2. DESCRIPTION OF ALTERNATIVES

2.1 Overview

2.1.1 SBSP Restoration Project Long-Term Alternatives

Three South Bay Salt Pond (SBSP) Restoration Project long-term alternatives were developed to evaluate a range of restoration scenarios within the three pond complexes over the 50-year planning horizon. These alternatives include:

- Alternative A, the No Action Alternative;
- Alternative B, the Managed Pond Emphasis Alternative (50:50 tidal habitat : managed ponds by area); and
- Alternative C, the Tidal Emphasis Alternative (90:10 tidal habitat : managed ponds by area).

The mix of habitats in the restoration alternatives is expected to benefit a diversity of wildlife, including special-status species and migratory birds, and to increase the overall abundance and diversity of native species in South San Francisco Bay. The SBSP Restoration Project alternatives are designed to maintain or improve existing levels of flood protection and provide high quality public access and recreation opportunities.

Alternative A, the No Action Alternative, is included for National Environmental Policy Act / California Environmental Quality Act (NEPA/CEQA) comparison to the two restoration alternatives, Alternatives B and C. Alternatives B and C were formulated to explore different responses to the Project Objectives by varying the extents of tidal habitat and managed pond restoration.

The restoration alternatives represent two potential "end states" at Year 50 of the SBSP Restoration Project. Alternatives B and C are analyzed in this Environmental Impact Statement / Report EIS/R as "bookends," representing a range of outcomes from a 50:50 ratio of tidal habitats to managed ponds, to a 90:10 ratio. The two ends of the range are reasonable endpoints to potentially meet the Project Objectives and represent different trade-offs. The lower end of the tidal restoration range (50:50) was set at the minimum amount of tidal restoration considered necessary to achieve sufficient enhancement of tidal habitats to achieve the Project's Objectives related to tidal habitat associated species. The upper end of the tidal restoration range (90:10) was set by the minimum amount of managed pond area required to meet certain pond-associated objectives. The optimal configuration that best meets the overall Project Objectives may be somewhere between the two bookends. The Project would use adaptive management (Section 2.3) as an integral part of the planning and implementation process to maximize the benefits of the Project and constrain the amount of tidal restoration beyond 50:50 and guide selection of the ultimate endpoint.

The habitat, flood management, and recreation and public access features that are expected to occur under each alternative by Year 50 are shown in Table 2-1. Detailed descriptions and maps of the alternatives are presented in Section 2.4 below.

Table 2-1 Summary of SBSP Restoration Project 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.	▪ 7,500 acres (50% of the Project Area).	▪ 13,400 acres (90% of the Project 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.	▪ 7,500 acres (50% of the Project Area). ▪ 20% of the managed pond area would be reconfigured for birds; the rest would have no grading or minimal grading (some island creation).	▪ 1,600 acres (10% of the Project 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.

2.1.2 Program- and Project-level Analysis

The SBSP environmental document is both a programmatic EIS/R covering the 50-year long-range plan as well as a project-level EIS/R addressing the specific components and implementation of the initial phase of the Restoration Project under either alternative B or C (*i.e.*, the components of Phase 1 are common to both Alternatives). The project level analysis of Phase 1 components and the corresponding No Action alternative (Alternative A) are discussed separately from the analysis of the programmatic alternatives to facilitate understanding and comparison of the environmental consequences at the project level. Table 2-2 shows the elements of the SBSP Restoration Project that would be evaluated at a program- and project-level of detail.

Table 2-2 Evaluation of SBSP Restoration Project Components in the EIS/R

PROJECT COMPONENT	LEVEL OF DETAIL	
	Program-Level	Project-Level
SBSP Long-Term Alternatives		
Alternative A: No Action	√	
Alternative B: Managed Pond Emphasis	√	
Alternative C: Tidal Emphasis	√	
Phase 1 Actions		√
Note: A general discussion of the Shoreline Study and its potential actions is presented in this SBSP Restoration Project EIS/R. However, Shoreline Study alternatives were not available at the time the SBSP Restoration Project EIS/R was prepared. The Shoreline Study alternatives will be addressed in a separate project-level EIS/R.		

CEQA Guidelines

According to Section 15168 of the CEQA Guidelines, a program EIR is an EIR that may be prepared on a series of actions that can be characterized as one large project and are related either (1) geographically; (2) as logical parts in the chain of contemplated actions; (3) in connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program; or (4) as individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways. The SBSP long-term alternatives are evaluated at the program level in this EIS/R because they are broadly defined and cover a series of actions in a coherent geographic area (the South Bay south of the San Bruno Shoal) that would occur over the 50-year planning period. A program EIR is typically followed by site-specific, project-level environmental analysis because proposed components have not been developed to the detail necessary to conduct a detailed analysis. A programmatic EIR is useful because it enables the decision-makers to examine the overall effects of a multi-phase program that otherwise may be overlooked in a series of project-level EIRs for each individual phase.

A project-level EIR, on the other hand, is prepared when site-specific information is available. A project-level EIR examines the environmental impacts of a specific development project in all its aspects: planning, construction, and operation. A project EIR does not require further environmental evaluation once decision-makers certify the EIR and approve the project. The SBSP Restoration Project would be implemented in a series of phases over many years, on the order of several decades. It is anticipated that each pond would be managed in a manner similar to the Initial Stewardship Plan (ISP) until its implementation phase. The initial phases, including Phase 1, would include a range of habitat types – tidal habitat, enhanced managed ponds, and reconfigured managed ponds – as early experiments for adaptive management (see Section 2.3). Each phase would have its own project-level NEPA/CEQA impact analysis. The Phase 1 actions are evaluated at a project level in this EIS/R. Subsequent phases would tier from this programmatic EIS/R.

CEQ Regulations for Implementing NEPA

The Council of Environmental Quality (CEQ) Regulations for Implementing NEPA addresses the concept of program- and project-level impact analysis in its definition of "tiering" (43 FR 56003 Section 1508.28). According to the CEQ regulations, "'tiering'" refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. Tiering is appropriate when the sequence of statements or analyses is:

(a) From a program, plan, or policy environmental impact statement to a program, plan, or policy statement or analysis of lesser scope or to a site- specific statement or analysis.

(b) From an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe." (43 FR 56003 Section 1508.28)

SBSP EIS/R and Tiering

Both NEPA and CEQA Guidelines have generally the same definition for tiering. As noted above, tiering refers to using the analysis of general matters contained in a broader Environmental Impact Statement (EIS) or EIR with subsequent environmental documents (*e.g.*, NEPA EIS or environmental assessment; CEQA EIR or [mitigated] negative declaration) that address narrower components of the larger program. Tiering is appropriate when the sequence of analysis is from an EIS or EIR prepared for a program to an environmental document for an action or project of lesser scope, as is anticipated for the subsequent phases of the proposed SBSP Restoration Project. Both NEPA and CEQA encourage agencies to tier the environmental analyses which they prepare for separate but related projects to reduce repetition.

2.1.3 Overview of Adaptive Management

Adaptive Management is an integral component of the SBSP Restoration Project and allows for lessons learned from earlier phases to be incorporated as management plans are updated and the designs of future actions are developed. This approach to phased implementation acknowledges that uncertainties exist and provides a framework for adjusting management decisions as we understand the cause-and-effect linkages between management actions and the physical and biological response of the system more fully. A key aspect of the adaptive management approach is to avoid adverse environmental impacts by triggering specific pre-planned intervention measures if monitoring reveals the ecosystem is evolving (responding to prior interventions) along an undesirable trajectory.

As implementation progresses, adaptive management would guide selection of the ultimate mix of habitats and the extent of public access features. Since the restoration plan would be implemented over many years, on the order of decades, later phases would be subject to adaptive management based on lessons learned from earlier actions. As a result of management plan updates, the ultimate mix and amount of tidal and managed pond habitats would likely lie between the two restoration bookends defined by Alternatives B and C.

The SBSP Restoration Project Adaptive Management Plan included in Appendix D (Trulio and others 2007) includes a discussion of its scientific basis and institutional structure. A crucial element of the Adaptive Management Plan is a feedback loop between information generation (science) and decision making (management) while keeping the public informed and involved in the overall process. The loop between science and management is designed to occur at every phase along the adaptive management "staircase" as shown in Figure ES-6 in the Executive Summary. During each phase, the Project managers would assess progress toward the Project Objectives and decide whether or not to continue along the trajectory, or "staircase," of additional tidal restoration. For example, the Project may decide to temporarily halt additional tidal restoration in order to perform additional experiments (applied studies) to increase the level of certainty that the Project Objectives would be achieved. Based on the results of these analyses, the Project may decide to continue up the staircase or to halt additional tidal restoration.

The staircase approach, when coupled with adaptive management decisions, allows for a range of outcomes between Alternatives B and C. Note that even if the Project results in a 90:10 ratio of tidal to managed pond habitat, adaptive management provides for the possibility that the exact distribution of managed ponds may be different from the configuration shown in Alternative C. Any such changes would be analyzed prior to implementation in subsequent project-level NEPA/CEQA documents. Even under Alternative A (No Action), large areas are expected to convert to tidal habitat through uncontrolled breaching of levees.

Applied studies would be performed as restoration actions move along the adaptive management staircase to address the key uncertainties listed in the Adaptive Management Plan in Part 2, Section A (Trulio and others 2007). As described in Section 2.6, it is critical to sequence the uncertainties that can be accommodated in Phase 1, since some of the applied studies may take decades to generate useful information. In addition to implementing applied studies, questions concerning the effectiveness and cost/benefit trade-offs of particular restoration design elements or management approaches would be addressed through examining specific restoration techniques in Phase 1. Ongoing monitoring would provide additional information for adaptive decision making by tracking progress toward the Project Objectives. This adaptive management decision-making process would also be used to determine which public access features would be added as the effects on wildlife and the desire for additional trails and other public access features become better understood over time.

2.2 Alternatives Development Process

The following discussion describes the alternative development process for the SBSP Restoration Project. The Shoreline Study will use the US Army Corps of Engineers' (Corps's) six-step planning process as described in Section 1.6.1. The Shoreline Study planning process will be described in detail in subsequent Shoreline Study project-level EIS/Rs. The planning processes used by the SBSP Restoration Project and the Shoreline Study will be compatible to ensure consistency between the alternatives selected for implementation.

2.2.1 Summary of SBSP Alternative Development Process

The SBSP Restoration Project presents a significant challenge for alternatives formulation and evaluation because alternatives can be formulated at many distinct scales – from the South Bay landscape to an individual pond with countless possibilities for creating and varying alternatives. The Alternative Development Framework (ADF) was developed to: provide a consistent methodology for identifying, contrasting, and evaluating the alternatives; facilitate the consideration of a range of reasonable alternatives; and provide a defensible basis for the selection of the preferred alternative (PWA and others 2004a). The steps in the alternatives development process include:

- Identification of Project goals and objectives, assessment of opportunities and constraints (PWA and others 2004b),
- Documentation of existing conditions (Brown and Caldwell and others 2005; EDAW and others 2005; H. T. Harvey & Associates and others 2005; PWA and others 2005a; PWA and others 2005b),
- Identification of initial options for restoration at each pond complex (PWA and others 2004c),
- Formulation and refinement of preliminary alternatives (PWA and others 2005c), and
- Evaluation of how well the refined alternatives respond to the Project Objectives (PWA and others 2006).

The ultimate goal of the ADF process was to result in the selection of a preferred alternative and Phase 1 actions for implementation.

The ADF process is based on the six Project Objectives and two evaluation factors that support the overarching goal of the Project (see Section 1.3.1), which were developed by the Project Management Team (PMT) with input from the Stakeholder Forum, Science Team, and Regulatory and Trustee Agency Group, and adopted by the Stakeholder Forum on February 18, 2004. The Project Objectives provide broad categories of desired Project benefits such as creating, restoring and enhancing habitats and maintaining or improving existing levels of flood protection, while the evaluation factors consider additional Project considerations such as cost effectiveness and environmental impacts.

To make these broad objectives more usable for formulating and evaluating alternatives, each objective is further described in a set of evaluation criteria. The evaluation criteria are further described using "metrics" for use in rating how well an alternative achieves a given criterion. The evaluation criteria and metrics were developed with input from the PMT, the Regulatory and Trustee Agency Group, the Science Team, the Stakeholder Forum, and several public work groups, including the Public Access and Recreation Work Group, the Habitat Work Group, and the Flood Management Work Group. The evaluation criteria and metrics were further refined and expanded upon based on comments and insights provided by the various groups as these criteria and metrics have been applied.

Once the evaluation criteria and metrics were developed, the alternatives formulation proceeded at two spatial scales – the landscape scale and the pond scale. The landscape scale provides a "top down" consideration of how to achieve the Project Objectives from a regional, South Bay perspective, and provides a systematic rationale for proceeding with a specific mix and geographic distribution of tidal and managed pond habitats within the South Bay. The pond scale provides a "bottom up" formulation, with habitat restoration decisions based on the characteristics of individual ponds and pond clusters. In this formulation, alternatives are the sum of choices made at the pond scale.

The pond scale approach was used to develop a set of initial restoration options for each pond complex (PWA and others 2004c), and these options were later combined into a set of preliminary alternatives (PWA and others 2005c). The preliminary alternatives were evaluated against an applicable subset of the evaluation criteria and metrics to assist in the selection of final alternatives for evaluation in the EIS/R (PWA and others 2006). Throughout this process, input was solicited from the public via the Stakeholder Forum and Work Groups, and from the Science Team, the National Science Panel, and the Regulatory and Trustee Agencies Group.

2.2.2 Criteria for Evaluating Alternatives

As part of the ADF process, the Project Objectives were further described using evaluation criteria, and for each criterion a metric or metrics were identified for evaluating how well a given alternative achieves the criterion. For example, one Project Objective is to "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 San Francisco Bay habitat for all or part of their life cycles". This Project Objective was further described by five evaluation criteria relating to specific species or populations, such as "contribute to the recovery of the South Bay subspecies of the salt marsh harvest mouse" and "contribute to the recovery of the California clapper rail". Each evaluation criterion was then assigned a metric or metrics that could be used to measure the success of a given alternative at meeting the evaluation criterion. For example, the recovery of the salt marsh harvest mouse could be assessed by evaluating the area of restored salt marshes with broad marshplain habitat and upland transition zones, the connectivity of such existing and restored marshes within and adjacent to the Project Area, and the proximity of the restored marshes to existing salt marsh harvest mouse habitat. The complete list of evaluation criteria and the associated metrics is contained in the ADF (PWA and others 2004a).

The evaluation criteria and metrics were applied at two stages during the process. The first stage supported the initial screening of preliminary alternatives and the selection of final alternatives. The evaluation criteria and metrics were also utilized to refine and evaluate the final alternatives and serve as a guide for analyzing potential Project-related impacts.

Each evaluation criterion assists in distinguishing between alternatives. Therefore, the evaluation criteria do not include design details common to all of the alternatives. Examples of design details are: including transition zones between restored tidal marsh and levees, lowering levees where feasible, and conducting operations and maintenance (O&M) for control of invasive species.

Metrics are generally "relative" indicators of performance. Some metrics, called exclusion criteria, are "absolute" or "fatal flaw" criteria. If a possible alternative did not satisfy an exclusion criterion, it was not analyzed further.

The metrics are designed to be as quantifiable as possible, such as total area of tidal marsh and habitat area for breeding birds. Some metrics identify habitat that has broad benefits beyond those specified in the evaluation criterion. For example, mudflat habitat benefits shorebirds, but also benefits a variety of fish, invertebrates and waterfowl that use and depend on the mudflats.

Note that the evaluation criteria and metrics are not to be confused with Project performance criteria. The evaluation criteria and metrics are for use in alternatives development only. Project performance criteria are for post-implementation assessment during monitoring and adaptive management.

2.2.3 Alternatives Considered But Eliminated from Detailed Study

Additional preliminary alternatives were considered but not recommended for further analysis because they were infeasible or did not meet Project Objectives. These preliminary alternatives are described below.

Expanded Geographic Area Alternative

This alternative would expand the Project Area to include other land within the Authorized Expansion Boundary of the Refuge. Although analyzed in this section with other alternatives, this “alternative” is in essence a re-definition of the geographic scope of the Project by extending the analysis of the existing alternatives to land outside the current Project Area.

The SBSP Restoration Project is a direct outgrowth of the acquisition of the salt pond complexes (either in fee ownership or the salt making rights) from Cargill in 2003. As discussed in more detail in Section 1.4.6, there are areas outside the Project Area that present opportunities for restoration and other conservation action. It would not, however, be practical or feasible to include these other lands within the SBSP Restoration Project now. None of the other land beyond the SBSP Restoration Project Area is currently available for restoration as part of the SBSP Restoration Project. The Project proponents either do not own the land or they do not possess the right to restore the land – and there are no proposals to give the agencies the ability to restore these areas. It would not be reasonable nor would it be practical to develop expensive restoration plans and studies now for these lands when they may never be available for restoration for many years, when circumstances may have changed considerably. Such plans are likely to be outdated or even rendered useless, depending on how and when the land becomes available. While the Project proponents seek to maximize restoration in the South Bay, and welcome opportunities to expand the Project to restore additional land, it would be speculative to assume that the Project would be able to acquire any of this land in the near future. Moreover, adding additional ponds into the analysis of the alternatives would not alter the current priorities of what ponds should be restored first since none of the additional lands would be available for restoration. Further, those studies would divert money from and delay restoration of the current Project Area.

USFWS reiterates that it would like to restore all potentially restorable areas within the Authorized Expansion Boundary when these areas become available. (See the discussion in Section 1.4.6). Circumstances may change in the future and nothing precludes the Project from expanding the geographic scope of the Project in the future.

Continued ISP Management Alternative

The ISP could be completed and extended as a long-term management alternative. The main feature of the ISP includes circulating Bay waters through small systems of ponds in order to prevent salt production and maintain water quality as described by Life Science! (2003). In addition, some ponds would be dewatered and managed as seasonal wetlands, select ponds in the Alviso pond complex would be managed as high salinity ponds to support specific wildlife populations, and a limited number of ponds would be managed with different summer and winter water levels to optimize habitat for migratory shorebirds and waterfowl. Under the ISP, the only areas currently designated for tidal habitat restoration are the Island Ponds (Ponds A19, 20, and 21) in the Alviso pond complex (Life Science! 2003). The existing pond levees would be maintained to preserve existing levels of flood protection and public access afforded by the salt ponds. However, the pond levees, as well as much of the existing inboard levee system, do not meet the engineering criteria for levees that provide flood protection, and therefore, are not certified or recognized by Federal Emergency Management Agency (FEMA).

The ISP Management alternative was eliminated from consideration because it does not meet the Project Objectives. The quality of the managed pond habitat is not as high with respect to bird use as the more intensively graded and managed pond habitat included in the final restoration alternatives. Extending existing ISP operations indefinitely would not satisfy Project Objective 1A (promote restoration of native special-status plans and animals) or 1C (support increased abundance and diversity of native species) because no restoration activities to improve the existing habitats would be planned. It is also unlikely that a long-term funding source would be identified to maintain a levee system that is not adequately designed for flood control.

All Tidal Restoration Alternative

This alternative was identified as a potential long-term vision at the National Science Panel Project Charrette conducted in February 2005. This alternative is desirable in that it relies on natural physical and biological processes to form and maintain sustainable habitats, with only limited ongoing O&M required. However, this alternative was not retained for further analysis because it is not expected to meet Project Objective 1B for maintaining migratory bird species that use the existing ponds or Project Objective 1C for supporting increased abundance and diversity of the native species of the South Bay. This expectation is predicated on the assumption that the salt panne habitat that would develop in the restored tidal marshes would not fulfill all the functions proposed by the enhanced/reconfigured ponds. Limited data exist to demonstrate the actual value of salt panne habitats in the South Bay in part because of the limited amount of tidal marsh (and limited extent of natural salt pan) that exist there. This assumption would be tested in the adaptive management program and the restoration modified if appropriate.

Majority Managed Pond Alternative

This alternative was not retained for further analysis because it does not meet Project Objectives for tidal-marsh-dependent species. Retaining most ponds as managed ponds would not meet Project Objective 1A for promoting the restoration of special-status and native species as this objective requires large areas of tidal restoration. In addition, this alternative would not satisfy Project Objective 4 because water quality in the South Bay would not be improved. These outcomes would conflict with federal and state plans for endangered species recovery and would be widely considered unacceptable to agencies and other stakeholders.

75:25 Mix of Tidal : Managed Pond

This alternative was one of the Preliminary Alternatives proposed in January 2005 (PWA and others 2005c). Though it is possible that the ultimate habitat mix would be between the 50:50 and 90:10 bookends, and possibly at 75:25, this alternative does not need to be evaluated explicitly. All habitat mixes between the bookends are already implicitly included in the range of potential Project outcomes since tidal restoration beyond 50:50 would be constrained by the ability of the adaptive management approach to avoid significant impacts that may occur.

Large-scale Sediment Import Alternative

Large-scale sediment import to accelerate tidal marsh formation was eliminated from consideration because of limitations in the amount of clean fill that could feasibly and economically be supplied to the South Bay. Approximately 40 to 70 million cubic yards (cy) of sediment would be required to raise the pond bottoms of all the tidally-restored ponds to vegetation colonization elevations, assuming 50 to 90 percent of the ponds were restored to tidal habitat. Obtaining this amount of clean fill as the Project demands it, for purposes of accelerating the transition to tidal habitat, is not possible. Restoration Alternatives B and C include the potential for importing lesser amounts of sediment to create upland transition zones, construct levees, and raise the bottom elevations in a small subset of the ponds.

2.3 Adaptive Management Plan

The Adaptive Management Plan for the SBSP Restoration Project is described below and presented in Appendix D. The Shoreline Study will have its own adaptive management plan that will be different from, but compatible with, the SBSP Restoration Project Adaptive Management Plan.

2.3.1 The Adaptive Management Process

Adaptive management acknowledges that uncertainties exist in predicting how restoration actions affect important resources, and provides a scientific and institutional framework for adjusting future management decisions as understanding of the ecosystem improves through on-going monitoring and experimentation (applied studies). This allows Project managers to both more effectively achieve restoration objectives in successive phases of implementation, and avoid potential adverse environmental impacts. In addition to informing the design of future phases and pond management, the success of adaptive management would determine how far beyond the 50:50 ratio the Project would proceed along the staircase toward the tidal emphasis alternative (Alternative C).

As depicted in Figure 2-1, the adaptive management process consists of the following steps:

1. Determine progress toward Project Objectives and restoration targets based on the most current understanding of the ecosystem gathered through monitoring and applied studies;

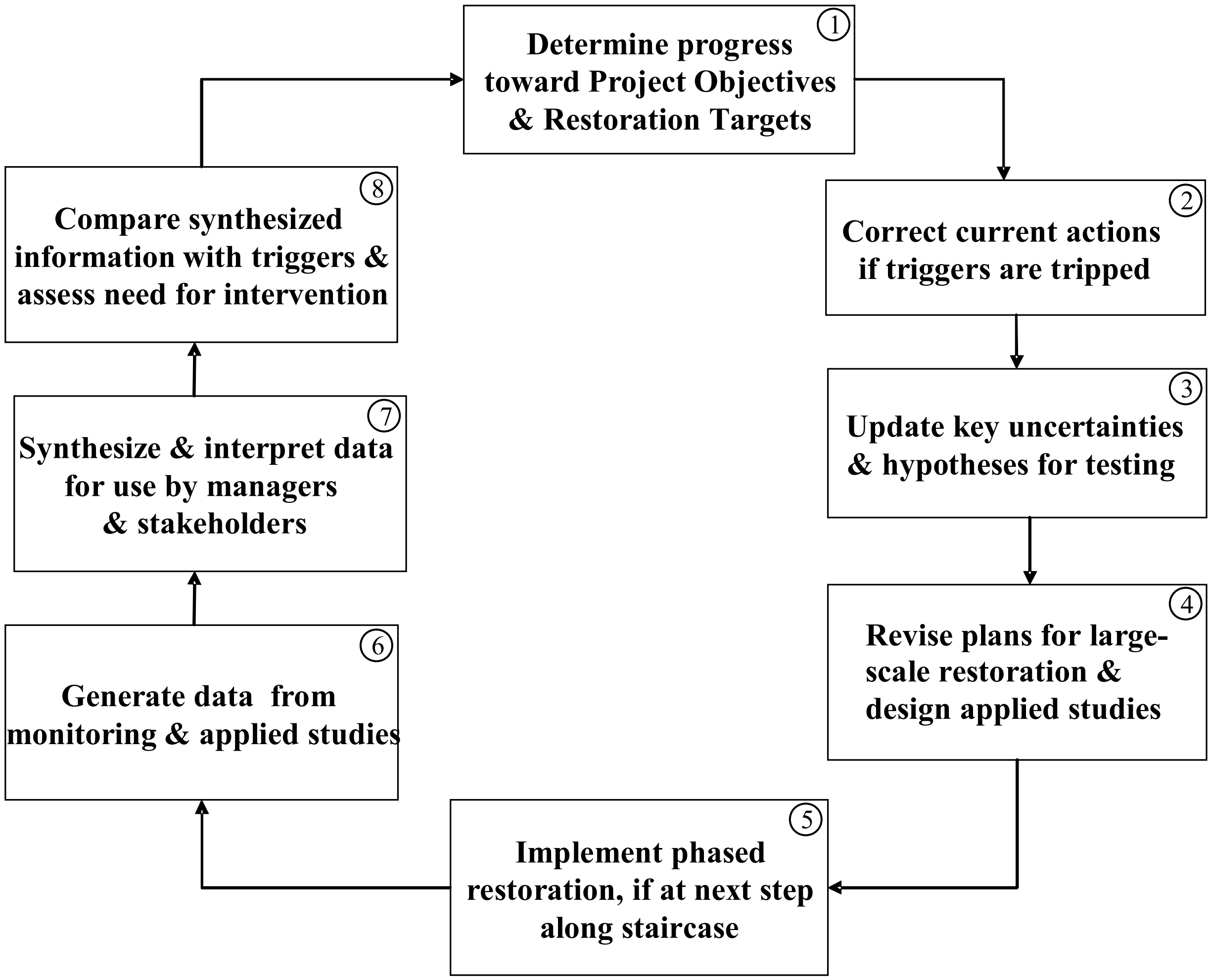

Figure 2-1

South Bay Salt Pond Restoration Project

The Adaptive Management Process

PWA

2. Correct previously implemented restoration actions if monitoring data show the Project is diverging from restoration targets;

3. Update key uncertainties and revise testable hypotheses that form the basis for experimentation based on most current understanding of the ecosystem as well as restoration targets if needed;

4. Revise plans for large-scale restoration, including Project phasing and habitat mix, and design applied studies to test specific hypotheses;

5. Implement phased restoration and applied studies, if it is appropriate to proceed to next phase of implementation;

6. Generate data on physical and biological parameters associated with applied studies and from monitoring the system response to restoration actions;

7. Synthesize and interpret monitoring data and information generated from applied studies for use by managers and stakeholders; and

8. Assess monitoring information and compare data with triggers to determine if management action is warranted.

Using information from monitoring and applied studies, Project managers may then reassess the Project's progress toward objectives and restoration targets, correct current operations if triggers are tripped, revise conceptual models and restoration plans based on an improved understanding of ecosystem function, and integrate this new understanding into future decision making (Loop through steps 1, 2, 3 and 4). The adaptive management process would provide the opportunity for managers to review the Project Objectives and restoration targets if one or more of them are not being achieved. However, any changes to the Project Objectives require consultation with the stakeholders, as they were central in developing these Objectives.

A crucial element of the adaptive management process outlined above is the feedback loop between information generation (science) and decision-making (management). This feedback allows for existing management operations, management plans, and designs of future phases to be updated based on the most current understanding of the evolving South Bay ecosystem. This loop between science and management is designed to occur throughout Project implementation as managers assess progress toward achieving the Project Objectives and decide whether or not to continue along the staircase of additional tidal habitat restoration.

Adaptive management relies upon an organizational structure that clearly identifies how scientific information is integrated into decision making. The organizational structure described in the Adaptive Management Plan (Trulio and others 2007) (Appendix D) was developed to achieve the following objectives:

- Generate and synthesize data;
- Convert synthesized data into effective short- and long-term management decisions;
- Involve the public in decision-making; and
- Store and organize data for use by the decision-makers and the public.

As described in Appendix D, a Science Program, directed by the Lead Scientist, supports the PMT by generating and interpreting data and assisting in the evaluation of Project progress. Information is organized, stored, and disseminated by the Information Management Team. The PMT, Lead Scientist, and Information Management Team would receive input from the Stakeholder Forum, although the PMT is ultimately responsible for decision-making.

2.3.2 Summary of SBSP Restoration Plan Adaptive Management Plan

The SBSP Restoration Project Adaptive Management Plan was developed to help implement the process outlined above as the Project proceeds along the staircase of additional tidal restoration. In order to resolve key scientific uncertainties, the Adaptive Management Plan includes early implementation of applied studies that address specific uncertainties about how the South Bay ecosystem may respond to restoration actions. Some of these applied studies consist of active experimentation within the Phase 1 actions, as described in Section 2.5. Monitoring the small- and large-scale response to tidal restoration and pond management is used to track progress toward one or more Project Objectives and detect early signs of problems.

A summary of how the Adaptive Management Plan combines monitoring and applied studies with adaptive decision-making is presented in Table 2-3. Each row of this table focuses on a *restoration target* that provides a quantitative or qualitative goal that is directly linked to one or more Project Objectives. Targets are typically based on information compiled from existing literature or generated from baseline monitoring, as discussed in Adaptive Management Plan (Trulio and others 2007) (Appendix D). *Monitoring parameters* describe the physical, biological, and social variables to measure progress toward restoration targets as well as the basic monitoring approach. The frequency and spatial extent of monitoring activity would vary depending on the variable being measured. Some variables may be measured several times a year within an individual pond, while others would require surveys across the entire South Bay less frequently.

Depending on the rate of change in response to tidal restoration and management actions, the *timeframe for adaptive decision-making* would differ for various monitoring parameters. In some cases, the time required for a measurable response may be on the order of one or two years (*e.g.*, bird densities in reconfigured ponds). In other instances, decades may pass before useful information can be gleaned from monitoring the large-scale response to previous restoration actions (*e.g.*, loss of outboard mudflats in the South Bay). Once changes in the monitoring parameters do occur, these observations would be compared with *management triggers* to determine if intervention is appropriate.

While restoration targets provide a means to assess success relative to the Project Objectives, management triggers define the point at which monitoring data indicate the ecosystem may be evolving on an unfavorable trajectory and intervention may be appropriate. As illustrated conceptually in Figure 2-2 and discussed in below, triggers have been selected to allow for *management action* (*i.e.*, intervention) before the changes result in a significant adverse environmental impact. Table 2-3 lists potential adjustments to the phasing and design of future restoration actions, although other management responses would likely be identified as the understanding of the ecosystem response to restoration actions improves.

For species with populations that vary substantially from year to year due to influences external to the SBSP Restoration Project, or for species without long-term survey results against which future monitoring can be compared, management triggers require consideration of several years worth of data (*e.g.*, the mean of survey results over a three-year period) to avoid having the trigger "tripped" too frequently due to interannual variation. Examples of such species are migratory shorebirds or salt pond associated migratory birds. For species with less variable abundance within the study area or long-term survey results (*e.g.*, breeding avocets, stilts, and terns), or for species for which any apparent decline is cause for concern (*e.g.*, western snowy plover), shorter-term survey data (*e.g.*, over one or two years) provide the means for determining whether a trigger has been tripped. For species for which the South Bay is very important on a population level (*e.g.*, western snowy plover or California least tern), any apparent decline would trip the management trigger. For other species, an apparent decline of a certain percentage below baseline levels would be necessary to trip the trigger (such as salt pond associated migratory birds).

In most instances the response to exceeding a trigger would be to first assess the implications of the observed changes and determine whether they are a result of the SBSP Restoration Project or external factors. Information generated by *applied studies* (see below) would also inform the management response. In the event that no management action is proven effective at reversing a negative trend in the trajectory of the evolving ecosystem, the PMT may decide to cease additional tidal restoration until applied studies demonstrate appropriate ways to avoid significant adverse effects.

In the event that no management action is proven effective at reversing a negative trend in the trajectory of the evolving ecosystem, or if responses to multiple triggers are mutually incompatible, the PMT would reconsider additional tidal restoration and may decide to stop further tidal restoration altogether.

2.3.3 Learning from Phase 1 Actions

The applied studies listed in Table 2-3 are based on the most critical uncertainties identified by the Science Team that may hinder the ability to achieve the Project Objectives as restoration progresses along the staircase. These key uncertainties are based on syntheses of the available literature and broad conceptual models developed by the Science Team that illustrate how tidal restoration and pond management affect the South Bay ecosystem (Trulio and others 2007) (Appendix D). The key uncertainties based on the current understanding of the most relevant cause-and-effect linkages are listed below and were developed by the Science Team through a process of workshops, community meetings, and peer-reviewed literature summaries. Background, rationale and additional detail for each uncertainty are provided in the Adaptive Management Plan (Trulio and others 2007) (Appendix D).

Table 2.3 Adaptive Management Summary Table

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Sediment Dynamics Project Objective 1 (Preserve existing estuarine habitat areas)	No significant decrease in South Bay intertidal and subtidal habitats (south of San Bruno shoal), including restored pond mudflat, intertidal mudflat, subtidal shallow and subtidal channel areas.	▪ Area of restored mudflat. ▪ Area of outboard mudflat. ▪ Area of subtidal shallows and channel. Methods: Bathymetry and LiDAR surveys will be performed periodically, initially every 3–5 years and then less frequently if data suggest slower rates of changes over time.	▪ Change in tidal mudflat and subtidal shallows expected to vary at the pond complex scales. Areas will be estimated and reported on the pond complex scale. ▪ Changes in South Bay need to be placed within system-wide (San Francisco Estuary) context to assess influence of external factors.	▪ Change in tidal mudflat & subtidal shallow: 10–20 years, assuming significant tidal habitat restoration continues beyond Phase 1. ▪ Subtidal channel change: 0–5 years.	▪ Outboard mudflat decreases greater than the range of natural variability + observational variability/error.	▪ Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning (such as plankton, benthic, fish or bird diversity or abundance) in the South Bay? ▪ Development of a 2- and 3-D South Bay tidal habitats evolution model.	▪ Convene study session to review and interpret findings to assess if observed changes are due to restoration actions or system-wide changes in the sediment budget (*e.g.*, effects of sea level rise). ▪ Study biological effects of loss of mudflat, subtidal shallows, and/or subtidal channel habitat. ▪ Adjust restoration phasing and design to reduce net loss of tidal mudflats. Potential actions include remove bayfront levees to increase wind fetch and sustain tidal mudflat, phase breaching to match demand and supply, and/or breach only high-elevation ponds to limit sediment demand ▪ Reconsider movement up staircase
Sediment Dynamics Project Objective 1 (Rate of accretion indicates trajectory toward vegetated marsh)	Accretion rate of the restored ponds is sufficient to reach vegetation colonization elevations.	▪ Areas of inboard mudflat and pioneer marsh inside ponds ▪ Sedimentation rate inside breached ponds. Methods: Transects or SET in breached ponds, annually at first and then less frequently as rates of accretion slow. LiDAR surveys (see above).	▪ Pond scale	▪ 2–10 years depending on initial pond elevation	▪ Projections based on the rate of inboard mudflat accretion suggest vegetation colonization elevations are not likely to be achieved within the planning time frame.	▪ Will sediment accretion in restored tidal areas be adequate to create and to support emergent tidal marsh ecosystems within the 50-yr projected time frame?	▪ Convene study session to review findings to assess if observed changes are due to restoration actions and whether colonization is compromised. ▪ Study biological effects of slower tidal flat evolution. ▪ Adjust phasing and design to increase inboard mudflat accretion. Potential management actions include adding wave breaks or adding fill. ▪ Reconsider movement up staircase

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Sediment Dynamics Project Objective 1 (Maintenance or increase of current vegetated marsh is essential to key species)	No long-term net loss of vegetated tidal marsh throughout the South Bay.	Total area of tidal salt marsh Methods: Bathymetry and LiDAR surveys and/or Iconos satellite data and/or aerial photography and ground truthing	Pond Complex and South Bay	10 to 20 years	▪ Observed net loss of tidal salt marsh (area of outboard fringe marsh losses > greater area of tidal marsh in restored ponds) than the range of natural variability + observational variability/error.	▪ Will sediment accretion in restored tidal areas be adequate to create and to support net increase in emergent tidal marsh habitat within the 50-yr projected time frame? ▪ Development of a 2- and 3-D South Bay tidal habitats evolution model	▪ Convene study session to review findings to assess if observed changes are due to restoration actions. ▪ If tidal marsh area is not meeting projections, assess biological significance of long-term loss of tidal marsh. ▪ Adjust phasing and design to accelerate marsh development. Potential management actions include filling to colonization elevations, adding wave breaks and/or preserving bayfront levees ▪ Adjust phasing and design to reduce erosion of existing marsh. For example, phase tidal restoration to match sediment demand and supply.
Flood Protection Project Objective 2	No increase in tidal or fluvial flood risk at any project phase and improve tidal and fluvial flood protection in the South Bay in specific areas	▪ Survey slough channel cross-sections (scour) in the vicinity of breaches; ▪ Survey marshplain accretion in the ponds; initially frequently, then less often ▪ Measure water surface elevations inside the ponds and in the sloughs in the vicinity of breaches; initially annually, then less frequently ▪ Collect high water mark elevations in the vicinity of breaches and upstream, following large flood events ▪ Inspect for levee erosion initially monthly, then annually, and after major rainfall and/or tidal events ▪ Monitor relative sea level rise (sea level rise and land subsidence) every few years ▪ Water levels and cross-sections upstream in flood-prone channels	Slough (drainage) scale	▪ Slough channel cross-sections, marshplain accretion, and water levels: rapid initial response (within approximately five years) followed by slower changes over decades. ▪ Flood high waters: approximately every ten years (depends on timing of large events) ▪ Levee erosion: same timeframe as channel cross-section and marshplain accretion responses above, or as dictated by rainfall, tidal, and other events. ▪ Relative sea level rise: approximately ten years or longer	▪ Flood modeling predicts a current or future increase in flood risk (*e.g.*, decrease in levee freeboard). ▪ Significant levee erosion observed ▪ Elevated water surface elevations projected by modeling effort and/or observed in the field ▪ Field data collection and/or observation indicates that flood risk is greater than that predicted by models (*e.g.*, water surface elevation is higher)	Will restoration activities always result in a net decrease in flood hazard?	▪ Adjust phasing and design to provide fluvial flood protection. For example, set back or lower additional levees to increase flood conveyance or dredge channels. ▪ Adjust phasing and design to protect levees. For example, adjust levee maintenance or implement levee improvements (*e.g.* widen shoulder, raise, armor, set back levee)

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Water Quality Project Objective 4	Water quality parameters in ponds will meet RWQCB standards South Bay water quality will not decline from baseline levels Dissolved oxygen (DO) levels meet Basin Plan Water Quality Objectives	▪ Water quality parameters (DO, pH, suspended sediment and turbidity, trace contaminants other than mercury, etc.) set by RWCQB in ponds and Bay (methods as per Takekawa and others 2005). ▪ Sediment oxygen demand ▪ Continue as is under regulatory requirements for managed ponds. ▪ Relate to RMP for conventional pollutants (Use RMP infrastructure for Far South Bay main water mass.) ▪ Relate to RMP for trace contaminants (Use RMP process for determining frequency and methods for Far South Bay main water mass. Also use RMP process for determining need for and frequency of tidal habitat special studies.)	Ponds, receiving waters, and entire South Bay	Ongoing	▪ Annual data review to determine variation from past trends ▪ Review of RMP results indicate abnormal conditions ▪ Other indication of abnormal conditions such as fish kills ▪ Increases in chlorophyll-a to levels indicating eutrophic conditions ▪ Increases in sediment oxygen demand to levels indicating risk of low DO ▪ Low dissolved oxygen in ponds or receiving waters	▪ What is the effect of a) pond management, including increased pond flows and associated managed pond effects, and b) increased tidal prism from tidal marsh restoration on water quality, phytoplankton and fish diversity and abundance, and food web dynamics in South Bay? ▪ Can residence time be altered to prevent low dissolved oxygen? ▪ Is it possible to re-aerate water prior to discharging to the Bay? ▪ What effect would progress all the way to 90/10 (Alternative C) have on the BOD loading to the Bay?	▪ Applied studies to find causes of water quality problems in ponds (need salinity, temperature, wind speed, solar radiation, sediment oxygen demand, and net primary production) ▪ Applied studies of Bay-wide conditions ▪ Applied studies of WQ effects on pond/Bay species (plankton, shrimp, fish, birds) ▪ Active management such as baffles, aerators, etc. ▪ Decrease number of ponds monitored as conversion away from managed ponds to full tidal occurs. Focus on managed ponds with compliance issues. ▪ Review all available data. ▪ Reduce pond residence times. ▪ Accelerate conversion from managed ponds to tidal habitat. ▪ Eliminate managed pond discharges by converting to seasonal wetlands. ▪ Decrease pond residence time ▪ Introduce re-aeration mechanisms at discharge points ▪ Reconsider movement up staircase
Mercury Project Objective 4	Levels of Hg in sentinel species do not show significant increases over baseline conditions Levels of Hg in sentinel species are not higher in target restoration habitats than in existing habitats	Hg levels in sediment, water column and sentinel species (methods as per Collins and others 2005)	Ponds and pond complexes	1–3 years depending on specific data and overall geographic scope	▪ One or more sentinel species show higher levels of Hg in target habitats than existing habitats ▪ One or more sentinel species show higher than ambient levels of Hg in Pond A8 or Alviso Slough.	▪ Will tidal marsh restoration and associated channel scour increase methylmercury (MeHg) levels in marsh and bay-associated sentinel species? ▪ Will pond management increase MeHg levels in ponds and pond-associated sentinel species?	▪ Applied study of sources of Hg and causes of increases ▪ Applied study of sediment capping methods (if relevant) ▪ Applied study of methylation processes (*e.g.*, photo-degradation, microbial methylation) ▪ Adjust phasing and design; for example, undertake preventative dredging or prevent draining of interstitial spaces or pore water. ▪ Reconsider opening more Alviso ponds to tidal action.

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Algal composition and abundance	Nuisance and invasive species of algae are not released from the Project Area to the Bay. Algal blooms do not cause low DO within managed ponds	Algal species – visual observations of macrophytes and plankton tows Chlorophyll-a Sediment oxygen demand (SOD)	Ponds (visual), Bay (plankton tows) Ponds	Annually Annually	▪ Nuisance macrophytes are observed ▪ Harmful exotic species of phytoplankton are characterized in Bay	▪ Does pond configuration affect algal composition and abundance? ▪ Do harmful exotic species of algae persist in the Bay?	▪ Alter pond configuration ▪ Introduce artificial shading ▪ Stop progression towards Alternative C
Tidal Marsh Habitat Establishment Project Objective 1A	Tidal marsh vegetation/habitat mosaic (including vegetation acreage and density, species composition, acreage of mudflat, channels, marsh ponds and transition area) is on a trajectory toward a reference marsh and/or other successful marsh restoration sites in South San Francisco Bay.	▪ Tidal marsh habitat acreage (*e.g.*, vegetation, mudflat, channel, pan, transition zones, etc.; collected via remote imagery with limited ground-truthing) as a percent of the total restoration area; plant species composition, including abundance of non-natives such as non-native *Spartina* spp. (qualitative assessments for invasive species will occur annually, quadrant or transect sampling once marsh has 20% vegetation cover); habitat trajectory toward a reference marsh and other restoration sites ▪ Tidal marsh habitat quality rated as high, medium, or low based on usefulness to clapper rail and salt marsh harvest mouse, determined every 2-3 years using aerial photos and ground-truthing ▪ Habitat mapping will take place every 5 years, beginning 5 years after the restored area has reached vegetation colonization elevation. Once 40% native vegetation cover has been achieved, species composition will be collected (in years corresponding to the habitat mapping) in a variety of zones (low marsh, high marsh, upland transition) within each restored marsh. (It would be beneficial to have increased frequency of monitoring in the early Project phases.)	Entire South Bay	Establishment depends on initial pond elevation, vegetation colonization anticipated to be detectable within 5 years (or less) of reaching appropriate elevations, while habitat development trajectory anticipated to be detectable within 15 years (and possibly less) of the onset of vegetation colonization	▪ Vegetation deviates significantly (30–50%) from projected trajectory after colonization elevations are achieved. ▪ Channel and marsh pond formation does not occur as predicted. ▪ Non-native *Spartina* present on the site.		▪ Review sediment dynamics ▪ Study causes of slow vegetation establishment and channel development (ex: gypsum) ▪ Active revegetation ▪ Increased non-native invasive species control ▪ If invasive species cannot be controlled, study biotic response to non-native vegetation ▪ Continue to re-evaluate what is meant by "control" of invasive species and adjust monitoring and management triggers based on the latest scientific consensus ▪ Adjust phasing and design ▪ Reconsider movement up staircase

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Vector Control Project Objective 5	The need for mosquito control does not exceed NEPA/CEQA baseline as determined by the Vector Control agencies	▪ Presence/absence of mosquitoes in former salt ponds ▪ Number of acres of breeding mosquitoes ▪ Number of larvae/dip in potential breeding habitat ▪ Number of acres within the Project Area treated for mosquitoes ▪ Costs/level of effort (*e.g.*, hours spent in treatment, amount of material applied, helicopter cost, etc.) to control mosquitoes	Focal areas that may support mosquito sources throughout the South Bay	Ongoing	▪ Detection of breeding mosquitoes in a former salt pond ▪ Detectable increase in monitoring parameters (relative to NEPA/CEQA baseline), particularly in areas with human activity/exposure ▪ Detection of mosquitoes that are known disease vectors and/or are of particular concern (*i.e.*, *Aedes squamiger*, *A. dorsalis*) in the Project Area		▪ Adjust design to enhance drainage or tidal flushing, control vegetation in ponded areas, and/or facilitate access (for control) to marsh ponds ▪ Increase level of vector control (preferably only as an interim measure while design issues are addressed to reduce mosquito breeding habitat) ▪ Study relationships of fish abundance and community composition and mosquito larval abundance in marsh features (*e.g.*, ponds and pannes) and managed ponds ▪ Ensure management actions are consistent with Refuge mosquito management policies
Clapper Rails Project Objective 1A	Meet recovery plan criteria for clapper rail habitat within the SBSP Restoration Project Area	Clapper rail tidal salt marsh habitat acreage, quality (see Tidal Marsh Habitat Establishment above)	Entire South Bay	Likely decades for high-quality tidal marsh development (10-year targets)	See triggers for *Sediment Dynamics*, *Vegetation Establishment* above	▪ How do clapper rails and/or other key tidal marsh species respond to variations in tidal marsh habitat quality and what are the habitat factors contributing to that response?	▪ See *Vegetation Establishment* above ▪ Reconsider movement up staircase
	Meet recovery plan criteria for clapper rail numbers (0.25 birds/ac over 10-year period) within the SBSP Restoration Project Area	Winter numbers, censused during high-tide airboat surveys, and breeding-season numbers, censused at representative locations	Entire South Bay	Monitoring not expected to show substantial results until 5–10 years after cordgrass establishment in 300 acres or more (10-year targets)	▪ Numbers drop below 0.20 birds/ac in any given year for Project Area as a whole ▪ Rate of increase in clapper rail numbers deviates significantly from projection		▪ See *Vegetation Establishment* above ▪ Applied studies of habitat parameters, contaminant levels, and predation pressure related to rail densities and productivity (and implement related management actions as appropriate) ▪ Reconsider movement up staircase
Salt Marsh Harvest Mice Project Objective 1A	Meet recovery plan criteria for salt marsh harvest mouse habitat within the SBSP Restoration Project Area	Salt marsh harvest mouse tidal salt marsh habitat acreage, quality (see Tidal Marsh Habitat Establishment above)	Entire South Bay	Likely decades for high-quality tidal marsh development (10-year targets)	See triggers for *Sediment Dynamics*, *Vegetation Establishment* above	▪ How do salt marsh harvest mice and/or other key tidal marsh species respond to variations in tidal marsh habitat quality and what are the habitat factors contributing to that response?	▪ See *Vegetation Establishment* above ▪ Adjust phasing and design; for example, add or enhance upland transition habitat within and between restored marshes ▪ Reconsider movement up staircase

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
	75% of viable habitat areas within each large marsh complex with a capture efficiency level of 5.0 or better in five consecutive years	Capture efficiency (targeting multiple areas with a CE of at least 5.0)	Entire South Bay	Monitoring not expected to begin for 5–10 years after pickleweed establishment in 300 acres or more	Rate of increase deviates significantly from projection		▪ See *Vegetation Establishment* above ▪ Adjust phasing and design; for example, add or enhance upland transition habitat within and between restored marshes ▪ Reconsider movement up staircase
Migratory Shorebirds Project Objective 1B	Maintain numbers of migratory shorebirds at pre-ISP baseline numbers, if known, or as close to that baseline as can be determined.	▪ Use previously collected data (USGS, PRBO, SFBBO) on foraging shorebird densities, as well as modeled densities, to set targets for densities of foraging shorebirds for each restored/managed habitat type (*e.g.*, reconfigured ponds and restored mudflats) by season. Targets would be based on densities (by habitat type and/or geographic area) necessary to maintain pre-ISP numbers. Conduct limited surveys in a sample of habitats/locations within the SBSP Restoration Project Area to estimate foraging densities. ▪ Use existing data from Flyway Project surveys and data from initial few years of window surveys to determine the percentage of small migratory shorebirds that occur in the South Bay compared to the entire Bay. Monitor abundance in fall, winter, and spring via high-tide, baywide "window" surveys (in which multiple observers census a number of locations in a brief [*e.g.*, 3-day] period) conducted throughout San Francisco Bay. SBSP Restoration Project would provide for the coordination of these surveys.	▪ Monitoring stations in a sample of habitats/locations within the SBSP Restoration Project Area (for collection of data on shorebird densities in various habitats) and throughout the Bay Area (for collection of data on the percentage of small migratory shorebirds that occur in the South Bay compared to the entire Bay)	▪ Changes in shorebird foraging densities are expected to be immediate upon changes in management (*e.g.*, reconfiguration and management of a pond for optimal foraging depths, or conversion of a salt pond bottom to intertidal mudflat upon breaching of levees), although any changes in densities within a given habitat type will be slower. ▪ May take years or decades for the percentage of San Francisco Bay birds using the South Bay to change in response to SBSP Restoration Project.	▪ Three consecutive years in which observed densities of foraging shorebirds for selected habitat types are below targets. ▪ Three consecutive years in which the percentage of San Francisco Bay small migratory shorebirds that use the South Bay is below the baseline (as determined using window survey data).	▪ Will the habitat value and carrying capacity of South Bay for nesting and foraging migratory and resident birds be maintained or improved relative to current conditions? ▪ Will ponds reconfigured and managed to provide target water and salinity levels significantly increase the prey base for, and pond use by waterfowl, shorebirds and phalaropes/grebes compared to existing ponds not managed in this manner? ▪ To what extent will the creation of large isolated islands in reconfigured ponds maintain numbers (and reproductive success) of terns and other nesting birds in the South Bay, while increasing densities of foraging birds over the long term compared to ponds not managed in this manner? (including studies of mudflats and managed ponds invertebrate productivity, time-energy budgets for foraging birds, relative importance of and prey use in ponds with different salinities) ▪ Will intramarsh pond and panne habitats in restoring tidal marshes provide habitat for significant numbers of foraging and roosting shorebirds and waterfowl?	▪ Analyze all available monitoring data for South Bay, Bay Area, and entire Pacific Flyway to determine whether declines are likely the result of SBSP Restoration Project, or the result of external factors. Coordinate with other Pacific Flyway studies; develop the larger structure for a centralized flyway monitoring network. ▪ Conduct Bay-wide survey to determine whether Project has displaced birds to other areas ▪ If declines are likely the result of SBSP Restoration Project: − Adjust design, for example reconfigure more ponds for use by foraging shorebirds − Adjust management, for example, manage more ponds for optimal water levels and salinities for foraging shorebirds ▪ Reconsider movement up staircase

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Breeding Avocets, Stilts, and Terns Project Objective 1B	Maintain numbers and breeding success of breeding avocets, stilts, and terns using the South Bay at pre-ISP baseline numbers, if known, or as close to that baseline as can be determined.	▪ Monitor total numbers of nesting Forster's and Caspian terns in the South Bay via comprehensive breeding-season surveys (per methods currently employed by SFBBO). Baseline has been established through past/ongoing monitoring conducted by SFBBO. ▪ Sample selected areas within the South Bay during the breeding season to determine the numbers of stilt/avocet nests in those areas. ▪ Estimate reproductive success by sampling a subset of breeding locations/colonies.	▪ Local (pond-level) scale for management actions, such as island creation, at specific ponds ▪ Entire South Bay for estimates of numbers (with estimates of breeding success in a few representative areas)	▪ Immediate response (increase) expected due to Phase 1 actions ▪ Longer-term trends monitored annually	▪ Decline in numbers (in the South Bay as a whole) or reproductive success of breeding stilts, avocets, and Forster's and Caspian terns below baseline for two consecutive years	▪ Will the habitat value and carrying capacity of South Bay for nesting and foraging migratory and resident birds be maintained or improved relative to current conditions? ▪ To what extent will the creation of large isolated islands in reconfigured ponds maintain numbers (and reproductive success) of terns and other nesting birds in the South Bay, while increasing densities of foraging birds over the long term compared to ponds not managed in this manner? (including predation and predator control studies, vegetation management approaches and Hg uptake in eggs, and related toxicity studies) ▪ Will California gulls, ravens, and crows adversely affect (through predation and encroachment on nesting areas) nesting birds in managed ponds?	▪ Analyze all available monitoring data for South Bay, Bay Area, and entire Pacific Flyway to determine whether declines are likely the result of SBSP Restoration Project, or the result of external factors (taking into account the downward trends in abundance of Forster's terns over last few decades, which are unrelated to salt pond conversion). ▪ If declines are likely the result of SBSP Restoration Project: – Undertake applied studies of habitat parameters, contaminant levels, prey availability and type, juxtaposition of nesting and brood rearing/foraging areas, predation pressure, and disturbance to determine appropriate design/management adjustments – Conduct Bay-wide survey to determine whether SBSP Restoration Project has simply displaced birds to other Bay-area locations. – Adjust design to construct more, or more optimal, nesting islands – Adjust design to reduce Hg uptake – Adjust management. For example, manage more ponds for optimal water levels and salinities for breeding and foraging stilts and avocets, manage more ponds for optimal water depths and salinities for foraging terns and/or control predation, vegetation, human disturbance. ▪ Reconsider movement up staircase

