Update to the San Francisco Bay Region IRWM Plan for Climate Change Adaptation: Managing Risk to Water-Related Resources on the Bay Shoreline

Bay Area IRWMP Planning Grant Application

March 9, 2012

Work Plan

Submitting Organization:

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1.0 Introduction and work plan content

This document describes how the San Francisco Estuary Institute (SFEI) will update and expand the Bay Area Integrated Regional Water Management Plan (IRWMP) to ensure that the plan is compliant with the state's IRWMP standards, specifically with regard to climate change. The purpose of the update is to provide the technical content necessary to address the emergent issues of climate change and sea level rise, and to address the compounding challenges of water resource management and sea level rise in the lower portions of the Bay's watersheds.

SFEI is a non-profit science center established to support government agencies and partners with regional science tools. SFEI works closely with many of the IRWMP partners and has been asked to lead this project in support of the IRWMP update. The project builds on datasets developed by SFEI in collaboration with IRWMP partners.

2.0 Current state of the Bay Area IRWMP

The Bay Area Integrated Regional Water Management Plan was completed and adopted in December 2006. The Bay Area IRWMP received Round 1 funding, and the plan is currently in the process of being updated. One of the key changes to the IRWM plan will be to address climate change in the San Francisco Bay Region.

3.0 Update proposed in this submission

The IRWM Water Planning Act (California Water Code, Section 10541 (3) (10)) states that IRWMPs must evaluate how water management systems in the region can adapt to climate change. IRWMPs should discuss regional vulnerabilities to relevant issues related to climate change. While there will likely be increased variability in the amount, timing, and intensity of precipitation, vulnerability to sea level rise may be the most important consideration for Bay Area regional water resource management.

While the existing IRWM Plan provides a brief description of the potential effects of climate change, it does not evaluate the region's vulnerabilities to the effects of climate change, especially in low-lying disadvantaged communities, or potential adaptation responses (Figure 1).

