

ADVANCING DREDGING AND INNOVATIVE BENEFICIAL USE PRACTICES FOR MORE RESILIENT SYSTEMS

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AND THE TEAM!



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Government Dredge Merritt working near Ring Island



New Jersey Intracoastal Waterway
Maintenance Dredging with Sturgeon
Island Beneficial Use Placement



“A Partnership for our Planet”



- **Persist, Innovate, Challenge, Advance, Evolve**
- A Collaborative Approach: *Working Together through the Regional Sediment Management and Engineering with Nature Programs*
- Illustrated Success: *Innovative Navigation Dredging and Placement Projects in New Jersey*
- Building Momentum: *Evolving the Practice for Dredging and Natural Infrastructure to Improve Resilient Systems*



USACE Navigation Mission



- Nationally, USACE dredges 200 to 300 Million cubic yards annually. Over 5 Billion cubic yards over the last 25 years
- Philly District maintains federal channels, including the Delaware River & Bay, coastal channels through 4 tidal inlets and **the 117-mile New Jersey Intracoastal Waterway**
- In order to dredge, USACE needs:
 - Authorization (law)
 - Appropriation (\$\$)
 - Placement Area (State)
 - Federal Standard
- Navigation O&M is fast time scale
- Chief's Goal of 70% BU by 2030!





Regional Sediment Management (RSM)



A systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable, resilient water resource projects, environments, and communities
= *Healthy Systems*

Navigation/ Dredging



Flood Risk Management



Environmental Restoration



RSM Operating Principles

- Recognize sediment as a regional resource; SEDIMENT AS AN ASSET
- Balanced, economically viable, environmentally sustainable solutions
- Improve economic performance by linking multiple projects
- Optimize operational efficiencies & natural exchange of sediments
- Consider local & regional impacts (physical, environmental, social)

Partnership with USACE's Engineering Research and Development Center (ERDC)

ENGINEERING WITH NATURE

USACE Proving Grounds

Proving Grounds identify opportunities to implement EWN across current and future programs and projects and with other agencies

- Galveston District
- Buffalo District
- **Philadelphia District (2016)**
- Mobile District
- San Francisco District
- St. Louis District
- South Pacific Division



...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration

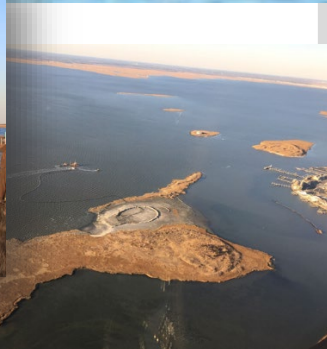
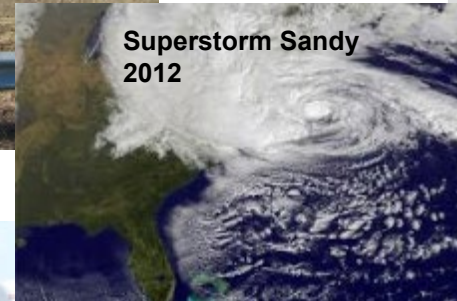
A “Persistent” Approach Navigation and Nature

▪ “Sediment is the currency of marsh ecosystems” ~
Dr. Lenore Tedesco, The Wetlands Institute

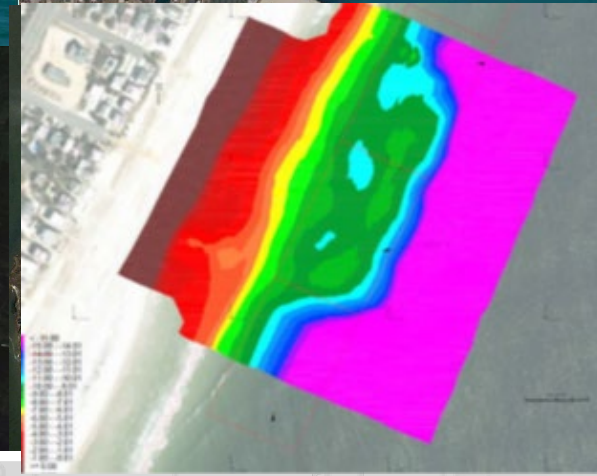
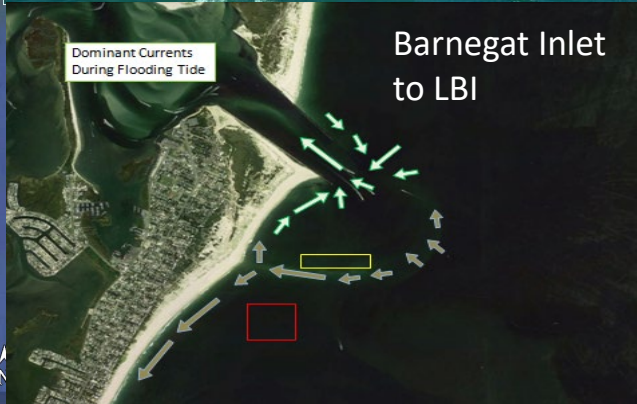
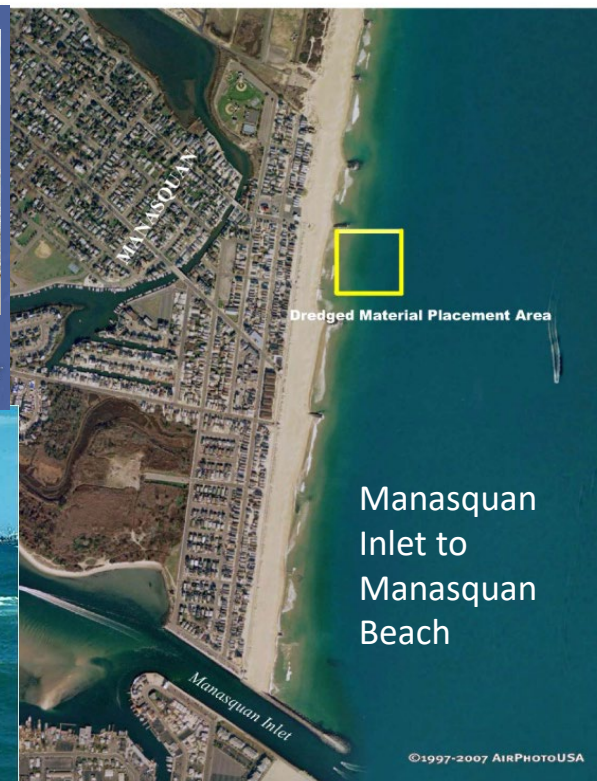
▪ USACE is perhaps the largest national “sediment broker” due to navigation mission and dredging

Challenge to Change

- How can we improve our stewardship of that clean sediment “currency” and improve system resilience?
- Need to challenge our thinking & continue to evolve benefits in progression from *caution and risk-averse* to being cost-effective, proactive & innovative
- Planning, Design, Permitting, Construction, Monitoring, Adaptive Management
- RSM and EWN Programs have and continue to support evolving principles and practices for sediment management and NNBF

