuration. This method may require dredge access through pre-approved locations (i.e., dredge locks). In limited instances, levee fortification may be accomplished by importing fill material to place on the top of and on the banks of levees, or by dredging muds from the outside, bay, or slough side of the levee for placement on the salt pond levee. Both alternate methods avoid the need for dredge lock access. Dredged sediment deposition occurs on approximately 5 percent of the salt pond levees a year (10 miles out of 200 total miles). Up to 12 different dredge locks are anticipated to be entered over a 10-year period, fortifying up to 100,000 linear feet of outboard levees and up to 134,000 linear feet of inboard levees. The levee tops are disked and graded prior to maintenance.

Riprap will be placed in the minimum amount necessary to protect existing levees, as approved according to Special Condition 11-C (previously part of BCDC Permit No. 4-93, issued to Cargill). Riprap is required because of continued localized erosion from high wave energy and is maintained on a continuing basis. The amount placed will be the minimum required to provide protection and will be placed from the levee toe upwards onto the levee or to stabilize structures. It is anticipated that riprap will be used to maintain outboard levees of ponds that do not have outboard marsh habitats and that are likely to be restored to tidal circulation in the future. For the purposes of this Phase 1 BO, the maximum length of riprap in the action area is on the order of several thousand feet. If more extensive riprap is necessary to protect levees, effects will be addressed on a project-specific basis. New riprap will be comprised of ¼ ton to ½ ton rock, or may be small pieces of rebar-free demolition rubble (broken concrete slabs), that is compacted in place along outboard and inboard levees as needed to fortify the slopes and prevent erosion, so long as the permittee has adequately demonstrated that the proposed new riprap is placed below the high tide line and/or high pond level at a slope of about 3:1 where needed, taking care to minimize the number of voids between the rubble that might be utilized by red fox (*Vulpes vulpes*) and other nuisance species. Riprap placed on top of non-eroding salt marsh is not authorized.

Dock and Other Structure Maintenance. Docks, boat launches, existing marine crossings, existing bridges, bridge foundations and abutments within the network of levees, intake channels, tide gates, ditches, pumps, piers, trestles, walkways, fences, bulkheads, platforms and other facilities will be used, maintained, and replaced on an in-kind, as needed basis, that does not result in a significant enlargement or increase of square footage (i.e., not more than 100 feet^2) over that of the existing dock (previously part of BCDC Permit No. 4-93, issued to Cargill). If required, maintenance may require the installation and use of new pipes, weirs, berms, culverts, siphons, intake structures, electrical distribution lines for the operation, and pumping facilities, all involving the minimum dredging or fill necessary. Portable pumps, such as diesel-powered

pumps, may be used occasionally for O&M activities, such as supplementing gravity flows through the water control structures or dewatering cells or canals for maintenance.

Material Storage. On-going maintenance requires the storage, on a temporary basis, of shoreline protection or levee surface materials in certain previously approved or designated areas approved in writing by for levee protection purposes at specific, dry land locations approved in writing for levee protection purposes (previously part of BCDC Permit No. 4-93). The proposed action includes the continued practice of using existing dredged material stockpile locations, which are used to dry material to create an effective dam after dredge lock and salt pond access, thus ensuring that disturbance occurs generally in the same area. As the material is removed and then replaced with new material on each pass (typically once every 5 to 10 years), the material is new Bay fill each time it is placed. The temporary fill is a necessary part of maintenance activities for shoreline protection surrounding the pond system. Cargill used the same stockpile locations at the dredge locks for many years, where the best locations are for the purpose of maintaining pond levees and preventing unnecessary erosion of the dredge locks themselves.

Island Maintenance. The nesting islands are expected to settle, or erode, over time due to the weak and soft condition of the Bay mud. Maintenance is expected to be required within about 5 to 10 years to raise the nesting islands, unless the lower, subsided nesting island elevations are used successfully by nesting birds. The nesting islands were designed to test the effectiveness of both island shape and spacing. Once the results of that testing are complete, the islands may be recreated in a different configuration.

In locations where the borrow areas for the nesting islands are near historic channels in the cells, the borrow areas will be excavated to connect to these channels. This is expected to facilitate circulation within these borrow areas. In other locations, connections will not be excavated to borrow areas except to facilitate construction access.

Vegetation Management. A number of non-native plant species occur within the project area, some of which have been identified as invasive or potentially invasive. Vegetation management activities will focus on detection and removal of invasive plant species that threaten native habitats and/or alter listed species or migratory bird habitat. This includes vegetation maintenance on created nesting islands (including native wetland vegetation) or shallow water habitat if it is determined that the vegetation is impeding the intended function of providing nesting and foraging habitat for native waterbirds. Also, vegetation management may also be required on levees and berms if they become infested with invasive plants. Preferred vegetation management will involve non-mechanized methods of removal including hand-pulling, saline spray, pond flooding (during non-breeding seasons), and substrate-based controls. Substrate-based controls on plant growth may include adding layers of coarse sand, oyster shell, gravel, and gypsum fragments on nesting islands. If necessary, managers may use gas-powered tools such as weed trimmers and mowers or CDFG-approved herbicides. The conservation measures, as described in the PBO, will be implemented during vegetation removal in order to minimize impacts to nesting birds, other wildlife and fish.

Nuisance Species Management. Predation by a number of both native and non-native predator species impacts populations of special-status and sensitive species in the Bay. The level of

impact to a species by a particular predator varies by site, depending largely upon the local predator population level, habitat conditions, and surrounding landscape features. Some of the most common predators include: 1) non-native mammals such as red foxes, Norway rats (*Rattus norvegicus*), roof rats (*Rattus rattus*), and feral cats (*Felis catus*), 2) native mammals such as gray foxes (*Urocyon cinereoargenteus*), striped skunks (*Mephitis mephitis*) and raccoons (*Procyon lotor*), and 3) native birds such as California gulls, northern harriers (*Circus cyaneus*), common ravens (*Corvus corax*), and American crows (*Corvus brachyrhynchos*). Other less common nuisance species (e.g. Canada geese, *Branta canadensis)* may have either localized or larger scale impacts to certain special-status or sensitive species as well as health and human safety.

Predator management will occur on an as-needed basis to protect special-status and sensitive species, such as snowy plovers, clapper rails, harvest mice, and least terns from predators, as well as health and human safety. Predator management will also focus on protection of common nesting species, in order to help the project meet the objective of protection of the breeding birds within the region.

The Service has just begun the Comprehensive Conservation Planning (CCP) process for the Refuge, and the predator management program will be expanded to include both avian and mammalian nuisance species through this process. CDFG will continue predator management under an existing contract with United States Department of Agriculture (USDA), Wildlife Services, which currently includes all species described above, or any newly developed contract.

Operation and Maintenance Schedule

As described in the PBO, conservation measures require abbreviated call-count surveys to confirm the absence of clapper rails prior to any construction or excavation work near tidal marsh habitat during the breeding season (i.e., February 1 to August 31). If these surveys indicate the presence of clapper rails, construction related to O&M activities between February 1 and August 31 will be allowed only at a distance greater than 700 feet from clapper rails in adjacent marsh areas and a distance greater than 200 feet from clapper rails across a major slough channel from the construction site. Otherwise, O&M activities will take place during the non-breeding season.

Construction and excavation activities, related to O&M, in snowy plover nesting areas will occur from September 20 to February 1. Activities between September 20 and February 1 can occur only if pre-construction surveys (and monitoring, if plovers are detected within the pond) determine that no snowy plovers are actively nesting within those areas (i.e., there are no nests with eggs), all young have fledged, or that active nest sites with eggs are located more than 600 feet from the construction site. After the snowy plovers have chicks, work can be performed as long as the chicks are able to move well away from the work area and safely forage. On-going monitoring is expected to ensure that the snowy plovers are not affected by the work area.

Operation and Maintenance Action Area

The on-going O&M activities include a number of actions that may occur throughout the SBSP

Project area. The SBSP action area is described in detail in the PBO and is hereby incorporated by reference.

Proposed Operations and Maintenance Activities for PG&E

PG&E will perform regularly scheduled O&M, as well as unscheduled activities when necessary, within the SBSP Project area. O&M activities will include line patrols, tower inspections, line work, tower maintenance, access road maintenance, boardwalk maintenance, and boardwalk and boat dock construction.

The scope of this Phase 1 BO includes PG&E O&M for all the ponds and the adjoining habitats that are within the SBSP Project area and attempts to capture all future actions that PG&E may have to perform as part of routinely scheduled activities, and unforeseen unscheduled activities. All of these activities will require access (by land, water, or air), staging areas, and temporary storage areas.

Project Location

PG&E O&M activities will occur within the SBSP Project, located in Bay in Northern California within San Mateo, Santa Clara, and Alameda Counties. A detailed description of the SBSP Project area is discussed in the PBO and is hereby incorporated by reference.

PG&E Operation and Maintenance Activities

The PG&E O&M activities include the following:

- Line patrol and tower inspection
- Line work
- Tower and distribution pole maintenance
- Access road maintenance
- Boardwalk and dock maintenance
- Dock and boardwalk construction

These are described in more detail in the following sections.

Line Patrol and Tower Inspection. Scheduled and unscheduled line patrol and tower inspections will occur along PG&E boardwalks and transmission towers. Patrols and inspection access will include walking, driving vehicles, boating, and the use of helicopters. Walking will occur on PG&E boardwalks, levees, and through marsh, and other wetland habitats, when footings are inspected. Driving access will include the use of levees roads and access by boat will include docking of small watercraft at boardwalk docks, which are located at the terminus of boardwalks in slough channels, (e.g. Pond A6 dock in Alviso Slough). Helicopters will be used for inspections, cleanings, repair work, and other maintenance work on towers and lines. Helicopters may hover above, or adjacent to, lines and towers, and landings may occur on designated landing pads (e.g. Pond A6 landing pad).

Line Work. Scheduled and unscheduled line work includes reconductoring (replacing and splicing damaged conductors) and replacing damaged insulators. Reconductoring usually occurs in 2-mile sections, with a tension site and a pull site. Each site requires an area approximately 200 x 300 feet. New conductors are typically installed by temporarily splicing them to the ends of the existing conductors and pulling them through pulleys attached to the arms of the towers or pole cross arms. Boom trucks are used to install the pulleys, unless winches are required in areas where boom trucks cannot access the site. Truck mounted tensioners, small cranes, conductor reel trailers, and conductor reels are used to tension the conductors. Historic pull and tension sites are used whenever possible.

Access includes walking, driving vehicles, boating, and occasionally flying helicopters. Walking will be limited to levees and boardwalks, driving access will include the use of levees roads, and access by boat will involve docking of small watercraft at boardwalk docks, which are located at the terminus of boardwalks in slough channels. Helicopters may hover above lines, or adjacent to lines, and landings may occur on designated landing pads.

Tower and Distribution Pole Maintenance. Scheduled and unscheduled tower maintenance may include replacing damaged steel, towers, and footings, repairing concrete footings, or raising and modifying towers as necessary. Access for tower maintenance will include walking, driving vehicles, boating, and the flying helicopters. Walking will occur on PG&E boardwalks, levees, and through marsh, and other wetland habitats, when footings are inspected. In addition to inspections, construction activities may involve heavy trampling through wetlands adjacent to towers. Driving access will include the use of levees roads and access by boat will include docking of small watercraft at boardwalk docks, which are located at the terminus of boardwalks in slough channels. Tower maintenance will include the use of heavy equipment including jackhammers and impact wrenches, which will produce loud, concussive noises and vibrations. Helicopters may hover above, or adjacent to, towers during maintenance.

Access Road Maintenance. Maintenance to access roads will occur on an as-needed basis. Access road maintenance may include blading (grading) levee tops, mowing vegetation, rut repair, and other activities necessary to maintain vehicular access on levees.

Boardwalk and Dock Maintenance. Boardwalks and docks will periodically require maintenance including replacing broken planks, rebuilding boardwalk sections, raising boardwalk sections, and relocating boardwalks to different areas. Access for boardwalk and dock maintenance will include walking, driving vehicles, boating, and the use of helicopters. Walking will occur on PG&E boardwalks, levees, and through marsh, and other wetland habitats, when boardwalks are inspected. In addition to inspections, boardwalk and dock repair or construction may involve heavy trampling through wetlands. Driving access will include the use of levees roads and access by boat will include docking of small watercraft at boardwalk docks, which are located at the terminus of boardwalks in slough channels. Boardwalk and dock maintenance will include the use of heavy equipment including jackhammers and impact wrenches, which will produce loud, concussive noises and vibrations. Helicopters may hover above, or adjacent to, boardwalks and docks during maintenance.

Dock and Boardwalk Construction. New boat docks and boardwalks may be built to allow boat access to existing boardwalks and spurs may be built off existing boardwalks to allow helicopters to land equipment that is too heavy for boat transport. Access for new dock boardwalk construction will include walking, driving vehicles, boating, and the use of helicopters. Walking will occur on PG&E boardwalks, levees, and through marsh, and other wetland habitats. Boardwalk and dock construction may involve heavy trampling through wetlands. Driving access will include the use of levees roads and access by boat will include docking of small watercraft at boardwalk docks, which are located at the terminus of boardwalks in slough channels. Boardwalk and dock construction will include the use of heavy equipment including jackhammers and impact wrenches, which will produce loud, concussive noises and vibrations. Helicopters may hover above, or adjacent to, boardwalks and docks during construction.

Operation and Maintenance Schedule

- Line patrols (by foot, vehicle, driving, and helicopter) will be scheduled throughout the year as necessary and whenever a power lines go offline due to unplanned events.
- Tower inspections will be scheduled outside of the clapper rail breeding season (February 1 through August 31) unless an emergency requires work within that time frame.
- Line, tower, boardwalk, and access road maintenance will be scheduled outside of the clapper rail breeding season unless an emergency requires work within that time frame. Also, work may be conducted during the clapper rail breeding season if PG&E completes protocol-level surveys that determine there are no clapper rails within 700 feet of the project site and access route.

As noted above in *PG&E Operations and Maintenance Activities*, unscheduled line patrols, tower inspections, line work, tower and distribution pole maintenance, and other activities may occur when equipment is damaged or otherwise in need of immediate maintenance.

