



U.S. Fish & Wildlife Service

Seal Beach National Wildlife Refuge Thin Layer Salt Marsh Sediment Augmentation Project

Kirk Gilligan - Refuge Manager, Seal Beach NWR



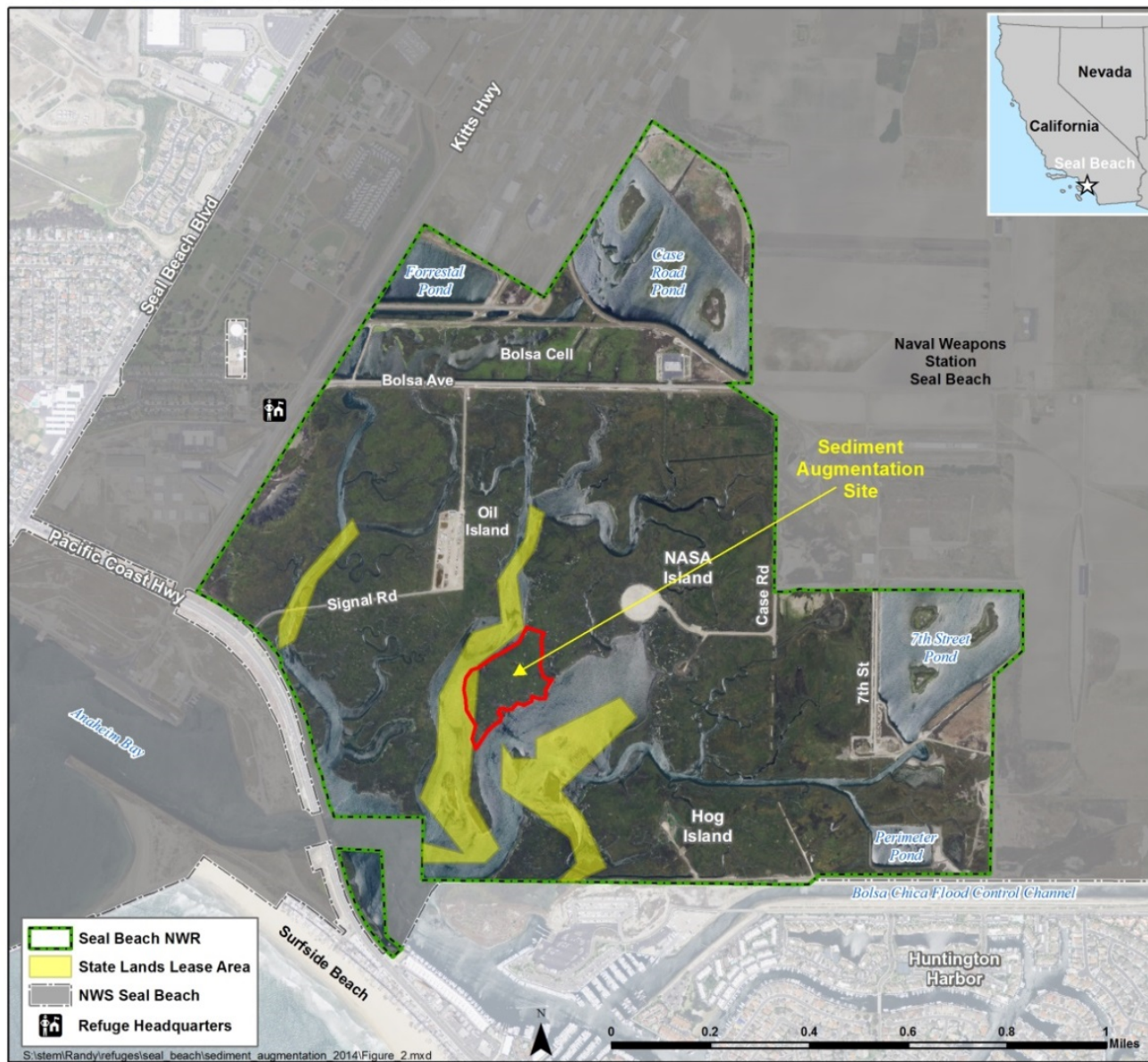
U.S. Fish & Wildlife Service



U.S. Fish & Wildlife Service

Seal Beach