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Diving Ducks Project Objective 1C	Maintain numbers of diving ducks using the South Bay at pre-ISP baseline numbers	Use mid-winter waterfowl survey data to monitor winter numbers of diving ducks in the South Bay. Baseline has been set by previous mid-winter surveys and Accurso's studies.	Entire South Bay	Local changes in abundance are expected to be immediate upon changes in management (*e.g.*, reconfiguration and management of a pond, or conversion of a salt pond bottom to intertidal mudflat upon breaching of levees). Larger-scale changes in abundance will likely be slower (on the order of years to decades).	Decline in South Bay numbers below baseline conditions for two consecutive years	▪ Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning (such as plankton, benthic, fish or bird diversity or abundance in the South Bay? ▪ Will the habitat value and carrying capacity of South Bay for nesting and foraging migratory and resident birds be maintained or improved relative to current conditions? ▪ Will intramarsh pond and panne habitats in restoring tidal marshes provide habitat for significant numbers of foraging and roosting shorebirds and waterfowl over the long term?	▪ Analyze all available monitoring data for South Bay, Bay Area, and entire Pacific Flyway to determine whether declines are likely the result of SBSP Restoration Project, or the result of external factors ▪ If declines are likely the result of SBSP Restoration Project: – Undertake applied studies of habitat use and effects of human disturbance to determine appropriate design/management adjustments – Adjust design to increase the restoration of shallow subtidal habitat – Adjust management. For example, manage more ponds for optimal water depths and salinities for foraging diving ducks and/or control human disturbance ▪ Reconsider movement up staircase
Salt Pond Associated Migratory Birds (Wilson's and Red-necked Phalaropes, Eared Grebes, Bonaparte's Gulls) Project Objective 1B	▪ Maintain these species' use of SBSP Restoration Project Area ▪ Minimize declines in the South Bay relative to pre-ISP baseline	Focused surveys would be conducted targeting seasonal peaks (*i.e.*, late summer/early fall for phalaropes, fall and winter for Eared Grebes and Bonaparte's gulls) and geographic concentrations (*e.g.*, high-salinity ponds and other areas known to support large proportions of South Bay numbers of these species) to determine the numbers of these species using the South Bay.	Entire South Bay (as determined by surveys in areas where these species are concentrated)	Local changes in abundance are expected to be immediate upon changes in management (*e.g.*, reconfiguration and management of a pond, or conversion of a salt pond bottom to intertidal mudflat upon breaching of levees). Larger-scale changes in abundance will likely be slower (on the order of years to decades).	Three consecutive years in which numbers are more than 25% below the NEPA/CEQA baseline, or any single year in which numbers are more than 50% below NEPA/CEQA baseline	▪ Will the habitat value and carrying capacity of South Bay for nesting and foraging migratory and resident birds be maintained or improved relative to current conditions? ▪ Will ponds reconfigured and managed to provide target water and salinity levels significantly increase the prey base for, and pond use by waterfowl, shorebirds and phalaropes/grebes compared to existing ponds not managed in this manner?	▪ Analyze all available monitoring data for South Bay, Bay Area, and entire Pacific Flyway to determine whether declines are likely the result of SBSP Restoration Project, or the result of external factors (taking into account declines that have already occurred due to ISP). ▪ If declines are likely the result of SBSP Restoration Project: – Adjust management to have more ponds with optimal water levels and salinities for foraging pond-associated birds ▪ Reconsider movement up staircase

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
Western Snowy Plovers Project Objective 1A	Contribute to the recovery of the western snowy plover by providing habitat to support 250 breeding birds within SBSP Restoration Project Area, and maintain a 5-year average productivity level as required by the Recovery Plan.	Snowy plover numbers and estimated nest success, determined through comprehensive, annual South Bay surveys and monitoring during the breeding season	Entire South Bay for estimates of numbers (with estimates of breeding success in a few representative areas)	Local changes in abundance are expected to be immediate upon changes in management (*e.g.*, reconfiguration and water level/prey management of ponds). Longer-term trends will be monitored annually.	▪ Rate of population change declines substantially from projected trajectory toward target ▪ South Bay population declines in any given year below 2006 baseline	Will shallowly flooded ponds or ponds constructed with islands or furrows provide breeding habitat to support sustainable densities of snowy plovers while providing foraging and roosting habitat for migratory shorebirds compared to existing ponds not managed in this manner? (including predation studies and predator control studies, vegetation management approaches, and Hg- related toxicity studies	▪ Analyze all available monitoring data for South Bay, Bay Area, and entire Pacific Flyway to determine whether declines are likely the result of SBSP Restoration Project, or the result of external factors (taking into account the downward trends in abundance of plovers over last few decades, which are unrelated to salt pond conversion). ▪ If declines are likely the result of SBSP Restoration Project: – Undertake applied studies of habitat parameters, contaminant levels, prey levels/type, juxtaposition of nesting and brood rearing/foraging areas, predation pressure, and disturbance to determine appropriate design/management adjustments – Adjust design to construct more, or more optimal, nesting habitat, create more open salt panne habitat, and/or to reduce Hg uptake – Adjust management of water levels and salinities in more ponds for optimal breeding and foraging habitat and/or control predation, vegetation, human disturbance ▪ Reconsider movement up staircase
California Least Terns	Maintain numbers of post-breeding California least terns in the Project Area at multi-year average levels including natural variation in numbers; avoid negative effect of SBSP Restoration Project on Bay-area least tern breeding bird numbers (multi-year average levels with natural variation)	Counts of birds using the South Bay as a post-breeding foraging area (or breeding area, if that occurs) and breeding pairs at Bay-area nesting colonies	Post-breeding foraging sites and breeding colonies	Local changes in abundance may be immediate upon changes in management (*e.g.*, reconfiguration and management of a pond, or conversion of a salt pond bottom to intertidal mudflat upon breaching of levees). Larger-scale changes in abundance will likely be slower (on the order of years to decades).	Decline in total number of birds using the South Bay as a post-breeding foraging area or breeding pairs in the S.F. Bay Area below 2006 baseline levels, in any given year		▪ If numbers decline, first use available information to attempt to determine whether declines are resulting from SBSP Restoration Project or other factors (*e.g.*, the impact of South Bay California gulls on nesting colonies or changes in Bay fisheries). ▪ Conduct applied study of post-breeding habitat use and diet, especially in the South Bay. ▪ Implement management or adjust

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
							design (*e.g.*, if applied study finds more foraging occurs in ponds than Bay, manage more ponds for suitable least tern foraging conditions). ▪ Reconsider movement up staircase.
Steelhead Project Objective 1C	Enhance numbers of salmonids and juvenile in rearing and foraging habitats relative to NEPA/CEQA baseline numbers	Counts of upstream-migrating salmonids to monitor spawning populations in South Bay streams	South Bay spawning streams	5–10 years likely for effects of restoration on salmonids to be detectable	Reduction in number of upstream-migrating salmonids	Will increased tidal habitat increase native fish and harbor seal survival, growth and reproduction? (including specific study of steelhead)	▪ If numbers decline, first use available information to attempt to determine whether declines are resulting from SBSP Restoration Project or other factors (*e.g.*, factors associated with spawning streams). ▪ Conduct applied study of constraints to population growth (ex: Hg, water quality, food chain). ▪ Conduct applied study of condition of salmonids seaward of restoration site (sample Chinook using minnow net upstream from, at, and downstream from restoration sites before and after restoration; determine whether fish are larger and healthier after than before restoration). ▪ If numbers decline, conduct diet studies on piscivorous birds (to determine whether increased bird predation is responsible). ▪ Implement management or adjust design (*e.g.*, restore more tidal habitat adjacent to spawning streams). ▪ Reconsider movement up staircase.
Estuarine Fish Project Objective 1C	Enhance numbers of native adult and juvenile fish in foraging and rearing habitats relative to NEPA/CEQA baseline numbers	▪ Presence/abundance of surfperch in restored marshes (as measured in permanent monitoring locations with pilings installed to facilitate monitoring) ▪ Presence/ absence of native flatfish, such as starry flounder, in restored un-vegetated shallow water areas	Monitoring results will reflect conditions at monitoring stations scattered throughout the SBSP Restoration Project Area, in tidal habitat, ponds, and sloughs	Varies by trigger – ▪ fish are expected to move into newly restored areas almost immediately but assemblages will change as habitat matures ▪ surfperch not expected to use restored marshes until vegetation is established ▪ negative impacts may be	▪ Detection of a fish die-off ▪ Absence of detections of surfperch using restored tidal marsh ▪ Increase in percent of individuals sampled in restored marshes that are non-native ▪ Detectable reduction in water quality (as determined	Will increased tidal habitat increase native fish abundance and will restored habitat support healthy populations? (including specific study of native estuarine fish)	▪ Use available information to attempt to determine whether declines are resulting from SBSP Restoration Project or other factors (*e.g.*, factors associated with spawning streams). ▪ Applied study of constraints to population growth (ex: Hg, water quality, food chain) ▪ If fish populations decline,

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
		▪ Species richness and abundance of native fish species in a range of habitats including restored marshes and associated unvegetated shallow water areas, major and minor sloughs, and deep and shallow-water ponds ▪ Water quality parameters (see "Water Quality" Key Category)		immediate if poor water quality from a pond discharge causes a die-off	by monitoring described under "Water Quality" Key Category) ▪ Deviation from expected trajectory of native fish use of restored marshes and associated unvegetated shallow water areas		conduct diet studies on piscivorous birds (to determine whether increased bird predation is responsible). ▪ Consider possible effects of recreational angling pressure. ▪ Implement management or adjust design (*e.g.*, remove more levees to increase connectivity in restored ponds) based on study results ▪ Reconsider movement up staircase
Harbor Seals Project Objective 1C	▪ Maintain or enhance numbers of harbor seals using the South Bay	▪ Conduct periodic monitoring at known South Bay haul-out sites (*e.g.*, Mowry, Newark & Alviso Sloughs, and expand to include haul-out site in Corkscrew Slough) to determine trends in productivity and abundance, and changes in distribution. If incidental sightings at other areas are not adequate to determine if new haul-out sites are established, periodically survey other locations as well. Existing data include over 5 years of weekly survey data for Mowry and Newark sloughs, and 5 years of monthly survey data for Alviso Slough. ▪ Mercury parameters (see "Mercury" Key Category)	Focal areas (*i.e.*, known haul-out sites) throughout South Bay	Negative response to human disturbance from improved public access may be immediate; response to habitat restoration or increased mercury availability may be longer-term (a decade or more)	▪ Decline in overall South Bay numbers and pup production, if known, at haul-out sites below 2006 baseline levels for 2 consecutive years ▪ Reduction in frequency of use and pup production, if known, of Mowry Slough and adjacent haul-out/pupping areas	▪ Will increased tidal habitat increase native fish and harbor seal survival, growth and reproduction? ▪ Will increases in boating access significantly affect birds, harbor seals or other target species on short or long timescales?	▪ See management actions under "Mercury" and "Public Access" Key Categories ▪ Other potential management actions may include: – Restrict public access and/or improve public education near seal haul-out sites – Create seasonal closure in areas that might be appropriate for seal protection during pupping season, including buoys restricting access to sloughs to boats and land-based trails. – Enforce protective measures such as increased patrolling etc. ▪ If seal populations decline or pupping rates decline, conduct studies on seal health (pollutant exposure), potential disturbance changes, habitat/prey alternations (fish declines or fish community changes), or reduced access to sites due to steep gradient, tidal restrictions, or insufficient deep water
Public Access Project Objective 3	▪ High quality visitor experience is maintained ▪ Facilities are not degraded by over usage	▪ Visitor use surveys (numbers, activities, demographics, overall experience and peak use (surveys yearly) ▪ Staff observations ▪ Complaints or compliments registered with land managers	Within the Project Area.	Based on construction of facilities and public use (5+ years of usage)	▪ Survey results show dissatisfaction ▪ Overcrowding at staging areas ▪ Conflicts between users (recorded incidences) ▪ Maintenance costs exceed budget	▪ Will public access features provide the recreation and access experiences visitors and the public want over short or long timescales? (Study visitor traits and use patterns, visitor satisfaction with experience, public	▪ Adjust design. For example, limit number of visitors to a given area, provide alternate use times for certain activities and/or reduce development of some uses, increase others, based on demand. ▪ Hold public meetings/workshops

Table 2.3 Adaptive Management Summary Table (Continued)

CATEGORY/ PO	RESTORATION TARGET	MONITORING PARAMETER (METHOD)	SPATIAL SCALE FOR MONITORING RESULTS	EXPECTED TIME FRAME FOR DECISION-MAKING	MANAGEMENT TRIGGER	APPLIED STUDIES	POTENTIAL MANAGEMENT ACTION
		▪ Cost of maintaining facilities				demand for other uses, facility degradation)	to inform the public of applied studies findings to determine how best to meet public recreation desires given specific problems ▪ Hold charrette (group design process over 1-day)
Public Access Project Objective 1A, B, C	▪ Public use does not prevent reaching restoration targets as measured by significant impacts to target species.	Numbers, species richness and behavior of target species in public access areas	Within the Project Area, except as noted in restoration targets for shorebirds, diving ducks, breeding birds, California clapper rail, Western snowy plovers, and harbor seals.	Some parameters are immediate (*i.e.*, behavior); others may take 3 years or much more	▪ For species or guilds without specific population targets: statistically significant abundance, species richness or behavioral changes compared to control sites ▪ For species with population targets: reduction in abundance or density of breeding and/or non-breeding animals due to public access	▪ Will landside public access significantly affect birds or other target species on short or long timescales? (including studies of waterfowl, clapper rail and snowy plover responses to public access, and roosting bird response to public access) ▪ Will increases in boating access significantly affect birds, harbor seals or other target species on short or long timescales? (including studies of waterbird response to boaters)	▪ Adjust design. For example, provide edge condition to prevent visitors from moving off-trail (*e.g.*, fencing). change design to reduce wildlife disturbance based on study findings, or, in sensitive areas, restrict public access and redirect. ▪ Increase public access if species goals are met, but continue to monitor species' response ▪ Evaluate changes in population or density of species with population targets in light of restoration targets and other impacts on the species ▪ Design future phases to avoid significant impacts to species and optimize public access in areas of little or no species impact

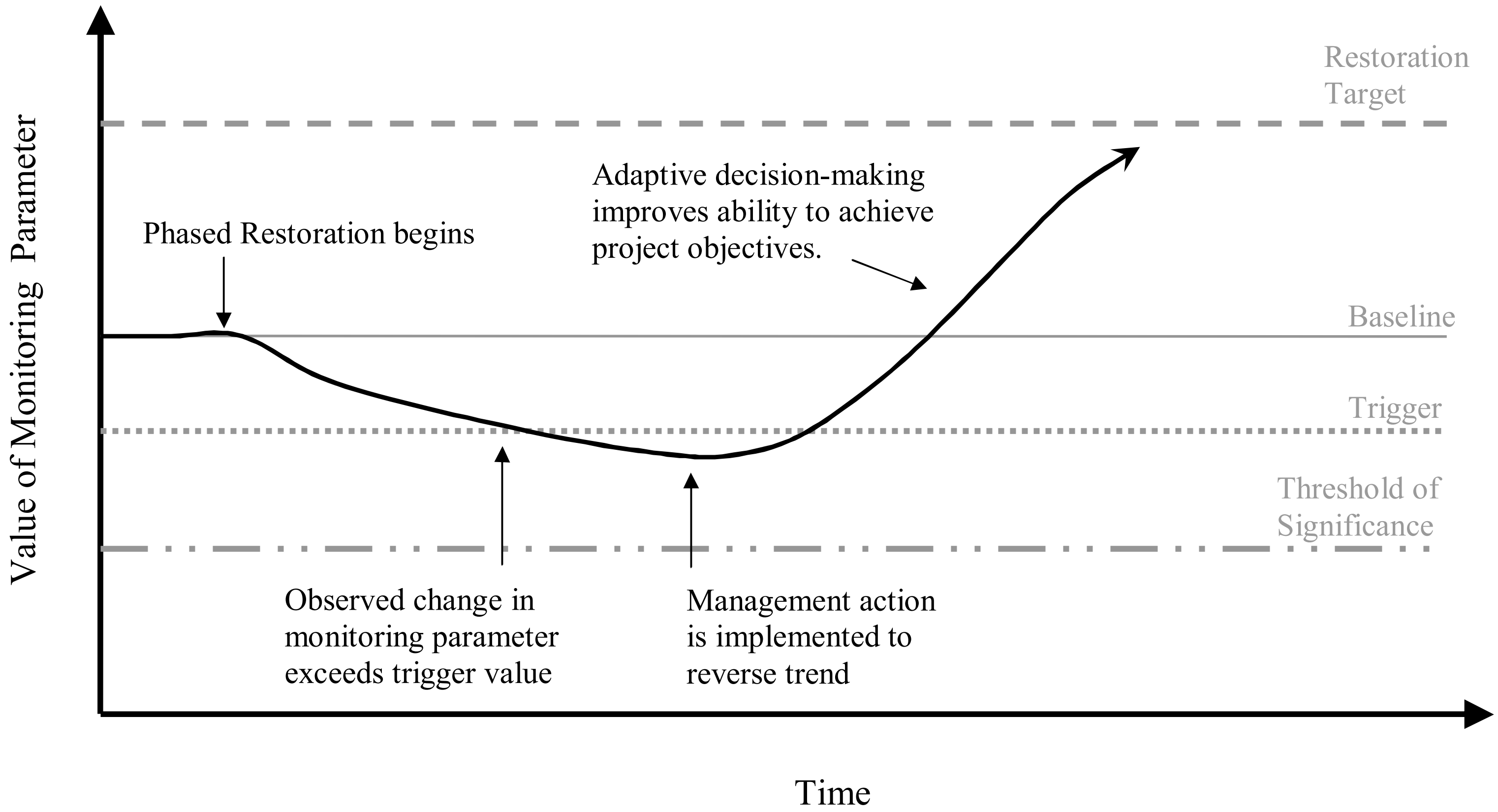

Figure 2-2

South Bay Salt Pond Restoration Project

How Monitoring and Adaptive Management Avoids Significant Impacts

PWA

March 2007
1750.04

Key Uncertainty #1: Sediment Dynamics. Is there sufficient sediment available in the South Bay to support marsh development without causing unacceptable impacts to existing intertidal habitats?

Key Uncertainty #2: Bird Use of Changing Habitats. Can the existing number and diversity of migratory and breeding shorebirds and waterfowl be supported in a changing (reduced salt pond) habitat area?

Key Uncertainty #3: Non-avian Species. Can restoration actions be configured to maximize benefits to non-avian species both onsite and in adjacent waterways?

Key Uncertainty #4: Mercury. Will mercury be mobilized into the food web of the South Bay and beyond at a greater rate than prior to restoration?

Key Uncertainty #5: Invasive and Nuisance Species. Can invasive and nuisance species such as *Spartina alterniflora* (or the invasive *Spartina* hybrid), corvids and the California gull and, if warranted, raptors such as the northern harrier, be controlled? If not, how can the impacts of these species be reduced in future phases of the Project?

Key Uncertainty #6: Water Quality. Will restoration adversely affect water quality and productivity?

Key Uncertainty #7: Public Access. Will trails and other public access features / activities have significant negative effects on wildlife species?

Key Uncertainty #8: Social Dynamics. How can the Project gain support from the public now and into the future, including support for continued funding of restoration and management?

Applied Studies

As discussed in Section 2.6, a number of applied studies are incorporated into the Phase 1 actions so that as much information as possible would be available to future phases of tidal restoration. In addition to the monitoring of large-scale response to restoration actions, as summarized in Table 2-3, applied studies focusing on issues such as bird response and mercury methylation would provide valuable information regarding how the observed changes are linked to specific restoration actions.

The Science Team developed a tiered approach to sequencing the applied studies. The first tier (*e.g.*, the Phase 1 applied studies) should be initiated before or at the beginning of Phase 1. Complete descriptions of the Phase 1 applied studies are provided in the Adaptive Management Plan (Appendix D). Three of the most important studies are summarized below.

Bird Use in Ponds Reconfigured for Nesting and Foraging (Key Uncertainty #2)

Applied studies would be implemented at ponds reconfigured in Phase 1 to determine how islands, vegetation, nearby human activities, and water depths affect nesting and foraging birds. The decision to progress with additional tidal restoration along the staircase toward the 90:10 distribution of tidal habitat to managed ponds depends, in large part, on the ability to increase bird densities in the reconfigured ponds.

As in all reconfigured ponds, the Phase 1 ponds selected for nesting studies (Ponds SF2 and A16) would also be used to evaluate whether high bird densities can be achieved and sustained by management of shallow water levels specifically for foraging shorebirds. This would be assessed by managing water levels adaptively and monitoring the numbers of birds.

The applied studies designed for Phase 1 ponds reconfigured with nesting islands would provide an important model for island design, provide an understanding of the vegetation requirements, and determine an acceptable level of public access for reproductive success of bird species using this pond. This understanding would help inform and guide the design of optimal pond configurations that would be used at other managed pond locations in the South Bay.

As discussed below, these experiments have been designed to test: 1) the effects of island spacing and shape on nesting use and reproductive success; 2) the effects of vegetation type, density and distribution on island use by nesting birds; and 3) the effects of nearby public access and trails on island use or nesting success.

Island spacing, shape and distance to adjacent islands. Various nesting bird species may respond differently to contrasting island shapes. For example, terns may benefit more from circular islands while shorebirds such as black-necked stilts, American avocets, and snowy plovers may benefit from long, linear islands. In addition to contrasting shapes, it is important to understand the effect of island density on habitat value. For example, high-density islands may increase potential nesting habitat, but reduce foraging area between islands and increase aggressive interactions among family groups of American avocets and black-necked stilts.

Vegetation type, density, and distribution. Vegetation also plays an important role in nesting success, as different bird species have varying vegetation tolerances or requirements. Snowy plovers typically avoid vegetated areas for nesting, and avocets usually nest in bare or sparsely vegetated areas. While some South Bay tern colonies are located in areas with little or no vegetation, other tern colonies, as well as many black-necked stilt nests, are located in areas having some vegetation, which may also provide shade and cover from predators for chicks. Nesting waterfowl are likely to nest almost exclusively in vegetated areas.

Public Access. Although human activity in the vicinity of these ponds is expected to be limited to trails with non-motorized recreation (*i.e.*, walking or biking around the levee of the pond) and pond/island maintenance, it is unknown whether this level of activity would affect island use or nesting success by birds.

Bird Use in High and Low Salinity Ponds (Key Uncertainty #2)

In addition to the applied study above, the Phase 1 action at Ponds E12 and E13 provides an opportunity to determine the 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. Understanding the linkages between salinity and shorebirds would be important as more of the former salt ponds are converted to lower-salinity managed ponds and tidal habitat.

Several shorebird species, particularly Wilson's and Red-necked Phalaropes, have long been known to occur in the South Bay primarily within higher-salinity ponds; such species generally forage in high-salinity ponds throughout the tidal cycle. In addition, studies by Point Reyes Bird Observatory (PRBO) and others have demonstrated that some species that typically forage on intertidal habitats during low tide, such as Western sandpipers and dunlin, show an affinity for higher-salinity (versus lower-salinity) ponds at high tide, and that many individuals of these species forage in higher-salinity ponds at high tide. However, very high densities of shorebirds have also been observed foraging in South Bay ponds that do not have high salinities, but that rather have optimal foraging depths for small shorebirds. Therefore, the experimental design proposed here, in which ponds are expected to differ in salinity (and therefore in the abundance of different prey types) but are expected to provide the same, extensive foraging habitat based on water depth, would better elucidate any preferences for ponds of certain salinity by these birds. Having a better understanding of the importance of ponds of certain salinities for foraging by migratory shorebirds, and understanding the responses of these birds' prey to varying salinity, would inform future decisions in pond management for the Project.

The few nesting islands in Ponds E12 and E13 may provide some information regarding nesting bird use at the different salinity levels across the pond complexes; however this applied study would focus on the effects of salinity on migratory bird use of managed ponds. This experimental arrangement also allows for study of the localized effects of trail use (public access) on bird species using these ponds.

Wildlife Response to Increased Exposure of MeHg (Key Uncertainty #4)

The potential exists to inadvertently increase the risk of mercury (Hg) accumulating in South Bay fish and wildlife through hydrological modification of salt ponds. The concern is that some management actions would favor conversion of Hg into toxic methylmercury (MeHg) and its uptake into local food webs. Ponds within the Alviso pond complex and Alviso Slough are especially of interest because they contain more Hg than most other areas of South Bay and are slated for early management actions.

Although Hg concentration data are being collected at various locations within the South Bay, very little is known about the regional and habitat-specific processes governing Hg physical transport, Hg methylation, and bioacccumulation. This applied study would address (a) how much legacy Hg is contained in sediments of different habitats; (b) how readily available this legacy Hg currently is for conversion to toxic MeHg; (c) how effectively and by what specific pathways MeHg is incorporated into local food webs; and (d) how various management actions being considered might affect the availability of legacy Hg and its incorporation into the food web as MeHg. Bayland managers need to know how restoration actions may affect the risk of mercury toxicity in wildlife. This risk can be assessed most directly by monitoring Hg in 'biosentinel' wildlife species that represent bayland conditions. Coupling such a monitoring effort to study MeHg production and uptake is essential to understand how the risk of Hg bioaccumulation can be reduced in light of the various management options under consideration. The mercury applied study that has already been initiated and would be continued in Phase 1 would include the following activities during a three-step process:

Step 1 would:

- Develop sentinel species indicators of Hg exposure;
- Map the legacy Hg in Alviso Slough that might be mobilized by Phase 1 action at Pond A8;
- Assess the mercury problem for dominant specific habitat types associated with Pond A8 and Alviso Slough;
- Establish a baseline for tracking the effects of management actions on the Hg problem into the future.

Step 2 would:

- Expand the survey of the extent of the mercury occurrence using the sentinel species, sub-habitat designations, and biogeochemical indicators to encompass more of the South Baylands. This would provide a picture of the spatial variability of the relative mercury risk within and between bayland habitats throughout the South Bay.

Step 3 would:

- Initiate focused research to better understand the linkages between Hg contamination in sentinel species and bio-geochemical indicators for specific habitat types in selected areas, based upon the results of Step 2;
- Help translate the scientific understanding of the Hg problem into habitat designs and management options that minimize the problem.

Monitoring

The primary purposes of monitoring are to:

- Assess progress toward Project Objectives;
- Evaluate effects of a specified management action;
- Characterize baseline/reference conditions;
- Track regulatory compliance; and
- Detect early signs of potential problems and anticipated changes.

To achieve these purposes, the Project would monitor a large number of parameters. The Project's 50-year horizon necessitates measuring short- and long-term characteristics. For example, it is expected that large-scale changes in the area of mudflat (the first restoration target in the Table 2-3) would not be detectable for 10-20 years. In contrast, breeding birds are likely to respond to restoration changes in the next breeding season. In addition to varying time scales, the Project would also track changes at various spatial and ecological scales. The spatial extent of monitoring would vary depending on the variable being measured. Some variables may be measured within an individual pond, while others would be measured over a broader geographic area. Monitoring is not limited to the locations of the Phase 1 restoration actions. For example, tidal habitat development within a Phase 1 restoration action can be informed by monitoring at other tidal restoration sites at various stages of development in order to provide an additional basis for comparison.

Modeling

The development and application of numerical models is an important component of the Adaptive Management Plan. While some applied studies may contain modeling components, the primary modeling endeavor would be the development and application of an integrated model that captures "understanding of system processes based on information currently available, to identify important areas of uncertainty where additional information is needed, and to predict system outcomes under different scenarios" (National Science Panel 2005). The development, revision, and application of such a model would require continuous effort and coordination during Project implementation.

The model would be used to integrate and analyze applied studies, monitoring, and other Project information. In particular, the model should allow managers to predict how the system is likely to respond to management actions and also to external factors such as sea level rise and other consequences of climate change. This forecasting function would be especially valuable for designing future Project phases. The model would also inform applied studies by allowing preliminary testing and refinement of hypotheses and improve monitoring programs by identifying areas of variability that should be resolved by monitoring. A state-of-the-art numerical model would also be useful for many additional restoration projects and other environmental studies in the South Bay.

Restoration Techniques

In addition to applied studies, monitoring, and modeling, the Phase 1 actions accommodate design features and pond operations that examine the feasibility and effectiveness of specific restoration techniques. Monitoring the effectiveness and sustainability of the elements would inform future planning and design activities, and possibly modifications of management approaches implemented during Phase 1. The following restoration techniques have been identified for inclusion in Phase 1.

Vegetation Management on Islands and in Managed Ponds

While some vegetation on nesting islands may be acceptable, management is necessary to prevent dense, tall vegetation from substantially encroaching on the islands and to maintain habitat for species averse to nesting in vegetation. Vegetation management may also be required in areas of ponds managed for shallow water habitat. The East Bay Regional Park District (EBRPD) has been successful in controlling vegetation using saline spray. In addition to active vegetation control, the nesting island designs would also factor in substrate-based controls on plant growth including layers of coarse sand, oyster shell, gravel, and gypsum fragments. Phase 1 provides an early opportunity to learn about which methods are most efficient and cost-effective in controlling vegetation.

Water Management for Discharge Requirements

The shallow water environment of managed ponds provides valuable habitat that supports various species of invertebrates and fish, many of which serve as food for nesting birds. However, compliance with water quality discharge requirements for discharge to sloughs, particularly dissolved oxygen (DO), has been problematic during ISP operations. Reconfigured Phase 1 ponds would include approaches to determine the most cost-effective approach to meet regulatory standards while simultaneously providing high quality bird habitat.

Predator Control at Managed Ponds

Islands within managed ponds provide nesting habitat for a variety of birds. The proposed Phase 1 tidal restoration and pond reconfiguration would displace predatory California gulls currently nesting in Pond A6, increase wetland nesting habitat for predatory Northern Harriers in restored marshes, create island nesting habitat that may attract breeding California gulls, and concentrate nesting islands for terns and other birds into fewer locations. As a result, predation pressure by avian (and possibly mammalian) predators on birds nesting on the islands would increase, potentially limiting the number and success of nesting birds utilizing the islands. Phase 1 management actions would include approaches to examine the most effective and cost-effective method for controlling predation.

Sustainability of Constructed Marsh Pond and Panne Habitat

Pannes and ponds were typical, but not ubiquitous, features of historic salt marshes that provided important habitat for certain bird species. These features have rarely formed naturally in restored marshes, and constructed marsh ponds and pannes have been difficult to maintain due to vegetation colonization and erosion of the topographic elements that control tidal inundation. The Phase 1 actions include restoration techniques to evaluate if constructed pond and panne habitat can be maintained through natural processes over the long term.

Ditch Blocks and Interior Channel Development

Re-establishment of the relict tidal drainage network is typically preferable since channel complexity provides a variety of microhabitats that support many marsh-dependent species. However, during channel formation within restoration sites, borrow ditches can capture and dominate the evolution of the tidal drainage system. The Phase 1 actions include restoration techniques to evaluate the extent to which ditch blocks enhance the re-establishment of relict dendritic channel networks within restored marshes.

Wave-Break Berms and Pond Sedimentation

Wind blowing across open expanses of water, such as low restoration sites at high water, can generate waves that are sufficient to inhibit sediment deposition and re-suspend previously deposited material. These effects can slow or possibly prevent marsh plain formation. Monitoring associated with Phase 1 tidal habitat restoration would include elements to assess the effectiveness of installing or retaining wave breaks at different wind fetch spacing to prevent reduction in pond sedimentation.

Gypsum Pre-Treatment and Vegetation Establishment

Gypsum is a salt that precipitates in high salinity waters during the salt production process, forming a hard layer on the pond bed. Within the SBSP Restoration Project Area, gypsum is present in: Ponds E8 and E8A in the Eden Landing pond complex; the Island Ponds (Ponds A19, 20 and 21) and Ponds A22 and 23 in the Alviso pond complex; and in Ponds R2, R3, R4, R5, RS5, and SF2 in the Ravenswood pond complex. The presence of gypsum may inhibit vegetation establishment and plant community development in restored marshes by blocking root growth, preventing full drainage at low tide, or other factors. It is uncertain at this time whether gypsum would constrain vegetation establishment at higher intertidal ponds. In lower elevation ponds, the layer of gypsum would likely be buried underneath accreting sediments; therefore, the presence of gypsum may not hinder marsh colonization. There are few examples of tidal habitat restoration in ponds with gypsum layers and therefore little evidence of the effects of gypsum on habitat development.

The dissolution or degradation of the gypsum would depend on environmental factors, which include the density and depth of the gypsum layer, water exchange rates, surface flow velocities, water chemistry, precipitation, and inundation period. Increased inundation increases the potential for gypsum dissolution, so areas near creek banks may actually dissolve more quickly. While gypsum dissolution may take from 4 to 76 years at mean higher high water (MHHW) pond elevations, Siegel and Bachand (2001) estimate that lower elevation gypsum-covered ponds may dissolve at a faster rate (2 to 38 years for ponds 1 foot (ft) below mean high water [MHW] to MHW and 1 to 19 years from ponds between mean tide level [MTL] and mean low water [MLW]). Anecdotal evidence suggests that gypsum may break up and/or dissolve more quickly than dissolution rates alone would suggest. Within the Island Ponds complex, gypsum has been observed to be cracking and collapsing along borrow ditches and in many of the creek channels (Callaway 2007, pers. comm.).

Adaptive management experiments would be performed as part of the Phase 1 action at Ponds E8A, E9, and E8X to examine the effectiveness of mechanically disturbing a portion of the existing gypsum layer in Pond E8A prior to tidal restoration. A portion of the gypsum layer would be left undisturbed for comparison. Additional adaptive management experiments would help determine sedimentation rates and subsequent vegetation establishment within the tidally-restored and gypsum-covered ponds to inform future restoration in gypsum-covered ponds.

The Initial Opportunities and Constraints Summary Report (PWA and others 2004) describes potential opportunities and constraints, including the presence of gypsum, relevant to achieving the Project Objectives. PWA and others (2004) provide a map showing the distribution of gypsum within and adjacent to the SBSP Restoration Project Area, and the pond bed elevations relative to the tides (PWA and others 2004; Figure 9). This figure includes ponds that are outside of the SBSP Restoration Project Area. The likelihood of gypsum-covered ponds interfering with restoration within the Project Area are described below based on gypsum-constraint classifications presented in Siegel and Bachand (2001):

- Ponds in which gypsum is likely to interfere with tidal marsh restoration (bed elevations above MHW) comprise less than two percent of the SBSP Restoration Project Area (Pond E8A in the Eden Landing pond complex),

- Ponds in which gypsum could interfere with tidal marsh restoration (bed elevations between 1 ft below MHW and MHW) comprise three percent of the SBSP Restoration Project Area (Pond E8 in the Eden Landing pond complex and Pond A22 in the Alviso pond complex),
- Ponds in which gypsum is less likely to interfere with restoration (bed elevations between MTL and 1 ft below MHW) comprise a total of 13 percent of the SBSP Restoration Project Area (the Island Ponds and Pond A23 in the Alviso pond complex and Ponds R2, R3, R4, R5, RS5, and SF2 in the Ravenswood pond complex).

2.3.4 How Adaptive Management Relates to the EIS/R

The SBSP Adaptive Management Plan was developed to both maximize the likelihood of achieving Project Objectives and avoid long-term adverse impacts. At each incremental phase of tidal restoration along the staircase, the PMT would assess its progress and decide whether or not to continue restoring tidal habitat. Data generated through monitoring would both inform adaptive management decisions and help determine environmental impacts of early phases of the Project. Whereas monitoring is intended to provide information on how the ecosystem is evolving, applied studies are designed to illuminate processes and reduce uncertainties so managers can understand why the ecosystem is changing.

Adaptive management supports the following activities relative to the SBSP Restoration Project EIS/R.

Establish Baseline Conditions

Data regarding the existing conditions of the South Bay ecosystem are incomplete, especially in relation to the abundance of some wildlife species, particularly shorebirds. Although previous and ongoing surveys have provided a great deal of information regarding these species' abundance in the South Bay, natural variability is so high that the "baseline," and the variability around that baseline, are still not well established for some species. Therefore, monitoring would be required to better characterize baseline conditions before the effects of large-scale restoration actions can be fully determined. Potential environmental impacts that require baseline monitoring, and the associated monitoring parameters and methods, are discussed in Chapter 3.

Evaluate Effects of Management Actions

During each phase of implementation, monitoring would be used to assess Project progress and applied studies would be carried out through experimental design to reduce uncertainty. Phase 1 monitoring and applied studies that have the potential to influence the extent to which future phases of restoration should continue along the staircase toward additional tidal restoration are described in Section 2.3.3. The cycle of experimentation and phased implementation allows for improved understanding of ecosystem response to feed back into the management decisions, and reduces the likelihood of unexpected adverse effects.

Additional engineering features and management actions would be developed to examine the effectiveness of specific restoration techniques. These restoration techniques are important to assess for their effectiveness, but do not require the experimental rigor of applied studies. Specific restoration techniques incorporated into Phase 1 are presented in Section 2.3.3.

Detect Early Signs of Problems

Monitoring key attributes of the physical, chemical and biological conditions of the South Bay ecosystem may allow managers to detect early signs of unexpected or uncertain adverse effects. If monitoring data reveal that a specific attribute is trending toward an undesirable state to the extent that a "trigger" is "tripped", a focused evaluation is performed. The purpose of the focused evaluation is to use available data from within and outside the South Bay to assess whether the observed trend is a result of the Project or external factors. This may result in changes in existing management, design of restoration plans for future phases to avoid or ameliorate the potential problem, or adjustment of the trigger if external factors are determined to be the cause.

Avoid Significant Impacts through Management Response

As mentioned above, triggers have been selected to provide the opportunity to modify the phasing and design of future phases or change pond management before thresholds of significance are exceeded. Figure 2-2 illustrates this process conceptually. In this example, monitoring data provide an indication that the evolving South Bay is tending towards an undesirable condition before a threshold of significance is reached, and triggers a management response. This response may be informed by additional applied studies, and consists of changes to the design of future phases or modifications of existing pond management that reverses the trajectory of the evolving South Bay ecosystem.

Guide the Selection of the Ultimate Habitat Mix and Public Access Features

The SBSP Restoration Project's ability to progress along the adaptive management staircase would depend on the nature and extent of problems detected by ongoing monitoring and whether management responses to these problems are successful and otherwise achieving the biological habitat and public access Project Objectives. The SBSP Restoration Project would only progress toward the 90:10 ratio of tidal habitat to managed ponds and construct additional public access features through the repeated process of experimentation, monitoring, modeling, evaluation, and design refinement. In the event that a management trigger is "tripped" and no management response proves successful, the Project would suspend additional tidal restoration and, thereby, "step off" the staircase. Further tidal restoration would continue only if practicable and effective adaptive management responses to the observed adverse trends are identified. Similarly, the effects of additional public access features would be monitored and managed adaptively. In other words, progression along the staircases of additional tidal habitat restoration and public access features would be halted before negative impacts to the environment become significant. This process of monitoring and evaluating the effectiveness of adaptive decision-making would guide the ultimate mix of pond and tidal habitat and the extent and types of public access features. Depending on the results of monitoring data and the ability of future adaptive management actions to avoid significant environmental impacts, the long-term endpoint for the Project would likely occur between the 50:50 and 90:10 bookends. The paragraphs below further explain how adaptive management would be used to guide the selection of the ultimate habitat mix and extent of public access.

Figure 2-3a provides a specific example of how adaptive management decisions may inform the long-term distribution of habitat within the SBSP Restoration Project Area. Under ISP conditions, avocets,

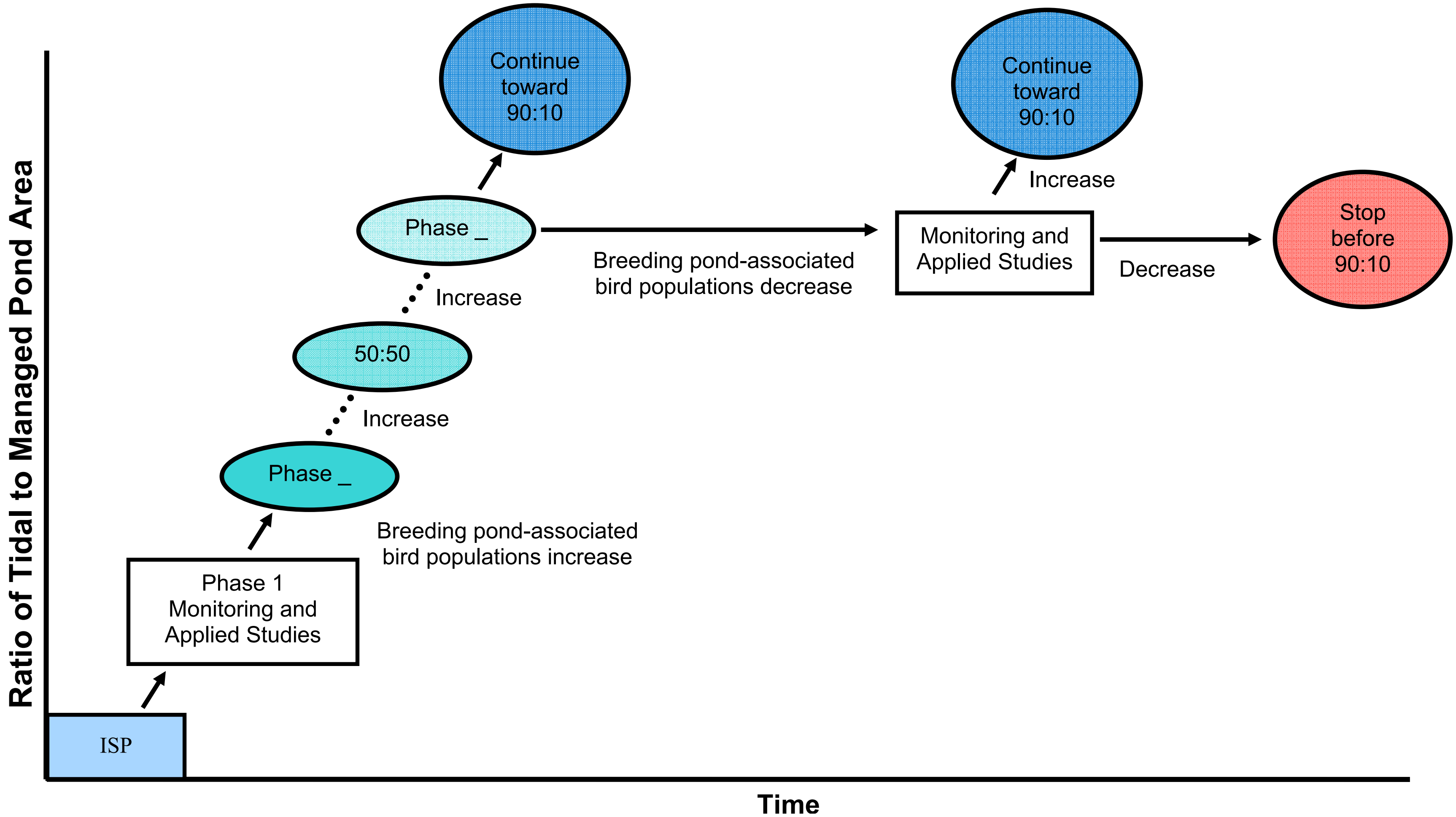

figure **2-3a**

South Bay Salt Pond Restoration Project

An Example of How Adaptive Management Decisions May Affect the Ultimate Endpoint: Breeding Pond-Associated Birds

PWA

January 2006
Color Update December 2007

stilts and terns nest on islands, levees and other bayside habitats and forage in the shallow water of the former salt ponds. Avocets and stilts forage in salt ponds, marsh ponds, and other shallow-water habitats; avocets also forage on intertidal mudflats when they are not inundated. Terns forage on fish, which they catch in the Bay, in lower-salinity ponds within the SBSP Restoration Project Area, and in artificial ponds, lagoons, and reservoirs throughout the South Bay.

Conversion of managed ponds to tidal habitat could result in adverse effects on South Bay populations of these breeding pond-associated waterbirds by inundating dry nesting areas, reducing the extent of ponds in which nesting islands can exist, and decreasing aquatic foraging habitat in the ponds. As described above, the Phase 1 actions would accommodate applied studies designed to evaluate whether high bird densities can be achieved and sustained in ponds specifically reconfigured for nesting and foraging habitat. This type of pond reconfiguration or modified configurations would be repeated in subsequent phases if bird populations increase in response to the constructed nesting islands and shallow water pond management. If populations of breeding pond-associated birds decrease at some point in the future, and these declines are determined to be the result of the SBSP Restoration Project, additional restoration of tidal habitat would be suspended and adaptive management actions would be undertaken to attempt to reverse the trend. Depending on the nature of the problem, management responses may include the construction of additional islands, the creation of islands of a different size and/or configuration, adjustment of water depths, and increased levels of predator and/or vegetation management. The management actions taken would be informed by the results of the Phase 1 and other applied studies. If populations of breeding pond-associated birds increased or held steady in response to the management actions, progression along the staircase of further tidal restoration would continue. As shown conceptually in Figure 2-3a, in the event that all practicable adaptive management actions are exhausted, and it is determined that additional tidal restoration would further decrease breeding pond-associated bird populations, the Project would halt progressing along the staircase.

Figure 2-3b illustrates how decisions regarding construction of additional public access features would be made over time. Public access features associated with Phase 1 and the Bay Trail spine build upon the existing public access in the Project Area and encompass the minimum amount of new public access the Project would provide. Additional features would be added as wildlife impacts, public demand, and funding allow. As this public access staircase shows, if adaptive management studies reveal that the use of public access features (*e.g*., trails, kayak launches, etc.) constructed as part of Phase 1 or future actions do not trip an adaptive management trigger (declines in bird numbers, species diversity, specified behaviors, or changes in other appropriate parameters caused by public use at public access versus control sites), the SBSP Restoration Project would continue to add as many of the public access features proposed in Alternatives B and C as practical and as public demand allows.

The maximum amount of public access currently allowed is that level described in the EIR/S under Alternatives B and C. After the level of access described in the EIS/R is completed, if public access demand remains high and impacts to wildlife are few or manageable, the same decision-making process described in Figure 2-3b could be used to create additional recreational improvements not included in Alternatives B or C. However, public access features beyond those described in this EIS/R would require additional environmental review.

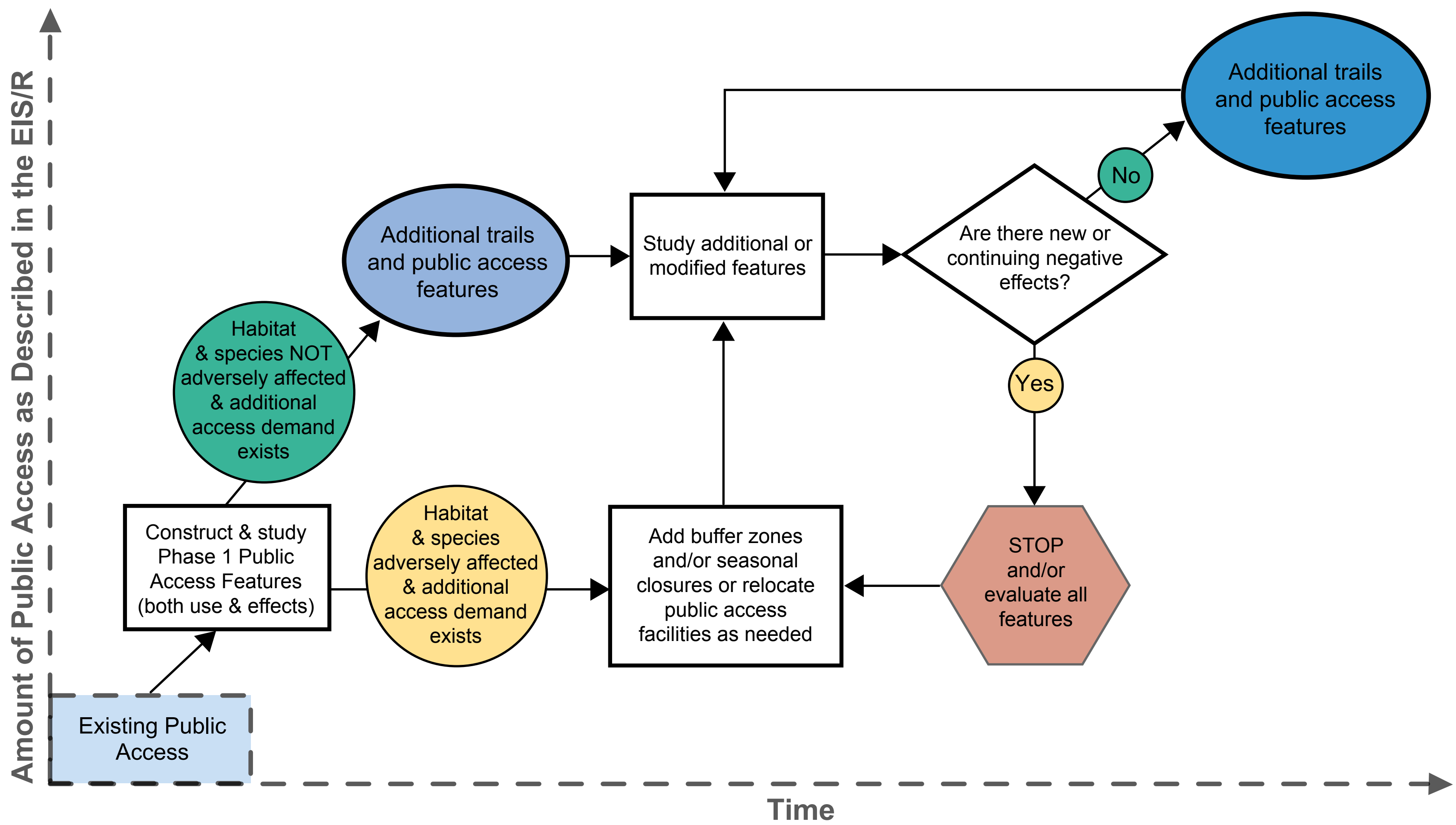

Figure 2-3b

South Bay Salt Pond Restoration Project

The Adaptive Management Staircase of Recreation and Public Access

If adaptive management studies show a trigger has been tripped by Phase 1 or any subsequently constructed public access features, the Project managers would determine the appropriate corrective action after receiving input and recommendations by a panel of experts convened for this purpose. Several likely management responses to mitigate impacts include:

- *Seasonal closures*. Seasonal closures mean that a trail or public access feature would be temporarily closed in order to reduce public access impacts during particularly sensitive times in a species' life cycle (*e.g*. nesting season). Timing and duration would depend on the species impacted, but would be expected to be for a short part of the year, such as a few months.
- *Add buffers to trails or public access features.* In some cases, a visual buffer or set-back of an appropriate distance would be added to reduce public access impacts. An appropriate visual buffer or set-back distance would be determined based on the species affected and scientific literature reviews.
- *Close trails or public access feature*. If public access impacts could not be mitigated through the previous measure, land managers would consider closing trails.
- *Move trails or public access feature*. Trails could be moved if a delineation that provides visitors with an equal or superior experience but fewer wildlife impacts is located. The Project would provide a relocated trail if the closed trail or public access feature were associated with Phase 1 or included a portion of the Bay Trail spine. Project managers would attempt to provide alternative public access if the closed feature was constructed after Phase 1. Alternative public access would be evaluated on a case-by-case basis. Relocating a trail would likely require permits from appropriate agencies.
- *Accept wildlife impact in one area, but provide overall benefits to species*. If a trigger is tripped at a particular site and no corrective measures can be found, managers may decide to accept the wildlife impact at that site, if:
    a. the site is of unique public access importance,
    b. the amount of habitat impacted by the feature is very small relative to the amount of high quality habitat available to the affected species in the Project Area, and
    c. the abundance of the affected species is stable or increasing in the Project Area even with the impact of the public access feature in question.
- *Stop construction of trails or public access features*. If a feature trips a trigger and no corrective action or alternative can be found for the feature, land managers would halt construction or use of the additional recreational facilities. Further study might reveal a corrective measure that would allow the feature to be added in the future.

Implementation of any of these measures above would be discussed at the appropriate regional Work Group meetings. While land managers would have the ultimate decision-making authority, the regional Work Groups would provide an opportunity for public comment and problem-solving.

2.3.5 Making the Adaptive Management Plan Adaptable

Although the basic monitoring elements of the Adaptive Management Plan have been identified, the program itself needs to be adaptable. For example, the frequency of collecting data associated with tracking a particular Project Objective may change as the initial rounds of monitoring provide information on how rapidly the ecosystem is actually responding. Triggers and pre-planned management responses are also expected to change as monitoring data and applied studies improve the understanding of ecosystem response to restoration actions. The Adaptive Management Plan describes the process and timelines the Project would use to reevaluate restoration targets, monitoring methods, applied studies, management triggers and other elements of adaptive management (Trulio and others 2007) (Appendix D).

2.4 Long-Term Alternatives

2.4.1 Overview

Ecosystem Restoration

The SBSP Restoration Project would restore a mosaic of tidal and managed-pond habitats over an approximate 15,100-acre footprint. Tidal habitats would be affected by the twice-a-day inundation of bay water, and marsh establishment would rely primarily on estuarine sedimentation and natural vegetative colonization. Successful restoration of tidal habitats would contribute to the recovery of endangered, threatened, and other special-status, tidal-marsh-dependent species, as well as the recovery of South Bay fisheries. Upland transition zones represent an important habitat type largely absent from the South Bay currently, and restoration of this portion of the tidal landscape is an important component of the ecosystem restoration. Managed ponds would encompass a range of water depths and salinity regimes through the use of flow control structures, grading, and other means. Many of the ecological benefits of the former salt production ponds would be maintained within a reduced salt pond habitat area by providing habitat features and managing water and salinity regimes for target species, especially migratory shorebirds and waterfowl, as well as nesting terns and shorebirds.

The mix of tidal habitat and managed pond habitat restoration is intended to balance the trade-offs between several of the Project's ecological Objectives. Restoration of tidal habitat benefits special-status and native species (Project Objective 1a). Maintenance of managed pond habitats helps maintain migratory bird species that utilize the existing ponds (Project Objective 1b). Both habitat types support increased abundance and diversity of the native species of the South Bay (Project Objective 1c).

The SBSP Restoration Project would restore a continuous band of tidal marsh (a "tidal marsh corridor") along the edge of the Bay to provide connectivity of habitat for tidal marsh dependent species, particularly the California clapper rail and salt marsh harvest mouse. Fill placement and grading would be used to create transitional habitats from marsh to upland habitat along portions of the upland edge, providing high tide refugia for tidal marsh species. In addition, tidal habitat would be restored adjacent to the major sloughs that serve as migration corridors for anadromous fish. Where possible, large tidal marsh systems would be restored to provide broad areas isolated from human and predator access.