Conservation Measures

The conservation measures described below are specific to PG&E O&M actions. PG&E will implement the following conservation measures while conducting O&M activities to reduce or avoid adverse effects to listed species:

- Notify the Service and CDFG each time access is required
- Obey invertebrate season restrictions (dry conditions)
- Use established access routes (roads, levees, boardwalks)
- Avoid walking or driving through artificial mitigation ponds
- Minimize foot traffic in wetland vegetation

- Obey avian breeding season restriction (September 1 through January 31), unless call counts demonstrate nesting clapper rails are at least 700 feet away from PG&E's project area.
- Hover high over marsh and avoid harbor seals when using helicopters
- Avoid inspections within 2 hours of high tide when tides are higher than 6.5 feet as measured at the Golden Gate
- Not conduct work within 2 hours of high tide at construction sites in salt marshes on those days that the tide is higher than 6.5 feet as measured at the Golden Gate Bridge
- Place protective matting on marsh habitat when performing tower footing maintenance
- Conduct worker environmental training before construction begins
- Have a copy of the project description on-site during construction
- Document by brief descriptions and photographs the areas where marsh habitat was impacted immediately before work is started and work is completed. The areas will be revisited after one growing season to make sure the area has recovered
- Use established areas for pull and tension sites, turnarounds and equipment staging areas. If additional work areas are needed, they will be created in upland areas and approved by Service staff before construction
- Use shooflies when absolutely necessary and placed in upland areas approved by Service staff before construction
- Restrict the use of jackhammers to the minimum amount necessary needed to complete the work. Jackhammer usage should not exceed approximately two hours per footing in one day
- Not stage materials on marsh vegetation. Materials should be stored in upland areas, or on boats, barges and boardwalk. If necessary, temporary landing areas (constructed similar to boardwalks) in wetland areas may be used if approved by the Refuge.
- Not grade in or near artificial mitigation ponds. PG&E will place an environmental monitor on-site to monitor and document construction activities.
- Work with the Service on an ongoing basis to develop work practices which can be implemented safely by the field crews which minimize any disturbance to the sensitive species or their habitat.
- Work with the Service to develop a mitigation package for any damage done to the habitat during the emergency work.
- Repair levees as soon as practical under the guidance of Service staff. PG&E should not drive on the levees when the levees are wet.
- Minimize impacts to the hunting public such as avoiding low helicopter flights over hunters, no levee access on ponds open to waterfowl hunting on days ponds are open to hunting, and minimize the disruption of hunters using boats in sloughs. Waterfowl

hunting season will be from October through January and hunters are most numerous on weekends.

- Not conduct engine maintenance or vehicular refueling while on Service property.
- Remove construction materials from the Service's property as soon as possible and nothing will be left on the Service's property after the close of the project period.
- Deposit food and related trash in closed containers and removed from the Service's property at the end of each day.
- Immediately report all sightings of trespassers, feral cats, dogs, or red foxes observed on the Service's property. Fox dens will not be approached or searched.

Operations and Maintenance Action Area

The PG&E O&M activities include a number of actions that may occur throughout the Bay. The action area encompasses:

- Three pond complexes (Eden Landing, Alviso, and Ravenswood) and the neighboring sloughs (Mt. Eden Creek, North Creek, Old Alameda Creek, Alameda Creek Flood Control Channel, Mud Slough, Coyote Creek, Alviso Slough, Guadalupe Slough, Stevens Creek, Mountain View Slough, Charleston Slough, and Ravenswood Slough)
- Associated staging areas, parking lots and access points near the three pond complexes
- Portions of the Bay that may be traversed by water-based equipment that may be used for dredging or other actions that require water access
- Any other areas in the vicinity of maintenance and operations that may be directly or indirectly affected by noise, dust, or other factors resulting from associated operations.

Proposed Conservation Measures

The conservation measures described in the PBO will be implemented by the Pond SF2 Restoration Action, Pond A6 Restoration Action, Pond A5, A7 and A8 Restoration Action, Pond A16 and A17 Restoration Action, Pond E8A, E8X, and E9 Restoration Action, Pond E12 and E13 Restoration Action, and O&M Activities for the Service and CDFG within the SBSP Project Area. Each of these Phase 1 actions propose to implement all of the conservation measures in the PBO to further reduce or avoid adverse effects to clapper rails, least terns, harvest mice, and snowy plovers. All of the conservation measures are described in the PBO and are hereby incorporated by reference.

STATUS OF THE SPECIES

The status of the species is described in detail in the PBO for the harvest mouse, clapper rail, least tern, and snowy plover, and is hereby incorporated by reference.

ENVIRONMENTAL BASELINE

Pond SF2 Environmental Baseline

Salt marsh harvest mouse

Small mammal trapping has not been conducted in the salt marsh outboard of Pond SF2, but the harvest mouse is known from the tidal marshes immediately to the south near Cooley Landing. Approximately 14 acres of habitat in the action area is suitable for the species.

California clapper rail

Clapper rails are known from tidal marshes to the south of Pond SF2 in the vicinity of Cooley Landing, and are known to occur in the area north of the Pond SF2, in Ravenswood Slough. The marsh adjoining Pond SF2 is relatively narrow, and could support foraging or dispersing clapper rails. This marsh (approximately 14 acres) may be too narrow to support a breeding pair or population of clapper rails, and no more than one pair likely would nest in this marsh. During one informal site assessment in February 2008, no clapper rails responded to a playback tape (J. Albertson, pers. comm.).

Western snowy plover

Since salt production was abandoned in the Ravenswood pond system, snowy plovers have established several nests each year within Pond SF2 for the past few years. Since that time, Pond SF2 and other ponds to the north of the Dumbarton Bridge have been allowed to seasonally dry and snowy plovers have colonized several of these ponds, albeit in relatively low numbers. Numbers of nests have ranged from 6 in 2004, 2 in each of 2005 and 2006, and none in 2007.

California least tern

There are no records of least terns nesting at Pond SF2, and there is no foraging habitat for the species under current pond conditions. Least terns roost and forage in ponds several miles to the south in the Mountain View and Alviso areas; the nearest nesting site is Hayward Regional Shoreline to the northeast of Pond SF2. Although no habitat currently exists at Pond SF2 for least terns, implementation of the proposed action may create potential nesting habitat that may be used by this species in the future.

Pond E12 and E13 Environmental Baseline

Salt marsh harvest mouse

The harvest mouse is known to occur in the marshes along Mount Eden Creek and there is marginal pickleweed habitat outboard of the eastern side of Ponds E12 and E13. Existing habitat in the immediate overall area is approximately 880 acres. Additionally, there is an on-going tidal restoration project on the north and east sides of this site, and tidal restoration is proposed for ponds south of the site (630 acres). Thus, these ponds may eventually be surrounded by tidal marsh that will likely support harvest mice in the future.

California clapper rail

No clapper rails are known from the marshes adjoining Ponds E12, E13 and E14, or from Mount Eden Creek, however clapper rails may wander into this area for foraging. Additionally, there is an on-going tidal restoration project to the north and east of the project site, and tidal restoration is proposed for the ponds south of the site (630 acres). Thus, these ponds may eventually be surrounded by tidal marsh that will likely support clapper rails in the future.

Western snowy plover

Ponds E12 and E13, especially in the vicinity of the historic salt works, have supported several breeding snowy plovers on a periodic basis over the years. Many of the ponds in the ELER complex periodically support several to moderate numbers of breeding snowy plovers. Depending on site conditions, the concentrations of breeding individuals tends to change from year to year.

Management of pond systems within the ELER complex has recently (2006-2008) focused on early drawdown of certain ponds to provide enhanced foraging and breeding habitat for snowy plovers. In 2006, early drawdown of several ELER ponds (E8, E8A, E6A, E6B) led to early establishment of 41 nests. Later that season, 23 more nests were found in Ponds E12, E13 and E14. The pattern in 2007 and 2008 was similar, with late-season nesting in Ponds E12 and E14, and earlier nesting in Pond E8A and other locations. With the dry winter, more nesting habitat was available early in the season. Additionally, late in the season as many as 150 snowy plovers were observed in the complex (including up to 100 within Pond E14 and 50 in E12 on August 10, 2007), many of which had likely nested in other sites earlier in the season (C. Robinson pers. comm.).

Current potential snowy plover nesting habitat to be impacted by the proposed action includes the dry Ponds E12 and E13 (230 acres). Other existing snowy plover habitat in the vicinity varies depending on rainfall patterns, but includes dry Ponds E8 (242 acres), E6A (322 acres), E6B (291 acres), E11 (125 acres), E14B (30 acres), E15B (45 acres), and E16B (65 acres).

California least tern

Least terns occasionally forage in ELER ponds including Ponds E10, E9, and E8A typically in late summer. The high number of individuals includes 305 birds in August of 2006, although an average of 18 birds may forage in these three ponds in the summer (USGS, prelim. data).

Least terns historically did not nest in the ELER complex of ponds. However, several pairs of least terns attempted to breed in Pond E8A in 2007 and two nests were observed in 2008 (C. Robinson pers. comm.), although the nests were depredated soon after initiation. The depredation of the least tern nests was concurrent with an influx of California gulls, although no direct observations of gull predation has been recorded. ELER ponds have been managed over the last few years to encourage breeding and foraging by snowy plovers; least terns apparently responded to these managed conditions on the site. No least terns currently utilize ponds E12 or E13.

Pond E8A, E8X, and E9 Environmental Baseline

Salt marsh harvest mouse

Little trapping of the outboard marsh adjacent to Ponds E8A, E8X, and E9 for harvest mice has been performed. However, the species is known to occur in the marshes along Mount Eden Creek and it is likely present, and relatively widespread, in high and middle elevation marsh

areas in the vicinity. Existing habitat in the immediate overall area is approximately 880 acres. No suitable habitat for harvest mice currently exists within Ponds E8A, E8X, E9, or E10.

California clapper rail

Breeding habitat for clapper rails is present in the marsh south of Pond E8A within the Old Alameda Creek channel and to the west of Ponds E8A and E9 in Whale's Tail Marsh. Whale's Tail Marsh supports only a few nesting clapper rails, but Old Alameda Creek consistently supports a population of 20 to 30 clapper rails (Service, unpubl. data). Existing habitat in the immediate overall area is approximately 149 acres. No suitable habitat for clapper rails currently exists within Ponds E8A, E8X, and E9 or within pond E10.

Western snowy plover

Many of the ponds in the ELER complex periodically support low to moderate numbers of breeding snowy plovers. Concentrations of breeding snowy plovers tend to change location from year to year, depending on site conditions in each pond. Pond E8A has supported breeding snowy plovers in recent years. Twenty-six snowy plover nests were initiated in 2007, and approximately 42 have been recorded as of June 2008, although 21 are known to have been depredated (C. Robinson pers. comm.). Five nests were initiated in Pond E8X in 2007 and none have been initiated as of June 2008. Ponds E12 and E13, especially in the vicinity of the historical salt works, have also regularly supported several breeding snowy plovers (22 nests in 2006 and 14 nests in 2007).

Current potential snowy plover nesting habitat to be impacted by the proposed action includes the dry Pond E8A (282 acres). Other existing snowy plover habitat in the vicinity varies depending on rainfall patterns, but includes dry Ponds E8 (242 acres), E6A (322 acres), E6B (291 acres), E11 (125 acres), E14B (30 acres), E15B (45 acres), and E16B (65 acres).

California least tern

Least terns historically did not nest in the ELER complex of ponds. However, several pairs of least terns attempted to breed in Pond E8A in 2007 and 2 nests were observed in 2008 (C. Robinson pers. comm.), although the nests were depredated soon after initiation. The depredation of the least tern nests was concurrent with an influx of gulls although no direct observations of gull predation have been recorded. ELER ponds have been managed over the last few years to encourage breeding and foraging by snowy plovers and least terns apparently responded to these managed conditions on the site. Current potential least tern nesting habitat is the dry Pond E8A (282 acres), where least terns nest in extremely low density.

Pond A6 Environmental Baseline

Salt marsh harvest mouse

No trapping of the outboard marsh adjacent to Pond A6 for harvest mice has been performed. Although this outboard marsh is narrow, providing little in the way of refugia during extreme

high tides, this pickleweed salt marsh provides suitable habitat for harvest mice, and the species is likely present here. Approximately 50 acres of narrow tidal marsh habitat exists on the outboard of Pond A6.

California clapper rail

There is virtually no breeding habitat for clapper rails in the marsh immediately surrounding Pond A6 due to the narrowness of the outboard marsh. Non-breeding clapper rails are expected to forage infrequently in the marsh immediately adjacent to Pond A6, including the areas that will be directly affected by pilot channel creation, due to the paucity of tidal channels. Tidal marsh is somewhat wider in certain areas along Alviso Slough upstream from Pond A6 (where water-based access may occur), and clapper rails have been recorded during the breeding season on both sides of Alviso Slough, along the northeastern side of Pond A5. In 2007, Point Reyes Bird Observatory (PRBO) conducted surveys for clapper rails along the middle and lower reaches of Alviso Slough. A single clapper rail was detected near the mouth of the slough, but none were heard farther upstream. Clapper rails are rarely recorded as far up Alviso Slough as the marina.

Western snowy plover

Snowy plovers historically bred in Pond A6, but since the pond was colonized by nesting California gulls in the 1980s, snowy plovers have not nested there. Within the action area for Pond A6 restoration, snowy plovers occur only within Pond A8, where they nest on exposed salt flats and remnant levees (11 nests found in 2006; 4 nests found in 2007). They occasionally nest and forage in such areas in close proximity to the "Hoxie Highway;" because this area might be used for land-based access to Pond A6, it is within the action area for Pond A6 restoration activities. No nesting habitat currently exists for snowy plovers in Pond A6.

Pond A8 Environmental Baseline

Salt marsh harvest mouse

The habitat along the bayward (i.e., downstream) reaches of Alviso and Guadalupe Sloughs (approximately 246 and 386 acres, respectively), where pickleweed is more widely distributed than in the upper reaches of these sloughs, has the potential to support harvest mice. Recent trapping results discovered this species in brackish marshes along Coyote Creek, indicating that this species could occur in at least small numbers in the brackish marshes along these two sloughs as well. However, the freshwater marshes in the vicinity of the proposed notch are not appropriate habitat for the species.

There are patches of pickleweed on inboard sides of the levees around and within these ponds, especially on the levee between Ponds A5, A7 and A8. These patches are small and isolated, and subject to inundation during high rainfall years and/or when flood flows enter these ponds. As such, it is very unlikely that they support harvest mice on a regular basis.

California clapper rail

Few surveys for clapper rails have been conducted along the middle and upper reaches of Alviso Slough or Guadalupe Slough. Although clapper rails are present in the downstream reaches of these sloughs, where the tidal marsh is dominated by salt-marsh plant species, they are not expected to nest in outboard marsh adjacent to the notch location at Pond A8, which is dominated by freshwater vegetation (e.g., California bulrush (*Scirpus californicus)* and cattail (*Typha latifolia*)). Two clapper rails were detected in a broad patch of alkali bulrush (*Scirpus robustus*) marsh along Guadalupe Slough, north of Pond A4 (approximately 17.6 acres), during surveys conducted in 1990 and 1991. However, clapper rails are not expected to nest farther upstream along Guadalupe Slough. The overall reaches of Alviso and Guadalupe Sloughs consist of approximately 246 and 386 acres, respectively.

In 2007, PRBO conducted surveys for clapper rails along the middle and lower reaches of Guadalupe and Alviso Sloughs. Single clapper rails were detected near the mouths of these sloughs (i.e., along Guadalupe Slough near the A5/A6 levee and along Alviso Slough east of Pond A6), but none were heard farther upstream.

