South Bay Salt Pond Restoration Project
Selected Monitoring and Applied Studies

2008 Request for Proposals

October 2008

South Bay Salt Pond Restoration Project

Restoring the Wild Heart of the South Bay

SYNOPSIS

A. Request for Proposals Synopsis

The South Bay Salt Pond Restoration Project Management Team is seeking proposals for applied research projects that will advance understanding of, and guide management decisions regarding, the SBSP Restoration Project. All projects will take place in the southern reaches of San Francisco Bay (South Bay), California, although some may extend to larger areas of the Bay.

This RFP will fund research in the following nine areas:

1. Measuring Habitat Evolution Utilizing Satellite Imagery
2. Assessment of Mercury Bioavailability Utilizing Sentinel Species
3. Waterbird Nesting and Foraging in Managed Ponds
4. Waterbird Response to Trail Use
5. Pond, Slough, and Bay Water Quality Interactions
6. Baseline Bird Data and Data Needs Assessment
7. Effects of Restoration on Fish Assemblages
8. California Gull Displacement Study
9. Open Call for Graduate Fellows

B. Award Information

Anticipated Type of Award: Grant

Estimated Number of Awards: 9-12

Anticipated Total Funding: $2,000,000

Potential Funding per Grant: $20,000–$500,000

Length of Funding: Up to four years, from the date of award depending on the project proposal

C. Eligibility Information

Any organization capable of entering into a grant agreement with the State of California, Federal Government, or Resources Legacy Fund (or other nonprofit organizations) may apply. These entities include, but are not limited to, local agencies, private for-profit or nonprofit organizations, tribes, universities, state or federal agencies. Candidates for the Graduate Fellowship Program must at the time of application be in, or have recently been admitted to, a graduate degree program in natural resources, environmental sciences, or coastal, aquatic, or related studies at any accredited institution of higher education. Graduate Fellowship candidates

must remain associated with an accredited institution of higher learning for the duration of the grant.

D. Deadline

Proposals will be accepted from November 1, 2008, through December 5, 2008.

E. Contacts

Applicants may address questions on the process or about an individual research question (but not submit proposals) to Cheryl Strong at Cheryl_Strong@fws.gov. For assistance with the Project website or uploading proposals, contact Mike May at mikem@sfei.org.

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SOUTH BAY SALT POND RESTORATION PROJECT, SELECTED MONITORING AND APPLIED STUDIES, 2008 REQUEST FOR PROPOSALS

I. Introduction

A. Overview of the South Bay Salt Pond Restoration Project

Project History

The South Bay Salt Pond (SBSP) Restoration Project is the largest tidal wetland restoration project on the West Coast. When complete, the restoration will convert 15,100 acres of commercial salt ponds at the southern end of San Francisco Bay (South Bay) to a mix of tidal marsh, mudflat, managed ponds, and other wetland habitats. San Francisco Bay has lost over 85 percent of its historic wetlands and tidal marshes to fill or alteration, resulting in the proposed listing or protection of more than 100 species (Takekawa et al. 2000). This loss has also led to decreased Bay water quality and increased local flood risks. Restoration of the South Bay salt ponds provides an opportunity to begin reversing these trends and improve the health of San Francisco Bay for years to come.

The South Bay salt pond property was purchased by the State of California and the Federal Government from Cargill Salt, Inc., in 2003. Shortly thereafter the California Department of Fish and Game (DFG), the U.S. Fish and Wildlife Service (FWS), and the California Coastal Conservancy launched a 5-year public process to design a restoration plan for the property. In 2003, the FWS and DFG began implementing the Initial Stewardship Plan (ISP), a management strategy to decouple the ponds from salt making and prepare the ponds for restoration under the Project.

The Project area consists of 54 ponds ranging from 30 to 680 acres in three complexes bordering the South Bay: the Alviso Complex (7,997 acres in 25 ponds), the Eden Landing Complex (5,450 acres in 22 ponds), and the Ravenswood Complex (1,618 acres in 7 ponds) (Figure 1). The entire Project area is surrounded by the highly urbanized landscape of the South Bay, also known as Silicon Valley.

The Project was the subject of a Final Environmental Impact Statement and Environmental Impact Report (EIS/EIR) that was released in December 2007. The final project plan is anticipated to be adopted in 2008 and the first phase of restoration (Phase 1) is about to begin. The following Project objectives will guide restoration:

Project Objectives

1. Create, restore, or enhance habitats of sufficient size, function, and appropriate structure to:

    a. Promote restoration of native special-status plants and animals that depend on South Bay habitat for all or part of their life cycles.

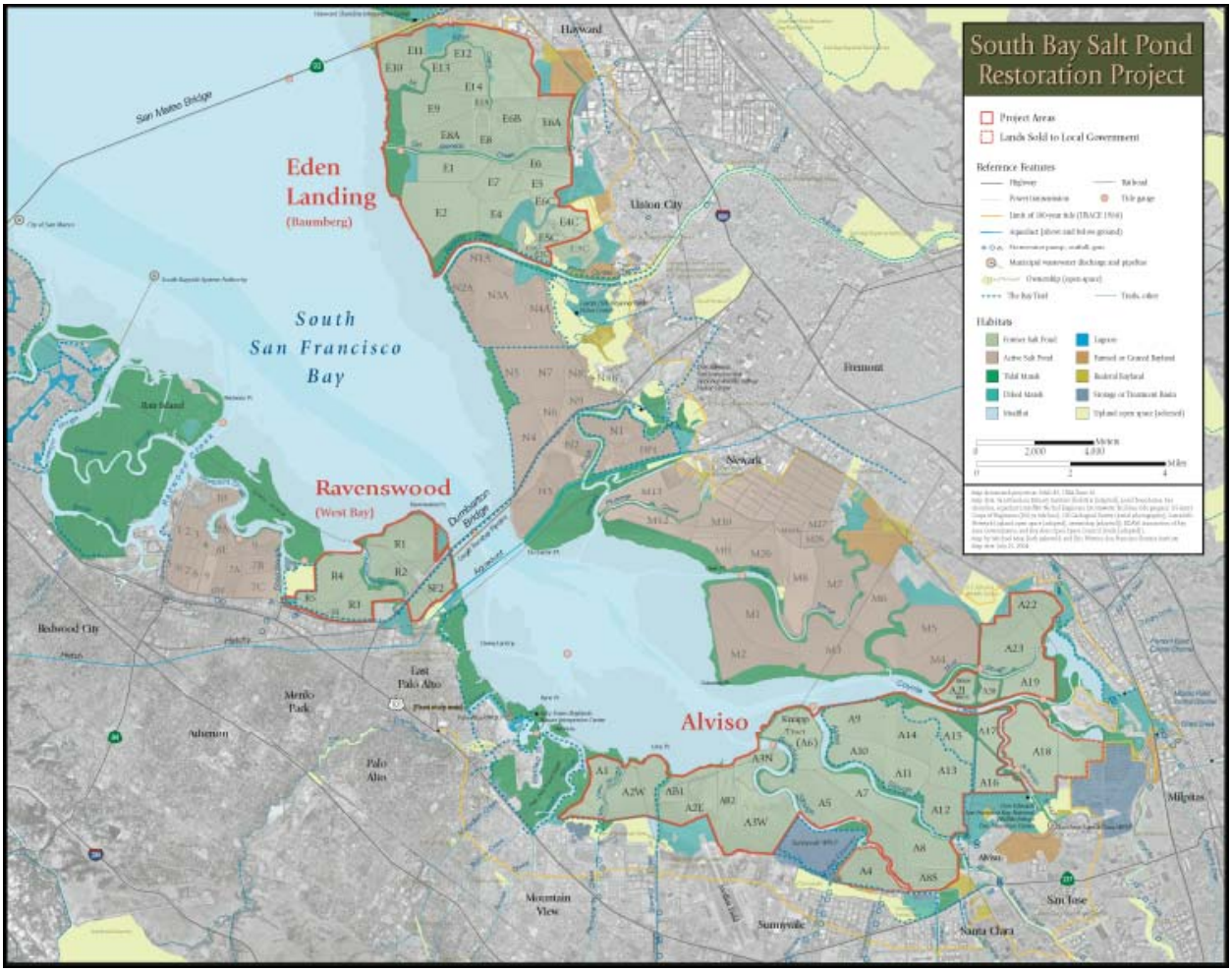
b. Maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees.

