Sea Level Rise & Coastal Wetland Restoration in the San Francisco Bay: Sears Point and Hamilton Wetlands

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Elizabeth Murray, US Army Engineer Research and Development Center

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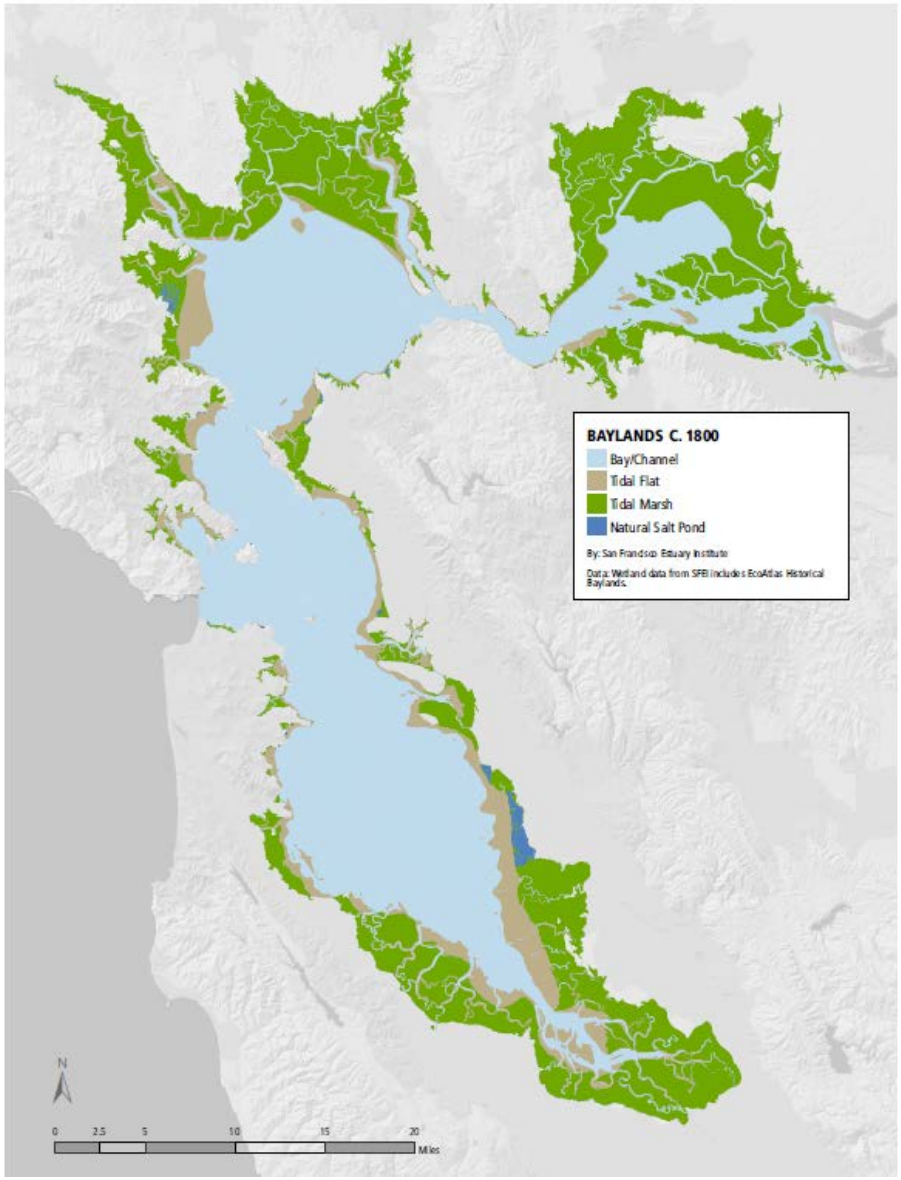
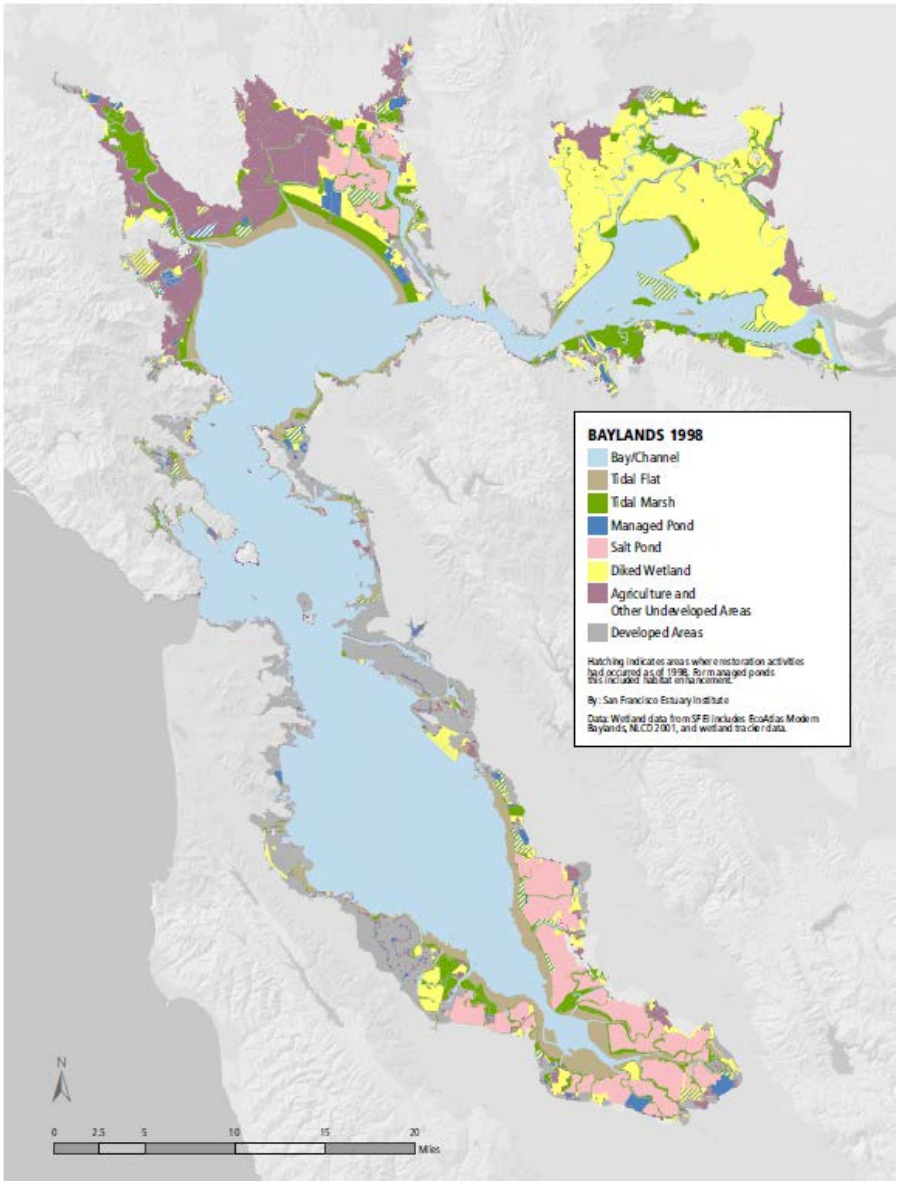
ERDC
US Army Engineer Research and Development Center