On rare occasions, clapper rails have been recorded in brackish/freshwater transition marshes along upper Alviso Slough as far as the Alviso marina and the Gold Street Bridge, and along Guadalupe Slough as far as the non-tidal freshwater ponds between Calabazas and San Tomas Aquino Creeks north of Highway 237. However, such individuals are likely wandering, foraging individuals, and their occurrence in these areas is expected to be sporadic. For example, surveys conducted at the Alviso marina found no clapper rails during early spring 2003 and 2004. Any occurrence by clapper rails in the vicinity of the Pond A8 notch would likely be by occasional non-breeding birds.

Western snowy plover

Low densities of snowy plovers have been recorded during the breeding season, with nests and chicks, at Pond A8. Breeding occurred sporadically during the 1990s and early 2000s, and there was no recorded nesting over a period of several years. Under the ISP management regime, Pond A8 has been managed as a seasonal pond, drying every summer. That management program has attracted snowy plovers to again nest in small numbers on the pond. In 2006, 10 nests were located in Pond A8; and in 2007, 5 nests were located.

Pond A16 Environmental Baseline

Salt marsh harvest mouse

The harvest mouse is known to occur in New Chicago Marsh to the south (approximately 819 acres of marginal habitat) and Triangle Marsh to the west (approximately 85 acres) of the project area. Although no surveys have been conducted in this area, harvest mice likely occur in the marshes immediately north of Pond A17 (approximately 16 acres), and they may also be present in marsh habitat around the pond A20 dredge lock due to the presence of suitable habitat.

California clapper rail

Clapper rails are known to be present in Triangle Marsh west of Pond A17 (approximately 85 acres) and are expected to breed there. They likely use the outboard marsh between Pond A17 and Coyote Creek only for foraging due to the relatively narrow nature of this marsh, although use by breeding clapper rails is possible (approximately 50 acres). Although this marsh is brackish, dominated by alkali bulrush, such brackish marshes have been found to support breeding and wintering clapper rails in the Bay at least some years. Clapper rails may occasionally forage in the freshwater habitat of Artesian Slough (e.g., one was recorded along Artesian Slough near the EEC in January 1999 and January and February 2001; approximately 64 acres), but nesting in this freshwater habitat is not expected.

Western snowy plover

Snowy plovers are not known to occur in Ponds A16 or A17. However, if these ponds are drained prior to construction, the pond bottom could provide potentially suitable nesting habitat. Snowy plovers have been recorded in New Chicago Marsh to the south, though not in close proximity to Pond A16. Snowy plovers have occasionally bred in the impoundment to the southwest of Pond A16, between the UPRR tracks and Pond A12. No nesting habitat for plovers currently exists at Ponds A16 and A17.

California least tern

Least terns forage in nearby ponds, but USGS has recorded no least terns in either Ponds A16 or A17 during their monthly surveys from October 2002 to October 2007. There are no records of least terns breeding on or near the proposed action area. No nesting habitat for least terns currently exists at Ponds A16 and A17.

Operations and Maintenance (USFWS, CDFG and PG&E) Environmental Baseline

The environmental baseline for harvest mice, least terns, clapper rails, and snowy plovers were previously described in the PBO for the SBSP Project area and are hereby incorporated by reference.

EFFECTS OF THE PROPOSED ACTION

Pond SF2 Effects

Salt marsh harvest mouse

Habitat Loss and Restoration and Associated Loss of Individual Harvest Mice

The proposed excavation of pilot channels and intakes for the new water control structures for Pond SF2 would permanently eliminate 1.19 acres (0.48 hectares) and temporarily affect 2.64 acres (1.07 hectares) of tidal marsh currently available for harvest mice. However, SBSP Project on a programmatic level will compensate for the loss of habitat available for harvest mice on a

programmatic basis with the tidal restoration of other ponds (Ponds E8A, E8X, E9, A6, A8, and R1) in the area as part of the long-term SBSP Project.

Construction-related Effects

Construction within the action area could affect individual harvest mice through increased noise and vibrations from equipment and construction activities. Operation of construction equipment could result in displacement of harvest mice from protective cover and their territories (through noise and vibrations). These disturbances likely would disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and likely result in the displacement of harvest mice from their territory in the areas where their habitat is destroyed. Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Thus, displaced harvest mice may suffer from increased predation, competition, and mortality.

Human Disturbance and Predation Effects Associated with Public Access

Human use of the bayfront trail and viewing platforms may result in disturbance of harvest mice immediately adjacent to trails. Mammals including rats, cats, skunks, and raccoons which can prey upon harvest mice, are known to use the trails currently in the action area. It is possible that as human use increases after rehabilitation of the existing bayfront trail, predation on harvest mice may increase due to more garbage/food along the trail that may attract predators.

California clapper rail

Habitat Loss and Restoration and Associated Loss of Individual Clapper Rails

The proposed excavation of pilot channels and intakes for the new water control structures for Pond SF2 would permanently eliminate approximately 1.19 acres (0.48 hectares) of suitable habitat and temporarily impact approximately 2.64 (1.07 hectares) acres of suitable habitat that may occasionally be used for foraging by clapper rails and could possibly be used for nesting by up to one pair of clapper rails. The proposed action would attempt to manage Pond SF2 at optimal water depths for shorebird foraging, which could benefit foraging clapper rails. However, there are no certainties that managing optimal water depths within Pond SF2 would result in actual use by clapper rails. The proposed SBSP Project will attempt to compensate for the loss of habitat available for clapper rails on a programmatic basis with the tidal restoration of other ponds in the area as part of the long-term SBSP Project.

Construction-related Effects

The proposed action is likely to result in disturbance to clapper rails within the tidal marsh habitat adjacent to Pond SF2. These disturbances are most likely to result from work activities associated with creating pilot channels and intakes for the water control structure; and along routes used for construction access into Pond SF2. The proposed action proposes to conduct construction activities within the tidal marshes from September 20 and February 1 to avoid the clapper rail breeding season. Implementation of the conservation measures described in the PBO will minimize construction-related impacts to clapper rails.

Human Disturbance and Predation Effects Associated with Public Access

Human use of the bayfront trail and viewing platforms may result in disturbance of clapper rails foraging in the narrow outboard marsh between Pond SF2 and the Bay. Recreational use of the public access facilities at Pond SF2 could disturb foraging clapper rails, expose clapper rails to predation (especially during extremely high tides) by limiting their use of cover at the marsh edge, and limit use of this section of tidal marsh by this species. Revegetation proposed for the inboard side of the levee in some locations may provide additional temporary refuge for clapper rails foraging in the area. Mammals including cats, which can prey upon clapper rails, are known to use the trails currently in the action area. It is possible that as human use increases after rehabilitation of the existing bayfront trail, predation on clapper rails may increase due to more garbage/food along the trail that may attract predators.

The effects of recreational access on birds will be studied at Pond SF2. This will especially apply to nesting birds on the islands that are created, but any obvious effects of public use on clapper rails will be noted and the Service will identify any additional take that may occur which was not anticipated in this Phase 1 BO.

Western snowy plover

Habitat Loss and Restoration and Associated Loss of Individual Snowy Plovers

Approximately 159 acres (64.3 hectares) of the dry salt pond substrate habitat known to support as many as 6 pairs of nesting snowy plovers will be permanently eliminated. The proposed action would attempt to manage 81 acres (32.8 hectares) of Pond SF2 as seasonal wetland habitat, which could be used by nesting snowy plovers, and would provide suitable habitat for shorebird foraging. In addition, the remaining 159 acres (64.3 hectares) of habitat will be managed as shallow water foraging habitat with approximately 36 nesting islands. However, there are no certainties that successful restoration of these wetland habitats within this area would result in actual use and occupancy by breeding snowy plovers. Therefore, proper design of the seasonal wetlands areas within the action area is critical to optimizing the success of the proposed action. The proposed action will attempt to compensate for the loss of 159 acres (64.3 hectares) of potential snowy plover nesting habitat with the maintenance of shallow-water conditions in the central and eastern cell, the creation of islands within these acres for nesting snowy plovers, and on a programmatic basis under the SBSP Project at other nearby sites, notably with the managed pond habitat at Ponds R3 and R4.

Construction-related Effects

The proposed action is likely to result in disturbance to snowy plovers within the dry salt pond substrate. These disturbances are most likely to result from work activities associated with creating pilot channels and intakes for the water control structure; and construction of other elements of the proposed action within the interior of Pond SF2. Construction activities in the seasonal wetland area will occur between September 20 and February 1, after the breeding season as described above, if nesting snowy plovers are present. Pre-construction surveys will

ensure that no snowy plovers are nesting in the construction area. However, construction activities may still disturb snowy plovers that forage in the Pond SF2 action area.

Human Disturbance and Predation Effects Associated with Public Access

The restoration of Pond SF2 has been designed to maintain a 300-foot buffer between the nesting islands to be constructed in the central and eastern cells and the edge of the pond, and between the nesting islands and PG&E boardwalk and towers. Because activities in any one area of the trail or PG&E boardwalk and towers are expected to be of short duration, this 300-foot buffer will limit disturbance of any snowy plovers that might nest or forage on the constructed islands by recreational trail users. Because the two observation platforms are expected to be points of concentration for human activities, the island layout has been designed to maintain a 600-foot buffer between islands and these two platforms to avoid disturbance of nesting snowy plovers. Human activity along Highway 84 and University Avenue could potentially disturb nesting, roosting, or foraging snowy plovers in the seasonal wetland habitat in the southwestern cell of Pond SF2. Nest abandonment or loss of eggs or chicks due to exposure or predation could result from disturbance of adult snowy plovers during the breeding season, and loss of foraging opportunities could result from disturbance of foraging snowy plovers. Because human use of these two roadsides will be ongoing during the nest-site selection period, snowy plovers that are intolerant of human activities are likely to nest far enough from the pond's edge so as not to be significantly disturbed by humans along Highway 84 and University Avenue. However, snowy plovers nesting for the first time may have a difficult time with nest site selection.

The proposed action intends to study the effects of trail use on birds at Pond SF2. This will especially apply to nesting birds on the islands that are created. The final design of that study has not been developed, but the general concept of the study has been developed. The public access trail will be open year-round, and the distribution of the nests in relationship to the trails will be analyzed. The study would analyze all nesting species, but nests of snowy plovers would receive special attention in the decisions regarding site management. It is anticipated that the results of the study would be incorporated into the SBSP Adaptive Management Plan (AMP), which may identify additional measures needed to avoid human-related disturbances to snowy plovers.

California least tern

Habitat Loss and Restoration and Associated Loss of Individual Least Terns

Least terns do not currently use Pond SF2, therefore no existing habitat will be impacted or eliminated and no least terns will be lost as a result of the proposed action.

Human Disturbance and Predation Effects Associated with Public Access

If least terns begin to use Pond SF2, the proposed 300-foot buffer between the nesting islands and the pond edge, and the proposed 600-foot buffer between the nesting islands and the viewing platforms, may or likely would minimize disturbance of nesting or roosting terns by human activities around the pond edge. If least terns were to nest in the seasonal wetland habitat in the

southwestern cell, they could nest far enough from the pond's edge so as not to be significantly disturbed by human activities along Highway 84 and University Avenue. However, similar to snowy plovers, least terns nesting for the first time may have a difficult time with nest site selection.

The proposed action intends to study the effects of trail use on birds, particularly nesting birds on the islands that are created, will be studied at Pond SF2. Because least terns do not currently use Pond SF2, any use of the pond could be a net benefit to the species, however, it is possible that Pond SF2 may create a nesting "sink" for the species. Therefore, the study would analyze all nesting species, but nests of least terns would receive special attention regarding site management.

Pond E12 and E13 Effects

Salt marsh harvest mouse

Habitat Loss and Restoration and Associated Loss of Individual Harvest Mice

There will be a permanent loss of tidal marsh habitat (less than 0.1 acre) due to the construction of the intake and outlet pilot channels for the new water control structures at the complex. However, the SBSP Project on a programmatic level will attempt to compensate for the loss of habitat available to harvest mice, particularly at the adjacent tidal marsh restoration of Ponds E8A, E8X, and E9 (discussed in this Phase 1 BO below).

Construction-related Effects

It is possible that individuals will be directly lost due to construction of the intake and outlet pilot channels for the new water control structures between Mount Eden Creek and Ponds E12 and E13. Conservation measures should minimize the possibility of encountering harvest mice during construction, thereby preventing loss of individuals. There is some chance that construction activities will disturb harvest mice in the vicinity of the water control structures or along routes used for access, particularly along routes that are adjacent to Mount Eden Creek outboard marshes. This disturbance is likely to be minimal and implementation of the conservation measures described in the PBO should minimize this disturbance.

Human Disturbance and Predation Effects Associated with Public Access

Human use of the levees around ponds E12 and E13, including the viewing platform at the shoreline viewing area may result in disturbance of harvest mice immediately adjacent to the trail. It is possible that as human use increases on the levees around Ponds E12 and E13, mammals including rats, cats, skunks, and raccoons, which can prey upon harvest mice, may increase due to more garbage/food along the levees that may attract these predators. Therefore, predation on harvest mice may increase.

California clapper rail

Habitat Loss and Restoration and Associated Loss of Individual Clapper Rails

There will be a permanent loss of tidal marsh habitat (less than 0.1 acre) that may occasionally be used by clapper rails in the non-breeding season due to the excavation of the pilot channel between Mount Eden Creek and ponds E12 and E13. It is anticipated that this loss of habitat for clapper rails will be compensated on a programmatic basis by the SBSP Project at other nearby sites, notably the tidal restoration of Ponds E8A, E8X, and E9.

Construction-related Effects

It is possible that the construction of water control structures and pilot channel excavations through the fringe Mount Eden Creek tidal marsh will affect clapper rails. Although the marsh is newly restored and does not yet provide nesting habitat, the proposed action may adversely affect clapper rails foraging in the action area due to construction-related disturbance. Implementation of the conservation measures described in the PBO should minimize the disturbance to foraging clapper rails and prevent the loss of individual clapper rails during construction.

Human Disturbance and Predation Effects Associated with Public Access

Human use of the levees around ponds E12 and E13, including the viewing platform at the shoreline viewing area may result in disturbance of clapper rails immediately adjacent to the trail. It is possible that as human use increases on the levees around Ponds E12 and E13, mammals including cats, which can prey upon clapper rails, may increase due to more garbage/food along the levees that may attract these predators. Therefore, predation on clapper rails may increase.

Western snowy plover

Habitat Loss and Restoration

The 230 acres of pond that will be flooded in Ponds E12 and E13 will no longer be available for nesting snowy plovers. These ponds were historically part of the salt production system, so until recently were not available snowy plover breeding habitat. However, once the system was taken over by the CDFG, management practices have encouraged nesting in these ponds.

