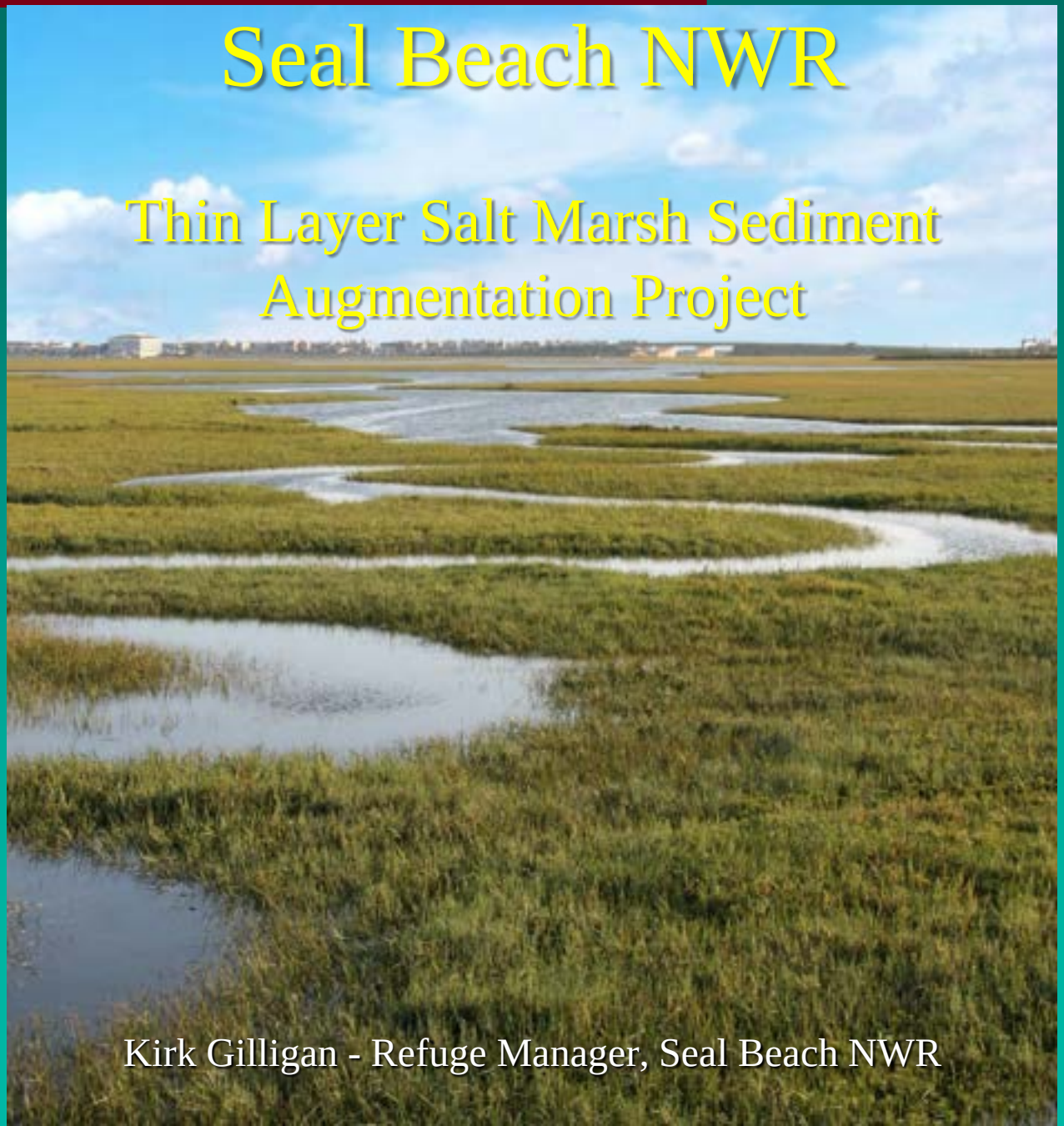
U.S. Fish & Wildlife Service

Seal Beach NWR

Thin Layer Salt Marsh Sediment Augmentation Project



Kirk Gilligan - Refuge Manager, Seal Beach NWR

Thin Layer Salt Marsh Sediment Augmentation

Beneficial Use of Dredge Material by Thin Layer Placement

- First Study – 1978 Georgia
- Many applications since - TX, LA, GA, NC, MD
- Often used where natural systems of sediment deposition have been altered
- 2015/2016 – Seal Beach NWR - First thin layer addition project on west coast of US?