US Army Corps of Engineers
San Francisco District

Historic Marsh Losses



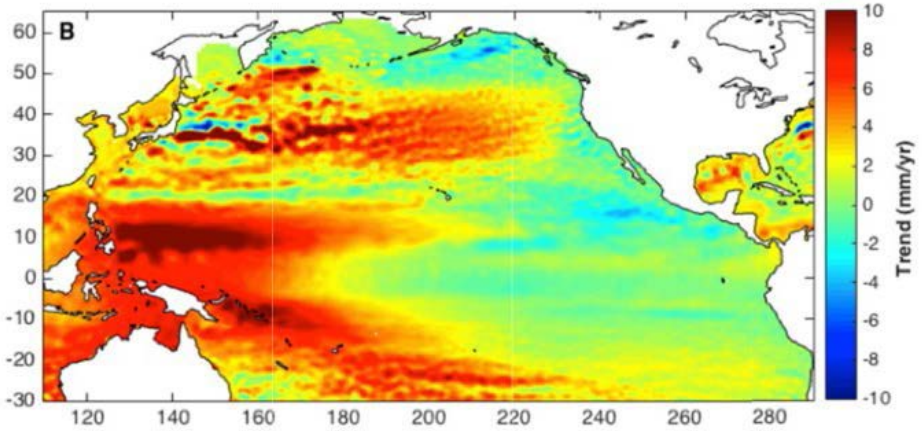


Goals Project, 2015.

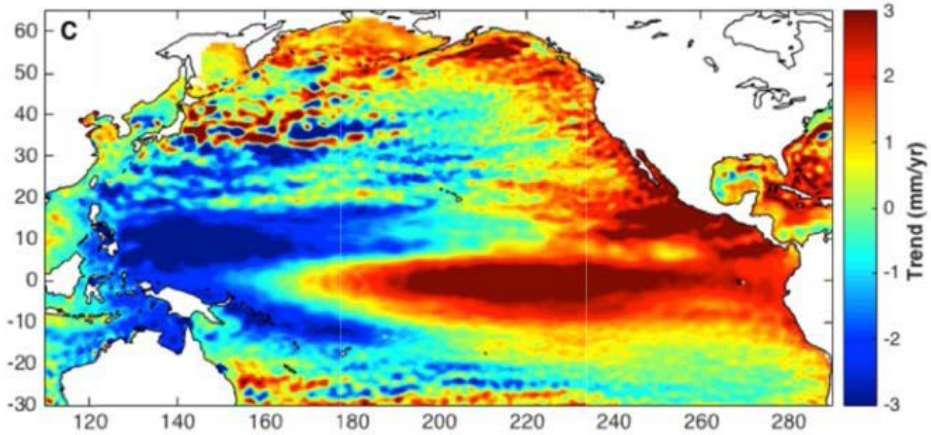
Accelerated Sea Level Rise in East Pacific