The restored managed ponds would be located in accessible areas, to provide for ease of O&M. Their proposed distribution on the landscape would consider the benefits of clustering the ponds for ease of maintenance, and the need to disperse the ponds so they are readily available to birds traveling between the ponds and other habitats throughout the South Bay. The SBSP Restoration Project relies on gravity flow structures as much as possible to minimize the costs of pumping while providing adequate pond habitat to support high densities of birds. Ponds near interpretive opportunities, such as the historic salt works, would be managed as appropriate to preserve the resource of interest.

Flood Management

A key element of the SBSP Restoration Project is to ensure that flood hazards to adjacent communities and infrastructure do not increase as a result of the restoration. Therefore, the proposed restoration alternatives contain provisions to manage flood hazards from both fluvial (stream) and coastal flood sources. One feature consistent across restoration alternatives is an inboard levee system (along the landward side of the ponds) to reduce the hazards of coastal flooding. This proposed line of flood protection may include modifying (raising or retrofitting) existing levees, placing fill to raise high ground areas, and constructing new levees that provide flood protection. Flood modeling and analyses of the proposed flood levees is presented in the Flood Analyses Report (PWA 2006a) (Appendix E).

Existing outboard levees (*i.e.*, bayfront and slough/creek levees adjacent to tidal waters) were built to enclose evaporation ponds on former tidal marshes and mudflats and to protect the salt ponds from Bay inundation. The smaller inboard levees (*i.e.*, pond levees constructed inland along the historic Bay margin) are predominantly former salt pond levees that offer the last line of defense against flooding of low-lying, inland areas. Internal levees separate the individual salt ponds from each other and are typically smaller than the outboard levees. Generally, salt pond levees were not designed, constructed, or maintained following a well-defined standard and would almost certainly require retrofit or replacement to provide an adequate level of flood protection. Levee construction methods, levee materials and subsurface conditions are further detailed in reports by Tudor Engineering Company (Tudor Engineering Company 1973), the Corps (U.S. Army Corps of Engineers 1988), and Moffatt & Nichol Engineers (Moffatt & Nichol Engineers 2004). Furthermore, levee maintenance is documented in Cargill Inc.'s (Cargill) annual "maintenance work plan" and "completed maintenance" reports, which have been summarized in the SBSP Restoration Project Levee Assessment Report.

The proposed levees that provide flood protection would tie in to levees along the creeks. The levees that provide flood protection would extend into the ponds on Project lands, or to the inboard side of the ponds on non-Project lands if land is available, to provide sufficient levee width. Some of the levees that provide flood protection would require easements or other property rights in areas outside the SBSP Restoration Project Area.

The SBSP Restoration Project is committed to ensuring that future flood protection with the Project is equal to, or better than existing conditions. Beyond this, it is desirable that all entities develop a flood management program around the entire SBSP Restoration Project Area that would provide a consistent level of flood hazard management with flood protection measures (levees, high ground) meeting both FEMA and Corps criteria.

Following implementation, all levees would require some ongoing inspection and maintenance to sustain their intended level of protection. Maintenance of a single engineered inboard levee system is expected to require a lower level of effort and cost than maintaining the existing complex of Cargill levees, since most of the new levees would be stronger, and have an outboard extent of vegetated marshplain to dissipate erosive wave energy.

Flooding is possible from the major stream channels that flow from the surrounding watersheds through the salt ponds to the Bay. During large rainstorms, these channels convey flood flows to the Bay. Because the channels are currently constricted by the existing pond levees, these flood flows can produce high water levels upstream resulting in levee overtopping and local flooding. If flood events occur concurrent with high tides, flood hazards are increased. From a fluvial flood-management perspective, there are two approaches to reducing flood hazards: providing increased channel-flow conveyance or providing increased flood storage (detention). The SBSP Restoration Project uses a conveyance approach where possible, though both approaches may be utilized within the Project alternatives.

Conveyance can be increased by removing, breaching, or setting back the existing pond levees, widening the channel and providing additional cross-sectional area for flow. Conveyance can also be increased using regular tidal scour to enlarge the channel cross-section. Breaching slough levees would route more tidal flow through the sloughs/channels, resulting in channel deepening and widening downstream of the breaches. The expansion of the cross-section would increase channel flood flow conveyance and thereby reduce upstream water levels and flood hazards.

In existing channels confined on one or both sides by levees, the channel scour described above could result in the erosion of existing downstream levees. This would be addressed in the Project design in one of several ways. In many locations where channel scour is expected, the levees on either one or both sides would no longer be needed and can be removed or allowed to scour. Where levees are to be maintained, they would either be relocated to accommodate the expected channel enlargement or levee armoring may be required to ensure that the levee remains intact. It is recognized that these types of changes (channel expansion by scour, possible levee erosion) would occur gradually in response to the restoration plan implementation, and it would be important to provide a consistent level of flood hazard management throughout all phases of the Project.

Flooding impacts may also be reduced by providing temporary storage of flood water within the managed ponds. Conversion of ponds to muted tidal or seasonal wetland with flood-flow diversion would increase storage of fluvial flood waters, resulting in decreased water levels and reduced flood hazards in the tributary channels.

Recreation and Public Access

The integration of public access and recreation features into the SBSP Restoration Project Area addresses the objectives for public access, as presented in three public workshops held in September and October 2004. Additional field tours and a design workshop held in September and October of 2005, as well as comments received from stakeholders, formed the basis for revisions to the alternatives presented herein. The public access and recreation plan is part of an integrated program between the social and cultural aspects of the Project with the ecologic restoration and engineering components such as flood control. The proposed public access and recreation features would include an interrelated system of connector lines and nodes in the form 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 staging and parking areas.

The trail component of public access and recreation would have segments helping to complete the Bay Trail spine, some spur segments that would also be part of the Bay Trail regional system, and some local trail connectors that may be part of an existing local system. Land and water-based trails form the network of interconnection between the SBSP Restoration Project Area and other recreation and public access features including the future San Francisco Bay Area Water Trail system. Where possible, new loop trails are proposed near areas where the restoration may result in the removal of existing loop trails. Trail segments would vary in size, width, surfacing and the types of users they can accommodate and when visitors would have access.

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. Trail location and type are further developed and discussed in Sections 2.4.3 and 2.4.4.

Cultural features would be accessible as part of the larger trail network and where interpretive signage and guided or self-guided walks can be accommodated. 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 Bay for duck hunting are examples of themes that could 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 are proposed at strategic locations along the trail network within the SBSP Restoration Project 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 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. Water-based activities such as non-motorized and small motorized boating would be incorporated into the public access plan as well as access for hunters and anglers.

Public access, flood management, and habitat features would 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. 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. 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, USFWS must take a conservative approach to protecting endangered or threatened species. Thus, tidal habitat species are currently considered sensitive to public access. The costs of maintaining access in areas that are open to tidal action are also an issue for public access in these areas. The final alternatives are subject to change as more is understood about the effects of human interface with the different elements of restoration.

Public access and recreation features would provide a variety of aesthetic experiences (including access to the Bay and access away from urbanized areas), encourage recreation for a variety of visitors (including multi-use trail users, kayakers, hunters, anglers, school and other interested groups), and close gaps in the Bay Trail spine for the South Bay. Access would be designed to be as barrier-free as possible to provide access for visitors of varying abilities and to comply with the Americans with Disabilities Act (ADA). The design would consider city and county standards and would strive to harmonize with existing facilities.

2.4.2 SBSP Long-Term Alternative A: No Action

The No Action Alternative is the most likely outcome in the absence of a long-term restoration plan. The No Action Alternative is based on the professional judgment of the landowners and Project planners with respect to future levels of funding for land-management, the expected lifetime of existing levees and hydraulic structures, and other factors that are inherently difficult to estimate.

The long-term effects of global climate change on sea level rise, habitat distributions and flood hazards were also considered. The analyses of Alternative A used the Intergovernmental Panel on Climate Change (IPCC) mid-range estimate of 0.5 ft (0.15 meter [m]) of future global sea level rise over the next 50 years (IPCC 2001). Estimates of sea level rise contain a large degree of uncertainty, and scientific research continues to refine and update global estimates of sea level rise. In May 2007, the IPCC released revised sea level rise estimates for the twenty-first century (2000 to 2100) (IPCC 2007). The revised estimates were compared with the previous IPCC (2001) estimates used in the EIS/R. The 2007 IPCC estimates are not substantially different from the 2001 estimates, although the band of uncertainty has been narrowed in the 2007 estimates (IPCC 2007). IPCC (2007) does not specify a 50-year mid-range estimate for direct comparison with the 2001 value. However, the midpoint of each of the 2007 climate change scenarios is within 10 percent of the corresponding 2001 estimate (IPCC 2007). Ongoing monitoring efforts in and around San Francisco Bay by others would also inform local estimates of sea level rise. Changes in estimates of sea level rise would be addressed in subsequent phases of the Project.

Figures 2-4a through 2-4c show the No Action Alternative at Year 50. The following sections detail the specific No Action scenarios for each pond complex.

Eden Landing

The mission of the California Department of Fish and Game (CDFG) is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. This includes habitat protection and maintenance in a sufficient amount and quality to ensure the survival of all species and natural communities. CDFG is also responsible for the diversified use of fish and wildlife habitat and resources, including recreational, commercial, scientific and educational uses.

Under the No Action Alternative, CDFG would continue to operate and maintain the Eden Landing pond complex in a manner similar to the ISP (Life Science! 2003), although ongoing O&M activities would be scaled back (see Section 1.4.4). The ISP was intended as an interim plan for managing the ponds during development of the long-term SBSP Restoration Project. In the absence of a long-term restoration plan, the ISP would be replaced by a smaller set of prioritized O&M actions, balancing habitat protection and flood management with available funding. The No Action Alternative assumes that CDFG would not have funding to maintain full ISP operations or implement extensive habitat restoration activities over the 50-year planning horizon.

Initially, under the No Action Alternative, pumping would be discontinued due to lack of funding for electricity, with the exception of the pump at Pond E1. Continued operation of the Pond E1 pump would be required to operate the Pond E1 system as managed ponds and meet salinity discharge requirement in the summer and in dry years. The remaining pumps would be maintained as funding allows but would not be operated and the ponds utilizing these pumps for water circulation under the ISP would be dewatered or allowed to evaporate, becoming seasonal ponds that fill and dry through rainfall and evaporation. In the absence of pumping, the ponds within the 'C' sub-system (Ponds E1C, E4C and E5C) would be the first ponds to become seasonal wetlands because no summer inflow exists in the absence of pumping. Pond E2C could operate as muted tidal using the existing ISP control structure. CDFG would manage water circulation in some or all of the remaining ponds using gravity-flow control structures, with the extent of management depending on available funding.

Over time, operations would become more limited. Water management would be discontinued on a pond-by-pond basis as hydraulic structures break, creating more seasonal ponds. With continued levee settlement and sea level rise, the levees would be increasingly prone to failure. Stopgap measures such as sand bags and rock would be used to slow deterioration of key levees that provide protection from flood, as funding allows. Other levees would be allowed to erode and tidal action would be restored to some ponds through uncontrolled breaching.

Levees with the highest risk of failure or overtopping are: levees around Ponds E8A, E9, E12, E13 and E14; the bayward levees along Ponds E1 and E2; and levees along the south side of Ponds E2, E4, and E5. In the short- to medium-term, Ponds E1, E2, E4 and E7 could operate as managed ponds, and Ponds E5, E6, and E6C could operate as high salinity ponds in the winter and seasonal ponds in the summer. However, all internal structures would likely fail within 5 to 20 years and the ponds would become seasonal. Successive dry years would cause all the ponds with the exception of Ponds E1 and E2 to become seasonal earlier due to the limited ability to circulate adequate amounts of bay water through the system to meet salinity discharge requirements.

Figure 2-4a depicts the No Action Alternative for Eden Landing at Year 50. Ponds E10, E11, E8, E6A and E6B would remain as managed ponds for the 50-year planning horizon, and the outboard pond levees would be maintained and/or repaired as funding allows. These levees are shown in Figure 2-4a as the levees most likely to be maintained. The pond levees for Ponds E8A, E9, E12, E13 and E14 would not be

Figure 2-4a. Alternative A: No Action, Eden Landing, Year 50
South Bay Salt Pond Restoration Project
Project Area
Infrastructure Features
Highway
Railroad
Distribution Line
Overhead Power Transmission Line
Habitat Features
Managed Pond (pond levees most likely to be maintained)
Managed Pond (outside project area)
Seasonal Pond (pond levees least likely to be maintained)
Tidal Through Uncontrolled Breaching (pond levees least likely to be maintained)
Tidal
Flood Management Features
Existing Levee Most Likely To Be Maintained*
Existing High Ground**
Existing Levee Outside Project Area** (includes engineered flood protection levees and non-engineered levees)
*Other pond levees may also be maintained depending on availability of resources.
** Level of flood protection not specified
Note: Levees along creeks extend upstream of the endpoints shown. All levee and high ground locations are approximate.
Recreational Features
Existing Trail
N
100 Acres
1,300 650 0 1,300 Feet
600 300 0 600 Meters
Map datum and projection: NAD83, UTM Zone 10N
Map data: Siegel & Bachand, 2002 (sewer force mains, H.H. Aqueduct, power transmission lines, distribution lines), Cargill (pond boundaries), SFEI (baylands), EDAW (highways), NASA (South Bay Imagery)
Map by: EDAW Inc. Map Date: October, 2007
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Hayward Regional Shoreline
Hayward Shoreline Interpretive Center
92
880
E10
E11
E12
E13
E14
E9
E8X
E6B
E6A
E8A
E8
Old Alameda Creek
E1
E6
E7
E5
E6C
E2
E4
E4C
E1C
E5C
E3C
E2C
Alameda Creek Flood Control Channel
Newark Ponds
Coyote Hills Regional Park

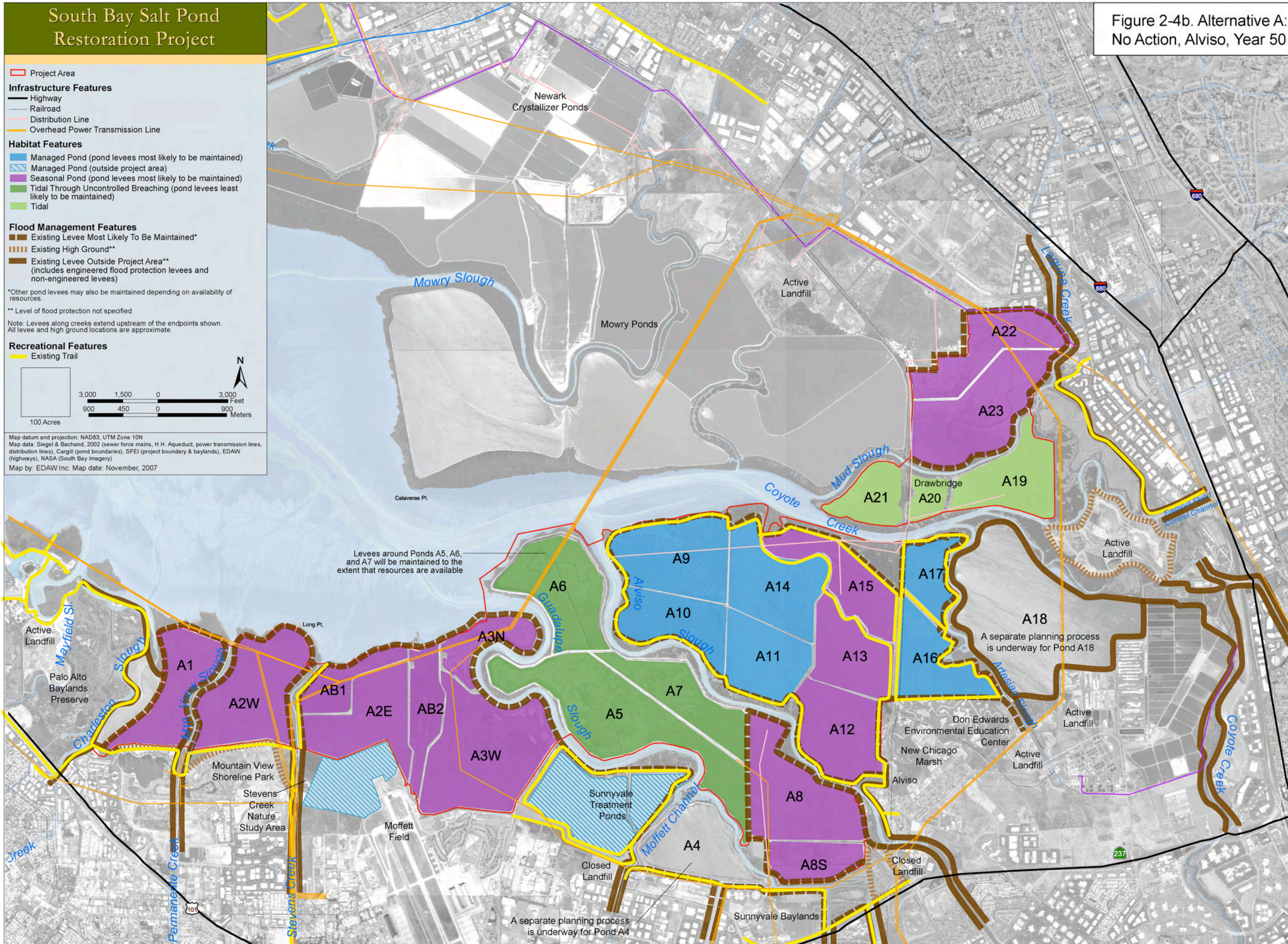

Figure 2-4b. Alternative A: No Action, Alviso, Year 50

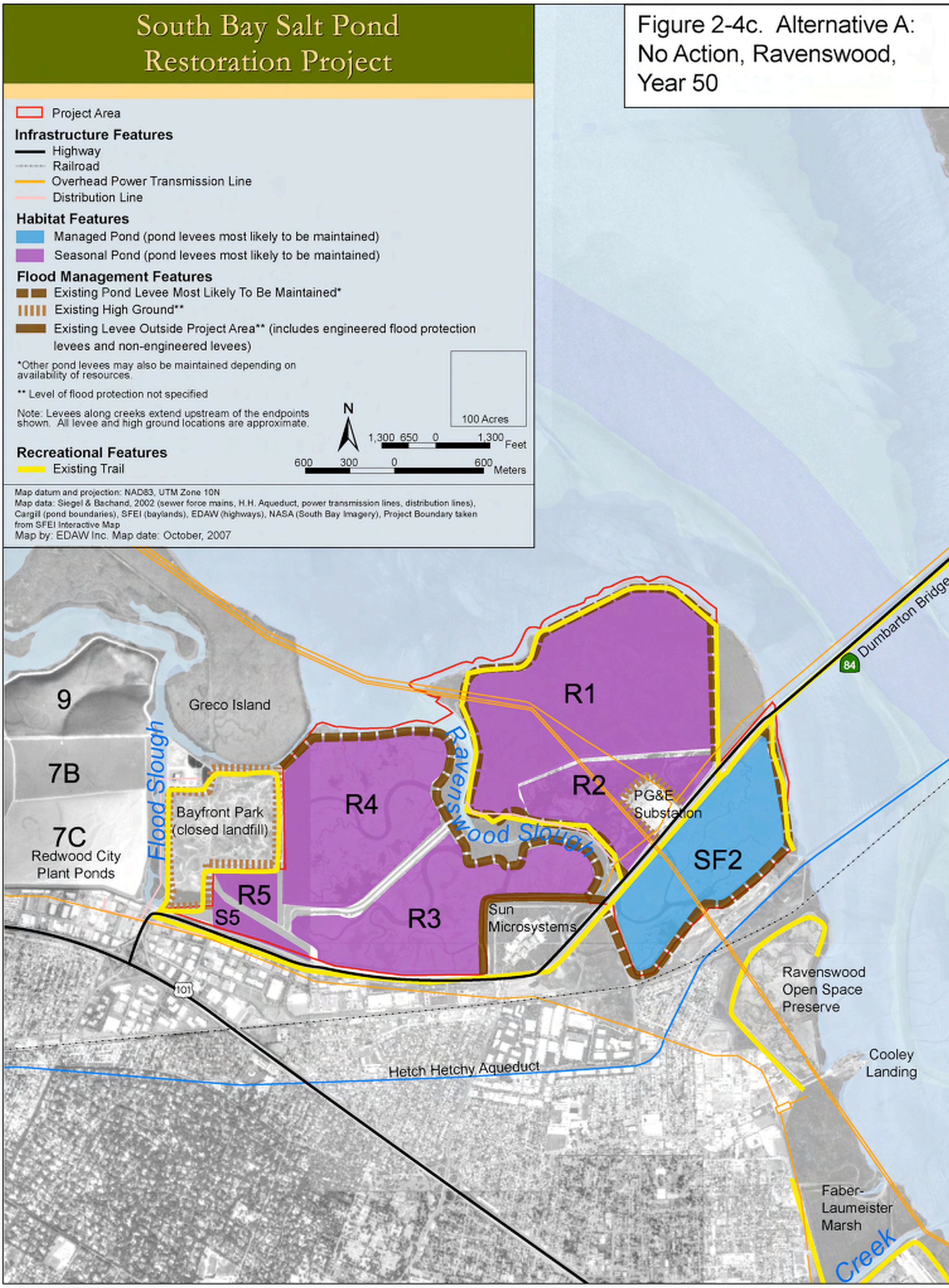

Figure 2-4c. Alternative A: No Action, Ravenswood, Year 50

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maintained. These ponds would initially operate as seasonal wetlands, and would eventually become tidal as the levees erode and breach. The levees outboard of Ponds E1 and E2 would fail and all ponds between Old Alameda Creek (OAC) and the Alameda Creek Flood Control Channel (ACFCC) would eventually become tidal with the exception of Ponds E1C, E2C, E4C and E5C. These ponds would be maintained as seasonal wetlands in order to provide some level of flood protection.

CDFG would focus their limited levee maintenance and improvement funds on the levees along the east side of Ponds E4, E5, E6 and E6C, as shown on Figure 2-4a, to reduce the potential for periodic overtopping into areas that currently provide flood detention for low-lying areas of Alameda County. CDFG would also coordinate levee maintenance and land management activities with the proposed ACFCC project. No new public access or recreational facilities would be constructed under this alternative. Existing public access and recreational value would decrease due to the deteriorating condition of the levees.

Alviso

In the absence of a specific long-term restoration plan, USFWS would increase the Project Area according to its statutory mandates and its existing policy and management directives. USFWS provides federal leadership to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of people. The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans" (16 USC 668dd-668ee). The Refuge includes both the Alviso and Ravenswood pond complexes and was established "…for the preservation and enhancement of highly significant habitat…for the protection of migratory waterfowl and other wildlife, including species known to be threatened with extinction, and to provide opportunity for wildlife-oriented recreation and nature study..." (86 Stat 399, dated June 30, 1972).

The National Wildlife Refuge System Improvement Act of 1997 (Refuge Improvement Act) requires future national wildlife refuge to complete a Comprehensive Conservation Plan (CCP) by 2012. The Refuge is just beginning the process to develop a CCP, which will provide a framework for guiding refuge management decisions. Without a specific long-term restoration plan, the CCP would provide general management direction for the Project Area, supplemented by future site-specific decisions. The current No Action assumptions are based on the professional judgment of the landowners and Project planners, and these assumptions may change depending on the outcomes of the CCP process. The CCP process includes substantial public involvement and complies with standards outlined in NEPA. NEPA requires CCPs to examine a full range of alternative approaches to refuge management and also to involve the public in selecting the alternative best suited to the refuge's purposes. In addition, the Refuge Improvement Act states that refuges must "develop and implement a [planning] process to ensure an opportunity for active public involvement in the preparation and revision of comprehensive conservation plans."

Under the No Action Alternative, USFWS would continue to operate and maintain the Alviso pond complex in a manner similar to the ISP (Life Science! 2003) or similar to current management for Pond

A6, although ongoing O&M activities (see Section 1.4.4) would be scaled back to match available funding and habitat conservation and flood management priorities. The ISP was intended as an interim plan for managing the ponds during development of the long-term SBSP Restoration Project. In the absence of a long-term restoration plan, the ISP and other current management would be replaced by a smaller set of prioritized O&M actions. The No Action Alternative assumes that USFWS would not have funding to maintain full ISP operations or implement extensive habitat restoration activities over the 50-year planning horizon.

In general, the Alviso pond complex infrastructure is in better condition than that of the Eden Landing or Ravenswood pond complexes; however, many of the ponds have subsided due to historic groundwater extraction. Most of the internal hydraulic structures have been recently upgraded or replaced, with the exception of the siphons which are old, hidden, and unreliable. Under the ISP, the Island Ponds (Ponds A19, A20 and A21) were breached in March 2006, restoring tidal action to these ponds. With continuing pond sedimentation, marsh is expected to establish within these ponds in the next 10–15 years, or sooner.

The Pond A9 levee system (Ponds A9, A10, A11, A12, A13, A14 and A15) has been recently maintained in accordance with typical salt pond maintenance (*i.e.*, placement of excavated bay sediment on the levees). While these levees are not designed as flood protection structures, the maintained salt pond levees have provided limited historical flood protection benefits. The levee system from Ponds A1 through A8 has not been maintained within the past six years except spot land-based repairs and is in poorer condition. The outboard (Bayward) levees along Ponds A1 through A6 are subject to high erosive forces and are therefore more prone to erosion and failure.

Over the 50-year planning horizon, continued ISP operations would become more limited. Water management would be discontinued on a pond-by-pond basis as hydraulic structures break, creating more seasonal ponds. With continued levee settlement and sea level rise, the levees would be increasingly prone to failure. Figure 2-4b shows both the levees that would be repaired and/or maintained as funding allows, and the levees that would be allowed to erode thus restoring ponds to tidal action. In the Alviso pond complex, the majority of the levees would be maintained to some degree, with the exception of the levees along Ponds A5, A6 and A7. These levees would be allowed to erode, creating tidal habitat in Ponds A5, A6 and A7 through uncontrolled breaching. The levee along the west side of Pond A8 would be raised to prevent frequent tidal overtopping into Ponds A8 and A8S. The existing electrical distribution line along the Pond A8 levee would be removed or abandoned as necessary when the levee is raised. Ponds A8 and A8S would operate as a seasonal wetland with direct rainfall and evaporation only. Existing flood detention storage would be maintained in Pond A8, but not in Ponds A5, A6 and A7. This loss of flood detention storage has the potential to raise water surface elevations at the mouth of Guadalupe River/Alviso Slough and possibly reduce flood protection.

The scenario depicted in Figure 2-4 and described above is considered the most likely outcome in the absence of the SBSP Restoration Project. However, a range of No Action outcomes is possible. In the Pond A8 vicinity, for example, it is possible that additional funding could be available to the Refuge, allowing the Refuge to maintain the Pond A5, A7, and A8 perimeter levees, and forego improvements to the Pond A8 west levee. Alternately, the Santa Clara Valley Water District (SCVWD) could maintain the levee along Guadalupe Slough/Pond A5 (where they have an existing easement for levee maintenance) and the Refuge could then focus its limited funds on maintaining the Alviso Slough/Pond A7/Pond A8 levee and the Pond A6 south levee. The Refuge would take steps to maintain current levels of flood protection as funding allows; however, potential actions and funding are not known at this time.

The levees around the ponds west of Guadalupe Slough (Ponds A1 through A3W) are high priority levees to be maintained. The levees for the ponds between Stevens Creek and Guadalupe Slough currently provide some level of flood protection for Moffett Federal Airfield. It is assumed that these outboard levees would be maintained (or repaired upon failure) and the associated ponds would not be actively managed. As the hydraulic structures fail, Ponds A1 through A3W would become seasonal wetlands. Ponds A9, A10, A11, A14, A16 and A17 would remain as managed ponds, and Ponds A12, A13 and A15 would become seasonal wetlands if funding is not available to operate the pump. Ponds A22 and A23 would become seasonal wetlands.

As with the Eden Landing pond complex, no new public access or recreational facilities would be constructed under this alternative. Although much of the levee system in the Alviso pond complex would be maintained or repaired upon failure, the integrity of the existing recreational trail systems would not be maintained, therefore the existing public access and recreational value would decrease.

Ravenswood

As with the Alviso pond complex (described above), USFWS would manage the Ravenswood pond complex according to its statutory mandates and its existing policy and management directives in the absence of a long-term restoration plan. The CCP that will be developed in the future would provide general management direction for the Ravenswood pond complex, supplemented by site-specific decisions for these ponds.

Cargill is currently maintaining the Ravenswood pond complex until salinities are reduced, and then the ponds will be turned over to USFWS for ongoing management. Figure 3 of Appendix B, depicts the planned ISP operations for the Ravenswood pond complex. It is unlikely that any of the ISP structures will be installed due to lack of funding, with the exception of the Bay connection in Pond SF2. Therefore, under the No Action Alternative (Figure 2-4c), Pond SF2 would continue to operate as a managed pond for the 50-year planning horizon. The remaining ponds (Ponds R1, R2, R3, R4, R5 and S5) would function as seasonal wetlands. The outboard levees along Pond R1 and R4 are in poor condition and subject to strong erosion forces from Bay winds and waves; however, these levees would be maintained or repaired upon failure to maintain a similar level of flood protection that exists now for the Pacific Gas & Electric (PG&E) substation. The outboard levees of these two ponds are the most erosional of the Ravenswood and Alviso systems and take the most effort to maintain. The outboard levees along Ponds R3, R4 and SF2 would also be maintained or repaired upon failure.

No new public access or recreational facilities would be constructed under this alternative. Although much of the levee system in the Ravenswood pond complex would be maintained or repaired upon failure, the integrity of the existing recreational trail systems would not be maintained, therefore the existing public access and recreational value would decrease.

2.4.3 SBSP Long-Term Alternative B: Managed Pond Emphasis

Alternative B (shown in Figures 2-5a through 2-5c) emphasizes managed pond habitat and provides an approximately 50:50 mix by area of tidal habitat and managed pond.

This alternative, the lower tidal habitat bookend, was formulated by estimating the minimum amount of tidal restoration needed to provide significant, large-scale tidal habitat and flood-management benefits. Tidal habitat restoration includes creating continuous bands of broad tidal marsh, large marsh complexes (*e.g.*, 1,000 acres or more) with large channel networks, broad upland transition zones, and tidal restoration along major creeks and sloughs for flood protection and to benefit anadromous fish. The end result of this configuration was an alternative with approximately 50 percent of the area dedicated to tidal restoration. Maintaining pre-ISP bird populations on roughly half the managed pond footprint would require doubling the density of bird use on the remaining managed ponds. This is considered achievable, since the ponds would be managed for the benefit of birds, rather than for salt production. Alternatively, some proportion of the birds using the existing ponds may use other locations within the South Bay (*e.g.*, remaining salt production ponds) or elsewhere.

As discussed under Alterative A in Section 2.4.2, the long-term effects of global climate change on sea level rise, habitat distributions and flood hazards were considered. Ongoing monitoring efforts in and around San Francisco Bay by others and by the Project would be used to inform local estimates of sea level rise and any significant changes in sea level rise estimates would be addressed in subsequent phases of the Project and through adaptive management.

Ecosystem Restoration

Alternative B would provide approximately 7,500 acres of tidal habitat and maintain continuous tidal marsh corridors from Greco Island (north of the Ravenswood ponds) to Mud Slough (north of Alviso Ponds A19 through A21) and along most of the Eden Landing shoreline. The tidal corridor between Alviso Slough and Coyote Creek would consist of a several hundred-ft-wide strip of fringe marsh outboard (along the bayward edge) of Ponds A9, A14 and A15. It is possible that this existing fringe marsh may widen or narrow (scour) following restoration. This alternative would restore large patches of tidal marsh with high-order drainage channels, most notably all of southern Eden Landing (south of OAC) and Alviso Ponds A5, A6, A7 and A8/A8S. Tidal habitat would be restored along at least one side of the major sloughs (*e.g.*, OAC, ACFCC, Alviso Slough, and others) via breaches in the levees along the sloughs. These connections would provide improved nursery habitat for various fish species. Because most tidal areas would require sheltered conditions to evolve from mudflat to vegetated marsh, the outboard levee would generally need to be maintained or repaired upon levee failure until tidal marsh develops. Upland transition areas would be created along the landward edge of the tidally-restored marshes. The design of these broad, gently sloping areas adjacent to flood protection levees or adjoining upland habitat would incorporate variations in width, slope and topography and the creation of backshore ponds and pannes. The gently sloping marsh/upland transition zone surface would consider the long-term effects of sea level rise and provide an elevation gradient over which tidal marsh could shift upslope as sea level rises.

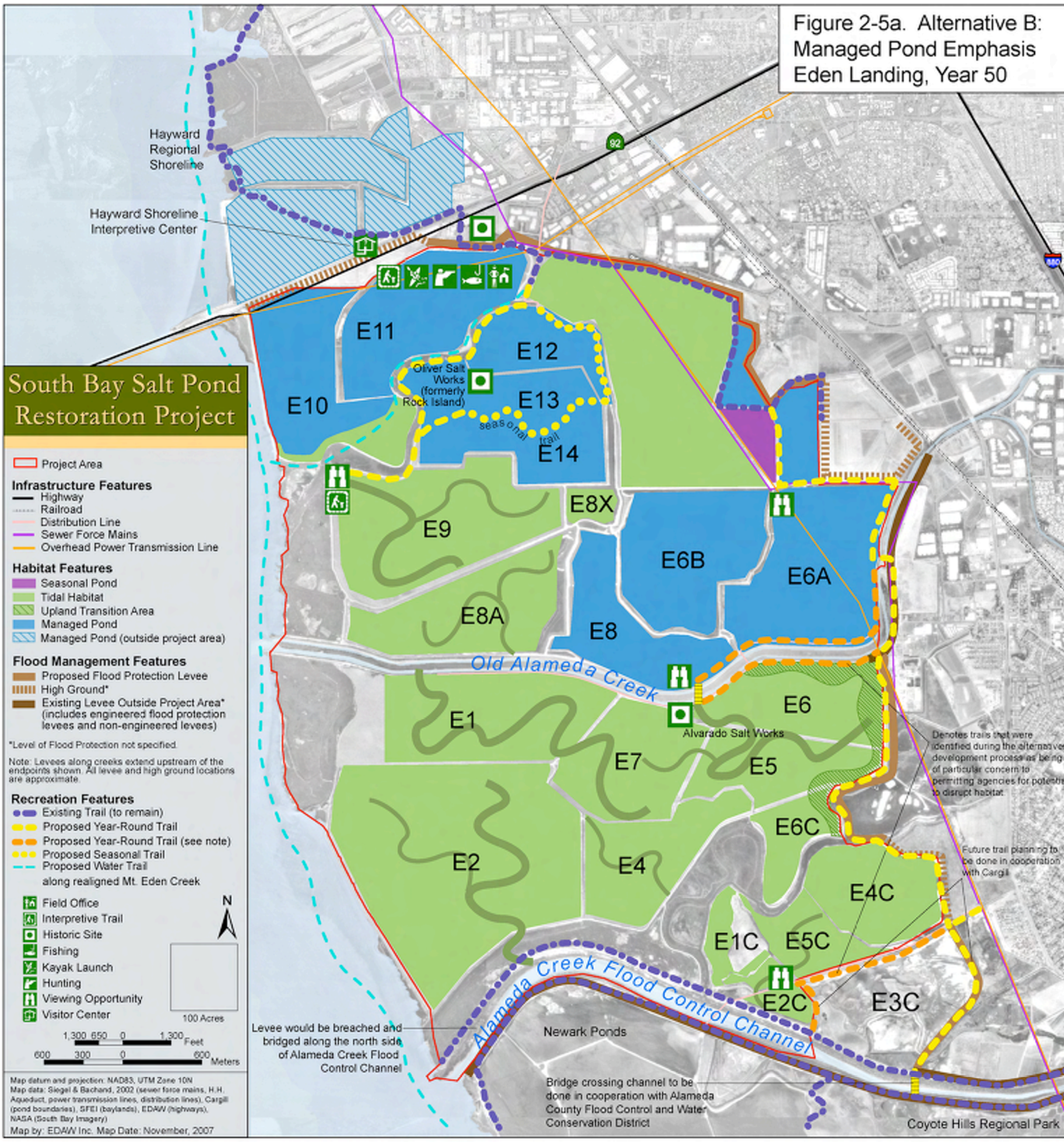

Figure 2-5a. Alternative B: Managed Pond Emphasis Eden Landing, Year 50

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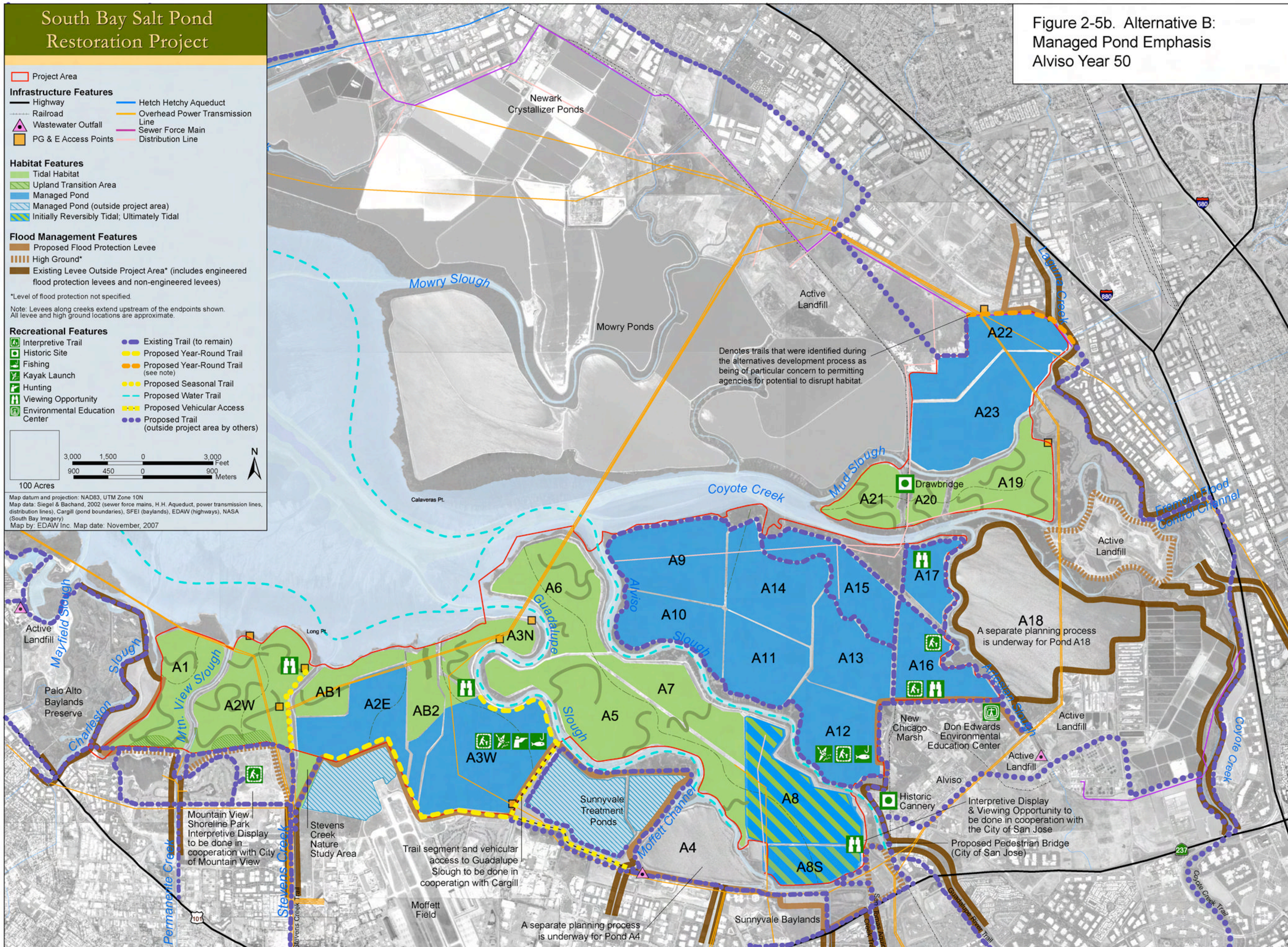

Figure 2-5b. Alternative B: Managed Pond Emphasis Alviso Year 50

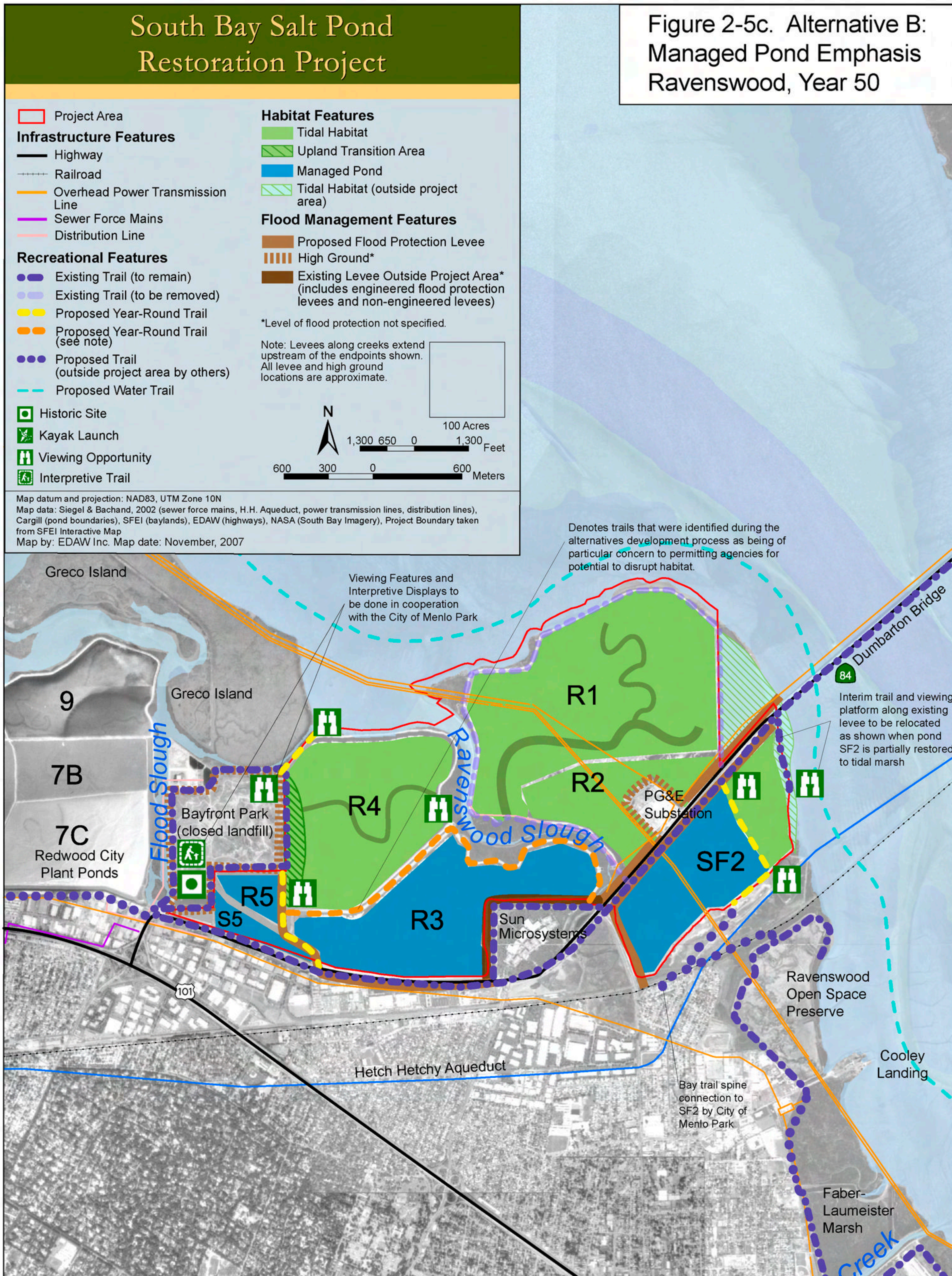

Figure 2-5c. Alternative B: Managed Pond Emphasis Ravenswood, Year 50

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Of the 7,500 acres of managed ponds that would be provided under Alternative B, approximately 1,500 acres (10 percent of the SBSP Restoration Project Area) would be reconfigured (graded extensively) to improve foraging, roosting, and nesting opportunities for shorebirds, waterfowl, and other waterbirds. The remainder of the ponds (enhanced ponds) would undergo little or no grading (though some island creation and replenishment is expected to occur in some ponds) but would have salinities, water depths, and/or seasonality that are actively managed for target bird species. The ponds would be grouped for ease of management, with many of the pond groupings corresponding to those in the ISP. Management activities such as vegetation control, predator control, pumping, monitoring of the effects of certain activities on target bird numbers, and adaptive management of pond conditions are expected to occur at both reconfigured and enhanced ponds at a substantially greater level under Alternative B than under either pre-ISP or ISP conditions.

Under Alternative B, the anticipated mix of habitats would include tidal habitat, upland transition areas, and managed ponds. In general, tidal restoration would be clustered within areas isolated from human and predator access. Managed ponds would also be clustered for ease of access and management. The actual mix of habitats under Alternative B would be informed by adaptive management with respect to salinities, depths, and water, vegetation and predator management within certain pond types. The mix of habitats may be adapted to target species or groups if monitoring indicates disproportionate declines in abundance (see Section 2.3).

Each phase of restoration would analyze potential impacts to PG&E infrastructure and to PG&E's access to perform O&M activities. On a pond-by-pond basis, the Project proponents would be responsible for ensuring that any changes to PG&E infrastructure (such as raising, replacing or relocating boardwalks, reinforcing or replacing tower footings, or raising towers or transmission lines) would be implemented as part of the implementation of each phase of restoration. The Project proponents would evaluate the costs and benefits of restoring ponds where restoration would significantly affect utility infrastructure on a project-by-project basis. In addition, where a Project phase would eliminate or substantially alter a current access route across either USFWS or CDFG land to PG&E's facilities, the Project would provide alternative, equivalent access. Finally, where the numbers of individual or species or habitat increase as a result of the Project, USFWS and CDFG would work collaboratively with PG&E to develop appropriate measures that would avoid or minimize impacts to threatened or endangered species. These measures would be documented (*i.e.* a special use permit) and would be part of the Section 7 consultation under the ESA. To avoid or minimize impacts to PG&E facilities and access, the Project would involve PG&E at the earliest practicable date in planning and design of restoration actions at the project level.

Flood Management

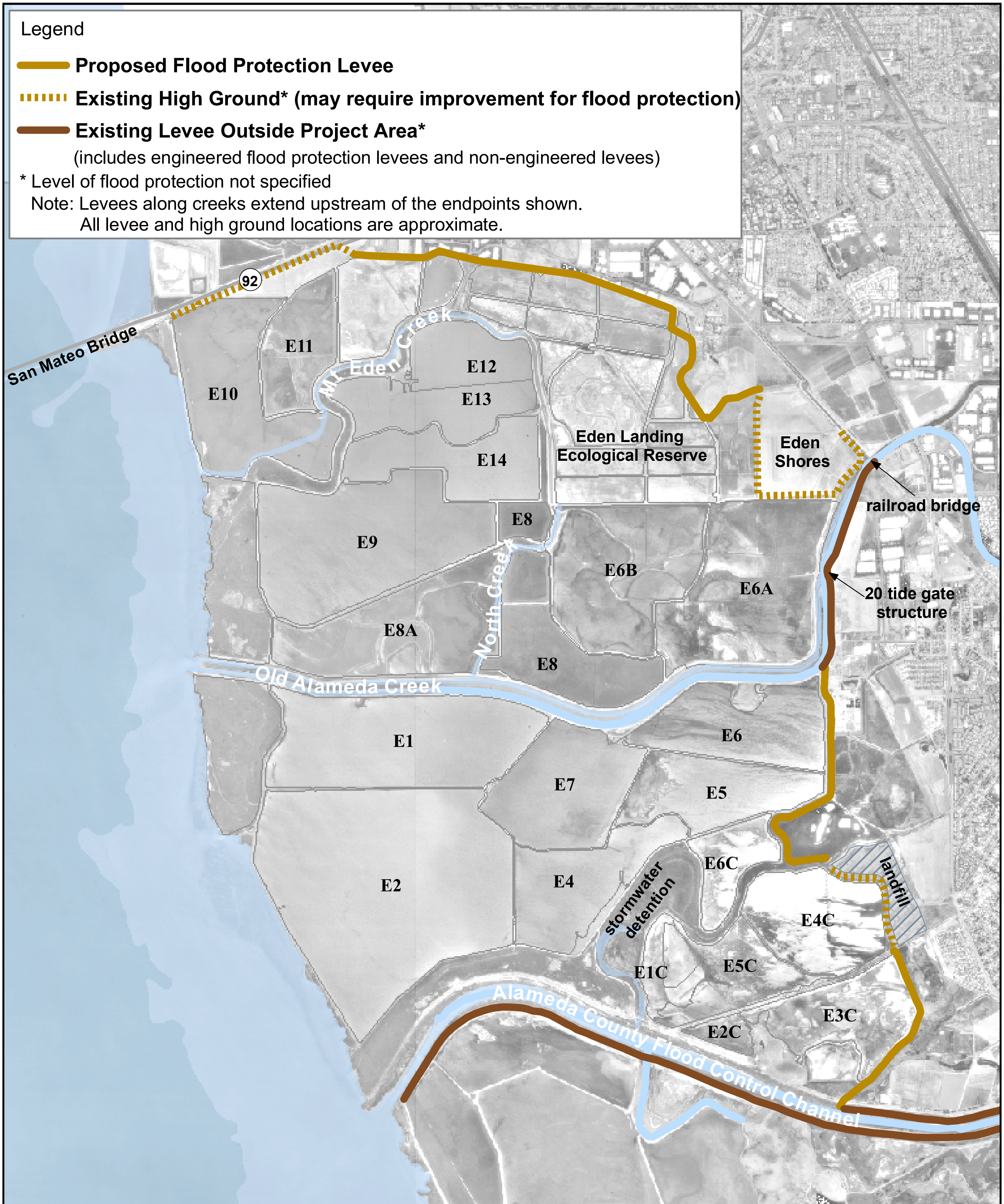
Alternative B would include levees and other features designed to maintain or improve existing levels of flood protection for adjacent communities and infrastructure. Presently, the former salt ponds provide protection from coastal flooding (U.S. Army Corps of Engineers 1988), although the pond levees were not designed or ever intended for flood management. Restoring the ponds to tidal inundation would require new flood protection for adjacent developed areas. Alternative B would provide a coastal levee system that would provide flood protection along the landward perimeter of the SBSP Restoration Project Area. This coastal levee system would tie into levee systems along the creeks. The Project would improve fluvial flood protection upstream along the major creeks by removing constricting pond levees and increasing channel conveyance within the Project Area.

The design criteria for Alternative B would be to provide a level of flood protection that is equal to, or better than, existing conditions. Beyond this, it is desirable to achieve flood protection that meets both FEMA and Corps criteria around the entire SBSP Restoration Project Area. The Project expects to be able to achieve this objective. However, the actual level of protection over and above existing would depend on available funding.

The alignment of the proposed perimeter flood protection levee for Alternative B is shown in Figures 2-6a through 2-6c and described for each pond complex below. The levee configuration shown represents the current preferred alignment, based on input from landowners, stakeholders, and local flood protection agencies. However, the alignment is subject to refinement during subsequent detailed-design studies. In many locations, the levees that provide flood protection would follow the alignment of the existing inboard pond levees. Existing pond levees which form portions of the perimeter levee would tie into existing flood protection levees or high ground to provide a continuous system of engineered flood management.

It should be noted that in Figures 2-6a through 2-6c, areas shown as "Existing High Ground" may require flood protection improvements, depending on the exact ground elevations and design flood level. These areas may be high enough to provide desired flood protection with no improvements, may require placement of fill and possibly slope protection, or may require construction of a low levee to provide flood protection. Levees shown as "Existing Flood Protection Levee" on Figure 2-6a through 2-6c may also require improvements to comply with FEMA standards, if applicable.

Along the proposed alignment, levees would be maintained or improved by modifying (raising or retrofitting) existing levees, placing fill to raise high ground areas, or constructing new levees that provide flood protection. The proposed levee would generally have a higher crest and greater base width than the existing levees along the proposed alignment. The Flood Analyses Report (PWA 2006a) (see Appendix E of this EIS/R) presents preliminary levee cross-sections, including crest elevations and side slopes. The specifics of the proposed levee cross-section would vary by location and would be designed in future studies prior to each phase of implementation. The levee design would take into account expected extreme water levels (including sea level rise), wind-wave exposure, and wave run-up. The future design of the flood protection levees would take into account available information on sea level rise at the time of project-levee planning and design. Higher than anticipated sea level rise would require subsequent design phases to raise the levee (*i.e.*, widening and raising the levee or building a flood wall) before sea level rises above the design level for flood protection. Other options would include overbuilding the levee initially to anticipate a higher rate of sea level rise, either by building a higher levee, or by building a levee with a wider base to more easily accommodate future increases in levee height. Expected extreme water levels would consider coastal, fluvial, and joint fluvial-coastal flood events, as appropriate. Over time, the tidally-restored ponds would develop into mature salt marsh, providing wave energy dissipation and reducing potential coastal flood hazards.