ERDC/EL TN-07-1
December 2007

US Army Corps of Engineers,

Thin Layer Placement of Dredged Material on Coastal Wetlands: A Review of the Technical and Scientific Literature

by Gary L. Ray

PURPOSE: Coastal wetlands in many areas are deteriorating due, in part, to sediment depletion, subsidence, and sea level rise. The purpose of this technical note is to review and synthesize the available scientific and technical literature concerning thin layer placement of dredged materials in wetlands to ameliorate these effects.

BACKGROUND: The stability of coastal wetlands is largely a function of the balance between sediment accretion, marsh subsidence, and sea-level rise (Mitsch and Gosselink 2000). In southern Louisiana, this balance has been upset by a variety of factors including control of the flow of the Mississippi River and construction of levees which act to restrict the supply of sediment, reduced freshwater inflow, and salt water intrusion due to construction of pipeline canals (Cahoon and Cowan 1987, 1988). As a result, Louisiana leads the United States in wetland loss, losing as much as 24 square miles each year (Louisiana Department of Natural Resources 2007). Extreme events such as hurricanes can result in even greater losses. For instance, the United States Geological Survey (USGS) estimates that as much as 217 square miles of coastal lands including marshes (Figure 1) were converted to open water following Hurricanes Katrina and Rita (USGS 2007).

Figure 1. Salt marsh vegetation (USACE photo).

One method of potentially slowing wetland loss is to artificially supply sediments to subsiding marshes. Techniques normally employed to move and distribute sediments are impractical in the unstable soils of wetlands, so new methods have been developed. The primary method is to deposit thin layers of sediment, usually by spraying a sediment slurry under high pressure over the marsh surface. The technique is essentially a modification of existing hydraulic dredging methods in which sediments are hydraulically dredged, liquefied, and then pumped through a high-pressure spray nozzle. Developed in Louisiana, it has since been performed on the Gulf and Atlantic coasts and shows promise for general application.

STUDIES OF THIN LAYER PLACEMENT: Studies of the effects of placing dredged materials on marshes originated with recognition that marshes are adapted to respond to natural processes, such as storms, which deposit wrack and sediments on the marsh surfaces. In one of the first studies of placement of dredged materials on marshes, Reimold et al. (1978) manually

1


Seal Beach National Wildlife Refuge
Case Rd. Pond
Forrestal Ave.
Bolsa Ave.
Observation Deck
Nature Center
Kitts Highway
Road
Signal
Case Road
NASA Island
7th Street Pond
7th Street
Pacific Coast Highway
Hog Island
Perimeter Road

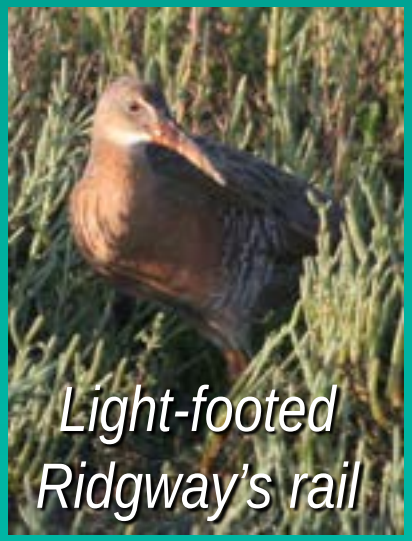
Refuge Purpose

"Preserve and manage the habitat necessary for the perpetuation of two endangered species – the light-footed clapper rail and CA least tern."
"Preserve habitat used migratory waterfowl, shorebirds, and other water birds."


Western snowy plover


Pacific green sea turtle


Belding's savannah sparrow


Light-footed Ridgway's rail


California least tern

What's missing?