Recent Rates

1993-2011

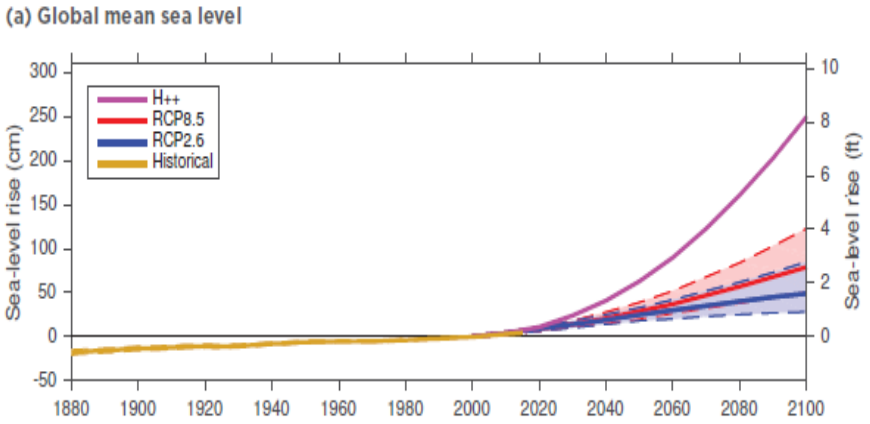


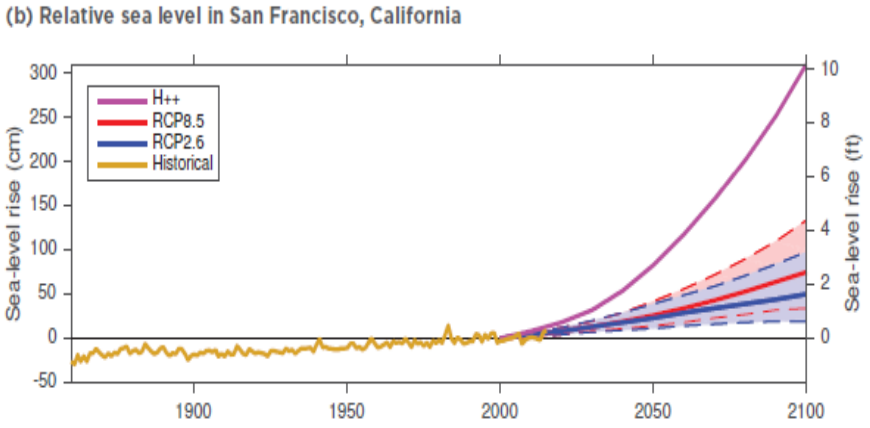
2011-2015



Hamlington et al. 2016

Projections

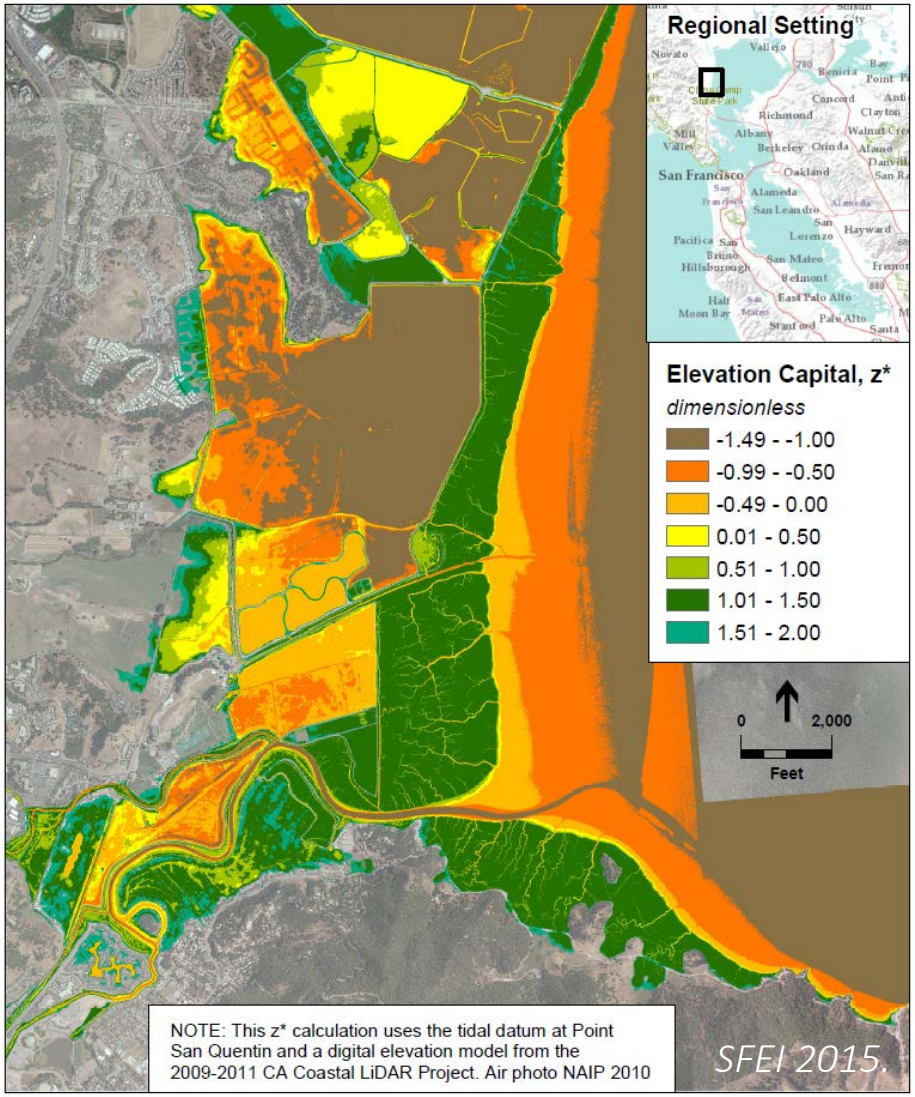




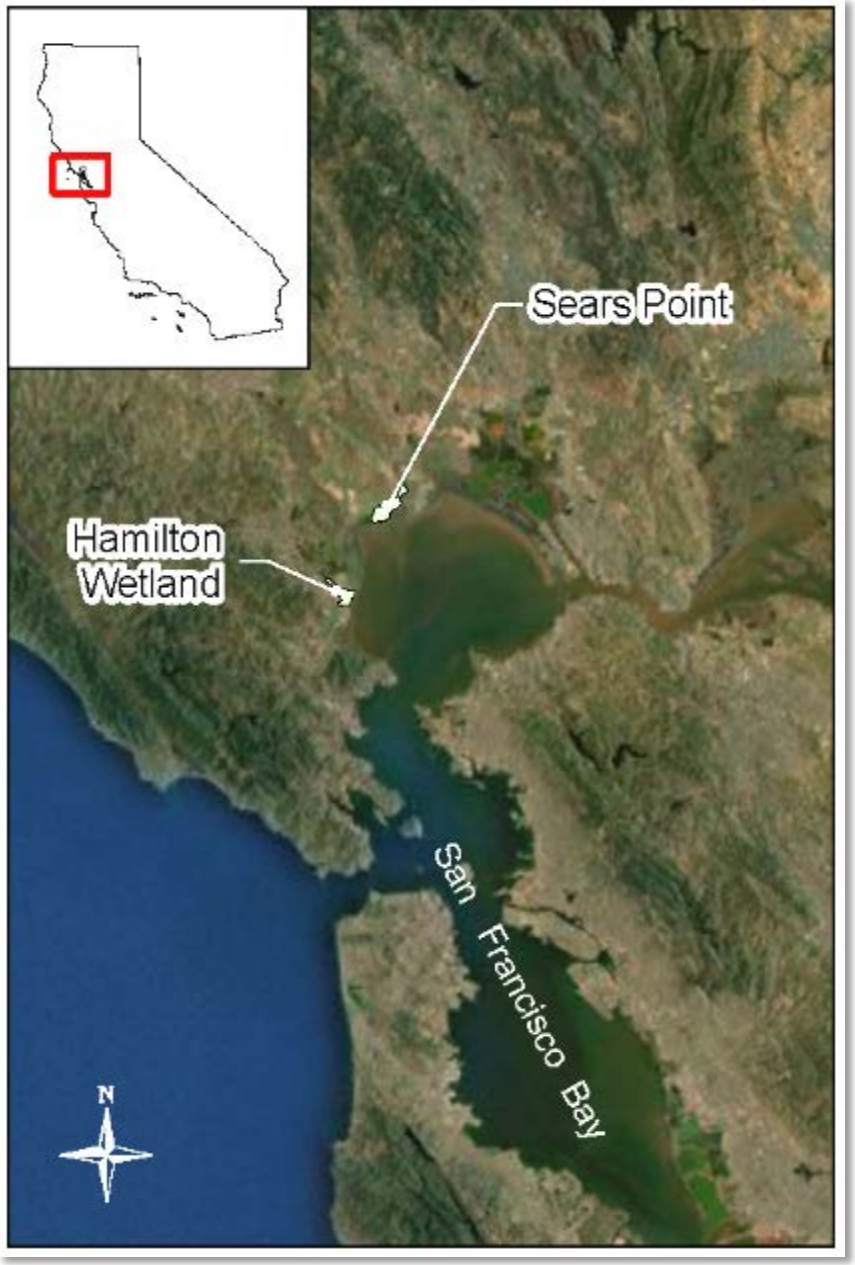
Griggs et al., 2017

Sediment and Subsidence

- Sediment supply reduced
- Diked baylands have subsided 1-2 m
- Dark green are marsh elevations.
- Yellow, orange and brown are below marsh elevation.
- <u>In order to restore these baylands, sediment needs to be brought in or encouraged to accrete.</u>