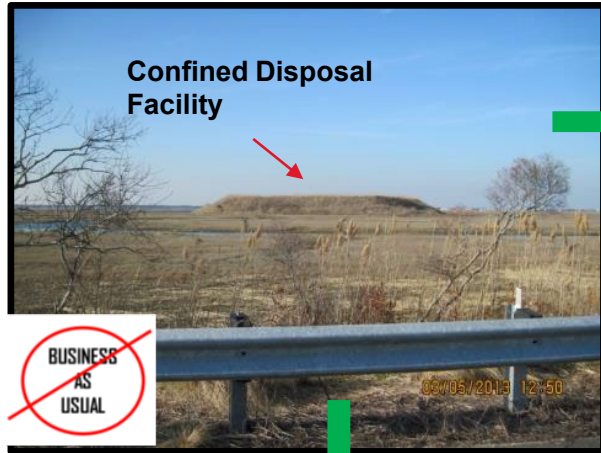


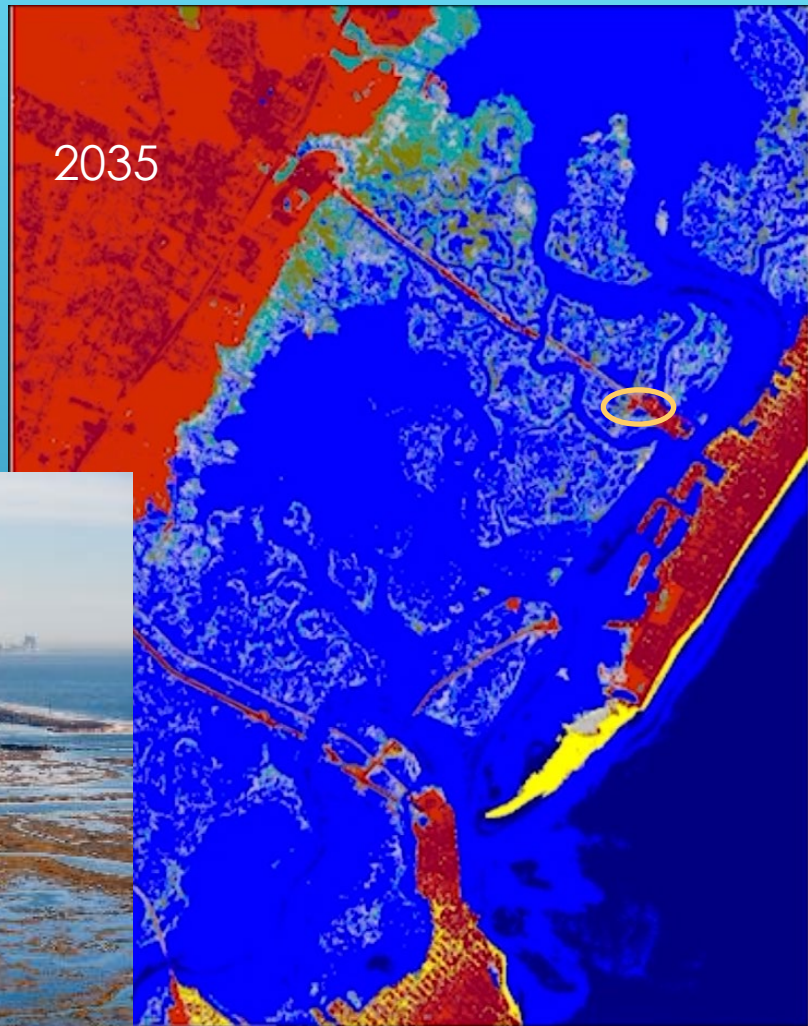
Navigation Channels With Nearshore Nourishment





A Sediment Progression: From Confinement To Natural Infrastructure





HIGH TIDE FLOODING (MHW SLAMM) AND COASTAL RESILIENCE



Some Operational Lessons Learned



- ***Sediment Testing & Constructability*** up front!
- Project driver is dredging
- Strong ***“Purpose and Need”*** Statement is critical including Systems Approach and Resilience
- Cohesive sediments aren't bad!
- ***Don't Over-Engineer***
- ***Adaptive management and flexibility are key*** during construction and contract implementation
- ***Specialized Experience*** requirements in contract solicitations, maybe RFP Best Value Approach
- ***Safety!***
 - Winter vs environmental windows
 - Pipe moves can't be overdesigned

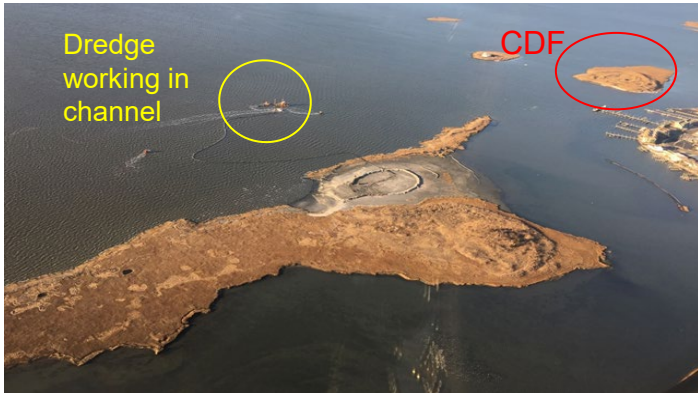




Pilots After Hurricane Sandy: EWN in NJ Back Bays



**Mordecai Island Restoration
Beach Haven NJ
(2015 and 2017)**



**“Thin” Layer Placement
(Sediment Enrichment)
Avalon NJ
(2014 and 2016)**



**Elevated Habitat
& TLP
Ring Island NJ
(2014 and 2018)**



Now Back to CDFs??



NJ Intracoastal Waterway Avalon Pilot Project: Dredging “The Football Field” and Thin-Layer Placement



- Constructed in two phases: Dec 2014 and Winter 2015/16
- Thin Layer Placement & filling pools
- Fine-grained material 55,000 cy on 50 acres
- Lessons learned document by NFWF Team and Thin Layer Placement Design Guidance by ERDC in preparation
- *Multiple ERDC work units support project*



Avalon Coir Log
Containment



Don't Over Engineer
Don't Over Contain
Let Nature Do the Work!