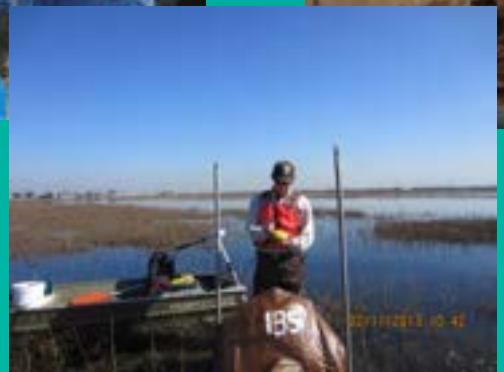
But of course!

Management Programs -Endangered Species

Light-footed Ridgway's Rail

LFRR Platform maintenance: Built and replaced approximate 20 LFRR platform covers & bases. Maintained all 90 nesting platforms. Fall count – 102

Captive-bred rail release – 2014

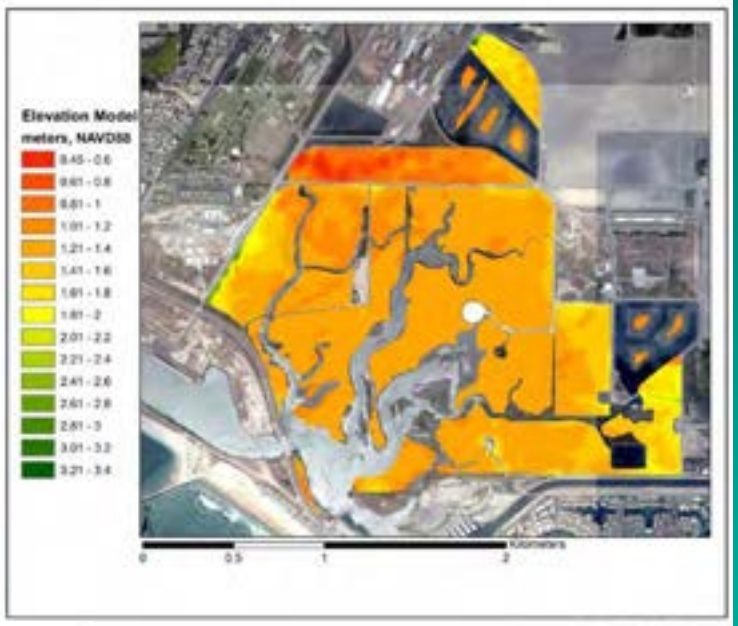


Seal Beach NWR – Lowest of the Low

Seal Beach NWR had the lowest mean elevation and mean elevation relative to MHW out of 8 CA marshes studied by UCLA and USGS.

Elevation

- We conducted surveys with a Leica Real Time Kinematic GPS (± 2 cm x, y, z, accuracy)
- Surveyed along transects every 12.5m; transects separated by 50 m
- 4757 elevation measurements; 266 hectares