Map datum and projection: NAD83, UTM Zone 10N
Sources: Cargill (pond boundaries), SFEI (baylands), USGS (streams), EDAW (highways), NASA (South Bay Imagery)
Map by: PWA
Map Date: August 23, 2007

0 1,000 2,000 4,000 6,000 8,000 Feet

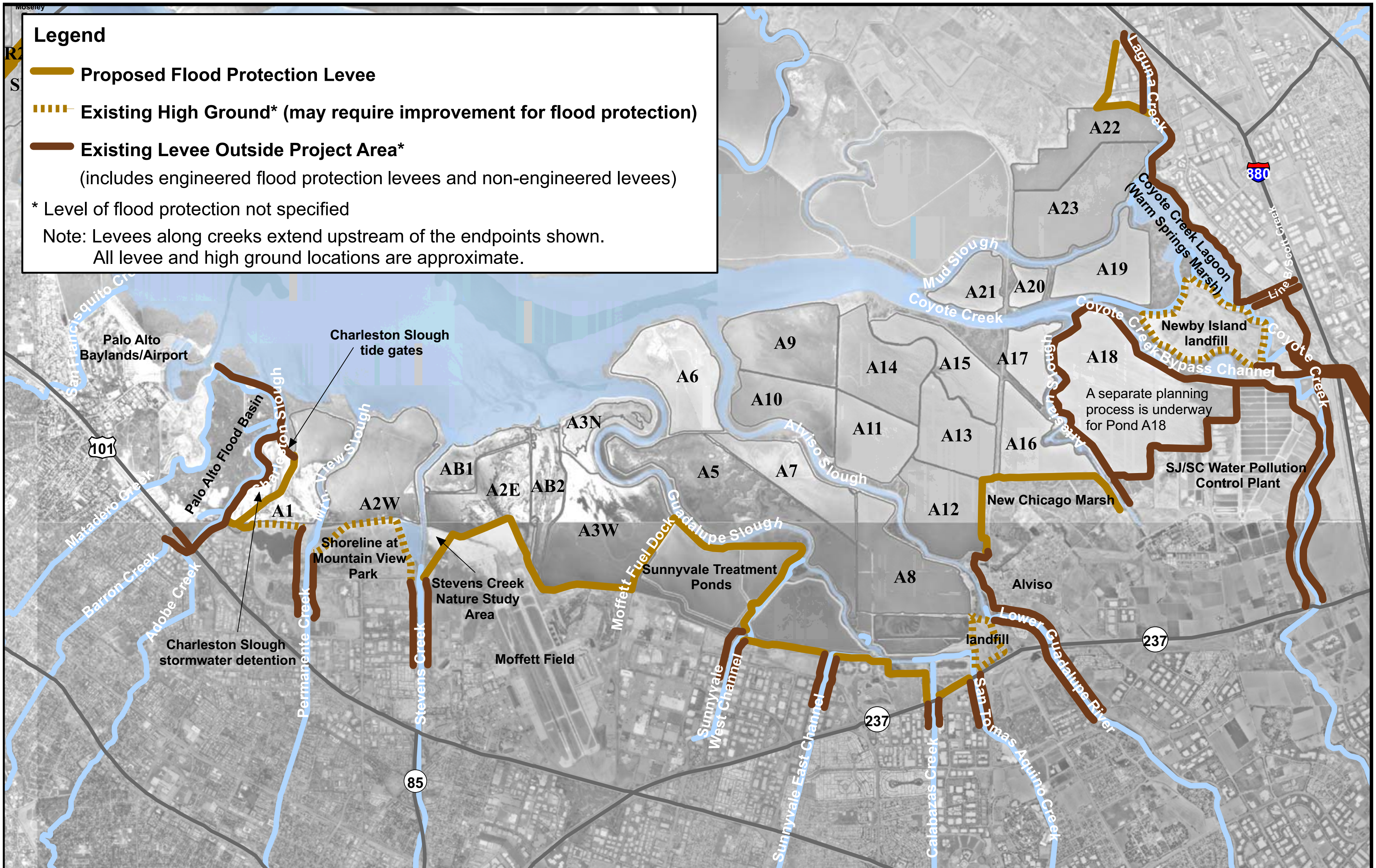
N

figure 2 - 6a

South Bay Salt Pond Restoration Project

Eden Landing Flood Protection Levee Alignment for Alternatives B and C

Proj. # 1750



Map datum and projection: NAD83, UTM Zone 10N
Sources: Cargill (pond boundaries), EDAW (highways), USGS (streams), SFEI (baylands), NASA (South Bay Imagery)
Map by: Philip Williams & Associates
Map Date: August 23, 2007

0 2,000 4,000 8,000 12,000 16,000 20,000 Feet

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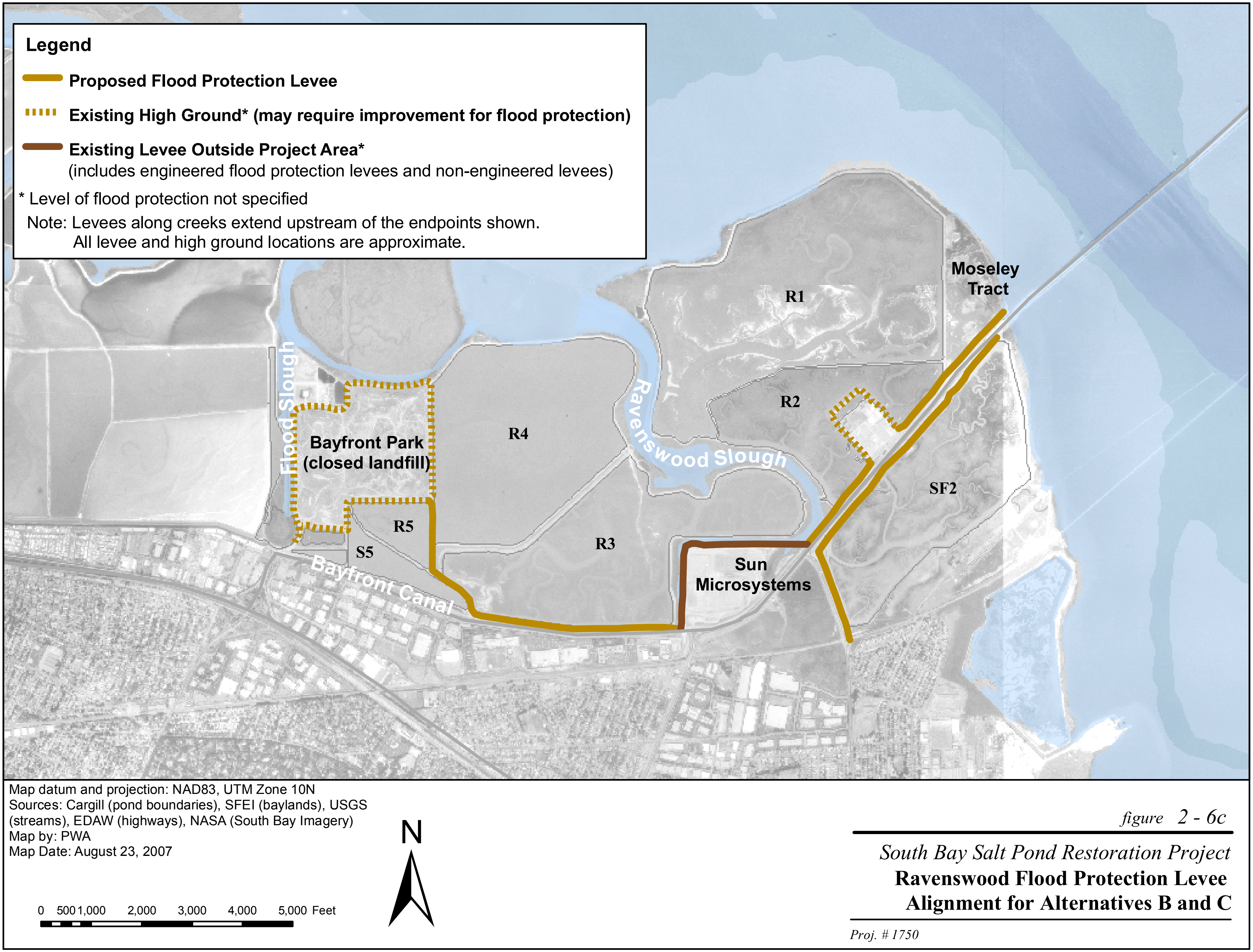
figure 2 - 6b

South Bay Salt Pond Restoration Project

Proposed Flood Protection Levee Alignment for Alternatives B and C, Alviso

Proj. # 1750



Map datum and projection: NAD83, UTM Zone 10N
Sources: Cargill (pond boundaries), SFEI (baylands), USGS (streams), EDAW (highways), NASA (South Bay Imagery)
Map by: PWA
Map Date: August 23, 2007

figure 2 - 6c

South Bay Salt Pond Restoration Project

Ravenswood Flood Protection Levee Alignment for Alternatives B and C

Proj. # 1750

The proposed perimeter levee would cross a number of utility corridors, including pipelines, wastewater treatment plant discharges, power transmission lines, access roadways. Protection of, and continued access to, these facilities would be required. In addition, the levee alignment would intersect the Union Pacific Railroad, requiring design consistent with rail operations. This would be an issue where the proposed Alviso levee that provides flood protection crosses the railroad between Ponds A13 and A16.

Fluvial flood protection under Alternative B would be enhanced by increasing channel conveyance. Fluvial flooding occurs during large rainstorms when the major stream channels carry runoff flows from the surrounding watersheds through the ponds to the Bay. These channels are currently constricted by the existing pond levees; therefore, these flows can produce high water levels upstream, resulting in levee overtopping and local flooding. With Alternative B, ponds adjacent to the major stream channels would be tidally restored. Levees along the channels would no longer be needed and would be removed or lowered as funding allows. Levee removal and lowering provide flood protection benefits by creating additional conveyance following construction. In addition, levees would be breached along the channels, thus routing more tidal flows through the channels and promoting channel scour. As the channels widen and deepen in response to the restoration, the channels' flood flow conveyance potential would increase, thereby reducing upstream water levels and flood hazards. If necessary, temporary flood storage would also be provided in order to reduce fluvial flood hazards. In locations subject to both fluvial and coastal flooding, the levee systems would be designed to accommodate the appropriate risk of both individual (*i.e.*, fluvial or coastal) as well as coincident high tide and high channel flow flood occurrences.

Flood modeling and analyses of the proposed levees that provide flood protection and proposed fluvial flood improvements are presented in the Flood Analyses Report (PWA 2006a) (see Appendix E of this EIS/R). Additional modeling and analyses would be completed prior to each phase of implementation to verify flood performance and ensure that existing or improved levels of flood protection would be provided.

The levees that provide flood protection would require ongoing maintenance (see Section 2.4.5) and would require a detailed maintenance plan for certification to comply with FEMA standards if the levees are improved to provide FEMA 100-year flood protection. Adaptive management (see Section 2.3) would be used to monitor flood performance and take actions as needed to successfully meet the flood protection objectives as the site evolves over the course of the Project.

Eden Landing

The proposed perimeter levee system is shown on Figure 2-6a for the Eden Landing pond complex. The proposed levee would begin at State Route (SR) 92 at the San Mateo Bridge near the northeast corner of Pond E11, providing flood protection to the bridge and allowing roadway drainage as required. The levee would tie into the existing high ground along SR 92. Extending eastward, the levees that provide flood protection would be constructed along the alignment for the new trail/levee being constructed as part of the Eden Landing Ecological Reserve (ELER) Restoration Project. A new reach of levee would then tie into the high ground around the Eden Shores development in Hayward, which extends to the engineered levees that provide flood protection on the northern side of OAC along Pond E6A. The existing levees that provide flood protection along the opposite bank of OAC would be maintained from the railroad bridge crossing to the northeast corner of Pond E6. At this time, it is expected that the levee along the north side of OAC west of the Eden Shores and the levee along the south side of OAC from Pond E6 westward would no longer need to be maintained for fluvial flood protection, although a portion of the northern levee would be maintained for managed pond habitat.

Continuing from the northeast corner of Pond E6, the perimeter levee would be constructed along the inboard levees of Ponds E6, E5, E6C, and E4C, and tie into the existing landfill. It would continue south behind Ponds E4C and E3C and connect with the existing engineered levee that provides flood protection along the northern bank of the ACFCC. The western reach of this ACFCC levee that provides flood protection, from Pond E3C to the Bay, would no longer be maintained for flood protection. The existing stormwater detention area northwest of Pond E1C would no longer be useable for flood management. This storage capacity would be compensated for with new flood protection measures east of the SBSP Restoration Project Area. Flood protection in this reach of the ACFCC would be coordinated with ongoing efforts by the Alameda County Flood Control and Water Conservation District (ACFCWCD).

Table 2-4 provides a summary of the flood management approach by drainage channel for Alternative B in the Eden Landing pond complex. The table (and the tables for Alviso and Ravenswood that follow) identifies locations where existing flood protection and managed pond levees would no longer be needed and would be abandoned. Note that levee abandonment, in this context, would provide opportunities to increase fluvial flood flow conveyance, thereby reducing upstream water levels and flood hazards. Additional conveyance would be created by removing or lowering abandoned levees (as funding allows) and by breaching abandoned levees to promote channel scour. Abandoned levees would not require ongoing maintenance, thus resulting in cost savings.

Table 2-4 Alternative B Eden Landing Fluvial Drainage Elements

DRAINAGE CHANNEL (WATERSHED)	FLOOD MANAGEMENT APPROACH
Mt. Eden Creek (Alameda Creek)	The existing levees along the creek would not be maintained for flood protection but would be maintained for managed pond habitat along Ponds E10, E11, E12, E13 and E14. The perimeter levee would provide flood protection for developed areas upstream of these managed ponds.
OAC (Alameda Creek)	Existing flood protection would be maintained on the eastern side of the channel across from Pond E6A. At this time, it is expected that the levee along the north side of OAC west of the Eden Shores and the levee along the south side of OAC from Pond E6 westward would no longer need to be maintained for fluvial flood protection and would be abandoned (the levee along the north bank would be abandoned adjacent to Pond E8A but maintained for managed pond habitat adjacent to Ponds E8 and E6A).
ACFCC (Alameda Creek)	Existing levees that provide flood protection would be maintained along the south bank of the channel and along the north bank upstream of Pond E3C. Along the north bank downstream of Pond E3C, the levee would be abandoned. Existing stormwater detention would be not be needed.

Alviso

The proposed perimeter levee system is shown on Figure 2-6b for the Alviso pond complex. Linkage of the proposed levees to existing flood protection levees would be coordinated with the SCVWD in Santa Clara County and with the ACFCWCD in Alameda County. A new levee that provides flood protection would be constructed from the Charleston Slough tide gates southward to the high ground at Mountain View Shoreline Park, to maintain flood detention capacity in Charleston Slough. The northern half of this levee does not provide flood protection for the detention basin and would be abandoned. The high ground of Mountain View Shoreline Park provides flood protection along the southern boundary of Pond A1 to Stevens Creek. The proposed perimeter levee would tie into the existing fluvial levees/high ground at Stevens Creek then continue east around Moffett Federal Airfield and behind Pond A3W. The perimeter levee would extend bayward of the City of Sunnyvale WPCP (providing protection to this facility), and behind Ponds A4 and A8/A8S, tying into several fluvial levees (*i.e*., the Sunnyvale West and East Channels, Calabazas Creek and San Tomas Aquino Creek) before linking into the existing high ground of the landfill. The existing levees that provide flood protection along the lower Guadalupe River/Alviso Slough would continue to provide flood protection between the landfill and Pond A12.

A levee that provides flood protection would be constructed around New Chicago Marsh (along the eastern side of Pond A12 and south side of Pond A16, providing flood protection for the community of Alviso. The western end of the proposed levee would link into the existing levees that provide flood protection along lower Guadalupe River/Alviso Slough. The eastern end of the proposed SBSP Restoration Project levee, along Artesian Slough, would be coordinated with the City of San Jose's master planning process for the San Jose/Santa Clara Water Pollution Control Plant (WPCP) lands. The exact location of the eastern end of the SBSP Restoration Project levee would be determined in future project-level planning for a subsequent phase of implementation. Existing levees at Pond A18 consist of salt pond levees and engineered flood protection levees along the outboard side of Pond A18 (along Coyote Creek and Artesian Slough) and salt pond levees along the inboard side of Pond A18 (the stair-shaped levee).

From Pond A18, the perimeter levee would continue behind the Newby Island landfill and the Coyote Creek Lagoon (a.k.a. Warm Springs Marsh) to the fluvial levee along the eastern bank of Laguna Creek, tying into several fluvial levees along the way (Coyote Creek Bypass Channel, Coyote Creek, and Line B/Scott Creek). The fluvial levee along the western bank of Laguna Creek would tie into the existing Pond A22 inland levee alignment, and then head north following the west side of the commercial development north of Pond A22 extending to Interstate (I)-880. These levee alignments are subject to change as parallel efforts planned by the ACFCWCD move forward. The ACFCWCD is considering coordinating with USFWS and the Corps to create an overflow from Laguna Creek into Ponds A22 and A23 to reduce upstream flooding along Laguna Creek.

Table 2-5 provides a summary of the flood management approach by drainage channel for Alternative B in the Alviso pond complex.

Table 2-5 Alternative B Alviso Fluvial Drainage Elements

DRAINAGE CHANNEL (WATERSHED)	FLOOD MANAGEMENT APPROACH
Charleston Slough (Lower Peninsula)	The existing pond levee adjacent to Pond A1 would be improved from the self-regulating tide gates southward to maintain flood detention capacity within the Charleston Slough detention basin. The remaining length of the Slough levee would not be maintained for flood protection and would be abandoned.
Mountain View Slough/Permanente Creek (Lower Peninsula)	Existing flood protection would be maintained upstream of the Project Area. Existing pond levees adjacent to Ponds A1 and A2W would no longer be maintained for flood protection and would be abandoned.
Stevens Creek/Wiseman Slough (Lower Peninsula)	Existing flood protection upstream of the Stevens Creek Nature Study Area would be maintained. The existing levee along the east bank adjacent to Stevens Creek Nature Study Area would be improved and set back to the eastern perimeter of the Nature Study Area. All other existing pond levees would not be maintained for flood protection (pond levees bordering Pond A2E would be maintained for the protection of managed pond habitat; pond levees along the remaining length of the slough would be abandoned).
Guadalupe Slough (West Valley)	Existing levees bordering the City of Sunnyvale WPCP (*i.e.*, between the City of Sunnyvale WPCP and Pond A3W to the west, along Moffett Channel to the west, and along the Sunnyvale East Channel to the east) would be improved for flood protection as part of the perimeter levee. All other existing pond levees along Guadalupe Slough would not be maintained for flood protection. The eastern bank levee along Pond A8S would be maintained for habitat, as needed (Pond A8 and A8S would be restored initially as a reversibly tidal pond in order to address mercury concerns). The pond levees along the western bank adjacent to Ponds A3W and A4 would be maintained for the protection of managed pond habitat. The remaining length of existing pond levees along both sides would be abandoned.
Alviso Slough/Guadalupe River (Guadalupe River)	Existing flood protection would be maintained along the eastern bank upstream of Pond A12 and along the western bank upstream of Pond A8S. Downstream, the existing levees would no longer be maintained for flood protection (the pond levee along eastern bank would be maintained for the protection of managed pond habitat; the pond levee along the western bank would be maintained adjacent to Pond A8, as needed; the pond levee along the western bank would be abandoned downstream of Pond A8). The pond levee along the west side of Pond A8 would be raised to prevent high bay waters from inundating Pond A8 until this pond could be made fully tidal.
Coyote Slough/Coyote Creek (Coyote Creek)	Existing flood protection would be maintained upstream of the Project Area. Pond levees within the Project Area would no longer be maintained for flood protection (those along the south bank would be maintained for protection of managed pond habitat).
Artesian Slough (Coyote Creek)	Existing levees would be maintained upstream of Pond A18 along the east bank. A new levee that provides flood protection would be constructed upstream of Pond A16 which would extend along the southern perimeter of A16 and eastern perimeter of A12. Existing pond levees downstream of Ponds A18 and A16 would not be maintained for flood protection (pond levees would be maintained for the protection of managed pond habitat).
Mud Slough/Laguna Creek (Coyote Creek)	Existing flood protection would be maintained along the length of the east bank and along the west bank upstream of Pond A22. Existing pond levees downstream of Pond A22 along the west bank would not be maintained for flood protection (these levees would be maintained for protection of managed pond habitat in Ponds A22 and A23).

Ravenswood

The proposed perimeter levee system is shown on Figure 2-6c for the Ravenswood pond complex. A new levee that provides flood protection would be constructed along the south side of SR 84 (the approach to the Dumbarton Bridge) to protect the roadway. The levee would turn southward along the backside of SF2. While this would provide improved flood protection compared with the existing Pond SF2 levee, there is no existing or proposed levee that provides flood protection south of Pond SF2 for the new levee to connect with at this time. Construction of this levee would be coordinated with the City of East Palo Alto. Tidal restoration of Pond SF2 would not commence until a southern levee tie-in is identified.

A similar new levee that provides flood protection would be constructed on the north side of SR 84, along the backside of the Moseley Tract and Pond R2 and around the PG&E substation. This levee would connect with the existing engineered levee around the perimeter of the Sun Microsystems complex, and then extend west along the south side of Pond R3. The levee would turn north to isolate Ponds R5 and S5 as managed ponds, and tie into the high ground at Bayfront Park.

Table 2-6 provides a summary of the flood management approach by drainage channel for Alternative B in the Ravenswood pond complex.

Table 2-6 Alternative B Ravenswood Fluvial Drainage Elements

DRAINAGE CHANNEL (WATERSHED)	FLOOD MANAGEMENT APPROACH
Ravenswood Slough (San Francisquito)	Existing pond levees north of SR 84 would no longer be maintained for flood protection (levees along Pond R3 would be maintained for protection of managed pond habitat; all other existing pond levees would be abandoned).
Flood Slough (Atherton)	Flood Sough receives local drainage from upstream of the Project site, from Atherton Channel and the Bayfront Canal. Current levels of flood protection would be maintained.

Recreation and Public Access

Public access and recreation are described by pond complex below. Certain features identified as part of Alternative B or C may be interchangeable prior to Project approval, or adaptively as the Project is implemented.

Eden Landing

Figure 2-5a and Table 2-7 below show the public access and recreation features of Alternative B for the Eden Landing pond complex. Key provisions of this trail system would include links between the existing Bay Trail spine north and south of the pond complex, as well as increased visitor access into the site. A year-round trail along the flood protection levee on the eastern portion of the site would provide key missing links in the Bay Trail spine in this area. The Bay Trail spine would continue through the pond complex south to join the Alameda Creek Regional Trail along the north side of the ACFCC. From this point, a proposed bridge, to be constructed in cooperation with the ACFCWCD, would connect this portion of the Bay Trail spine with Coyote Hills Regional Park to the south. From the Bay Trail spine,

Table 2-7 Proposed Eden Landing Recreation and Public Access Features under Alternative B

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Trails	Year-Round Levee Trail	Along northern perimeter of Ponds E12, E13, E14 and E9
	Year-Round Levee Trail	Northern edge of Pond E12 provides year-round access to Oliver Salt Works Historical Site
	Seasonal Levee Trail	Eastern edge of Pond E12 and southern edge of Pond E13
	Year-Round Levee Loop Trail	Southern edges of Ponds E4C and E5C and along eastern edge of Pond E2C. This would form a loop trail that could be accessed from the Alameda Creek Stables staging area.
	Year-Round Levee Trail	North side of OAC, along the southern edge of Ponds E8 and E6A with bridge crossing to south side of creek and Alvarado Salt Works.
	Year-Round Levee Trail	South side of OAC, along the northern edge of Pond E6 with bridge crossing to north side of creek.
	Year-Round Levee Trail (Bay Trail Spine)	On flood protection levees along northern and eastern edges of pond complex
Access Points and Staging Areas	Staging Area	Provided at entry to Eden Landing Road near Mt. Eden Creek bridge and northern edge of Pond E12
	Staging Area	Existing staging area at Alameda Creek Stables to provide access to E3C and E1C[1] trails.
	Bridge Crossing	Bridge Crossing at ACFCC[1]
Boating	In Bay and sloughs, launching site at southeastern corner of Pond E11	Accessible slough and marsh channels (>4 m wide)
Historic Features	Oliver Salt Works	West end of Pond E12 north of Pond E13
	Alvarado Salt Works	West end of Pond E6
Waterfowl hunting	Controlled access on specific hunt dates (from blinds and levees as specified by CDFG)	Marsh areas and all ponds with sufficient water except Pond E6A (recreation access may be limited during waterfowl hunting dates)
Fishing[2]	Controlled access by season and area	From boat or from shore, as designated by CDFG
Interpretive/Education Stations		Provided at Oliver Salt Works, Alvarado Salt Works and at key locations along trails
Viewing Platforms	Raised accessible structures or placed at a key high point for best vantage of surrounding landscape; interpretive signage and information integrated into design	Terminus of year-round trail at northwest corner of Pond E9
		Terminus of year-round trail in southern part of Pond E8
		Terminus of year-round trail in northern part of Pond E7 at northwestern corner of Pond E6A
		Terminus of trail north of Pond E2C

Note:
1 Bridge crossing in cooperation with ACFCWCD.
2 Shore fishing would not be possible in areas where fencing is installed.

several "spur" trails provide access into the site. The northern portion of the pond complex would serve as a new formalized entry with a staging area and future field office/information center. This would provide key visitor contact to learn about the use of the site, the restoration projects that are underway and the level and intensity of access provided. It could also serve as shelter for CDFG staff and provide public restrooms. The main spur trail from the staging area would have three branches: (1) a trail north of Pond E12 that would provide year-round access to the Oliver Salt Works Historical Site, (2) a year-round trail south of Mt. Eden Creek that would lead to the Bay, and (3) a seasonal loop trail along the perimeter of Ponds E12 and E13 that would culminate at the Oliver Salt Works Historical Site. Seasonal trails would be available based on sensitive species nesting patterns and applied studies taking place in the adjacent managed ponds. Kayak and human-powered boat launching as well as motorized boating for hunting and operations would be provided on Mt. Eden Creek. Fishing and waterfowl hunting access would be available from this main staging area, as per CDFG regulations for these activities. A viewing platform and interpretive information would be provided along the Bay Trail spine north of Pond E6A. A second spur trail would be located on the north side of OAC, on the southern edges of Ponds E8 and E6A with a bridge crossing OAC to reach another spur trail along the south side of the creek and to allow access to the old Alvarado Salt Works. An additional spur trail would be located in the southeastern part of the pond complex on the southern edges of Ponds E5C and E4C and eastern edge of Pond E2C to provide a loop trail utilizing the existing Alameda Creek Regional Trail on the north side of ACFCC. A viewing platform would be located near the junction of Ponds E5C and E2C. Alternative B assumes that the levee along the north side of the ACFCC would remain largely intact, with pedestrian/equestrian bridges constructed across the proposed breaches. The existing trail that is part of the Alameda Creek Regional Trail, managed by EBRPD, would remain along this existing levee. The existing staging area at the Alameda Creek Stables could continue to be used for access to this segment of trail.

Alviso

Figure 2-5b and Table 2-8 below show the public access and recreation features of Alternative B for the Alviso pond complex. Public access and recreation features at Alviso would provide key links in the Bay Trail system and provide strategically placed spur trails for education and interpretation of the site and the ongoing restoration. Additionally, a series of multi-use trails, viewing platforms, interpretive signage and stations, small watercraft launching, and waterfowl hunting and fishing access could be designed to be compatible with adjacent wildlife habitat and conform to USFWS Refuge use-compatibility requirements.

In the southwestern region, the existing Bay Trail exits the pond complex at Pond A2W, heading south to become the Stevens Creek Trail. A proposed seasonal trail would extend north from its point of departure to access a viewing area located in Pond A2W, at the terminus of Stevens Creek as it enters the Bay. South of Pond A2W within the City of Mountain View, an interpretive station would be proposed in cooperation with the City. This station would be accessible utilizing existing spur trails within the Park to the proposed Bay Trail Spine at Pond A2W. This year-round trail segment would extend east from the Stevens Creek Trail, along a proposed flood protection levee connecting it to proposed and existing trails around the City of Sunnyvale WPCP and north to a viewing area located on the southeast corner of Pond A3N. The segment of Bay Trail spine from Stevens Creek to Sunnyvale would be along an existing levee

Table 2-8 Proposed Alviso Recreation and Public Access Features under Alternative B

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Trails	Seasonal Levee Trail	Eastern edge of Pond A2W – coincides with PG&E access
	Year-Round Levee Trail (Bay Trail spine)	Southern edge of Ponds A2E, A3W linking existing segments of the Bay Trail Spine
	Proposed Year-Round Levee Trail (outside of Project Area (Bay Trail spine))	South from year-round flood-control levee trail (south of Pond A2E) along western edge of Stevens Creek Open Space Preserve
	Year-Round Levee Trail (Bay Trail spine)	Northern edge of Pond A22 to connect existing Bay Trail Spine to points south
	Vehicular Access	Southerly side of the City of Sunnyvale WPCP and along the southeast edge of Pond A3W[1]
	Proposed Trail (outside Project Area by others)	City of San Jose Bay Trail spine segment surrounding the "Legacy" property, located at the southeast corner of Pond A8S. The City of San Jose has proposed a pedestrian bridge crossing Alviso Slough to access this proposed Bay Trail segment
	Proposed Trail (outside Project Area) Bay Trail spine	Connects Guadalupe River Trail with Coyote Creek Trail (alternate Bay Trail spine segment)
	Proposed Trail (outside Project Area by others)	Northeastern edge of Pond A22 to existing segments of Bay Trail Spine
Access Points and Staging Areas		Refuge EEC
		Kayak launch, fishing and trail access provided on southwest corner of Pond A12, at Alviso Marina County Park (immediately adjacent to pond complex)
		Access to Pond A8 (waterfowl hunting and service only)
		Kayak, waterfowl hunting, and fishing access provided on eastern side of Pond A3W
Boating	Bay, Alviso Slough Channel, Guadalupe Slough Channel	Accessible slough and marsh channels (>4 m wide) (Check for seasonal closures)
Historic Features	Drawbridge remnants	Between ponds A20 and A21
	Historic Cannery Building	In Alviso, outside of the SBSP Restoration Project Area but owned by USFWS
Waterfowl hunting	Controlled access on specific hunt dates and areas (from blinds and levees as specified by USFWS)	Currently to match the ISP Hunt Plan Amendment, Ponds A2E, AB1, AB2, A3W, A3N, A5, A7 and the northern portion of A8 within the Alviso complex would be open to waterfowl hunting on Saturdays, Sundays, and Wednesdays; a Refuge Special Use Permit would be required. Pond A19 is open to waterfowl hunting under the current Hunt Plan.

Table 2-8 Proposed Alviso Recreation and Public Access Features under Alternative B (Continued)

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Fishing	By boat in Bay and sloughs only	Mallard Slough closed to boating March 1 – August 31
Interpretive/Education Stations and Programs	Refuge EEC	Located south of Pond A16, outside of Project Area
	Docent-led tours Interpretive displays[2] Environmental education field trips, hands-on activities, classroom presentations and other outreach	Along hiking trails, at wildlife observation areas, and throughout the Refuge
Viewing Platforms		At terminus of seasonal trail along Pond A2W
		At terminus of year-round trail at northeastern edge of Pond AB2
		Northeastern corner of Pond A8S (to be coordinated with City of San Jose)
		Northern edge of A17 for viewing of Drawbridge remains
		Southern edge of Pond A16

Notes:
1 Trail segment at A3W to Guadalupe Slough in cooperation with Cargill.
2 Interpretive display at Shoreline Park in cooperation with the City of Mountain View.

and is subject to security requirements that may affect access in some locations since it is located adjacent to Moffett Federal Airfield. The alignment would remain but be re-developed and designed as part of the future flood protection levee, once that is constructed. A staging area providing kayak, fishing and waterfowl hunting access would be accessible from this trail. In this alternative, vehicular access is provided along the southerly side of the City of Sunnyvale WPCP (to be completed in cooperation with the City of Sunnyvale) and along the southeast edge of Pond A3W (to be completed in cooperation with Cargill) to the staging area for boaters, hunters, and for persons with disabilities to access these portions of the restoration area. The paved access road at Pond A3W is owned by Cargill and the terminus was previously used for duck hunters and other boating access. A renovation of this area could provide access to the spur trails proposed along A3W, AB2 and A3N as well as water access to Guadalupe Slough.

In the east-central region of the Alviso pond complex, a proposed year-round trail would provide access to a viewing platform and interpretive signage on the west edge of Pond A8S and would connect the existing San Tomas Aquino Trail to the Guadalupe River Trail. This trail is part of the San Jose Bay Trail Master Plan on a parcel known as the Legacy property. An interpretive trail and fishing and kayak access point would be located on the southern edge of Pond A12, accessible from the Alviso Marina County Park. The existing Bay Trail in this region would provide access to the Refuge Environmental Education Center (EEC), south of Pond A16. Portions of the existing trail around Pond A16 would remain to provide access to a proposed viewing platform and interpretive station on the southern edge of Pond A16 with an interpretive station along the eastern edge of the pond. Along the northern edge of Pond A17, a viewing platform and interpretive station would look out over the remains of the abandoned town of Drawbridge. Outside of the Project Area, a proposed trail would connect the Coyote Creek Trail westerly to the Project Area and the Guadalupe River Trail. This would serve as another option for the Bay Trail spine from the City of San Jose to the Project Area spur trails, in addition to the north-south Drawbridge option at Ponds A13, A15 and A21.

Ravenswood

Figure 2-5c and Table 2-9 below shows the public access and recreation features of Alternative B for the Ravenswood pond complex. Key provisions of this trail system would include links between the site and the existing Bay Trail surrounding the complex, and increased visitor access and interpretive opportunities within the site. Two proposed trails that extend north from the existing Bay Trail Spine would provide year-round access to a viewing platform at the northwestern corner of Pond R4, with views to Greco Island, South San Francisco Bay, and Pond R4. A viewing platform at the northeast corner of the City of Menlo Park's Bayfront Park would be accessible via this proposed trail. Establishment of this platform would require coordination and agreement with the City of Menlo Park. An additional viewing platform would be accessible via this trail, located on the levee dividing Ponds R3 and R4. A year-round loop trail would be proposed along the perimeter of Pond R3 to follow the existing levee that would remain. This would connect to the existing spur trail along the bayside of the Sun Microsystems complex and to the Bay Trail spine along SR 84. It would also connect to the proposed spur trail along Pond R5 and Bayfront Park. A viewing platform is proposed where this trail meets Ravenswood Slough. A proposed year-round trail along a portion of the eastern edges of Pond SF2 would connect the Bay Trail spine along SR 84 with a proposed north-south segment of the Bay Trail Spine (outside of the Project Area). This proposed trail would allow visitors to view restored managed pond and tidal marsh, as well as the Bay. A proposed viewing platform is located at the junction of the year-round trail and the Bay Trail spine along SR 84 as well as where the San Francisco Public Utilities Commission (SFPUC) property joins the eastern edge of the pond along the new Bay Trail segment. The former is planned as a relocation point for the viewing platform that would be part of Phase 1 and located along the existing trail where Pond SF2 meets the Bay. This existing trail would be rehabilitated for use as part of Phase 1 and then recreation features here would be removed and relocated once this portion of Pond SF2 becomes tidal and the levee is removed. An additional viewing platform is proposed on the southeastern corner of the pond complex, accessed via an existing spur trail at the northeastern edge of Pond SF2, at the water's edge. Future design of the year-round trail around Pond SF2 would need to take into consideration the proposed Dumbarton Rail Corridor Project. Similarly, the proposed trail (outside of the Project Area) linking Pond SF2 with the Ravenswood Open Space Preserve would need to be designed for compatibility with the existing railroad line in the area to provide for public safety (*e.g.*, signage, fencing and/or grade separation). In both alternatives, an existing trail around Ponds R1 and R2 is designated for removal once these ponds are breached and restored to tidal habitat. An interpretive display would be offered at the historic Red Barn site, located in the southwest corner of Bayfront Park, which would require partnership with Cargill (owners of the barn).

Table 2-9 Proposed Ravenswood Recreation and Public Access Features under Alternative B

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Trails	Year-Round Trail	From existing Bay Trail Spine north between Ponds R5/S5 and R4/R3
	Year-Round Trail	Northwestern edge of Pond R4
	Year-Round Trail	Spur trail along a portion of the eastern edge of Pond SF2 and between managed and tidal marsh sections along existing levee.
	Year-Round Loop Trail	Northern and eastern edges of Pond R3 creating a loop trail from existing Bay Trail spine along SR 84
	Proposed Trail (outside Project Area by others)	West from existing Bay Trail Spine, south of Pond 7C
	Proposed Trail (outside Project Area by others)	Connection to the existing Bay Trail Spine north of Ravenswood Open Space Preserve to Year-Round Trail in Pond SF2
	Proposed Trail (outside Project Area by others) (Bay Trail spine)	Connection to the Existing Bay Trail spine segments west of Faber-Laumeister Marsh
Boating	Bay and its tributaries	Accessible slough and marsh channels (>4 m wide) (Check for seasonal closures)
Historic Features	Historic red barn	South of Bayfront Park by Pond S5 in cooperation with Cargill (owners of barn)
Waterfowl hunting	Controlled access on specific hunt dates and areas (from blinds and levees as specified by USFWS)	Ponds R1 and R2 (except the southeastern portion of R2 next to the highway); from boats, shore, or levees
Fishing		Not allowed from ponds; available from the Bay
Interpretive/Education Stations and Programs	Docent-led tours Environmental education field trips, hands-on activities, classroom presentations and other outreach	Various locations
Viewing Platforms		Along proposed year round trail, east of Pond R5
		Northeast corner of Bayfront Park in cooperation with the City of Menlo Park
		At terminus of proposed year-round trail northwest of Pond R4
		Eastern region of Complex, at Pond SF2 and SR 84. Between managed and tidal portion of pond
		At junction of proposed year-round trail and Bay Trail Spine, east edge of Pond SF2
		At northeastern corner of Pond R3 accessed by proposed year-round trail at Pond R3

Coordination with the Invasive Spartina Project

As discussed in Chapter 1, Introduction, the Invasive Spartina Project has begun implementing a coordinated, region-wide eradication program to stave off the invasion of non-native invasive cordgrasses. The Project has worked with the Invasive Spartina Project to develop a set of "best practices" for tidal marsh restoration to minimize the risk of spreading invasive *Spartina* and its hybrids. Those practices include:

- No *Spartina* is proposed to be planted in the Project Area. If circumstances arise where *Spartina* would be planted in the Project Area, the plantings would be genetically verified to be *Spartina foliosa*.
- The Project would not plant native *Spartina* where it may become pollinated by hybrid *Spartina*.
- The Project Area should be monitored annually for the presence of non-native or hybrid *Spartina*. In addition to field identification, representative samples of any found *Spartina* should be genetically analyzed to verify absence of *S. alterniflora* or *S. densiflora* genetic markers. Any found non-native or hybrid *Spartina* plants should be removed or killed before their first season of flowering and seed set.
- One measure of the Project's success in achieving the Project Objective regarding management of "the spread of non-native invasive species" is that there is no non-native or hybrid *Spartina* found in the Project Area.
- The Project would not initiate connection of ponds with tidal flows (full or muted) at locations where *S. alterniflora* or *S. alterniflora* x *S. foliosa* seed or propagules are likely to get into the Project Area.
- The Project would take care to not introduce non-native *Spartina* seed or propagules into the Project Area on contaminated excavators, dredges, or other equipment. The Project would require that all equipment be cleaned prior to entry into an intertidal part of the Project Area if it has been in contact with non-native *Spartina* plants, seeds, or roots.
- The Project would make sure that any dredged materials brought to the Project Area do not contain non-native *Spartina* seed or fragments.
- Variations to the above best practices may be appropriate based on site-specific conditions and scientific analysis. Proposed variations should be developed with assistance or review from the Invasive Spartina Project. Additionally, the Project would discuss any proposed variations with nearby marsh owners/managers, who could be affected by the actions of the Project.

2.4.4 SBSP Long-Term Alternative C: Tidal Habitat Emphasis

Alternative C (shown in Figures 2-7a through 2-7c) emphasizes tidal restoration and provides an approximately 90:10 ratio by area of tidal habitat to managed pond.

The 90:10 scenario was selected as the upper bookend because it would maximize the benefits of tidal restoration while providing habitat for pond-associated species. Based on nesting densities achieved in managed ponds elsewhere (H. T. Harvey & Associates 1996, unpublished data), existing populations of stilts and avocets in the SBSP Restoration Project Area, and the contribution to the draft recovery plan goal for western snowy plovers attributable to the SBSP Restoration Project Area (250 adults), it was estimated that ten percent is the minimum pond area required to support breeding pond-associated birds (*e.g.*, snowy plovers, stilts, and avocets). This estimate assumes that 10 percent of ponds (approximately 1,600 acres) would be reconfigured to provide shallow water habitat and numerous islands, thus providing breeding and foraging habitat. Alternative C assumes intensive water level management, and successful predator and vegetation control in the ponds.

As with Alternative B, the long-term effects of global climate change on sea level rise, habitat distributions and flood hazards were considered over the 50-year planning horizon. If the rate of sea level rise is higher than anticipated during Project planning, the timeframe for tidal marsh development would be delayed, and tidally-restored areas within the SBSP Restoration Project Area would likely persist as intertidal unvegetated mudflats or shallow open water habitat for prolonged periods. The South Bay, and in particular the far South Bay, have historically been sediment-laden depositional environments (Jaffe and others 2006a, Jaffe and others 2006b), therefore the tidally-restored ponds are expected to accrete sediment and vegetation is expected to establish in the face of accelerated sea level rise (PWA 2006b, Appendix I). However, higher than anticipated sea level rise rates that result in delayed or arrested marsh establishment could hinder the progression towards the 90:10 bookend. As discussed previously, the SBSP Restoration Project would only proceed to the 90:10 scenario if adaptive management actions are successful at avoiding significant adverse impacts that may result as managed ponds are converted to tidal habitat.

Ecosystem Restoration

Alternative C would provide approximately 13,400 acres of tidal habitat and create the widest and most extensive tidal marsh corridor of the alternatives. This alternative would maintain continuous tidal marsh corridors from Greco Island to Mud Slough and along most of the Eden Landing shoreline.

Alternative C would restore the largest patches of tidal marsh with high-order drainage channels. In addition to the large tidal areas restored in Alternative B (southern Eden Landing and Alviso Ponds A5, A6, A7, and A8/A8S), Alternative C would tidally restore Alviso Ponds A9 though A15. Tidal habitat would be restored along at least one side, and generally along both sides, of the major sloughs with existing or potential spawning habitat for anadromous fish. Because more tidal acreage would be restored under Alternative C, more opportunities would exist for the creation of upland transition zones along the adjacent flood protection levees and adjoining upland areas. Most of the tidally-restored areas would require sheltered conditions to evolve from mudflat to vegetated marsh; therefore the outboard levee would generally need to be maintained in these areas until tidal marsh develops.

Alternative C would provide approximately 1,600 acres of managed ponds. All the managed ponds in Alternative C would be reconfigured to substantially enhance foraging, roosting, and nesting opportunities for shorebirds, waterfowl, and other waterbirds. Reconfiguration is particularly important in Alternative C since it has the smallest area of managed pond of the three alternatives.

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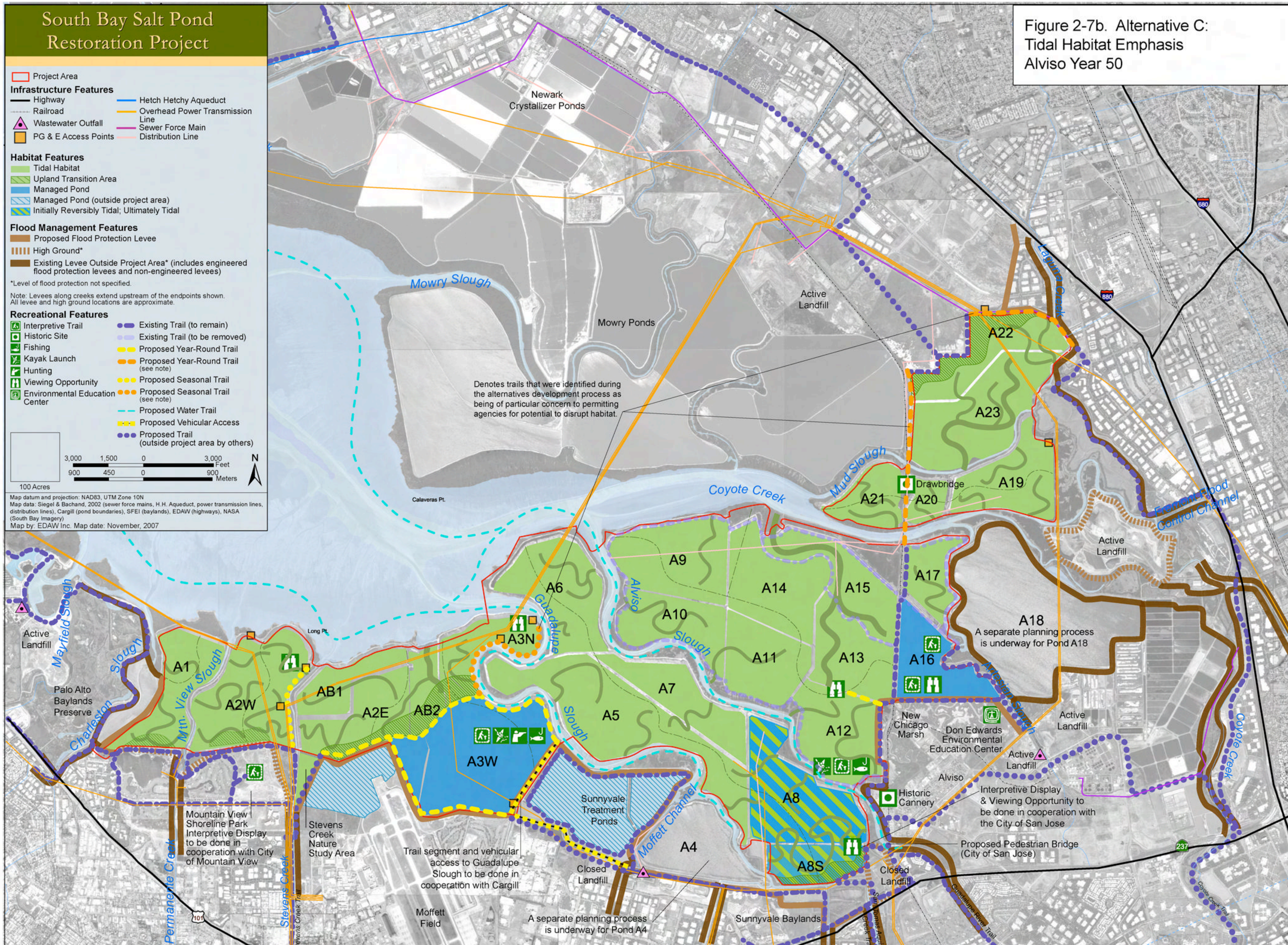

Figure 2-7b. Alternative C: Tidal Habitat Emphasis Alviso Year 50

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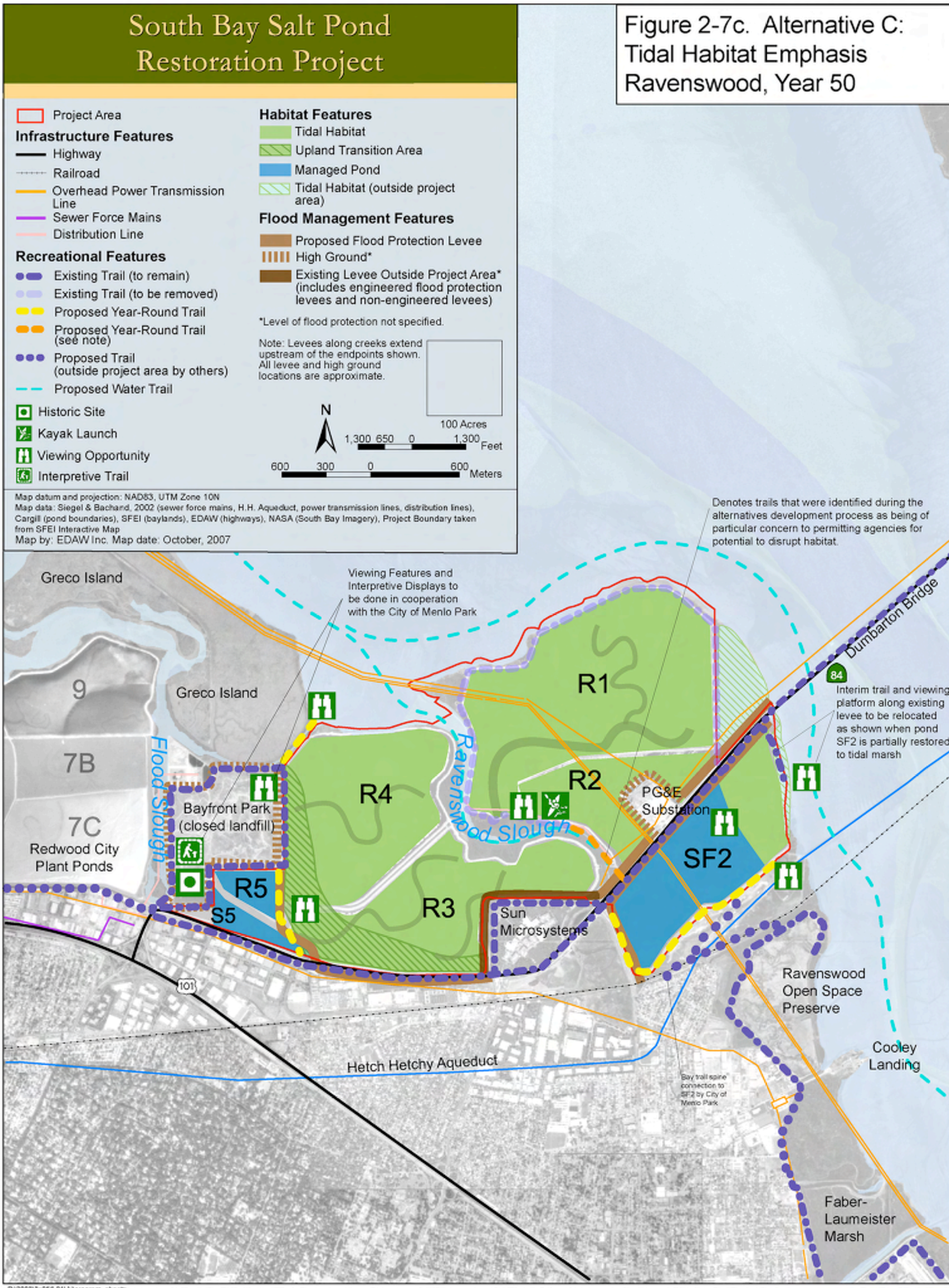

Figure 2-7c. Alternative C: Tidal Habitat Emphasis Ravenswood, Year 50

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Each phase of restoration would analyze potential impacts to PG&E infrastructure and to PG&E's access to perform O&M activities. On a pond-by-pond basis, the Project proponents would be responsible for ensuring that any changes to PG&E infrastructure (such as raising, replacing or relocating boardwalks, reinforcing or replacing tower footings, or raising towers or transmission lines) would be implemented as part of the implementation of each phase of restoration. The Project proponents would evaluate the costs and benefits of restoring ponds where restoration would significantly affect utility infrastructure on a project-by-project basis. In addition, where a Project phase would eliminate or substantially alter a current access route across either USFWS or CDFG land to PG&E's facilities, the Project would provide alternative, equivalent access. Finally, where the numbers of individual or species or habitat increase as a result of the Project, USFWS and CDFG would work collaboratively with PG&E to develop appropriate measures that would avoid or minimize impacts to threatened or endangered species. These measures would be documented (*i.e*. a special use permit) and would be part of the Section 7 consultation under the ESA. To avoid or minimize impacts to PG&E facilities and access, the Project would involve PG&E at the earliest practicable date in planning and design of restoration actions at the project level.

Flood Management

Alternative C would provide coastal and fluvial flood protection that is nearly identical to that described above for Alternative B. As with Alternative B, Alternative C would be designed to maintain or improve existing levels of flood protection, would provide a coastal levee system the provides flood protection along the landward perimeter of the SBSP Restoration Project Area, would tie the coastal levee system into levee systems along the creeks, and would improve fluvial flood protection upstream along the major creeks by removing constricting pond levees and increasing channel conveyance within the Project Area. Flood protection for Alternative C is the same as discussed for Alternative B, except as described below.

The alignment of the proposed perimeter levee that provides flood protection for Alternatives B and C is shown in Figures 2-6a through 2-6c, and is described in more detail in the discussion of Flood Management under Alternative B. The major differences between Alternatives B and C are due to the increased acreage of tidally-restored ponds in Alternative C. Sections of the proposed perimeter levee that lay behind managed ponds under Alternative B, and behind tidally-restored ponds or upland transition zones under Alternative C, would require greater levee cross-sections under Alternative C in order to provide the same level of flood protection to adjacent communities and infrastructure. The levees behind the tidally-restored ponds would also be exposed to greater erosive potential, at least until a vegetated marshplain established in the tidal ponds. Therefore, the levees in Alternative C would be designed for additional energy dissipation or would include additional erosion control measures. The phased nature of the Project's implementation would require that flood protection be provided prior to restoring the additional acreage of tidal restoration. As in Alternative B, modeling and analyses would be completed prior to each phase of implementation to verify flood performance and ensure that existing or improved levels of flood protection would be provided. If the levee is designed and constructed before the type of habitat to be restored to the outboard ponds is known, the levee can either be constructed to the larger (Alternative C) cross section or built to the smaller (Alternative B) cross section and raised later, if needed. Higher than anticipated sea level rise would also require subsequent design phases to raise the levee (*i.e*., widening and raising the levee or building a flood wall) before sea level rises above the design level for flood protection. Other options would include overbuilding the levee initially to anticipate a higher rate of sea level rise, either by building a higher levee, or by building a levee with a wider base to more easily accommodate future increases in levee height. The future design of the flood protection levee would balance the cost and benefits of the potential approaches at the time of design. The project-level analysis and design would be presented in a future project-level EIS/R.

The length of abandoned existing slough levees (levees no longer maintained for flood management or managed pond habitat protection) within the SBSP Restoration Project Area would be greater under Alternative C than Alternative B due to the increased acreage of tidally-restored ponds. The additional sections that would be abandoned in each pond complex are identified in the tables below. Note that levee abandonment, in this context, would provide opportunities to increase fluvial flood flow conveyance, thereby reducing upstream water levels and flood hazards. Additional conveyance would be created by removing or lowering abandoned levees (as funding allows) and by breaching abandoned levees to promote channel scour. Abandoned levees would not require ongoing maintenance, resulting in cost savings.

Eden Landing

The perimeter levee alignment would be identical to that described under Alternative B, as shown on Figure 2-6a. Table 2-10 provides a summary of the flood management approach by drainage channel for Alternative C in the Eden Landing pond complex.

Table 2-10 Alternative C Eden Landing Fluvial Drainage Elements

DRAINAGE CHANNEL (WATERSHED)	FLOOD MANAGEMENT APPROACH
Mt. Eden Creek (Alameda Creek)	The flood protection approach would be identical to that described for Alternative B. The Pond E14 levees would no longer be maintained for managed pond habitat.
OAC (Alameda Creek)	The flood protection approach would be identical to that described for Alternative B. The levees along Ponds E8 and E6A would no longer be maintained for managed pond habitat.
ACFCC (Alameda Creek)	The flood protection approach would be identical to that described for Alternative B.

Alviso

The perimeter levee alignment would be identical to that described under Alternative B, as shown on Figure 2-6b. Table 2-11 provides a summary of the flood management approach by drainage channel for Alternative C in the Alviso pond complex.

Ravenswood

The perimeter levee alignment would be identical to that described under Alternative B, as shown on Figure 2-6c. Table 2-12 provides a summary of the flood management approach by drainage channel for Alternative C in the Ravenswood pond complex.