Although potential nesting habitat will be lost in these ponds when they are restored to tidal action, the overall SBSP Project is committed to meeting the recovery plan goal for the snowy plover. While habitat will no longer be available in these ponds, other managed ponds within ELER (including Ponds E6A, E6B, E8, E16B, E15B, E14B, and E14) and Pond SF2, will be managed intensively for the species. Therefore, the proposed action will compensate for this loss of habitat for snowy plovers on a programmatic basis as part of the SBSP Project.

Construction-related Effects

There is some potential for snowy plovers to nest within Ponds E12 and E13 during construction and snowy plovers may forage along access roads used for construction equipment. Therefore, some potential exists for loss of snowy plovers during construction. Pre-construction surveys and other conservation measures described in the PBO should avoid or reduce the possibility of direct loss of individual snowy plovers.

Construction activities have the potential to disturb snowy plovers. These disturbances may be minimized by the flooding ponds such as Ponds E12, E13, and E14. If flooding of work areas does not occur, pre-construction surveys will be implemented and 600-foot buffers will be applied around any active snowy plover nest. Also, conservation measures described in the PBO should minimize this disturbance.

Human Disturbance and Predation Effects Associated with Public Access

The Pond E12-E13 restoration has been designed to maintain a 300-foot buffer between the nesting islands and the pond edge. Because the viewing platforms are expected to be a point of concentration for human activities, the island layout has been designed to maintain a 600-foot buffer between islands and the platform to avoid disturbance of nesting snowy plovers. Nest abandonment or loss of eggs or chicks due to exposure or predation could result from disturbance of adult snowy plovers during the breeding season, and loss of foraging opportunities could result from disturbance of foraging snowy plovers. However, because recreational use of the trails and viewing platforms will be ongoing during the nest-site selection period, snowy plovers that are intolerant of human activities are likely to nest far enough from the pond's edge so as not to be significantly disturbed by human disturbance. However, it is possible that first-time nesters may have a difficult time with nest site selection.

California least tern

Habitat Loss and Restoration

Least terns do not currently use Ponds E12 and E13, therefore no existing habitat for this species will be impacted or eliminated as a result of the proposed action.

Construction-related Effects

Some ELER ponds, as well as the Bay and possibly the lower reaches of Mount Eden Creek and Old Alameda Creek, are currently used for foraging by small numbers of least terns. Therefore, some least terns could be present in the vicinity during construction activities. However, it is unlikely that construction at the project site will preclude the least tern's use of adjacent areas for foraging or the islands for nesting, and ample habitat for least terns is available in the Bay. The enhancement of fish habitat resulting from tidal marsh restoration is expected to increase fish populations in the Bay, benefiting least terns in their post-breeding staging areas.

Human Disturbance and Predation Effects Associated with Public Access

Pond E12-E13 restoration has been designed to maintain a 300-foot buffer between the nesting islands and the pond edge. Because the viewing platforms are expected to be a point of concentration for human activities, the island layout has been designed to maintain a 600-foot buffer between islands and the platform to avoid disturbance of nesting least terns. Nest abandonment or loss of eggs or chicks due to exposure or predation could result from disturbance of adult least terns during the breeding season, and loss of foraging opportunities could result from disturbance of foraging least terns. However, because recreational use of the trails and viewing platforms will be ongoing during the nest-site selection period, least terns that are intolerant of human activities are likely to nest far enough from the pond's edge so as not to be significantly disturbed by human disturbance. However, it is possible that first-time nesters may have a difficult time with nest site selection.

Pond E8A, E8, and E9 Effects

Salt marsh harvest mouse

Habitat Loss and Restoration and Associated Loss of Individual Harvest Mice

No harvest mouse habitat currently exists in Ponds E8A, E8X, E9, or E10, however dredging of channels and breaching of levees will result in a temporary loss of 0.30 acres and a permanent loss of 1.1 acres of tidal marsh habitat for this species. In the longer term, the larger tidal prism introduced into the system is predicted to scour approximately 30 acres of additional tidal marsh in the vicinity of Pond E8A along the Old Alameda Creek and in Mount Eden Creek. Since these marshes largely consist of pickleweed, they are likely occupied by the harvest mouse, although surveys to confirm their presence have not been conducted. Although the proposed action will result in short-term loss of harvest mouse habitat, these losses will be offset by larger gains in suitable habitat as marsh is restored. The 630 acres of tidal restoration in Pond E8A, E8X, and E9 will contribute substantially to achieving the goals for recovery of the species.

Construction-related Effects

Levee lowering and levee construction activity, such as driving on outboard levees, will occur in the vicinity of habitat for the harvest mouse. Disturbance will result in displacement of harvest mice from protective cover and their territories/home ranges (through noise and vibrations) and/or direct injury or mortality (through crushing). Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance to females during the period of March through November may mean abandonment or failure of the current litter. Thus, displaced harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success. The benefits of habitat restoration are expected to far exceed any adverse effects of construction disturbance on salt marsh harvest mice. The conservation measures as described in the PBO should minimize disturbance to harvest mice by limiting activities that can occur in marsh habitats.

California clapper rail

Habitat Loss and Restoration and Associated Loss of Individual Clapper Rails

No clapper rail habitat currently exists in Ponds E8A, E8X, E9 or E10, however, dredging of channels and breaching of levees will result in a temporary loss of 0.30 acres and a permanent loss of 1.1 acres of tidal marsh habitat for this species, although channel habitat produced as a result of dredging will likely support foraging clapper rails. In the longer term, the larger tidal prism introduced into the system is predicted to scour approximately 30 acres of additional tidal marsh in the vicinity of Pond E8A along the Old Alameda Creek and in Mount Eden Creek. This area has historically supported foraging and breeding clapper rails.

Although these activities will result in the short-term loss of clapper rail tidal marsh habitat, these losses will be offset by gains in suitable habitat as marsh is restored in the newly breached ponds. The 630 acres of tidal restoration in this area due to implementation of Pond E8A, E8X, and E9 will contribute substantially to achieving the goals for recovery of the species.

It is unlikely that individuals will be directly lost due to construction activity during dredging of the channel through the marsh into the Old Alameda Creek channel or Mount Eden Creek, or activities adjacent to Whale's Tail Marsh. Nests, eggs, and young are unlikely to be present in areas where excavation will occur within the marsh, and any work performed during the breeding season will be preceded by surveys, as described in the conservation measures in the PBO, to ensure that centers of calling activity are avoided. However, it is possible that up to one pair of clapper rails could be present in the area.

Construction-related Effects

Levee lowering and levee construction activity, such as driving on outboard levees, will occur in the vicinity of foraging and breeding habitat for clapper rails, as described above. The most likely effect of such activities would be to cause harassment of clapper rails as they move farther from these activities to avoid the disturbance. While such an effect would effectively reduce the extent of foraging habitat temporarily, the long-term benefit of tidal marsh and tidal channel restoration will benefit clapper rails. Implementation of the conservation measures described in the PBO should minimize disturbance in the breeding season by avoiding work in clapper rail breeding areas.

Western snowy plover

Habitat Loss and Restoration and Associated Loss of Individual Snowy Plovers

The 630 acres of tidal marsh area that is restored in Ponds E8A, E8X, and E9 will no longer be available for approximately 26 pairs of nesting snowy plovers that are known to occupy this habitat. While habitat will no longer be available in these ponds, other ponds within the ELER and other restoration sites will be managed intensely for this species. Also, other Phase 1 actions will create more than 100 islands that may support nesting snowy plovers in managed systems (Ponds E12, E13, SF2, and A16). It is anticipated that these islands will provide high-quality

nesting habitat and may attract nesting snowy plovers.

Construction-related Effects

Ponds E8A, E8X, E9, E10, E13, and E14 will be inundated prior to Pond E8A, E8X, and E9 restoration activities to prevent snowy plovers from nesting in the action area. Pond E12 will be segregated from Pond E13 and drained to provide nesting habitat for snowy plovers during restoration activities. Therefore, snowy plovers should not be nesting in ponds directly adjacent to construction activity for Ponds E8A, E8X, and E9. There is some potential for snowy plovers, including chicks, to forage along access roads for construction equipment, and thus some potential disturbance to snowy plovers during construction. However, conservation measures, including pre-construction surveys should greatly reduce, if not avoid the possibility of direct loss and disturbance of individuals.

California least tern

Habitat Loss and Restoration and Associated Loss of Individual Least Terns

The nesting habitat for least terns in Pond E8A, where least terns established nesting in 2007, will no longer be available for 2 pairs of nesting least terns after tidal marsh habitat is restored. However, tidal marsh restoration will benefit least terns by increasing the prey availability for this species. Also, other Phase 1 actions will create more than 100 islands that may support nesting birds in managed systems (Ponds E12, E13, SF2, and A16). These islands will provide nesting habitat and may attract nesting least terns.

Construction-related Effects

Ponds E8A, E8X, E9, E10, E13, and E14 will be inundated prior to Pond E8A, E8X, and E9 restoration activities to prevent birds, including least terns, from nesting in the action area. Conservation measures should greatly reduce, if not eliminate, the possibility of direct loss and disturbance of individuals.

Some of these ponds, as well as the Bay and possibly the lower reaches of Mount Eden Creek and Old Alameda Creek, are currently used for foraging by small numbers of least terns. Therefore, some individuals could be present in the vicinity during construction activities. However, it is unlikely that construction at the project site would preclude the least tern's use of adjacent areas for foraging, and ample foraging and roosting habitat for least terns is available in the Bay. In addition, restoration of tidal habitat in Ponds E8A, E8X, and E9 may provide foraging habitat for least terns in the short term, as terns may forage within the pond at high tide until sediment accretion raises the pond elevation to the point that it becomes colonized by vegetation. The enhancement of fish habitat resulting from tidal marsh restoration is expected to increase fish populations in the Bay, benefiting least terns in their post-breeding staging areas.

Pond A6 Effects

Salt marsh harvest mouse

Habitat Loss and Restoration and Associated Loss of Individual Harvest Mice

Breaching of levees and excavation of pilot channels will result in the permanent loss of 1.3 acres of outboard salt marsh habitat available for harvest mice. The lowering of levees and the construction of ditch blocks will result in the permanent loss of approximately 0.1 acre of narrow strips of pickleweed on the interior of the salt pond. Widening of channels through scour resulting from increased tidal prism is expected to cause the loss of up to 20 acres of additional existing marsh. Although no surveys have been conducted, this marsh currently provides suitable habitat for harvest mice.

Construction-related Effects

Construction and excavation activities will result in increased levels of disturbance to harvest mice from noise, vibrations from equipment, and construction activities. Disturbance may result in displacement of harvest mice from protective cover and their territories/home ranges (through noise and vibrations). Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance to females during the period of March through November may mean abandonment or failure of the current litter. Thus, displaced harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

California clapper rail

Habitat Loss and Restoration and Associated Loss of Individual Clapper Rails

Breaching of levees and excavation of pilot channels will result in the permanent loss of 1.3 acres of outboard salt marsh habitat. Widening of these channels through scour resulting from increased tidal prism is expected to cause the loss of up to 20 acres of additional existing outboard marsh around the new breaches and at the mouth of Alviso and Guadalupe Sloughs. This marsh is currently used as foraging habitat by clapper rails, although use is likely to be infrequent and by small numbers of clapper rails. It is unlikely that the tidal marsh habitat that is lost is used as breeding habitat due to its narrow nature. Channel habitat produced as a result of dredging may support foraging clapper rails.

Although these activities will result in small short-term and larger long-term loss of clapper rail tidal marsh habitat, these losses will be compensated for by the creation of suitable habitat as tidal marsh is restored in the newly breached pond. The tidal marsh that develops within Pond A6 after restoration is expected to provide high-quality breeding and foraging habitat, and the 330 acres of tidal restoration in this area will contribute to achieving the goals for recovery of the species.

Construction-related Effects

There is some potential for disturbance of clapper rails due to the noise and activity of construction equipment during excavation of pilot channels, levee lowering, levee breaching, and PG&E boardwalk construction. The most likely effect of such activities would be to displace clapper rails if they move farther from these activities to avoid the disturbance. While such an effect would temporarily reduce the extent of foraging habitat, the foraging habitat adjacent to Pond A6 is of relatively low quality due to the narrow nature of the marsh and relative scarcity of channels. These marshes would be available to any foraging clapper rails following the completion of the initial restoration activities.

Western snowy plover

Habitat Loss and Restoration and Associated Loss of Individual Snowy Plovers

Snowy plovers do not currently use Pond A6, therefore no existing habitat will be impacted or eliminated as a result of the proposed action.

Construction-related Effects

If the "Hoxie Highway" that separates Ponds A8N and A8S is used by equipment or personnel to access Pond A6 during construction activities, there is potential for disturbance of foraging or nesting snowy plovers in Pond A8N or Pond A8S, leading to the potential loss of eggs or chicks. However, implementation of the conservation measures described in the PBO requires careful monitoring of the locations of active nests and chicks on the levee. Coordination with the Service prior to the use of this levee for Pond A6 access and seasonal restrictions on the use of this access route when nesting snowy plovers are present will avoid and minimize the potential for loss of snowy plovers, including eggs and chicks.

Pond A8 Effects

Salt marsh harvest mouse

Habitat Loss and Restoration and Associated Loss of Individual Harvest Mice

The 0.8 acre of tidal marsh lost as part of the proposed action is not suitable habitat for the harvest mice, however, the larger tidal prism introduced into the system is predicted to scour additional tidal marsh habitat downstream near the vicinity of Pond A6. Some of those marshes could support harvest mice.

Additionally, some of the isolated habitat within the pond complex will be inundated by the new flood regime. However, the water in the pond complex is expected to be relatively saline, and will facilitate pickleweed colonization in other areas. A band of vegetation is expected to quickly develop above the water level of the ponds under the new management regime. Harvest mice may colonize these areas, or use them occasionally in dispersal or for refugia at high tide.

Construction-related Effects

Construction and excavation activities will result in increased levels of disturbance to harvest mice from noise, vibrations from equipment, and construction activities. Disturbance may result in displacement of harvest mice from protective cover and their territories/home ranges (through noise and vibrations). Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Therefore, there is a possibility that individual harvest mice may be harmed during the excavation of the pilot channel through the outboard marsh from the notch to Alviso Slough. However, this is unlikely because the habitat (fresh water marsh) is not suitable for harvest mice, and thus there is a low probability that harvest mice will be present.

California clapper rail

Habitat Loss and Restoration and Associated Loss of Individual Clapper Rails

The 0.8 acre of tidal marsh lost as part of the proposed action is not suitable nesting habitat for clapper rails and provides only low-quality foraging habitat for the clapper rail. However, the larger tidal prism introduced into the system is predicted to scour additional marsh areas downstream to near the vicinity of Pond A6. Some of those marshes could support nesting or foraging clapper rails.