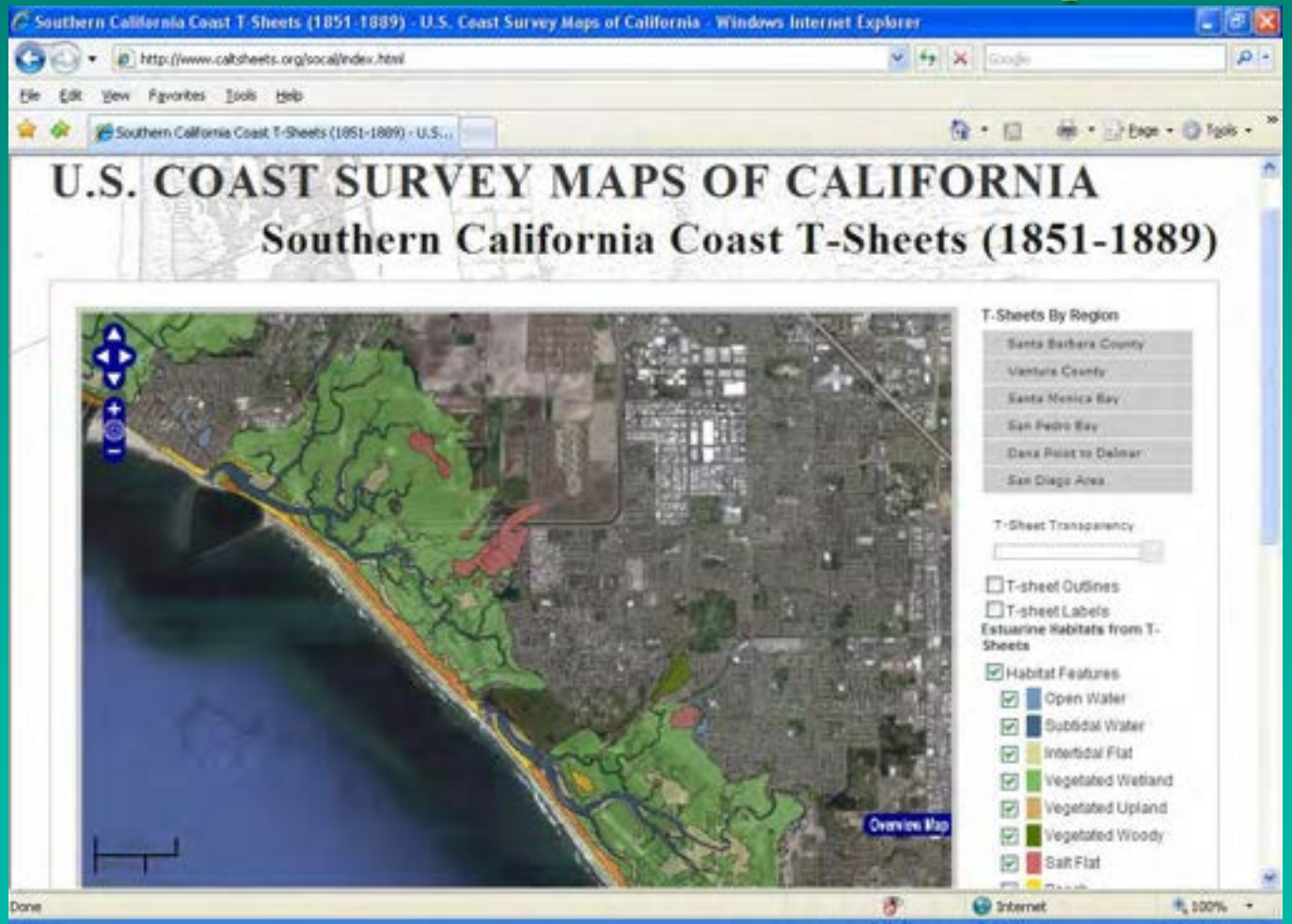


Site	Hectares	Elevation Measurements (n)	Mean Elevation	Maximum Elevation	Minimum Elevation	Elevation Range	Mean releative to MHW
Humboldt	169	3020	1.77	2.82	0.58	2.24	0.32
Bolinas	87	1832	1.58	3.42	1.12	2.3	0.03
San Pablo Bay	1410	1725	1.95	4.99	-0.17	5.16	0.11
Morro Bay	188	3115	1.63	3.05	0.5	2.55	0.25
Pt. Mugu	112	1924	1.73	2.76	1.04	1.72	0.35
Seal Beach	266	4757	1.34	3.56	0.31	3.25	0.01
Newport	61	1234	1.53	1.53	0.68	0.85	0.17
Tijuana Slough	374	5832	2.22	5.32	0.99	4.33	0.21

USGS science for a changing world

Why elevation challenged?