Gull Island vs. Avalon Marsh Enhancement Techniques



Photo credit: Jim Wright/LightHawk/TNC



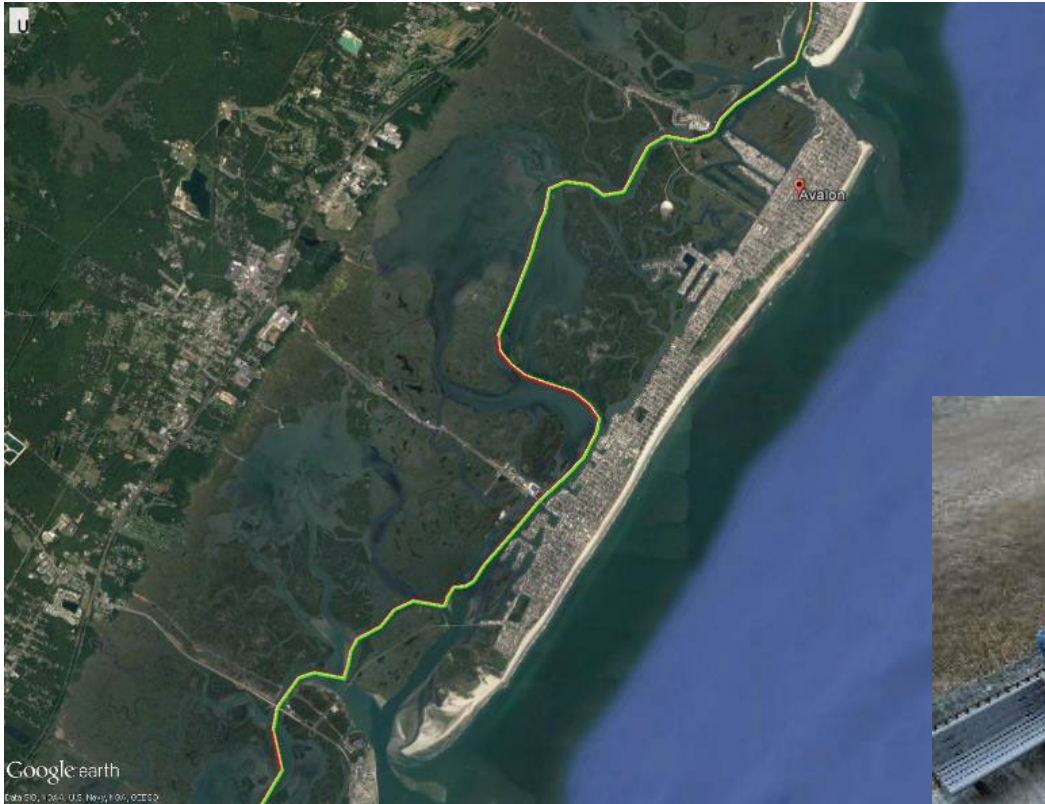
BUILDING MOMENTUM: EVOLVING FROM PILOTS TO SOLUTIONS THROUGH THE SEVEN MILE ISLAND INNOVATION LAB





Seven Mile Island Innovation Laboratory

Established 2019



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Inspired by the Dutch



Fine sediment: from waste to resource

Throughout the world, different coasts, shores, lakes and rivers have to deal with excess sediment or sediment shortages. The natural balance between the removal and deposition of sediment is disrupted by human interventions such as dams in a river or ports in an estuary. As a result, sediment doesn't reach places where it is needed and too much accumulates in other locations. Ecosystems are affected and life becomes difficult for plants and animals. People are also pressured, for example in terms of food supplies, ports and leisure activities.

<https://www.ecoshape.org/en/projects/living-lab-mud>

Seven Mile Island Innovation Lab Background

- Established in 2019 as partnership between **USACE, NJDEP and TWI**
- **A Proving Ground** using Natural and Nature-Based Features to provide ecological uplift and enhanced resilience for ecosystems and coastal communities
- **Test Bed** to advance and improve dredging techniques and marsh restoration and coastal feature creation techniques with **mixed sediment** types
- 24 sq mi **Back Bay Marsh Dominated System** with shallow bays, sounds and tidal inlets bisected by the NJ Intracoastal Waterway
- 50+ Member **Working Group** for knowledge sharing
- More than **30** Scientists Working in SMIL
- Publications, presentations, fact sheets **shared** on TWI and USACE Websites



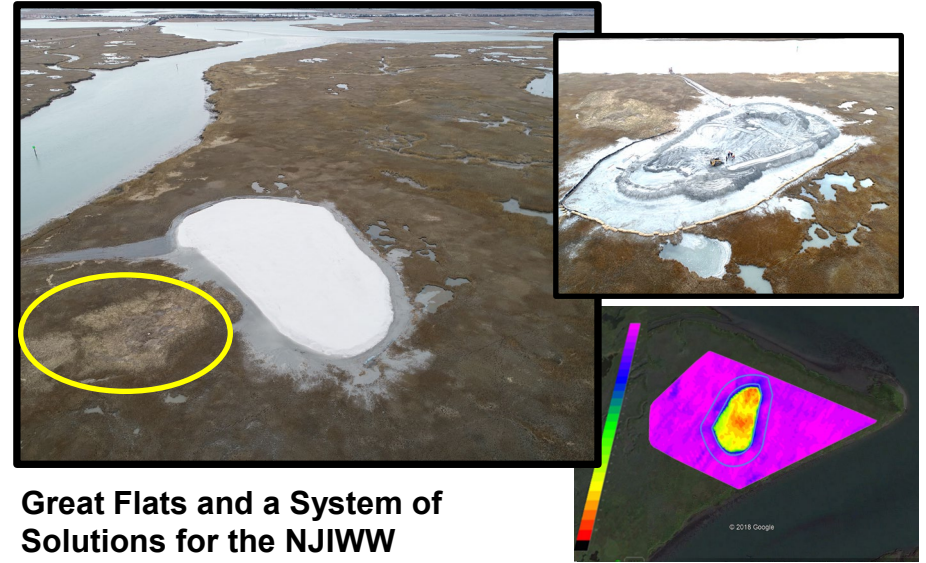


Advancing Dredging & Placement Techniques in SMILL

Learning from the Past, Innovating Now and Evolving to the Future



The Original Pilots & Beyond



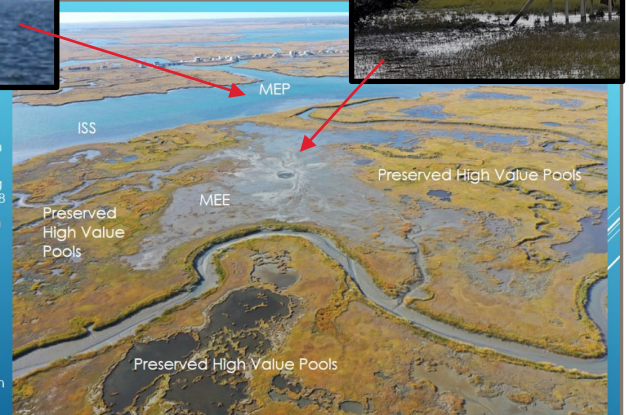
Taking it to the Next Level at Gull and Sturgeon Islands



Landscape Approach at Gull Island, RSM/EWN!