Construction-related Effects

Clapper rails are not expected to nest in the marsh that will be directly affected by excavation of the pilot channel between the notch and Alviso Slough, and in the event that a foraging individual is present in the impact area when excavation commences, an individual would likely be displaced before it would be killed or injured. Therefore, it is unlikely that individuals will be directly lost due to construction activity. Nevertheless, if construction at the Pond A8 notch is to occur during the breeding season, surveys (e.g., two surveys using tape playbacks during the February to mid-March primary calling period) will be conducted prior to construction to determine whether nesting clapper rails are present in the vicinity, and buffers between clapper rail activity centers and construction will be in place according the conservation measures described in the PBO. There is some potential for disturbance of clapper rails due to the noise and activity of workers and heavy equipment during excavation of the pilot channel and construction of the armored notch. However, this is very unlikely because the habitat (fresh water marsh) is of low quality to clapper rails, and nesting is not expected to occur near the notch.

Western snowy plover

Habitat Loss and Restoration and Associated Loss of Individual Snowy Plovers

All of the habitat in Pond A8 that has been used in the past by nesting snowy plovers will be inundated under the muted tidal management for this complex. Although potential nesting habitat will be lost in this pond when the pond is flooded prior to construction, and lost

permanently when muted tidal action is introduced, the overall SBSP Project is committed to meeting the recovery plan goal for the snowy plover. Thus, while snowy plover habitat will no longer be available in Pond A8, other ponds within ELER, Warm Springs, Alviso, and Ravenswood will be managed intensively for the species, compensating for the loss of habitat at Pond A8.

Construction-related Effects

There is some potential for loss or disturbance of snowy plovers (including eggs and chicks) due to construction activities. Staging on the "Hoxie Highway", or vehicular access to or construction activity at the notch location, could potentially disturb nesting snowy plovers. However, because Pond A8 will be flooded prior to the breeding season in which construction will occur, and high water levels will be maintained to discourage snowy plovers from nesting within 600 feet of construction areas, there is a low probability that such impacts will occur. Implementation of the conservation measures described in the PBO requires careful monitoring of the locations of active nests and chicks on the levee. Consultation with Service personnel prior to the use of this levee for ponds A5 and A7 access will further minimize the potential for loss or disturbance to snowy plovers.

Pond A16 Effects

Salt marsh harvest mouse

Habitat Loss and Restoration and Associated Loss of Individual Harvest Mice

There will be a permanent loss of habitat due to the construction of the intake channel for the new water control structures at Pond A17 (0.4 acre), and possibly a temporary loss due to excavation during access to the Pond A20 dredge lock (0.1 acre). This loss is compensated on a programmatic basis as part of the SBSP Project at other nearby sites, notably and concurrently with the tidal restoration of Pond A6.

Construction-related Effects

It is possible that some harvest mice will be harmed due to excavation of pilot channels and levee breaching in the marshes outboard of Pond A17, and possibly during dredge lock access at Pond A20. There is some chance that construction activities will disturb harvest mice in the vicinity of the water control structures and adjacent to routes used for access. These areas may include New Chicago Marsh, Triangle Marsh, and marshes outboard of Pond A17. This disturbance is likely to be temporary and minimal, relative to the railroad traffic that generates noise, vibrations, and dust on a regular, recurring basis in the proposed action area.

Human Disturbance and Predation Effects Associated with Public Access

Human use of the trail may result in disturbance of harvest mice immediately adjacent to the trail. However, dense pickleweed cover occurs in this area, which may provide adequate cover to minimize human-related disturbance. Mammals including rats, cats, skunks, and raccoons

which can prey upon harvest mice, are known to use the trails currently in the action area. It is possible that as human use increases on this trail, predation on harvest mice may increase due to more garbage/food along the trail that may attract predators.

California clapper rail

Habitat Loss and Restoration and Associated Loss of Individual Clapper Rails

There will be a permanent loss of habitat that may occasionally be used by clapper rails due to the construction of the intake channel for the new water control structures at Pond A17 (0.4 acre), and possibly a temporary loss of habitat due to excavation during access to the Pond A20 dredge lock (0.1 acre). It is anticipated that this loss of habitat will be compensated for on a programmatic basis as part of the SBSP Project at other nearby sites, notably and concurrently with the tidal restoration of Pond A6.

Construction-related Effects

It is unlikely that individual clapper rails will be directly lost due to construction activity during either excavation of the pilot channels through marshes, levee breaches, or accessing the Pond A20 dredge lock. Nevertheless, if construction in or adjacent to suitable habitat is to occur during the breeding season, surveys (e.g., two surveys using tape playbacks during the February to mid-March primary calling period) will be conducted prior to construction to determine whether nesting clapper rails are present in the vicinity, and buffers between clapper rail activity centers and construction will be in place as described in the PBO, which will minimize the disturbance effects to clapper rails.

Human Disturbance and Predation Effects Associated with Public Access

Human use of the levees around Ponds A16 and A17, including the view platform and interpretive station, may result in disturbance to clapper rails immediately adjacent to the trail. Recreational use of the public access facilities at Pond A16 could disturb foraging clapper rails, expose clapper rails to predation (especially during extremely high tides) by limiting the clapper rails' use of cover at the marsh edge, and limit the use of adjacent tidal marsh by clapper rails. However, given the low density of clapper rails in these areas, and the low probability that nesting is occurring in the outboard marsh north of Pond A17, it is unlikely that clapper rails will be disturbed by activities along the trail.

Western snowy plover

Habitat Loss and Restoration and Associated Loss of Individual Snowy Plovers

Snowy plovers do not currently nest or occur in the proposed action area, therefore no loss of individuals or habitat will occur.

Construction-related Effects

Snowy plovers do not currently occur on the project site. Because snowy plovers may attempt to nest on the pond bottom if it is de-watered prior to construction, pre-construction surveys will ensure that no snowy plovers are nesting in the area prior to construction. Therefore, implementation of Pond A16 restoration is not expected to have adverse effects on snowy plovers.

Human Disturbance and Predation Effects Associated with Public Access

Pond A16 has been designed to maintain a 300-foot buffer between the nesting islands and the pond edge. Nest abandonment or loss of eggs or chicks due to exposure or predation could result from disturbance of adult snowy plovers during the breeding season, and loss of foraging opportunities could result from disturbance of foraging snowy plovers. However, because recreational use of the Alviso Slough Trail and viewing platform will be ongoing during the nest-site selection period, snowy plovers that are intolerant of human activities are likely to nest far enough from the pond's edge so as not to be significantly disturbed by human disturbance. However, first-time nesters may have a difficult time with nest site selection

The effects of trail use on nesting birds will be studied at Pond A16. The public access trail will be open year-round and the distribution of the nests in relationship to the trails will be analyzed. The study would analyze all nesting species, but nests of snowy plovers would receive special attention in the decisions regarding site management.

California least tern

Habitat Loss and Restoration and Associated Loss of Individual Least Terns

Least terns do not currently occur on the project site. Therefore, construction will not result in disturbance on roosting or foraging habitat for least terns.

Human Disturbance and Predation Effects Associated with Public Access

Although least terns do not nest in Pond A16, it is possible that this species may establish nests on the islands constructed in the pond and forage in the pond under the new water management regime, and/or roost on islands in the pond. If least terns use the pond, management of water levels and vegetation could potentially result in the disturbance of nesting, roosting, or foraging least terns. If least terns use Pond A16 for roosting and/or nesting, the 300-foot buffer between the nesting islands and the pond edge would minimize disturbance of nesting or roosting least terns by human activities around the pond edge. As noted above, the effects of trail use on birds, particularly nesting birds on the islands will be studied at Pond A16. The study would analyze all nesting species, but nests of least terns would receive special attention in the decisions regarding site management.

Service and CDFG Operations and Maintenance Effects

Salt Marsh Harvest Mouse

Habitat Loss and Associated Loss of Individual Harvest Mice

The proposed project is likely to result in injury or death, and harm to harvest mice through the permanent loss of their habitat and through crushing by equipment and machinery. Harvest mouse habitat may be destroyed or fragmented by dredge lock use, levee maintenance, riprap installation, and other activities that involve the movement of dredge, or other material. Creating dredge lock access channels through fringe tidal marsh may fragment harvest mouse habitat and reduce up to 4.8 acres of available marsh habitat over a 10-year period, particularly when dredge material from channels longer than 70 feet are sidecast into adjacent marshes. The inadvertent spilling of dredge material from the top of salt pond levees or storage areas may also degrade or fragment harvest mouse habitat. Barren areas of land more than 16.4 feet wide, reaches of water more than 42 feet wide, and brackish or freshwater marsh more than 820 feet wide act as barriers to movement of the southern subspecies of the harvest mouse, and hence barriers to gene flow. To reduce potential adverse effects to insignificant levels, the conservation measures described in the PBO (such as the use of temporary or permanent chokers on outboard levees, sloping the levees toward the pond, and removing and revegetating slip-outs) will be implemented.

Since Phase 1 of the SBSP Project will ultimately restore hundreds of acres of salt marsh designed to create new habitat for harvest mice, impacts related to these O&M activities are compensated through the SBSP Project and contribute to meeting the recovery objectives for this species.

Disturbance Due to On-going Operations and Maintenance Activities

On-going O&M activities may disturb harvest mice. Inspections and maintenance of ditch blocks, water control structures, docks, marine crossings, intake channels, tide gates, borrow ditches, pumps, and other routine management practices may temporarily disturb harvest mice in adjacent marsh areas. Noise and vibration 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 nearby harvest mice. Noise and vibrations will result in displacement of harvest mice from protective cover and their territories and/or direct injury or mortality. These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of harvest mice from their territory in the areas where their habitat is destroyed. Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Disturbance to females March to November may cause abandonment or failure of the current litter. Thus, displaced harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Effects of Habitat Change

Restoration activities resulting in habitat changes (e.g. pond to tidal marsh) will increase harvest

mouse habitat, thereby creating potential unforeseen disturbance issues relating to maintenance activities. For instance, as restored ponds become suitable for harvest mice, they will colonize areas where they previously did not occur. Maintenance activities in, or adjacent to restored ponds, may result in disturbance of harvest mice that will not have occurred in those areas prior to restoration activities.

California Clapper Rail

Habitat Loss and Associated Loss of Individual Clapper Rails

Activities including dredge lock use, levee maintenance, riprap installation, and other forms of maintenance that involve the movement of large equipment, and/or dredge material, may inadvertently crush and kill individual clapper rails, nests, or young. Tidal marsh and high tide refugial habitat for clapper rails could be impacted on the outboard side of the salt pond levees if dredged material were to accidentally fall or flow into the marsh. If levee topping occurred during the clapper rail breeding season, any incidental slippage of material along the salt pond levee also could result in loss of eggs or young if nests were located within the area of incidental slippage in the tidal marsh. Clapper rail habitat may be impacted by dredge lock use, levee maintenance, riprap installation, and other activities that involve the movement of dredge, or other material, that may degrade or fragment adjacent tidal marsh habitat. Creating dredge lock access channels through fringe tidal marsh may fragment clapper rail habitat and reduce up to 4.8 acres of available marsh habitat over a 10-year period, particularly when dredge material from channels longer than 70 feet are sidecast into adjacent marshes. To reduce potential adverse effects to insignificant levels, the conservation measures described in the PBO (such as the use of temporary or permanent chokers on outboard levees, sloping the levees toward the pond, and removing and revegetating slip-outs) will be implemented.

Since Phase 1 of the SBSP Project will ultimately restore hundreds of acres of salt marsh designed to create new habitat for harvest mice, impacts related to these O&M activities are compensated through the SBSP Project and contribute to meeting the recovery objectives for this species.

Disturbance of Foraging Habitat due to On-going Operations and Maintenance Activity

On-going O&M activities may disturb clapper rails. Inspections and maintenance of ditch blocks, water control structures, docks, marine crossings, intake channels, tide gates, borrow ditches, pumps, and other routine management practices may temporarily disturb clapper rails from breeding territories and/or 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 clapper rails. Clapper rails vary in their sensitivity to human disturbance, both individually and between marshes. In some marshes, clapper rails seem highly tolerant to human activity (e.g. Palo Alto Baylands Nature Preserve), whereas others have demonstrated sensitivity to disturbance (e.g. Laumeister Marsh). This variance in sensitivity is likely correlated with the amount of routine anthropogenic disturbance associated with recreation and maintenance activities. Clapper rail reactions to disturbance may vary with season; however both breeding and non-breeding seasons are critical times.

Disturbance during the nonbreeding season may primarily affect survival of adult and subadult clapper rails. Adult clapper rail mortality is greatest during the winter, primarily due to predation. Disturbance issues may be worsened during winter high tide events, as clapper rails may experience increased vulnerability to predators. The presence of people in the high marsh plain or near upland areas during winter high tides may prevent clapper rails from leaving the lower marsh plain. Clapper rails that remain in the marsh plain during inundation are vulnerable to predation due to minimal vegetative cover available.

Effects of Habitat Change

Restoration activities resulting in habitat changes (e.g., salt pond to tidal marsh) will increase clapper rail habitat, thereby creating potential unforeseen disturbance issues relating to maintenance activities. For instance, as restored ponds become suitable for clapper rails, they will colonize areas where they previously did not occur. Maintenance activities in, or adjacent to restored ponds, may result in disturbance of clapper rails that will not have occurred in those areas prior to restoration activities.

Western Snowy Plover

Habitat Loss and Associated Loss of Individual Snowy Plovers

It is unlikely that on-going O&M activity will cause the loss of snowy plover habitat. Minimal loss of habitat could occur during inadvertent spilling of dredge material from the top of salt pond levees or storage areas into snowy plover breeding or foraging areas. Ponds that are managed as seasonal ponds, which could support snowy plovers, may require flooding in order to perform maintenance of the levees. There could also be minimal, temporary loss of breeding habitat as a floating dredge moves from pond to pond by excavating through the separating levee.

There is some potential for the loss of snowy plover chicks due to on-going O&M activity involving vehicular access on roads that are adjacent to snowy plover breeding habitat. In particular, levee roads adjacent to Ponds A8, A22 and A23, E6A, E6B, SF2, and R1 have the highest risk of snowy plover mortality. However, careful monitoring of the locations of active nests and chicks, a 600-foot buffer around nests and broods, and consultation with the Refuge personnel prior to the use of levee access will minimize the potential for loss of snowy plovers, including eggs and chicks.

Disturbance Due to On-going Operations and Maintenance Activities

There is some potential for disturbance of foraging snowy plovers, and possibly disturbance of nesting adults or chicks leading to the loss of eggs or chicks, due to vehicular access near snowy plover breeding areas as described above. 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 snowy plovers. These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of snowy plovers from disturbed areas. A

minimum buffer of 600 feet around snowy plover nests will be implemented to reduce disturbance to breeding snowy plovers.

Effects of Habitat Change

Habitat changes resulting from future SBSP Phase 1 restoration activities will likely shift snowy plover habitat use from current areas, described above, to newly created managed ponds, such as Pond A16. A shift in snowy plover distribution, particularly in breeding locations, will expose snowy plovers to new disturbances associated with on-going O&M activities. For instance, maintenance activities associated with managed ponds may disturb breeding snowy plovers in those areas.