1. Diversion of freshwater inputs
   - -Change in salinity
   - -Reduction or loss of sediment inputs

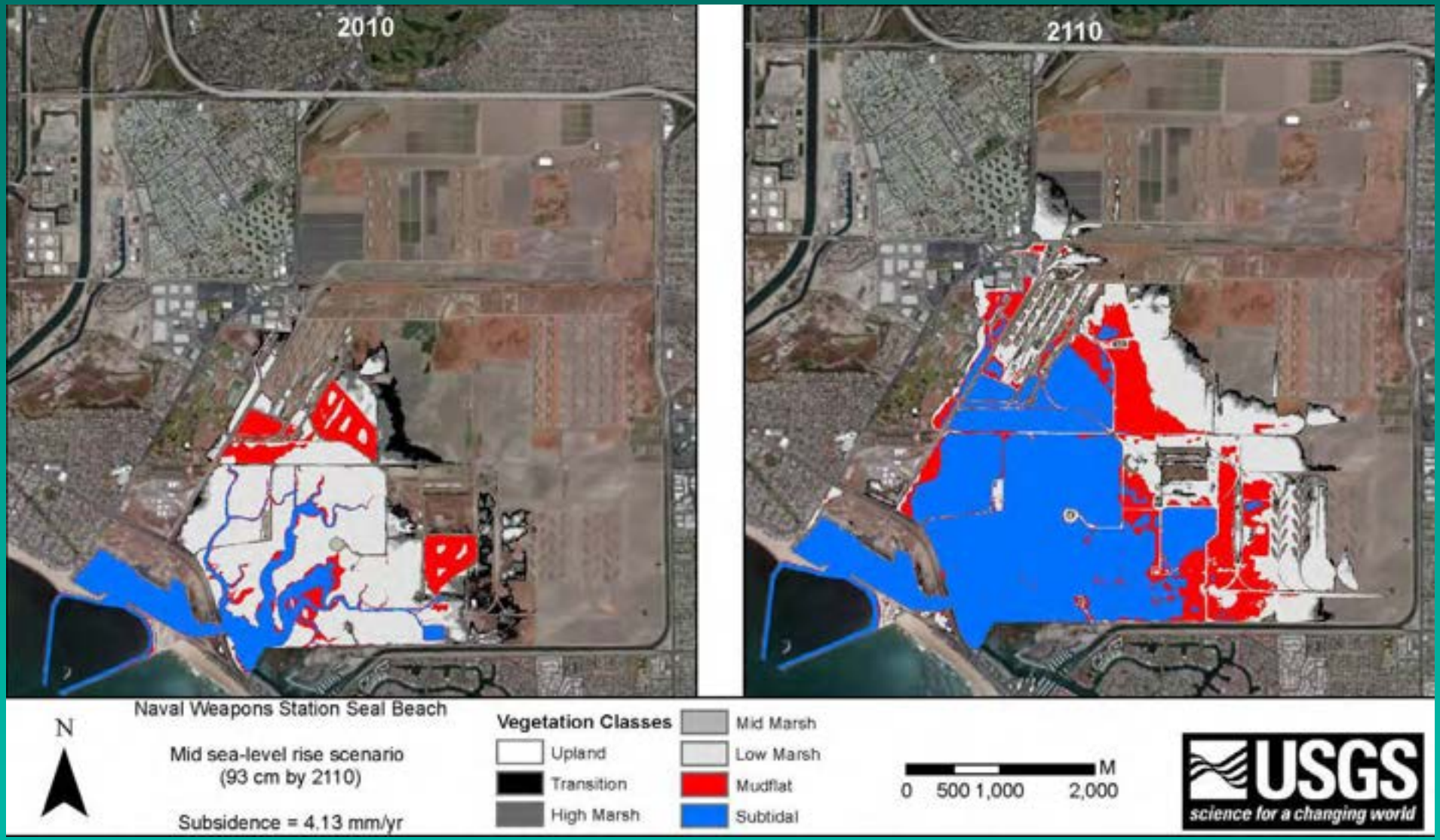


2. Land subsidence – subterranean fluid extraction and tectonic action

Evaluation of Subterranean Subsidence at Seal Beach National Wildlife Refuge (Takekawa et al, 2013)

- Subsidence occurring at NWSSB at a rate of -4.13 mm/yr (SE ± 1.21 mm/yr)
- SBNWR is experiencing a relative sea-level rise rate three times more (6.23 mm/yr) than that of similar southern California marshes not experiencing subsidence

3. Sea level rise – historic and future




U.S. Fish & Wildlife Service
Seal Beach
National Wildlife Refuge
Proposed Project Location
Nevada
California
Seal Beach
Tidal Conveyance Cell
Bolsa Cell
Bolsa Ave
Naval Weapons Station Seal Beach
Sediment Augmentation Site
Oil Island
NASA Island
Case Rd
7th St
Signal Rd
Hog Island
Surfside Beach
Huntington Harbor
Seal Beach NWR
State Lands Lease Area
NWS Seal Beach
Refuge Headquarters