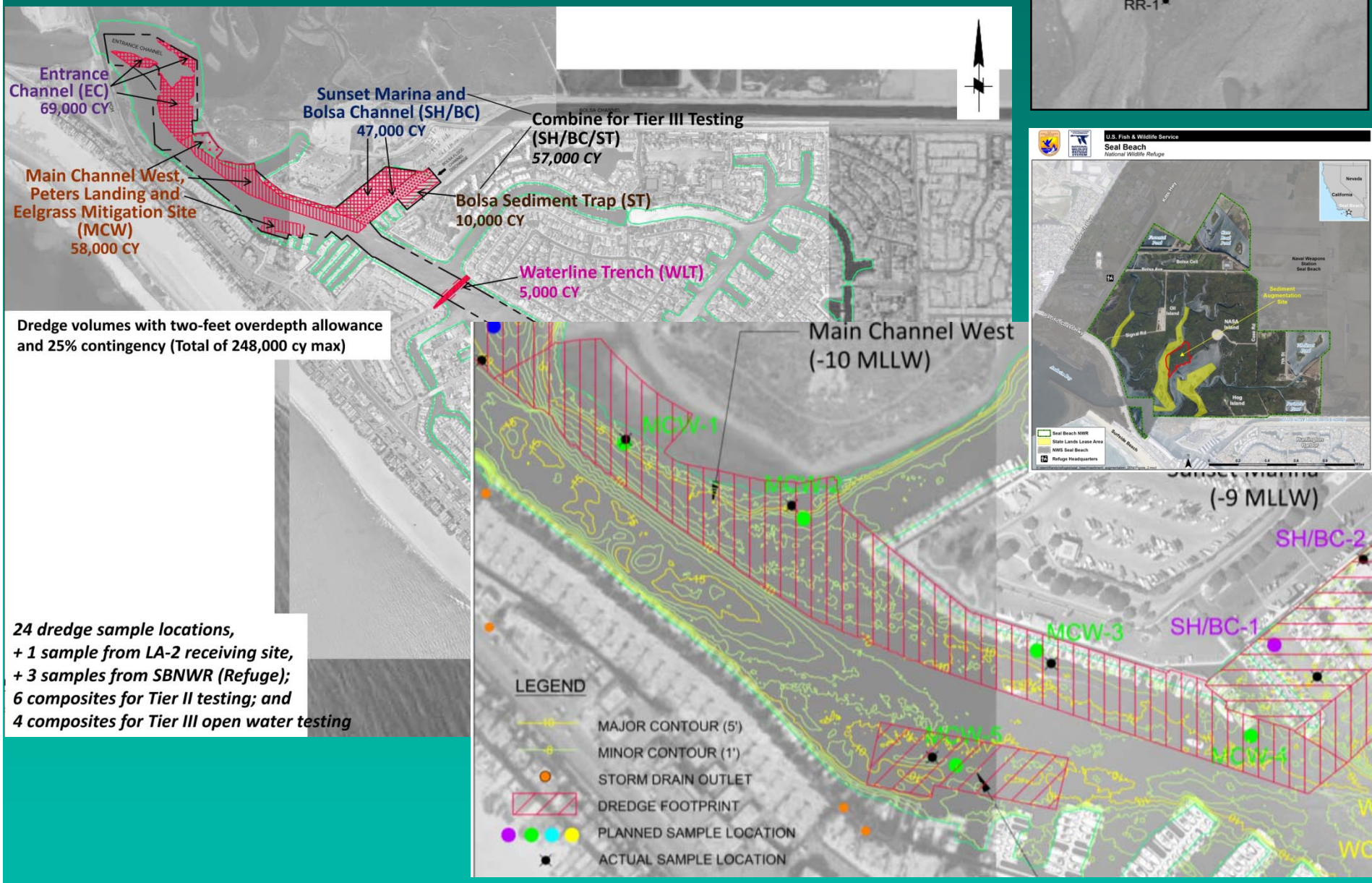
National Wildlife Refuge





U.S. Fish & Wildlife Service

Sediment Characterization





U.S. Fish & Wildlife Service

Table 12. Bulk Sediment Physical and chemical Results for the Sunset/Huntington Harbour Tier II Composite Samples and Reference Samples.