Table 2-11 Alternative C Alviso Fluvial Drainage Elements

DRAINAGE CHANNEL (WATERSHED)	FLOOD MANAGEMENT APPROACH
Charleston Slough (Lower Peninsula)	The flood protection approach would be identical to that described for Alternative B.
Mountain View Slough/Permanente Creek (Lower Peninsula)	The flood protection approach would be identical to that described for Alternative B.
Stevens Creek/Wiseman Slough (Lower Peninsula)	The flood protection approach would be identical to that described for Alternative B. Existing levees at Ponds A2E would not be maintained for protection of managed pond habitat and would be abandoned.
Guadalupe Slough (West Valley)	The flood protection approach would be identical to that described for Alternative B.
Alviso Slough/Guadalupe River (Guadalupe River)	The flood protection approach would be identical to that described for Alternative B. Levees along both sides of Alviso Slough, downstream of the community of Alviso, would no longer be maintained for protection of managed pond habitat and would be abandoned.
Coyote Slough/Coyote Creek (Coyote Creek)	The flood protection approach would be identical to that described for Alternative B. Levees within the Project Area would no longer be maintained for protection of managed pond habitat and would be abandoned.
Artesian Slough (Coyote Creek)	The flood protection approach would be identical to that described for Alternative B. Levees at Pond A17 would no longer be maintained for protection of managed pond habitat and would be abandoned.
Mud Slough/Laguna Creek (Coyote Creek)	The flood protection approach would be identical to that described for Alternative B. Existing levees at Ponds A22 and A23 would not be maintained for protection of managed pond habitat and would be abandoned.

Table 2-12 Alternative C Ravenswood Fluvial Drainage Elements

DRAINAGE CHANNEL (WATERSHED)	FLOOD MANAGEMENT APPROACH
Ravenswood Slough (San Francisquito)	The flood protection approach would be identical to that described for Alternative B. Existing levees along Pond R3 would no longer be maintained for managed pond habitat and would be abandoned.
Flood Slough (Atherton)	The flood protection approach would be identical to that described for Alternative B.

Recreation and Public Access

Public access and recreation are described by pond complex below. As mentioned above, certain features identified as part of Alternative B or C are options that may be interchanged prior to Project approval, or adaptively as the Project is implemented.

Eden Landing

Figure 2-7a shows the public access and recreation features of Alternative C for the Eden Landing pond complex. The features for Alternative C are largely the same as in Alternative B in the northern portion of the pond complex with differences noted below and in Table 2-13. One of the differences between the

Table 2-13 Proposed Eden Landing Recreation and Public Access Features under Alternative C

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Trails	Year-Round Levee Loop Trail	Northern and western edges on Pond E6C south through Pond E1C to connect with existing trail along northern edge of ACFCC to levee trail along east side of Pond E3C. This forms a loop trail that could be accessed from the Alameda Creek Stables staging area.
	Year-Round Levee Trail	Southern edges of Ponds E4C and E5C (Alternative B only)
	Year-Round Levee Trail	North side of OAC, along the southern edge of Ponds E8 and E6A (Alternative B only)
Viewing Platforms	Raised accessible structures or placed at a key highpoint for best vantage of surrounding landscape; interpretive signage and information integrated into design.	Terminus of trail north of Pond E2C (Alternative B only)
		Western edge of Pond E6C along levee trail
All features same as Alternative B, as shown in Table 2-7 except as noted above.		

two alternatives is that the proposed year-round trail along OAC in Alternative C would follow the south side of the creek, culminating at the Alvarado Salt Works and viewing area. This is shown as an option to the alignment illustrated in Alternative B. Alternative C would have a year-round trail on the northern and western edges of Pond E6C extending south through Pond E1C to the existing trail along the northern edge of ACFCC. Alternative C would not provide the trail along Ponds E4C and E5C that is shown in Alternative B. An additional difference between the alternatives is the proposed removal of segments of the existing Alameda Creek Regional Trail along the northern edge of ACFCC. The proposed trail configuration is based on the assumption that portions of the levee that the trail follows would need to be removed to meet the Project Objectives for flood management. Subsequent flood analyses would test this assumption. If the levee is not removed, the existing trail configuration would be maintained.

Alviso

Figure 2-7b shows the public access and recreation features of Alternative C for the Alviso pond complex. The public access and recreation proposals are similar for both restoration Alternatives B and C, although there are some differences noted below and shown in Table 2-14. Alternative C would provide an option for the Bay Trail spine to utilize the existing Union Pacific Railroad corridor and cross through the historic remains of the Town of Drawbridge.

This segment, from the northwest corner of Pond A22 to the northwest corner of Pond A17 is not shown in Alternative B, but could be developed in the managed pond alternative if feasible. Alternative C also shows that the Bay Trail spine can be linked via existing and proposed trails (some outside the Project boundary) to the east of the Alviso pond complex as in Alternative B. These options are interchangeable between alternatives and illustrate that both alternatives can provide alternate routes to complete the Bay

Table 2-14 Proposed Alviso Recreation and Public Access Facilities under Alternative C

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Trails	Year-Round Trail Adjacent to Existing Rail Corridor (Bay Trail spine)	Northwestern corner of Pond A23 south to northeastern corner of Pond A17 to pass through Drawbridge
	Year-Round Levee Trail	Northern edge of Pond A3W to creating a loop trail from Bay Trail
	Year-Round Spur Trail between Ponds A12 and A13	Spur trail off of existing trail from Alviso Marina County Park for viewing out over tidal marsh
	Seasonal Levee Trail along eastern edge of Pond A3N	From Pond A3W trail out along edge of slough
Interpretive/Education Stations and Programs	Refuge EEC	South of Pond A16, outside of Project Area
	Docent-led tours Interpretive displays Environmental education field trips, hands-on activities, classroom presentations and other outreach	Along hiking trails, at wildlife observation areas, and throughout the Refuge
Viewing Platforms	Raised accessible structures or placed at a key highpoint for best vantage of surrounding landscape; interpretive signage and information integrated into design	Northeast edge of Pond A3N adjacent to Guadalupe Slough
		Northern edge of Pond A17 for viewing of Drawbridge remains (Alternative B only)
		Viewing platform between Ponds A12 and A13

Note:
All features same as Alternative B, as shown in Table 2-8 except as noted above.

Trail spine in the Alviso area. The viewing platform and interpretive station planned in Alternative B at the north edge of Pond A17 would not be constructed in Alternative C since this pond would become tidal and the existing levee would be removed. Similarly the portion of existing trail that follows this existing levee would also come out to allow for uninterrupted tidal marsh habitat to be developed in this location. Another difference between Alternatives B and C is that with the full tidal restoration proposed in Alternative C, the Alviso loop trail around Ponds A9 through A15 would be removed. However, with the maintenance of Pond A3W as a managed pond and a new levee along its northern border, a new loop trail would be provided that would coincide with the adjacent staging area. This would provide a lengthy spur trail from the Bay Trail spine in this vicinity. Alternative C also would include an option for public access to coincide with PG&E access along the southern and eastern edge of Pond A3N and a spur trail and viewing platform between Ponds A12 and A13.

Ravenswood

Figure 2-7c shows the public access and recreation features of Alternative C for the Ravenswood pond complex. The public access and recreation proposals are similar for both restoration Alternatives B and C, although there are some differences noted below and shown in Table 2-15. Since Pond R3 is tidal in this alternative, Alternative C would not include the trail around the perimeter of Pond R3 that is included in Alternative B. Instead, Alternative C would include a proposed spur trail along the edge of Pond R2 that would provide a viewing platform and small watercraft launch at Ravenswood Slough. An additional difference between the alternatives is that the proposed Bay Trail connection between the Ravenswood Open Space Preserve and SR 84 at Pond SF2 is located on the southwestern and western edges of the pond, as opposed to through the central portion of the pond as in Alternative B. This proposed year-round trail in Alternative C would also connect to the Bay Trail spine along SR 84, as in Alternative B, however at a different point than in Alternative B. In this Alternative the viewing platform and interpretive station at Pond SF2 where the pond meets the water's edge would be re-located as shown to be closer to the access from SR 84, since most of the levee at the current edge would be removed to allow for uninterrupted tidal marsh in this location. The other viewing platform and interpretive station at Pond SF2 would remain the same as in Alternative B.

Table 2-15 Proposed Ravenswood Recreation and Public Access Facilities under Alternative C

RECREATIONAL FEATURES	DESCRIPTION	LOCATIONS
Trails	Year-Round Trail	Eastern and southern edges of Pond SF2
	Year-Round Loop Trail	Northern and eastern edges of Pond R3 creating a loop trail from existing Bay Trail spine along SR 84 (Alternative B only)
	Year-Round Trail	Existing levee trail along southwest corner of Pond R2 to remain and provide access to new kayak launch
Access Points and Staging Areas	Kayak Launch	Eastern region of complex, at base of Ravenswood Slough
		At terminus of proposed year-round trail northwest of Pond R4 (Alternative B only)
		Eastern region of pond complex, at southern terminus of existing spur at Pond SF2 and water's edge
		At northeastern corner of Pond R3 accessed by proposed year-round trail at Pond R3 (Alternative B only)
		Base of Ravenswood Slough, at northern terminus of proposed year-round trail
Note: All features same as Alternative B, as shown in Table 2-9 except as noted above.		

Coordination with the Invasive Spartina Project

Please refer to the Section 2.4.3, Coordination with the Invasive Spartina Project, for a discussion of the "best practices" that have been developed by the Project and the Invasive Spartina Project.

2.4.5 Construction and Operations and Maintenance

Construction

Alternative A would not result in any construction activities; limited O&M activities would occur as discussed under the heading Operations & Maintenance below. Alternatives B and C would result in short-term construction activities (for each phase) including general earthmoving, excavation, and installation of facilities, such as water control structures, recreation facilities (*e.g.*, trails, viewing platforms, interpretative signage). These activities would occur almost entirely within the boundaries of the pond complexes. In addition, due to the availability of space within the pond complexes, staging of material and equipment would be accommodated entirely within these properties. Construction would require the use of the following types of land-based and/or amphibious equipment (other types of equipment may be used as necessary):

- Dozer or Tractor;
- Excavator;
- Front-end Loader;
- Backhoe;
- Vibratory Roller;
- Crane;
- Truck;
- Piledriver;
- Water Pump; and
- Diesel Generator.

It is assumed that construction activities could occur anywhere within the pond complexes. However, certain equipment, such as piledrivers, would be used only for replacement of water control structures.

Construction activities would require the import of as much as 10 to 15 million cy of fill for levee construction, filling or blocking of borrow ditches, and the creation of upland transitional habitat over the 50-year planning horizon. Temporary fill would also be used at staging locations if required. The material may be brought to the Project site by barge and/or trucks. The locations and phasing of projects and actual amount of imported fill required for each phase have not yet been determined. Potential sources of fill that may be well-suited for the SBSP Restoration Project include the excavated material from SCVWD's Stream Maintenance Program and the proposed tunnel for the Hetch Hetchy Aqueduct near SR 84. Development projects in nearby upland areas are another potential source of fill. Fill from offsite sources would be received during each permitted phase of restoration, as needed. Traffic impacts associated with fill transport and handling are described in Section 3.12.

A construction worker team typically consists of five to ten people. More people per team and/or more teams may be required if construction timelines demand that work proceed at multiple sites simultaneously. It is assumed that each worker would drive their own vehicle to the site each day. Within the Refuge access would be provided along existing maintenance routes and public access roads. Generally, access into the pond complexes would include the following:

- Eden Landing pond complex: Multiple accesses are available, including from SR 92 or I-880 to local streets. Various arterial, collector, and local streets provide access to the ponds from these highways.
- Alviso pond complex: Due to the scattered nature of the ponds, multiple accesses are available. The site may be accessed by SR 237, I-880, or US 101. Various arterial, collector, and local streets provide access to the ponds from these highways.
- Ravenswood pond complex: This site is accessed directly from SR 84 and Bayfront Parkway.

Heavy vehicles would avoid crossing structures in the levees if the vehicle exceeds the weight-bearing capacity. If this is not possible, engineer-approved precautions would be taken to avoid damaging the structure.

Operations and Maintenance

The long-term operation of Alternative A and Alternatives B or C (until specific actions are implemented) would involve O&M activities including the replacement and/or repairs of water control structures, and maintenance of existing levees. Certain O&M activities would require the use of piledrivers. O&M activities would occur periodically over the 50-year planning horizon and cannot be anticipated at this time.

All O&M activities at the pond complexes would be covered by the existing Corps Permit #19009S98 which was subject to a review and the requirements of an Endangered Species Act Section 7 Biological Opinion. The Corps issued the permit in November 1995 to Cargill Salt Division for certain structures and work occurring in or affecting navigable waters of the U.S. and the discharge of dredged or fill material into waters of the U.S, pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act. The portions of the permit covering lands which are part of the Refuge and the Reserve were transferred to USFWS and CDFG in May 2003.

The permit described the work allowed, the general conditions by which the permittee must abide, best management practices (BMPs) that must be implemented to the extent practicable, and other conditions/evaluations/plans that address protection of sensitive biological resources.

A summary of the permit relevant to the proposed Project is provided below:

1) Repair, replacement and servicing of existing facilities. These would not require the Corps's specific approval as described in 2), below.

    a. Repair and replacement of existing bay intake structures, brine control structures, and related facilities such as pumps, gates, pipelines, siphons, open channels and culverts. Removal of silt and algae.

    b. Excavating, clearing, and retrenching of existing intake structures and brine conveying ditches so long as the existing configuration is not altered substantially.

c. Repair and replacement of existing bridges, bridge foundations and abutments within the network of salt pond levees.

d. Repair and replacement of other items such as existing fences, tide gates, siphons in nontidal areas, power lines, etc., provided such repair and maintenance does not deviate from the plans of the original facility.

e. Repair of existing authorized reaches of riprap. The authorized riprap areas are designed to have approximately 4:1 slope. If additional work would exceed the existing reach by 10 linear ft, then the proposed design should be submitted in accordance with the procedures for new work in the rip rap section 2h) below.

2) Ongoing and new work

The following activities require site specific review and approval by the Corps in consultation with USFWS, USEPA, CDFG, BCDC and RWQCB pursuant to the notification procedure and in accordance with the BMPs described in the permit.

a. Placement of dredged and fill material on the pond side of salt pond levees including replacement of the eroded beach below the plane of high water in the pond for the purpose of raising and fortifying the levees to prevent degradation. The material, either dredged mud from the salt ponds or imported fill, will be placed along the inside and the top of the salt pond levee in accordance with the BMPs.

b. Dredging of existing and new borrow ditches within the salt ponds for the purpose of placing the dredged material on existing levees.

c. Dredging in salt ponds to allow the floating dredge to cross a pond, with the replacement of dredged material on the pond bottom along the side of the dredged channel.

d. Dredging of and replacement of dredged material at 38 existing dredge locks, and at any newly constructed authorized dredge locks.

e. Dredging within shallow sloughs to provide up to 4 ft of clearance for access by the Mallard.

f. Installation of new intake and brine control structures, new pumps, siphons, culverts, power transmission lines channels/ditches, crossings of channels and streams, in conjunction with new work, or relocation of existing structures.

g. Construction of new pumping donuts, internal coffer dams, and internal salt pond levees.

h. Placement of new riprap made up mostly of small pieces of demolition rubble along outboard and inboard levees as needed to fortify the slopes and prevent erosion.

i. Repair and replacement of siphons that cross salt marsh, sloughs and channels that would require extensive trenching and sidecasting mud.

j. Dredging and placement of bay muds into eroded areas along selected outboard levees with the purpose of encouraging the establishment and expansion of salt marsh vegetation to diffuse wave energy and prevent levee erosion.

k. Dredging a "sump" approximately 75 ft by 75 ft by 2 ½ ft deep, in the mud flat of a slough in the immediate vicinity of a staked access cut to a dredge lock, placing the dredged mud on an adjacent levee.

Under Alternative A, O&M activities would involve regular maintenance staff traveling between the pond complexes.

The long-term operation of Alternatives B and C would also involve periodic maintenance activities that are assumed to require approximately one maintenance staff person who would travel to the pond complexes one or two times a week. Periodic maintenance activities would include predator control, general vegetation control and vandalism repairs. In addition, operation of Alternatives B and C would include the Adaptive Management Plan monitoring activities, which would require additional workers (*e.g.*, staff, consultants) to access the site for monitoring activities. The frequency of traffic trips assessing the site would depend on the monitoring activities involved, and would vary by season (*e.g.*, during the bird breeding season there may be more trips to the site than during the non-breeding season).

Alternatives B and C would require the operation of portable diesel pumps anywhere within the pond complex and electric pumps at specific locations within specific ponds. The portable pumps would be diesel and have a capacity of 20,000 gallons per minute (gpm). The frequency of use of the portable pumps has not yet been determined, but may be operated continuously for periods of one to two days several times per year.

Alternatives B and C would also require ongoing levee maintenance for pond levees that surround managed ponds and for the proposed perimeter levee that provides flood protection (as part of O&M activities as described above). Levee maintenance activities would include the placement of additional earth on top of or on the pond side of the levees as the levees subside, with the level of settlement dependent upon geotechnical considerations. In general, pond levees which are improved to provide flood protection would likely exhibit the greatest degree of settlement. Levees that require erosion control measures would also require routine inspections and maintenance. If the levees that provide flood protection are improved to provide FEMA 100-year flood protection, a detailed levee maintenance plan would be required for certification to comply with FEMA standards.

2.5 Project-Level Phase 1 Actions

2.5.1 Overview

The SBSP Restoration Project would be implemented in a series of phases over many years, on the order of several decades. It is anticipated that each pond would be managed in a manner similar to the ISP until its implementation phase. The initial phases, including Phase 1, would include a range of habitat types – tidal habitat, enhanced managed ponds, and reconfigured managed ponds – and early experiments for adaptive management (see Section 2.3). Each phase would have its own project-level NEPA/CEQA documentation, which would tier off of this programmatic EIS/R.

The phasing of tidal- and managed-pond restoration would 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, would 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 would also likely 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 (see Section 2.6.1 for information on future actions). The SBSP Restoration Project and Shoreline Study planning efforts are, and will continue to be, closely coordinated.

The proposed Phase 1 actions were selected based on the following criteria:

- Available funding;
- Likelihood of success;
- Ease of implementation;
- Visibility and accessibility;
- Opportunities for adaptive management and applied studies;
- Value in building support for the Project; and
- Certainty of investment.

The SBSP long-term alternatives include a common set of proposed Phase 1 actions. The Phase 1 actions would consist of tidal habitat restoration and pond management in the three pond complexes, plus improvements in public access (Figure 2-8).

Restoration

The Phase 1 restoration actions would provide approximately 1,560 acres of tidal habitat (including approximately 570 acres of reversible muted tidal habitat) and 710 acres of reconfigured managed ponds across the Eden Landing, Alviso, and Ravenswood pond complexes. Tidal habitat restoration is expected to benefit endangered, threatened, and other special-status, tidal-marsh-dependent species, as well as

South Bay fisheries. The managed ponds would be reconfigured to create and enhance foraging and nesting habitat for migratory and resident shorebirds and other waterbirds. The Phase 1 restoration actions would provide the opportunity to perform applied studies and test restoration techniques to inform future restoration through the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R). The restoration actions would be implemented along with certain Phase 1 public access and recreation actions discussed below. The Phase 1 restoration actions would not include construction of levees that provide flood protection, as the restoration actions were selected to avoid areas where levees that provide flood protection would be required.

Table 2-16 summarizes the proposed Phase 1 restoration actions. The Phase 1 action at Alviso Pond A8 would be an initial action that would subsequently be modified based on learning gained through monitoring and adaptive management of the Phase 1 action. At Ravenswood Pond SF2, the Phase 1 restoration action would reconfigure the entire managed pond. Tidal restoration of the outer part of the Pond SF2 Phase 1 reconfigured managed pond is expected in a later phase, to be coordinated with the implementation of long-term flood management measures in this area. The Phase 1 action restoration plans for the reconfigured managed ponds at Pond SF2 and Alviso Pond A16 are similar. Lessons learned through monitoring and adaptive management at either Pond A16 or Pond SF2, whichever is implemented first, are expected to benefit the design and implementation of the other.

The Phase 1 restoration actions, including objectives and restoration plans for each action, are further described below by pond complex.

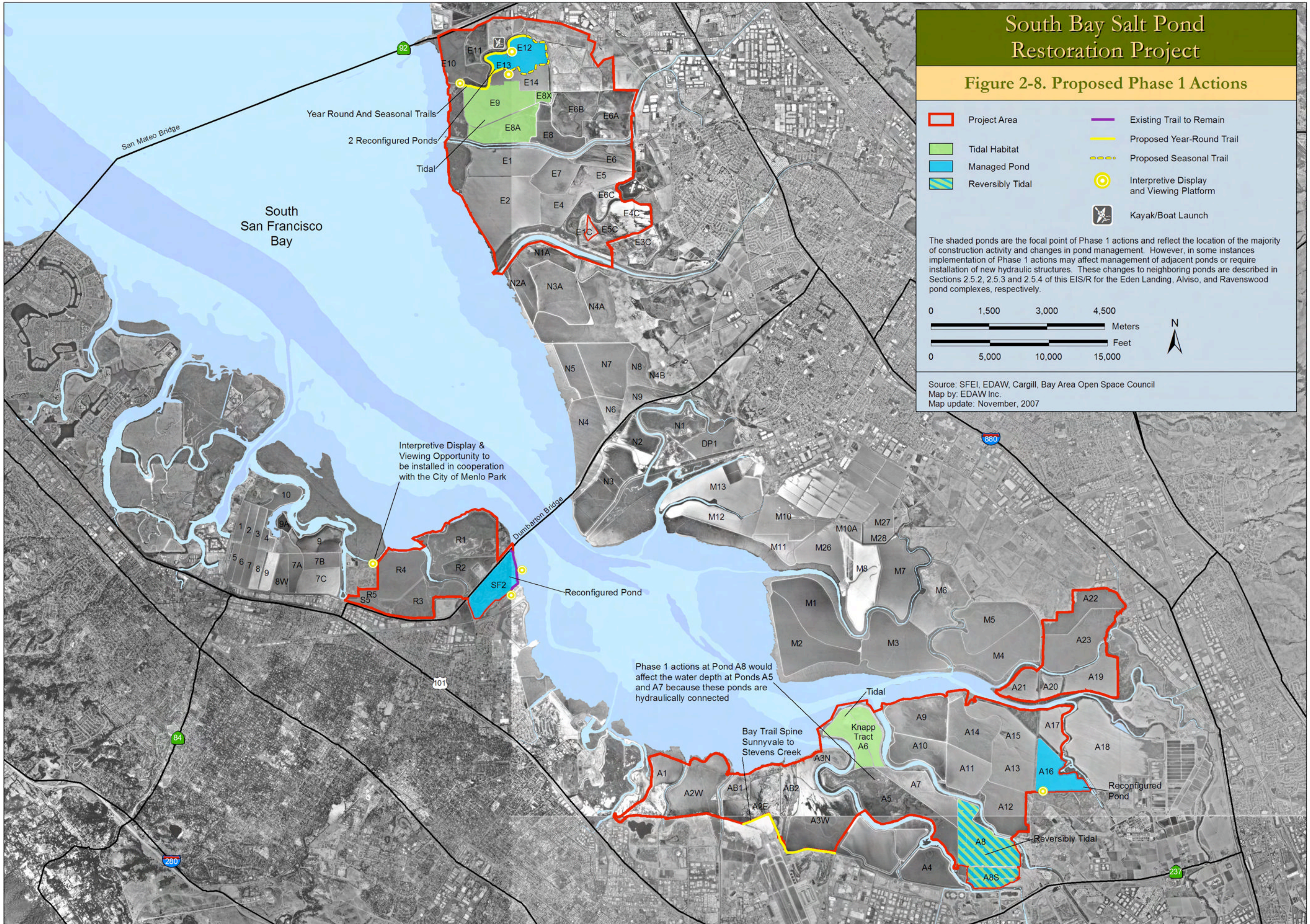
Table 2-16 Proposed Phase 1 Restoration Actions

PHASE 1 RESTORATION ACTION	TYPE OF RESTORATION	APPROXIMATE ACREAGE
Eden Landing Pond Complex (CDFG)		
Ponds E8A, E9, and E8X	Tidal habitat	630
Ponds E12 and E13	Reconfigured managed pond	230
Alviso Pond Complex (USFWS)		
Pond A6	Tidal habitat	360
Pond A8	Reversible muted tidal habitat	570[1]
Pond A16	Reconfigured managed pond	240[1]
Ravenswood Pond Complex (USFWS)		
Pond SF2	Reconfigured managed pond	240
Total Acreage		**2,270**

Note:
[1] Acreage includes only the pond(s) where major construction activities and habitat restoration would occur. Additional ponds would be affected by the restoration efforts (*e.g.*, Pond A5 and A7 would be affected by tidal inundation over the low internal levees that separate these ponds from Pond A8; Pond A17 would be operated jointly with Pond A16 to manage water levels within Pond A16.

Recreation and Public Access

As described in the long-term alternatives, recreation and public access in the SBSP Restoration Project Area would include an interrelated system of trails and viewing platforms, interpretative stations, waterfowl hunting, access to and interpretation of cultural resource features, opportunities for research, field education and interpretation, small watercraft launching points and associated staging and parking


South Bay Salt Pond Restoration Project
Figure 2-8. Proposed Phase 1 Actions
Project Area
Tidal Habitat
Managed Pond
Reversibly Tidal
Existing Trail to Remain
Proposed Year-Round Trail
Proposed Seasonal Trail
Interpretive Display and Viewing Platform
Kayak/Boat Launch
The shaded ponds are the focal point of Phase 1 actions and reflect the location of the majority of construction activity and changes in pond management. However, in some instances implementation of Phase 1 actions may affect management of adjacent ponds or require installation of new hydraulic structures. These changes to neighboring ponds are described in Sections 2.5.2, 2.5.3 and 2.5.4 of this EIS/R for the Eden Landing, Alviso, and Ravenswood pond complexes, respectively.
0 1,500 3,000 4,500 Meters
0 5,000 10,000 15,000 Feet
N
Source: SFEI, EDAW, Cargill, Bay Area Open Space Council
Map by: EDAW Inc.
Map update: November, 2007
South San Francisco Bay
San Mateo Bridge
Dumbarton Bridge
Year Round And Seasonal Trails
2 Reconfigured Ponds
Tidal
Interpretive Display & Viewing Opportunity to be installed in cooperation with the City of Menlo Park
Reconfigured Pond
Phase 1 actions at Pond A8 would affect the water depth at Ponds A5 and A7 because these ponds are hydraulically connected
Bay Trail Spine Sunnyvale to Stevens Creek
Knapp Tract A6
Reversibly Tidal
Reconfigured Pond
92
880
101
84
280
237
E10 E11 E12 E13 E14 E8X E9 E8A E8 E6B E6A E1 E7 E6 E5 E2 E4 E6C E4C E1C E5C E3C N1A N2A N3A N4A N5 N7 N8 N4B N9 N6 N4 N1 N2 DP1 N3 M13 M12 M10 M10A M27 M28 M11 M26 M8 M7 M6 M1 M2 M3 M5 M4 A22 A23 A19 A21 A20
10 9A 9 1 2 3 4 5 6 7 8 9 7A 7B 7C 8W R1 R2 R4 R5 S5 R3 SF2
A9 A14 A15 A17 A18 A10 A11 A13 A16 A1 A2W AB1 AB2 A3N A2E A3W A7 A5 A12 A8 A8S A4

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areas. The Phase 1 component of the Project would allow for initial construction of a smaller subset of this larger interrelated system of public access and recreation within the SBSP Restoration Project Area. The Phase 1 recreation actions would be implemented along with Phase 1 actions to allow for early public use of the SBSP Restoration Project lands. The locations and types of Phase 1 actions are dispersed throughout all three pond complexes and provide public access and recreation at strategic locations that were not previously accessible to the public.
The Phase 1 actions are subject to the laws and regulations of the land-owning agencies CDFG and USFWS as well as the Bay Conservation and Development Commission (BCDC) and other regulatory agencies, and the property rights of parties adjacent to or within the Project boundary (such as PG&E easements). For Phase 1 actions at the Alviso and Ravenswood pond complexes, USFWS would prepare a Compatibility Determination to ensure that the Phase 1 actions meet the National Wildlife Refuge System Improvement Act, which requires that public use be compatible with the purposes of the Refuge. See Section 3.7, Recreation Resources, of this EIS/R for more information on regulatory requirements pertaining to Project recreation components.

Public Access and Recreation Plan

The Phase 1 recreation and public access plan is part of the larger, program level actions and integrated with restoration and flood control actions. An overview of all Phase 1 actions can be found in Figure 2-8. Table 2-17 provides the general characteristics of Phase 1 public access and recreation components. All Phase 1 actions are designed to be accessible under the ADA of 1990, however not all levee trail improvements may be completed in the initial phases of construction due to funding constraints. Many of the proposed Phase 1 action sites may be universally accessible with the current levee surfacing however some locations would need improvements such as regrading and resurfacing. For the Bay Trail spine segment along the existing levee at Pond A3W, it would be made open to the public in its current condition, with a smooth earthen surfacing. Ultimately this trail segment would be rebuilt when the flood control levee is built so future improvements for accessibility would be made at that time.

The federal Access Board provides guidelines for accessibility for Outdoor Developed Areas (Regulatory Negotiation Committee on Accessibility for Outdoor Developed Areas) and these were used to develop the program and project-level public access and recreation plan.

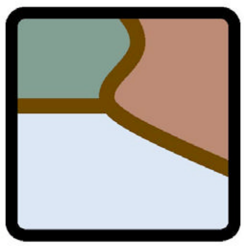
The Phase 1 actions were developed within an overall Project-wide system of public access points or trails and nodes that would include educational and interpretive program elements. The design of these features would create a unified series of forms and features that would provide identity for the SBSP Restoration Project and a sense of place for visitors. Common forms and colors across the Project Area would be developed while responding to site-specific requirements. These refer back to the past cultural landscape and how it was used for salt production. To assist in communicating to and educating visitors about the SBSP Restoration Project, five key themes that exemplify the Project components were developed and graphic symbols were designed. Table 2-18 illustrates these themes and the key messages that the symbols would provide. Appendix F of this EIS/R illustrates how the educational messages are related to the past and future landscape changes and interpretive themes noted below. These overall themes would provide the basis for developing interpretive storyboards at each interpretive station and

Table 2-17 Proposed Public Access and Recreation Phase 1 Actions General Characteristics

EDEN LANDING POND COMPLEX (CDFG)	GENERAL CHARACTERISTICS
Year-round access trail from Mt. Eden Creek staging area to historic salt works with interpretive station.	0.79-mile year-round trail connector from staging area between Ponds 12B and 14B to historic Oliver Salt Works and interpretive station.
Kayak/boat launch to Mt. Eden Creek from staging area. Accessible for waterfowl hunting as managed by CDFG.	Vehicular access from entry staging area to launching dock into Mt. Eden Creek, north of Pond E12 out to Bay. Provides San Francisco Bay Area Water Trail connection.
Seasonal loop trail around Ponds E12 and E13 and interpretive station near Archimedes screw.	1.50 mile seasonal trail from north side of Pond E12 around southern edge of Pond E13 to join Salt Works year round trail.
Year-round trail to shoreline with viewing platform and interpretive station.	1.50 miles from Oliver Salt Works along levee adjacent to Ponds E13, E14 and E9 on south side of Mt. Eden Creek to Bay and back.
ALVISO POND COMPLEX (USFWS)	
Pond A16 viewing platform and interpretive station	Staging area at the Refuge EEC and existing boardwalk would provide access to raised viewing platform overlooking managed pond restoration at central point along southern edge of Pond A16.
Pond A16 interpretive station	Existing Artesian (Mallard) Slough levee trail would provide access to interpretive station at central point along eastern edge of Pond A16.
Sunnyvale to Stevens Creek Bay Trail Spine	Uses existing levee on Refuge land to open 2.5 mile segment of Bay Trail spine connection between Sunnyvale WPCP to Stevens Creek.
RAVENSWOOD POND COMPLEX (USFWS)	
Trail rehabilitation along existing levee at east and south edges of Pond SF2	1.4 miles from existing staging area at northeast corner of Pond SF2 existing levee along Bay and southern edge to be re-graded for ADA access.
Viewing platforms (2) and interpretive stations at northeast and southeast boundary of Pond SF2	Two raised viewing platforms with interpretive stations to be integrated into rehabilitated trail at Pond SF2.
Bayfront Park viewing platform and interpretive station	Work with City of Menlo Park to provide an at grade viewing platform at high point in Bayfront Park overlooking pond R4 and Greco Island.

Notes:
All trails are multi-use excluding equestrians unless otherwise specified. Vehicular access only where noted.
Waterfowl hunting access remains the same as designated in the ISP and as specified in the program-level Project description.
Seasonal trails may be closed during bird nesting in the months of April through August. Trails subject to seasonal closures would alternate to provide maximum feasible public access, based on species and applied study results.

Table 2-18 Public Access Educational Messages and Interpretive Themes

EDUCATIONAL MESSAGES	SYMBOLS	SAMPLE INTERPRETIVE THEMES
Water		Water movement and flow Water quality Historic slough network Water control structures
Alteration		Maintaining levees for flood protection Red color of the water How is salt harvested Engineering for marsh creation
Habitats		Types of research and applied studies Landscape scale restoration and purpose Nesting islands shape and size Marsh vs. managed pond species
Partnerships		Landowners and adjacent community Multi-agency cooperation Stakeholder diversity Historic land use
Human Interface		Shoreline access Human disturbance Barrier-free access Research and education

through other signage in the SBSP Restoration Project Area, based on the specific site locale and as shown in the character simulations.

The interpretive stations and viewing platforms would be designed as key nodes throughout the SBSP Restoration Project Area to provide educational information and places where people can have a high quality experience within the salt ponds landscape. Directional and regulatory signage would be provided in addition to the interpretive information, as needed. An overarching goal for signage for the Project Area is to have a unifying logo that would provide the visitor with an understanding that they are within the SBSP Restoration Project Area, regardless of who owns or manages it. The signage would allow visitors to view various aspects of the restoration and to be connected to different parts of the landscape and shoreline. Site amenities such as seating would be provided at strategic locations within the overall public access system. Fencing along trails, if needed, would be provided for public safety or to minimize human disturbance to birds and other wildlife habitat areas. Docent-led tours, school groups and researchers would also utilize the public access locations for various educational and scientific data collection efforts. Sketches of the Phase 1 public access and recreation features as they relate to restoration and flood control were developed to assist the reader in visualizing the landscape character and the interface between visitors and the landscape as the restoration progresses. These are referenced below in the pond complex descriptions. The strategic locations for these features have been determined and would ultimately be designed to focus visitors where they can have the highest quality experience and learn the most about the Project elements, while minimizing their impact to adjacent habitats.

Pursuant to the Refuge Improvement Act, the Refuge will need to determine which public uses are compatible with the purposes of the Refuge and its mission.

Table 2-19 further outlines the specific uses that the Refuge preliminarily believes to be compatible uses on Refuge lands for Phase 1 action locations. A determination will be made about both the appropriateness and compatibility of these public uses prior to Phase 1 action implementation. See Section 3.7, Recreation Resources, for more information regarding compatible uses.

2.5.2 Eden Landing Pond Complex

Phase 1 actions in the Eden Landing pond complex would include tidal habitat restoration in Ponds E8A, E9, and E8X; a reconfigured managed pond restoration at Ponds E12 and E13; and recreation and public access actions in the northern portion of the pond complex.

Phase 1 No Action

Ponds E8A, E9 and E8X

In the absence of a Phase 1 action at Ponds E8A, E9, and E8X, CDFG would initially continue to operate and maintain the ponds in a manner similar to the ISP (Life Science! 2003), although ongoing O&M activities would be scaled back based on available funding (see Section 1.4.4 and Figure 1 in Appendix B of this EIS/R). Ponds E8A and E9 would operate together as a managed pond system. Bay water would flow by gravity into Pond E9 through the water control structure on Mt. Eden Creek at the northwest corner of Pond E9. The water would then circulate through Pond E9 and into Pond E8A through two

Table 2-19 USFWS Preliminary Phase 1 Action Compatible Uses

PHASE 1 ACTION LOCATION	POTENTIALLY ALLOWABLE PUBLIC USES
ALVISO	
Pond A6	No Allowable Uses
Ponds A5, A7, A8	Waterfowl hunting
Pond A16	Wildlife Observation Wildlife Photography Environmental Education Environmental Interpretation Hiking Bicycling Jogging (There may be seasonal closures of these trails, and to cooperate with applied study requirements, some of these activities would be restricted to one side of the pond or the other side or have temporal closure).
Bay Trail between Stevens Creek and City of Sunnyvale WPCP	Wildlife Observation Wildlife Photography Environmental Education Environmental Interpretation Hiking Waterfowl Hunting Access Bicycling Jogging Boating associated with waterfowl hunting from blinds only
RAVENSWOOD	
Pond SF2	Wildlife Observation Wildlife Photography Environmental Education Environmental Interpretation Hiking Jogging
Note: Compatible Use Designations apply to Refuge lands only as part of federal law on USFWS lands (The Refuge Recreation Act of 1962).	

water control structures located near the northwest and northeast corners of Pond E8A, and then flow out of the system and into OAC through a water control structure near the southwest corner of Pond E8A.

The discharge salinity into OAC would be maintained below 40 parts per thousand (ppt) in order to meet discharge requirements. Reversal of intake and outlet flow would be possible in order to better maintain water levels within the ponds, allow for the ponds to be drained if needed after storm events, and to serve as a contingency should a water control structure fail.

The water levels in Ponds E9 and E8A would be managed differently in the summer and winter months. In the winter, water levels would be higher due to the higher tributary inflows in Mt. Eden Creek in response to rainfall and lower evaporation rates. Pond E9 would also receive high salinity inflows from Pond E14 in the winter when Ponds E12, E13 and E14 operate as a system of high salinity ponds. In the summer, due to lower tributary inflows in Mt. Eden Creek and high evaporation rates, the water levels in Pond E9 would be lower. Due to the high pond bottom elevations in Pond E8A, the lower water levels would cause much of Pond E8A to dry-down in the summer and operate as a seasonal pond. Salinity in Pond E8A would therefore fluctuate due to residual salt in the pond, rainwater inflows and evaporation. Ponds E12, E13 and E14 would also operate as seasonal ponds in the summer; therefore, no high salinity inflows from Pond E14 to Pond E9 would occur. Summer operations would also be used in the winter during dry years. Pond E8X would operate as a reversibly tidal pond through a two-way flow water control structure to North Creek.

Over time, the operation of Ponds E8A, E9 and E8X would become more limited. As the water control structures fail over the next 5 to 20 years, water management would be discontinued and the ponds would be operated as seasonal ponds on a year round basis. The levees around Ponds E8A and E9 have a high risk of failure and overtopping, and once breached, the levees would not be repaired. As the levees erode and breach, Ponds E8A, E9 and E8X would become tidal in an unplanned and uncontrolled manner. The levees around Ponds E8, E6A and E6B would be maintained by CDFG and these ponds would continue to operate as managed ponds.

Ponds E8A, E9 and E8X are relatively high in the tide frame, with bed elevations approximately two to 3 ft above MTL; therefore salt marsh vegetation would likely begin to colonize shortly after the unplanned tidal conversion commences. However, the breaches would not be planned to optimize the reoccupation of remnant tidal channels and encourage the re-establishment of the historic tidal drainage system. The majority of tidal flows would be captured by borrow ditches, possibly inhibiting the formation of smaller tidal channels that provide nesting habitat for California clapper rails and serve as intra-marsh refugia for salt marsh harvest mice, rails, and other species. Vegetation establishment in Pond E8A may be inhibited due to the presence of a gypsum layer.

No public access and recreation access currently exists at Ponds E8A, E9 and E8X, and no new public access or recreational facilities would be constructed under this alternative.

Ponds E12 and E13

In the absence of a Phase 1 action at Ponds E12 and E13, CDFG would initially continue to operate and maintain the ponds in a manner similar to the ISP (Life Science! 2003), although ongoing O&M activities would be scaled back based on available funding (see Section 1.4.4 and Figure 1, Appendix B). Under the ISP, Ponds E12 and E13 would operate as high salinity ponds in the winter and seasonal ponds in the summer, in combination with Pond E14. Ponds E12 and E13 are high in elevation relative to the tides, with bed elevations approximately 1.3 ft below MHHW; therefore, the potential for gravity flows into the ponds would be limited. Winter high salinity pond operations rely on the existing intake pump from Pond E8X to Pond E13 as the primary source of water for the system. Water would then flow from Pond E13 to Pond E12 through multiple gaps in the abandoned levee between Ponds E12 and E13, and water would flow from Pond E13 to E14 through existing water control structures at the southwest corner of Pond E13. High salinity water would be discharged from Pond E14 to Pond E9 for dilution before it would be discharged to OAC through the existing water control structure in Pond A8A.

In the summer months, and during dry winters when high salinity discharges to Pond E9 are not practical, Ponds E12 and E13 would operate as seasonal ponds. The existing pump to Pond E13 would not be operated and the ponds would be allowed to dry-down. Salinity in the ponds would not be controlled and would fluctuate based on residual salt in the ponds, rainwater and evaporation.

If funding is available for pump O&M, CDFG would continue to operate Ponds E12 and E13 as high salinity ponds in the winter. However, if funding is not available to maintain or operate the pump, the ponds would become seasonal ponds year round. The levees around Ponds E12 and E13 have a high risk of failure or overtopping, and once breached, the levees would not be repaired. Tidal action would be restored to the ponds in an unplanned and uncontrolled manner. The levees around Ponds E8A, E9 and E14 could also erode and fail, thereby restoring tidal action to Ponds E12 and E13 from the south.

Because Ponds E12 and E13 are relatively high in the tide frame, salt marsh vegetation would likely begin to colonize shortly after the unplanned tidal conversion commences. However, the breaches would not be planned to optimize the reoccupation of remnant tidal channels and encourage the re-establishment of the historic tidal drainage system. The majority of tidal flows would be captured by the ponds' borrow ditches, possibly inhibiting the formation of higher-order tidal channels that provide nesting habitat for California clapper rails and serve as intra-marsh refugia for salt marsh harvest mice, rails, and other species.

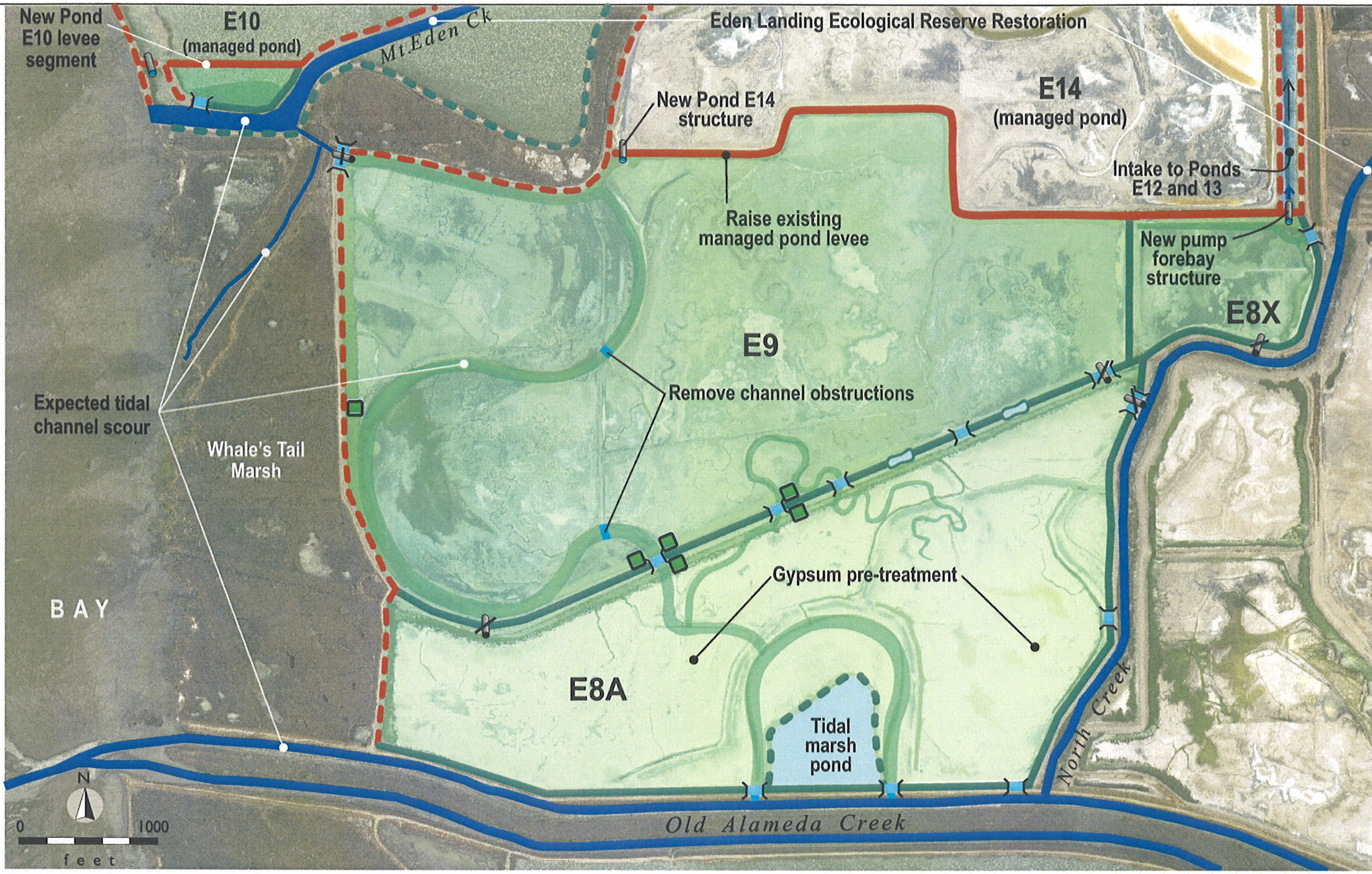
No public access and recreation access currently exists at Ponds E12 and E13, and no new public access or recreational facilities would be constructed under this alternative.

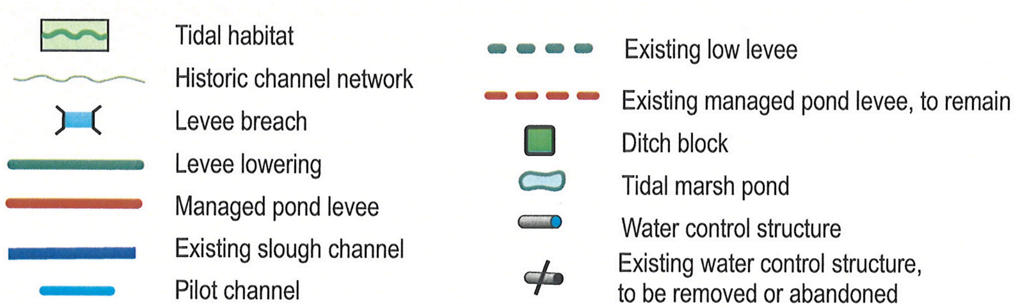
Phase 1 Restoration Actions

Ponds E8A, E9 and E8X

Introduction. Eden Landing Ponds E8A, E9 and E8X would be restored to tidal action to create approximately 730 acres of tidal salt marsh and tidal channel habitat (see Figure 2-9). As specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R) and described in the Ponds E8A, E9 and E8X Adaptive Management section below, the Ponds E8A, E9 and E8X restoration would test the effectiveness of restoration techniques to create tidal marsh pond habitat and pre-treat the gypsum layer in Pond E8A. The restoration would also test the influence of marsh restoration on flood hazards, the rates and effects of marsh sedimentation within the ponds on existing outboard tidal habitats, and the ecological value of tidal marsh ponds as applied studies.

Restoration Plan. Ponds E8A, E9 and E8X would be restored to tidal habitat by: breaching and lowering the outboard and inboard levees; improving the levee between Pond E14 and Ponds E9 and E8X; excavating pilot channels through the fringe marsh outboard of the breaches; constructing ditch blocks in the borrow ditches; maintaining existing and constructing new pond/panne habitats; and reconfiguring culvert connections (see Figure 2-9).





South Bay Salt Pond Restoration Project

figure 2-9

Eden Landing Ponds E8A, E9, and E8X Phase 1 Action Restoration Plan

Figure by Philip Williams & Associates Figure Date: 10-3-07

PWA Ref# 1750/phase1/basemaps/concept plans/tidal ponds/ pond E8A&E9_10-3-07.cdr

Although Ponds E8A, E9 and E8X have been diked for salt production, minimal subsidence has occurred. Existing bed elevations range from approximately 5.2 ft North American Vertical Datum (NAVD) (1.6 m NAVD) to 6.2 ft NAVD88 (1.9 m NAVD), or about 2 to 3 ft above the MTL. Because typical bed elevations of Ponds E8A, E9, and E8X are relatively high in the tide frame, the restoration action would likely initiate 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 marshplain to the elevation of adjacent mature marshes (approximately MHHW). The gypsum layer in Pond E8A may inhibit vegetation establishment and would therefore be pre-treated as discussed below.

Levee breaches. Tidal inundation would be restored to Ponds E8A, E9 and E8X by excavating six breaches through the perimeter levees to OAC, North Creek, and the historic Mt. Eden Creek channel. Most of the breaches would be located at the mouths of relict tidal channels to encourage the re-establishment of the natural drainage system. The historic systems of sinuous branching channels are expected to provide quality habitat for fish and wildlife, including the endangered California clapper rail.

Three breaches would reconnect Pond E8A to OAC. Two additional breaches would restore tidal connectivity between Ponds E8A and E8X and North Creek. A sixth breach at the location of the existing Pond E9 water control structure would restore tidal action between Pond E9 and Mt. Eden Creek. The levee breaches would be sized to provide full tidal exchange between the restored ponds and adjacent tidal sloughs.

Downstream of the Pond E9 breach, Mt. Eden Creek is expected to scour and widen in response to restored tidal flows. The restoration would include measures to allow Mt. Eden Creek to scour and widen without eroding or breaching the Pond E10 levee along the north bank of Mt. Eden Creek. For example, the segment of the Pond E10 levee downstream of the Pond E9 breach could be relocated approximately 360 ft (110 m) to the north of its current location as shown in Figure 2-9. The existing Pond E10 levee could also be reinforced and Mt. Eden Creek could be enlarged as part of the restoration. Specific measures for improvement to the Pond E10 levee and Mt. Eden Creek would be specified in the design phase.

The internal levees between Ponds E8A, E9 and E8X would be breached in several locations to restore the historic tidal channel system and improve tidal drainage, and circulation. The breaches along the interior levee between Ponds E8A and E9 would reconnect relict historic tidal channels and improve tidal drainage to the entire Pond E8A, E9 and E8X area. The internal levee between Ponds E9 and E8X would be breached to allow drainage along the existing borrow ditch. All breaches across internal levees would be constructed to the approximate width and depth of the historic channels.

Pilot channels. Pilot channels would be excavated from the outboard levee breaches to the tidal sloughs through the existing vegetated marsh. Pilot channels would facilitate tidal exchange through the breaches by removing erosion-resistant marsh vegetation and providing an initial drainage channel that would gradually enlarge through tidal scour. Constructed pilot channels would be narrower than the breach excavations in order to minimize costs and impacts to existing marsh. Material excavated from the pilot channels would either be used to construct the borrow ditch blocks or cast to the side on the marsh adjacent to the pilot channels. This material would likely erode as the pilot channel banks scour.

A portion of Mt. Eden Creek may be excavated to enlarge the channel and improve tidal exchange through Mt. Eden Creek and the Pond E9 breach. The existing pilot channel connecting the Pond E9 water control structure to Mt. Eden Creek may also be enlarged. Enlarging these channels would also reduce the time for the channels to scour.

Levees. Perimeter levees along OAC and North Creek and the internal levees between Ponds E9 and E8A and Ponds E9 and E8X would be lowered to approximately MHHW (7.0 ft NAVD or 2.1 m NAVD). Lowering of the outboard levee would create pickleweed salt marsh habitat around the perimeter of the restoration site, which is expected to provide escape cover for the endangered salt marsh harvest mouse. Lowering the levee would restore the hydrologic connectivity between the adjacent sloughs and the restored marsh areas during the highest tides.

The bayfront levee between Whale's Tail Marsh and Ponds E8A and E9 would not be lowered in order to reduce the potential for wave action and overtopping of this levee from the Bay, and subsequent overtopping into Ponds E14 and Ponds E12 and E13. This bayfront levee would be allowed to degrade over time while tidal marsh establishes in Ponds E8A and E9.

The levee between Ponds E9 and E8X and Pond E14 would be raised to prevent frequent tidal inundation into Pond E14. The elevation of the levee would be raised by approximately one to 4 ft. Material generated from levee lowering would be used to raise and widen the levee cross-section. A gentle slope would be created on the outboard (tidal) side of the levee to provide upland-transition habitat in Ponds E9 and E8X as well as wind-wave dissipation to reduce levee maintenance needs.

The levee between Ponds E8X and E14 would be extended a short distance to the east across the narrow northern extension of Pond E8X (along the eastern edge of Pond 14), connecting to the levee between Pond E8X and North Creek. A water control structure would be installed in this new levee segment. This would allow the northern extension of Pond E8X to be managed as a forebay for the intake pump to the Phase 1 action reconfigured managed pond at Ponds E12 and E13 (see Ponds E12 and E13 section below).

As discussed above, the restoration would include measures to allow Mt. Eden Creek to scour and widen without eroding or breaching the Pond E10 levee along the north bank of Mt. Eden Creek.

Borrow ditch blocks. Borrow ditch blocks would be constructed to block flow in the borrow ditches and promote re-establishment of the historic tidal drainage system in Ponds E8A, E9 and E8X. The existing borrow ditches were excavated along perimeter and interior levees, and are expected to remain features in the marsh landscape over the long term. Ditch blocks would inhibit flow through the borrow ditch and direct tidal scour through relict historic channels. Ditch block locations were selected to provide complete drainage of the borrow ditch at low tide to avoid potential fish trapping. Borrow ditch blocks would be constructed across the borrow ditch with material obtained from levee lowering. Additional material excavated from the lowered levees may be placed along the edge of the borrow ditch to create additional marsh habitat. In these locations, the borrow ditch would not be blocked and the conveyance of tidal flows in the borrow ditch would be maintained. Certain portions of the borrow ditches would not be blocked to facilitate drainage, such as the borrow ditches draining to the Pond E9 and Pond E8X breaches.