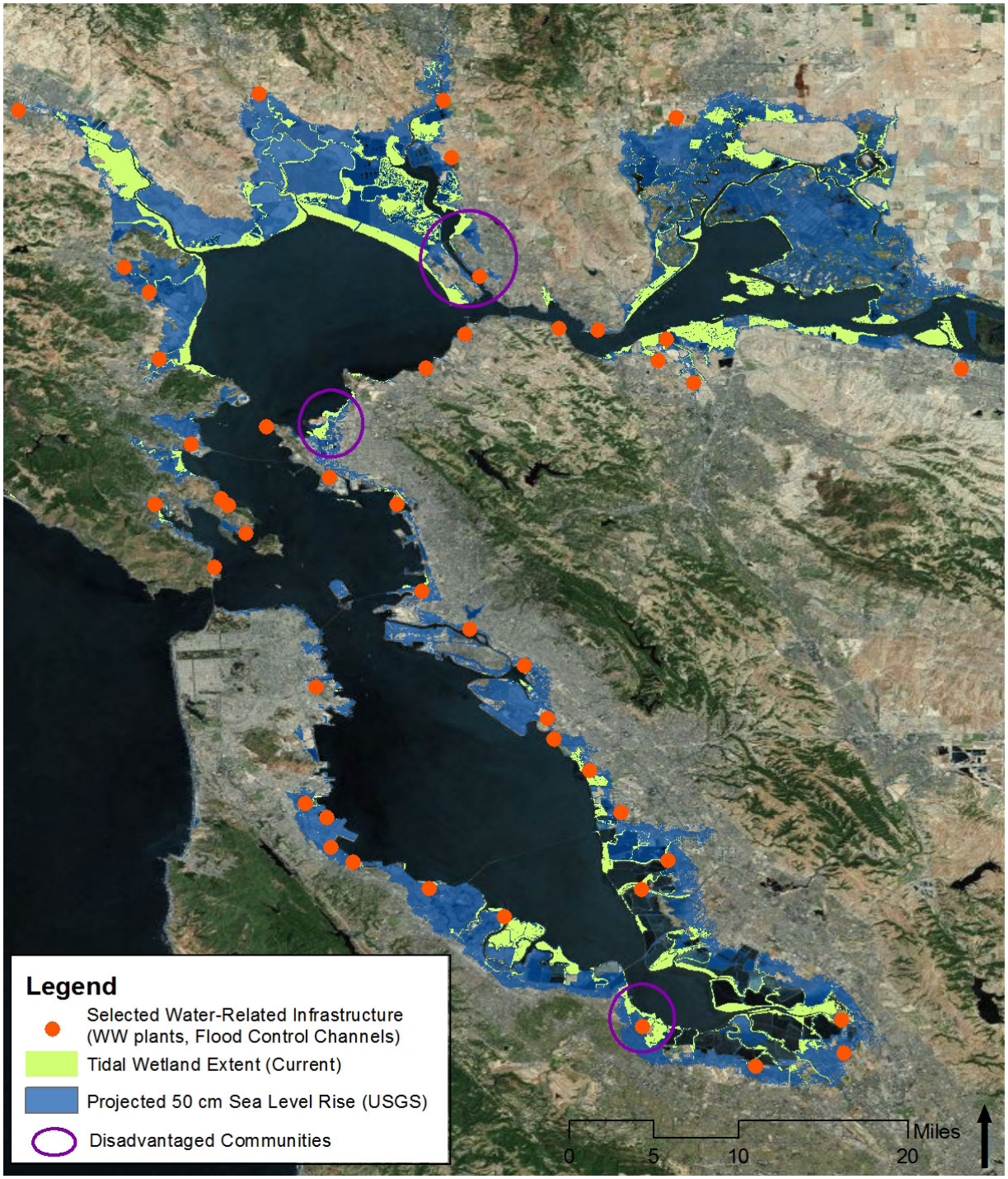

Figure 1. Map of San Francisco Bay Area showing projected sea level rise and potentially vulnerable resources.

4.0 Summary of work to be completed

The proposed project is comprised of five interrelated tasks to be implemented by SFEI in coordination with IRWMP partners, with the overall objective of bringing the Bay Area IRWM Plan into compliance as it is updated. This will be accomplished by assessing the vulnerabilities around the Bay shoreline and lower tidal reaches of Bay tributaries and addressing adaptation and prioritization strategies for sea level rise and climate change.

Total grant funding requested is $157,444. Local match for the project of $57,000 is provided by Zone 7 Water Agency. Federal match for the effort is $40,000, provided by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE) as part of the Coastal Impact Assistance Program. Therefore the total cost of the project is $254,444. SFEI will serve as the lead agency. If awarded the project will begin August 6, 2012 and will end no later than two years from the effective start date.

Task 1: Synthesize and analyze local historical data on lower reaches of Bay tributaries and shoreline interface

An essential element for designing more resilient flood protection systems is developing an understanding of how these systems operated under more natural conditions (Figure 2). Many of these data have been developed recently by SFEI on behalf of local flood control agencies but have not been compiled for regional use. In this task, we will synthesize local historical ecology data at the shoreline interface and lower reaches of Bay Area creeks, to the upstream limit of the San Francisco Bay, or the Head-of-Tide (HOT). Head-of-tide (HOT) is a transition zone between the tides and the inflowing tributary rivers and creeks of the Bay and is particularly susceptible to flooding because of the convergence of hydrologic and climatic conditions. At the same time tributary watersheds of the Bay vary in land use condition as well as climatic, physical, ecological, and biological conditions. The HOT analysis consists of two primary parts: (1) development of a protocol for identifying HOT locations (e.g., what are the HOT ecological and hydrological attributes); and (2) development of a HOT basemap and guidance for managers on how to assess HOT migration due to sea level rise and coastal flooding induced by climate change (e.g., where it is and how alternative methods of forecasting migration differ in terms of cost and risk assessment).

In concert with the Bay Conservation and Development Commission (BCDC) and other IRWMP stakeholders, we will then develop conceptual models of the lower riparian-fluvial-tidal interface based on the synthesis of historical data, current conditions, and projected changes. The task will apply the HOT analysis (predictive mapping and field methods to assess position of the HOT Zone) to identify relative risk and potential adaptation approaches for different HOT types, and will create migration predictions of flooding and infrastructure risk with sea level rise. The conceptual models will include past, present, and future scenarios.