California Least Tern

Habitat Loss and Associated Loss of Individual Least Terns

There will not likely be a loss of habitat for least terns associated with on-going O&M activities. Minimal loss of foraging habitat may occur, as a result of an increase in turbidity and a reduction in dissolved oxygen, in areas where dredging occurs. However, these losses are expected to be localized and temporary.

There is some potential for the loss of least tern chicks or nests due to on-going O&M activity involving vehicular access on roads that are adjacent to least tern breeding habitat. In particular, levee roads adjacent to Pond E8A, where the most recent least tern nesting has occurred, or other roads near areas where they may breed in the future, have the highest risk of least tern mortality. However, careful monitoring of the locations of active nests and chicks and consultation with the Refuge personnel prior to the use of levee access will minimize the potential for loss of least tern eggs and chicks.

Disturbance due to On-going Operations and Maintenance Activity

On-going O&M activities may disturb least terns. Both adult and juvenile least terns roost on salt pond levees (both outboard levees and interior levees between ponds) and boardwalks. Inspections and maintenance of ditch blocks, water control structures, docks, marine crossings, intake channels, tide gates, borrow ditches, pumps, and other routine management practices may temporarily disturb 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 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 on-going O&M activities will cause substantial disturbance to least terns.

Effects of Habitat Change

Habitat changes resulting from future Phase 1 restoration activities may shift least tern roosting sites from current areas, described above, to newly created managed ponds, such as Ponds A16

and SF2. A shift in least tern distribution could expose least terns to new disturbances associated with on-going O&M activities. For instance, maintenance activities associated with managed ponds may disturb roosting least terns in those areas.

Potential Effects of Mercury Exposure

The listed species addressed are currently exposed to mercury when foraging on mudflats and in sloughs with high levels of mercury contamination. It is possible that certain O&M activities may increase the exposure of these species to mercury by stirring up sediments containing mercury, potentially making mercury more bioavailable to these species. The SBSP Project will be monitoring effects of Phase 1 restoration activities in the Alviso Complex on mercury contamination in sentinel species.

PG&E Operations and Maintenance Effects

Salt Marsh Harvest Mouse

Habitat Loss and Associated Loss of Individual Harvest Mice

Harvest mice habitat may be destroyed or fragmented by boardwalk construction and maintenance, dock construction, and other activities that involve work in tidal marsh. Also, the inadvertent spilling of materials from the top of salt pond levees during access road maintenance may also degrade or fragment harvest mouse habitat. Barren areas of land more than 16.4 feet wide, reaches of water more than 42 feet wide, and brackish or freshwater marsh more than 820 feet wide may act as barriers to movement of the southern subspecies of the harvest mouse, and hence barriers to gene flow.

Activities including line patrol, tower inspection, tower and distribution pole maintenance, access road maintenance, boardwalk construction and maintenance, dock construction, and other forms of maintenance or construction that involves trampling of marsh may inadvertently crush and kill individual harvest mice, nests, or young. Noise and vibration created by helicopters, trucks, jackhammers, impact wrenches, and other large equipment may temporarily disturb harvest mice in adjacent marshes. Disturbance will result in displacement of harvest mice from protective cover and their territories. Displaced harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predation.

Disturbance Due to On-going Operations and Maintenance Activities

Activities such as line patrol, line work, tower inspection, tower and distribution pole maintenance, access road maintenance, boardwalk construction and maintenance, dock construction, and other O&M activities generating loud noise and vibration may disturb harvest mice. Noise and vibrations will result in displacement of harvest mice from protective cover and their territories and/or direct injury or mortality. These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of harvest mice from their territory in the areas where their habitat is destroyed. Displaced harvest mice may have to compete for resources in occupied habitat, and may be more

vulnerable to predators. Disturbance to females during the period of March through November may mean abandonment or failure of the current litter. Thus, displaced harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success. However, conservation measures will minimize disturbance to salt marsh harvest mouse

Effects of Habitat Change

Restoration activities resulting in habitat changes (e.g. pond to tidal marsh) will increase harvest mouse habitat, thereby creating potential unforeseen disturbance issues relating to PG&E O&M activities. For instance, as restored ponds become suitable for harvest mice, they will colonize areas where they previously did not occur, such as Pond A6. Maintenance activities in, or adjacent to newly restored ponds, may result in disturbance to harvest mice that will not have occurred in those areas prior to restoration activities. However, since the formation of marsh plain in areas like Pond A6 is expected to take many years, perhaps decades, potential future impacts to marsh species will be covered under PG&E's Habitat Conservation Plan (HCP) that is currently under progress.

California Clapper Rail

Habitat Loss and Associated Loss of Individual Clapper Rails

Clapper rail habitat may be destroyed or fragmented by boardwalk construction and maintenance, dock construction, and other activities that involve work in tidal marsh. The inadvertent spilling of materials from the top of salt pond levees during access road maintenance may also reduce or degrade clapper rail habitat.

Activities including line patrol, tower inspection, tower maintenance, access road maintenance, boardwalk construction and maintenance, dock construction, and other forms of maintenance or construction that involves trampling of marsh may inadvertently crush and kill individual clapper rail nests, or young.

Disturbance of Foraging Habitat due to On-going Operations and Maintenance Activities

Activities such as line patrol, line work, tower inspection, tower maintenance, access road maintenance, boardwalk construction and maintenance, dock construction, and other O&M activities generating loud noise and vibration may disturb clapper rails. Noise and vibration created by helicopters, trucks, jackhammers, impact wrenches, and other large equipment may also temporarily disturb individual clapper rails. Clapper rails vary in their sensitivity to human disturbance, both individually and between marshes. In some marshes, clapper rails seem highly tolerant to human activity (e.g. Palo Alto Baylands Nature Preserve), whereas others have demonstrated sensitivity to disturbance (e.g. Laumeister Marsh). This variance in sensitivity is likely correlated with the amount of routine anthropogenic disturbance associated with recreation and maintenance activities. Clapper rail reactions to disturbance may vary with season; however both breeding and non-breeding seasons are critical times. Disturbance during the nonbreeding season may primarily affect survival of adult and subadult clapper rails. Adult clapper rail

mortality is greatest during the winter, primarily due to predation. Disturbance issues may be worsened during winter high tide events, as clapper rails may experience increased vulnerability to predators. The presence of people in the high marsh plain or near upland areas during winter high tides may prevent clapper rails from leaving the lower marsh plain. Clapper rails that remain in the marsh plain during inundation are vulnerable to predation due to minimal vegetative cover available. However, conservation measures will minimize disturbance to the clapper rail.

Effects of Habitat Change

Restoration activities resulting in habitat changes (e.g. pond to tidal marsh) will increase clapper rail habitat, thereby creating potential unforeseen disturbance issues relating to PG&E O&M activities. For instance, as restored ponds become suitable for clapper rails, they will colonize areas where they previously did not occur, such as Pond A6. Maintenance activities in, or adjacent to newly restored ponds, may result in disturbance to clapper rails that will not have occurred in those areas prior to restoration activities. However, since the marsh development in areas like Pond A6 is expected to take many years, perhaps decades, potential future impacts to marsh species will be covered under PG&E's HCP that is currently under progress.

Western Snowy Plover

Habitat Loss and Associated Loss of Individual Snowy Plovers

It is unlikely that O&M activity will cause the loss of snowy plover habitat. Minimal loss of habitat could occur during inadvertent spilling of material from the top of salt pond levees during road maintenance.

There is some potential for the loss of snowy plover chicks due to O&M activity involving vehicular access on roads that are adjacent to snowy plover breeding habitat. In particular, levee roads adjacent to Ponds A8N and A8S, A22 and A23, E6A, E6B, SF2, and R1 have the highest risk of snowy plover mortality. However, careful monitoring of the locations of active nests and chicks, a 600-foot buffer around nests and broods, and coordination with the Service prior to the use of levee access will minimize the potential for loss of snowy plovers, including eggs and chicks.

Disturbance Due to On-going Operations and Maintenance Activities

There is some potential for disturbance of foraging snowy plovers, and possibly disturbance of nesting adults or chicks leading to the loss of eggs or chicks, due to vehicular access or helicopter flight near snowy plover breeding areas. Noise and vibration created by trucks, jackhammers, impact wrenches, and other large equipment may also temporarily disturb individual snowy plovers. These disturbances are likely to disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and are likely to result in the displacement of snowy plovers from disturbed areas. A minimum buffer of 600 feet around plover nests will be implemented to reduce disturbance to breeding snowy plovers.

Effects of Habitat Change

Habitat changes resulting from future Phase 1 restoration activities will likely shift snowy plover habitat use from current areas, described above, to newly created managed ponds, such as Pond A16. A shift in snowy plover distribution, particularly in breeding locations, will expose snowy plovers to new disturbances associated with PG&E O&M activities. For instance, maintenance activities associated with Pond A16 may disturb breeding snowy plovers that colonize the area.

California Least Tern

Habitat Loss and Associated Loss of Individual Least Terns

There will not likely be a loss of habitat for least terns associated with PG&E O&M activities. Minimal loss of foraging habitat may occur, as a result of an increase in turbidity and a reduction in dissolved oxygen, in areas where boat dock construction occurs in the water. However, these losses are expected to be localized and temporary.

There is some potential for the loss of least tern chicks or nests due to O&M activity involving vehicular access on roads that are adjacent to least tern breeding habitat. In particular, levee roads adjacent to Pond E8A, where the most recent least tern nesting has occurred, or other roads near areas where they may breed in the future, have the highest risk of least tern mortality. However, careful monitoring of the locations of active nests and chicks and coordination with the Service prior to the use of levee access will minimize the potential for loss of least tern eggs and chicks.

Disturbance due to On-going Operations and Maintenance Activities

O&M activities may disturb least terns. Both adult and juvenile least terns roost on salt pond levees (both outboard levees and interior levees between ponds) and boardwalks. Activities such as line patrol, line work, tower inspection, tower maintenance, access road maintenance, boardwalk construction and maintenance, dock construction, and other O&M activities generating loud noise and vibration temporarily disturb least terns from roosting and foraging areas. Noise and vibration created by trucks, jackhammers, impact wrenches, and other large equipment may also temporarily disturb individual 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 on-going O&M activities will cause substantial disturbance to least terns. However, conservation measures will minimize disturbance to the least tern.

Effects of Habitat Change

Habitat changes resulting from future Phase 1 restoration activities may shift least tern roosting and breeding sites from current areas, described above, to newly created managed ponds, such as Pond SF2. A shift in least tern distribution could expose least terns to new disturbances associated with PG&E O&M activities. For instance, maintenance activities associated with Pond SF2 may disturb roosting or nesting least terns. Also, least terns may forage in areas like

Pond A6 prior to marsh accretion, and therefore may be disturbed by PG&E activities in that area as well.

Cumulative Effects

Cumulative effects of projects in the South Bay on the harvest mouse, clapper rail, snowy plover, and least tern, are discussed in the PBO for the SBSP Project and are hereby incorporated by reference.

CONCLUSION

After reviewing the current status of the clapper rail, harvest mouse, snowy plover, and least tern, the environmental baseline for these species within the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of these species.

We based this determination on the following: (1) successful implementation of the conservation measures described in the PBO to minimize the adverse effects on individual clapper rails, least terns, snowy plovers, and harvest mice, and their habitats; (2) the relatively low number of clapper rails, harvest mice, snowy plovers, and least terns that will be harassed, harmed, or killed; and (3) the restoration actions associated with the programmatic SBSP Project will be implemented and will result in 6,800 to 11,880 acres of tidal habitat restoration and managed ponds that support these species, and is anticipated to more than compensate for the existing habitat lost identified in this biological opinion.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species 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.

The incidental take statement accompanying this biological opinion exempts take of clapper rails, harvest mice, snowy plovers, and least terns 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 Service.

If the Service (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 Service and described in the "Description of the Proposed Action" of the PBO will reduce, but do not eliminate, the potential for incidental taking of clapper rails, harvest mice, snowy plovers, and least terns. The Service expects that incidental take of the 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 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 harvest mice, clapper rails, least terns, and snowy plovers 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 action.

SBSP Project Phase 1 Restoration Actions

Due to implementation of the Phase 1 restoration actions, incidental take for harvest mice, clapper rails, least terns, and snowy plovers of is expected in the form of:

1. 4.01 acres of tidal marsh habitat available for the harvest mouse and clapper rail will be permanently lost; and 4.34 acres of tidal marsh habitat for these species will be temporarily affected as a result of construction of the proposed Phase 1 action;
2. harm, mortality, or harassment of a maximum of six (6) pairs of clapper rails due to construction of the proposed Phase 1 action within the 2 year construction time
3. harm, mortality, or harassment of up to two (2) pairs of least terns after the permanent loss of 630 acres of salt pond habitat in the Phase 1 action area due to construction of the proposed action;
4. harassment associated with public access of all least terns currently inhabiting 472 acres in Ponds A16, E12 and E13 in the Phase 1 action area; and
5. harassment associated with public access of all least terns which may occupy the newly restored 159 acres of nesting islands and seasonal habitat in Pond SF2 in the Phase 1 action area.
6. harm, mortality, or harassment of a maximum of forty-seven (47) pairs of snowy plovers after the permanent loss of 1,435 acres of salt pond nesting habitat for this species in the Phase 1 action area due to construction of the proposed action;
7. harm or mortality of harvest mice, clapper rails, least terns, and snowy plovers (either directly or by affecting their food sources and habitat availability) in the Phase 1 action area due to predation and invasion of non-native plant species;
8. harassment associated with construction (noise and vibrations) of the proposed action of all harvest mice, clapper rails, least terns, and snowy plovers within the Phase 1 action

area over the 2 year construction time; and

9. harassment associated with public access of all harvest mice, clapper rails, and snowy plovers currently inhabiting the Phase 1 action area.

Operations and Maintenance Activities

Due to implementation of operation and maintenance activities over a 10-year period, incidental take for harvest mice, clapper rails, least terns, and snowy plovers of is expected in the form of:

1. 4.8 acres of tidal marsh habitat available for harvest mice and clapper rails will be temporarily affected due to operation and maintenance activities that will occur over a 10-year period; and
2. harassment associated with operations and maintenance (noise and vibrations) of the proposed action of all harvest mice, clapper rails, least terns, and snowy plovers within the SBSP Project action area over the 10 year period.

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 clapper rail, harvest mouse, snowy plover, and least tern:

1. Minimize the potential for harm, harassment, or mortality of harvest mice, clapper rails, snowy plovers, and least terns.

2. Minimize the impacts of permanent loss or degradation of habitat on harvest mice, clapper rails, snowy plovers, and least terns.

TERM AND CONDITION

To be exempt from the prohibitions of section 9 of Act, the Service must comply with the following term and condition, which implements the reasonable prudent measures described above. This term and condition is nondiscretionary.

Implement the proposed action as described along with the proposed conservation measures as described in this biological opinion.