Marsh ponds. Marsh pond habitat would be created by constructing shallow depressions along the top of the lowered internal levee between Ponds E9 and E8A. At the locations of the restored marsh ponds, the levee would be lowered to elevations varying from MHHW to slightly above MHHW to test the sustainability of marsh ponds at different elevations as a restoration technique (see the Ponds E8A, E9, and E8X Adaptive Management section below). The restored marsh ponds would be inundated during high tides and would pond water during periods of lower tides. Prolonged inundation and concentration of salts would be expected to inhibit vegetation establishment in the ponds and maintain open water in the pond. Bird use in the marsh ponds would be monitored to test their ecological value as an applied study.

The existing low internal berm that forms a pond within Pond E8A along its southern edge would remain intact. This area is expected to become a large tidal marsh pond after restoration. This marsh pond would also be monitored to test the sustainability and ecological value of this type of pond.

Water control structures. The existing water control structures would be abandoned or removed, as they would not be needed once Ponds E8A, E9 and E8X are restored to tidal action. New water control structures would be installed between Ponds E9 and E14 and between Pond E8X and the northern extension of Pond E8X. These passive water control structures would be used to manage water levels and flows in Pond E14 and the pump forebay in the northern extension of Pond E8X. Gravity flows through the water control structures would be driven by the tides in Ponds E8A, E9, and E8X.

Gypsum pre-treatment. Portions of the existing gypsum layer across the Pond E8A bed would be mechanically disturbed prior to restoration to break up this hard layer. The gypsum layer could inhibit vegetation establishment and delay habitat development until the gypsum layer dissolves and degrades over time. The dissolution of the gypsum would depend on environmental factors, which include the density of gypsum, water exchange rates, surface flow velocities, water chemistry and inundation periods (Siegel and Bachand 2001). The Pond E8A bed and gypsum layer are above the elevation at which marsh vegetation colonizes emerging mudflats and within the elevation range where plant roots grow, and may block root growth (Siegel & Bachand 2001). Construction equipment or other techniques would be used to disturb the gypsum layer. The gypsum would be treated only in certain locations, and not in others, to test the effectiveness of this restoration technique (see the Ponds E8A, E9 and E8X Adaptive Management section below).

Adaptive Management. Adaptive management for the Phase 1 action at Ponds E8A, E9 and E8X would include applied studies and restoration techniques as specified in the Adaptive Management Plan (see Section 2.3 and Appendix D).

Applied Studies. Phase 1 experiments at Ponds E8A, E9 and E8X would test:

1. Relative influence of slough scour and marsh restoration on flood hazards.

2. Rates of marsh sedimentation.

3. Effects of pond sedimentation on existing outboard intertidal habitat.

- Relative Influence of Slough Scour and Marsh Restoration on Flood Hazards. Tidal restoration at Ponds E8A, E9 and E8X is expected to enlarge reaches of OAC and Mt. Eden Creek downstream of breaches in the perimeter levee by increasing tidal current velocities. These potential changes in slough geometry would increase the ability to convey flood flows and lower upstream water levels when the large amounts of runoff from the watershed is routed to the creek. However, modifications of the tides in the slough (*i.e.*, increasing water levels at low tide) may lead to short-term adverse impacts to existing flood hazards. The Phase 1 tidal restoration at Ponds E8A, E9 and E8X would provide an opportunity to assess the changing flood conveyance along OAC and determine if flood hazards are decreased over both the short- and long-term. Monitoring data of slough scour and the tidal regime would provide the necessary information to examine changes to baseline flood hazards. If it is determined that the backwater elevation increases upstream of the breached ponds as a result of tidal habitat restoration, different approaches to levee breaching may be incorporated in subsequent phases.
- Rates of Marsh Sedimentation. Tidal restoration at Ponds E8A, E9 and E8X would set in motion accretionary sedimentary processes that would raise the bed elevations over time. Natural sedimentation within the ponds would depend upon the sediment supply for local tributaries, transport of estuarine sediment from the bay and sloughs, and deposition and retention of sediment in the ponds. Flood tides carry in suspended estuarine sediments that deposit in the slack waters. Ebb tidal currents are insufficient to resuspend deposited muds and silts, except in the locations of nascent tidal channels. As mudflats in the restored ponds rise in elevation, changes to the period of inundation would decrease and the rate of sedimentation would decline. Once mudflats reach a high enough elevation relative to the tidal frame, pioneer plant colonization would occur. Monitoring data collected at Ponds E8A, E9, and E8X would provide information on sedimentation rates of ponds relatively high in the tidal frame and help to improve robust predictive models of pond accretion. Sedimentation rates measured inside the restored ponds would also determine the sediment demand of this Phase 1 action and help explain observed changes to the adjacent tidal sloughs and outboard mudflats.
- Effects of Pond Sedimentation on Existing Outboard Intertidal Habitat. Tidal restoration rests on the assumptions that suspended sediments transported into the ponds on flood tides would be deposited when tidal current velocities decrease at slack tide and that colonization by marsh vegetation would follow. The South Bay contains regions that tend to be more depositional and regions that tend to be more erosional on a seasonal or annual basis. When ponds are breached near regions that are currently depositional, it is likely that the breached ponds would be filled with sediment that would have formerly been deposited on accreting South Bay mudflats. It remains unclear, however, if the sediment supply in these depositional regions would be great enough to prevent the formerly accreting mudflats from eroding. When ponds are breached near regions that are currently erosional, it is unclear from where the sediment source for filling the ponds would come.

Restoration Techniques. The Phase 1 action at Ponds E8A, E9 and E8X would test the effectiveness of restoration techniques for the creation of marsh pond/panne habitat and gypsum pre-treatment.

- Creation of Marsh Pond/Panne Habitat. Marsh ponds, as discussed above, are typical, but not ubiquitous, features of historic and mature salt marshes that provide important habitat for certain bird species. Marsh ponds would be constructed at various elevations above MHHW to study their general constructability as well as the relationship between marsh pond sustainability and marsh pond elevation above MHHW. The internal levee between Ponds E9 and E8A would be lowered throughout most of its length to MHHW. A portion of the levee would be lowered to variable elevations above MHHW. Small depressions would be constructed within the portions of the levee which would presumably fill with water seasonally after precipitation or on spring tides. Seasonal field surveys of vegetation cover, soil salinities, bird use and erosion along the margins of the graded ponds would be conducted and the data compiled to compare the relative sustainability and use of marsh ponds at different elevations above MHHW. If applicable, the optimal elevation or range of elevations would then be applied to tidal restoration in future stages of the Project.
- Gypsum pre-treatment. The hard layer of gypsum deposited over the bed of Pond E8A when it was operated for salt production may delay or impair marsh plant community development, which is central to the biological functions of a wetland ecosystem. Pre-treatment would disturb or fracture the gypsum layer in select locations, while the layer would be left intact in other locations. The thickness of the gypsum layer would be measured across the pond prior to restoration, and would be considered in selecting areas for pre-treatment. Once restored, vegetation establishment (overall and by species) in treated areas of Pond E8A would be compared with monitoring data from areas where the gypsum layers are intact.

Restoration Monitoring. Monitoring (summarized in Table 2-3) would include physical and vegetative processes and ecological and species response for the purposes of adaptive management (*i.e.*, applied studies) and evaluating Project performance (*i.e.*, for any permit requirements). Low-tide aerial photographs, possibly supplemented with annual ground surveys, would provide information on channel and marsh development to assess the performance of restoration techniques. For example, the aerial photos and ground surveys could be used to track the development of low, medium and high marsh zones, which provide different habitat values for the California clapper rail and salt marsh harvest mouse. Once suitable vegetated marsh habitat develops in Ponds E8A, E9, and E8X, surveys of California clapper rail and salt marsh harvest mouse would be performed to track the progress of these endangered species towards recovery, in accordance with Section 7 of the Endangered Species Act. Invasive plant monitoring and control would be coordinating with existing control efforts, such as the Invasive Spartina Project, as discussed in the Introduction (Chapter 1), and under the SBSP Long-term Alternatives B and C (see Sections 2.4.3 and 2.4.4, respectively).

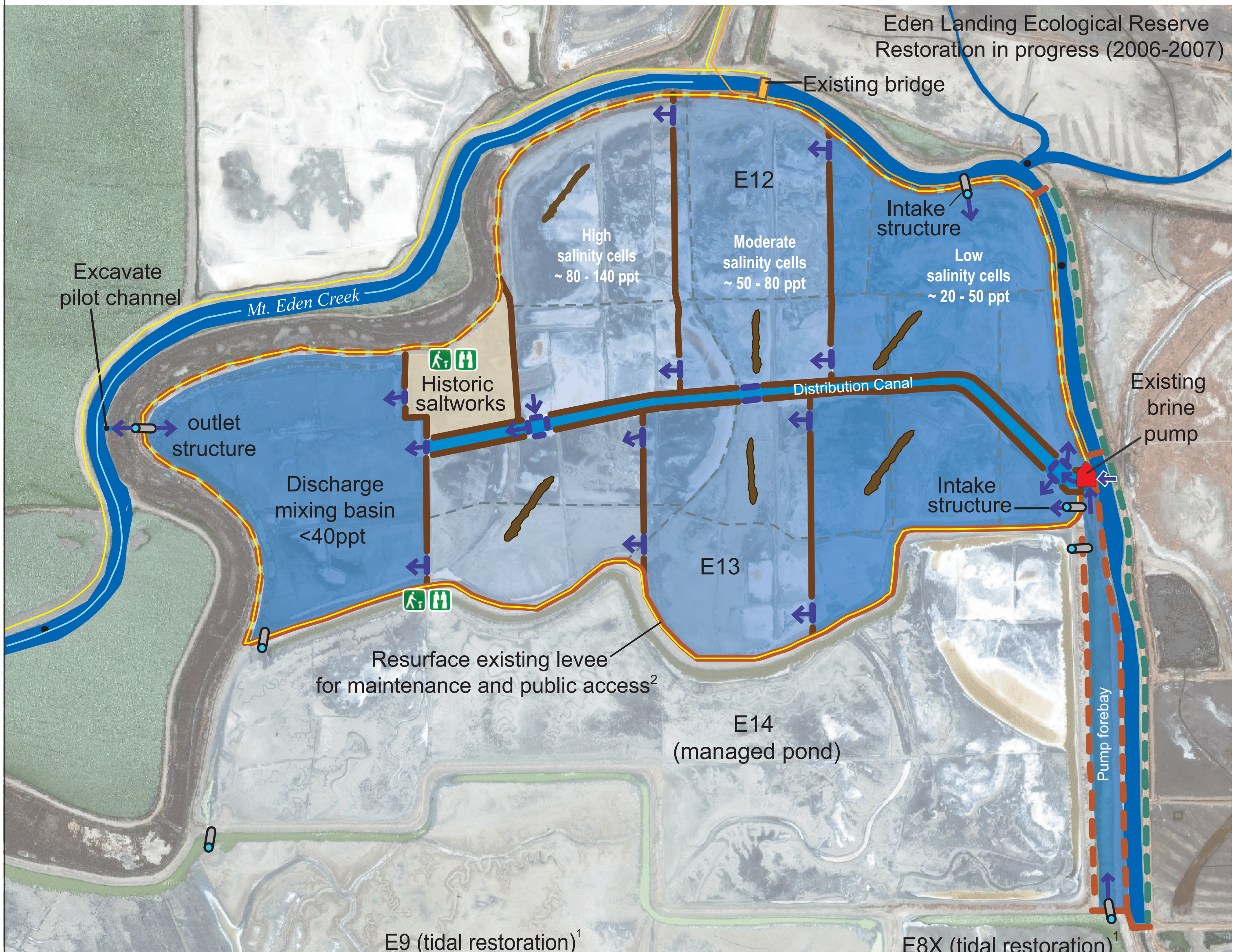
Ponds E12 and E13

Introduction. The Eden Landing Ponds E12 and E13 would be reconfigured to create shallow water foraging habitat for migratory shorebirds, with a range of salinities, and a limited number of islands for nesting bird habitat (see Figure 2-10). As specified in the Adaptive Management Plan (see Section 2.3 and Appendix D), the Ponds E12 and E13 restoration would test the extent to which focused management of shallow water habitats can increase migratory shorebird densities, the importance of salinity on the density of foraging shorebirds and their prey as applied studies, and techniques for vegetation

South Bay Salt Pond Restoration Project

figure 2-10

Eden Landing Ponds E12 and E13 Phase 1 Action Restoration Plan



Legend

- Low-salinity cells ~20 - 50 ppt and discharge mixing basin <40 ppt
- Moderate-salinity cells ~50 - 80 ppt
- High-salinity cells ~80 -140 ppt
- Historic salt works
- Water control structure (weir)
- Typical flow direction
- Existing brine pump
- Earth berm or wood fence
- Improve managed pond levee
- Existing levee
- Existing lowered levee
- Existing remnant crystalizer fence gaps to be constructed for circulation
- Nesting island
- Intake/outlet water control structure
- Pilot channel
- Existing slough channel
- PG&E power distribution line
- Trail[2]
- Water trail[2]
- Interpretive station[2]
- Viewing platform[2]

[1]See Figure 2-8 for Ponds E9, E8X and E8A restoration plan.

[2]See Figure 2-10 for Eden Landing Phase 1 Actions public access and recreation features.

Figure by Philip Williams & Associates
Figure Date: 1-25-07

#1750/phase1/basemaps/concept plans/tidal ponds/Pond E12 & E13_1-25-07.ai management, predator management, and water and salinity management. Recreation and public access features for the Ponds E12 and E13 restoration are described in the Eden Landing Recreation and Public Access Actions section below.

Restoration Plan. Ponds E12 and E13 would each be divided into three cells (six total) with progressively increasing salinity levels in each cell (see Figure 2-10). Of the six cells, two cells would be managed to maintain low salinity levels (approximately 20 to 40 ppt) similar to Bay salinity levels; two cells would be managed to maintain moderate salinity levels (approximately 40 to 80 ppt); and the remaining two cells would be managed to maintain high salinity levels (approximately 80 to 120 ppt) during the dry season. The water depths within each cell would be managed to provide optimal shallow water habitat for shorebird foraging. One island would be constructed in each of the six cells to create habitat for nesting birds. Consistent with the adaptive management approach of the SBSP Restoration Project, this Phase 1 action allows for multiple flow paths and management flexibility.

Water management. Water levels and flows in Ponds E12 and E13 would be managed using passive water control structures, such as culverts and/or weirs with gravity flows driven by the tides, and supplemental pumping as needed. The elevation of the ponds gently slopes from east to west and averages 5.7 ft (1.7 m) NAVD, which is approximately 1.3 ft (0.4 m) below 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 would occur through new intake structures located between Mt. Eden Creek and Pond E12, and between the northern extension of Pond E8X and Pond E13. Mt. Eden Creek and the ELER Restoration Project Area has been restored to tidal action in the fall of 2006 under a separate project. Pond E8X would be restored to tidal action as part of the Phase 1 action at Ponds E8A, E9 and E8X (see description above). The narrow northern extension of Pond E8X (along the eastern edge of Pond 14) would connect Ponds E12 and E13 to North Creek. The existing brine pump would 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 would likely silt in and become vegetated if restored to tidal action; therefore, a new culvert with tide gates would be installed between Pond E8X and the northern extension to create a managed forebay. This pump forebay would 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 Eden Landing, the existing culverts would be replaced with new culverts with adjustable tide gates. Pond E14 may be managed to provide seasonal or year-round pond habitat.

Within Ponds E12 and E13, earth berms (or similar structures) would be constructed to separate the ponds into six cells. Passive water control structures, such as flashboard weirs, would be used to maintain water depths ranging from approximately 2 inches (5 cm) to 1 ft (30 cm), with an average depth of less than 6 inches (15 cm), to provide shorebird foraging habitat. The shallowest areas would support smaller *Calidris* sandpipers and the deeper areas would support larger shorebirds. Gaps would be excavated through the existing remnant structures (wood fences separating former salt crystallizer cells) to improve circulation within the cells.

The restoration plan includes a water distribution canal between Ponds E12 and E13, with water control structures connecting the canal to each of the six cells. This distribution canal would 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 would be created by constructing a new earth berm (or similar structure) south of the existing borrow ditch between Ponds E12 and E13 and rebuilding the remnant levee north of the borrow ditch as needed.

Salinity management. Bay water (with a salinity level of approximately 20 to 30 ppt) would flow into the low salinity cells from the adjacent sloughs. During the dry season (approximately May to September), evaporation would cause salinity levels to increase in each of the cells (*i.e.*, by removing water and concentrating salt). Water in the low salinity cells would range in salinity from approximately 20 to 50 ppt. Water from the low salinity cells would flow into the moderate salinity cells. This would further concentrate salt and raise salinity levels to approximately 50 to 80 ppt in the moderate salinity cells. Moderate salinity water would flow into the high salinity cells, progressively increasing salinities to approximately 80 to 140 ppt in the high salinity cells. High salinity cells would be managed to keep salinities below approximately 140 ppt to reduce the potential for gypsum and other less soluble salts to precipitate and deposit in the pond. The effectiveness of different water and salinity management approaches would be tested as part of the Adaptive Management Plan. Appendix G of this EIS/R (Eden Landing Ponds E12 and E13 Water and Salt Balance Modeling) documents hydrologic modeling performed to assess the feasibility of water and salinity management in Ponds E12 and E13.

During the wet season (approximately October to April), rain would dilute saline water in the cells. To accommodate rain water inputs to the cells, the water control structures would be adjusted to reduce flows into the ponds and maintain target shallow water depths in the cells. At the end of the wet season, the structures would be adjusted to drain rain water, fill the cells with Bay water, and increase salinity levels to target levels.

Discharge mixing basin. A discharge mixing basin would be created in the western end of Pond E13 to dilute high salinity water before discharging it back into Mt. Eden Creek. The bed elevation of the mixing basin would be approximately 5.0 ft (1.5 m) NAVD, which is approximately 2 ft (0.6 m) below MHHW and slightly lower than the rest of Ponds E12 and E13. Water from the high salinity cells would flow into the mixing basin where it would mix with bay salinity water (approximately 20 to 30 ppt in the summer) from Mt. Eden Creek before discharging to Mt. Eden Creek. Water would flow between the mixing basin and Mt. Eden Creek through a new outlet structure, such as several 24-inch or 48-inch culverts with adjustable tide gates. Water would flow both in and out of the outlet structure to allow mixing and discharge. The water discharged back to Mt. Eden Creek would meet water quality discharge requirements for salinity of less than 44 ppt and DO of greater than 5.0 mg/L. The discharge would either be passively managed by allowing muted tidal flow in and out of the mixing basin through the new culvert or actively controlled by discharging water less frequently. Water from the discharge mixing basin could also flow into Pond E14 to dilute or store high salinity water as needed. Appendix G of this

EIS/R (Eden Landing Ponds E12 and E13 Water and Salt Balance Modeling) documents a technical feasibility assessment of the Pond E13 discharge mixing basin.

Nesting islands. One island would be graded in each of the six cells to provide nesting bird habitat. Nesting islands are expected to be used by snowy plovers, Caspian and Forster's terns, American avocets, and black-necked stilts. Each island would be approximately 3 ft (1 m) high, 300 ft long, and 50 ft wide. The islands would be constructed using fill material (on-site borrow) excavated from the windward side of the islands. Water depths would 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. The islands would be located at least 300 ft (90 m) from the edge of the pond to provide a buffer between nesting birds and mammalian predators and to minimize disturbances to threatened and endangered nesting birds by human activity on the levee (*e.g.*, recreation associated with public access trails). The islands would be located at least 600 ft (180 m) from any focal areas for human use, such as viewing platforms, benches and the historic salt works.

Levees. The existing managed pond levee between Pond E13 and Pond E14 would be improved and resurfaced to create a maintenance road and public access trail. The existing levee around the rest of Ponds E12 and E13 would remain as is.

Historic salt works. The historic salt works in Pond E12 would be preserved for recreation and public access (see Eden Landing Recreation and Public Access Actions section below for a description of these recreation and public access features). An earth berm would separate the historic salt works from the rest of Ponds E12 and E13. A new water control structure, such as a culvert or weir, would be installed in the berm to connect the historic salt works to the discharge mixing basin. The historic salt works would wet and dry seasonally due to rainfall and evaporation. The new water control structure would allow water levels in the historic salt works to be managed as needed.

Infrastructure. The existing PG&E power distribution lines and poles would remain to provide power to the existing brine pump located at the eastern corner of Pond E13 as shown on Figure 2-10.

Adaptive Management. Adaptive management for the Phase 1 action at Ponds E12 and E13 would include both an applied study and restoration techniques, as specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R).

Applied Studies. Phase 1 experiments at Ponds E12 and E13 would test the 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.

Several shorebird species, particularly Wilson's and Red-necked Phalaropes, have long been known to occur in the South Bay primarily within higher-salinity ponds. These species generally forage in high-salinity ponds throughout the tidal cycle. In addition, studies by PRBO and others have demonstrated that some species that typically forage on intertidal habitats during low tide, such as Western sandpipers and dunlin, show an affinity for higher-salinity (vs. lower-salinity) ponds at high tide, and that many individuals of these species forage in higher-salinity ponds at high tide. However, very high densities of shorebirds have also been observed foraging in South Bay ponds that do not have high salinities, but do have optimal foraging depths for small shorebirds. The Ponds E12 and E13 experiment would assess whether foraging shorebirds prefer low, moderate, or high salinity levels (and the associated prey types) in cells with similar shallow water depth habitat. The results of the Ponds E12 and E13 experiment would determine the need for ponds with elevated salinity levels for foraging by migratory shorebirds in future phases of the Project within the Adaptive Management Plan.

The nesting islands may provide some information regarding nesting bird use at the different salinity levels in the pond; however, this would not be the focus of the Ponds E12 and E13 applied study.

Phase 1 applied studies would also include research on the effect of trail use on shorebirds using the Pond E12 and E13 foraging habitats. Recreational access, especially where the public directly approaches birds, could potentially have impacts on shorebird behavior and numbers. Studies both before and after trail use is initiated at a particular site would provide more complete data about shorebird responses to trail use. Ponds E12 and E13 would provide for such a study regarding the effects of trail use on shorebirds.

Restoration techniques. The Phase 1 action at Ponds E12 and E13 would test the effectiveness of management approaches for:

1. Water and salinity management

2. Vegetation management.

- <u>Water and salinity management.</u> The effectiveness of different water and salinity management approaches for high salinity cells and discharge water quality would be tested. Two potential water and salinity management approaches would be tested to allow either periodic or continuous flow between the cells. For periodic flows, the water control structures would be opened approximately every ten days to allow water to flow into the low salinity cells and between each of the cells. The water control structures would then be closed. Evaporation would decrease water depths and increase salinity levels in the cells until the structures were opened again to refill the cells. Water depths would fluctuate by approximately 2 inches (five cm) and salinity levels would vary within the ranges described above. For continuous flow between cells, the water control structures would be adjusted to allow flows that balance evaporation and result in target salinities. Flows, water levels, and salinities, would be relatively constant compared to the periodic flows and fluctuations. Similarly, the effectiveness of both periodic and continuous mixing and discharge of high salinity outflows into the discharge mixing basin would be tested.
- <u>Vegetation management.</u> Vegetation management on the nesting islands would also be tested as a restoration technique to assess the effectiveness of high salinity in discouraging vegetation growth.

Restoration Monitoring. Restoration monitoring would be performed at Ponds E12 and E13 to evaluate restoration performance, as part of some applied studies, and test restoration techniques. Inspections related to O&M are addressed in Section 2.5.6.

- Water and salinity management. As discussed in the O&M section in Section 2.5.6, water levels and salinity would be routinely monitored on a weekly basis (approximate) to evaluate pond operation. During periods when different restoration techniques would be tested, water level and salinity monitoring would likely be more frequent (approximately daily observations).
- Vegetation management. Vegetation encroachment on the nesting islands and pond bed would be monitored to test elevated salinity levels as a vegetation management technique. Vegetation monitoring would be performed as discussed for Alviso Pond A16 (see Section 2.5.3 below).

Phase 1 Recreation and Public Access Actions

The Phase 1 public access and recreation plan for Eden Landing would occur in the northern portion of the pond complex (see Figure 2-11). Both year-round and seasonal trails would link to the Bay Trail Spine segment that would be constructed as part of the 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 SR 92 and the Hayward Regional Shoreline to the east and south towards Union City and Coyote Hills Regional Park.

In total, 3.8 miles of new trail would be constructed along existing levees as part of the Phase 1 public access plan at Eden Landing and 1.6 miles of water trail would be provided at Mt. Eden Creek. These trails along with the kayak and boat launching site, the viewing platforms and interpretive stations would provide an opportunity for a wide range of visitors. The proposed features would provide a diversity of recreational opportunities, including walking, cycling, kayaking/boating, fishing, waterfowl hunting, learning about the history of the area, and viewing of surrounding habitat and wildlife.

Most of the trails proposed at Eden Landing for the Phase 1 plan would be 6 ft wide on an existing managed pond levee, and would have firm and stable, hardened surfacing to allow for hikers, wheelchairs and cyclists. Dogs are permitted at the reserve for waterfowl hunting and as per CDFG regulations. Currently the managed pond levees provide firm and compacted surfaces so paving would not be required; however for ADA compliance some re-surfacing may be necessary. In some instances, such as the loop trail on the levee between Ponds E13 and E14, the levee would need to be re-graded, leveled and re-surfaced to allow for safe access and maintenance operations. The trails would be open to the public during typical hours of operation, from sunrise to sunset and would include amenities along the trail such as seating. Fencing may be required along certain portions of the trails to prevent human disturbance to adjacent habitat areas. Under the Phase 1 actions, one seasonal trail is proposed within the Eden Landing pond complex from the northeast corner of pond E12 south and westerly between ponds E13 and E14. Typically, the bird nesting season occurs between the months of March through August. See Eden Landing Phase 1 Map for a plan of Phase 1 actions (Figure 2-11).

The kayak/boat launch, located north of Pond E12 and on the north side of Mt. Eden Creek would be accessible year-round from the existing levee road that leads from the staging area to the Mt. Eden bridge and designed for ADA compliance. The staging area would support 58 vehicles and would be built as part of the restoration plan for the northern 835 acres of ELER, a separate action currently underway. The launch would be approximately 8 to 10 ft wide and 20 ft long to accommodate non-motorized boats (*e.g.*, kayaks and canoes) and small motorized boats for hunting and operations. Additionally, this area can be used to launch small motorized boats for management and operations and waterfowl hunting access to certain designated areas of the pond complex. Mt. Eden Creek was restored to tidal action in 2007. Figure 2-12 shows a sketch of the launching area. With construction of a kayak launch as part of the SBSP Restoration Project, kayakers can travel 1.6 miles from the launch point to the Bay. Other amenities at the launch/staging area would include seating areas and interpretive information. Future, nearby restroom facilities may be constructed as part of the field office near the staging area as defined in the program-level alternatives. However, in the short-term, chemical toilets would be provided when the Bay Trail Spine project is completed. The inclusion of a kayak/boat launch and associated water trail could become part of the San Francisco Bay Area Water Trail, which is being planned as a network of landing and launch sites to allow a continuous paddling experience for the enjoyment of the historic, scenic and environmental resources of San Francisco Bay.

The historic Oliver Salt Works (also known locally as the Rock Island Salt Works) currently consists of remnants of the old salt production / harvesting-related facilities (*e.g.*, pilings, foundations). Under the proposed Phase 1 actions, the saltworks would be accessible to the public by a new accessible trail, and would be open year-round. Depending on seasonal water flow through this area, visibility of the remnants vary. An interpretive station would be designed to tell the history of the salt works at this location, explain how salt is produced, and explain the saltwork's cultural, economical, and social linkage to the greater San Francisco Bay Area. The interpretive station would be placed along the trail in the central portion of the remains. Figure 2-13 shows a sketch of how this area would look and the placement of the interpretative station. Two additional viewing areas would be developed along with site-specific interpretive information. One would be between Ponds E13 and E14 along the levee loop trail and looks out over the remains of historic Archimedes screws as well as provides opportunities to see the managed pond habitats and learn about species-related experiments that would take place in adjacent ponds. Figure 2-14 shows a sketch of this location. This site would be accessible year round from the loop trail approaching from the west and seasonally from another trail segment approaching from the east. The viewing area would also provide seating to be a resting stop along the trail loop. The other viewing area at Eden Landing would be at the terminus of the shoreline trail where it would be part of the existing levee along Pond E9 and near where Mt. Eden Creek and Whale's Tail Marsh meets the Bay's open water edge.

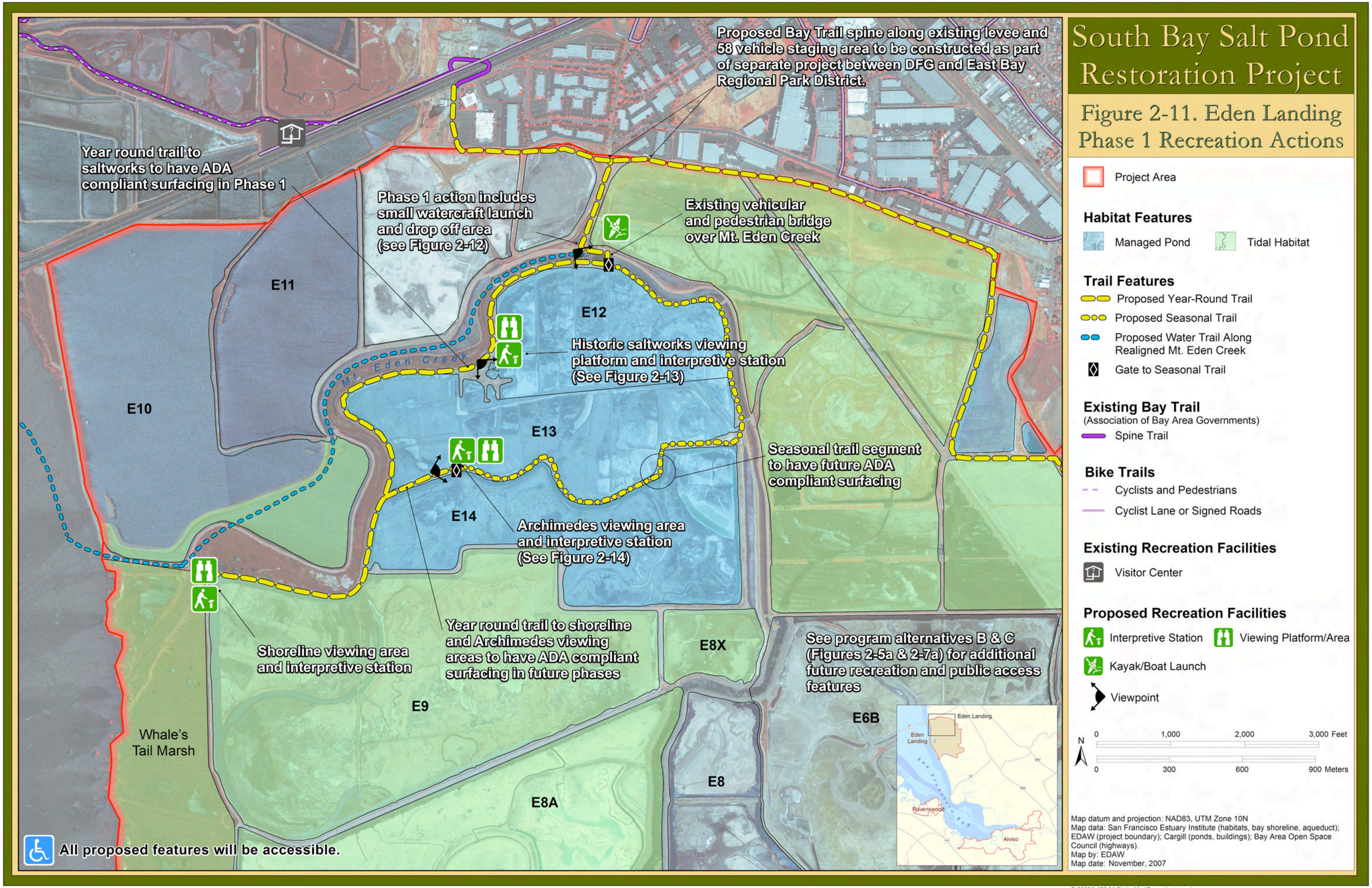
2.5.3 Alviso Pond Complex

Phase 1 actions in the Alviso pond complex would include tidal habitat restoration in Pond A6, reversible tidal restoration in Pond A8, a reconfigured managed pond restoration at Pond A16, and recreation and public access actions at Pond A16 and near Ponds A2E and A3W.

Phase 1 No Action

Pond A6

In the absence of a Phase 1 action at Pond A6, USFWS would continue to operate and maintain Pond A6 under its current management, although ongoing O&M activities would be scaled back based on available



South Bay Salt Pond Restoration Project

Figure 2-11. Eden Landing Phase 1 Recreation Actions

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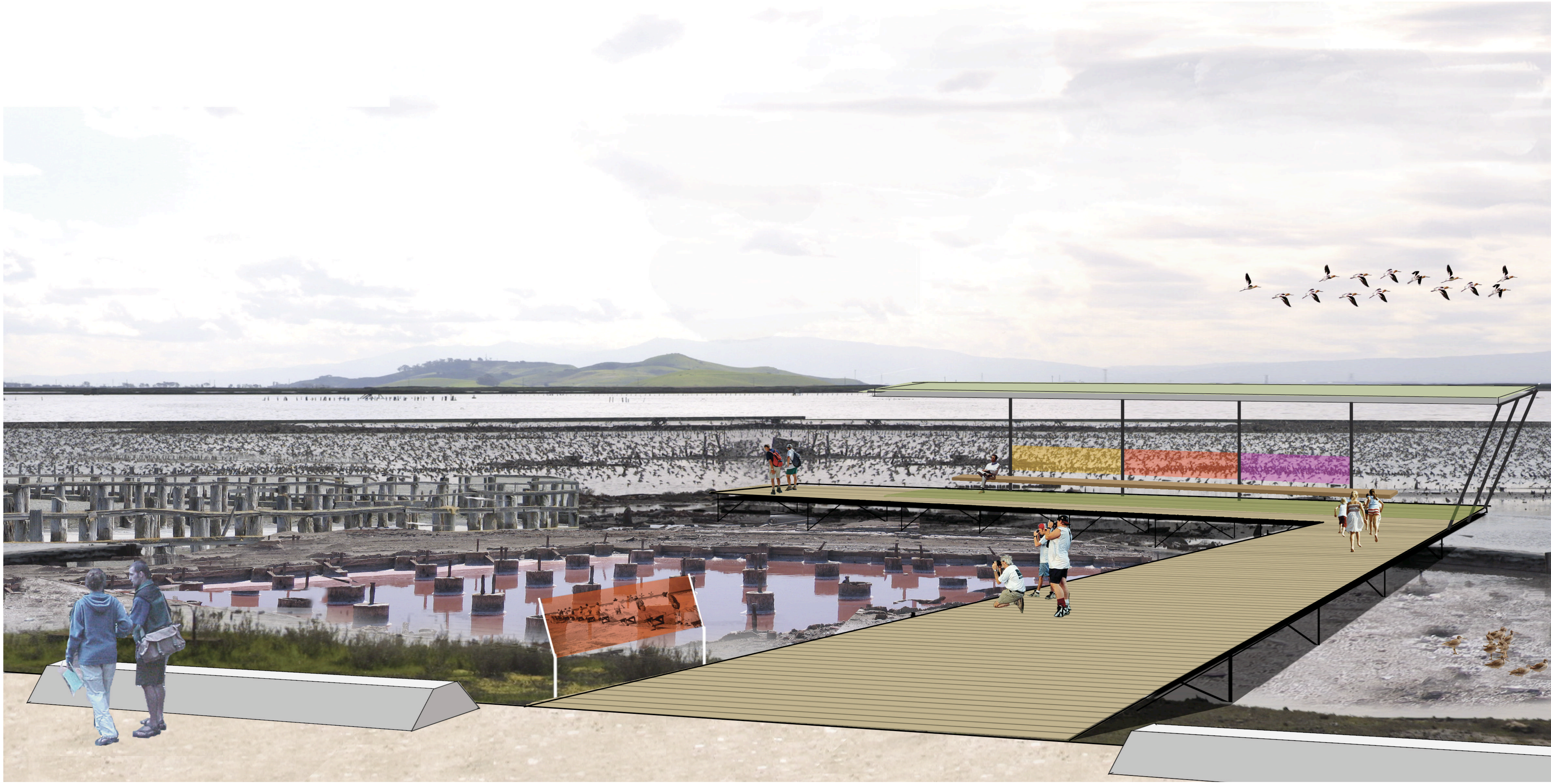
South Bay Salt Pond Restoration Project

Eden Landing – Kayak Launch and Trailhead

Figure 2-12

EDAW | AECOM

March 2007



South Bay Salt Pond Restoration Project

Eden Landing – Historic Salt Works Viewing Platform and Interpretive Station

Figure 2-13

EDAW | AECOM

March 2007

South Bay Salt Pond Restoration Project

Eden Landing – Archimedes Screw Loop Trail

Figure 2-14

EDAW | AECOM

March 2007

funding (see Section 1.4.4 and Figure 2, Appendix B of this EIS/R). Pond A6 operates as a seasonal pond with no direct hydraulic connection to the Bay or Ponds A5 and A7. Pond A6 would continue to fill with rainwater or high groundwater during winter and allowed to dry-down in the summer through evaporation. Salinity would not be controlled and would fluctuate due to residual salt in the pond, rainwater inflows and seasonal evaporation.

The northern segment of the outboard levee of Pond A6 adjacent to Coyote Creek and the Bay, referred to here as the bayfront levee, is actively eroding. To protect its existing facilities in Pond A6, PG&E replaced the eleven existing transmission towers with nine new towers and reconductored two of the three transmission lines. In addition, PG&E has previously replaced its boardwalk that it uses to service the transmission towers and lines in Pond A6. Upon levee failure, Pond A6 would convert to tidal action in an unplanned and uncontrolled manner.

Since the time Pond A6 was leveed to create a salt pond, it has subsided by approximately 5 ft (1.5 m) to an average elevation of 2.3 ft NAVD (0.70 m NAVD). The elevation of Pond A6 is below MTL and below the elevation at which marsh vegetation colonizes. Therefore, sediment accumulation would be required to raise pond bottom elevations so that salt marsh vegetation could establish. However, erosion of the bayfront levee would likely prevent significant sediment accumulation, particularly in the more exposed northern reaches of Pond A6. Wind-waves generated across the Bay would have the potential to limit sedimentation, vegetation colonization, and potentially erode the emerging mudflats within the pond. Therefore, in the long term, the unplanned tidal conversion of Pond A6 would likely create a mix of open Bay, intertidal mudflat and vegetated emergent marsh habitat within Pond A6.

The levee along the southern border of Pond A6, between Pond A6 and Ponds A5 and A7 was reinforced by Cargill in the 1990s. During extreme flood events in Alviso Slough, flood storage in Ponds A8, A5 and A7 may overtop this levee and flow into Pond A6. With the unplanned tidal conversion of Pond A6, the overflow from Ponds A5 and A7 would flow directly into tidal water. The unplanned tidal conversion would also increase the erosive forces along the levee between Pond A6 and A5 and A7. This levee would likely not be maintained by USFWS and Ponds A5 and A7 would eventually convert to tidal action in an unplanned manner. The levee along the east side of Pond A8 would be raised to prevent frequent tidal overtopping into Ponds A8 and 8S. Existing flood detention storage would be maintained in Pond A8 and A8S, but not in Ponds A5, A6 and A7. This loss of flood detention storage has the potential to raise water surface elevations at the mouth of Guadalupe River/Alviso Slough and reduce flood protection. USFWS would coordinate with SCVWD to complete the necessary hydraulic assessment to determine the most effective method for compensating for the loss of flood storage and maintaining flood hazard management at its current level.

No public access and recreation access currently exists at Pond A6, and no new public access or recreational facilities would be constructed under this alternative.

Pond A8

In the absence of a Phase 1 action at Pond A8, USFWS would continue to operate and maintain the pond in a manner similar to the ISP (Life Science! 2003), although ongoing O&M activities would be scaled back based on available funding (see Section 1.4.4 and Figure 2, Appendix B of this EIS/R). Pond A8 operates as a seasonal or high salinity pond depending on conditions. As a seasonal pond, Pond A8 would be allowed to fill with rainwater during the winter and draw-down in the summer through evaporation. Salinity would not be controlled and would fluctuate due to residual salt in the pond, rainwater inflows and seasonal evaporation. As a high salinity pond, water would either be diverted from Pond A7 to A8, or water would be pumped from Pond A8 to A7 as needed to control water levels and salinity. If funding is not available to continue operating and maintaining the existing pump, Pond A8 would be operated as a seasonal pond year round.

Pond A8 also contains an overflow weir, and during flood events greater than a 10-year flood in the lower Guadalupe River/Alviso Slough, overflows into Pond A8 would occur and Ponds A5, A6, A7 and A8 would initially be used for flood storage. In the absence of the Phase 1 action at Pond A6, the pond would continue to provide flood storage during large rainfall events. In the long-term, Ponds A5, A6, and A7 would likely convert to tidal action, thereby reducing the available flood detention storage. This loss of storage has the potential to raise water surface elevations in Guadalupe River/Alviso Slough and Guadalupe Slough, and possibly reduce flood protection. It would require hydraulic assessment to determine the most effective method for compensating for the loss of flood storage and restoring flood hazard management to the current level, if needed. The levees surrounding Ponds A8 and A8S would be maintained in order to provide a portion of the existing flood storage capacity, and the levee along the west side of Pond A8 would be raised to prevent frequent tidal overtopping into Ponds A8 and 8S.

The scenario depicted in Figure 2-4 and described above is considered the most likely outcome in the absence of the SBSP Restoration Project. However, a range of No Action outcomes is possible. In the Pond A8 vicinity, for example, it is possible that additional funding could be available to the Refuge, allowing the Refuge to maintain the Pond A5, A7, and A8 perimeter levees, and forego improvements to the Pond A8 west levee. Alternately, SCVWD could maintain the levee along Guadalupe Slough/Pond A5 (where they have an existing easement for levee maintenance) and the Refuge could then focus its limited funds on maintaining the Alviso Slough/Pond A7/Pond A8 levee and the Pond A6 south levee.

No public access and recreation access currently exists at Pond A8, and no new public access or recreational facilities would be constructed under this alternative.

Pond A16

In the absence of a Phase 1 action at Pond A16, USFWS would continue to operate and maintain the pond in a manner similar to the ISP (Life Science! 2003), although ongoing O&M activities would be scaled back based on available funding (see Section 1.4.4 and Figure 2, Appendix B of this EIS/R). Under the ISP, USFWS operates Pond A16 as a managed pond in combination with Pond A17. Water flows through the existing intake structure from Coyote Creek into Pond A17, through an existing gap between Ponds A16 and A17, and from Pond A16 into Artesian Slough through the existing outlet structure. In order to meet DO discharge requirements, the existing intake and outlet structures are opened to their fullest extent and the flows are essentially muted tidal. In the winter, the flow through the system is reversed in order to minimize the entrainment of migrating salmonids in Coyote Creek. Pond A16 also operates as a dilution pond, receiving high salinity water through an existing siphon from Pond A15.

In the long-term, the levees surrounding Pond A16 would be maintained or repaired upon failure and USFWS would maintain or repair the water control structures as necessary to continue managed pond operations. No new public access or recreational facilities would be constructed under this alternative. An existing recreational trail surrounds Pond A16 and the trail would be maintained or repaired along with the pond levees, therefore maintaining the existing public access and recreational value.

Phase 1 Restoration Actions

Pond A6

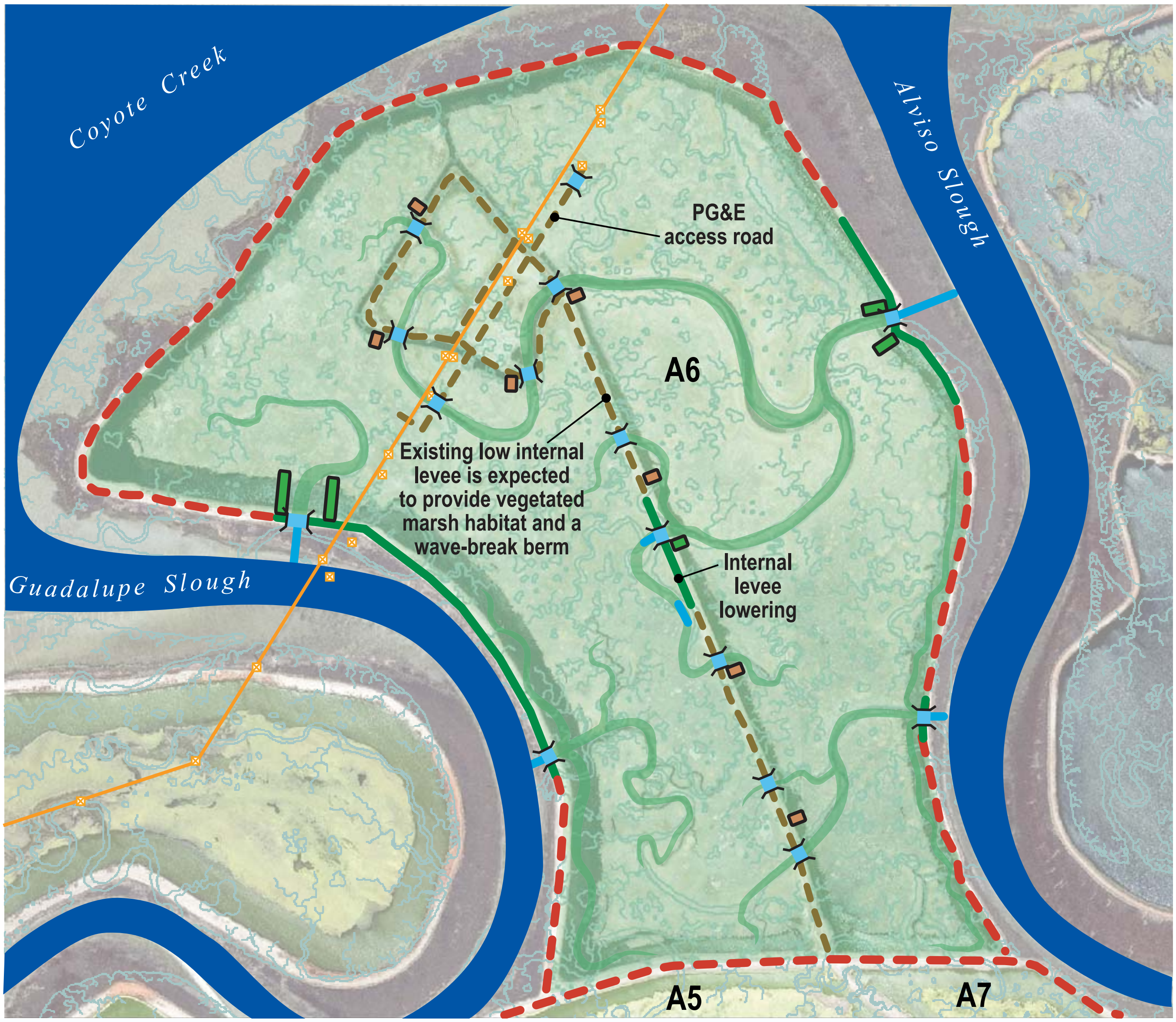
Introduction. Alviso Pond A6 would be restored to tidal action to create approximately 360 acres of tidal salt marsh and tidal channel habitat (Figure 2-15). As specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R), the Pond A6 restoration would test the effectiveness of borrow ditch blocks and wave-break berms as restoration techniques (see the Pond A6 Adaptive Management section below). The Pond A6 restoration would not include recreation or public access features.

Restoration Plan. Pond A6 would 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 2-15). Since the time Pond A6 was leveed to create a salt pond, it has subsided by approximately 5 ft (1.5 m) to an average elevation of 2.3 ft NAVD (0.70 m NAVD). The elevation of Pond A6 is below MTL (3.3 ft NAVD or 1.0 m NAVD) and below the elevation at which marsh vegetation colonizes emerging mudflats. The 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.

Levee breaches. Tidal inundation would be restored to Pond A6 by excavating four breaches through the outboard levee. The breaches would be located at the mouths of remnant historic tidal channels in Pond A6 to encourage the re-establishment of the natural historic tidal channel system. The historic systems of sinuous branching channels are expected to provide quality habitat for fish and wildlife, including the endangered California clapper rail. Two breaches would reconnect historic tidal channel systems to Guadalupe Slough, located to the west of Pond A6. Two additional breaches would restore the historic tidal channels to Alviso Slough to the east. The levee breaches would be sized to provide full tidal exchange between the sloughs and the restored marsh area.

The internal levee bisecting Pond A6 and surrounding the former duck club pond in the middle of Pond A6 would be breached in several locations. These internal levee breaches would reconnect remnant historic tidal channels across the levee and provide full tidal drainage in the former duck club pond. The internal levee breaches would be constructed to the estimated width and depth of the historic channels.

Pilot channels. Pilot channels are small excavated channels that facilitate tidal exchange between the breached pond and the adjacent slough. The required length of the pilot channel depends on the width of existing vegetated fringe marsh (if any) between the outboard pond levee and the slough. The pilot



Tidal Habitat
Historic channel network
Levee breach
Levee lowering
Existing low internal levee/berm, to remain
Existing levee, to remain
Pilot channel
Borrow ditch block
Fill placement
PG&E power transmission line and power towers[1]

[1]PG&E completed construction of nine new power towers in Pond A6 in 2007.

N

0 1000 2,000
feet

South Bay Salt Pond Restoration Project

figure 2-15

Alviso Pond A6
Phase 1 Action Restoration Plan

Figure by Philip Williams & Associates
Figure Date: 6-7-07

PWA Ref# 1750 phase1/basemaps/concept plans/pondA6_6-07-07.cdr channels would be narrower than the breach excavations in order to minimize impacts to existing marsh and minimize construction costs. The pilot channels are expected to widen over time as restored tidal flows scour the pilot channel banks. Pilot channels would be excavated from the outboard levee breaches to the sloughs through the existing vegetated fringe marsh outboard of the levee. Material excavated from the pilot channels would either be used to construct the borrow ditch blocks, placed within the pond, or cast on the marsh adjacent to the pilot channels. The casted material would likely erode as the pilot channel banks scour.

Levees. Along Guadalupe and Alviso Sloughs, portions of the outboard levee would be lowered to the elevation of MHHW (approximately 7.5 ft NAVD or 2.3 m NAVD). Lowering of the outboard levee would create pickleweed salt marsh habitat around the perimeter of the restoration site, which is expected to provide escape cover for the endangered salt marsh harvest mice. Lowering the levee would restore the hydrologic connectivity between the adjacent sloughs and the restored marsh areas during the highest tides.

The bayfront levee would remain to limit the propagation of waves from the Bay into Pond A6, minimize potential disturbances to California clapper rail that may forage in the bayfront fringe marsh, and reduce the extent and cost associated with levee lowering. If the bayfront levee were removed, wind-waves generated across the Bay would have the potential to limit sedimentation and vegetation colonization and erode the emergent mudflats in Pond A6. Leaving the bayfront levee in place is expected to limit wave action from the Bay while the emergent mudflats develop into vegetated marsh in the pond. Over time, the bayfront levee is expected to erode, exposing tidal habitat in Pond A6 to wave action; however, the bayfront levee would benefit marsh development in the short term.

The levee between Pond A6 and Ponds A5 and A7 would remain in place to limit the potential for coastal flooding in Ponds A5 and A7. Cargill reinforced this levee in the 1990s by placing rip-rap on the north (Pond A6) side of the levee and covering the rip-rap with bay mud (Mapelli 2007 pers. comm.). The levee is expected to be overtopped and subject to erosion during storm events because the minimum levee crest elevation is at the two-year return period still water level in the Bay (PWA and H.T. Harvey & Associates 2007). The levee would be inspected after storm events and maintained as needed to limit the potential for unintentional levee breaching. Any breach would be repaired to prevent tidal inundation of Ponds A5, A7, and A8. The levee may be improved as part of the restoration design or as part of future levee maintenance to reduce maintenance requirements and the risk of coastal overtopping, erosion, and breaching. Levee improvements could consist of raising low points along the levee crest, armoring the back side of the levee slope, and/or constructing an engineered overflow structure (*e.g.*, weir). During extreme flood events in Alviso Slough, flood storage in Ponds A8, A5, and A7 may overtop this levee and flow into Pond A6. With the restoration of Pond A6, overflow from Ponds A5 and A7 would flow directly into tidal water.

The internal levee bisecting Pond A6 would not be lowered and would act as a wave-break across the site. The elevation of the internal levee in Pond A6 (4.6 ft NAVD or 1.4 m NAVD) is intertidal and cordgrass is expected to establish on the levee soon after restoration, forming a low vegetated wave-break berm. This berm is expected to break waves generated during high tides within Pond A6 by predominant winds from the northwest. As described in the Adaptive Management section below, the effectiveness of this wave-break in increasing marsh sedimentation and vegetation development would be tested as a restoration technique. A short portion of the internal levee would be lowered as part of this test and to provide borrow material to create a borrow ditch block in the borrow ditch adjacent to the internal levee.

Borrow ditch blocks. Borrow ditch blocks would be constructed at the north breaches to encourage the re-establishment of the historic tidal channel system in Pond A6. The borrow ditch blocks are expected to inhibit flow through the borrow ditch, direct flow into the remnant historic tidal channels, and promote scour of the silted-in remnant channels. The locations of the borrow ditch blocks would allow for complete drainage of the borrow ditch, avoiding the potential to trap fish at low tide. Borrow ditch blocks would be constructed across the borrow ditch with material excavated from the levee breaches and lowered levees. Additional material excavated from the lowered levees may be placed along the edge of the borrow ditch to create additional marsh habitat. In these locations, the borrow ditch would not be blocked and the conveyance of tidal flows in the borrow ditches would be maintained.

To test the effectiveness of borrow ditch blocks as a restoration technique, borrow ditch blocks would not be constructed at the south breaches (see the Adaptive Management section below). One additional borrow ditch block would be constructed in the internal borrow ditch adjacent to the internal levee. This internal borrow ditch block is expected to enhance the re-establishment of the historic tidal channel system across the internal levee.

Infrastructure. To protect its existing facilities in Pond A6, PG&E replaced the eleven existing transmission towers with nine new towers and reconductored two of the three transmission lines. PG&E previously replaced its boardwalk that it uses to service the transmission towers and lines in Pond A6. PG&E's previous access routes to its facilities in Pond A6 would be eliminated by the planned breaches of the levees. Therefore, PG&E's existing boardwalk would be extended and a platform would be constructed to allow for the delivery of heavy equipment (via helicopter) needed for certain O&M activities. In addition, for more routine O&M activities, the boardwalk would be extended through the marsh outside the levee to connect with the existing boat dock.