Sears Point and Hamilton Wetlands

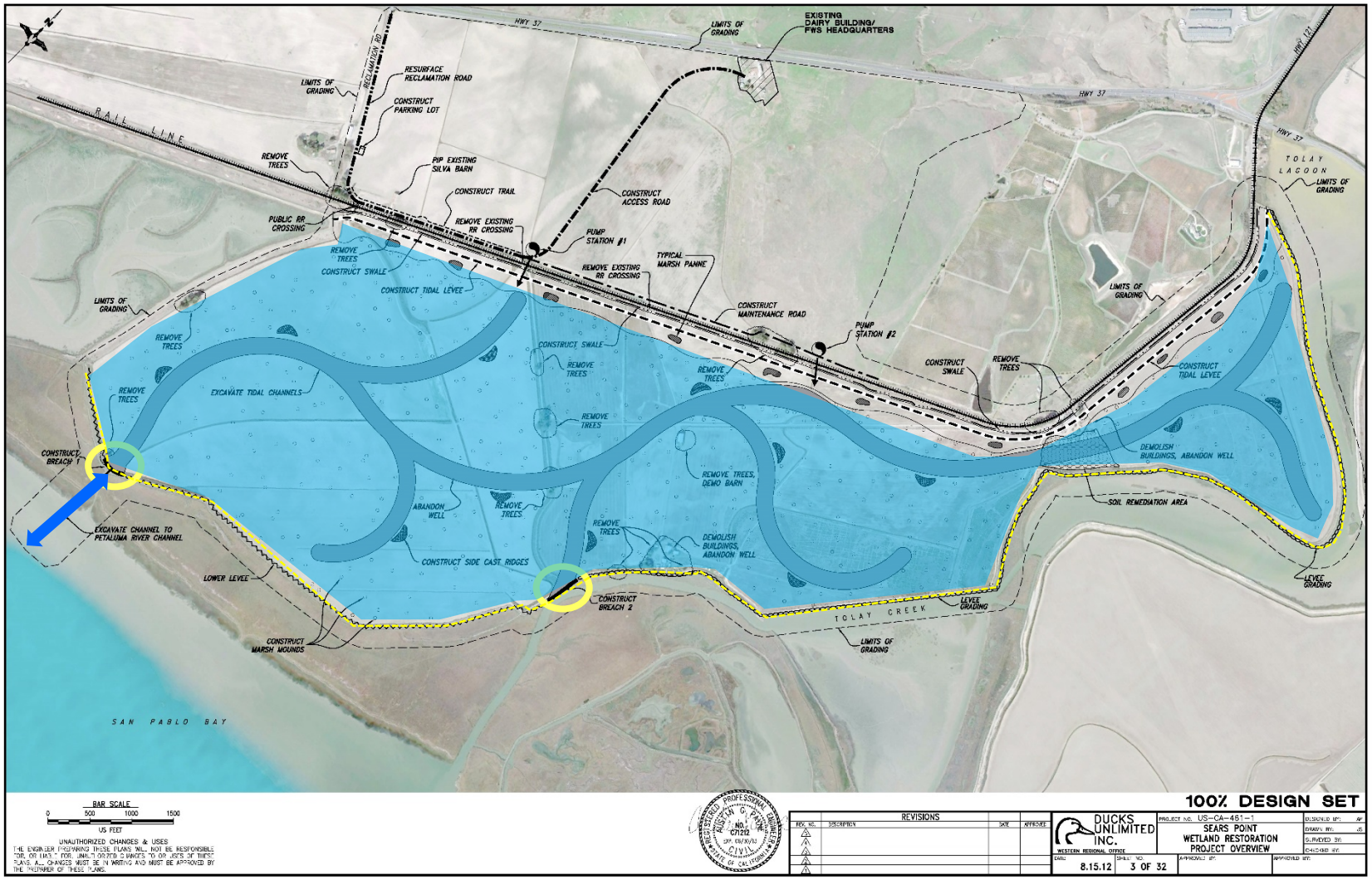


- Both in San Pablo Bay
- Both formerly diked, subsided baylands
- Both large
- Both involved multiple partners
  - SP: Sonoma Land Trust, Ducks Unlimited, CDFW, USFWS, WWR, plus 17 funders
  - HW: Corps of Engineers San Francisco District, California Coastal Conservancy, Port of Oakland (for dredged material), NOAA, BCDC
- Both designed to benefit species, including endangered species
- Both designs utilized natural processes, what we now call Engineering With Nature™
- Both subject to local constraints
- Both designs informed by Sonoma Baylands, completed 20 years ago

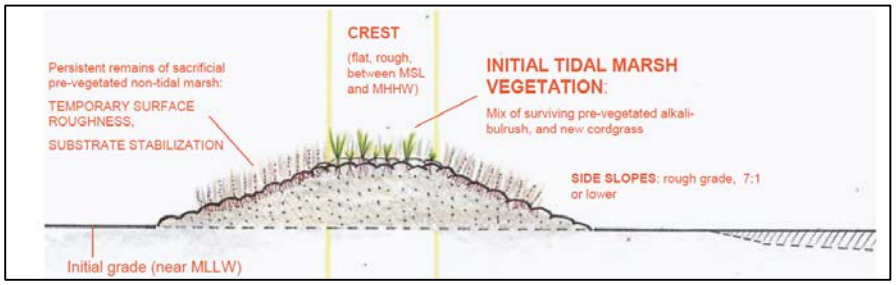
Sears Point

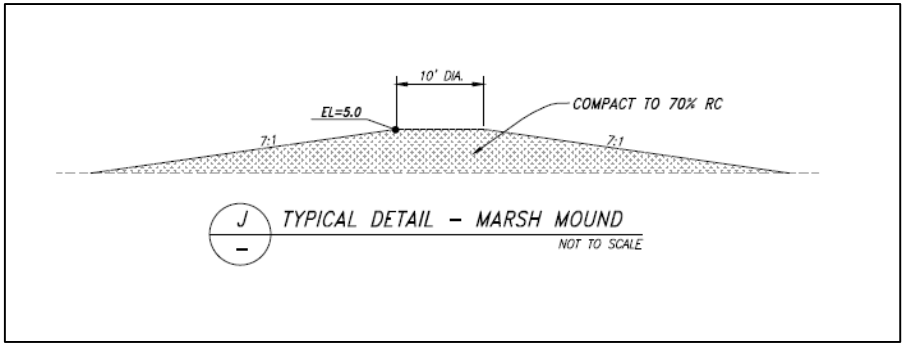
- 2,327-acre property protected by SLT in 2005
- Subsided 6 ft
- Constrained by infrastructure
- Focused on 970 acres

Sears Point


HWY 37
LIMITS OF GRADING
EXISTING DAIRY BUILDING/ FWS HEADQUARTERS
RESURFACE RECLAMATION ROAD
CONSTRUCT PARKING LOT
RAIL LINE
REMOVE TREES
PIP EXISTING SILVA BARN
CONSTRUCT TRAIL
CONSTRUCT ACCESS ROAD
PUBLIC RR CROSSING
REMOVE EXISTING RR CROSSING
PUMP STATION #1
TYPICAL MARSH PANNE
CONSTRUCT SWALE
CONSTRUCT TIDAL LEVEE
CONSTRUCT MAINTENANCE ROAD
PUMP STATION #2
TOLAY LAGOON
EXCAVATE TIDAL CHANNELS
CONSTRUCT BREACH 1
DEMOLISH BUILDINGS, ABANDON WELL
REMOVE TREES, DEMO BARN
SOIL REMEDIATION AREA
ABANDON WELL
EXCAVATE CHANNEL TO PETALUMA RIVER CHANNEL
CONSTRUCT SIDE CAST RIDGES
LOWER LEVEE
CONSTRUCT BREACH 2
LEVEE GRADING
TOLAY CREEK
CONSTRUCT MARSH MOUNDS
SAN PABLO BAY
BAR SCALE
0 500 1000 1500
US FEET
UNAUTHORIZED CHANGES & USES
THE ENGINEER PREPARING THESE PLANS WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR, UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES MUST BE IN WRITING AND MUST BE APPROVED BY THE PREPARER OF THESE PLANS.
100% DESIGN SET
REVISIONS
NO. DESCRIPTION DATE APPROVED
DUCKS UNLIMITED INC.
WESTERN REGIONAL OFFICE
PROJECT NO. US-CA-481-1
SEARS POINT
WETLAND RESTORATION
PROJECT OVERVIEW
DESIGNED BY: AP
DRAWN BY: JS
SURVEYED BY:
CHECKED BY:
DATE: 8.15.12
SHEET NO. 3 OF 32
APPROVED BY:

Sears Point

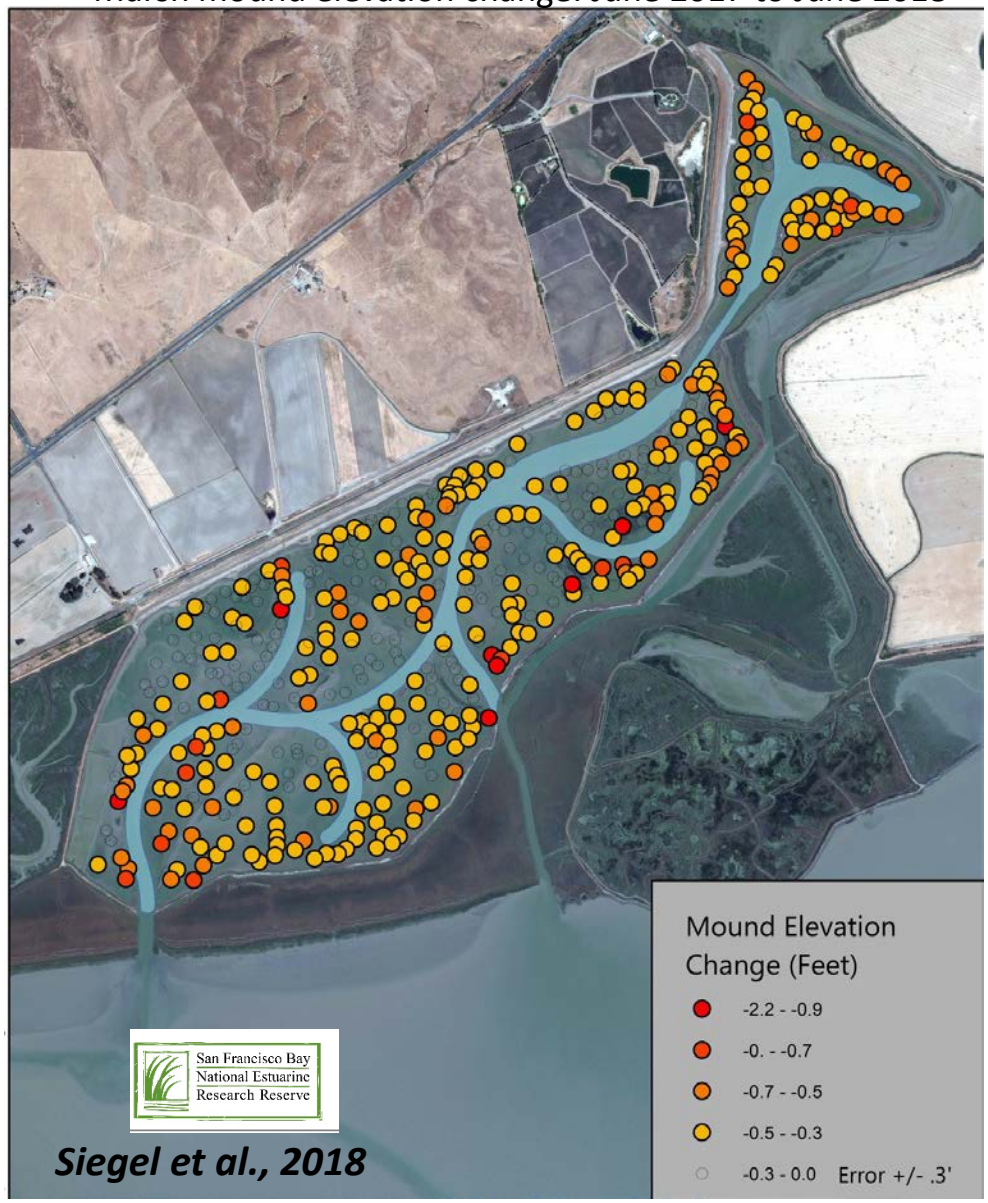


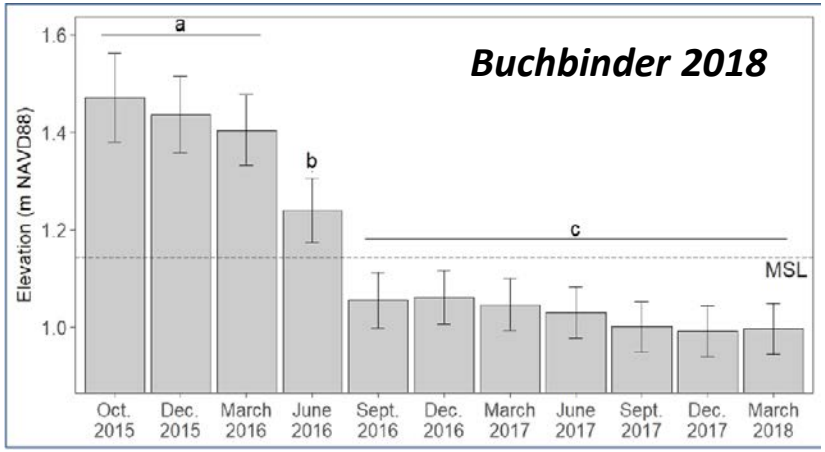


- 500 marsh mounds
- Reduce wind-wave energy
- Promote sediment accretion
- Serve as nuclei for vegetation

Are we losing our marsh mounds?