Subtasks include:

- Historical synthesis and interpretation of historical ecology data from Bay Area projects
- Synthesizing results of Head-of-Tide analysis and creating predictive scenarios of HOT migration under climate change conditions
- Creating conceptual models of how the lower reaches of Bay watersheds (riparian-fluvial-tidal) will interface with sea level rise, including past, present and future scenarios

Deliverable/Output: GIS layers and map outputs, conceptual model diagrams, and accompanying descriptive text.

Budget: $79,000

Schedule: August 2012-June 2013

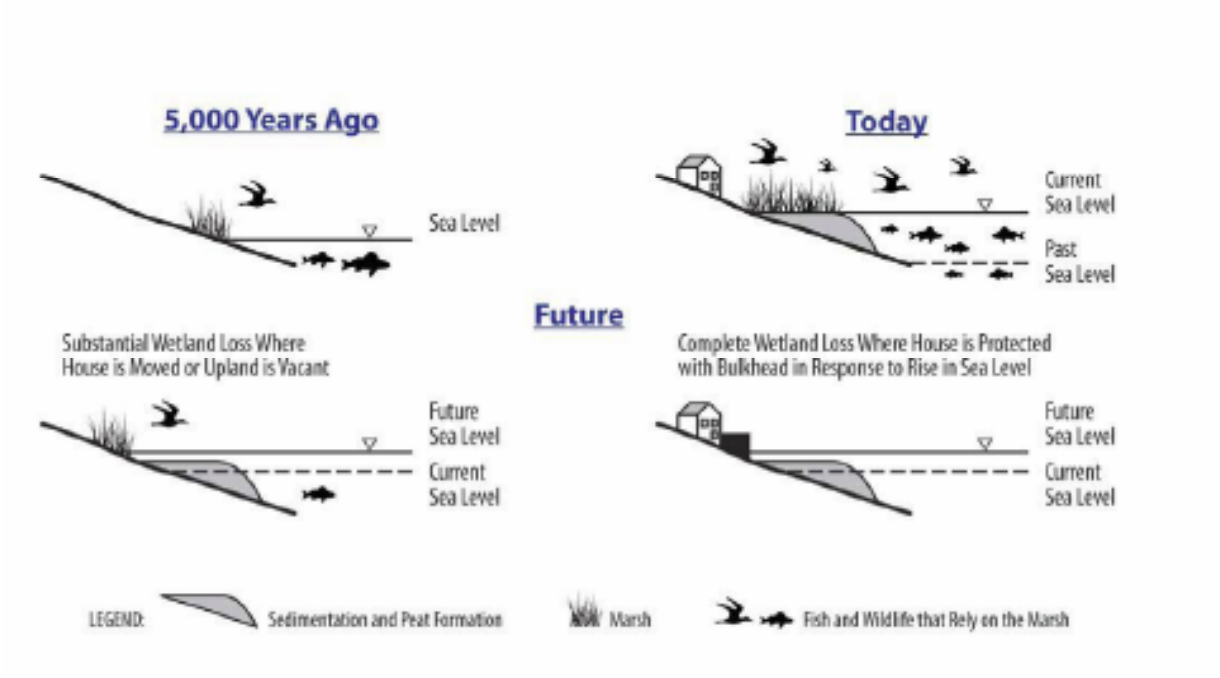

Figure 2. Shoreline resources, including residential communities, extensive water-related infrastructure, and ecological habitats, are all subject to impact by accelerated rates of sea level rise and associated flooding. (Courtesy EPA 2011)

Task 2: Extend shoreline change trend analysis to the South Bay and the Central Bay

Sea levels in San Francisco Bay have been rising over the last 7,000 years, which has resulted in the gradual landward movement of the mudflats and marshes that surround the Bay. In the last century, sea level rise has accelerated and at the same time the landward movement of the marshes has been restricted by the construction of bayfront levees. The marshes have been 'squeezed' between the rising bay water and the levees, resulting in erosion of the mudflats and loss of marsh (Figure 3). In turn, the loss of marsh in front of the levees has likely allowed larger waves to reach the levees and caused the toes of the levees to be undermined. However, there are no data indicating which shorelines are eroding most rapidly (and thus most at risk) and conversely which are most stable, suggesting lower risk to adjacent infrastructure, nearby communities, and ecological resources.