Adaptive Management. Adaptive management for the Phase 1 action at Pond A6 would include applied studies similar to those for Alviso Pond A8 and Eden Landing Ponds E8A, E9, and E8X (see Section 2.5.2) and restoration techniques as specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R).

Applied Studies. Phase 1 experiments at Pond A6 would test:

1. Relative influence of slough scour and marsh restoration on flood hazards.
2. Wildlife response to increased exposure of mercury (MeHg).
3. Effects of California gulls on nesting birds.
4. Rates of marsh sedimentation.

5. Effects of pond sedimentation on existing outboard intertidal habitat.

- Relative Influence of Slough Scour and Marsh Restoration on Flood Hazards. Tidal restoration at Pond A6 is expected to enlarge the downstream reaches of Alviso and Guadalupe Sloughs by increasing tidal prism. These potential changes in slough geometry would increase the ability to convey flood flows and lower water levels when large amounts of runoff from the watershed is routed to the sloughs. However, tidal restoration of Pond A6 would also eliminate the flood storage provided by this pond under existing conditions. The Phase 1 action at Pond A6 provides an opportunity to determine if flood hazards are decreased over the short- and long-term. Monitoring data of slough scour and tidal regime would provide the necessary information to examine changes to baseline flood hazards. This applied study would be coordinated with that carried out for the Phase 1 action at Pond A8 (see below). If it is determined that the backwater elevation increases upstream of breaches due to the Phase 1 action at Pond A6, different approaches to levee breaching at bayfront ponds may be incorporated at subsequent phases.
- Wildlife Response to Increased Exposure of MeHg. The production of MeHg, its uptake into food webs, and its bioaccumulation vary within and among species and habitats. Additionally, threshold concentrations of MeHg toxicity are not well known for most wildlife species. Led by the San Francisco Estuary Institute (SFEI), the South Baylands Mercury Project has been designed to estimate how much legacy Hg is contained in the sediments of different habitats along Alviso Slough, how readily Hg is converted to MeHg, and how effectively MeHg is incorporated into local food webs. The ecological risks of mercury toxicity in wildlife would be assessed by monitoring Hg in 'biosentinel' wildlife species that represent the baylands. Coupling such a monitoring effort to studies of MeHg production and uptake is essential to improve the understanding of how the risk of Hg bioaccumulation can be reduced, and thus develop effective management options. Although the focus of the South Baylands Mercury Project is Pond A8 and its environs, the evolving tidal marsh at Pond A6 would provide an opportunity to expand future monitoring of biosentinel species.
- Effects of California gulls on nesting birds. Although they did not nest in the Bay before the early 1980s, nesting California gulls now number more than 20,000, and their population is growing exponentially. Nearly all these birds nest in Pond A6. When this pond is restored to tidal habitat, this huge gull colony would be displaced and the birds would seek alternate nesting sites. This one species has the potential to displace many other nesting species from the Project Area, including avocets, stilts, and terns. California gulls may dominate the new nesting islands the Project would develop in Pond A16 (see below), islands that are meant to support the other South Bay nesting species. Applied studies in Phase 1 would document the current impacts of California gulls on other nesting species, investigate the causes of gull population growth, and attempt to understand the likely responses of the gulls to the loss of Pond A6 as a nesting site.

The applied studies at Pond A6 to test rates of marsh sedimentation, and effects of pond sedimentation on existing outboard intertidal habitat would replicate the applied studies described for Ponds E8A, E9, and E8X (see the Ponds E8A, E9, E8X Adaptive Management section in Section 2.5.2).

Restoration Techniques. The Phase 1 action at Pond A6 would test the effectiveness of wave-break berms and borrow ditch blocks as restoration techniques.

- Wave-break berms. Wind blowing across open expanses of water, such as low restoration sites at high tide, can generate waves that are sufficient to inhibit sediment deposition and resuspend previously deposited material. These effects can slow or possibly prevent the development of vegetation on the restored marsh plain. The wind fetch length and wave exposure would vary on either side of the wave-break berm and in different areas of the pond. The rate of sedimentation and vegetation development would be compared for areas with varying wind-wave exposures to evaluate the effectiveness of this restoration technique.
- Borrow ditch blocks. In previous salt pond restorations, large borrow ditches captured tidal flows and became the major tidal channels, limiting the re-establishment of a more natural channel system. The complexity of natural historic tidal channels is expected to provide improved habitat compared with the oversized, straighter borrow ditches. The borrow ditch blocks adjacent to the north breaches are expected to block flow directly from the borrow ditch to the breaches. North of these borrow ditch blocks, the severed borrow ditch is expected to drain through the upstream ends of the remnant channel systems. The severed borrow ditch would drain directly to the south breaches; however, the north borrow ditch blocks are expected to limit the marsh area drained by the borrow ditch to the south. The rate and extent of channel formation in the north and south channel systems would be compared to evaluate the effectiveness of these two approaches.

Restoration Monitoring. The Pond A6 restoration would be monitored to evaluate restoration performance, inform adaptive management, and to meet any permit requirements. O&M inspections are discussed in the Operations and Maintenance section in Section 2.5.6.

Physical processes and habitat development in Pond A6 would be evaluated by monitoring tides, sedimentation, channel development, and vegetation development. Monitoring would consist of ground surveys and ground and aerial photography at intervals ranging from one to several years. For example, the aerial photos and ground surveys could be used to track the development of low, medium and high marsh zones, which provide different habitat values for the California clapper rail and salt marsh harvest mouse. Once suitable vegetated marsh habitat develops in Pond A6, surveys of California clapper rail and salt marsh harvest mouse would be performed to track the progress of these endangered species towards recovery, in accordance with Section 7 of the Endangered Species Act.

Monitoring would also be performed to test the effectiveness of the wave-break berm and borrow ditch blocks as restoration techniques. For the wave-break berm restoration technique, sedimentation rates would be measured at various locations within Pond A6 to track the effects of fetch length on the ability of wind-wave action to retard sediment accretion. For the borrow ditch restoration technique, annual ground surveys would be collected to track channel formation. Low-tide aerial photographs would provide information on channel development throughout Pond A6.

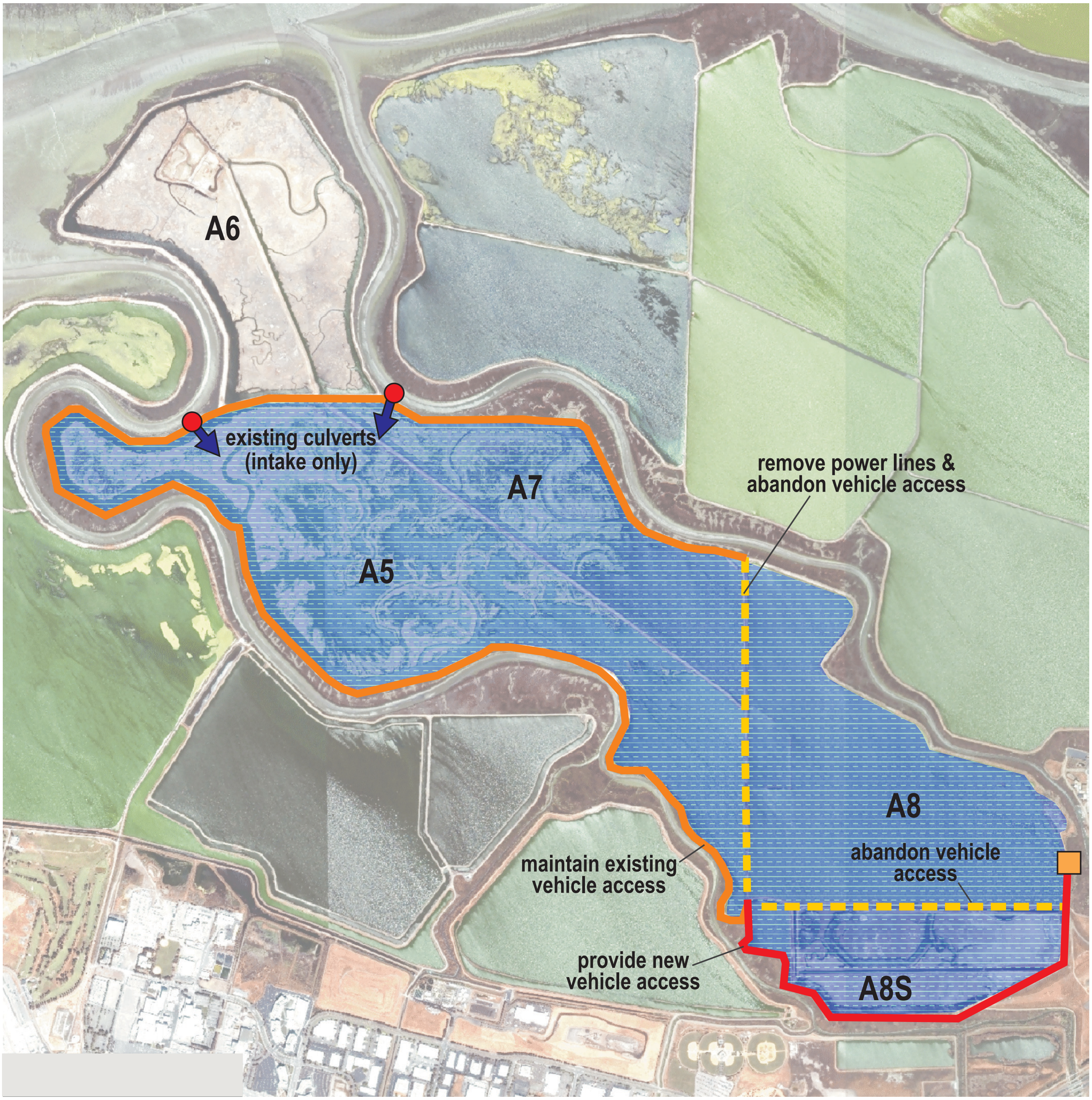
Invasive plant monitoring and control would be coordinating with existing control efforts, such as the Invasive Spartina Project, as discussed in the introduction (Chapter 1), and under the SBSP Long-term Alternatives B and C (see Sections 2.4.3 and 2.4.4, respectively).

Pond A8

Introduction. Implementation of a Phase 1 action at Pond A8 would introduce limited tidal exchange to create approximately 400 acres of muted subtidal habitat in Pond A8 and modify water depths in about 1,000 acres of existing shallow water habitat in Ponds A5 and A7 (Figures 2-16a and 2-16b). Restoration of tidal action at Pond A8 is designed to be adaptable and reversible so that in the event that unacceptable ecological impacts begin to occur, tidal exchange to Pond A8 can be modified or eliminated to prevent long-term adverse impacts and water management at Ponds A5 and A7 can revert to ISP operations. Water exchange would be limited and tidal range within the three ponds would be muted during the dry summer and fall months, and even with a fully open notch, water level fluctuation in the ponds over a tidal cycle would be small (approximately 0.5 ft) compared to the range of tidal change in the slough (over 8 ft). Initially, water level fluctuation in the ponds would be less as the notch would be only partially open. Water levels in Pond A8 (409 acres) would exceed elevations of internal levees and spill into adjacent Ponds A8S, A5 and A7 (1,023 acres) and modify the existing hydrologic regime in these ponds as well. Water levels would fluctuate over the tidal cycle evenly across the area of all the ponds but depths would vary due to differences in bed elevations. Depths would exceed those at which the ponds are presently managed (<1 ft) over the majority of the 1,400 acres most of the time. Prior to implementation of Phase 1 actions at Pond A8, water depths in other ponds would be lowered to replace the loss of shallow water foraging habitat presently offered in Ponds A5 and A7 (possible candidate ponds include: Ponds A1 and A2W; A9 and A11; AB1 and AB2; and A3N).

Partial restoration of tidal prism in these ponds would promote channel scour and increase salinity along Alviso Slough. The expected potential increases in channel width and salinity would improve navigation access in a sustainable fashion – a key objective of the Alviso Slough Restoration Project. Exchange between Pond A8 and Alviso Slough would be managed as needed during the wet season to avoid fish trapping and maintain existing levels of flood protection by either reducing the notch width or completely eliminating tidal exchange during this period. Initially, the notch would be closed from February through May unless the fish trapping applied study (see below) indicates that the open notch does not pose an unacceptable risk to migrating fish. Implementation of the Phase 1 action at Pond A8 would provide the opportunity to test scientific uncertainties related to the effects of tidal restoration on slough scour and the uptake of MeHg into the food web. Applied studies designed to address these uncertainties are part of the Adaptive Management Plan (see Pond A8 Adaptive Management section below and Appendix D of this EIS/R).

Restoration Plan. Restoration features are described below and shown in Figures 2-16a and 2-16b. These elements have been selected to allow for a muted tidal connection from adjacent sloughs to Ponds A8, A8S, A5, and A7 that can be blocked if there is evidence of adverse ecological impact. Water exchange would be limited and tidal range within the ponds would be muted, so that the change in water level in the ponds over a tidal cycle would be small (0.5 to 1 ft) compared to the range of tidal change in the slough (over 8 ft). Appendix G (Alviso Pond A8 Hydrodynamic Modeling and Geomorphic Analysis of this EIS/R) documents hydrodynamic modeling and other technical analysis of the Pond A8 restoration.



N

0 1000 2,000
feet

Armored notch (open)

Culverts with flap gates

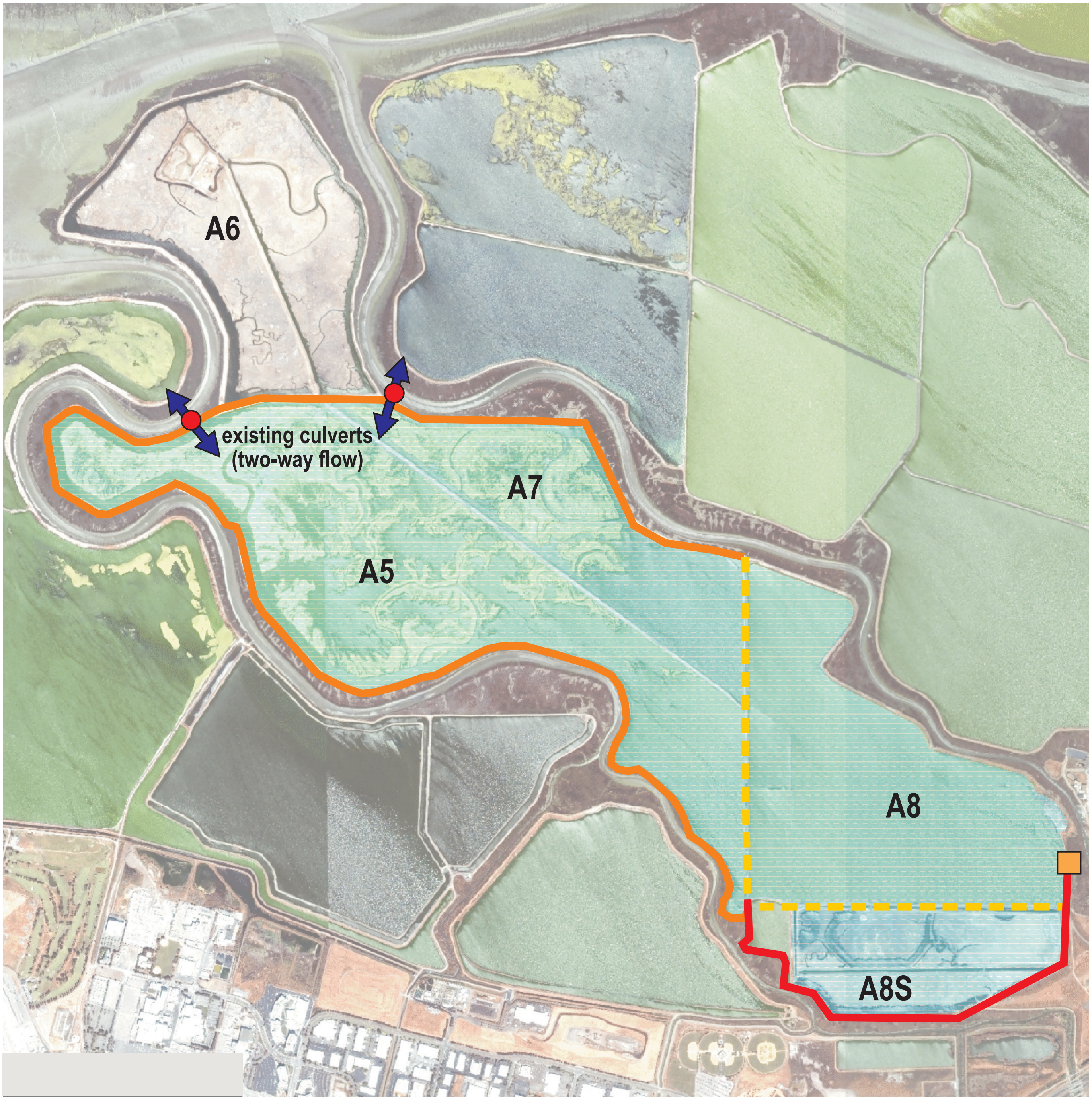
South Bay Salt Pond
Restoration Project

figure 2-16a

Alviso Pond A8
Phase 1 Action Restoration Plan
(Summer Operation)

Map by: **PWA**
Map date: August 8, 2007

PWA Ref# 1750/Task7/Final_Draft\Revised_Section2\Section2_fig/ pondA8__8_6_07.cdr



N

0 1000 2,000

feet

Armored notch (closed)

Culverts with flap gates

South Bay Salt Pond
Restoration Project

figure 2-16b

Alviso Pond A8
Phase 1 Action Restoration Plan
(Winter Operation)

Map by: **PWA**
Map date: August 8, 2007

PWA Ref# 1750/Task7/Final_Draft\Revised_Section2\Section2_fig/ pondA8__8_6_07.cdr

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. Notch width would be adjustable up to approximately 40 ft. The depth of the notch would extend to approximately 1 ft above the average bed elevation of Pond A8 (-0.5 ft NAVD88). The size of this structure has been selected to maximize the potential volume of water exchanged between the slough and the pond while controlling water levels within the pond. Due to structural considerations, the notch would likely consist of multiple 'bays' that can be opened and closed independently. This would allow tidal exchange between the Pond A8 and Alviso Slough to be adjusted based on monitoring data. Initially, the notch would be operated with only one bay open. Additional bays would be opened if monitoring data confirm that slough widening does not threaten downstream levees, in particular the levees along the east side of Alviso Slough (perimeter levees to Ponds A11 and A12). Flow through the notch would occur during both flood and ebb tides. In combination with the ebb only culverts, the notch would enable ebb dominated tidal asymmetry within the ponds to limit water levels within the ponds while maximizing the enhancement of tidal prism in Alviso Slough. Concrete armoring would be required to prevent unintentional widening and/or deepening of the notch.

Although much of the land that comprises Ponds A8, A5 and A7 was sold to USFWS as part of the SBSP Restoration Project land acquisition, Cargill retains ownership of the section of the Pond A8 perimeter levee along the Lower Guadalupe River Flood Protection Project overflow weir including the location of the proposed Phase 1 notch. SCVWD has an easement to maintain the overflow weir and is in discussions with Cargill to purchase the remaining land. It is expected that either the District would acquire ownership of this parcel prior to construction, and/or that USFWS would acquire an easement or other appropriate right-of-way suitable for pre-construction, construction, and post-construction activities. Alternatively, if the District acquires the property, the District and USFWS may work out another mutually agreeable arrangement for conducting the Project.

Outboard Pilot Channel. An approximately 475-ft-long pilot channel would be excavated through the fringe marsh of Alviso Slough immediately outboard of the armored notch. Excavated earth would be placed within Pond A8, or trucked to an upland landfill if testing indicates soil contamination exceeds allowable levels for wetland foundation. This channel would facilitate tidal exchange through the notch by providing a flow path between Pond A8 and Alviso Slough. The top width and area of the constructed pilot channel would approximately match its maximum expected equilibrium dimensions to limit the amount of sediment eroded by tidal flows once operation of the notch begins.

Infrastructure. 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 the Pond A8-A5/A7 interior levee would be overtopped on a daily basis. The Pond A8/A7 pump would be salvaged for other purposes since no electricity would be available (power lines along the Pond A8-A5/A7 levee would be removed). 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-A5/A7 and Pond A8/A8S interior levee would not be maintained under these restoration actions and would be limited to the perimeter levees of Ponds A8S, A5 and A7.

In addition to modification of the power lines and Pond A8/A7 pump, the expected 1-ft increase in water depths may 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 may require the levee surrounding the sump to be increased up to one ft. The need for this potential improvement would be assessed during subsequent design phases. The SCVWD monitoring well in the northeast corner of Pond A7 would be decommissioned prior to implementation of the Phase 1 action.

Periodic inspection and maintenance of restoration infrastructure, such as water control structures and pond levees would be required to ensure that the pond is operating as intended. More frequent inspection and maintenance of water levels and water quality (including salinity and DO), would be necessary to ensure that the appropriate amount of tidal connectivity is achieved so that scouring occurs in Alviso Slough, and to meet water quality requirements. Detailed O&M Plans would be developed for each Phase 1 action by USFWS.

Adaptive Management. Adaptive management for the Phase 1 action at Pond A8 would include applied studies as specified in the Adaptive Management Plan (see Section 2.3 and Appendix D).

Applied Studies. The Phase 1 experiments at Pond A8 would test wildlife response to increased exposure of MeHg, the relative influence of slough scour and changes in storage on flood hazards, and the potential for fish entrapment in Pond A8.

- <u>Wildlife Response to Increased Exposure of MeHg.</u> The production of MeHg, its uptake into food webs, and its bioaccumulation vary within and among species and habitats. Additionally, threshold concentrations of MeHg toxicity are not well known for most wildlife species. Led by SFEI, the South Baylands Mercury Project has been designed to estimate how much legacy Hg is contained in the sediments of different habitats along Alviso Slough, how readily Hg is converted to MeHg, and how effectively MeHg is incorporated into local food webs. The ecological risks of mercury toxicity in wildlife would be assessed by monitoring Hg in 'biosentinel' wildlife species that represent the baylands. Coupling such a monitoring effort to studies of MeHg production and uptake is essential to improve the understanding of how the risk of Hg bioaccumulation can be reduced, and thus develop effective management options. The expected channel scour along Alviso Slough associated with the Phase 1 action at Pond A8 would provide an opportunity to investigate if the selected biosentinel species are sensitive to increases of mercury into the food web. Testing of the Alviso Slough sediments show concentrations of total Hg ranging from 0.08 to 2.83 with a median concentration of 0.80 ug/g (Marvin-DiPasquale, 2007). These concentrations are generally higher than ambient Bay levels of contamination due to the legacy of historic mercury mining in the Guadalupe watershed.
- <u>Relative Influence of Slough Scour and Changes in Storage on Flood Hazards</u>. Restoration of muted tidal action at Pond A8 is expected to deepen and widen the channel along the upper (landward) portion of Alviso Slough due to substantial increases in the slough tidal prism. The magnitude of tidal current velocities and associated slough scour would be related to the size of the notch opening, with less deepening and widening occurring with fewer open bays. These

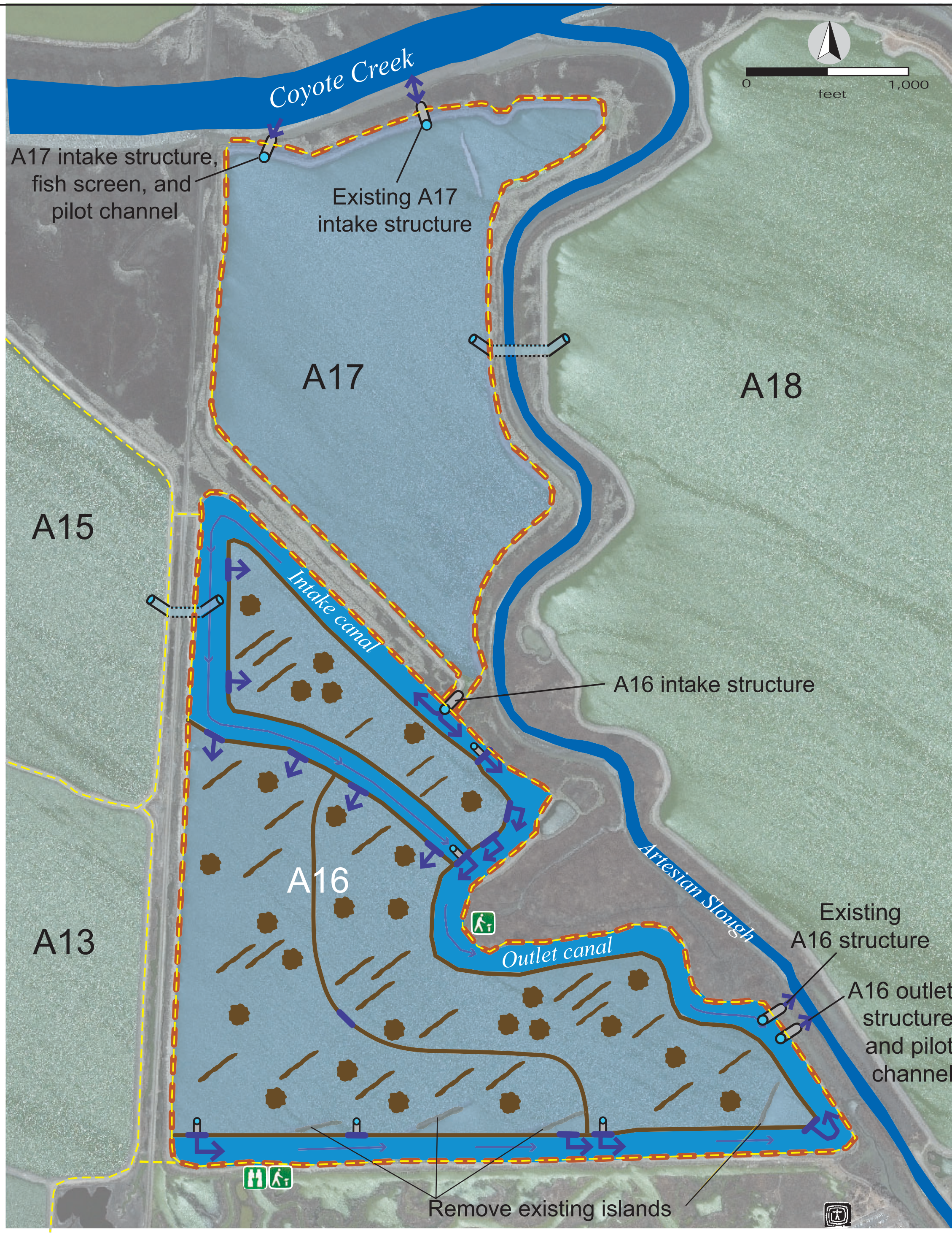
potential changes would increase the ability of the slough channel to convey flood flows and lower water levels associated with large rainfall-runoff events on the Guadalupe River. However, restoration of muted tides in Ponds A8, A7 and A5 during the rainy season would also reduce the amount of flood storage provided by these ponds and possibly result in higher maximum water elevations along Guadalupe Slough (see Figure 25 in Appendix G-5). The Phase 1 action at Pond A8 would provide an opportunity to assess the changing flood conveyance along Alviso Slough and determine if flood hazards are decreased over the both the short- and long-term. Monitoring data of slough scour and tidal regime would provide the necessary information to examine changes to baseline flood hazards, and would be coordinated with the applied study carried out for the Phase 1 action at Pond A6 (see above). If it is determined that changes in channel conveyance always compensate for losses of flood storage, seasonal management of the Phase 1 notch could be modified.

- Potential for Fish Entrainment. There is some potential for fish, possibly including anadromous salmonids and estuarine species, to enter Pond A8 through the notch and become trapped within the pond, because they are unable to find their way out. An applied study would be conducted to evaluate salmonid entrainment during the first 2 to 5 years of the Project. The specific study design is being developed, but discussions with NMFS involve establishing an acoustic monitoring array that is integrated with other acoustic monitoring being conducted in the central and north bay. Acoustic-tagged, hatchery raised juvenile Chinook salmon would be released in Alviso Slough and in the Pond A5/7/8 complex and monitored using stationary and mobile (boat-based) hydrophones. The study would be designed to determine if the salmon in the slough are attracted to the notch and/or move through it, and whether they can easily find their way back out to the slough. The work would be done in mid-May, just after the notch is opened after the seasonal closure. Results of this study would determine whether seasonal closure of the notch is even necessary to avoid impacts to salmonids, or whether seasonal closure is insufficient to minimize impacts, in which case additional measures (*e.g.*, fish screens) may be necessary on this and other ponds along salmonid streams. The results also could indicate that fish screens are not necessary in other ponds.

Restoration Monitoring. The Pond A8 restoration would be monitored to evaluate restoration performance and to meet any permit requirements. Also, continuous water level recording would be collected in Ponds A8, A5 and A7 and Alviso Slough at discrete periods during the summer months (at least four weeks) to confirm tidal regime inside the ponds and characterize any effects on slough tidal levels. Cross sections along Alviso Slough would be collected to determine changes in channel geometry. These surveys would occur on a seasonal basis (before and after notch closure). This information would be used to update flood models and assess changes in flood hazards on a regular basis. Salinity measurements along Alviso Slough would be collected to characterize the longitudinal gradient from the Bay to Gold Street Bridge. Surveys of channel widening in the immediate vicinity of the notch would also be performed to assess improvements to navigation at the Alviso Marina.

Pond A16

Introduction. The Alviso Pond A16 managed pond would be reconfigured to create islands for nesting birds and shallow water habitat for shorebird foraging (Figure 2-17). As specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R) and described in the Pond A16



Cell intake/outlet water control structure:
- weir
- culvert with weir
- Typical flow direction
- Earth berm
- Existing levee
- Existing trail
- Interpretive station
- Existing slough channel
- Nesting island-linear
- Nesting island-circular
- Pond intake/outlet water control structure (culverts with gates)
- Existing siphon
- Viewing platform
- Existing Environmental Education Center

South Bay Salt Pond Restoration Project

figure 2-17

Alviso Pond A16
Phase 1 Action Restoration Plan

Figure by Philip Williams & Associates
Figure Date: 5-31-07

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Adaptive Management section below, the Pond A16 restoration would test bird use for different island configurations as an applied study. The Pond A16 restoration would also test restoration techniques for vegetation management, predator management, and water quality management as part of the Adaptive Management Plan. Recreation and public access features for the Pond A16 restoration are described in the Alviso Recreation and Public Access Actions section below.

Restoration Plan. Pond A16 would be reconfigured to create islands for nesting birds and shallow water habitat for shorebird foraging (Figure 2-17). Three cells would be created within Pond A16. Nesting islands would be constructed in each cell. Water levels in each cell would be managed using water control structures to provide optimal depths for shorebird foraging. Water would flow into Pond A16 from Coyote Creek through Alviso Pond A17. Circulation through each cell in Pond A16 would be adaptively managed to meet water quality targets. Outflow from Pond A16 would discharge to Artesian Slough.

Nesting islands. Nesting islands would be constructed by grading the bottom of Pond A16. These islands are expected to be used for nesting by Forster's terns, American avocets, Caspian terns, black-necked stilts and snowy plovers. Different island shapes and densities would be created as an applied study (see the Pond A16 Adaptive Management section below). Each island would be approximately 3 ft (one m) high and have a surface area of approximately 15,000 square (sq) ft (1,400 sq m). The islands would be constructed using fill material excavated from the windward side of the islands. The islands would be located at least 300 ft (90 m) from the pond levees to provide a buffer between nesting birds and mammalian predators and to minimize disturbances by human activity on the levee (*e.g.*, passive recreation associated with the Refuge EEC). The islands would be located at least 600 ft (180 m) from any focal areas for human use, such as viewing platforms, benches, and the historic salt works. The existing islands along the southern edge of Pond A16 would be removed because these islands are close to the pond levee and proposed berm.

Berms. Cells would be created in Pond A16 by constructing low "check" berms around the cells, ranging in height from approximately 2 to 6 ft (0.6 to 2.0 m). The berms would be constructed by excavating fill material on-site. Pond bottom elevations vary from approximately 1 to 5 ft NAVD (0.3 to 1.5 m NAVD) and slope towards the southwest corner of the pond. Berms would be placed to: separate higher elevation 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. Water depths in each cell would range from approximately 2 inches (five cm) to 1 ft (0.3 m) to provide foraging habitat for smaller and larger shorebirds.

Water management. The current water management plan for the Pond A16 restoration includes features to allow management flexibility and design redundancy. Using adaptive management, different water management approaches would be tested at Pond A16 to assess the effectiveness of providing optimal shallow water habitat and meeting water quality objectives (see the Pond A16 Adaptive Management section below).

Water would flow into Pond A16 through a new water control structure, such as one or more 48-inch culverts with adjustable tide gates. The new intake structure would be installed in the existing opening (levee gap) between Pond A16 and Pond A17. The existing culvert with tide gates connecting Pond A17 to Coyote Creek (existing Pond A17 structure) would be opened to allow muted tidal action in Pond A17 and flow into Pond A16. In addition, a new intake water control structure, such as one or more 48-inch culverts with adjustable tide gates, would be installed between Pond A17 and Coyote Creek to increase the flow from Coyote Creek to Ponds A17 and A16. A pilot channel would be excavated through the existing vegetated fringe marsh between the new Pond A17 intake structure and Coyote Creek. If required by NOAA Fisheries, one or more fish screens would be installed on the new Pond A17 intake structure to prevent the entrapment of salmonid fish from Coyote Creek in Ponds A16 and A17 during the winter season (November through April). The existing Pond A17 structure could be closed during the winter season to prevent salmonid entrapment.

Intake and outlet canals would be created in Pond A16 to convey flow in and out of individual cells. The canals would be located around the perimeter of the cells in portions of the deep existing borrow ditch and remnant tidal channels in Pond A16. Water control structures, such as flashboard weirs, would be installed in the berms to regulate flow into and out of the cells. During low tides, water in the outlet canal would flow into Artesian Slough through the existing Pond A16 structure with tide gates between Pond A16 and Artesian Slough and a new outlet structure. The new Pond A16 outlet structure would consist of one or more 48-inch culverts with adjustable tide gates. A pilot channel would be excavated through the existing vegetated fringe marsh between the new Pond A16 outlet structure and Artesian Slough.

Water would be circulated through the cells in Pond A16 at rates sufficient to meet water quality objectives. The water quality objectives for Pond A16 would be to maintain adequate DO levels, salinity, and pH for habitat in the cells and to meet discharge requirements at the outlet structure. To test water management approaches within the Adaptive Management Plan, flows would be varied to assess the effects on DO levels and bird prey (see the Pond A16 Adaptive Management section below).

Flow through one of the cells could be modified without affecting the management of the other cells. Similarly, one cell could be completely drained of water for vegetation management (see the Pond A16 Adaptive Management section below) while other cells continue to provide shallow water habitat for shorebird foraging. Alternatively, water levels in Pond A16 could be periodically raised to inundate the nesting islands as a vegetation management technique. Raising water levels to inundate the island would also inundate the berms and water control structures and reduce the area of shallow water habitat.

Alviso Pond A15, which is part of the Alviso Pond A9 System (Ponds A9 through A15), is currently connected to Pond A16 by a siphon with a gate. High salinity water in Pond A15 can either flow into Pond A16 or back into the Pond A9 system through Pond A14. If Pond A16 is reconfigured, the existing siphon would be maintained, but high salinity water in Pond A15 would typically flow into Pond A14. The siphon could be opened to allow high salinity water to flow from Pond A15 into Pond A16 if water management or vegetation management call for higher salinity water.

Appendix G of this EIS/R (Alviso Pond A16 Hydraulic Modeling) documents hydraulic modeling performed to assess the feasibility of water management at Pond A16. The SBSP Nutrient and Contaminant Analysis Report (Appendix H) includes a water quality assessment for Pond A16.

Adaptive Management. Adaptive management for the Phase 1 action at Pond A16 would include both applied studies and restoration techniques, as specified in the Adaptive Management Plan (see Section 2.3 and Appendix D).

Applied Studies. Phase 1 experiments at Pond A16 would test:

1. The effects of island spacing and shape on nesting use and reproductive success.

2. The effects of vegetation type, density and distribution on island use by nesting birds.

3. The effects of nearby human activities on island use or nesting success.

Various nesting bird species may respond differently to contrasting island shapes. For example, terns may benefit more from circular islands while shorebirds such as black-necked stilts, American avocets, and snowy plovers may benefit from long, linear islands. In addition to contrasting shapes, it is important to understand the effect of island density on habitat value. For example, high-density islands may reduce foraging area between islands and increase aggressive interactions among family groups of American avocets and black-necked stilts. Vegetation also plays an important role in nesting success, as different birds species have varying vegetation tolerances or requirements. Snowy plovers typically avoid vegetated areas for nesting, and avocets usually nest in bare or sparsely vegetated areas. While some South Bay tern colonies are located in areas with little or no vegetation, other tern colonies, as well as many black-necked stilt nests, are located in areas having some vegetation, which may also provide shade and cover from predators for chicks. Nesting waterfowl are likely to nest almost exclusively in vegetated areas. Although human activity in the vicinity of Pond A16 would be expected to be limited to non-motorized recreation (*i.e.*, walking or biking around the outer levee of the pond) and O&M (see Section 2.5.6), it is unknown whether this level of activity would affect island use or nesting success by birds.

The experimental studies designed for Pond A16 would provide an important model for island design, provide an understanding of the vegetation requirements, and determine an acceptable level of human activity for reproductive success of bird species using this pond. This understanding would help inform and guide the design of optimal pond configurations that would be used at other locations in the South Bay.

- *Island spacing and shape*. Varying densities of islands would be created within Pond A16 to study the effects on bird nesting. There would be two island shapes: circular and linear (much longer than wide) to determine whether various nesting bird species respond differently to contrasting island shapes.
- *Vegetation type, density, and distribution*. Vegetation is expected to establish on some of the islands after one or more years. At that point, the vegetation can either be controlled or vegetation can be manipulated by planting or selective removal, to determine the effects of vegetation type, density, and spatial distribution on nesting use and reproductive success of bird populations. The species composition, type of vegetation, and vegetation distribution would be manipulated by planting or selective control/removal to conduct studies to determine the effects and distribution of vegetation on nesting success. The decision regarding which plant species

would be used in actual experiments would be determined by monitoring which vegetation types colonize (and thus can be expected to survive on the islands) during the first few years following island construction.

- Human activity. To determine whether human activities affect nesting birds at Pond A16, a portion of the trail (*e.g.*, along the entire northeastern side of the pond) could be closed during the breeding season every other year. The number of nests, nest success and fledging success would be determined for each island to determine whether the number and breeding success of birds on islands near the closed levee differs with full human access versus limited human access, and whether in years of limited human access the nesting bird populations vary substantially.

Restoration Techniques. Three restoration techniques would be tested in the Phase 1 actions at Pond A16:

1. Management of water to meet regulatory standards and creation of high quality bird habitat;

2. Management of vegetation growth in the pond and on islands;

3. Management of predators;

- Water management. Water in Pond A16 would be managed to maintain water quality to meet regulatory standards. Dissolved oxygen (DO) is an important water quality parameter in managed pond environments. DO concentrations are influenced by factors such as water temperature, phytoplankton abundance, mixing, and hydraulic residence time. Maintaining adequate DO concentrations in other managed ponds has been problematic during certain periods, such as warm summer months. At Pond A16, it may be necessary to increase flows and decrease residence times in the pond during warmer months to maintain adequate DO concentrations. Residence time may affect the abundance and productivity of invertebrates or fish, due to predation by birds nesting within the pond. The water control structures at Pond A16 would be adjusted to vary flow rates and study relationships between residence time, DO, phytoplankton abundance, and invertebrate productivity. In addition, other techniques to maintain DO concentrations may be tested, such as mechanically mixing pond water to induce re-aeration, re-aerating the discharge, or importing material to fill portions of the deep borrow ditches that have shown to be problematic for DO during ISP operations (May and Abusaba 2007).
- Vegetation management. While vegetation on nesting islands may benefit some bird species, vegetation management is expected to be necessary to maintain habitat for species averse to nesting in vegetation (*e.g.*, snowy plovers and American avocets) and to prevent dense, tall vegetation from encroaching on islands, and in shallow water foraging areas. Experimentation with various methods of vegetation management would be conducted to determine the methods that are most effective, and most cost-effective, in controlling vegetation. These methods would be implemented primarily during the non-breeding season. Methods that may be implemented to control vegetation on islands include maintaining substrate types for long-term effectiveness, mechanical control of vegetation by cutting, disking or raking, herbicide use, burning, spraying with highly saline water, or periodically raising water levels in Pond A16 to inundate the islands. Salvaged and recycled gypsum may be experimentally used as a vegetation-restricting measure

on roosting or nesting islands. Access and equipment for vegetation management may include trucks, boats, low-pressure construction equipment, and/or other equipment.

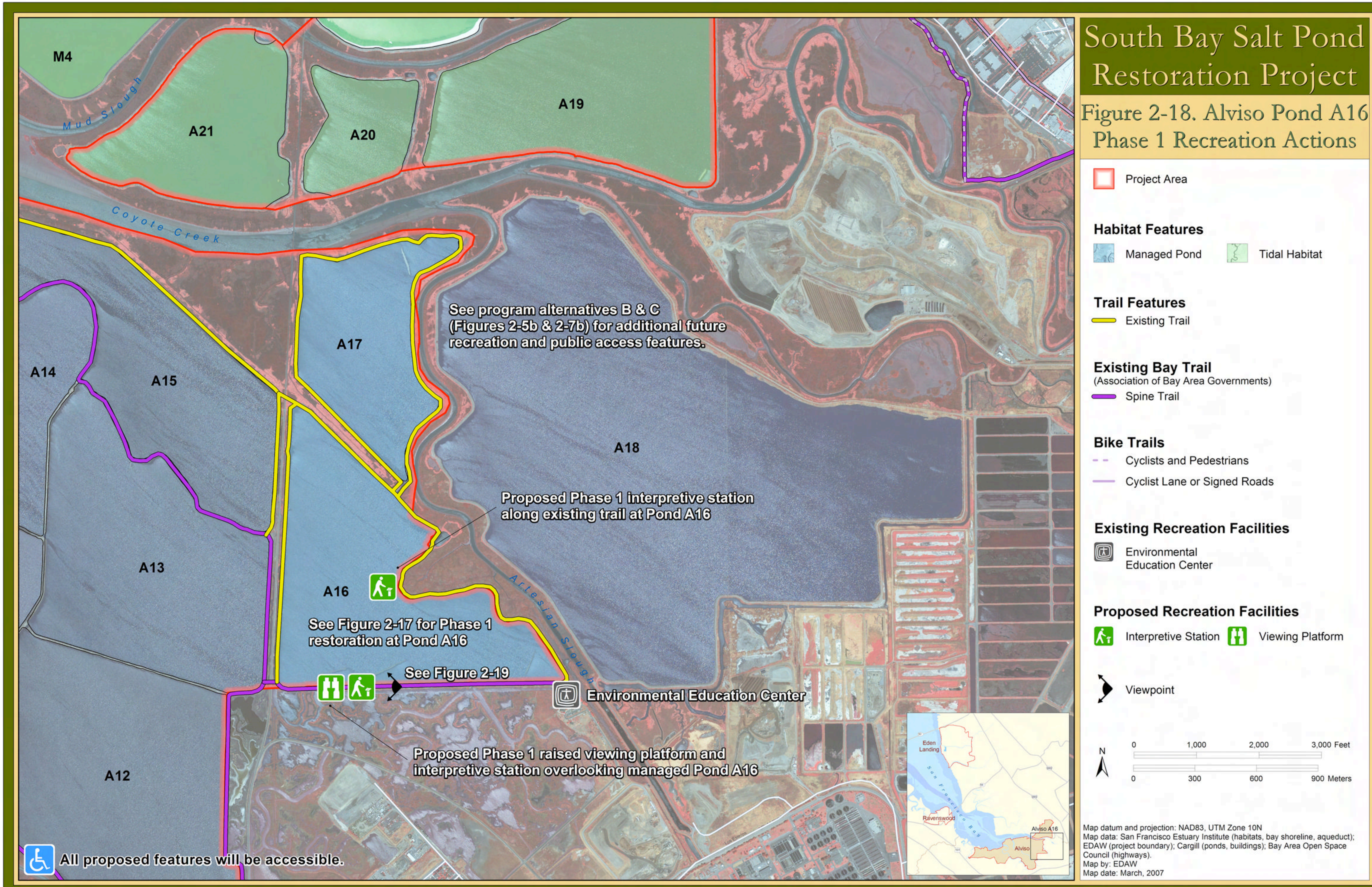
- *Predator management.* Predation would likely be an important factor limiting the number and success of nesting birds using the islands in Pond A16. Mammalian predation is not expected to be a problem, given the distance of the nesting islands from the pond edge and the ongoing predator control being employed by the Refuge. Avian predation is expected to be a concern. Predator management approaches would vary depending on the type of predator involved, and may vary depending on whether or not predators are nesting within the pond (*e.g*., gulls on islands). As a result, specific experiments to control predators would be designed once the nature and magnitude of predation is observed. Methods of reducing the effects of avian predation on nesting islands could include: hazing and removal of nest starts; provisions for vegetative or artificial cover (*e.g.*, chick shelters); trapping and relocation of predators within or near Pond A16; or lethal removal of individual problem avian predators if live capture is not successful.

Restoration Monitoring. Restoration monitoring would be performed to evaluate restoration performance and inform adaptive management, including the applied studies and restoration techniques. O&M inspections are discussed in the Operations and Maintenance section in Section 2.5.6.

- Island spacing and shape. Weekly surveys would be conducted throughout the breeding season to determine the number of nesting bird pairs/species on each island, and surveys at least once per week on a sample of islands would determine nesting success (proportion of nests that hatch at least one young) and fledging success. Surveys would be conducted from the levee around Pond A16, and from the interior of the pond as needed, by an observer using a spotting scope.
- Vegetation. Data on the percent cover, height, and density of vegetation (overall and by species) in random cells of a grid on each island would be collected.
- Predator management. Data would be collected on nest and fledging success of nesting terns and shorebirds on nesting islands, predation attempts and predation success on selected islands or in cells with different predator management treatments.
- Water management. During the late summer (after nesting has been completed), the flow rate would be varied to adjust the residence time of water within the pond. DO, water temperature, water depth, and salinity would be measured, and invertebrates would be sampled at 10 locations within each of the four cells on a weekly basis. Water levels would be managed to reduce the risk of low DO levels, so as to avoid fish kills, but evidence of any fish kills would be noted. The relationships between flow rate, air temperature, water temperature, and water depth on DO would be determined, and the relationships between these variables, DO, and salinity on invertebrate abundance would be determined.

Phase 1 Recreation and Public Access Actions

The recreational features within the Alviso pond complex would be managed by USFWS as part of the current public access program at the Refuge. The public access and recreation plan for the Phase 1 actions at the Alviso pond complex would occur in three principal locations near Ponds A16 and near Ponds A2E and A3W. See Figures 2-18 through 2-20 for plans that highlight recreation and public access in these locations.



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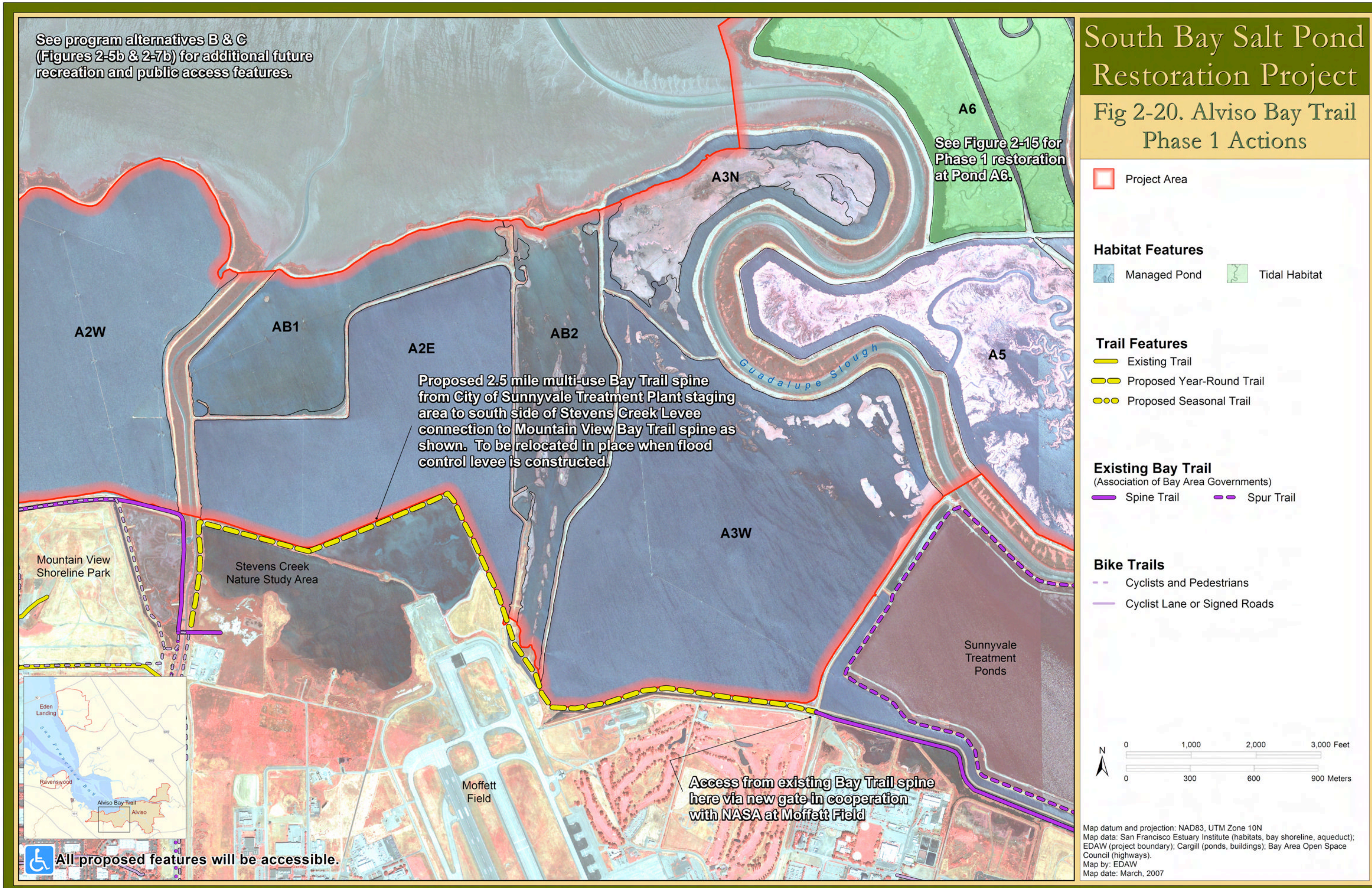
South Bay Salt Pond Restoration Project

Alviso – Pond A16 Viewing Platform and Interpretive Station

Figure 2-19

EDAW | AECOM

March 2007



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The proposed viewing platform and interpretive stations at Pond A16 would be accessible from the existing levee along the south edge of Pond A16 and Artesian (Mallard) Slough levee trail network that currently encircles the pond. These stations would be located at strategic locations along this existing trail network to provide visitors with unique viewing, birding and educational opportunities to learn about the transformation of Pond A16 as a managed pond. The Pond A16 viewing platform would be installed at the southern edge of Pond A16, close to the existing boardwalk from the Refuge EEC to allow visitors relatively close access to this station. Figure 2-19 shows a sketch of this location. The platform would be raised up to 5 ft above the existing grade of the levee as may be needed to allow visitors to overlook the managed pond restoration in Pond A16 and would be constructed of steel and recycled wood with ramps and railings as needed. An interpretive station would be incorporated into the design of the viewing platform. The other interpretive station would be located on the eastern edge of Pond A16 in a central location, approximately 1.4 miles from the existing boardwalk. The interpretive station layout in this location would be adjacent to the existing trail and allow for additional interpretive information to augment what is being planned for the other Pond A16 location.

The interpretive stations at Alviso would follow the prototype to be used at Eden Landing including a viewing portal, educational symbols and storyboard and would be constructed with a combination of wood and steel materials. See Figure 2-13 for an example of the interpretive station. These recreational features would be accessed from the existing staging area at the Refuge EEC.

The 2.25-mile Stevens Creek to Sunnyvale Bay Trail Spine would be an integral spine connection in Association of Bay Area Government's (ABAG) Bay Trail project, a partially constructed 400-mile recreational "ring around the Bay." It would be located at the southern boundaries of the pond complex, between the northwestern tip of the Stevens Creek Nature Study Area and the southwestern corner of the City of Sunnyvale WPCP adjacent to Moffett Federal Airfield on one side and a large expanse of managed ponds and tidal marsh on Bay side.

The spine trail is defined by ABAG as the main alignment that would provide a continuous recreational corridor around the Bay. The spine trail would be designed in accordance with ABAG Bay Trail Design Guidelines that require a two-way, multi-use trail 10 to 12 ft in width and paved with asphalt, with 2-ft shoulders on either side. The proposed trail would provide year-round access for pedestrians and bicyclists and other users and would meet California Department of Transportation (Caltrans) Class 1 bikeway standards. Trail design would need to be coordinated and compatible with future tidal wetland restoration work within the Stevens Creek Shoreline Nature Study Area and the Moffett Federal Airfield Site 25 remediation project.

In the longer term, this alignment would include a flood protection levee so the Bay Trail would then be retrofitted and incorporated in the design of the levee. As this may take many years, this segment of Bay Trail would be opened for immediate access to this part of the Project Area, utilizing the existing levee and would not be paved or meet the Caltrans Class I bikeway standards but would provide a key connection for many users until a more permanent segment can be constructed.

2.5.4 Ravenswood Pond Complex

Phase 1 actions in the Ravenswood pond complex would include reconfigured managed pond restoration and recreation and public access actions at Pond SF2.

Phase 1 No Action

Pond SF2

In the absence of a Phase 1 action at Pond SF2, USFWS would operate and maintain the pond in a manner similar to that described in the ISP (Life Science! 2003), although ongoing O&M activities would be scaled back based on available funding (see Section 1.4.4 and Figure 3, Appendix B). Water control structures would be installed along the bayfront levee between Pond SF2 and the Bay as described in the ISP. Pond SF2 would operate as a managed pond in isolation by exchanging water directly with the Bay.

The levees surrounding Pond SF2 would be maintained or repaired upon failure to continue providing some level of flood protection; however, the existing pond levee is not designed as a levee that provides flood protection and is expected to overtop during extreme events. Continued operation of Pond SF2 as a managed pond is not expected to affect PG&E access to the existing PG&E towers.