Marsh mound elevation change: June 2017 to June 2018

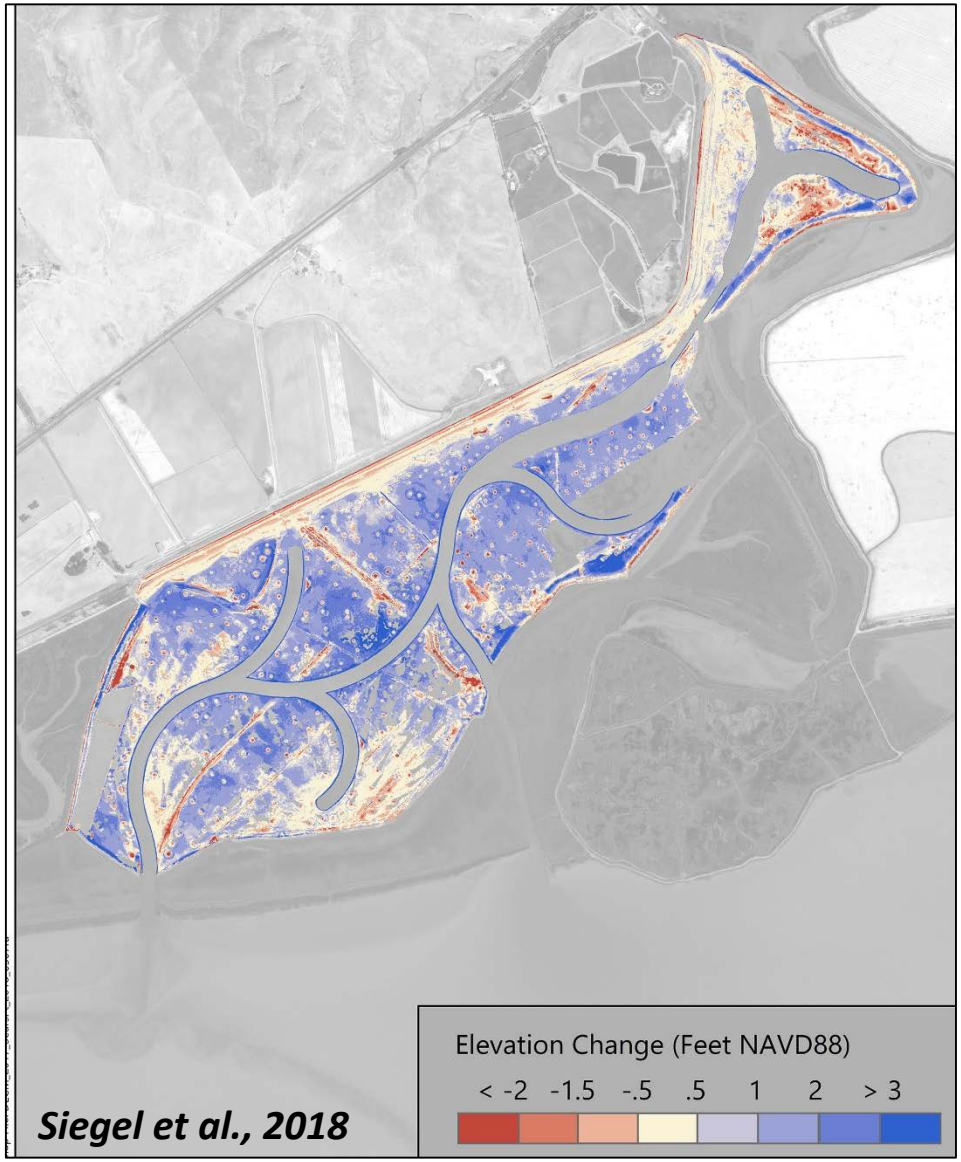


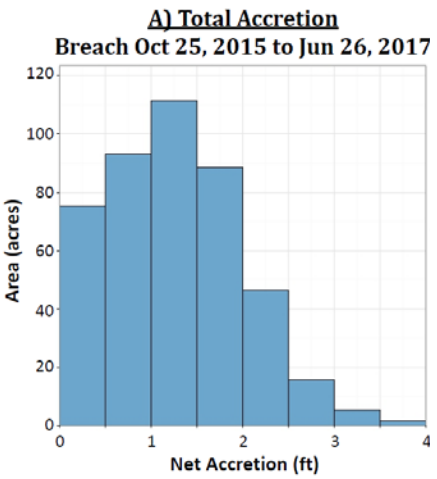


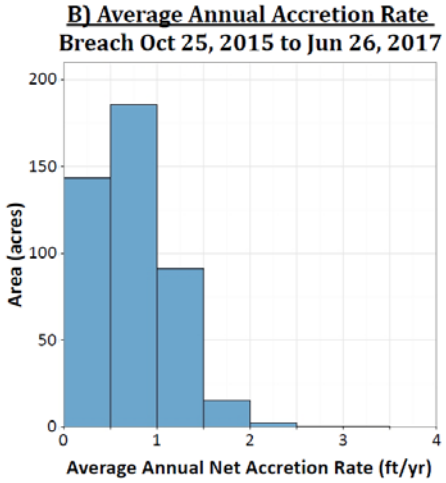
- Marsh mounds eroding up to 0.5m
- Planting cordgrass to stabilize mounds with suitable elevation

Sedimentation

Net sedimentation: Oct 25, 2015 (breach) to June 26, 2017







After 21 months:

- Median accretion 1-1.5 ft
- Total net accretion nearly 4ft max

Annual rate:

- Average 0.5-1 ft/yr
- Maximum 3-3.5 ft/yr

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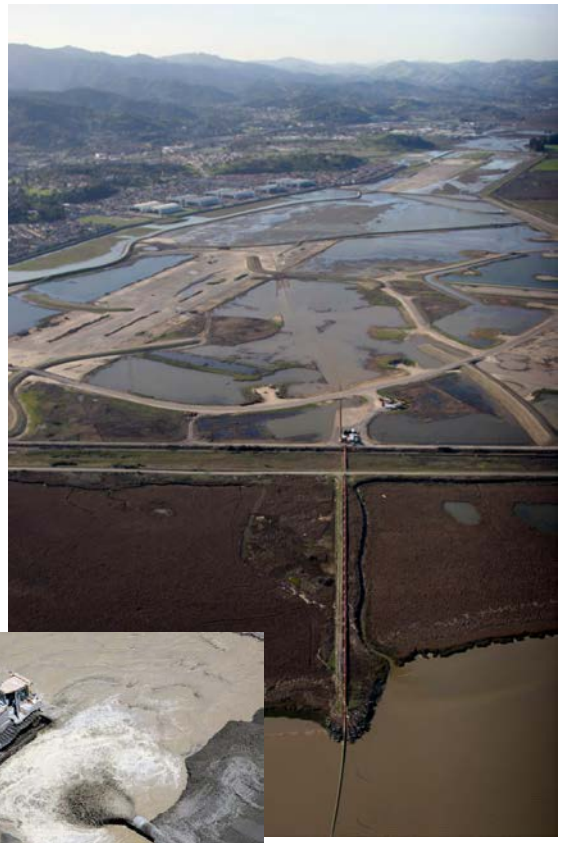
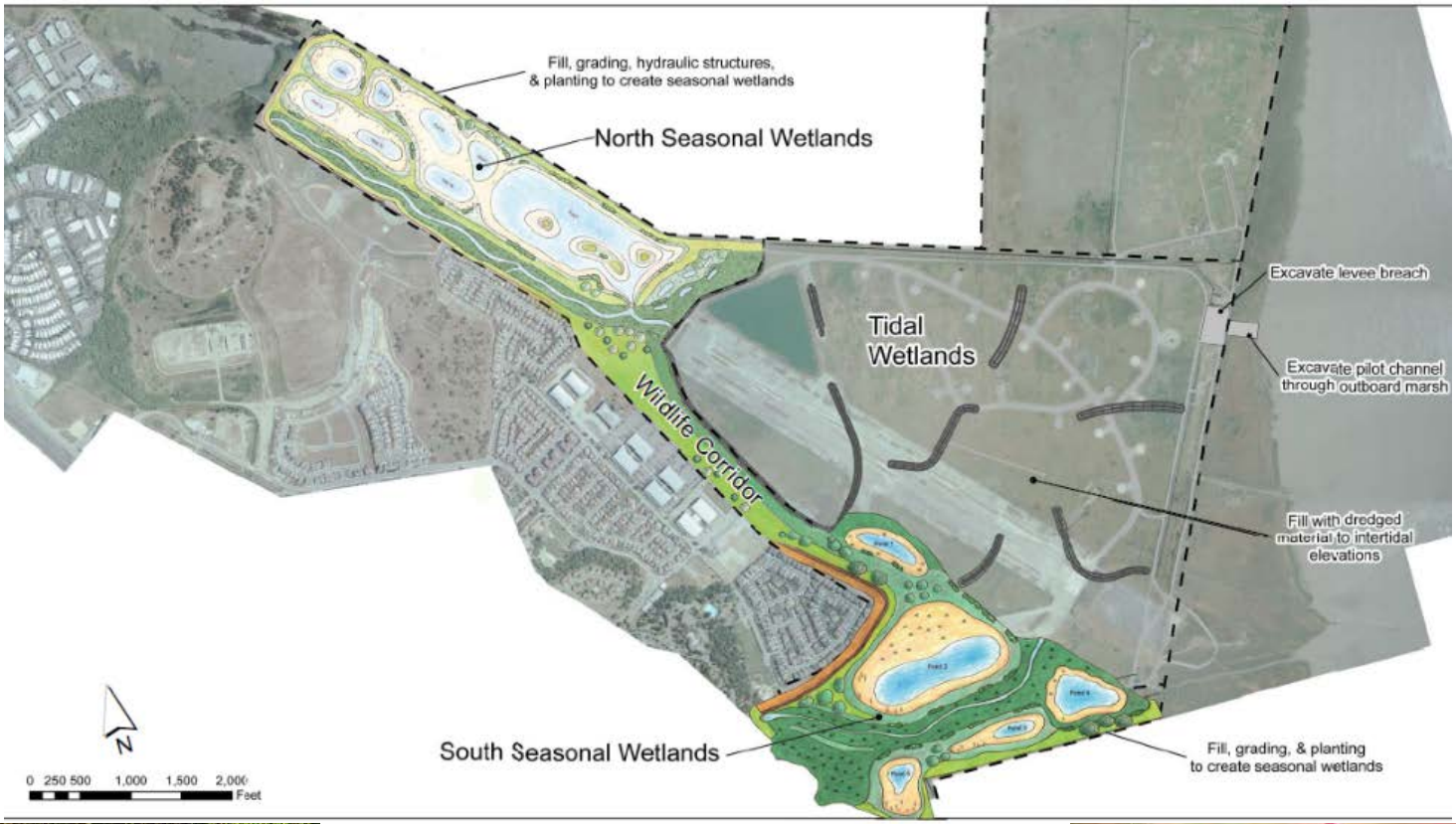
San Francisco Bay National Estuarine Research Reserve

Hamilton Wetlands

- Site diked ~150 yr ago for ag use
- Became an Army Airfield in 1930s
- Slated for restoration in 2003
- Significant subsidence
- 650-acre wetland restoration
- U.S. Army Corps of Engineers San Francisco District and the California Coastal Conservancy (Port of Oakland, NOAA, BCDC)
- Beneficial use of 5.8 M yd^3 of dredged material brought tidal areas within feet of target elevations
- Berms used as fetch reduction to promote accretion of sediment to achieve remaining elevation gains
- Breached levee on 4/25/14