REPORTING REQUIREMENTS

The Service must be notified within 24 hours of the finding of any injured or dead harvest mice, clapper rails, least terns, or snowy plovers, or any unanticipated damage to their habitats associated with the proposed action. Injured harvest mice, clapper rails, least terns, or snowy plovers shall be cared by a licensed veterinarian or other qualified person, such as the Service-approved biologist for the proposed action. Notification must include the date, time, and precise location of the specimen/incident, and any other pertinent information. Dead animals 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 Chris Nagano, Deputy Assistant Field Supervisor (Endangered Species Program) at the Sacramento Fish and Wildlife Office at 916/414-6600 and Resident Agent-in-Charge, Dan Crum of the Service's Law Enforcement Division at telephone 916/414-6660.

Any contractor or employee who during routine operations and maintenance activities inadvertently kills or injures a listed wildlife species must immediately report the incident to their representative. This representative must contact the California Department of Fish and Game immediately in the case of a dead or injured listed species. The California Department of Fish and Game contact for immediate assistance is State Dispatch at (916) 445-0045.

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. Assist the Service in implementing other recovery actions identified within most current recovery plans for the clapper rail, harvest mouse, least tern, and snowy plover.
2. 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 *Spartina* within the Estuary.
3. 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.
4. Facilitate additional educational programs geared toward the importance and conservation of tidal marsh and seasonal wetlands.
5. Sightings of any listed or sensitive species should be reported to the California Natural Diversity Database of the CDFG. 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.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the proposed Programmatic South Bay Salt Pond Restoration Project and Phase 1 actions. 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 biological opinion.

If you have any questions regarding this biological opinion on the proposed South Bay Salt Pond Restoration Project Long-term Plan and the Project-level Phase 1 actions, please contact Melisa Helton at (510) 792-0717 (ext. 228) or Ryan Olah at (916) 414-6625.

Sincerely,

Cay C. Goude

Cay C. Goude
Acting Field Supervisor

cc:
Scott Wilson, California Department of Fish and Game, Yountville, California
John Krause, California Department of Fish and Game, Yountville, California
Suzanne DeLeon, California Department of Fish and Game, Yountville, California
Steve Ritchie, California State Coastal Conservancy, Oakland, California

LITERATURE CITED

Adger, N., P. Aggarwal, S. Agrawala, J. Alcamo, A. Allali, O.Anisimov, N. Arnell, M. Boko, O. Canziani, T. Carter, G. Casassa, U. Confalonieri, R. V. Cruz, E. de Alba Alcaraz, W. Easterling, C. Field, A. Fischlin, B. B. Fitzharris, C. G. García, C. Hanson, H. Harasawa, K. Hennessy, S. Huq, R. Jones, L. K. Bogataj, D. Karoly, R. Klein, Z. Kundzewicz, M. Lal, R. Lasco, G. Love, X. Lu, G. Magrín, L. J. Mata, R. McLean, B. Menne, G. Midgley, N. M., M. Q. Mirza, J. Moreno, L. Mortsch, I. Niang-Diop, R. Nicholls, B. Nováky, L. Nurse, A. Nyong, M. Oppenheimer, J. Palutikof, M. Parry, A. Patwardhan, P. R. Lankao, C. Rosenzweig, S. Schneider, S. Semenov, J. Smith, J. Stone, J. van Ypersele, D. Vaughan, C. Vogel, T. Wilbanks, P. P. Wong, S. Wu, and G. Yohe. 2007. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Climate change impacts, adaptation, and vulnerability. Brussels, Belgium.

Ainley, D.G. 2000. Brown Pelican. In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. Oakland, California. p 322-323.

Alberston, J.A and J.G. Evens. 2000. California Clapper Rail (*Rallus longirostris obsoleuts*). In: Olofson P, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. Oakland, California. p 332-340.

Albertson, J.D. 1995. Ecology of the California Clapper Rail in South San Francisco Bay. Unpublished Masters Thesis. San Francisco State University. San Francisco, California. 199 p.

Allen J.R.L. 1990. Salt-marsh growth and stratification: A numerical model with special reference to the Severn Estuary, southwest Britain. Marine Geology 95:77–96.

Allen, J.R.L. 2000. Morphodynamics of Holocene salt marshes: a review sketch from the Atlantic and southern North Sea coasts of Europe. Quaternary Science Review 19(12):1155-1231.

Anderson, D.W. and F. Gress. 1983. Status of a northern population of California Brown Pelicans. Condor (85):79-88.

Anonymous. 2007. Global warming is changing the World. Science 316:188-190.

Atwater, B.F., S.G. Conrad, J.N. Dowden, C.W. Hedel, R.L. MacDonald, and W. Savage. 1979. History, Landforms, and Vegetation of the Estuary's Tidal Marshes. In: Conomos TJ, editor. San Francisco Bay: The Urbanized Estuary. Pacific Division, American

Association for the Advancement of Science. San Francisco, California. p 347-385.

Atwood, J.L. and D.E. Minsky. 1983. Least tern foraging ecology at three major California breeding colonies. Western Birds 14:57-72.

Avocet Research Associates. 2004. California Clapper Rail (*Rallus longirostris obsoletus*) breeding season survey San Pablo Bay and tributaries 2004. Final Report to Marin Audubon Society. May 28, 2004 (revised June 9, 2004). 17 pp. plus tables and maps.

Bias, M.A. 1994. Ecology of the salt marsh harvest mouse in San Pablo Bay. Unpubl. Ph.D. dissertation. University of California. Berkeley, California. 243 p.

Boarman, William I. and Bernd Heinrich. 1999. Common Raven (*Corvus corax*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/476

Briggs, K.T, W.B. Tyler, D.B. Lewis, and D.R. Carlson. 1987. Bird communities at sea off California: 1975 to 1983. Studies in Avian Biology 11.

Caffrey, C. 1995. California least tern monitoring packet. California Department of Fish and Game, Nongame Bird and Mammal Section Report. Yountville, California.

California Department of Fish and Game. 2000. Final Eden Landing Ecological Reserve (Baumberg Tract) Restoration and Management Plan. Prepared by Resource Management International, Inc. to The Wildlife Conservation Board, Yountville, California. 98 pp.

Casady, D.S. 1999. Snowy Plover (*Chardrius alexandrines* [sic]) nesting at the Baumberg Tract salt ponds, Hayward, California, 1999. CDFG. Yountville, California.

Clark, D.R., K.S. Foerster, C. M. Marn, and R. L. Hothem. 1992. Uptake of environmental contaminants by small mammals in pickleweed habitats at San Francisco Bay, California. Archives of Environmental Contamination and Toxicology 22:289-396.

Collins, L.D. 1994. A History and overview of Least Terns at the Alameda Naval Air Station. Proceedings of the Alameda Naval Air Station's Natural Resources and Base Closure Planning for the Future, Golden Gate Audubon Society. San Francisco, California. p 25-34.

Collins, J.N., J.G. Evens, and B. Grewell. 1994. A synoptic survey of the distribution and abundance of the California clapper rail *Rallus longirostris obsoletus* in the northern reaches of the San Francisco Estuary during the 1992 and 1993 breeding seasons. Final report to California Department of Fish and Game. Yountville, California. 22 pp. plus appendix.

DeGroot, D.S. 1927. The California clapper rail: it's nesting habitats, enemies, and habitat. Condor. 29:259-270.

Eddleman, W.R. 1989. Biology of the Yuma clapper rail in the southwestern U.S. and northwestern Mexico. Final report to the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. Sacramento, California. 127 pp.

Eisma, D and K.S. Dijkema. 1997. The influence of salt marsh vegetation on sedimentation. In: Eisma D, editor. Intertidal Deposits. CRC Press. Boca Raton, Florida. p 403-414.

Elliott, M.L, B.L. Saenz, C.A. Abraham, J.E. Roth, W.J. Sydeman, and A. Zoidis. 2004. Oakland Harbor deepening project (-50'): Least Tern, fish, and plume monitoring. Final Report Year 2003. Unpubl. Report, Tetra Tech, Inc. San Francisco, California.

Evens, J. and G. Page. 1983. The ecology of clapper rail populations at Corte Madera Ecological Preserve with recommendations for management. Report prepared for Marin Audubon Society. 62 pp.

Evens, J. and G. Page. 1986. Predation on black clapper rails during high tides in salt marshes. Condor 88:107-109.

Eyster, C., D. George, and G.W. Page. 2003. Management plan for the salt ponds in the California Department of Fish and Game Moss Landing Wildlife Area, Monterey County, CA. Unpublished Report. PRBO Conservation Science. Stinson Beach, California.

Feeney, L. R. 2000. California Least Tern in Goals Project. Baylands ecosystem species and community profiles: life histories and environmental requirements of key plants, fish, and wildlife (P. Olofson, ed.), pp. 359-362. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

Feeney, L.R and W.A. Maffei. 1991. Snowy Plovers and their habitat at the Baumberg Area and Oliver Salt Ponds, Hayward, California March 1989 through May 1990. Hayward, California: Report prepared for the City of Hayward. 162 p.

Fischer, B. 1998. Western Snowy Plover breeding survey and nest characterization; Don Edwards San Francisco Bay National Wildlife Refuge 1998. Unpublished Report. San Francisco Bay National Wildlife Refuge Complex. Newark, California.

Fisler, G.F. 1965. Adaptations and speciation in harvest mice of the marshes of San Francisco Bay. Unpubl. Ph.D. dissertation. University of California. Berkeley, California. 108 p.

Foerster, K.S. 1989. Summary of California Clapper Rail winter populations in the San Francisco Bay National Wildlife Refuge, Nov. 1988 to Jan. 1989. Unpublished report. San Francisco Bay National Wildlife Refuge. Newark, California.

Foerster, K.S and J.E. Takekawa. 1991. San Francisco Bay National Wildlife Refuge predator

management plan and final environmental assessment. U.S. Fish and Wildlife Service. Newark, California.

Foerster, K.S, J.E. Takekawa, and J.D. Albertson. 1990. Breeding density, nesting habitat, and predators of the California Clapper Rail. Fremont, CA: Unpubl. Rep. No. REFUGE-116400-90-1, San Francisco Bay Wildlife Refuge. Newark, California. 21+ p.

Foin, T.C, E.J. Garcia, R.E. Gill, S.D. Culberson, and J.N. Collins. 1997. Recovery strategies for the California clapper rail (*Rallus longirostris obsoletus*) in the heavily-urbanized San Francisco estuarine ecosystem. Landscape and Urban Planning 38(3):229-243.

Garcia, E.J. 1995. Conservation of the California clapper rail: An analysis of survey methods and habitat use in Marin County, California. Master Thesis. University of California. Davis, California. 135 pp.

Geissel, W, H. Shellhammer, and H.T. Harvey. 1988. The ecology of the salt-marsh harvest mouse (*Reithrodontomys raviventris*) in a diked salt marsh. Journal of Mammalogy 69(4):696-703.

Gill, R., Jr. 1978. Status and distribution of the California clapper rail (*Rallus longirostris obsoletus*). 21 pp. plus appendix.

Goals Project. 1999. Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. First Reprint. U.S. Environmental Protection Agency/San Francisco Bay Regional Water Quality Control Board. San Francisco and Oakland, California. 209 p.

Greenfield, B.K., J. A. Davis, J.L. Grenier, A.R. Melwani, J.A. Hunt, and S. Bezalel. 2006. Legacy mercury contamination in California sport fish, American Chemical Society 232nd National Meeting, September 10 – 14, San Francisco, California..

Grinnell, J., H.C. Bryant, and T.I. Storer. 1918. The game birds of California. University of California Press. Berkeley, California. 642 pp.

H. T. Harvey & Associates. 1984. Biological Assessment of the Ideal Cement Site, Project 243-01. Los Gatos, California. 18 p.

_____ 1985a. King and Lyons Property Salt Marsh Harvest Mouse Trapping Survey. Project 261-02. Los Gatos, California. 12 p.

_____ 1985b. Mayhew's Landing salt marsh harvest mouse trapping survey. Prepared for Oliver DeSilva Company. Report nr 152-03. Los Gatos, California. 11 p.

_____ 1985c. Salt Marsh Harvest Mouse and Small Mammal Trapping at Concord Naval Weapons Station. Project 263-01. Los Gatos, California. 31 p.

_____ 1987. Citation Homes Roberts Landing Salt Marsh Harvest Mouse Trapping, August, September, 1987. Project 184-03. Los Gatos, California. 33 p.

_____ 1990a. San Jose permit assistance program California Clapper Rail 1990 breeding survey. Prepared for CH2M Hill. Report nr 477-07. Los Gatos, California.

_____ 1990b. San Jose permit assistance program California Clapper Rail 1990 winter pilot survey. Prepared for CH2M Hill. Report nr 477-06. Los Gatos, California. 19 p.

_____ 1991. Sunnyvale permit assistance program California Clapper Rail breeding survey 1990 and 1991, Guadalupe Slough. Prepared for EOA, Inc. Report nr 577-01. Los Gatos, California. 19 p.

_____ 1994. Marsh Plant Associations of South San Francisco Bay: 1994 Comparative Study. Project No. 477-14. Los Gatos, California.

_____ 1996. Oro Loma Marsh Restoration Site Salt Marsh Harvest Mouse Monitoring. Project 1126-01. Los Gatos, California. 16 p.

_____ 1997a. Coyote Creek Flood Control Project, Reach 1A Mitigation Site, 1997 Monitoring Report. Project 182-30. Los Gatos, California.

_____ 1997b. Marsh plant associations of South San Francisco Bay: 1996 comparative study including Alviso Slough, Unpubl. report, 22 January, 1997. Project No. 477-18. Prepared for the City of San Jose, CA. Los Gatos, California. 117 p.

_____ 1998. Marsh Plant Associations of South San Francisco Bay: 1997 Comparative Study. Project No. 477-19. Prepared for the City of San Jose. Los Gatos, California.

_____ 1999. Marsh Plant Associations of South San Francisco Bay: 1998 Comparative Study. Project No. 477-20. Prepared for the City of San Jose. Los Gatos, California.

_____ 2000. Marsh Plant Associations of South San Francisco Bay: 1999 Comparative Study. Project No. 477-21. Prepared for the City of San Jose. Los Gatos, California.

_____ 2001a. Marsh Plant Associations of South San Francisco Bay: 2001 Comparative Study. Project 477-22. Prepared for the City of San Jose. Los Gatos, California.

_____ 2002. Marsh Plant Associations of South San Francisco Bay: 2002 Comparative Study. Project No. 477-22. Prepared for the City of San Jose. Los Gatos, California.

_____ 2003. Marsh Plant Associations of South San Francisco Bay: 2003 Comparative Study. Project No. 477-25. Prepared for City of San Jose. Los Gatos, California.

_____ 2006. Marsh Studies in South San Francisco Bay: 2005-2008. California Clapper Rail and Salt Marsh Harvest Mouse Survey Report, 2006. Project No. 477-28. Prepared for City

of San Jose. Los Gatos, California.

Hannon, M. and B. Clayton. 1995. Western Snowy Plover breeding survey, San Francisco Bay National Wildlife Refuge, 1995. Unpubl. report. U.S. Fish and Wildlife Service. Newark, CA. 19 p.

