

**Climate Smart Adaptation Case Study**  
Shoreline Change San Pablo Bay Pilot Study:  
Understanding Spatial Patterns of Marsh Sensitivity and Resilience

**Case Study Name:** Shoreline Change San Pablo Bay Pilot Study: Understanding Spatial Patterns of Marsh Sensitivity and Resilience

**Lead Agency/Organization and Partners:** The San Francisco Estuary Institute (SFEI) is leading the project. Funded by EPA Estuary 2100

**Project Description:** This project is an analysis of long- and short-term rates of tidal marsh erosion in San Pablo Bay. There has been substantial concern about marsh erosion in response to diminished regional sediment supply and accelerated sea level rise. However there has been no protocol or data set for assessing and evaluating these concerns. In this project we are (1) developing a methodology and conceptual model for mapping and comparing marsh shoreline positions over time; (2) mapping marsh margin positions at three time steps: circa 1856, 1993, and 2009/2010; (3) analyzing the spatial patterns of shoreline erosion/progradation during these intervals; and (4) discussing initial implications for understanding the underlying physical processes driving these trajectories and the applications for management strategies to protect and restore the marsh shoreline.

Our initial findings indicate that trajectories of shoreline erosion are highly heterogeneous, controlled by the local hydrogeomorphic and hydrodynamic settings. Contrary to expectations, we are finding that much of the San Pablo Bay marsh margin has been prograding rather than eroding over the past two decades (Figure 1). We also found that the morphology of the marsh margin varies substantially around the Bay; evaluating these marsh shoreline morphologies is critical to mapping them accurately and consistently.

The initial analysis of shoreline dynamics and trends suggests that marshes will respond quite differently to accelerated sea level rise, identifying more and less favorable settings for marsh persistence. This assessment identifies areas of relative shoreline resilience and sensitivity, suggesting reaches of high priority for marsh conservation, protection, and perhaps expansion -- where long-term physical processes maintain particularly resilient marshes -- as well as areas of greater concern, where strong erosive trends may necessitate more extreme measures (in terms of either protection or retreat).

This pilot study has developed a method for analyzing marsh shoreline change and applied that method to a limited geographic and temporal extent, generating a substantial new data set. While the findings already suggest some significant implications for sub-regional strategy and prioritization, this phase does not include the full analysis and interpretation necessary to support management. Several next steps will be important to understand and apply this information, including correlating marsh scarp types to calculated shoreline rates, and drivers such as wave energy, fetch, mudflat shape and size, as well as pairing with vertical accretion rates. Additional time steps will be necessary in selected locations to evaluate periodicity in relation to changes in the surrounding landscape and climatic setting. These

expansions of the study will greatly increase our understanding of shoreline dynamics and the specificity and validity of recommendations for shoreline management.

The pilot study should also be expanded geographically to the other parts of San Francisco Bay, as well as potentially upstream into the Napa-Sonoma and Petaluma marshlands. The total project budget for this study was \$200,000. The cost of additional efforts is to be determined.

**Approach to Vulnerability Assessment:** *How was vulnerability assessed in the planning process or during implementation? What data and decision support tools were used to evaluate vulnerability? Who was involved in the assessment and how were they engaged? Did participants prioritize risk? How much time did the assessment take?*

Because this project is focused on developing regional information and tools, rather than an on-the-ground implementation, a vulnerability assessment was not part of the process. However, this previously unavailable information and long- and short-term erosion/progradation rates will be directly useful for vulnerability assessments for a wide range of shoreline projects in San Pablo Bay.