c. Support increased abundance and diversity of native species in various South Bay aquatic and terrestrial ecosystem components, including plants, invertebrates, fish, mammals, birds, reptiles, and amphibians.

2. Maintain or improve existing levels of flood protection in the South Bay area.
3. Provide public access and recreational opportunities compatible with wildlife and habitat goals.
4. Protect or improve existing levels of water and sediment quality in the South Bay, and take into account ecological risks caused by restoration.
5. Implement design and management measures to maintain or improve current levels of vector management, control predation on special-status species, and manage the spread of non-native invasive species.
6. Protect the services provided by existing infrastructure (e.g., power lines, railroads).

The Project EIS/R evaluated three alternative 50-year visions for restoration: the "No Project alternative" in which ISP management continues for 50 years; a 50% tidal: 50% managed pond alternative; and a 90% tidal: 10% managed pond alternative. The eventual mix of habitats that will optimally meet the Project objectives will likely fall somewhere between the 50%:50% and the 90%:10% alternatives, but cannot be predicted at this time. Instead, the Project Management Team (PMT) will implement restoration in phases, using an adaptive management process for determining how far the system can move toward full tidal action and tidal habitats, while still meeting the Project objectives.

FIGURE 1. The South Bay Salt Pond Restoration Project Area



Adaptive Management

The process of learning by doing and then using the results to improve management actions is called *adaptive management* (Walters and Holling 1990). This process provides a guided approach to learning from restoration and management actions for which scientific and social uncertainties exist. Under an adaptive management process, the SBSP Restoration Project management will proceed in a stepwise manner. At each phase, current conditions and progress will be assessed, uncertainties will be identified, and applied studies to reduce those uncertainties will be implemented. The results of each phase of applied studies will guide the next phase of management actions.

B. Background of the Request for Proposals

1. Goals of this Request for Proposal

This RFP is one of several tools the PMT will use during Phase 1 of the SBSP Restoration Project. In addition to the applied studies funded under this RFP, the PMT's decisions will be guided by directed studies, ongoing monitoring processes, and independent but related research. The RFP is not meant to fund basic research, but to invest in studies that will specifically address

key uncertainties to aid project managers in the ongoing decision-making process. However, the intent is not to limit the approaches researchers might take towards addressing uncertainties, but to encourage researchers to submit creative designs and approaches to study the questions described herein.

2. Guiding Documents

Project applicants are encouraged to review the Project history, documents, maps, and related information, which are available at the SBSP Restoration Project website.

Specific documents that may be helpful include:

1. SBSP ISP
2. SBSP Restoration Project EIS/R
3. SBSP Final Project Alternatives Report
4. SBSP Technical Reports
5. SBSP Monitoring Reports
6. Adaptive Management Plan
7. The RFP References at (see Section V)

   http://www.southbayrestoration.org/rfq-rfp/2008rfp/refs.html

C. Funding for this Request for Proposal

Funding for this RFP will be provided by the Resources Legacy Fund (RLF), the FWS, and/or the California Coastal Conservancy. Approximately $2,000,000 is available through this RFP.

II. Priorities of the Request for Proposals

A. Preamble

The priority research study topic list was developed through the careful consideration of SBSP Restoration objectives, data needs, and ongoing studies. San Francisco Bay has a strong history of monitoring and data collection. Many of these data are publicly accessible through online databases and other sources. While considering study design, proponents should carefully review existing literature, including ongoing data collection efforts throughout the Bay Area. Studies should be designed to maximize use of existing data while adding value through new research efforts. Each study topic is designed to answer key questions necessary for optimum management of the SBSP Restoration Project as defined by the Project objectives. Therefore, proposals should be designed not only to collect new data, but to add to Project managers' ability to access and utilize those data.

B. Other Desirable Project Features

Overlap exists between study topics, and proposals that address two or more of these topics, thereby conserving resources and increasing informational output, will be looked on favorably.

Collaborative studies are encouraged, when collaboration among multiple parties will improve the study or reduce study costs. Collaborative studies must identify a single lead Principal Investigator and organization.

Demonstration or commitment of matching funds is highly encouraged.

C. Priority Research Study Topic List

1. Measuring Habitat Evolution Utilizing Satellite Imagery

a) Background/Rationale

This study addresses SBSP Restoration Objective 1: To create, restore, or enhance habitats that support native species. Native South Bay species use both tidal marshland and tidally influenced aquatic habitats. Restoration of salt ponds to a mixture of tidal marshland and tidal aquatic habitat is planned to aid in the recovery of at-risk native species. This restoration involves breaching salt ponds, and, in the case of tidal marshlands, sediment deposition to raise pond beds to depths shallow enough for the establishment of native tidal marsh flora.

Natural sedimentation is a key component of habitat creation and restoration within the Project. As ponds are breached and opened to tidal action, sediments are expected to gradually accumulate outside of slough areas, allowing colonization by tidal marsh plants, which will form the basis for tidal marsh habitat. The colonization of tidal marsh flora will evolve over time resulting in a mosaic of habitat types that can be mapped using satellite imagery and appropriate field verification.

In addition, while breaching of ponds is expected to increase sedimentation in those ponds, it will also allow for tidal scour. By introducing tidal flow, the proposed restoration will increase the tidal prism in slough channels and tidal velocity in the South Bay. This increase may lead to scouring and enlarging of slough channels and potential erosion of existing marsh habitat.

The use of annual satellite imagery for a minimum of three years, with subsequent field verification of images, will allow for baseline habitat mapping and habitat evolution tracking, including changes in the extent of mudflats as well as floral colonization. IKONOS satellite imagery, or its equivalent, should be utilized. Habitat mapping should be completed at a 1:2400 (1 inch = 200 feet) scale. The imagery should be timed so that the aerial extent of mudflats is captured at a standard point of low water. The expected accuracy for all mapped habitat is 80% or greater.

b) Questions to be Addressed

1. Will natural sediment accretion in restored tidal areas be adequate to create and to support emergent tidal marsh ecosystems?