Valid Analyte Name	Units	Sunset/Huntington Harbour Tier II Composite Samples						Reference Sediments		NWS Seal Beach Soil Background ¹	Ecological Screening ²		Res
		Entrance SH13-EC	Main West SH13-MCW	Sunset/Bolsa SH13-SH/BC	Sed. Trap SH13-ST	Waterline SH13-WLT	Main East SH13-MCE	LA-2	Refuge SH13-R		Salt ERL ³ / TEL ⁴	Salt ERM ³ / PEL ³	
SEDIMENT GRAIN SIZE													
Gravel (>2 mm)	%	0	0	0	0	0	0	0	0				
Very Coarse Sand (1 – 2 mm)	%	0	0	0	0	0	0	0	1.4				
Coarse Sand (0.5 – 2 mm)	%	8.2	0.29	0.34	1.8	0.06	0	0	7.4				
Medium Sand (0.25 – 0.5 mm)	%	17	2.9	5.4	6.7	4.6	3.5	0.58	8.1				
Fine Sand (0.125 – 0.25 mm)	%	34	28	12	8.6	18	13	19	11				
Very Fine Sand (0.0625 – 0.125 mm)	%	22	28	16	13	24	13	44	15				
Total Sand (0.0625 – 2 mm)	%	81	59	34	30	47	30	64	43				
Silt (0.00391 – 0.0625 mm)	%	15	43	51	54	30	54	30	53				
Clay (<0.00391 mm)	%	3.8	12	14	16	8.7	15	5.9	3.5				
SEDIMENT CONVENTIONALS													
Percent Solids	%	76	60.5	56.9	60.8	69.1	61.6	68	18.1				
Total Volatile Solids	%	0.6	1.4	2.8	3.2	1.6	2.9	1.2	4.2				
pH	pH Units	6.34	6.4	6.27	6.29	6.44	6.42	6.69	7.25				
Total Organic Carbon	%	0.32	0.84	1.5	2.2	0.75	2	0.74	9.3				
Oil and Grease	mg/kg dry	30	74	130	250	<11	160	20	170				
TRPH	mg/kg dry	133	26	58	110	<12	85	15	<45				
Total Ammonia	mg/kg dry	1.8	6	6.4	3.7	27	12	1.6	31				
Nitrate + Nitrite	mg/kg dry	0.433	0.483	0.503	0.90	0.693	0.323		<0.94	33.6			
Water Soluble Sulfides	mg/kg dry	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017	<0.017				
Acid Soluble Sulfides	mg/kg dry	58	220	490	660	41	420	<0.15	660				
Total Sulfides	mg/kg dry	900	1800	2500	2900	1200	2400	610	3000				
METALS													
Aluminum	mg/kg dry	6240	12200	17800	14200	14600	12500	9210	18100	36,271			
Antimony	mg/kg dry	0.07893	0.1243	0.2563	0.362	0.07123	0.2803	0.1383	<0.214				
Arsenic	mg/kg dry	2.39	4.26	4.88	4.01	4.48	4.5	2.04	6.85	15.38	8.2	70	
Beryllium	mg/kg dry	0.2183	0.503	0.66	0.561	0.593	0.51	0.2743	0.6343	2.11			
Cadmium	mg/kg dry	0.1103	0.366	0.762	0.717	0.335	0.772	0.2293	0.5803	2.22	1.2	9.6	
Chromium	mg/kg dry	11.2	20.8	30	24.4	23.9	22.5	24.7	28.9	46.24	81	370	
Cobalt	mg/kg dry	4.08	7.48	10.2	8.95	8.94	7.84	5.37	8.85				
Copper	mg/kg dry	10.5	32	70.7	57.8	27.7	58.6	12.3	42.0	39.04	34	270	
Lead	mg/kg dry	4.63	25.9	43.2	38.6	24.3	53.5	6.04	58.6	35.7	46.7	218	
Molybdenum	mg/kg dry	0.526	1.78	2.22	2.63	1.27	2.17	0.2583	9.54				
Mercury	mg/kg dry	<0.00783	0.02893	0.0566	0.0501	0.0308	0.053	0.01873	0.07243	0.30	0.15	0.71	
Nickel	mg/kg dry	7.15	13.8	19.6	17.4	16.1	15.8	13	22.6	32.49	20.9	51.6	
Selenium	mg/kg dry	<0.110	0.175	0.372	0.3113	0.159	0.419	0.319	1.003	0.44			
Silver	mg/kg dry	0.02743	0.1023	0.2153	0.2063	0.09023	0.2323	0.08303	<0.173		1	3.7	
Thallium	mg/kg dry	0.1463	0.2733	0.3023	0.2453	0.2873	0.2383	0.1773	0.2723				
Vanadium	mg/kg dry	20.3	36.6	50.8	42.9	43.4	39.1	27.7	57.6	85.95			
Zinc	mg/kg dry	44.4	110	222	215	94.1	231	51.5	172	177.17	150	410	2
BUTYLINS													
Dibutyltin	µg/kg dry	<0.86	27	61	65	<0.95	36	<0.96	<3.6				1
Monobutyltin	µg/kg dry	<0.86	<1.1	<1.1	<1.1	<0.95	<1.1	<0.96	<3.6				
Tetramethyltin	µg/kg dry	<1.0	<1.3	<1.4	<1.3	<1.1	<1.3	<1.1	<4.2				
Tributyltin	µg/kg dry	<0.76	<0.95	17	22	<0.83	9.3	<0.85	<3.1				1