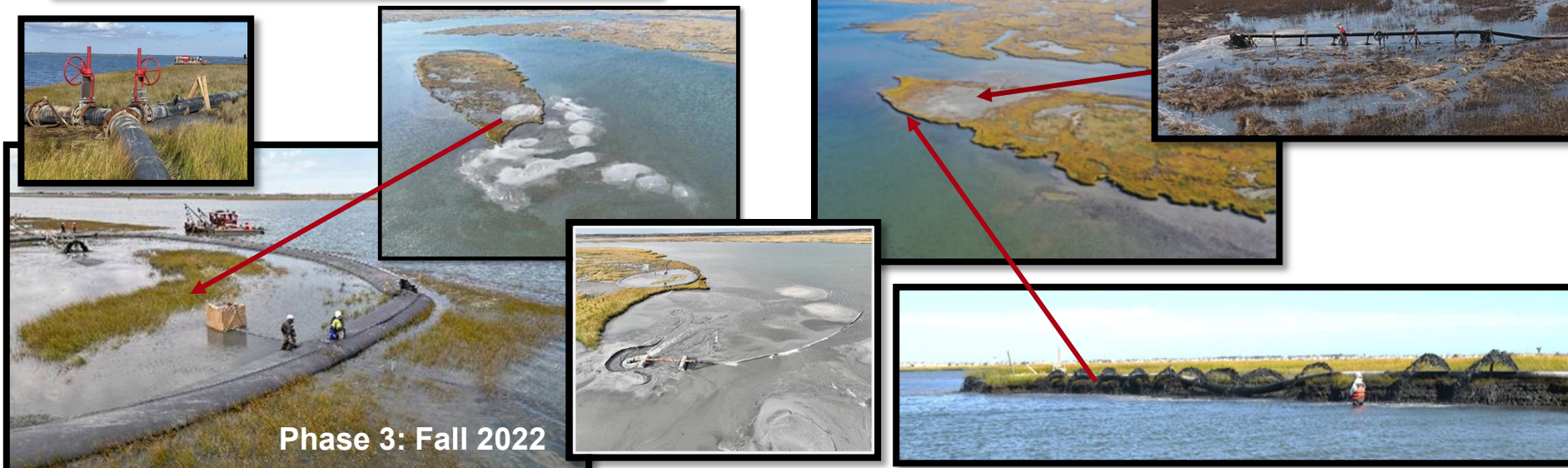
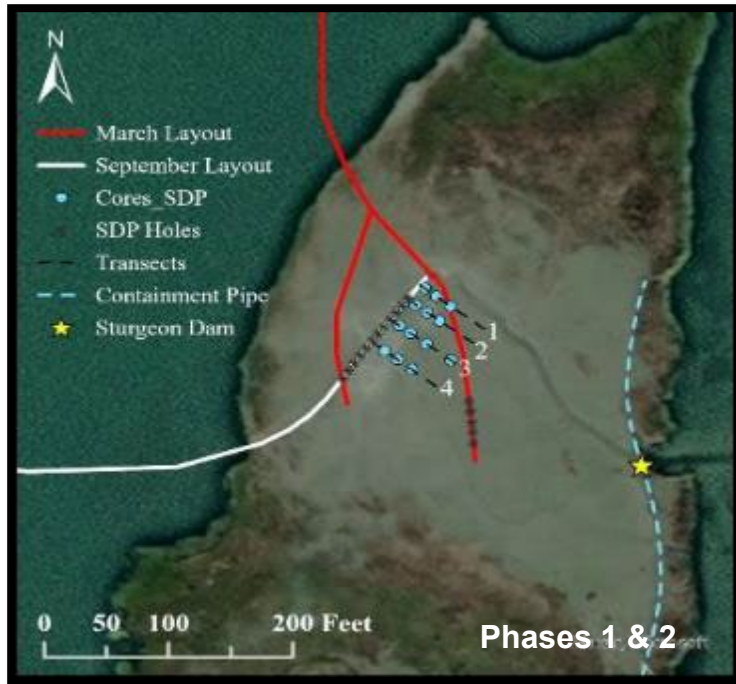
- Marsh Elevation Enhancement (MEE)
 - 21 acres of elevation lift
 - 3.9' NAVD88 grading down to 1.8' NAVD88
- Marsh Edge Protection (MEP)
 - Built to marsh edge (2.0' NAVD88) grading down to MLLW
- Enhanced Intertidal Shallows (ISS)
 - Shallowed up to MLLW along southern island flank



INITIAL ASSESSMENT GULL ISLAND PROJECTS

Partnering and Advancing Techniques at Sturgeon Island, NJ

Elevation Enhancement, Marsh Edge Protection, & Intertidal Shallows and Flats



WORKING ON PHASE 4 OF ELEVATION ENHANCEMENT



2020 UAV Orthomosaic

2021 UAV Orthomosaic

2022 UAV Orthomosaic

2023 UAV Orthomosaic



STURGEON ISLAND

Slide courtesy of The Wetlands Institute & University of Penn

MULTIHABITAT UNCONFINED PLACEMENT: GULL ISLAND



- 22 acres of marsh elevation enhancement by up to 2'
- Unconfined placement of 40,000 cubic yards of fine-grained sediments
- Natural flow paths spread material over large portion of placement area
- Lack of containment allowed for tidal connection to establish quickly
- Resulted in habitat mosaic at higher elevations to offset SLR elevation losses
- Excellent *Spartina* recovery and expansion by seedbank