2. Will natural sediment movement into restored tidal areas significantly alter habitat area in the South Bay?

3. At what rate will sufficient vegetative cover develop to support recovery of endangered species?

4. How does the mosaic of habitat types change from year to year?

c) Study Design Concepts

Study Site: The study should encompass all intertidal mudflat and subtidal habitats south of the San Bruno Shoal area. Marsh habitat mapping should be limited to SBSP Project ponds and tidal marsh areas from Steinberger Slough on the western side of the Bay (including Bair Island) to the Hayward Shoreline area on the eastern side of the Bay.

Study Habitats: Potential mapping units, listed below, include those vegetation alliances most likely to occur within the Project site and were assigned using the *California Manual of Vegetation* (Sawyer and Keeler-Wolf 1995) naming system. This floristic approach, which is supported by extensive field data, identifies alliances and association types that are repeatable within the landscape. The mapping units may include the following categories, but categories can be added or subtracted as needed to classify the habitats:

- **Subtidal/Open Water Habitat.** Includes deepwater habitat below the elevation of the tidal mudflats. These areas are permanently inundated.

- **Intertidal Mudflat.** Includes areas regularly flooded and drained by the tides that are not vegetated with emergent, vascular plants. Also includes areas within tidal channels and along the interface between tidal salt marsh and the subtidal/open water habitats of the Bay.

- **Giant Bulrush Semipermanently Flooded Herbaceous Alliance.** Giant bulrush (*Schoenoplectus californicus*): sole or dominant vegetative cover (considered brackish in nature); formerly *Scirpus californicus.*

- **Narrowleaf Cattail/Southern Cattail Tidal Herbaceous Alliance.** Cattail (*Typha angustifolia*/*Typha domingensis*) is the dominant vegetative cover.

- **Narrowleaf Cattail/Broadleaf Cattail – Bulrush Species Semipermanently Flooded Herbaceous Alliance.** Cattail and bulrush (*Typha angustifolia*/*Typha latifolia* with *Schoenoplectus* spp.) species co-dominate vegetative cover.

- **Alkali Bulrush Semipermanently Flooded Herbaceous Alliance.** Alkali bulrush (*Schoenoplectus robustus*): sole or dominant vegetative cover (considered brackish in nature); formerly *Scirpus robustus.*

- **Peppergrass-Dominated Vegetation.** Peppergrass (*Lepidium latifolium*) is the dominant vegetative cover.

- **Spearscale-Dominated Vegetation.** Spearscale (*Atriplex triangularis*) is the dominant vegetative cover.

- **Cordgrass Tidal Herbaceous Alliance.** Cordgrass (*Spartina foliosa, S. alterniflora,* and hybrid *S.* spp.) is the sole or dominant vegetative cover with herbs in the understory; considered saline.

- **Pickleweed Tidal Herbaceous Alliance.** Pickleweed (*Sarcocornia pacifica*) is the sole or dominant vegetative cover; considered saline; formerly *Salicornia virginica*.

- **Gumplant-Dominated Vegetation (not identified in NatureServe).** Gumplant *(Grindelia* spp.) is the sole or dominant vegetative cover.

- **Dead Vegetation**. Areas of dead vegetation are the sole or dominant cover.

- **Peripheral Halophytes**. This series includes a patchwork of species that generally occur along salt marsh edges such as levee slopes. Within this mixture, no one species exceeds 15% cover. The mixture of species may include pickleweed, alkali heath (*Frankenia salina*), and Australian saltbush (*Atriplex semibaccata*) and also mapping will include non-natives and invasive plant species, such as slender-leaved iceplant (*Mesembryanthemum nodiflorum*).

- **Upland Species**. The upland series includes species not considered by the FWS (1988) to be wetland indicators. These include ruderal species such as black mustard (*Brassica nigra*), sweet fennel (*Foeniculum vulgare*), and coyote brush (*Baccharis pilularis*). These species are categorized as occurring primarily in upland areas near freshwater habitat types.

Parameters measured: Extent of mudflats, rate of channel formation, vegetated mapping units.

2. Assessment of Mercury Bioavailabilty Utilizing Sentinel Species

a) Background/Rationale

This study addresses SBSP Restoration Objective 4: to protect or improve existing levels of water and sediment quality in the South Bay, and take into account ecological risks caused by restoration. A major water quality consideration in the South Bay is mercury contamination.

The Guadalupe watershed drains the New Almaden mercury mining district, and the river contains abundant mercury ore. In the early part of the 20th century, the mercury-rich river was diverted into Alviso Slough (Collins and Grossinger 2005). Sediments that have accumulated in Alviso Slough since that time are rich in mercury (Beutel and Abu-Saba 2004), and the Alviso Pond and Slough Complex is now one of the most mercury-contaminated areas in the San Francisco Bay (Conaway et al. 2004; San Francisco Estuary Institute 2005). Mercury can be toxic to fish, wildlife, and humans, and is known to bioaccumulate within individuals and biomagnify through trophic levels. While many forms of mercury are toxic, the most readily bioavailable forms are methylmercury (MeHg) and bimethylmercury (Me_2Hg). Methylation occurs readily in anoxic environments where both carbon and sulfate-reducing bacteria are available (National Research Council 2000; Wiener et al. 2003). These conditions are common to tidal marshes and estuaries. As salt ponds are converted into organic-rich tidal marshlands,

mercury methylation may increase. This concern is primary in the Alviso Pond Complex, especially in the ponds adjacent to Alviso Slough.

Biosentinel species: Project managers require information regarding the effect of management actions on mercury bioavailability and toxicity. This risk can be assessed most directly by monitoring mercury in "biosentinel" species that represent habitat conditions that typically result from the planned management actions. Coupling such a monitoring effort to studies of MeHg production and biological uptake will help managers understand mercury dynamics and adjust Project actions to reduce risks from mercury toxicity.

Tidal Scour: The proposed restoration of salt ponds to tidal marsh is predicted to increase the tidal prism, and scour and enlarge the sloughs, which in turn will increase aquatic habitat, decrease the need for dredging, and help sustain the adjacent marshlands. However, it will also lead to increased circulation of mercury-bearing sediments. A study of the distribution of mercury within the predicted scour zone may be a part of studies that address mercury bioavailability.

Previous research: Collaborative studies between U.S. Geological Survey (USGS) and the San Francisco Estuary Institute on South Bay mercury have been conducted from 2006 to the present (Grenier et al. 2006, 2007; Marvin-DiPasquale and Cox 2007). These studies investigated mercury in sediment, water, and biota in and near Alviso and Guadalupe sloughs. Biota included several species of birds and fish, as well as brine flies. In addition, USGS and others evaluated space use, diet, mercury exposure, bioaccumulation, reproduction, and risk in waterbirds breeding in the SBSP Restoration Project area over a 4-year period (2005–2008) to develop a precise wildlife-specific biosentinel using waterbird eggs (Ackerman et al. 2007). These studies have provided a baseline of information regarding mercury and its bioavailability in the area. Successful proposals will build upon these studies, but need not emulate study design or details.

b) Questions to be Addressed

1. Will tidal marsh restoration increase MeHg levels in sentinel wildlife species within managed ponds and tidal marsh?

2. Will the scour of Alviso Slough, following restoration of associated salt ponds, increase the bioavailability of MeHg?

c) Study Design Concepts

Study Site: Pond A8, Alviso Slough, and associated environments.