Project Goals

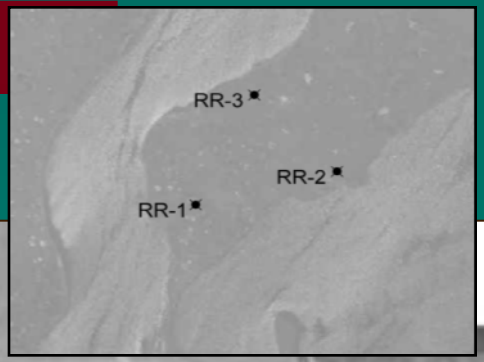
1. Sediment - Within 2 years of sediment augmentation, achieve a minimum 3 inch increase in the marsh plain elevation over pre-project conditions. Note: A 10” sediment layer will be applied during the application process.

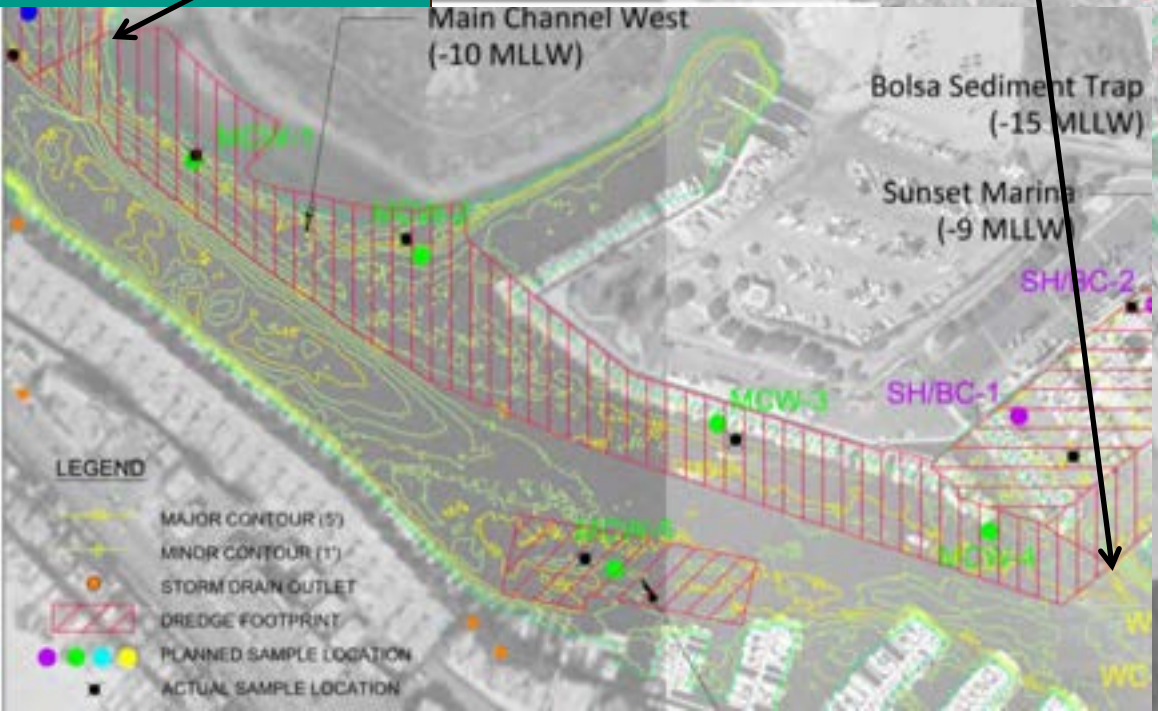
2. Cordgrass - Within 2 years of sediment augmentation, achieve cordgrass stem lengths equivalent to pre-project conditions and achieve terminal cordgrass elevations higher than pre-project conditions.

3. Invertebrates - Within 2 years of sediment augmentation, achieve a diversity and abundance of invertebrates within the project sediments that is similar to the selected reference site.

4. Light-footed Ridgway’s rails & Mig. Birds - Within 1 year of sediment augmentation, provide foraging opportunities for migratory birds, and within 2 years provide foraging and nesting opportunities for light-footed Ridgway’s rail.