NATURAL VEGETATION RECRUITMENT: GULL ISLAND

2020-11-04

View W Point 2



2021-07-12



2021-09-12



2022-08-02

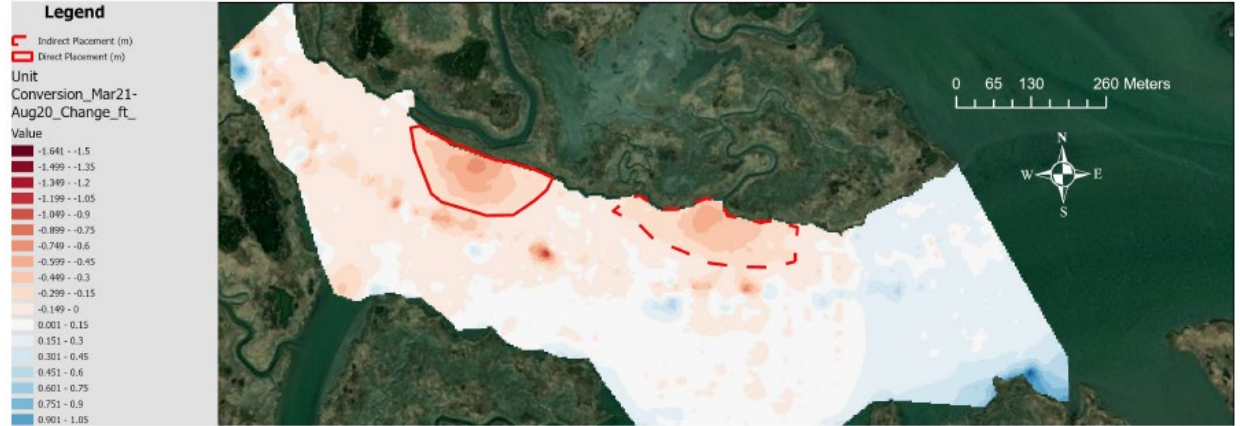


MARSH EDGE PROTECTION WITH MIXED SEDIMENT: GULL ISLAND

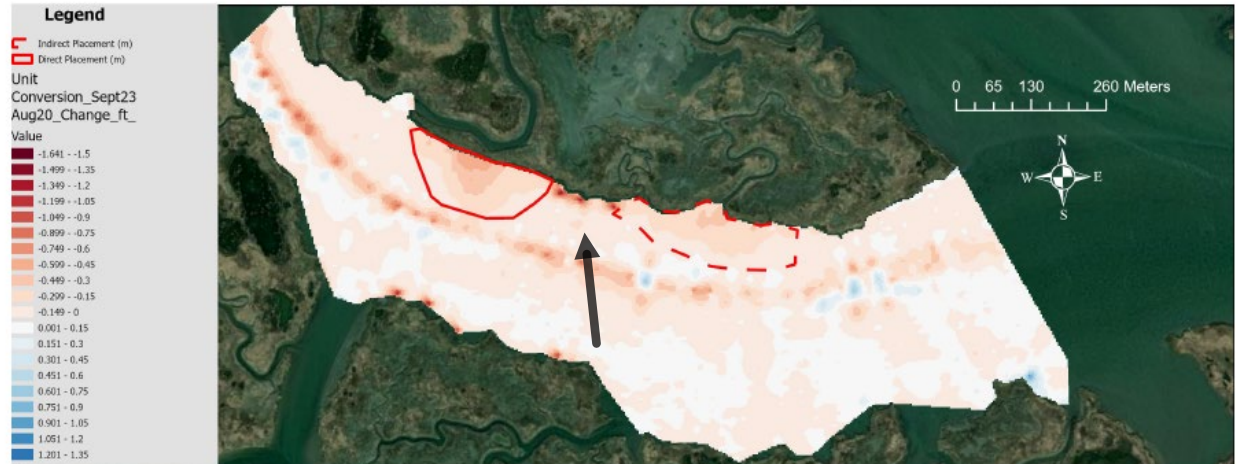


- ▶ Placed fine-grained sediment (59-73%) in each feature and gained 1 – 2.5' of elevation along marsh edge
- ▶ More than **90%** of directly placed material was accounted for in berm 6 mos post-placement without containment
- ▶ Features show 30-40% reduction in volume after 36 months
- ▶ Turbidity plume was localized, only marginally more than storms, and returned to background within 1 week

Bathymetry Change Aug 2020 to March 2021



Bathymetry Change Aug 2020 to Sept 2023



MARSH EDGE PROTECTION SUCCESS: GULL ISLAND



November 2022

- ▶ Marsh edge collapse occurring away from protection feature
- ▶ No block failure in areas of berms
- ▶ Next project at Ring Island in Fall 2024 and maybe back to Gull in 2025

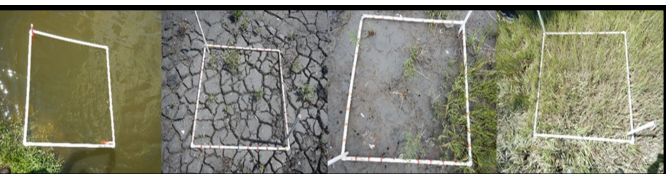
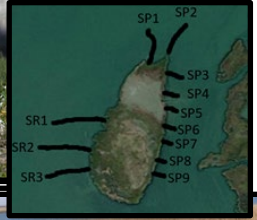


June 2022



Importance of Monitoring & Research in SMIL

USACE, State of NJ, TWI, UPENN, BC, USNA & Others





Monitoring & Research in the Seven Mile Island Innovation Lab



Marsh Vegetation Surveys	ERDC: Piercy/Russ
Hydrodynamic and Suspended Sediment within the SMIIIL	ERDC: ERDC/CHL TR-21-9, Fall, Perkey, Tyler and Welp
Gull-Sturgeon Turbidity	ERDC: Fall, et al., 2022, WEDA Journal of Dredging, Volume 20, No. 1 ERDC: Perkey, et al., in press, Frontiers of Science paper.
Sediment Distribution Pipe: Sturgeon-Gull	ERDC: Beardsley, et al., WEDA Journal of Dredging, Volume 20, No. 1 ERDC: Perkey, et al., 2024, ERDC/CHL TR-24-1
Sturgeon/Gull Sediments/Consolidation	ERDC: Harris, et al., 2024, Proceedings of Geo-Congress, ASCE
GCM Observations & Model Development	ERDC: Perkey/Fall
Sediment/Vegetation Interactions	ERDC: J. Smith/Ramirez
Vessel Wake Impacts on Marshes	ERDC: Priestas/Styles/Bain
Macroalgae/Benthic Surveys	ERDC: Altman/Balazik/Reine
Water Quality and Hydrodynamic Modeling	ERDC: Kim/Ding
Remote Sensing & EWN Landscape Architecture Applications	Univ of Pennsylvania: Burkholder & Van Der Sys
Monitoring and Adaptive Management of Elevated Nesting Habitats	The Wetlands Institute, NJ Fish & Wildlife
Monitoring and Adaptive Management of Gull and Sturgeon Islands	The Wetlands Institute, NJ Fish and Wildlife
Community Engagement Using Mental Modeling	ERDC: Thorne, et al., ERDC TR-22-12
Bathy/Topo/Currents/Sediments/Remote Sensing	USACE Philadelphia
Varied University Research	Univ of Penn, Boston College, Texas State, Louisiana State, Stevens, Univ of Washington, Stockton, Villanova, US Naval Academy



Government Dredge Merritt in SMIL: Sept 2023 Keeping Sediment in the System





Government Dredge Merritt in SMIL: Sept 2023





NJIWW Dredging & Scotch Bonnet Placement 25,000 cy in Fall/Winter 2024



Restoring low marsh in WMA for avian and terrapin habitats, use of coir logs & Y-valve, permitted for multiple lifts over time, complements larger NJDEP/TWI grant project

SMIIL TAKE HOME MESSAGES: WHAT HAVE WE LEARNED (SO FAR)

- ▶ Tidal marshes in significant areas of New Jersey have fallen behind rising seas and will benefit from elevation enhancement via sediment inputs.
 - ▶ Balance **short-term** impact with **long-term** benefits
 - ▶ Balance placing in **thin** layers to preserve existing vegetation (rare) **vs thicker** placement for more ecological uplift and comparable recovery time
- ▶ **Unconfined sediment placement** enables natural process to distribute sediments more effectively and can result in better outcomes when “**keeping sediment in the system**”.
 - ▶ Creates more natural marsh gradient and habitat mosaic
 - ▶ Allows for maintenance or rapid establishment of tidal exchange
- ▶ **Fine-grained sediments** build vertically and are deposited locally to much higher extent than is commonly believed
- ▶ **Building elevation may require multiple lifts** and if elevation is notably above surrounding marsh may require **containment** during construction
- ▶ **Vegetation recovery** does not appear to be related to placement thickness but rather appropriate elevations for flood frequency
 - ▶ Benchmark elevations are likely relict and underrepresenting target elevations
- ▶ **Marsh edge loss** is occurring at rapid rates in many areas and needs to be addressed along with marsh interior enhancements
- ▶ It is possible to build subtidal to intertidal berms in the near marsh environment that:
 - ▶ Have limited turbidity effects and benthic community impact
 - ▶ Provide marsh edge protection



SMIIL Overview References



- Chasten, M., Tedesco, L. and Kopkash, G. (2022). “Advancing Sediment Solutions in the Seven Mile Island Innovation Laboratory,” *Proceedings, 37th International Conference on Coastal Engineering*, Sydney, Australia, (37), 64-64.
- Chasten, M., Tedesco, L. and Kopkash, G. (2023). “Seven Mile Island Innovation Laboratory: Advancing Beneficial Use Practices to Support Coastal System Resilience,” *Proceedings, Coastal Sediments 23*, New Orleans, LA, 2040-2047.
- Chasten, M.A., Tedesco, L.P, and Perkey, D.W., (in press). “Advancing Dredging and Beneficial Use Practices Through the Seven Mile Island Innovation Laboratory,” *Proceedings of the Western Dredging Association Dredging Summit & Expo ‘24*, Tampa, FL, USA, June 24-27, 2024.