Cargill currently uses an existing pipe that runs through Pond SF2 from an existing siphon between Ponds SF2 and R2 to Cargill's transbay pipeline beginning at the bayfront levee. This pipe is buried along the northwest edge of the pond 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 Redwood City salt ponds to Cargill's Newark plant. Cargill expects to decommission the West Bay salt ponds and these pipes in the future. Once Cargill's operations are decommissioned, the existing siphon would be abandoned in place or reconfigured to provide flow between Pond SF2 and Ravenswood Slough.

No new public access or recreational facilities would be constructed under this alternative. An existing recreational trail is located between SR 84 and Pond SF2 and along Pond SF2's bayfront levee. The recreational trail between SR 84 and Pond SF2 would likely remain under this alternative; however, overtopping and erosion along the bayfront levee would diminish the integrity of this portion of the existing recreational trail, thereby reducing the existing public access and recreational value.

Phase 1 Restoration Actions

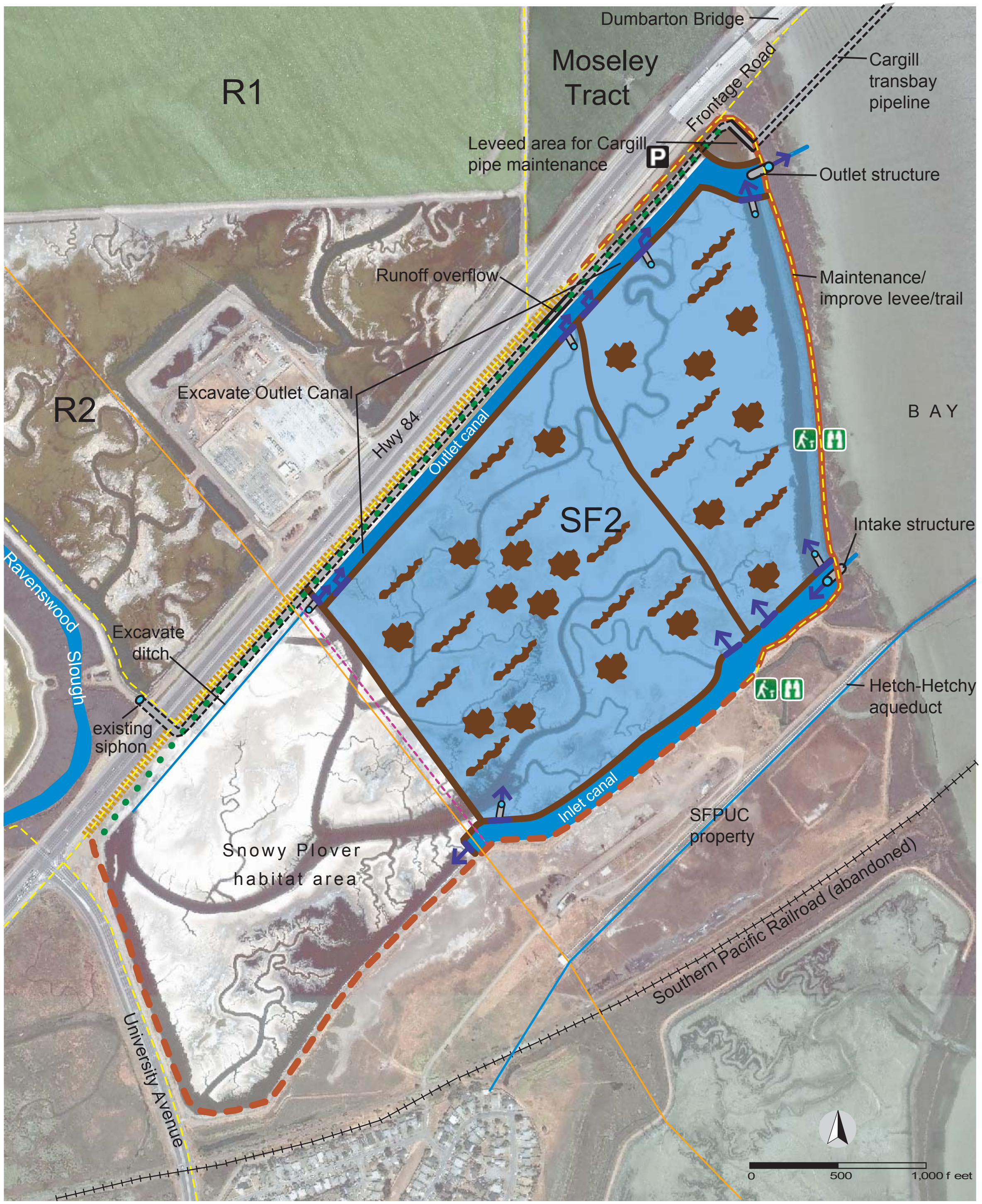
Pond SF2

Introduction. The central and eastern parts of Ravenswood Pond SF2 would be reconfigured to create islands for nesting birds and shallow water habitat for shorebird foraging throughout the year (Figure 2-21). The western part of Pond SF2 would be managed to provide snowy plover habitat similar to existing conditions (*i.e.*, salt panne). As specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R) and the Phase 1 action at Alviso Pond A16, the Pond SF2 restoration would test bird use for different island configurations as an applied study. The Pond SF2 restoration would also

South Bay Salt Pond Restoration Project

figure 2-21

Ravenswood Pond SF2 Phase 1 Action Restoration Plan



- Earth berm
- Existing levee, to remain
- Levee/trail maintenance improvement
- Existing high ground
- Plantings
- Pilot channel
- Typical flow direction
- Pond intake/outlet water control structure (culverts with gates)
- Cell intake/outlet water control structures:
  - Weir
  - Culvert with weir
- Existing above ground pipe, to remain
- Existing buried pipe, to remain
- Railroad
- Existing trails[1]
- Existing parking[1]
- Interpretive station[1]
- Viewing platform[1]
- PG&E overhead power transmission line
- Existing PG&E boardwalk
- Nesting island- linear (25)
- Nesting island- circular (25)

[1]See EIS/R Figure 2-22 for public access and recreation features.

Figure by Philip Williams & Associates
Figure Date: 11-08-07

PWA

#1750/phase1/basemaps/concept plans/tidal ponds/Ravenswd_PondSF 11_08_07.ai test restoration techniques for vegetation management, predator management, and water quality management as part of the Adaptive Management Plan. Recreation and public access features for the Pond SF2 restoration are described in the Ravenswood Recreation and Public Access Actions section below.

Restoration Plan. Three cells would be created within Ravenswood Pond SF2 (Figure 2-21). The central and eastern cells would be reconfigured to create islands for nesting birds and shallow water habitat for shorebird foraging. The restoration plan for these cells would be similar to the restoration plan for Pond A16 described in Section 2.5.2 above. Nesting islands would be constructed in these two cells. Water levels in these cells would be managed to provide optimal depths for shorebird foraging. The western cell would be managed for snowy plover salt panne habitat. The pond bed in the western cell would remain dry during the summer nesting season and provide nesting habitat for snowy plovers. Water levels and flows in the remnant tidal channels and borrow ditches would be managed to provide foraging habitat. Water control structures would be used to manage water levels and flows in each cell. Water would flow into and out of Pond SF2 through new water control structures located in the eastern levee between Pond SF2 and the Bay. Circulation through Pond SF2 would be managed to meet water quality targets.

Nesting islands. As at Pond A16, nesting islands would be constructed in the two eastern cells by grading the bottom of Pond SF2. These islands are expected to be used for nesting by Forster's terns, American avocets, Caspian terns, black-necked stilts, and snowy plovers. Different island shapes and densities would be created to replicate the Pond A16 applied study (see the Pond A16 Adaptive Management section in Section 2.5.2). The islands would be located at least 300 ft (90 m) from the pond levees to provide a buffer between nesting birds and both mammalian predators and human activity on the levee. The islands would also be located at least 600 ft (180 m) from any focal areas for human use, such as viewing platforms and benches. Further description of the nesting islands is included in the Pond A16 Restoration Plan description in Section 2.5.2. Nesting islands would not be constructed in the western snowy plover salt panne habitat area.

Berms. Cells would be created in Pond SF2 by constructing low "check" berms around the cells, ranging in height from approximately 2 to 6 ft (0.6 to 2 m). The berms would be constructed by excavating fill material on-site. The average pond bottom elevation is approximately 5.2 ft NAVD (1.6 m NAVD), which is approximately 2.1 ft (0.64 m) below MHHW and midway between MTL and MHHW. Pond bottom elevations vary by approximately 0.5 ft (0.15 m) and slope toward the southwest corner of the pond. Berms would be placed to allow water levels to vary between different cells, creating two cells with similar shallow water depths over the sloping pond bottom, and allowing the western snowy plover salt panne habitat area to remain dry during the nesting season. The berms and cells in Pond SF2 would also facilitate circulation through the elongated pond. Water depths in the two eastern cells would be managed as at Pond A16, ranging from approximately 2 inches (0.05 m) to 1 ft (0.3 m) to provide foraging habitat for smaller and larger shorebirds.

Water Management. The current water management plan for the Pond SF2 restoration includes features to allow management flexibility and design redundancy. Using adaptive management, different water management approaches would be tested at Pond SF2 to assess the effectiveness of providing optimal shallow water habitat and meeting water quality objectives (see the Pond SF2 Adaptive Management section below). Subsequent design phases of the Project would refine the specific type, number, size, and location of water control structures, berms, and other features.

Water would flow between Pond SF2 and the Bay through two sets of new water control structures, such as several 24-inch or 48-inch culverts with adjustable tide gates. During high tides, water would flow into Pond SF2 through the intake structure located in the southern portion of the bayfront levee. Water would flow out of Pond SF2 during low tides through the outlet structure located in the northern portion of the bayfront levee. In addition, the Pond SF2 restoration may include a pump to periodically supplement gravity flows through the intake water control structure, if monitoring and adaptive management indicate that a pump is required to meet water quality objectives. A pump may be necessary because the elevation of Pond SF2 is high relative to tide levels and may limit inflow by gravity.

Within Pond SF2, intake and outlet canals would be created to convey flow into and out of individual cells as at Pond A16. 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 canal along the southeast edge of the pond would be used as the intake canal and the canal along the northwest edge of the pond would be used as the outlet canal; however, Pond SF2 would be designed so that the flow direction could be reversed to allow for management flexibility. A portion of the pond bed along the northwest edge of the pond would be excavated to create an outlet canal because there is not a borrow ditch in this location. Water control structures, such as flashboard weirs, would be installed in the berms to regulate flow into and out of the cells.

Water would be circulated through the two eastern cells in Pond SF2 at rates sufficient to meet water quality objectives. As at Pond A16, the water quality objectives for Pond SF2 would be to maintain adequate DO levels, salinity, and pH in the cells and at the outlet structure. To test water management approaches within the Adaptive Management Plan, flows would be varied to assess the effects on DO levels and bird prey (see Pond SF2 Adaptive Management section below). Flow through one of the cells could be modified without affecting the management of the other cell. Similarly, one cell could be completely drained of water for vegetation management (see Adaptive Management section below) while the other cell continues to provide shallow water habitat for shorebird foraging. Alternatively, water levels in Pond SF2 could be periodically raised to inundate the edges of the nesting islands as a vegetation management technique. Raising water levels to inundate the islands would also inundate the berms and water control structures and reduce the area of shallow water habitat.

The outlet canal could be used as a mixing basin if needed to meet water quality targets at the outlet structure. The outlet water control structures would be adjusted to allow Bay water to flow into the outlet canal, diluting the outflow before releasing it to the Bay.

Water levels and flows in the remnant tidal channels and ditches in the western cell would be managed for snowy plover foraging habitat. Flows into and out of this cell may be limited to maintain moderate to high salinity foraging habitat. A ditch would be excavated along the northwest edge of the cell to act as a moat and deter human access into the snowy plover salt panne habitat area. The ditch may also improve water circulation. New channels may be excavated in other locations to connect the existing remnant channels and ditches and improve circulation. The western cell would be periodically or seasonally inundated for vegetation management and/or to manage the area for alternate bird use or habitat goals outside of the nesting season. Water levels would be similar to, or lower than, those described in the ISP.

For typical operations, target average water depths in the two eastern cells would be approximately 6 inches (15 cm), with some deeper and shallower areas and muted-tidal fluctuations of up to approximately 6 inches. The typical operation and periodic or seasonal management of Pond SF2 would not substantially increase winter-time water levels in Pond SF2 relative to Cargill or proposed ISP operations (Life Science! 2003).

Levees. The existing bayfront managed pond levee would be resurfaced and raised and/or widened to improve the public access trail (see Recreation and Public Access section below) and to maintain this portion of the managed pond levee (see Section 2.5.6). The existing levee around the rest of Pond SF2 would remain as is.

Revegetation. The northwest perimeter of Pond SF2, along the slope between the trail and the outlet canal, would be actively revegetated to provide habitat and an additional buffer from anthropogenic disturbance from the trail and the adjacent highway. Revegetation would also increase the aesthetic value of the trail experience. This transitional zone would be actively planted with species such as pickleweed (*Salicornia virginica*), alkali heath (*Frankenia salina*), salt grass (*Distichlis spicata*), big saltbush (*Atriplex lentiformis*) 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 peppergrass (*Lepidium latifolium*) and fennel (*Foeniculum vulgare*), which could otherwise thrive. These measures could include amending the soils or other steps. 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.

Infrastructure. The existing 36-inch siphon between Ponds SF2 and R2 would remain. Cargill currently uses a pipe that runs through Pond SF2 from the siphon to Cargill's transbay pipeline beginning at the bayfront levee. This pipe is buried along the northwest edge of the pond 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 Redwood City plant ponds to Cargill's Newark plant. Cargill will construct a new berm to separate the northeast corner of the pond, creating a bermed area for Cargill to perform maintenance on their pipe. Cargill expects to eventually decommission the Redwood City plant ponds and the transbay pipeline. Once Cargill's operations are decommissioned, the existing siphon may be reconfigured to provide flow between Pond SF2 and Ravenswood Slough.

The existing PG&E power towers and most of the existing boardwalk would be located within the western cell, where the pond bed would remain dry during the nesting season as it does under existing conditions. Up to 400 linear ft of the existing PG&E boardwalk may be modified to allow continued access across the proposed canal and ditch at the ends of the existing boardwalk within Pond SF2. Modifications may include raising, replacing, removing, and/or installing new sections of the boardwalk. Specifications for PG&E boardwalk modifications would be refined in the design phase in coordination with PG&E.

Adaptive Management. Adaptive management for the Phase 1 action at Pond SF2 would include the same applied studies and restoration techniques as Pond A16, as specified in the Adaptive Management Plan (see Section 2.3 and Appendix D of this EIS/R).

Applied studies. The applied studies at Pond SF2 to test how island density and shape; vegetation types, density, and distribution; and human activity effect bird nesting use and reproductive success would replicate the applied study described for Pond A16 (see the Pond A16 Adaptive Management section in Section 2.5.2).

Restoration Techniques. 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 of shorebirds would be tested as at Alviso Pond A16 (see the Pond A16 Adaptive Management section in Section 2.5.3).

*Restoration Monitoring***.** Restoration monitoring would be performed to evaluate restoration performance and inform adaptive management, including the applied studies and restoration techniques. Restoration monitoring at Pond SF2 would be identical to restoration monitoring at Pond A16, which is described in the Pond A16 Adaptive Management section in Section 2.5.3. O&M inspections are discussed in the Operations and Maintenance section in Section 2.5.6.

Phase 1 Recreation and Public Access Actions

The recreational features proposed within and outside the Ravenswood pond complex would be managed by USFWS. The public access and recreation plan for the Phase 1 actions at the Ravenswood pond complex would occur in two principal locations near Pond SF2 and overlooking Pond R4 in Bayfront Park. Figures 2-22 and 2-23 show plans that highlight recreation and public access in these locations.

The Ravenswood pond complex is situated on either side of the Dumbarton Bridge and highly visible to passersby. This affords an opportunity to share information about the SBSP Restoration Project and attract visitors to explore the area. Signage would include the Project logo and present key messages about the SBSP Restoration Project as well as direct people to strategic access points. The public access plan for this area also includes rehabilitation of the existing Bay Trail spur along the bayside of Pond SF2 and the addition 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. The trail follows an existing levee that would be rehabilitated to provide a width of 6 to 8 ft of compacted earth and allow multi-use excluding equestrians.

The viewing platforms would be raised above the existing grade of the levee trail to allow visitors a panorama view of the Bay and the large expanse of adjacent managed pond. Figure 2-24 shows a sketch of this area. Overall, the areas around Pond SF2 would be cleaned up and native vegetation would be strategically planted to visually enhance the SBSP Restoration Project Area and provide transitional plantings between the highway corridor and the adjacent restoration lands.

The viewing platform at Bayfront Park would be constructed in partnership with the City of Menlo Park and would be located at one of the highpoints in the Park that provides a great vantage point to view

Greco Island as it meets Pond R4. Currently the Park contains many trails but signage along existing trails would direct visitors to an at-grade viewing platform and interpretive station to describe the process of creating a functioning tidal marsh at Pond R4 such as is seen at Greco Island. The interpretive stations at the Ravenswood pond complex would follow the design prototype being used at the Eden Landing and Alviso pond complexes with a view portal, educational symbols and storyboarding, constructed of a combination of wood and steel and sized based on the site location.

2.5.5 Construction Methods

Introduction

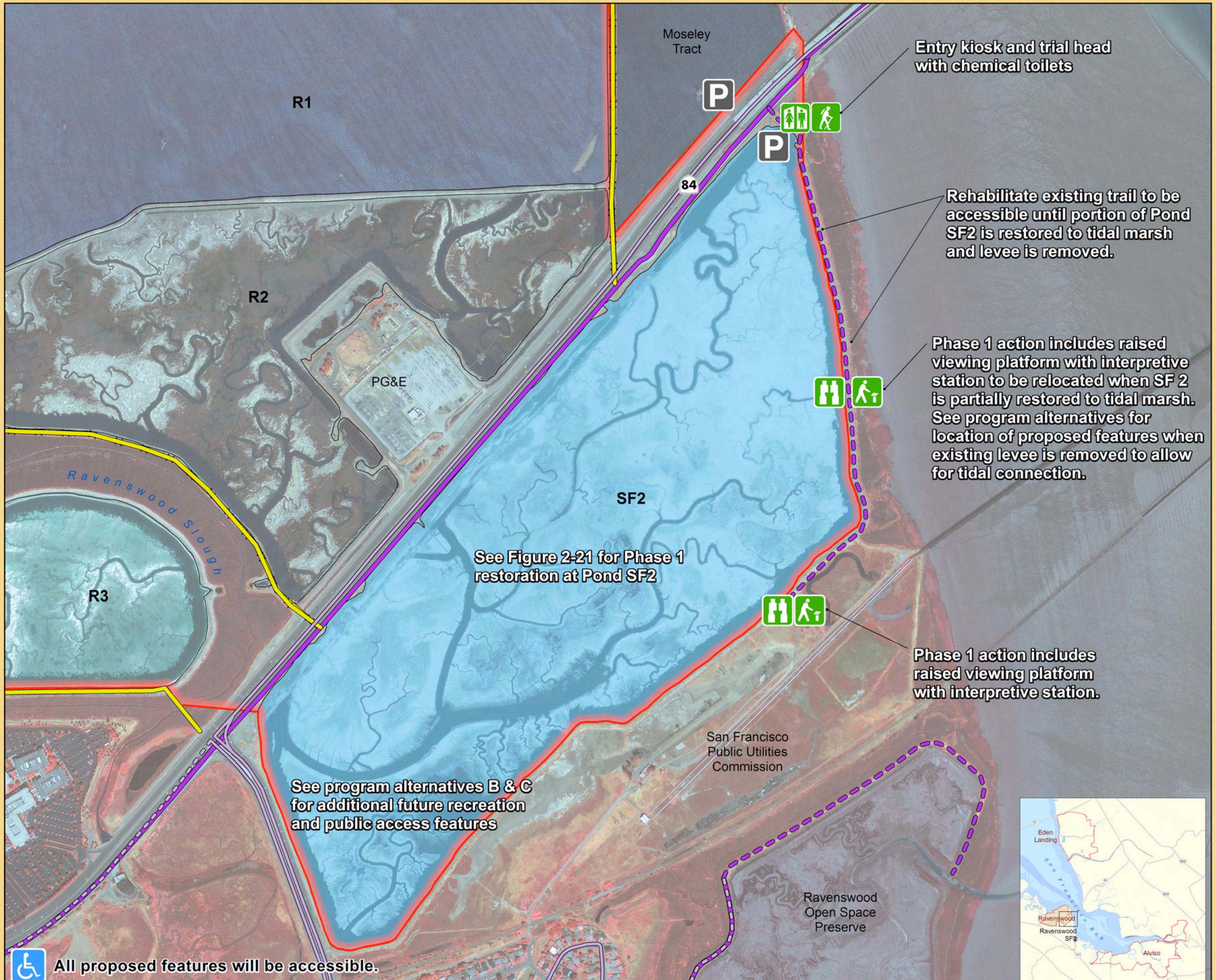
Construction methods for both the Phase 1 restoration actions and recreation and public access actions are discussed below, followed by further discussion for each Phase 1 action.

Restoration Actions

The Phase 1 restoration actions would be constructed using land-based and/or water-based equipment depending on the site, design, and contractor's preference (see Section 2.4.5 for a discussion of the equipment that would be used). If land-based equipment is used, the pond restoration site would be drained prior to and during construction and light, low pressure equipment and/or equipment on mats would be employed. Land based equipment is more likely to be used on pond perimeters near levees and berms, while water-based equipment is more likely to be used for construction in pond interiors. If water-based equipment is used, water levels in the restoration sites would be raised to provide sufficient depths for floating equipment.

The construction period and duration would be governed by both weather conditions and habitat windows for protected species. For example, if land-based equipment is used, construction may be limited to the dry season from May to October. Also, construction in certain areas would occur between August or September and January or February to avoid potential disturbance or impacts to birds during their breeding seasons, if specified by Project permits. Further discussion is included on each Phase 1 restoration action below, on the implementation schedule for the Phase 1 actions in Section 2.6, and on potential biological impacts due to construction activities in Section 3.6. Construction of each Phase 1 restoration is expected to last two to five months, as discussed below. If possible, construction would be accomplished in one season; however, if construction is not completed in one season due to the above constraints, construction would continue to completion in the following season and would require additional mobilization/demobilization.

Construction access and water control are two key considerations in salt pond restoration construction. It is likely that the selected construction contractor(s) would be allowed to select methods to deal with these issues within general parameters established by the owners and their engineers. In particular, the weight bearing capacity of the pond bottoms may not be sufficient to support land-based construction equipment without extraordinary effort, such as constructing temporary berms for equipment to access the pond interior. Water control would be necessary to drain the site for land-based equipment and maintain depth



South Bay Salt Pond Restoration Project

Fig 2-22. Ravenswood SF2 Phase 1 Recreation Actions

Project Area

Habitat Features

Managed Pond
Tidal Habitat

Trail Features

Existing Trail

Existing Bay Trail
(Association of Bay Area Governments)

Spine Trail
Spur Trail

Bike Trails

Cyclists and Pedestrians
Cyclist Lane or Signed Roads

Existing Recreation Facilities

Parking

Proposed Recreation Facilities

Chemical Toilet
Trail Head
Interpretive Station
Viewing Platform

N
0 500 1,000 1,500 Feet
0 150 300 450 Meters

Map datum and projection: NAD83, UTM Zone 10N
Map data: San Francisco Estuary Institute (habitats, bay shoreline, aqueduct); EDAW (project boundary); Cargill (ponds, buildings); Bay Area Open Space Council (highways).
Map by: EDAW
Map date: November, 2007

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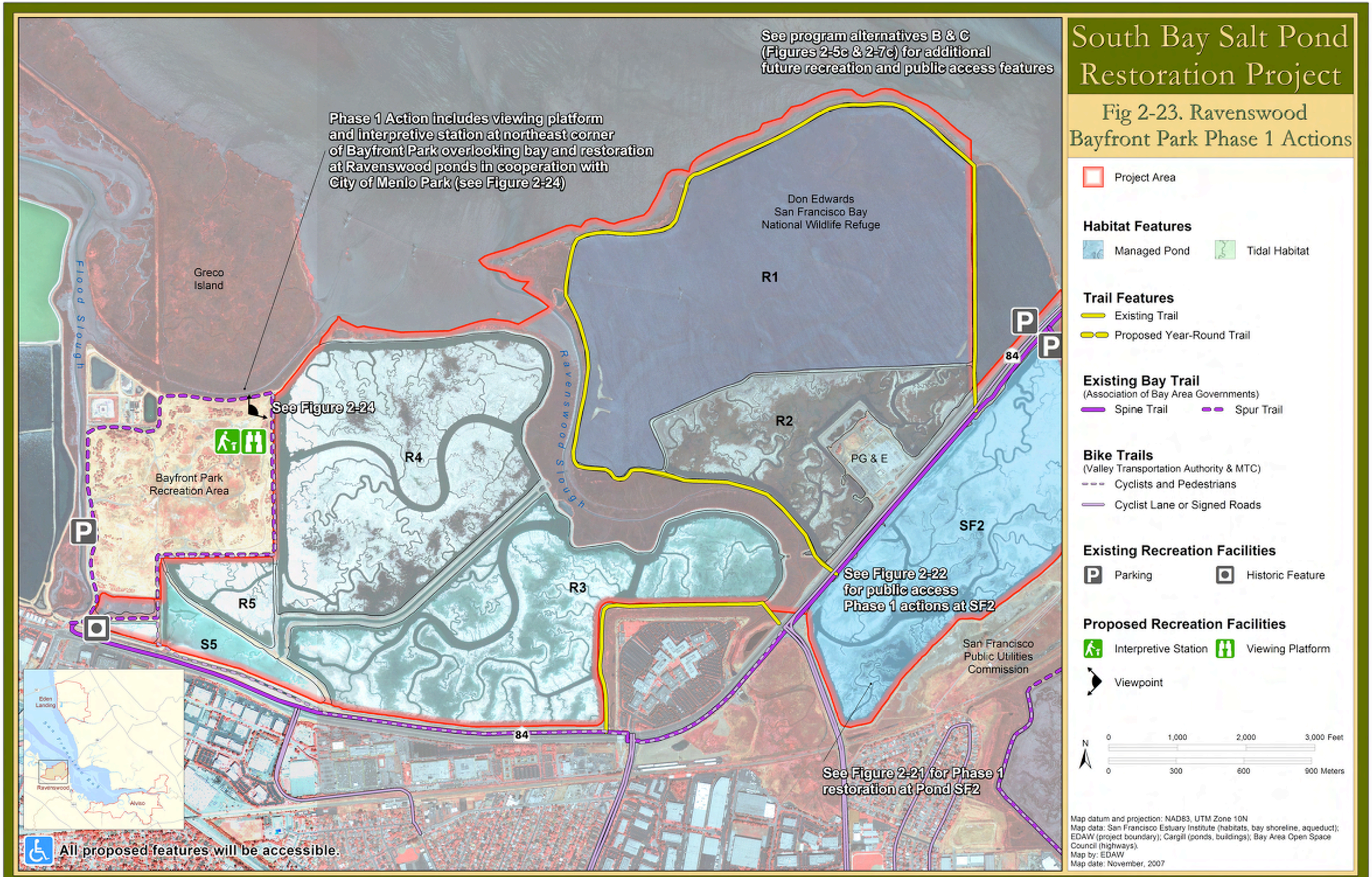

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South Bay Salt Pond
Restoration Project

Ravenswood – Bayfront Park Viewing Platform and Interpretive Station

Figure 2-24

EDAW | AECOM

March 2007

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for floating equipment. Water control may be accomplished using water control structures and tidal exchange and/or with pumps.

Mobilization/demobilization of equipment would take place over a period of approximately two to three days or more at the beginning and end of the Project. Land-based construction equipment could include an excavator, a front end loader, a bulldozer, a forklift, a vibratory roller, a dump truck, and a water truck. The water truck would be used for dust control on the site. Water-based equipment could include small barges for access and hauling earth, and hydraulic or bucket dredges. One or two diesel-powered barges with long reach excavators or cranes outfitted with clamshell buckets, and two to three small boats for maneuvering the barges, checking grades and ferrying personnel and equipment could be used. Ancillary equipment that may be used include a diesel generator, water pump and a piledriver. In some instances, using either land or water-based equipment, a crane may be brought on-site for specific tasks, and a piledriver may be necessary during the construction of certain structures. Dewatering and sheet piling may be 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. Restrictions would be specified for the operation and transport of larger equipment, such as cranes and excavators, near power lines to avoid contact with the lines.

Construction at each Phase 1 action restoration site would be performed by at least one construction worker team, typically consisting of five to ten people. More people per team and/or more teams may be required if construction timelines demand that work proceed simultaneously at multiple locations within a site. It is assumed that each worker would drive their own vehicle to the site each day. Access to each site is described below. Access within the pond complexes would be along existing maintenance routes and public access roads. Heavy vehicles would avoid crossing water control structures in the levees if the vehicle exceeds the weight bearing capacity of the structure. If this is not possible, engineer approved precautions would be taken to avoid damaging the structure.

It is assumed that all fill material would be reused on site, therefore fill is not expected to be brought in or hauled offsite. Occasional delivery of supplies and materials would be necessary, such as for piping, water control gates, lumber, and fuel. It is assumed that a water truck would refill three to five times per day, necessitating a drive offsite. It may be possible to refill with brackish water from on site. Approximately two to four deliveries on average of materials would be made per week for the duration of construction activity. Equipment would be refueled once per day. A staging area may temporarily be constructed at or near each Phase 1 action restoration site for activities such as fueling and equipment storage.

Recreation and Public Access Actions

Construction of the recreation and public access components would consist of construction of trails, viewing platforms, interpretive stations and a boat launch. Trail construction activity would consist of grading and surfacing improvements as may be necessary to allow for ADA compliance. Paving trails would not be necessary however existing earthen surfaces may have to be augmented with decomposed granite or gravel to ensure a firm and stable surface. Depending on the length of trail, construction activity could be one to seven days.

A boat launch facility for the launching of kayaks and small boats would require the building of a ramp for trailer access that would also be constructed with a gravel surface for stability. Equipment required might include a backhoe or excavator, compaction equipment and a dump truck for movement of fill and gravel as may be needed. Construction would take three to five days for each Phase 1 action.

Interpretive and directional signage would be placed at strategic locations as part of the Phase 1 actions. Equipment required for construction would comprise small, Bobcat-sized equipment, a backhoe or front-end loader, and a dump truck. Viewing platforms would be constructed of recycled plastic, wood and or steel materials as may be needed for long term durability and ease of maintenance. These would be largely assembled in-place using a backhoe or excavator and hand tools. Platform construction would take three to five days each. Interpretive stations may be built on-site, or may be prefabricated structures. Assembly/installation would require a backhoe or excavator and hand tools and take one to three days per station. Construction of recreation and public access elements would be the same for all complexes.

Eden Landing Complex

Restoration Actions

Ponds E8A, E9, and E8X. Access to the E8A/E9 site for both workers and equipment would likely be via a combination of Union City Boulevard, Bettencourt Way, Whipple Road, Horner Street, and Veasy Street. Water based access would be through Mt. Eden Creek, OAC, and/or the tidal marsh fringing San Francisco Bay. The total amount of disturbed ground is estimated as 70 acres. Restoration construction is expected to last three to five months. As required by permits, the timing of construction (construction window) would avoid impacts to special-status species, such as California clapper rails and snowy plovers, and other sensitive species, including nesting birds such as terns, avocets, and stilts.

Ponds E12 and E13. Access to the Pond E12/13 site for both workers and equipment would be either off SR 92 to the Clawiter Road exit just east of the San Mateo Bridge or from 880 to the Industrial Parkway exit, proceeding west on Industrial to Arden then Clawiter to the Reserve gate. Water-based access would be through Mt. Eden Creek if the creek depth allows for the equipment draft. This may limit access. There is an existing brine pump at Pond E12/13 that was used by Cargill. The pump is an electric 10,000 gpm pump and is estimated to be rated at 25 horsepower (hp). The total amount of disturbed ground is estimated as 60 acres. Restoration construction is expected to last three to five months. As required by permits, the construction window would avoid impacts to special-status species, such as snowy plovers, and other sensitive species, including nesting birds such as terns, avocets, and stilts.

Alviso Pond Complex

Restoration Actions

Pond A6. Access to the A6 site for both workers and equipment would be off of SR 237 via a combination of North First, Hope, Mill, Gold, and Elizabeth Streets. Water based access would be through Coyote Creek, Alviso Slough, and/or Guadalupe Slough. The total amount of disturbed ground is estimated as 40 acres. Restoration construction is expected to last two to four months. As required by permits, the construction window would avoid impacts to special-status and sensitive species, such as

California clapper rails. Restrictions would be specified for the operation and transport of larger equipment, such as cranes and excavators, near the PG&E power transmission lines to avoid contact with the lines.

Pond A8. Access to the A8 site for both workers and equipment would be off of SR 237 via a combination of North First, Hope, Mill, Gold, and Elizabeth Streets. Water based access would be through Coyote Creek, Alviso Slough, and/or Guadalupe Slough. The total amount of disturbed ground is estimated as one acre. Restoration construction is expected to last two to four months. As required by permits, the construction window would avoid impacts to special-status species, such as snowy plovers and other sensitive species, including nesting birds such as terns, avocets, and stilts.

Pond A16. Access to the Pond A16 site for both workers and equipment would be via Zanker Road off of SR 237. Water based access would be through Coyote Creek and Artesian Slough. The total amount of disturbed ground is estimated as 100 acres. Restoration construction is expected to last three to five months. As required by permits, the construction window would avoid impacts to special-status species and other sensitive species, including nesting birds such as terns, avocets, and stilts.

Ravenswood Pond Complex

Restoration Actions

Pond SF2. Access to the Pond SF2 site for both workers and equipment would be off of SR 84. Water based access would be through San Francisco Bay. The total amount of disturbed ground is estimated as 100 acres. Owing to the high site grades precluding floating equipment, and soft soils, earth embankments may be required to construct internal site features. Restoration construction is expected to last three to five months. As required by permits, the construction window would avoid impacts to special-status species, such as snowy plovers, and other sensitive species, including nesting birds such as terns, avocets, and stilts. Restrictions would be specified for the operation and transport of larger equipment, such as cranes and excavators, near the PG&E power transmission lines to avoid contact with the lines.

2.5.6 Operations and Maintenance

Introduction

O&M activities for the Phase 1 actions would be performed periodically for the reconfigured managed pond restorations, and less frequently for the tidal habitat restorations. O&M for the reconfigured managed ponds and tidal habitat restorations are discussed generally below, followed by additional discussion for each Phase 1 restoration action. Both reconfigured managed ponds and tidal habitat restoration actions would include maintenance activities to clean up trash and vandalism as needed. Please refer to Section 2.4.5, for a discussion of the O&M activities covered by Corps Permit #19009S98 at the pond complexes.

Refuge and CDFG staff or their contractors would use trucks to access the Phase 1 action restoration sites via existing maintenance roads on the levees to perform O&M activities. Boats may be used to access the canals, water control structures, and nesting islands in the reconfigured managed ponds and tidal habitat restoration features. Maintenance may require the use of land-based and/or water-based construction equipment as described in the Construction Methods section above.

Adaptive management approaches are discussed in the Adaptive Management sections for each Phase 1 action; monitoring related to adaptive management is discussed in the Restoration Monitoring sections for each Phase 1. More detailed O&M Plans would be developed for each Phase 1 action by the Refuge and CDFG.

Reconfigured Managed Ponds

For the Phase 1 action reconfigured managed pond restorations (Eden Landing Ponds E12 and E13, Alviso Pond A16, and Ravenswood Pond SF2), periodic inspection and maintenance of restoration infrastructure – such as water control structures, managed pond levees and berms, canals, and islands – would be required to ensure that the ponds are operating as intended. More frequent inspection and maintenance of habitat conditions in the ponds, such as water levels and water quality (including salinity and DO), would be necessary to ensure that the ponds are providing the appropriate environment for the target species. Water levels and flows in the reconfigured managed ponds would be controlled by adjusting the gate settings at culverts and by adding or removing flashboard risers at weirs. Routine monitoring of water levels would be necessary to ensure that the ponds are providing the appropriate habitat for desired species. Regular monitoring of water quality would also be necessary to ensure that target water quality parameters are met both inside the pond and in discharges. If water levels or water quality targets are not met, changes in the operation of water control structures may be necessary.

Routine inspection of water control structures in reconfigured managed ponds would be necessary to ensure that they are functioning properly. Inspection of water control structures and canals for debris or trash obstructions would 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 would also be necessary. If unintentional breaching or erosion occurs, the berm or levee would 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 would also need to be periodically examined for erosion.

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.

Tidal Habitat Restorations

The Phase 1 action tidal habitat restorations (Eden Landing Ponds E8A, E9, and E8X and Alviso Pond A6) would create sustainable habitats that require minimal ongoing active management or maintenance. However, periodic inspection and maintenance of restoration features, such as ditch blocks, would be required to ensure that the restoration is operating as intended. Routine inspection of ditch blocks for unintentional channel bypassing or erosion would be necessary, particularly following storm events. If bypassing or erosion occurs, maintenance of the ditch block may be performed to prevent unintended channel formation. Also, non-native *Spartina* would be controlled using mechanical methods and/or herbicides.

Recreation and Public Access Actions

O&M at Eden Landing would be a cooperative effort between CDFG and another entity such as the EBRPD. Currently, outside the SBSP Restoration Project Area these two agencies are partnering to build a staging area and a portion of the Bay Trail spine within the ELER. The exact type and level of management agreement that would be used is not known at this time. At the Alviso and Ravenswood pond complexes, O&M activities would be conducted by USFWS in partnership with other entities such as the City of Menlo Park at Bayfront Park. For the Bay Trail spine adjacent to Moffett Federal Airfield, an agreement with NASA related to operations may be necessary due to security issues with segments of this trail and its proximity to their facilities. Longer-term public access improvements at Alviso, near the City of Sunnyvale WPCP would require an agreement with Cargill (or any subsequent land owner) to have access over the existing road that leads to Guadalupe Slough. The trail connection and viewing platform at Pond A8 would require an agreement with the City of San Jose as it intersects with the "Legacy" property which would ultimately be developed and the City may secure easements for public access. Also, viewing platforms and trail connections in and around the City of Mountain View would require agreement between Mountain View and USFWS. Projects in the vicinity of Alviso would be coordinated with the City of San Jose, community of Alviso, SCVWD and County of Santa Clara Department of Parks and Recreation. As the Refuge has been functioning adjacent to these communities for many years, these new projects would further develop existing management relationships that are already in place. These projects would be an enhancement to the adjacent communities and should provide positive economic and public relations.

Throughout the Project Area, there may be other special agreements for partnering and funding of public access and recreation features. These would benefit a large population and entities such as the Bay Trail project and Coastal Conservancy may contribute funding, as well as others. Operational agreements would need to be specific to ensure that long-term functionality and a high quality visitor experience is maintained. Maintenance of public access and recreation features would include trail grooming, although this would not require a lot of repeated annual labor, it would need to be done to ensure that trail surfaces are kept safe and accessible for all types of users. Fencing that would be placed along trail edges as a "symbol" that visitors should not stray off of the designated corridor may need periodic repair; however, the design of these features would be done to reduce maintenance as much as possible.

There would be a need for trash removal along trails and more intensely at staging areas and trailheads. It is possible that trash containers would not be provided to promote the "carry in-carry out" concept; however, this would get abused from time to time and would require clean-up. The viewing platforms and interpretive stations would be designed to minimize maintenance utilizing durable and sustainable materials as much as possible to prevent degradation and the need for repeated maintenance. These would need to be checked periodically for defacement of interpretive boards and other potential vandalism. Many of the sites would be gated and only open from dawn to dusk so this would assist in preventing extensive vandalism. Partnering with user groups and other volunteers would extend the ability of agency staff to manage the public access components of the Project Area. A long-term volunteer program could be put into place to augment those that currently exist.

Eden Landing Pond Complex

Restoration Actions

Ponds E8A, E9 and E8X. The Ponds E8A, E9, and E8X tidal habitat restoration would create sustainable habitats that require minimal ongoing active management or maintenance as discussed in the Introduction section above. Routine inspection of ditch blocks and the managed pond levee separating Ponds E9 and E14 for unintentional overtopping, bypassing or erosion would be necessary, particularly following storm events. If overtopping, bypassing or erosion occurs, maintenance of the ditch block or levee may be required to prevent unplanned hydraulic connections.

Ponds E12 and E13. The Ponds E12 and E13 reconfigured managed pond restoration would require periodic O&M as discussed in the Introduction section above. The existing brine pump would be operated to supplement flows into Ponds E12 and E13 and manage water levels and salinity in the ponds as needed. This pump may be operated on a regular basis during the dry season, depending on the water management technique (see the Ponds E12 and E13 Adaptive Management section in Section 2.5.2 and Appendix G (Eden Landing Ponds E12 and E13 Water and Salt Balance Modeling). The pump is an electric 10,000 gpm pump and is estimated to be rated at 25 horse-power. In addition, a portable pump may be used occasionally as described in the Introduction section above.

The pump forebay for the brine pump may need to be dredged if sedimentation in the forebay substantially decreases the storage volume. Frequent maintenance dredging is not expected to be necessary, with dredging possibly occurring approximately once per decade. Material dredged from the forebay could be used to maintain levees, berms, or nesting islands as needed.

Techniques for water and salinity management and vegetation management are addressed in the Ponds E12 and E13 Adaptive Management section (see Section 2.5.2).

Alviso Pond Complex

Restoration Actions

Pond A6. The Pond A6 tidal habitat restoration would create sustainable habitats that require minimal ongoing active management or maintenance as discussed in the Introduction section above. However, periodic inspection and maintenance of restoration features, such as ditch blocks and the wave-break berm, and the levee between Pond A6 and Ponds A5 and A7 would be required to ensure that the restoration is operating as intended. The wave-break berm would be regularly checked for erosion. Maintenance of the wave-break berm may be performed if damage is extensive enough to inhibit its ability to break wind-waves. The levee between Pond A6 and Ponds A5 and A7 would also be regularly checked for erosion. This levee may be repaired to prevent unintentional breaching, preserve maintenance access on the levee, and preserve management of Ponds A5 and A7 for flood storage. Techniques for water management, vegetation management, and predator management are addressed in the Pond A16 Adaptive Management section in Section 2.5.3.

Pond A8. Implementation of Phase 1 action at Pond A8 would restore reversible muted tidal action to create shallow subtidal habitat. During the wet season (approximately November through May), muted tidal exchange could be stopped to maintain existing levels of flood storage capacity. Flashboard risers would be installed to close the notch in the levee between Pond A8 and Alviso Slough and stop muted tidal action. During this winter period, the water control structures at Ponds A5 and A7 and the two-way structure through the internal levee would be operated similar to baseline conditions. Over time, seasonal operation may cease if increase in channel conveyance along Alviso Slough is demonstrated to fully compensate for losses of flood storage.

Water levels within the pond and the exchange of water between the pond and tributary inflows would be controlled through adjustments to the gate settings at culverts and the installation/removal of flashboard risers at weirs. Frequent inspection and maintenance of water levels within the pond and annual inspection of Alviso Slough would be necessary to ensure that the appropriate amount of tidal connectivity is achieved so that scouring occurs in Alviso Slough.

Regular inspection of the Pond A12 perimeter levee between along Alviso Slough would be carried out to confirm projections of slough widening and assess whether or not the observed loss of fringing marsh threatens levee integrity. If slough widening were determined to be of concern, the Pond A8 notch would be reduced in width by closing one or more of its bays. Levee inspection would occur on an annual basis and after major rainfall or extreme tidal events.

Pond A16. The Pond A16 reconfigured managed pond restoration would require periodic O&M as discussed in the Introduction section above. Techniques for water management, vegetation management, and predator management are addressed in the Pond A16 Adaptive Management section (see Section 2.5.3).

Ravenswood Pond complex

Restoration Actions

Pond SF2. The Pond SF2 reconfigured managed pond restoration would require periodic O&M as discussed in the Introduction section above. Approaches for water management, vegetation management, and predator management are addressed in the Pond SF2 Adaptive Management section (see Section 2.5.4). The existing bayfront managed pond levee around Pond SF2 provides some level of flood protection, but is not designed as a levee that provides flood protection and is expected to overtop in extreme events. The bayfront levee would be repaired as needed to maintain the existing level of flood protection and the public access trail. In future phases of the Project, this levee would be breached to restore the outer portion of Pond SF2 to tidal action.

2.6 Future Actions and Long-Term Uncertainties

2.6.1 Future Actions

Future phases of the South Bay Salt Pond Restoration Project would integrate habitat restoration and management with flood protection and wildlife-compatible public access, which is the mission of the Project. Future actions would be based, in part, on the evaluation of adaptive management information collected in previous phases. Information collected in Phase 1 from monitoring and applied studies on bird response to management, MeHg, and public access-wildlife interactions would be instrumental in determining the extent and location of future tidal restoration and public access features.

Ultimately, future actions would be determined by evaluating this information in light of a number of decision criteria. Many of these criteria would be the same as those used in developing Phase 1, which were:

- Availability of funding;
- Likelihood of success;
- Ease of implementation;
- Visibility and accessibility;
- Opportunities for adaptive management;
- Value in building Project support; and
- Certainty of investment.

For actions after Phase 1, the same criteria would be applicable, but others would be relevant as well, including the following:

Readiness to Proceed

This criterion is similar to ease of implementation. It would favor actions for which the particular implementing agency is most timely in completing the necessary planning and design. This criterion would not outweigh certain others, particularly those described below.

Ability to Utilize Results from Earlier Applied Studies and Other New Knowledge

This criterion would favor projects that would be developed specifically to utilize the results of earlier applied studies, either to apply new design concepts based on earlier results or to develop new information to add to the knowledge base from earlier results. Also, it would take into account any other new knowledge that becomes available to the Project.

Dependency on Precedent Actions

Some actions cannot be implemented until specific precedent actions occur. A good example is that many ponds cannot be opened to unrestricted tidal action until a suitable levee that provides flood protection is constructed. In fact, after Phase 1, there are few opportunities to open ponds to unrestricted tidal action without precedent flood protection actions.

Dependency on Adaptive Management Progress

The basic layout of tidal and pond habitats in Alternatives B and C presumes a progressive conversion of ponds to tidal habitats over time. The two alternatives are laid out to represent a continuum: a gradual progression over time from a 50:50 ratio of tidal habitat to managed pond (Alternative B), to a 90:10 ratio (Alternative C) provided that monitoring results confirm that the Project Objectives are being achieved. The implicit assumption in this construct is that ponds that are managed ponds under Alternative C would not be converted to tidal action until after:

- the 50:50 mix of tidal and pond habitats under Alternative B is achieved, and
- monitoring has confirmed that further conversion of ponds to unrestricted tidal action is acceptable.

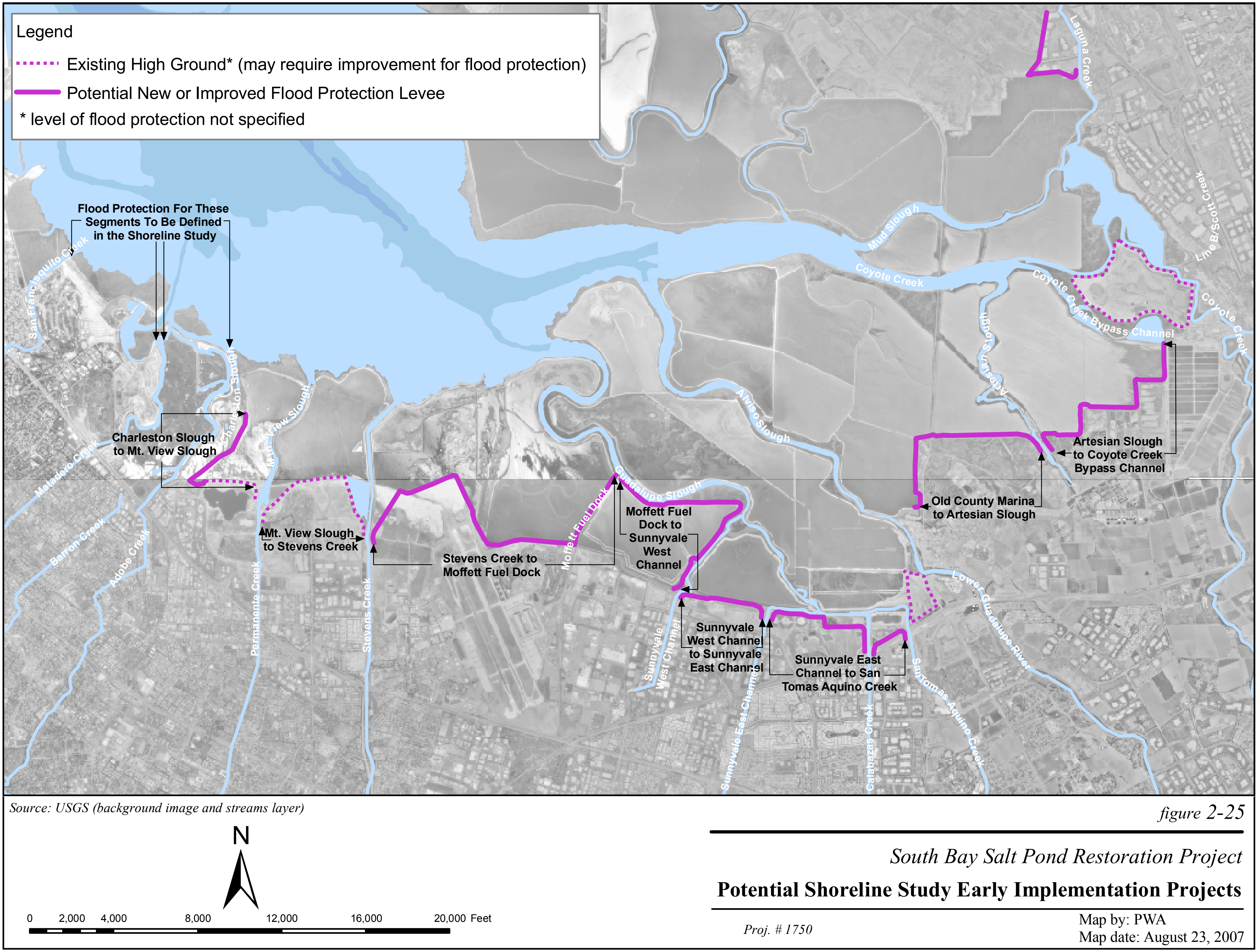
Flood Management Requirements

Many flood management actions proposed as part of the SBSP Restoration Project, such as levee construction, may wait for completion of the Water Resources Development Act (WRDA)-authorized South San Francisco Bay Shoreline Study. The Shoreline Study process will be used to determine the specific elements of one or more multi-objective projects that may be authorized for construction under WRDA. The advantage of the Shoreline Study process to the SBSP Restoration Project is that it will carry the analysis to project-level detail and may result in a substantial federal cost share for those elements contained within the WRDA-authorized project(s).

The Shoreline Study is not expected to be complete for several years. However, WRDA Section 104 provides for local sponsors of a Corps project to be given credit for early construction of flood damage reduction elements that are part of an ultimately authorized project. It does not provide similar crediting potential for restoration elements[1]. As a result the SBSP Restoration Project partners are evaluating candidate levee construction/improvement actions for early implementation in the Alviso pond complex by the SCVWD in cooperation with USFWS and the State of California. The value to the SBSP Restoration Project of early implementation in this manner is that it would improve basic flood protection for Silicon Valley and provide for necessary flood protection when coupled with further tidal habitat restoration actions. In fact, the opportunities for creating additional tidal habitats after Phase 1 are severely limited until adjacent levees that provide flood protection are constructed.

Figure 2-25 depicts the candidate levee actions in the Alviso pond complex being considered by the SCVWD and the state. One or more of the levee construction/improvement actions may be proposed for development and construction soon after Phase 1 of the SBSP Restoration Project is implemented. Environmental review of any actions proposed in this manner would be tiered off of the SBSP

[1] The Water Resources Development Act of 2007 was recently enacted which may amend these provisions for credit for early construction.



Source: USGS (background image and streams layer)

figure 2-25

South Bay Salt Pond Restoration Project

Potential Shoreline Study Early Implementation Projects

Proj. # 1750

Map by: PWA
Map date: August 23, 2007

Restoration Project programmatic EIS/EIR, and the actions would be developed to maximize the potential for crediting under WRDA. Specific factors to be considered by the SCVWD and the state in determining a project or projects to pursue include but are not limited to cost, degree of flood protection provided, acreage of restoration that is enabled by the levee construction/improvement, and ease of implementation.

For the Ravenswood pond complex, tidal habitat restoration would be closely linked to flood protection. In particular, the SR 84 approach from the west to the Dumbarton Bridge and the PG&E substation, as well as the Belle Haven neighborhood of Menlo Park, are potentially at risk from flooding if outboard levees are breached.

For the Eden Landing pond complex, the southern area (between OAC and the Alameda County Flood Control Channel) would be evaluated for a combined tidal habitat restoration and flood protection project led by the ACFCWCD.

Public Access Needs

Several public access projects are included in Phase 1 and additional actions, such as completion of Bay Trail spine segments, can proceed independently of changes in habitat. Many of the Bay Trail spine segments can and would be built when funds are available on existing or temporary levees that are ultimately proposed to be replaced with well-engineered levees that provide flood protection. When the levees that provide flood protection are constructed, it is the Project's intention that new and improved trail segments would be constructed on the levees, either on top of the levee or on a bench along one of the levee side slopes. Spur trails that go out into the habitat areas or loop around managed ponds would be considered for construction as habitat development occurs and as additional information becomes available regarding the compatibility of trail uses with species use of the developed habitats and based on information about public desire for such features.

Post Phase 1 Actions

The resulting application of these criteria would make implementation of actions in the future a varied mixture of activities at different times. A good example would be the set of actions following Phase 1. One may be the construction of a levee that provides flood protection in the Alviso area as described above, coupled with tidal restoration, another could be the development of an additional viewing area, and a third could be refinement of a Phase 1 applied study. These could be somewhat separated in time and space across the SBSP Restoration Project Area and be unrelated to each other, yet for other valid considerations they could be the most desirable set of actions to follow Phase 1.

Future actions are expected to open significant acreages of pond to tidal action in order to initiate development of significant areas of tidal habitat for clapper rail and salt marsh harvest mouse and to allow large-scale testing of sediment dynamics and supply questions. These goals argue for restoring tidal action to an entire slough complex. The location of these ponds would depend on results with respect to the factors listed above, as well as where flood protection work occurs. Possible locations include:

- Ponds along OAC in the Eden Landing pond complex;
- Ponds along Alviso Slough in the Alviso pond complex;

- Ponds along Guadalupe Slough in the Alviso pond complex; and
- Ponds along Ravenswood Slough in the Ravenswood pond complex.