Study Habitats and Population: Selected biosentinel species of birds, fish, and/or invertebrates that indicate local bioaccumulation of mercury. Candidate species must have a small home range and reside within a habitat targeted for enhancement or restoration by the SBSP Restoration Project. Study habitats may include pond and slough waters and sediments.

Parameters measured: Mercury levels within sentinel species. Parameters may include sediment and water quality and composition including total mercury and selected mercury species.

3. Waterbird Nesting and Foraging in Managed Ponds

a) Background/Rationale

This study addresses SBSP Restoration Objectives 1(a) and 1(b). Project Objective 1(a) requires promoting the restoration of native special-status plants and animals that depend on South Bay habitat for all or part of their life cycles. Project Objective 1(b) requires that the Project maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees. Ponds A16 and SF2 (Figure 1) will be reconfigured to create islands for nesting birds and will be managed to provide shallow-water habitat for foraging waterbirds, particularly shorebirds. The Phase 1 actions at Ponds A16 and SF2 are designed to help maintain successful breeding populations of bird species (Project Objective 1(b)) through the creation of nesting islands and to maintain or increase the number of foraging shorebirds (Project Objective 1(b)) by managing water levels to maximize foraging potential. Islands have been designed to allow testing of nesting bird use on different island configurations.

b) Questions to be Addressed

1. Will ponds that are reconfigured to create large isolated islands for nesting and foraging significantly increase reproductive success for terns and other nesting birds and also increase the numbers and densities of foraging birds over the long term compared to existing ponds not managed in this manner?

2. If pond reconfiguration includes numerous islands and water-level management, will the density of nesting and foraging shorebirds increase within Ponds A16 and SF2?

3. Does island shape affect nesting success?

4. Does an island's proximity to other islands affect nesting success?

5. Does vegetation type and density affect nesting success on the islands?

c) Study Design Concepts

Study Site: Ponds A16 and SF2 with appropriate comparison ponds.

Study Habitats and Population: Target bird species using Ponds A16 and SF2 with appropriate comparison ponds, particularly waterbirds and shorebirds.

Parameters measured: Island nesting species and densities, foraging species and densities, and reproductive success, relative to island dimensions and island configurations within the ponds.

4. Waterbird Response to Trail Use

a) Background/Rationale

This study addresses SBSP Restoration Objectives 1(a), 1(b), and 3. Project Objective 1 requires the creation, restoration, or enhancement of habitats of sufficient size, function, and appropriate structure to promote restoration of native special-status plants and animals that depend on South Bay habitat, and maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees. SBSP Restoration Project Objective 3 requires the Project to provide public access opportunities compatible with wildlife and habitat goals. Both DFG and

FWS support providing recreational opportunities to the public as part of the Restoration Project. However, researchers agree that birds can be very sensitive to human disturbance, whether the disturbance is from trail use, boats, or research activities (Carney and Sydeman 1999; DeLong 2002). Due to the sensitivity of birds to human disturbance, potential conflict exists between restoring and managing habitat for wildlife (Project Objective 1) and providing public access (Project Objective 3).

Previous Research: Studies by Carney and Sydeman (1999) found that scientific researchers and recreational visitors had a range of impacts on nesting bird species. In addition, other studies focused on the impact of landside recreational activities on non-breeding shorebirds, waterfowl, and colonial waterbirds. This study showed that bird responses varied based on a number of factors including human recreational activity, proximity of approach, directness of approach, and speed of movement, bird species and habituation to people, the time of year, and the geographic location. Burger and Gochfeld (1991) found that pedestrians always disturbed shorebirds if they approached directly, but found no significant disturbance from walkers on a parallel path. Other studies (Josselyn et al. 1989; Rodgers and Schwikert 2003) have observed larger birds flushing at much greater distances to human presence than smaller birds. Despite previous studies, research is still needed to address the specific reactions of local birds to human use of trails at the SBSP. One ongoing study is currently comparing the distance of waterfowl from publicly accessible levees compared to those non-accessible levees (H. White, San Jose State University, ongoing study). Successful projects will incorporate or complement the results of this study.

b) Questions to be Addressed

1. Will landside public access significantly affect birds or other target species on short or long timescales?

2. What is the effect of trail use on waterbirds?

3. What is the response of waterbirds at sites before trails exist compared to after they are opened?

c) Study Design Concepts

Study Sites: The South Bay, especially those areas designated for public access, as well as at nonpublic access sites for comparison.

Study Habitats and Population: All waterbirds in the South Bay, especially those in ponds designated for public access, as well as at nonpublic access sites for comparison.

Parameters Measured: Bird buffer distances, sustained changes in distribution, abundance and/or species richness, availability of impacted and non-impacted habitat.

5. Pond, Slough, and Bay Water Quality Interactions

a) Background/Rationale

Water quality standards for the Project are set by the Regional Water Quality Control Board (RWQCB). The SBSP Restoration Objective 4 is to protect or improve existing levels of water

and sediment quality in the South Bay, while taking into account ecological risks caused by restoration.

In 2003–2004, prior to transferring ponds from salt production to the ISP, Cargill reduced pond salinities to meet transfer water quality standards. In 2004, gated culverts were installed in ponds A1 through A3W (Charleston Slough to Guadalupe Slough) in the Alviso Complex, and Ponds B2 and B10 at Eden Landing. Culverts were opened to the Bay in July of that year, the first time in several decades that Bay water entered the ponds. In 2005 the same process was applied to Ponds A5 through A17 (Guadalupe Slough to Coyote Creek) in the Alviso Complex (Figure 1). In March 2006, the three Island Ponds, between Coyote Creek and Mud Slough, were breached to allow for tidal action.

Previous research: The USGS conducts monitoring to track water quality conditions before and after culverts were opened for ISP operation, beginning in 2003 (Takekawa et al. 2005; Shellenbarger et al. 2008). Project managers were concerned that salinity would not meet the RWQCB's standards, but monitoring indicated that salinity has not been a problem. However, low dissolved oxygen (DO) levels were a problem in multiple ponds, especially during warm weather. In certain Alviso Complex ponds, fish mortality was observed on at least two occasions. These early findings show that management actions in the Project area are already causing changes in the system, some of which are not easily predictable and require study to fully understand.

b) Questions to be Addressed

1. Will restoration adversely affect water quality and productivity?
2. What is the effect of pond water quality both inside the ponds and in the sloughs and Bay adjacent to pond discharge points?
3. What is the effect of increased pond flows and increased tidal prism from tidal habitat restoration on water quality, in ponds, sloughs, and the Bay?
4. Are DO concentrations in Guadalupe Slough similar to DO concentrations in Newark and Mowry Sloughs?
5. Does pond discharge affect DO concentrations in Guadalupe Slough?
6. Does changing the volume of discharge from ponds (one versus three culverts) substantially affect DO concentrations in Guadalupe Slough?

c) Study Design Concepts

Study Site: SBSP Restoration Area, particularly in and near ponds in the Alviso Complex.

Study Habitats: Ponds, sloughs, and bay.

Parameters measured: Standard water quality parameters.