Unknowns

Possible from a permitting standpoint? Never before attempted on west coast of US.

Possible from a funding standpoint? Thin layer placement much more expensive than open ocean disposal.



Grant Funding To Date	\$3,305,554
California State Coastal Conservancy	\$632,500
USFWS	
2015 Cooperative Recovery Initiative Grant	\$502,425
CDFW	
Wetland Restoration for GHG Reduction Grant Program	\$1,055,827
USACE	
Ecosystem Management and Restoration Research Program	\$50,252
Orange County Parks (in-kind)	\$1,064,550



U.S. Fish & Wildlife Service

Funding Partners

- U.S. Fish & Wildlife Service
- Orange County Parks
- California Coastal Conservancy
- CA Dept. of Fish & Wildlife - Greenhouse Gas Reduction Program
- USACE - Ecosystem Management & Restoration Research Program



US Army Corps
of Engineers

Research Partners

- USGS – Western Ecological Research Center, Karen Thorne, Ph.D.
- UCLA – Richard Ambrose, Ph.D. & Glen MacDonald, Ph.D.
- CSU Long Beach – Christine Whitcraft, Ph.D.
- Chapman University – Jason Keller, Ph.D.

Additional Partners

- Southwest Wetlands Interpretive Association
- Naval Weapons Station Seal Beach (Landowner)
- State Lands Commission (Landowner)
- Moffatt & Nichol (Engineering contractor)
- Curtin Maritime (Dredge contractor)



How thin is thin?

- *Spartina Alterniflora* studies - Reimold et al. (1978)
Spartina alterniflora stems can penetrate an overburden up to 23 cm/9" deep regardless of the sediment type.
- Historical elevation loss – Approx. 11.5" since 1960's (land subsidence and sea level rise)
- Cost for engineering and mobilization – placement on Refuge more expensive than open ocean disposal
- Augmentation site still within elevation growing range for *Spartina Foliosa* after 10"
- *Spartina Foliosa* sediment box experiment at Seal Beach NWR



U.S. Fish & Wildlife Service

Sediment Box Experiment





U.S. Fish & Wildlife Service

Sediment Pre-Tx Week 0 Week 8 Week 15 Week 22 Week 29 Week 36

depth
9 cm/3.5"

% Cover
Bare Ground
S. foliosa
S. pacifica



14 cm/5.5"