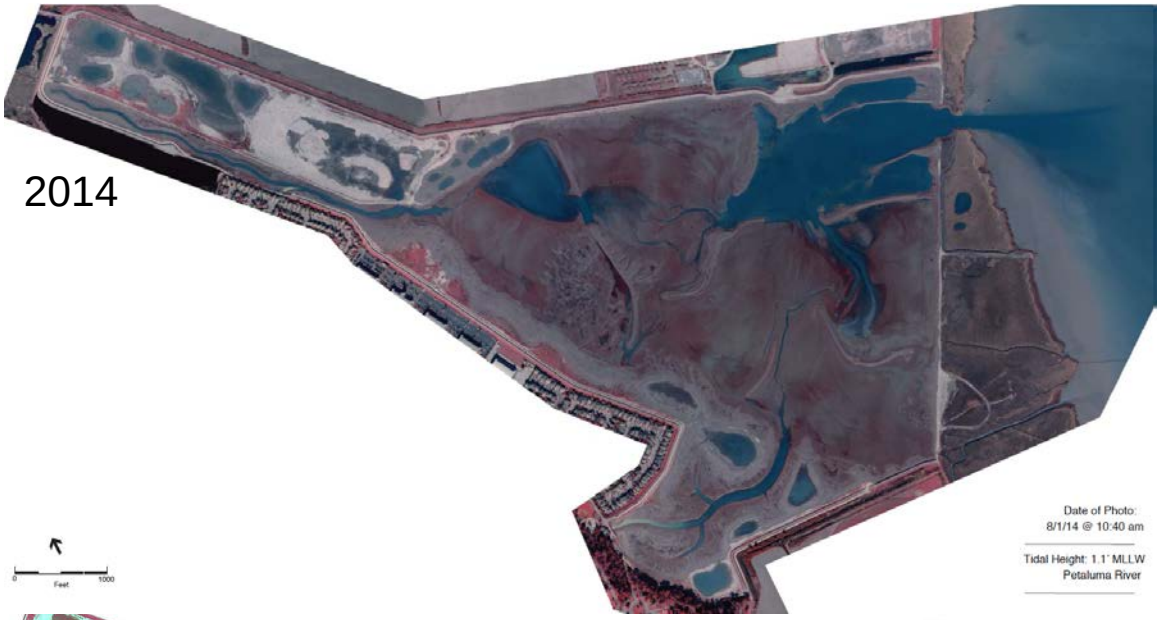


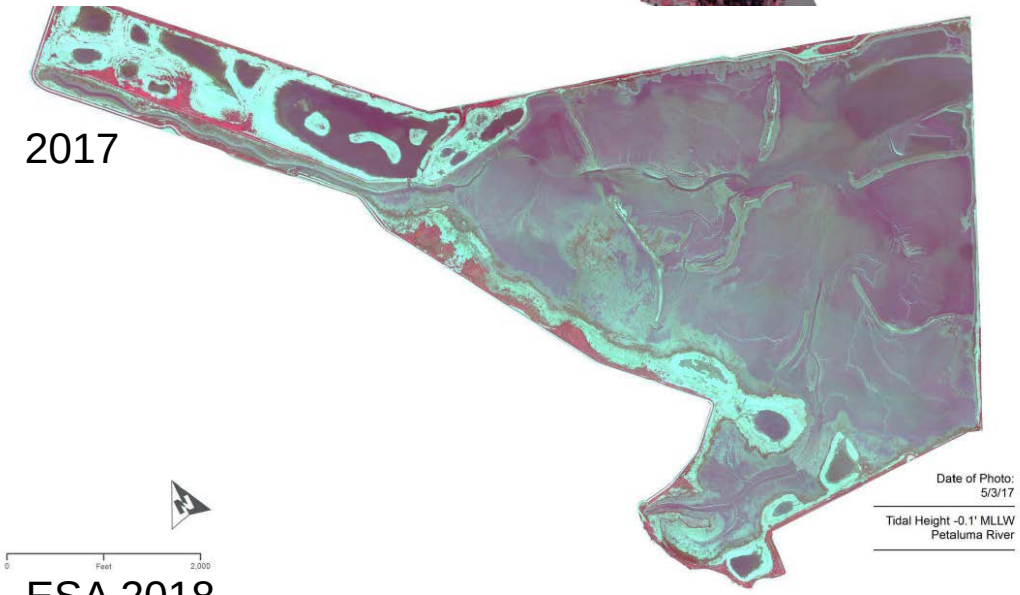
Hamilton Wetlands



- Tidal Wetlands designed to support Endangered Ridgway Rail and Salt Marsh Harvest Mouse
- North Seasonal Wetlands can shift to Tidal Wetlands with SLR

Hamilton Wetlands





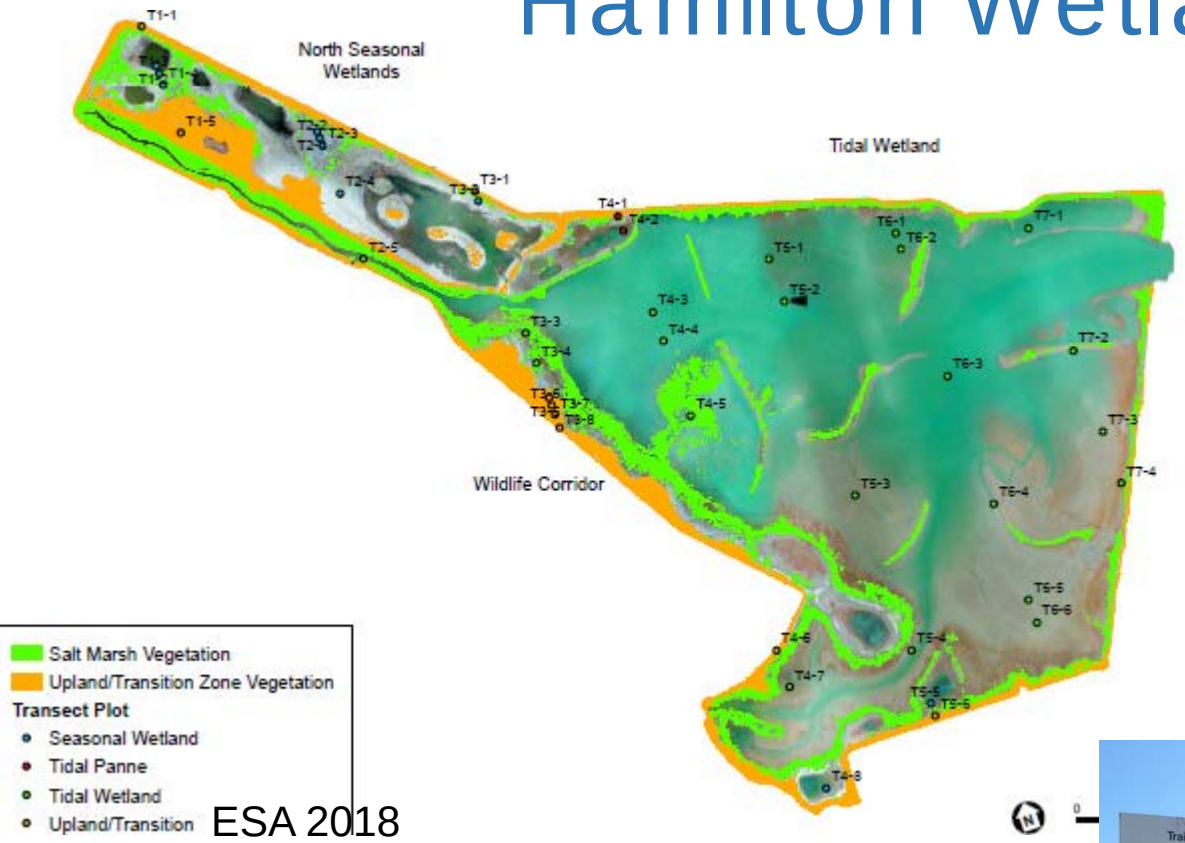
3-years of Monitoring

- Deepest parts of site filling in
- Highest levels of sedimentation occurring below 3.5 ft NADV where tidal inundation is currently > 50% frequency
- Native vegetation (pickleweed and cordgrass) has established on berm tops and site margins