- Additional Info and Fact Sheets:

<https://www.nap.usace.army.mil/Missions/Civil-Works/Coastal-Dredging-Beneficial-Use/>

<https://wetlandsinstitute.org/smiil/>



SCALING UP & OVER

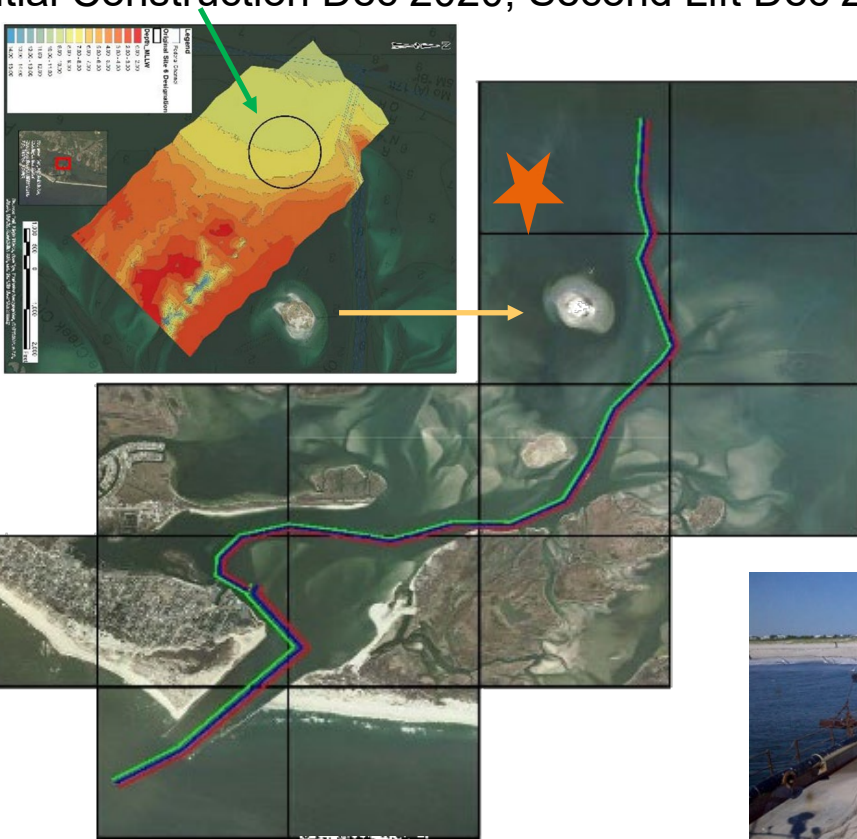


WRDA 2016 Section 1122 PILOT PROGRAM

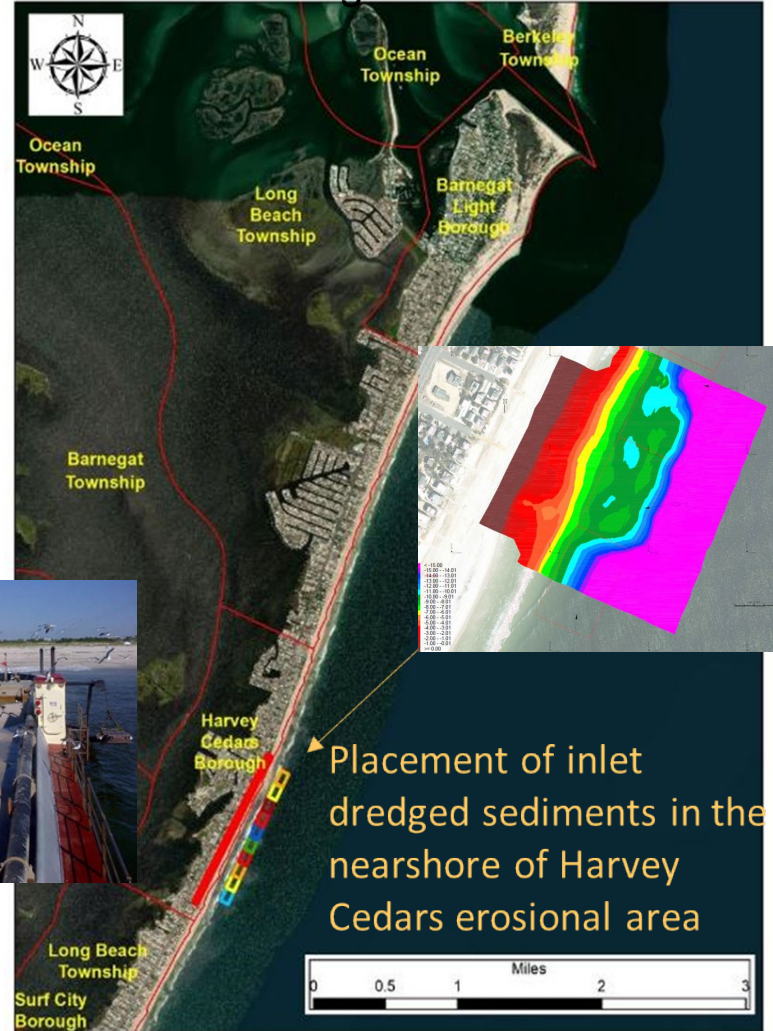
Beneficial Use Placement Opportunities in NJ Using Navigation Channel Sediments: Barnegat Inlet



Phase 1: "Intentional" Island Creation in Bay:
Initial Construction Dec 2020, Second Lift Dec 2022



Phase 2: Nearshore Placement:
Constructed Aug 2021



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Creating the New Island in Barnegat Bay

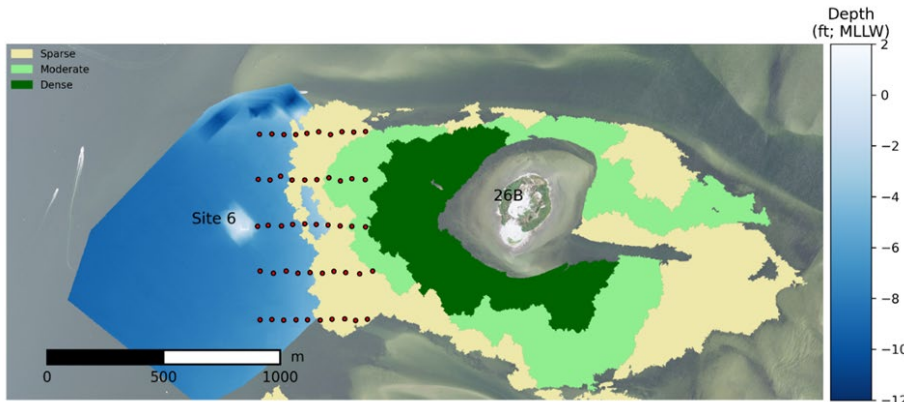


- Lift 1: Approximately 14,000 cu yds of predominantly fine sandy material from Oyster Creek federal channel placed in Dec 2020
- Lift 2: Additional 10,000 cubic yds placed in December 2022
- Lift 3: Additional 22,000 cu yd planned for August 2024