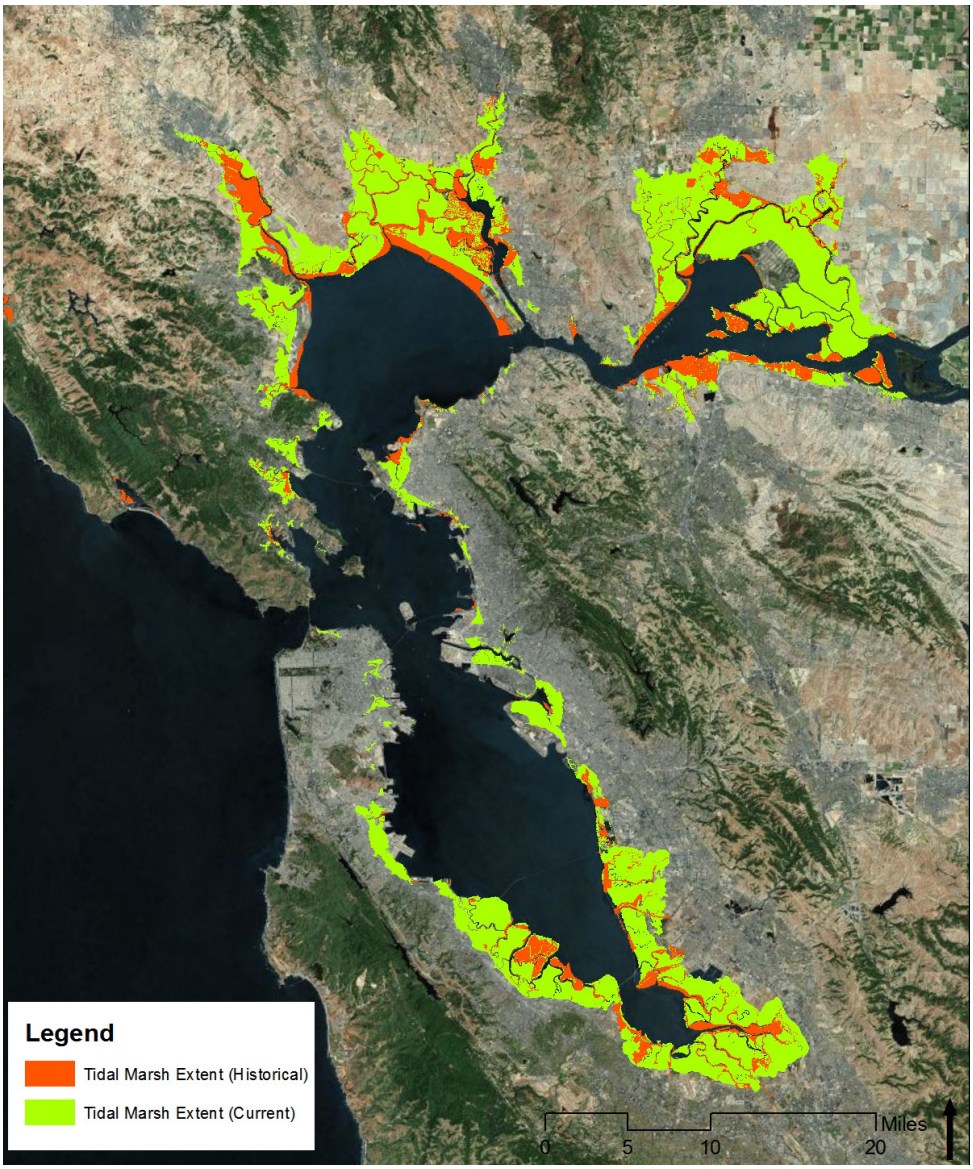

Figure 3. Historical tidal marsh extent contrasted with extent of current tidal marsh along the Bay shoreline. Data are from the EcoAtlas and BAARI (SFEI). The remaining marshes serve as important buffers to flooding of local communities and infrastructure, as well as providing critical ecological functions. Strategies for climate change adaptation require evaluation of the vulnerability of these features and tools for their protection and expansion.