ESA 2018

SPN

Hamilton Wetlands



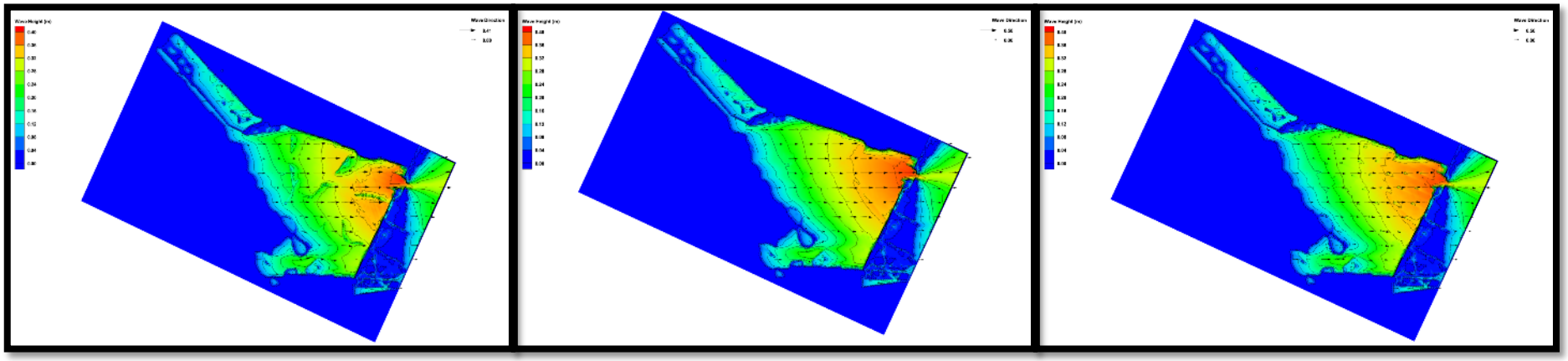
ESA 2018

3-years of Monitoring

- 20% of tidal areas vegetated with natives
- Vegetation expanding into highest mudflat areas
- 20 different fish species; 70% native
- Abundant invertebrates in multiple age classes

Engineering With Nature®
Research Into Harnessing Natural Processes

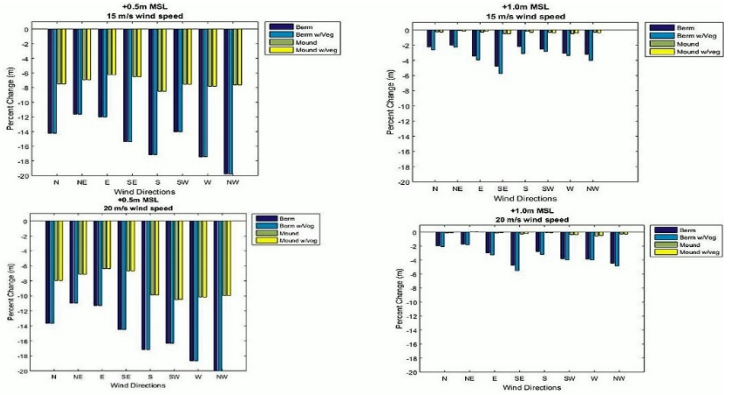
- At each site, use STWAVE to model wave height reduction from fetch reduction features
- Models validated based on data collected at each site for a year
- Models run on (1) As-Built, (2) Site stripped of features, and (3) Site with different features using same volume of material
- With and without Vegetation (parameters based on Corte Madera attenuation research)
- Models run for various wind directions and water heights

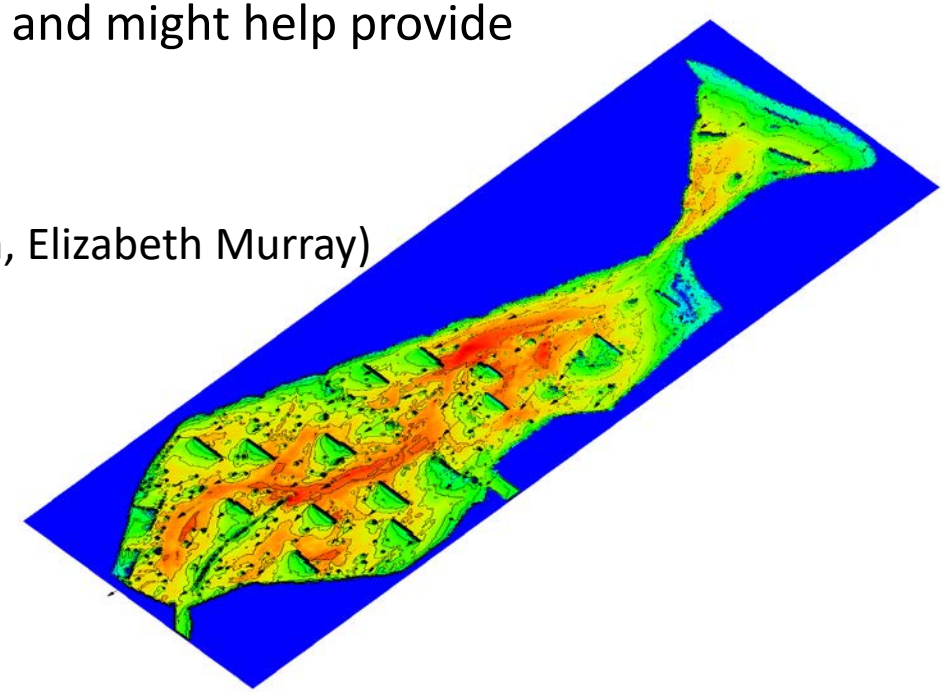


Linear Berms (As-Built) | No Berms (Control) | Mounds (ala Sears Pt.)

Engineering With Nature®
Research Into Harnessing Natural Processes

- At Hamilton, berms performed better (generally twice as well) but vegetation made a greater additional impact with the mounds
- Effect of both features diminishes as water levels increase
- At Sears Point, berms could not be placed in certain areas because of the narrow nature of the site and the excavated channel
- A combination of vegetated berms and mounds offered the most reduction in the model at Sears Point, and might help provide more vegetation loci at any site
- Submitted to Geomorphology
  - (Sally Dillon, Jane Smith, Jarrell Smith, Elizabeth Murray)





Sears Point and Hamilton Wetlands

- Both sites accreting and progressing toward marsh elevations
- Local sediment supply important consideration
- If using marsh mounds, compaction or pre-vegetation will promote persistence
- Cordgrass plantings can help to stabilize after the fact but the labor investment is significant
- Large breaches and multiple breaches facilitate tidal exchange and sediment accretion, but erosion must also be watched
- Just as these projects adapted their designs from Sonoma Baylands, future projects may adapt methods from these projects, ever improving our approach to bayland restoration throughout the estuary.