Contractor: Barnegat Bay Dredging Company, Harvey Cedars, NJ using 14-inch Dredge Fullerton



Monitoring, Evaluating Evolution and Optimizing Island Creation in Barnegat Bay



ERDC/TN EWN-23-1
Dredged Material Can Benefit Submerged Aquatic Vegetation (SAV) Habitats,
Russ, et al, Aug 2023

ADDITIONAL ERDC TECH NOTE in review,
“Beneficial Use of Dredged Material for Submerged Aquatic Vegetation Habitats: Overcoming challenges and seeking new opportunities,” Russ, et al , 2024

NEW R&D WORK UNIT: Identifying opportunities and guidance for Beneficial Use of Dredged Material (BUDM) to promote long-term SAV

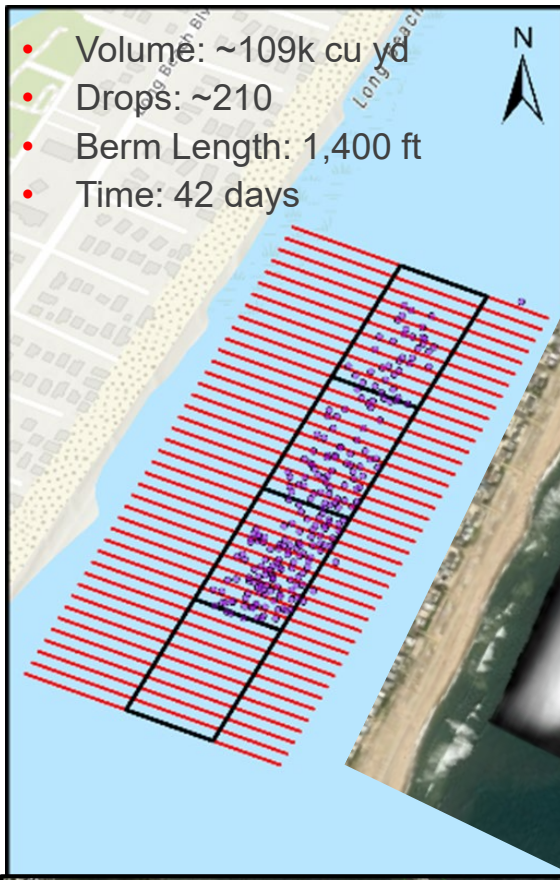
PROJECT PLACEMENT AND MONITORING REPORT: Beneficial Use of Dredged Material for Island Creation at Site 6, Oyster Creek Channel Barnegat Inlet Federal Navigation Project, USACE Philadelphia District, December 2023



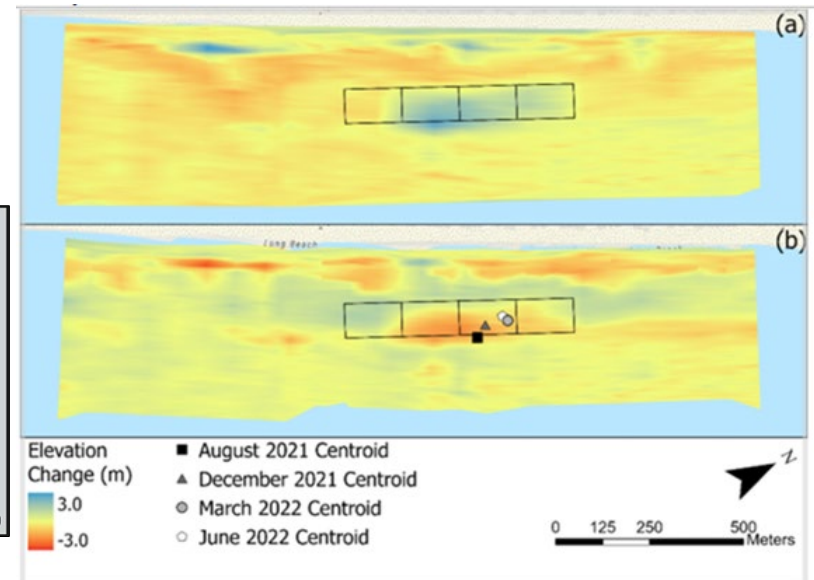
Next Lift of Island in August 2024



Regional Sediment Management: Monitoring the Harvey Cedars Placement



McGill, S. et al., "Morphological Analysis of a Nearshore Nourishment along the Atlantic Coast of New Jersey, USA," *J. Mar. Sci. Eng.* 2022, 10, 1622.





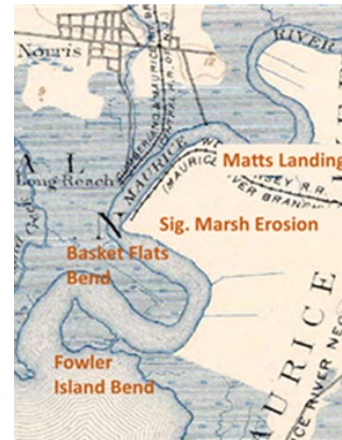
Maurice River NJ



Channel Dredging & Placement (Dec 2023)