Harding, E.K, J. Albertson, D.F. Doak, and J. Takekawa. 1998. Predator management in San Francisco Bay wetlands: past trends and future strategies. Final report. Prepared for Service Division of Ecological Services. Sacramento, California.

Harvey T.E. 1988. Breeding biology of the California Clapper Rail in South San Francisco Bay. Transactions of the Western Section of the Wildlife Society. 24:98–104.

Hothem, R.L. and A.N. Powell. 2000. Contaminants in eggs of western snowy plovers and California least terns: is there a link to population decline? Environmental Contamination and Toxicology. 65:42-50.

Hurt, R. 2004. (Service) email message to S. Rottenborn and L. Henkel, dated 6 August 2004.

Hurt, R. 2006. Breeding Status of the California Least Tern at Alameda Point, Alameda, California, 2005. Unpublished Report Prepared for the U.S. Navy, U.S. Fish and Wildlife Service. Newark, California.

IPCC. 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Houghton, J. T., Ding, D. J., Griggs, M., Noguer, P. J., van der Linden, X. Dai, K. Maskell, and C. A. Johnson (editors). Cambridge University Press, Cambridge, United Kingdom and New York, New York. 881 pp. Available at http://www.ipcc.ch/.

_____ 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Alley, R., T. Berntsen, N. L. Bindoff, Z. Chen, A. Chidthaisong, P. Friedlingstein, J. Gregory, G. Hegerl, M. Heimann, B. Hewitson, B. Hoskins, F. Joos, J. Jouzel, V. Kattsov, U. Lohmann, M. Manning, T. Matsumo, M. Molina, N. Nicholls, J. Overpeck, D. Qin, G. Raga, V. Ramaswamy, J. Ren, M. Rusticucci, S. Solomon, R. Somerville, T. F. Stocker, P. Stott, R.F. Stouffer, P. Whetton, R. A. Wood, D. Wratt. 21 pp. Available at http://www.ipcc.ch/.

Inkley, D.B., M.G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffin, J. Price, and T.L. Root. 2004. Global climate change and wildlife in North America. Wildlife Society Technical Report 04-2.

Jaques, D.L. 1994. Range expansion and roosting ecology of non-breeding California Brown Pelicans. Unpubl. Masters thesis. University of California. Davis, California.

Johnston, R.F. 1956. Population structure in salt marsh Song Sparrows. Part I. Environment and

annual cycle. Condor 58:24-58.

Johnston, R.F. 1957. Adaptation of salt marsh mammals to high tides. Journal of Mammalogy 38: 529-531.

Kanter, J. 2007. Scientists detail climate changes, Poles to Tropics. New York Times. April 10, 2007.

Keldsen T. 1997. Potential impacts of climate change on California Clapper Rail habitat of South San Francisco Bay. Unpublished Masters thesis. Colorado State University. Fort Collins, Colorado.

Ledig, D. 1990. Preliminary report on the ecology of the light-footed clapper rail at Mugu Lagoon, Ventura Co., California. Final Report to California Department of Fish and Game. Yountville, California. 11 pp. plus appendices.

Marriott, M.A. 2003. Microhabitat characteristics predictive of Snowy Plover (*Charadrius alexandrinus nivosus*) nest site selection in South San Francisco Bay. Unpublished Masters thesis. Humboldt State University. Humboldt, California.

Marriott, M.A. and C. Schelin. 2001. Pacific Coast Western Snowy Plover monitoring program at the Don Edwards San Francisco Bay National Wildlife Refuge, the Eden Landing Ecological Reserve, and selected Cargill salt division properties, year 2001. Unpubl. Report, U.S. Fish and Wildlife Service. Newark, California.

Marschalek, D.A. 2006. California least tern breeding survey, 2005 season. California Department of Fish and Game, Habitat Conservation and Planning Branch, Species Conservation and Recovery Program Report, 2006-01. Sacramento, California. 21 pp. + app.

Massey, B.W., and R. Zembal. 1987 Vocalizations of the Light-footed Clapper Rail. Journal of Field Ornithology, 58 (1): 32-40.

Appendix A National Marine Fisheries Service (NMFS) 1996. Making endangered species act determinations of effect for individual or grouped actions at the watershed scale. Habitat Conservation Division, Portland, Oregon.

Neuman, K.K, G.W. Page, L.E. Stenzel, J.C. Warriner, and S. Warriner. 2004. Effect of mammalian predator management on Snowy Plover breeding success. Waterbirds 27(3):257-263.

Orr, R.T. 1939. Fall wanderings of clapper rails. Condor. 41(4): 151-152.

Orr, M., S. Crooks, and P.B. Williams. 2003. Will Restored Tidal Marshes Be Sustainable? In: Larry R. Brown, editor. Issues in San Francisco Estuary Tidal Wetlands Restoration. San Francisco Estuary and Watershed Science. Vol. 1, Issue 1 (October 2003), Article 5.

Page, G.W. and J.G. Evens. 1987. The sizes of clapper rail populations at Corte Madera Ecological Preserve, Muzzi Marsh, San Clemente Creek, and Triangle Marsh. Report to Marin Audubon Society from Point Reyes Bird Observatory. 10 pp plus figures.

Page, G.W, C.M. Hickey, and L.E. Stenzel. 2000. Western Snowy Plover. In: Olofson PR, editor. Goals Project. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish and Wildlife. San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board. Oakland, California. p 281-283.

Page, G.W. and L.E. Stenzel. 1981. The breeding status of the Snowy Plover in California. Western Birds 12: 1–40.

Page, G.W, L.E. Stenzel, and W.D. Shuford. 1991. Distribution and abundance of the Snowy Plover on its western North American breeding grounds. Journal of Field Ornithology 62(2):245-255.

Page, G.W, L.E. Stenzel, and C.M. Wolfe. 1979. Aspects of the occurrence of shorebirds on a central California estuary. Studies in Avian Biology 2:15-32.

Page, G.W, L.E. Stenzel, J.C. Warriner, and P.W.C. Paton. 1995. Snowy Plover (*Charadrius alexandrinus*). In: A.Pool, F.Gill, editors. The Birds of North America: No. 154. Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Popper, B. and J. Bennett. 2005. Redwood Shore Annual Reports. U.S. Department of Agriculture APHIS-Wildlife Services. 9 pp.

Purdue, J. R. 1976. Adaptations of the Snowy Plover on the Great Salt Plains, Oklahoma. Southwestern Naturalist. 21:347-357.

Philip Williams & Associates (PWA). 2006. Flood Analyses Report. San Francisco: Prepared for: California State Coastal Conservancy, US Fish and Wildlife Service, California Department of Fish and Game. Yountville, California. 60 p.

Rigney, M. and T. Rigney. 1981. A breeding bird survey of the south San Francisco Bay salt pond levee system, 1981. South Bay Institute for Avian Studies. Alviso, California.

Robinson, C., C. Strong, L. Tucci, and J. Albertson. 2006. Western Snowy Plover numbers, nesting success, and avian predator surveys in the San Francisco Bay, 2006. San Francisco Bay Bird Observatory and U.S. Fish and Wildlife Service. Alviso and Newark, California.

Ryan, T.P. and J.L. Parkin. 1998. The Western Snowy Plover in southern San Francisco Bay: summary of detections made during colonial waterbird monitoring surveys from 1981 to

1997. San Francisco Bay Bird Observatory. Alviso, California. 19 p.

San Francisco Bay Bird Observatory. 1986. California clapper rail study, 1983-1986. Report submitted to California Department of Fish and Game. Yountville, California. 23 pp. plus appendix.

Schoellhamer D. 1996. Factors affecting suspended-solids concentrations in South San Francisco Bay, California Journal of Geophysical Research - Oceans 101(C5):12087-12095.

Schwarzbach, S. and T. Adelsbach. 2003. Field assessment of avian mercury exposure in the Bay-Delta ecosystem. Final Report to the California Bay Delta Authority. Sacramento, California. pp. 30.

Schwarzbach, SE., M. Stephenson, T. Ruhlen, S. Abbott, G.W. Page, and D. Adams. 2005. Elevated mercury concentrations in failed eggs of the Snowy Plovers at Point Reyes National Seashore. Baseline 50:1444-1447.

Schwarzbach, S.E., J.D. Albertson, and C.M. Thomas. 2006. Effects of predation, flooding, and contamination on the reproductive success of California clapper rails (*Rallus longirostris obsoletus*) in San Francisco Bay. Auk 123:45-60.

Shellhammer, H.S. 1982. *Reithrodontomys raviventris*. Mammalian Species 169(1-3).

Shellhammer HS. 1989. Salt marsh harvest mice, urban development, and rising sea levels. Conservation Biology 3(1):59-65.

Shellhammer HS, Duke R. 2004. Salt Marsh Harvest Mouse Habitat of the South San Francisco Bay: an analysis of habitat fragmentation and escape cover. San Francisco Estuarine Institute:26 + maps.

Shellhammer, H.S, R. Duke, H.T. Harvey, V. Jennings, V. Johnson, and M. Newcomer. 1988. Salt marsh harvest mice in the diked salt marshes of southern San Francisco Bay. Wasmann Journal of Biology 46(1/2):89-103.

Shellhammer, H.S, R. Jackson, W. Davilla, A.M. Gilroy, H.T. Harvey, and L. Simons. 1982. Habitat preferences of salt marsh harvest mice (*Reithrodontomys raviventris)*. Wasmann Journal of Biology 40(1/2):102-114.

Shields, M. 2002. Brown Pelican (*Pelecanus occidentalis*). In: Gill APaF, editor. The Birds of North America. Washington DC: Academy of Natural Sciences, Philadelphia, and American Ornithologists' Union, Washington, DC.

Appendix A Shuford, W.D. 1993. Clapper Rail. In: Shuford WD, editor. The Marin County Breeding Bird Atlas: A Distributional and Natural History of Coastal California Birds. California Avifauna Series 1. Bolinas: Bushtit Books, Bolinas, California. p 166-169.

Strong C. M. 2004. San Francisco Bay Bird Observatory, October 2004 comments on 50% draft of existing conditions report, and 6 August 2004 meeting with Steve Rottenborn.

Strong C.M. and R. Dakin R. 2004. Western Snowy Plover breeding season surveys for 2003. Unpubl. report. San Francisco Bay Bird Observatory. Alviso, California.

Strong, C.M., N. Wilson, and J. Albertson. 2004. Western Snowy Plover numbers, nesting success, and avian predator surveys in the San Francisco Bay, 2004. Unpubl. report. San Francisco Bay Bird Observatory. Alviso, California.

Appendix B Thompson, Bruce C., Jerome A. Jackson, Joannna Burger, Laura A. Hill, Eileen M. Kirsch and Jonathan L. Atwood. 1997. Least Tern (*Sterna antillarum*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/290

Appendix C

U.S. Fish and Wildlife Service and California Department of Fish and Game. 2007. South Bay Salt Ponds Restoration Project Final Environmental Impact Statement/Report. Prepared by EDAW, Philip Williams and Associates, Ltd., H. T. Harvey & Associates, Brown and Caldwell, and Geomatrix.

Appendix D

Appendix E U.S. Fish and Wildlife Service. 1980. California Least Tern Recovery Plan. April 2, 1980. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon. 56 pp.

Appendix F

_____ 1983. The California Brown Pelican Recovery Plan. U.S. Fish and Wildlife Service. Portland, Oregon.

Appendix G

Appendix H _____ 1984. Salt marsh harvest mouse and California Clapper Rail Recovery Plan. U. S. Fish and Wildlife Service. Portland, Oregon. 141 pp.

_____ 2007. Recovery Plan for the Pacific Coast Population of the Western Snowy Plover (*Charadrius alexandrinus nivosus*). U.S. Fish and Wildlife Service. Sacramento, California. xiv + 751 pages.

_____ 2008a. Final Biological Assessment for the Programmatic South Bay Salt Pond Restoration Project. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008b. Final Biological Assessment for the Ravenswood Pond SF2 Restoration Action. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008c. Final Biological Assessment for the Alviso Pond A6 Restoration Action. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008d. Final Biological Assessment for the Alviso Ponds A5, A7 and A8 Restoration Action. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008e. Final Biological Assessment for the Eden Landing Ponds E8A, E8X, and E9 Restoration Action. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008f. Final Biological Assessment for the Alviso Ponds A16 and A17 Restoration Action. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008g. Final Biological Assessment for the Eden Landing Ponds E12 and E13 Restoration Action. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008h. Final Biological Assessment for the Operations and Maintenance Activities for the Service and CDFG within the SBSP Project Area. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

_____ 2008i. Final Biological Assessment for the Operations and Maintenance Activities for Pacific Gas and electric (PG&E) within the South Bay Salt Pond SBSP Project Area. Prepared by U.S. Fish and Wildlife Service (SFBNWR) and H.T. Harvey and Associates. Sacramento and Los Gatos, California.

Verbeek, N. A. and C. Caffrey. 2002. American Crow (*Corvus brachyrhynchos*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/647

Wetlands Research Associates. 1994a. Biological evaluation for dredge lock use and levee maintenance. Prepared by Wetland Research Associates for the U.S Army Corps of Engineers. San Francisco, California.

Wetlands Research Associates. 1994b. Draft environmental assessment: Cargill salt maintenance activities, permit application number 4-93 SCH # 94023030. Prepared by Wetland Research Associates for San Francisco Bay Conservation and Development Commission. San Francisco, California.

Zembal, R. 1990. Light-footed clapper rail census and study, 1990. Nongame Bird and Mammal Section Report to California Department of Fish and Game. Yountville, California. 28 pp.

Zembal, R. 1994. Light-footed clapper rail management and population assessment, 1993. Final Report to California Department of Fish and Game. Yountville, California. 32 pp.

Zembal, R. and B.W. Massey. 1988. Light-footed clapper rail census and study, 1988. Final

Report to California Department of Fish and Game. Yountville, California. 29 pp.

Zembal, R., J.M. Fancher, C.S. Nordby, and R.J. Bransfield. 1985. Intermarsh movements by light-footed clapper rails indicated in part through regular censusing. California Fish and Game 71(3): 164-171. Yountville, California.

Zembal, R., B.W. Massey, and J.M. Fancher. 1989. Movements and activity patterns of the light-footed clapper rail. J. Wild. Manage. 53(1): 39-42.

Zembal, R., S.M. Hoffman, and J.R. Bradley. 1996. Light-footed clapper rail management and population assessment, 1995. Final Report to California Department of Fish and Game. Yountville, California. 43 pp.

Zembal, R., S.M. Hoffman, and J.R. Bradley. 1997. Light-footed clapper rail management and population assessment, 1996. Final Report to California Department of Fish and Game. Yountville, California. 28 pp.

Zembal, R., S.M. Hoffman, and J.R. Bradley. 1998. Light-footed clapper rail management and population assessment, 1997. Final Report to California Department of Fish and Game. Yountville, California. 23 pp.