6. Baseline Bird Data and Data Needs Assessment

a) Background/Rationale

This study addresses SBSP Restoration Objective 1, which requires the creation, restoration, or enhancement of habitats of sufficient size, function, and appropriate structure to promote restoration of native special-status plants and animals that depend on South Bay habitat, maintain current migratory bird species that utilize existing salt ponds and associated structures such as levees, and support increased abundance and diversity of native species in various South Bay aquatic and terrestrial ecosystem components.

Before we can determine if numbers of birds are changing, we must first establish a baseline number with which to compare. Research is needed to supply baseline numbers of birds to assess potential impacts, both positive and negative, to birds that utilize the salt ponds as restoration proceeds.

b) Questions to be Addressed

1. What is the current number of waterbirds utilizing San Francisco Bay habitats, particularly the salt ponds (including the ponds still managed as solar evaporators)?

2. Will the habitat value and carrying capacity of the South Bay for nesting and foraging migratory and resident birds be maintained or improved relative to current conditions?

3. What data need to be collected to determine the effects of restoration on the habitat value and carrying capacity of South Bay birds?

c) Study Design Concepts

Study Site: literature and data review will need to include several spatial scales including the restoration area, the South Bay, and the San Francisco Bay.

Study Habitats and Population: All waterbirds in the Bay.

Parameters Measured: Literature and data review to determine numbers, species diversity and density, habitat use.

7. Effects of Restoration on Fish Assemblages

a) Background/Rationale

SBSP Restoration Objective 1(c) requires that the Project support increased abundance and diversity of native species in the South Bay, including fish.

Fish populations and dynamics in the South Bay are not well understood, and little is known of the short- or long-term impacts of Project activities on local estuarine and anadromous fish.

Federally threatened steelhead and fall-run Chinook salmon are present in the SBSP Restoration Project area. In addition, pelagic fish assemblages in and outside of the restored ponds include anchovy, topsmelt, juvenile striped bass, shiner perch, white croaker, jack smelt, and herring. Demersal fish assemblages include leopard shark, yellowfin goby, longjaw mudsucker, carp,

diamond turbot, rainwater killifish, threespine stickleback, bat rays, California halibut, staghorn sculpin, and others.

An increase in salt-marsh habitat is expected to benefit steelhead and Chinook salmon populations by providing improved estuarine rearing habitat for juveniles and improved migratory conditions for both juveniles and adults. At the same time, restoration of tidal access and salt marsh is predicted to provide net benefits to local estuarine fish by increasing access to tidal areas, marsh channels, bays, and shallow open water habitats.

However, restoration activities will alter hydrology, slough profiles, and water quality in ways that may prove detrimental to fish species or assemblages. Changes to hydrodynamic mixing may significantly alter phytoplankton dynamics and, thus, alter the base of the food web. Pond discharges to the Bay may decrease water quality in neighboring habitats. Increased human access may degrade habitat and increase fishing pressure, and incidental take may be associated with Project construction activities and monitoring.

When ponds are breached, they will evolve over a multiyear time scale, as sediments are deposited, sloughs develop, and marsh vegetation colonizes the area. Boat-based monitoring will become restricted, over this evolution, to developing sloughs and subtidal areas. This long-term restriction should be taken into account during Project design, and monitoring efforts should allow for adaptation.

Ongoing Project impacts to area fish may best be viewed by analyzing both pelagic and demersal fish assemblages and specific fish indicator species.

Criteria for selection of fish assemblages could include:

1. Responsive to changes
2. Appropriate to the scale of concern
3. Differentially responsive to natural vs. anthropogenic changes
4. Comparable to reference conditions

Criteria for selection of indicator species could include:

1. Relative dependence on specific habitat types and water quality conditions likely to be found in the South Bay associated with the Project (e.g., California halibut).
2. Potential to utilize the habitats created by the Project over a large portion of a fish species' life cycle and that can also be found in areas that could serve as reference conditions for comparison (e.g., longjaw mudsucker, staghorn sculpin, shiner surfperch).
3. Federally or State-listed species

Previous research: National Oceanic and Atmospheric Administration Fish Model Study in previously restored marshes (URS 2008) and USGS study of salt ponds and adjacent sloughs (Mejia et al. 2008; Saiki and Mejia 2008).

b) Questions to be Addressed

1. Will increased tidal habitats improve survival, growth, and reproduction of native fish species, or increase the abundance of native fish?
2. How will restoration affect fish assemblages?
3. Will sediment movement into restored tidal areas significantly reduce habitat area and/or ecological functioning for fish in the South Bay?
4. What native estuarine fish species can be expected to use the Project area before, during, and after restoration?
5. Will water control structures significantly impact the ability of fish to benefit from managed ponds and muted tidal areas?
6. Are managed ponds a significant entrainment threat to fish? Do significant numbers of fish enter ponds, and what is their fate?
7. Is restored habitat of similar value to fish assemblages in terms of growth, feeding, and reproduction as reference habitats?
8. Will significant negative impacts occur from Project activities or increased public access?
9. How will restored habitat function to support species dependent on primary and secondary production?
10. How will fish utilize restored bottom habitats?
11. What areas, such as nursery habitats, are of special concern?
12. What fish assemblages use discrete habitat types?
13. What factors limit fish populations in the South Bay?

c) Study Design Concepts

Study Site: Far South Bay and sloughs in the Alviso Pond Complex.

Study Population: Anadromous fish, pelagic and demersal fish assemblages, and indicator species such as surfperch and native flatfish.

Possible parameters: Fish distribution, diversity, abundance, age, and fecundity; prey abundance at multiple trophic levels; water quality, sediment movement, habitat quality.

8. California Gull Displacement Study

a) Background/Rationale

This study addresses Project Objectives 1 and 5. Project Objective 1 requires restoration of native special-status animals in the South Bay; maintenance of current migratory bird species that utilize existing habitats; and support for increased abundance and diversity of native species,

including birds. Project Objective 5 requires the implementation of measures to control predation on special-status species.

In recent years, the population of California gulls in the South Bay has risen dramatically. The number of nests grew from <1,000 in 1982 to over 16,000 in 2006 (Ackerman et al. 2006). While utilizing salt ponds for nesting and foraging, California gulls have also frequently been seen foraging and roosting in and around landfills. As the population of California gulls has risen, Caspian and Forster's terns have declined in the South Bay (Strong et al. 2004). Observations show that South Bay gulls are disrupting snowy plover and least tern nests and preying on stilt and avocet young (Ackerman et al. 2006). Based on current information, California gulls may threaten the Project's ability to meet its objective to support the current abundance and diversity of other breeding birds by preying on their young, harassing adults, and taking over their nesting sites.

Certain Project activities may have further deleterious effects on current conditions. Pond A6 will be converted to tidal habitat in 2009 or 2010, forcing relocation of the ~24,000 gulls that nest in the pond. Where they relocate and what impacts they will have on other species are open questions. The SBSP Restoration Project also involves the construction of nesting islands for avocets, terns, stilts, and plovers in Ponds A16 and SF2. California gulls may severely limit the success of birds nesting on these islands either by encroachment or predation.

b) Questions to be Addressed

1. Will California gulls adversely affect (through predations and/or encroaching on nesting areas) nesting birds in managed ponds reconfigured with high densities of nesting islands?