By analyzing shoreline trends at a number of locations around the Bay over the last 20 years, and longer term, we will be in a position to address some of the management questions that local communities need to consider. Many of the lowland areas around the Bay most threatened by rising sea level and the erosion of natural shoreline buffers are disproportionately occupied by disadvantaged communities. In particular, East Palo Alto, Vallejo, and North Richmond are vulnerable to storm surge flooding, and may be subject to increased risk as adjacent tidal marshes are eroded. This task will provide critical information needed to preserve and expand Bay wetlands as buffers to wave induced erosion in the face of rising sea levels. This task will extend the shoreline change analysis, currently underway for San Pablo Bay, to the South Bay and the Central Bay to document historical rates of erosion and expansion rates of marsh shoreline between 1850, 1993, and 2010 (Figure 4).

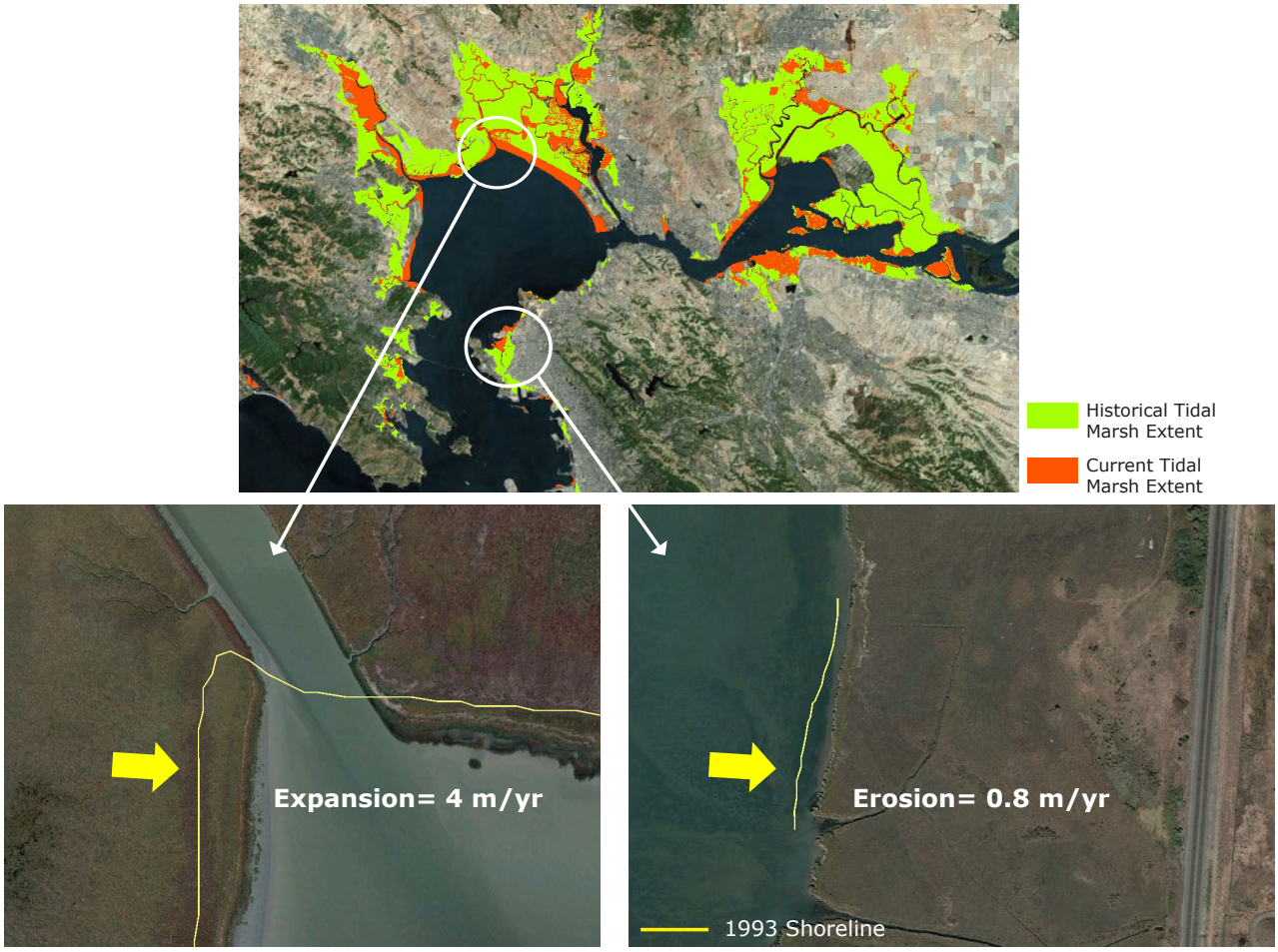

Figure 4. Examples of varying shoreline trends around the Bay shoreline since 1993. Some sites are more vulnerable than others, leading to different adaptation strategies. Lower images show current (2012) aerial photography with digitized shoreline shown in yellow from 1993.