% Cover
Bare Ground
S. foliosa
S. pacifica



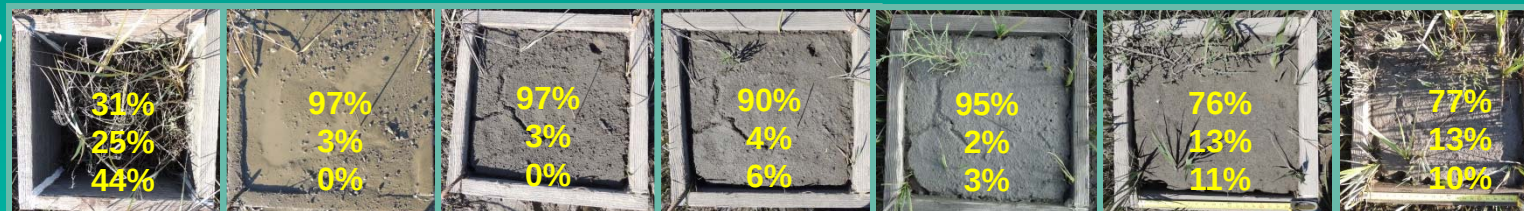
20 cm/7.9"

% Cover
Bare Ground
S. foliosa
S. pacifica



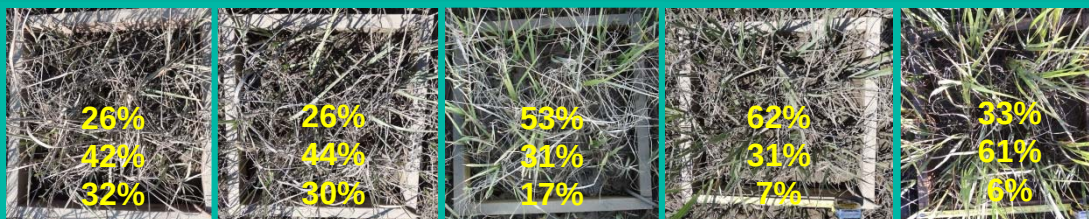
30 cm/11.8"

% Cover
Bare Ground
S. foliosa
S. pacifica



Control

% Cover
Bare Ground
S. foliosa
S. pacifica





U.S. Fish & Wildlife Service

Our goal – Apply
10” over 10 acres.
Test plots of 14”,
18”, and 22” depth.



U.S. Fish & Wildlife Service

Seal Beach

National Wildlife Refuge

Seal Beach NWR Salt Marsh Sediment Augmentation Project



MAP DATE: Mar 12, 2015
IMAGE SOURCE: US Navy
C:\Users\jlgilgan\Documents\Management\Files\ESRI\ESRDATA\Seal Beach Data\SealBeachSedimentAugmentationProject.mxd

Legend

- SBH_SedimentAugmentation_ProjectArea_201503012
- Eelgrass
- Seal Beach NWR Boundary





Project Goals

1. **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
2. **Light-footed Ridgway's rails & Migratory 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.
3. **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 over 10 acres during the application process.
4. **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.
5. **Carbon Sequestration** – Determine how the carbon storage capacity of the project site changes after sediment augmentation.