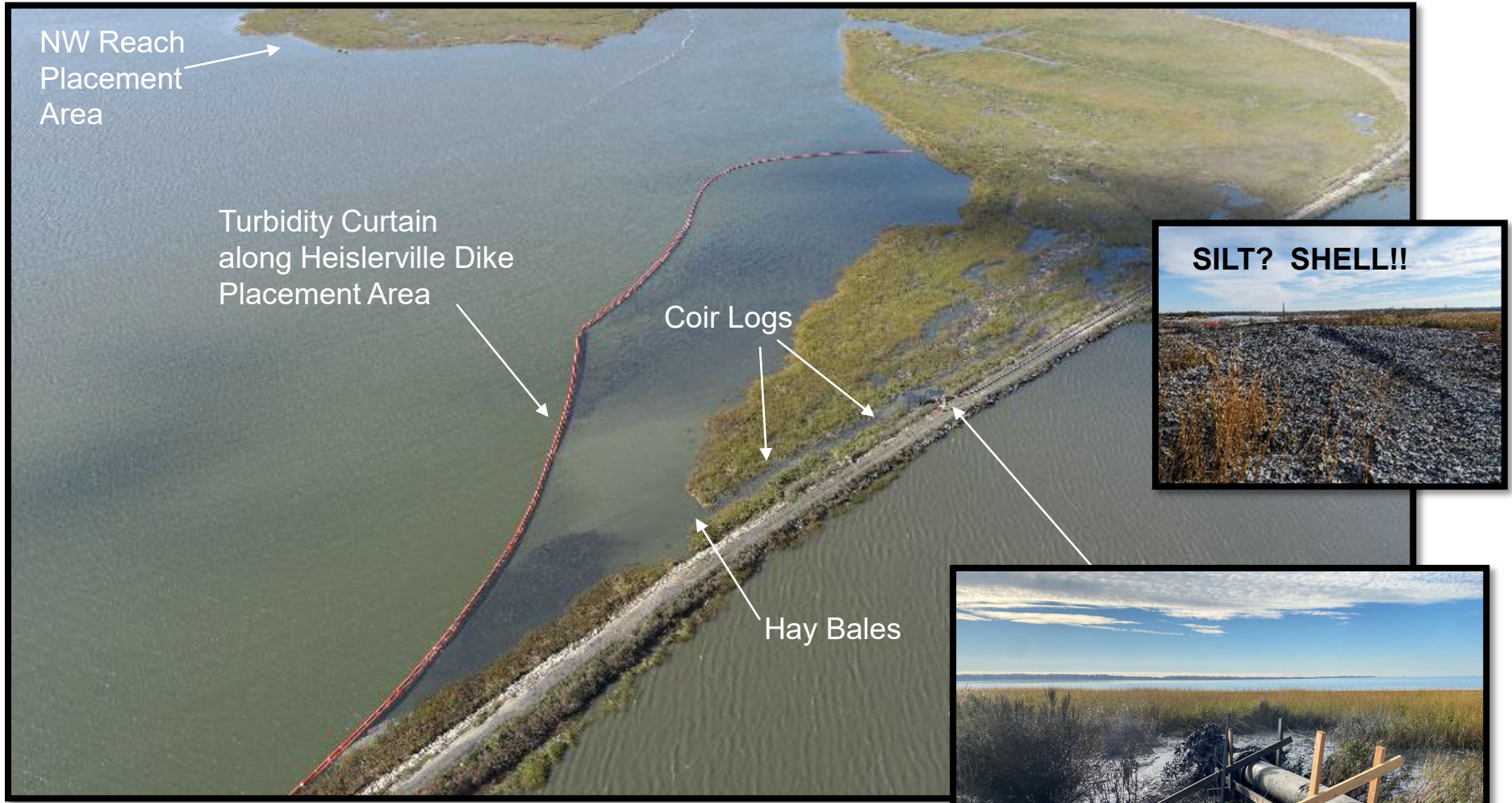


- Previous dredging in 1925 and 1996
- 1996 dredging **DISPOSED** of material in Cape May CDF while region is experiencing devastating erosion
- Contract to dredge channel and beneficially place material in partnership with NJDEP in Heislerville Wildlife Management Area, 100% BUDM NOW!
- **PLANNED** Approx 70,000 cy of fine-grained sediment to be dredged to support a struggling economy
- Changing practice with a new twist in this Delaware Bay community: EWN, UPENN Landscape Architects and SMILL knowledge





Maurice River Dredging & Placement TRUSTED Partnerships & Adaptive Management

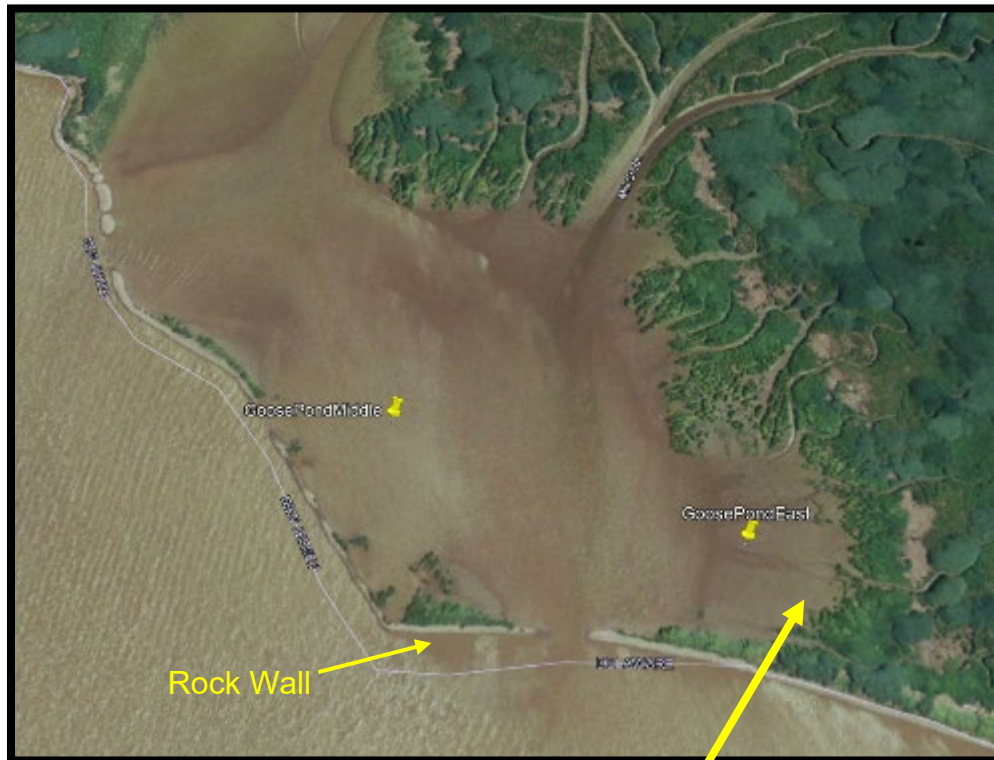


Approximately 75,000 cubic yards of mixed sediments with BU in State Wildlife Management Area, clearing a channel that has only been dredged twice in 100 years (completed December 2023)





Salem River Dredging with BUDM at Supawna Meadows National Wildlife Refuge



LOCATION: Salem County, NJ

CONTRACTOR: Cottrell Dredging

DREDGE TYPE: Pipeline

PLACEMENT: Beneficial Use to restore marsh using wye-valve and unconfined

QUANTITY: ~200,000 Cu Yd

DEPTH: 16' + 1' Allowable OD

CONTRACT TYPE: RFP Best Value

CONSTRUCTION: July to Sept 2024

SEDIMENT TYPE: Silt

PROJECT PARTNERS: USFWS, Ducks Unlimited, EA Engineering



Advancing Practice for Coastal Resilience

Rapid Progress in 10 Years! But more work to do.....

- **Momentum to embrace change; status quo no longer an option given climate change and the need to improve resilient systems**
- USACE has goal progression of 25% (pre-Sandy) to 60% (post-Sandy) to 100% **beneficial use of clean channel sediments** in coastal NJ, setting bar high!
- Increasing BUDM in larger nav channels is important to sustain Chief's 70% goal; ***small successes lead to larger actions***
- Importance of **Trusted Partnerships** are key for long-term Sustainability
- Work with cross-disciplinary teams and ***industry*** to improve designs, constructability and cost efficiency
- **Importance of monitoring** and leveraging with R&D to develop technologies, guidance, collaboration and knowledge/data management
- **Adaptive management** to manage risk are key in dynamic coastal system