2. Are gulls seeking out or opportunistically foraging on western snowy plovers, California least terns, or other nesting birds?

c) Study Design Concepts

Study Site: monitoring will need to encompass several spatial scales including the restoration area, the South Bay, and San Francisco Bay.

Study Population: California gulls and their prey.

Parameters Measured: Population size, relocation sites, nesting, roosting, landfill use, and predation of other avian species.

9. Open Call for Graduate Fellows

a) Background/Rationale

The goals of the Graduate Fellowship Program are to:

- Enable highly qualified graduate students to help advance the state of scientific knowledge on salt ponds, restored wetlands, and South San Francisco Bay.

- Provide support for the training and development of scientists conducting research that supports the Project objectives and implementation of the Adaptive Management Plan.

The fellowship will provide up to two years of support based on scope/type of projects and contingent upon the availability of funds, in the form of a grant/award of up to $25,000 per year and $5,000 for research-related expenses including supplies, equipment, and travel necessary to carry out the proposed research, brief the Science Program of progress, and attend scientific meetings.

The maximum amount requested including research-related expenses should not exceed $55,000 for a two year project. Continued support after the first year will be contingent on satisfactory performance of the fellow and on the availability of funds.

Prospective fellows must at the time of application be in, or have recently been admitted to, a graduate degree program in natural resources, environmental sciences, or coastal, aquatic, or related studies at any accredited institution of higher education. Candidates must remain associated with an accredited institution of higher learning for the duration of the grant.

The selection criteria will include:

- The quality of the research proposal including appropriateness of approach to be used.
- The relevance of the problem to Project objectives and the Adaptive Management Plan.
- The academic performance and experience of the applicant.
- The academic advisor's demonstrated abilities in the general area of questions addressed by the proposal.

III. Proposal and Submittal Requirements

A. Overview

Successful proposal submission requires that proponents have thoroughly and accurately completed the online application process, and have followed the prescribed format for the proposal document. Proposals submitted after the deadline of December 5, 2008, will not be considered. If you have questions on the process or about an individual research question, please contact Cheryl Strong at Cheryl_Strong@fws.gov. For assistance with the website or uploading proposals, contact Mike May at mikem@sfei.org.

B. Confidentiality and Conflict of Interest

Applicants should be aware that the titles and abstracts will be available for viewing on the Project website immediately after the solicitation has closed. After the PMT takes action on the Lead Scientist's final funding recommendations, the complete text of all funded proposals will be posted on the Project website. By submitting a proposal, the applicant agrees to waive any right to confidentiality of the proposal. Although the Project will not post proposal documents for unfunded proposals on their website, all submitted proposals, whether funded or not, are considered public documents and subject to disclosure under California law.

Both applicants and individuals who participate in reviews of submitted proposals are bound to State and Federal conflict of interest laws. Any individual who has participated directly in preparation of this RFP or who will participate in any part of the grant development and negotiation process on behalf of the public is ineligible to receive funds or personally benefit from funds awarded through this RFP. Explicitly, members of the SBSP Restoration Project Science Team, consultant team, or other Project participants who contributed to the development of the Adaptive Management Plan and related materials through the open processes of the SBSP Restoration Project are eligible to submit proposals on this RFP, consistent with the rest of this paragraph.

C. How to Submit a Proposal

Proposal coversheets and budget forms may be downloaded from http://www.southbayrestoration.org/rfq-rfp. The coversheet must be signed and scanned into electronic format. All proposals must be submitted electronically through the SBSP Restoration Project website at http://www.southbayrestoration.org/rfq-rfp. Hard copies will not be accepted. Complete proposals will include all eight documents listed in Section III. D. and be submitted as one PDF document.

D. Proposal Document Outline and Format

1) The enclosed *Cover sheet*

2) A proposal containing the following elements. Maximum 10 pages:

   a) *Abstract* – A brief, topical abstract (200 words or less).

   b) *Background and justification* – Statement of the problem(s) being addressed, hypotheses being tested, information needed, and relationship/relevance of the problem(s) being addressed to other SBSP Restoration Project actions or sponsoring agency projects and programs, with reference to appropriate literature citations regarding the problem(s).

   c) *Study objectives* – Description of the planned outcome of the study.

   d) *Study area(s)* – Description of the study location, i.e., whether it is a field and/or laboratory study. A field study proposal should include clear identification and description of the study sites, with a map.

   e) *Approach* – Description of the study approach, with sampling and analytical procedures clearly described for each objective. Include details on methods/techniques, equipment and facilities, data collection, statistical analysis and quality assurance procedures, and describe the criteria to be used in hypothesis testing.

   f) *Data archiving procedures* – Description of how the data will be handled, stored, and made accessible. All data collected under the auspices and funding of the SBSP Restoration Project will be made accessible through the Project database and website.

   g) *Work schedule* – An annual time line with expected start and stop dates, and accomplishment of major milestones.

h) *Expected product(s)* – List of planned publications, reports, presentations, advances in technology, information transfer at workshops, seminars, or other meetings.

3) Literature cited – List of all of the publications cited in the text of the proposal.

4) Qualifications of investigators, partnerships, and cooperators – Brief resumes (two pages maximum) of the principle investigators that include descriptions of the qualifications of principal personnel, identification of affiliations, expected contributions to the effort, including logistical support, and relevant bibliographic citations.

5) Budget and staff allocations – Detailed budget form which includes salaries and benefits for each project management participant and costs for travel, equipment, supplies, contracted services, vehicles, and necessary overhead (maximum 10%).

6) List of potential reviewers – Names (minimum of three) and addresses of research scientists with subject area expertise who could serve as potential peer reviewers for the proposal.

7) Necessary assessments, certifications, and permits – Identification of anticipated hazards or safety concerns affecting project personnel (e.g., aircraft, off-road vehicles, chemicals, and extreme environmental conditions) and necessary safety certifications is required. Identification of other necessary certifications and permits such as refuge special use permits or endangered species handling permits is required. Documentation of approved certifications and permits will be required of funded proposals before fieldwork commences.

8) Animal care and use certification – Discussion of anticipated uses of animals in the research. Documentation of approved forms for animal care and use will be required of funded proposals. If animals are not to be used, collected, manipulated, or experimented upon, include a specific statement to the fact that no animals will be used in the research.

E. Open Call for Graduate Fellows

1) All relevant documents and items listed in the previous section.

2) Personal Statement that describes how this research fits into career plans and summarizes experiences that specifically prepared the applicant for this research task (not to exceed two pages).

3) Curriculum Vitae of the Applicant.

4) Copies of Graduate and Undergraduate Transcripts (unofficial copies are acceptable).

5) Letter of commitment and support from academic advisor indicating willingness to advise the applicant and express support of the proposed research project (not to exceed two pages).

6) Curriculum Vitae of the Academic Advisor.

7) Signed Letters of Academic Recommendation.

F. Progress Reports and Workshop Participation Requirements

Each funded proposal will:

1. Brief the Science Program on progress once or twice a year, including presentations to Science Symposia and relevant workshops hosted by the Restoration Project.

2. Submit annual progress reports to the SBSP Restoration Project Lead Scientist. The progress report will detail the grantee's research activities, provide retrospective and prospective revision of the research plan, and report expenditures for the preceding year.

3. Submit a copy of any poster or other professional submissions to conferences or journals.

4. Submit a final research report, at the end of the respective funding period. The final report will summarize results and accomplishments of the project, including all publications since inception and a detailed financial statement comparing budget with actual spending.