NEPA/CEQA and Permitting

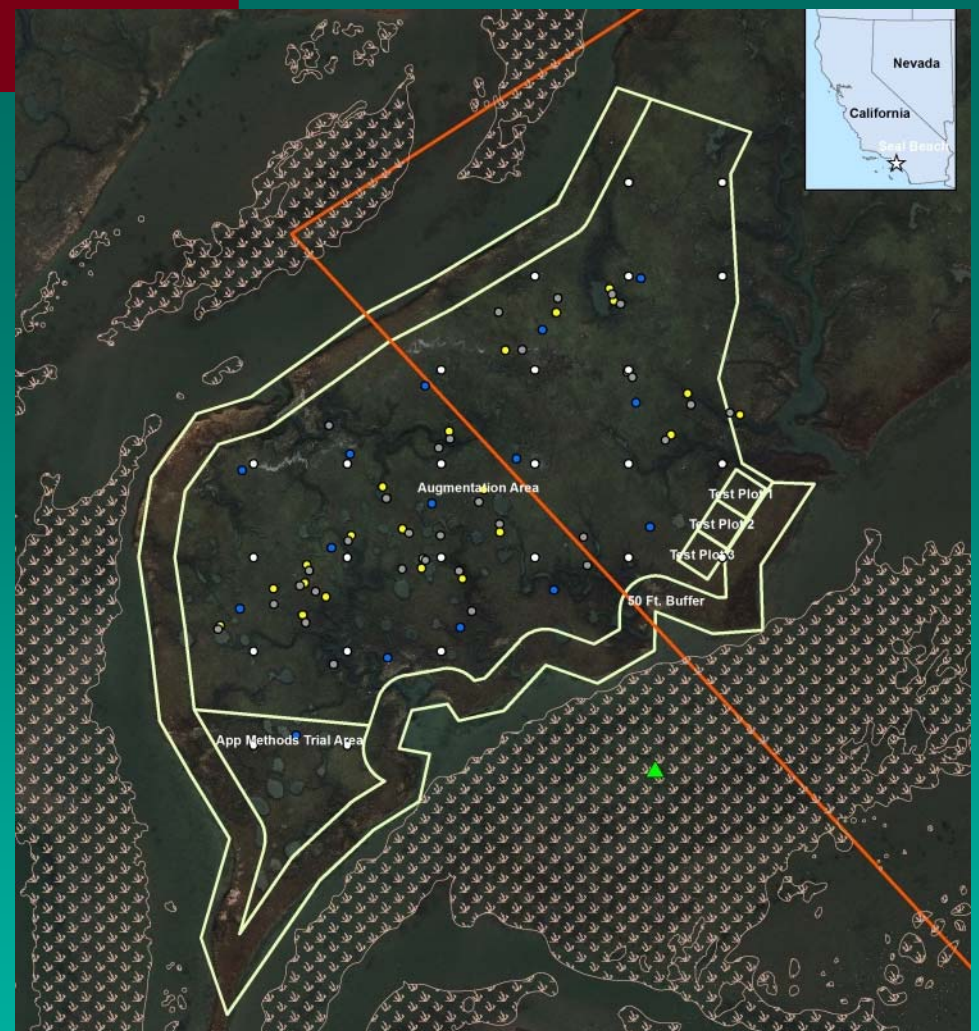
- EA/MND for Sediment Augmentation
- USACE Section 404 Compliance – Nationwide 27
- Section 7 (ESA) for USFWS and NMFS
- Essential Fish Habitat Assessment
- Section 106 Compliance (NHPA)
- RWQCB 401 Certification
- California Coastal Commission federal consistency determination
- California State Lands Commission lease agreement



U.S. Fish & Wildlife Service

Monitoring

Site elevations, sediment depth overtime, compaction rate, tidal creek reformation, vegetation % cover, species composition, biomass, cordgrass assessment, physiological plant conditions, invertebrate species composition, eelgrass health, rails activity, general avian surveys, and carbon sequestration studies



Pre-augmentation monitoring and 5-yr post augmentation monitoring



Statement of Work Development

- Engineering
- Thin layer POCs
- Creative thinking
- Key components of SOW
 - Application method.
 - Standards for sediment depth variability.
 - How to measure sediment depths and verify contractors work?
 - Payment method based on estimated volume of sediment required.
 - Navy small arms range scheduling restrictions.
 - Biological monitoring.
 - Biological mitigation and impact avoidance measures.
- Sediment placement plan to be submitted by contractor.
- Pre-bid meeting
- Bids for project were highly variable.



Construction Phase Biological Monitoring and Mitigation Measures

- Bio-monitor on site during construction activities
- Relocation of rail nesting platforms within augmentation area
- Eelgrass surveys (pre, 1 year, 2 year) and eelgrass impact avoidance
- Turbidity monitoring
- Hazing of birds off project site – noise and physical presence
- Patrols of pipeline to ensure adequate sea turtle passage
- Monitoring of marine mammals near dredge and pipeline
- Sequencing of spray areas
- In-water silt curtains for dredge operations
- Silt barriers on augmentation site
- Vegetated “Buffer zone” of 50 ft. from waters edge
- Height of poles and silt barrier limited so as to avoid predator perching opportunities after construction phase



Data Dissemination/Outreach of Project Results

Issue post-construction monitoring reports annually

Develop a webpage to provide quarterly updates, photos, & time lapse video

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 long term sustainability of Pacific coast marshes.



For further information contact:

Kirk Gilligan

Refuge Manager – Seal Beach NWR

kirk_gilligan@fws.gov

562-598-1024

Or

Vicki Touchstone

Refuge Planner – San Diego NWR Complex

victoria_touchstone@fws.gov

619-476-9150 Ext. 103