Sediment Characterization





Sediment Characterization Results

- Results report published and presented to SC-DMMT on May 28, 2014
- Grain size distribution (silt/clay/sand content) of Main Channel West dredge material similar to Refuge samples
- Chemistry, bioassay, and bioaccumulation testing of MCW material indicates suitability for SBNWR (or open ocean/LA-2) placement.

Sediment Application Methods

Slurry delivered via floating or submerged pipeline directly from dredge or barge

Photo by USACE

Sediment Application Methods (cont.)

Placed on Refuge via Rainbow Spray or end-of-pipe Baffle Impingement

Photo by Bob Blama, CENAB,USACE

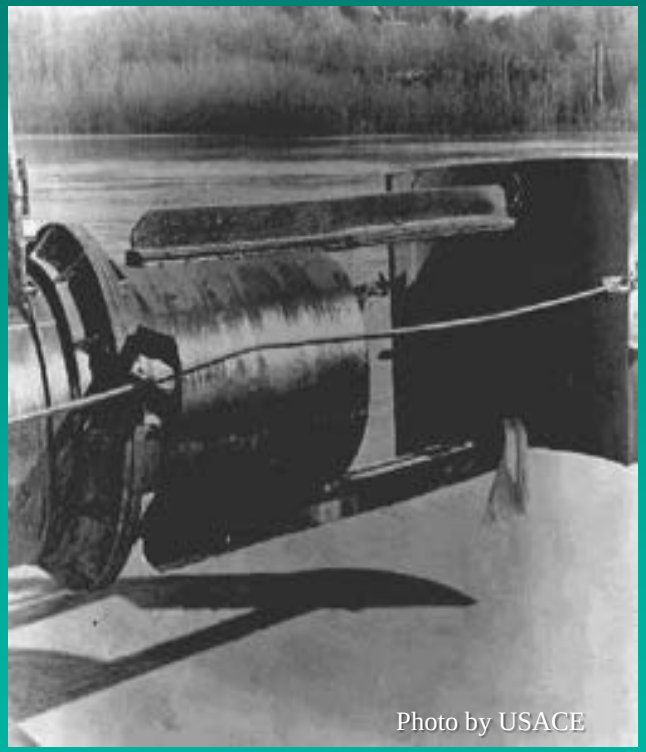


Photo by USACE

End up pipe pointed horizontal, up, or angled toward baffle

Monitoring Program

An essential component of this adaptation action is monitoring to evaluate both the ecological response to the action and the overall effectiveness of the action (specifically, have the project objectives been achieved).

Proposed Monitoring

- Sediment elevations; thickness, and compaction rate of applied sediment
- Sediment movement and turbidity in adjacent channels
- Tidal creek status/formation/reformation post sediment application
- Vegetation monitoring/Plant community assessment – to include % cover, biomass, cordgrass terminal elevation, cordgrass stem length, cordgrass stem density, physiological plant condition
- Abiotic parameter description
- Eelgrass monitoring
- Infaunal invertebrate community structure
- Epifaunal community diversity
- General avian surveys – abundance & diversity
- Light-footed Ridgway's rail monitoring

Implementation Schedule

Pre-project monitoring – Underway

Application of 10” sediment layer – Oct - Jan 2015/2016

Post-application monitoring – Initiate immediately following placement of sediment

Project Partners

- U.S. Fish and Wildlife Service
- OC Parks
- California Coastal Conservancy
- Naval Weapons Station Seal Beach
- State Lands Commission
- Southwest Wetlands Interpretive Association
- USGS – Western Ecological Research Center
- UCLA – Richard Ambrose, Ph.D.
- CSU Long Beach – Christine Whitcraft, Ph.D.
- Moffatt & Nichol

Data Dissemination/Outreach of Project Results

- Issue post-construction monitoring reports annually
- Develop a webpage to provide quarterly updates
- Conduct a workshop/webinar to present monitoring results
- Prepare a final report with lessons learned and recommendations for future projects

Bigger picture: End goal is to implement and evaluate the success of thin layer placement as a regional sea level rise and climate change adaptation strategy that can be used at regular intervals to ensure the the long term sustainability of Pacific coast marshes.