In this task we will:

- Synthesize and analyze historical and contemporary shoreline data to document patterns of local and regional shoreline erosion and progradation.
- Identify hotspots of shoreline erosion, sites with favorable shoreline trends, and priority sites for upland marsh expansion, in relation to water-related infrastructure and potential IRWMP projects.
- Translate findings to the IRWMP update as a part of developing practical climate change adaptation strategies to maximize wetland persistence along the Bay shoreline.

Deliverable/Output: Map of relative rates of erosion and progradation around SF Bay shoreline, and concise report detailing findings.

Budget: $45,000

Schedule: November 2012-September 2013

Task 3: Conceptual adaptation strategies for different Bay shoreline IRWMP settings and projects

In this task, we will integrate the products of Tasks 1 and 2 to create a set of conceptual adaptation strategies for different Bay shoreline IRWMP settings and projects. Descriptive text and illustrative diagrams will explain the challenges associated with different parts of the region and locally-appropriate responses. This task will effectively localize the guidance given in the DWR Climate Change Handbook for Regional Water Planning to produce a regional toolkit based on case studies of different shoreline typologies and observed and measured trends. The development of this toolkit will improve climate change planning, and specifically will guide both the selection and implementation of IRWMP projects. Potential adaptation strategies may likely include:

- Restore marshes and beaches to reduce incident wave energy on levees and other infrastructure.
- Reduce wave energy offshore of the intertidal zone using low-crested breakwaters, etc.
- Focus marsh preservation efforts on shorelines with favorable trends.
- Direct sediment inputs from local watersheds to target marshes and other protective shoreline features, either manually or through natural flood protection channel redesign.
- Reconnect floodplains to lower stream reaches to reduce maintenance dredging and flooding risk, while increasing habitat value.
- Protect or realign shoreline features where erosive trends indicate high risk.

These locally-specified adaptation strategies will support IRWMP implementation. These tools will also be widely used by other entities (including BCDC, EPA, DFG, SCC and local agencies) through related local and regional planning processes.

Deliverable/Output: GIS layers, maps, toolkit as a stand-alone report, and conceptual designs in report format.

Budget: $80,000

Schedule: June 2013-May 2014

Task 4: Community engagement

Local communities need to be engaged the IRWMP process to recognize the challenges of climate change to their water resources and to identify potential IRWMP implementation projects. In this project, we will focus on delivery to and engagement with specific disadvantaged communities and tribes particularly impacted by sea level rise and climate change processes. To interface with local communities, we will work with local partners and existing programs, including SFEI's Tribal Initiative, which will facilitate communication with local tribes. We anticipate a total of six presentations with meetings at the beginning of the work (to receive input and describe activities) and near project completion to share findings and next steps.

Deliverable/Output: 6 meetings/presentations and community outreach events (3 at start of project, 3 at end of project).

Budget: $30,000

Schedule: September 2012-December 2012, June 2014-May 2014 (and intermittently as appropriate)

Task 5. Incorporate climate change adaptation strategy into an update of the IRWMP website

Each task in this project will be developed in close communication with the Kennedy-Jenks/ESA/PWA project team carrying out the IRWMP update. The project will produce text, graphics, and maps for incorporation into the update and the IRWMP website. This will enable planners and others to quickly access information needed to develop adaptation strategies and also avoid placing projects at risk in vulnerable geographical areas.

Deliverable/Output: Maps, text, and graphics for update of IRWMP website; assisting with update of IRWMP website.

Budget: $10,444

Schedule: April 2014-August 2014

Task 6. Project Management and Oversight

Successful completion of this project requires project management and oversight. SFEI will oversee management and administration of this grant, and will be responsible for completing the tasks and managing the budget, reporting to IRWMP stakeholders, and managing project deliverables.

Deliverable/Output: Project management, communication with IRWMP stakeholders and partners, and management of project deliverables.

Budget: $10,000

Schedule: August 2012-August 2014