Early-Stage Outcomes at the Innovative Sears Point Tidal Marsh Restoration Project

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I. Introduction

Rebuilding tidal marsh elevations to restore emergent vegetated marsh and its associated ecological functions and ecosystem services and having these restored marshes strive to keep pace with sea level rise is a major question being examined in the San Francisco Estuary. The Sears Point Tidal Marsh Restoration Project of the Sonoma Land Trust is located on the northwest shore of San Pablo Bay, the broad, shallow northern embayment of the Estuary (Figure 1) where tidal currents and wind generally maintain very high suspended sediment loads in the water column.

Restoration design took advantage of this setting to utilize natural sedimentation as the approach to rebuild elevations on the property that had subsided into roughly mean lower low water, and it applied lessons learned from nearby “Carl’s Marsh” (Siegel 2002) and observations of the design team (Siegel, Baye, Leewald, Toms). For a variety of reasons, pre-breach vegetation of the site did not exist.

This poster presents the early results of sedimentation using two airborne LiDAR topographic monitoring data collection efforts and illustrates the performance of the mound structures including their early erosion and later efforts to stabilize and revegetate them.

II. Topography and Net Sedimentation Baseline to Year 2.7 (June 2018)

Sears Point has undergone a significant amount of natural sedimentation in its first three years of restoration. Figure 3A shows the as-built topography (comprised of mixture of ground-based LiDAR and engineering design elevations). Figure 3B shows the airborne LiDAR data for 1.7 years after breach, October 2015. Figure 3C shows the airborne LiDAR data for 2.7 years after breach, June 2016. Figure 3D through 3I show the change in elevation from baseline to Year 1.7, Year 1.7 to Year 2.7, and baseline to Year 2.7, respectively. To date, we have analyzed the 2017 LiDAR data and elevation change, and Figures 3J through 3M present the total accretion and average annual accretion rates, respectively.

At Year 1.7, total net accretion was nearly 4 ft maximum, with a median of 3.2 ft/yr and a maximum of 3.5 ft/yr. Net accretion reflects elevation change only and combines all processes of deposition, consolidation, and compaction that simultaneously deposited sediment undergoes. These rates are anticipated based on earlier findings from nearby Carl’s Marsh (Siegel 2002).

Spatial distribution of accretion also followed general predictions of the “prograding delta” concept wherein more deposition occurs near the inlet and along channel banks as flow velocities reduce and less sediment remains in the water column to deposit in the farther areas from tidal connections (Siegel 2002, WWR 2007). Figure 2 shows the generalized design predictions and Figures 3B and 3C show the site patterns. Actual patterns reflect interaction of flows through the two breaches.

These findings strongly suggest that tidal marsh restoration sites located near locally abundant sediment supplies and well connected to those tidal waters will undergo rapid natural deposition.

III. “Marsh Mounds” – Promote Deposition, Reduce Erosion, and Provide Marsh Vegetation Nuclei

About 500 “marsh mounds” – essentially, piles of on-site soil with top elevations around mean high water – were included in the restoration design to promote sediment deposition, reduce erosion of the new perimeter tidal flood control levee, and provide discrete points of marsh vegetation establishment (“nuclei”) throughout the restoration site. These ideas originated from lessons learned at nearby Carl’s Marsh (Siegel 2002) and observations of the design team (Siegel, Baye, Leewald, Toms). For a variety of reasons, mounds were not vegetated before breaching and consequently were subjected to significant erosion after breaching (Figure 5). An EID graduate student (Buchbinder) started field experiments immediately before breach in October 2015, and continued through 2018, surveying mounds for erosion, testing erosion control with bags, planting native cordgrasses (Figure 6A), and measuring vegetation and other physical and biological responses. That work identified the value of additional native cordgrass plantings, which the invasive Spartina Project then carried out in March 2018 at more than 30 mounds (Figure 6B). The recent 2018 site visit found very successful native cordgrass plantings (Figure 6C). Future monitoring will establish both vegetation spread as well as whether sedimentation rates are increased within vegetated areas.

References


Stuart Siegel, M. 2002. Effect of Slough Channel Network and Marsh Plain Functions and Ecosystem Services and Having These Restored Marshes Strive to Keep Pace with Sea Level Rise is a Major Question Being Examined in the San Francisco Estuary. The Sears Point Tidal Marsh Restoration Project of the Sonoma Land Trust is Located on the Northwest Shore of San Pablo Bay, the Broad, Shallow Northern Embayment of the Estuary (Figure 1) Where Tidal Currents and Wind Generally Maintain Very High Suspended Sediment Loads in the Water Column.

Restoration Design Took Advantage of This Setting to Utilize Natural Sedimentation as the Approach to Rebuild Elevations on the Property That Had Subsided into Roughly Mean Lower Low Water, and It Applied Lessons Learned from Nearby “Carl’s Marsh” (Siegel 2002) and Observations of the Design Team (Siegel, Baye, Leewald, Toms). For a Variety of Reasons, Pre-Breach Vegetation of the Site Did Not Exist.

This Poster Presents the Early Results of Sedimentation Using Two Airborne LiDAR Topographic Monitoring Data Collection Efforts and Illustrates the Performance of the Mound Structures Including Their Early Erosion and Later Efforts to Stabilize and Revegetate Them.

At Year 1.7, Total Net Accretion Was Nearly 4 Ft Maximum, With a Median of 3.2 Ft/Yr and a Maximum of 3.5 Ft/Yr. Net Accretion Reflects Elevation Change Only and Combines All Processes of Deposition, Consolidation, and Compaction That Simultaneously Deposited Sediment Undergoes. These Rates Are Anticipated Based on Earlier Findings from Nearby Carl’s Marsh (Siegel 2002).

Spatial Distribution of Accretion Also Followed General Predictions of the “Prograding Delta” Concept Wherein More Deposition Occurs Near the Inlet and Along Channel Banks as Flow Velocities Reduce and Less Sediment Remains in the Water Column to Deposit in the Farther Areas from Tidal Connections (Siegel 2002, WWR 2007). Figure 2 Shows the Generalized Design Predictions and Figures 3B and 3C Show the Site Patterns. Actual Patterns Reflect Interaction of Flows Through the Two Breaches.

These Findings Strongly Suggest That Tidal Marsh Restoration Sites Located Near Locally Abundant Sediment Supplies and Well Connected to Those Tidal Waters Will Undergo Rapid Natural Deposition.

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