G. Deadline

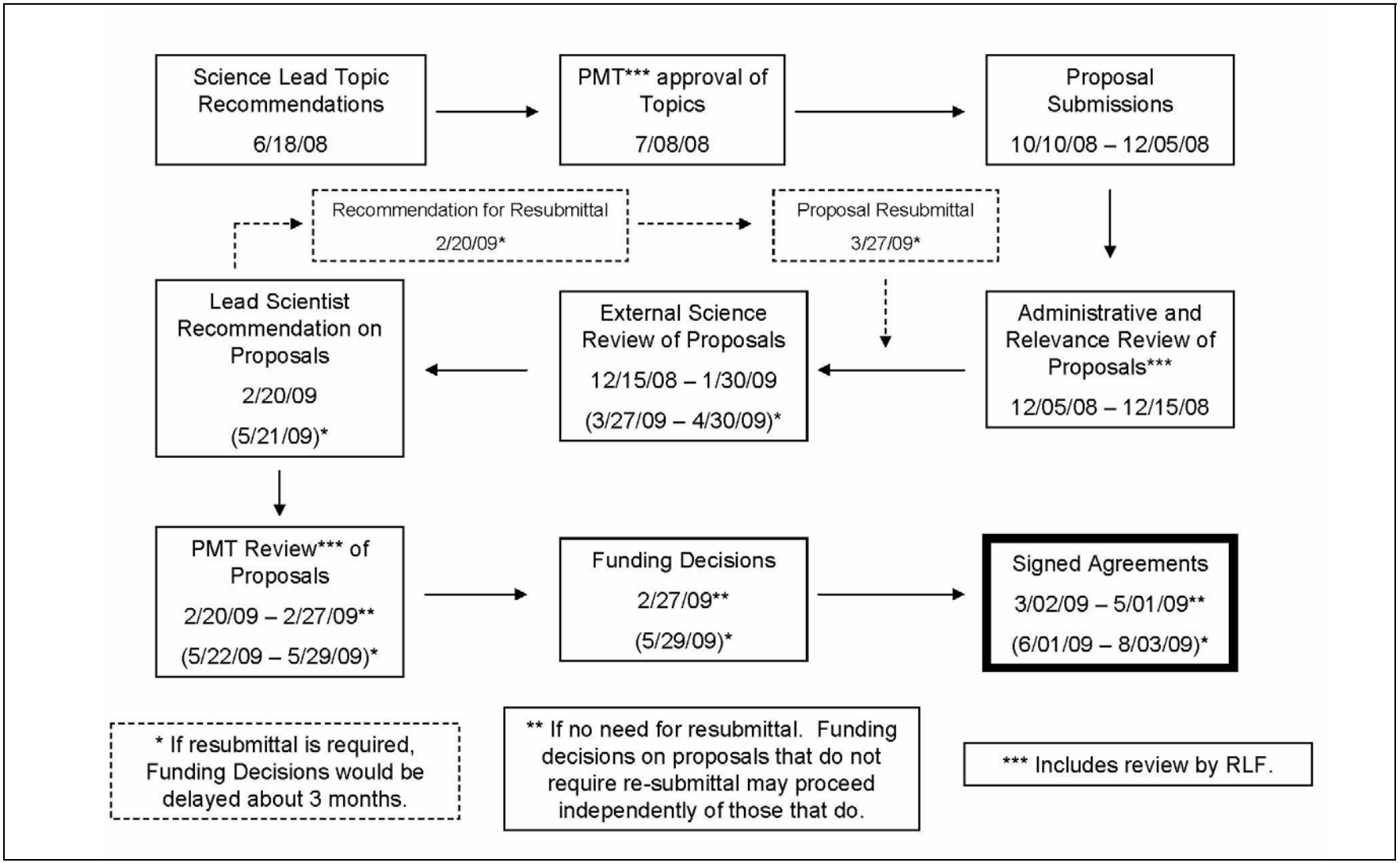
December 5, 2008

IV. Proposal Review and Selection

A. Review Process Summary and Schedule

The proposal review process and schedule, summarized on Figure 2, involves 4 steps. All complete proposals will undergo administrative review, external scientific review, and review by a lead scientist who will make recommendations on funding to the PMT. The PMT will then make funding recommendations to the funding agencies as applicable.

Figure 2. 2008 SBSP Science RFP Schedule



B. Administrative Review

SBSP Restoration Project staff will conduct an initial review of proposals to ensure the following:

- All proposal components have been completed by the submission deadline including all required application forms and associated documents, including the proposal document and detailed budget.
- Proposals are responsive to the RFP priorities.
- Acceptable past performance of project staff, including effective management of grants previously received (if any).

C. External Scientific Review

Independent external reviewers will be selected to review each proposal based on their expertise. The reviewers will evaluate submissions using a set of criteria that combine classic scientific review questions and elements designed by the SBSP Restoration Project to address common issues. The subject experts will also make overall recommendations to the SBSP Lead Scientist as to whether proposals are excellent, very good, good, fair, or poor, and explain their recommendations. The external scientific reviewers will thoroughly explain their reviews and base them on the following criteria:

Project Purpose

- Are the goals, objectives, and hypotheses clearly stated and internally consistent?
- Is the idea timely and important? Is the study justified relative to existing knowledge?
- Are results likely to add to the base of knowledge? Is the project likely to generate novel information, methodology, or approaches?

Background

- Is a conceptual model clearly stated in the proposal and does it explain the underlying basis for the proposed work?
- Is all other information needed to understand the basis for the proposed work included and well documented?

Approach

- Is the approach well designed and appropriate for meeting the objectives of the project?
- Is it clear who will be performing management tasks and administration of the project and are resources set aside to do so?
- Are products of value likely from the project? Is a plan for widespread and effective dissemination of information gained from the project? Are contributions to larger data management systems relevant and considered?

Feasibility

- Is the approach fully documented and technically feasible?
- What is the likelihood of success?
- Is the scale of the project consistent with the objectives and within the grasp of authors?

Budget

- Is it clear how much each aspect of the proposed work will cost including each task, salaries, equipment, etc.?
- Is the budget reasonable and adequate for the work proposed?

Relevance to the SBSP Restoration Project

- How well does the proposal address the priorities stated in the RFP?
- Does the proposal clearly and directly address one or more of the topics in the Priority Research Study Topic List?
- Will the information ultimately be useful to SBSP managers?

Qualifications

- What is the track record of authors/advisors in terms of past performance?
- Is the project team qualified to efficiently and effectively implement the proposed project?
- Do they have available the infrastructure and other aspects of support necessary to accomplish the project?

D. Lead Scientist Review

The role of the Lead Scientist is to provide final funding recommendations to the PMT based on the evaluation of each proposal's technical quality and responsiveness to the RFP priorities. The Lead Scientist will consider all external reviewer comments in their overall evaluation of the proposals. The Lead Scientist may also recommend conditions for funding such as the modifications of tasks, products, and funding.

E. Project Management Team Review and Action

The Lead Scientist will forward final recommendations to the PMT, which will consider the recommendations and make final funding recommendations to the funding agencies. The PMT and the funding agencies may, at their discretion, recommend and/or award a package of grants determined to be most responsive to the charge to promote implementation of the Project in a balanced manner, consistent with the Project goals and objectives.