**Adaptation Actions:** Several management implications arise from the work that has been done to date, and more will develop with completed analysis. These include:

- Regional synthesis of net shoreline movement and rates of change which could guide marsh restoration strategy, and direct regional efforts to ‘save’ marshes from sea level rise. Those marshes that are eroding quickly may be past the point of no return and have limited long-term potential. Conversely, shoreline segments that are prograding quickly, and have both short term and long term positive trends likely present persistent advantageous hydrodynamic and geomorphic settings that should be prioritized for conservation.
- Targeted beach nourishment (coarse sediment) to locations in the Bay that were mapped as beaches in the 1856 T-sheets, and have since retreated landward, and whose edges are currently eroding marsh. Prioritizing shoreline restoration efforts should also include some analysis of habitat type, ecological function, and physical evolution.

**Monitoring and management:** The project has established a method for tracking marsh shoreline position. Continuing and expanding these protocols to monitor relative rate of erosion and progradation in response to sea level rise and management efforts should be part of sea level rise response monitoring plans. Management strategies developed based on the results of this study can then be adapted based on new information developed during the monitoring phase.

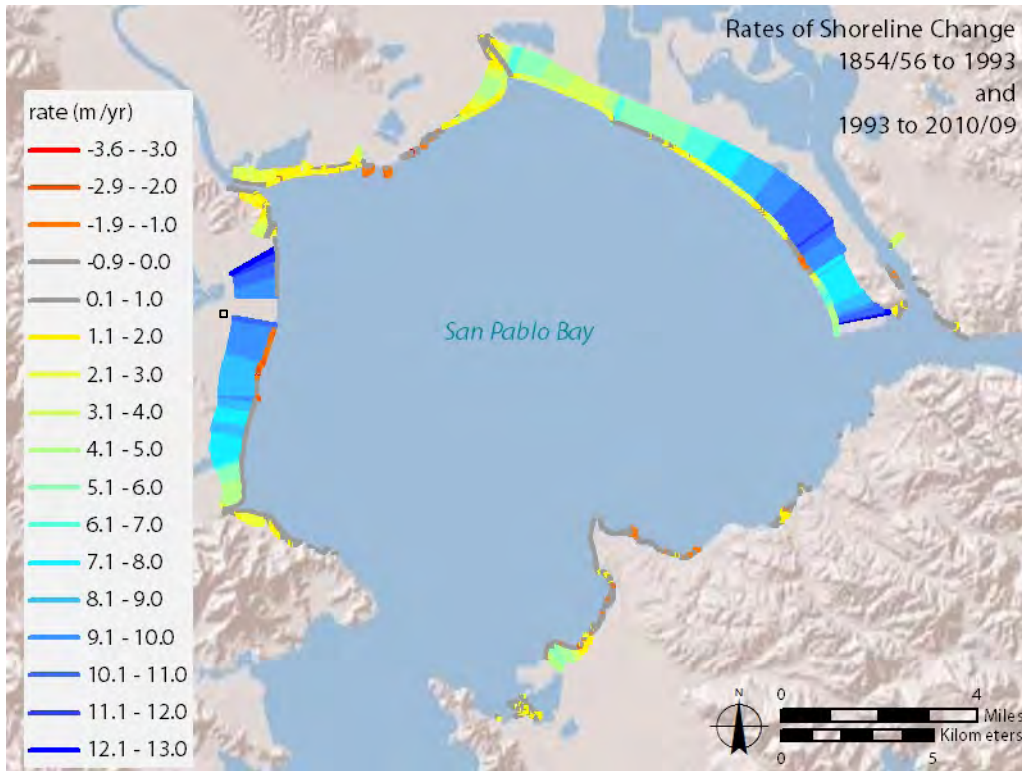
**For Further Information:**

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**PLEASE** include photos and any relevant maps that might help illustrate the case study.

**SUGGESTED LENGTH** is 2 – 4 pages including photos and maps.

Figure 1. (Above) Map of San Pablo Bay with long-term (1856-1993) and short-term (1993-2009/2010) shoreline erosion and progradation rates. Cooler colors indicate progradation and warmer colors indicate erosion. (Below) example of Novato shoreline showing example of long term progradation and short term erosion





Shoreline near Point Pinole. If you need a banner graphic.