F. Signed Grant Agreements

The process of finalizing grant agreements will begin as soon as projects are approved by the funding agencies. Depending on the complexity of each project, the institution receiving the funds, review panel requirements and modifications, and the complexity of the project, it will likely take 2-6 months to develop and finalize the grant agreements for successful proposals. Applicants should not commence work on their projects until a funding agreement is finalized by signature of the grantee and funding agency. Work performed prior to the signing of a funding agreement is done at the risk of the applicant and without expectation of reimbursement. General terms and conditions for grants will be negotiated with the funding agency. All documents, records, and other physical or intellectual property resulting from any funded proposal will be public property.

V. References

All references can be found at the following website link:

http://www.southbayrestoration.org/rfq-rfp/2008rfp/refs.html

Ackerman, J. T., C.A. Eagles-Smith, G.H. Heinz, S.E. Wainwright-De La Cruz, J.Y. Takekawa, T.L. Adelsbach, A.K. Miles, D.J. Hoffman, S.E. Schwarzbach, T.H. Suchanek, and T.C. Maurer. 2007. Mercury in birds of the San Francisco Bay-Delta: trophic pathways, bioaccumulation, and ecotoxicological risk to avian reproduction. 2006 Annual Administrative Report, U.S. Geological Survey, Western Ecological Research Center, Davis, CA, and U. S. Fish and Wildlife Service, Environmental Contaminants Division, Sacramento, CA.

Ackerman, J.T., J.Y. Takekawa, C. Strong, N. Athearn, and A. Rex. 2006. California gull distribution, abundance, and predation on waterbird eggs and chicks in the South San Francisco Bay. Final Report, U.S. Geological Survey, Western Ecological Research Center, Davis and Vallejo, CA.

Beutel, M., and K. Abu-Saba. 2004. South Bay Salt Ponds Restoration Project: Mercury Technical Memorandum. Brown and Caldwell, Larry Walker and Associates. Report prepared for the South Bay Salt Ponds Restoration Project Management Team.

Burger, J., and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of sanderlings (*Calidris alba)*. *Condor* 93:259-265

Carney, K.M., and W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. *Waterbirds* 22:68-79.

Collins, J.N., and R. Grossinger. 2005. Syntheses of scientific knowledge for maintaining and improving functioning of the South Bay ecosystem and restoring tidal salt marsh and associated habitats over the next 50 years at pond and pond-complex scales. Report to the South Bay Salt Pond Restoration Project.

Conaway, C.H., E.B. Watson, J.R. Flanders, and A.R. Flegal. 2004. Mercury deposition in a tidal marsh of south San Francisco Bay downstream of the historic New Almaden mining district, California. *Marine Chemistry* 90:175–184.

DeLong, A.K. 2002. Managing visitor use and disturbance in waterbirds—a literature review of impacts and mitigation measures. Prepared for Stillwater National Wildlife Refuge. Appendix L in *Stillwater National Wildlife Refuge Complex Final Environmental Impact Statement for the Comprehensive Conservation Plan and Boundary Revision* (Vol. II). U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, OR.

Grenier, L., J. Collins, J. Hunt, D. Yocum, A. Bezalel, Robinson, M. Marvin-DiPasquale, and D. Drury. 2006. *South Baylands Mercury Project 2006 Year-End Progress Report.*

Grenier, L., J. Collins, J. Hunt, D. Yocum, A. Bezalel, Robinson, M. Marvin-DiPasquale, and D. Drury. 2007. *South Baylands Mercury Project 2007 Year-End Progress Report.*

Josselyn, M., M. Martindale, and J. Duffield. 1989. Public access and wetlands; impacts of recreational use. Technical Report #9. Romberg Tiburon Center, Tiburon, CA

Marvin-DiPasquale, M., and M.H. Cox. 2007. Legacy Mercury in Alviso Slough, South San Francisco Bay, California: Concentration, Speciation and Mobility. Menlo Park, CA. *U.S. Geological Survey Open-File Report* 2007-1240.

Mejia, F.H., M.K. Saiki, and J.Y. Takekawa. 2008. Relation between fish species assemblages and water quality characteristics in South San Francisco Bay salt ponds and sloughs. *Southwestern Naturalist*. *In press.*

National Research Council. 2000. *Toxicological Effects of Methylmercury*. National Academies Press, Washington, DC.

Rodgers, J.A., Jr., and S.T. Schwikert. 2003. Buffer zone distances to protect foraging and loafing waterbirds from disturbance by airboats in Florida. *Waterbirds* 26: 437-443.

Saiki, M. K., and F. H. Mejia. 2008. Utilization by fishes of the Alviso island ponds and adjacent waters in South San Francisco Bay following restoration to tidal influence. *California Fish and Game*. *In press.*

San Francisco Estuary Institute. 2005. *The Pulse of the Estuary 2005*. Oakland, CA.

Sawyer, John, and Todd Keeler-Wolf. 1995. *A Manual of California Vegetation*. California Native Plant Society Press, Sacramento, CA.

Shellenbarger, G.G., D.H. Schoellhamer, T.L. Morgan, J.Y. Takekawa, N.D. Athearn, and K.D. Henderson. 2008. Dissolved oxygen in Guadalupe Slough and Pond A3W, South San Francisco Bay, California, August and September 2007. *U.S. Geological Survey Open-File Report* 2008–1097.

Strong, C.M., L. Spear, T. Ryan, and R. Dakin. 2004. Forster's tern, Caspian tern, and California gull colonies in San Francisco Bay: habitat use, numbers, and trends, 1982–2003. *Waterbirds* 27: 411-423.

Takekawa, J.Y., G.W. Page, J.M. Alexander, and D.R. Becker. 2000. Waterfowl and shorebirds of the San Francisco Bay estuary. In *Goals Project 2000. Baylands Ecosystem Species and Community Profiles: Life Histories and Environmental Requirements of Key Plants, Fish, and Wildlife*, P. Olofson, ed., pp. 309-316. Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

Takekawa, J.Y., A.K. Miles, D.H. Schoellhamer, B. Jaffe, N.D. Athearn, S.E. Spring, G.G. Shellenbarger, M.K. Saiki, F. Mejia, and M.A. Lionberger. 2005. South Bay Salt Ponds Restoration Project Short-Term Data Needs, 2003-2005. Unpublished Final Report, U.S. Geological Survey, Vallejo, CA.

Walters, C., and C.S. Holling. 1990. Large-scale management experiments and learning by doing. *Ecology* 71:2060-2068.

Wiener, J.G., D.P. Krabbenhoft, G.H. Heinz, and A.M. Scheuhammer. 2003. Ecotoxicology of mercury. In *Handbook of Ecotoxicology,* 2nd edition. D.J. Hoffman, B.A. Rattner, G.A. Burton, and J. Cairns, eds., pp. 409-463. Boca Raton, FL: CRC Press.

U.S. Fish and Wildlife Service (FWS). 1988. *National List of Plant Species that Occur in Wetlands*.

URS Corporation. 2008. *Fisheries in Restored South Bay Wetlands and Adjacent Habitats. Prepared for NOAA Restoration Center*. March.