

ADVANCING SEDIMENT SOLUTIONS IN THE SEVEN MILE ISLAND INNOVATION LAB

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US Army Corps
of Engineers®



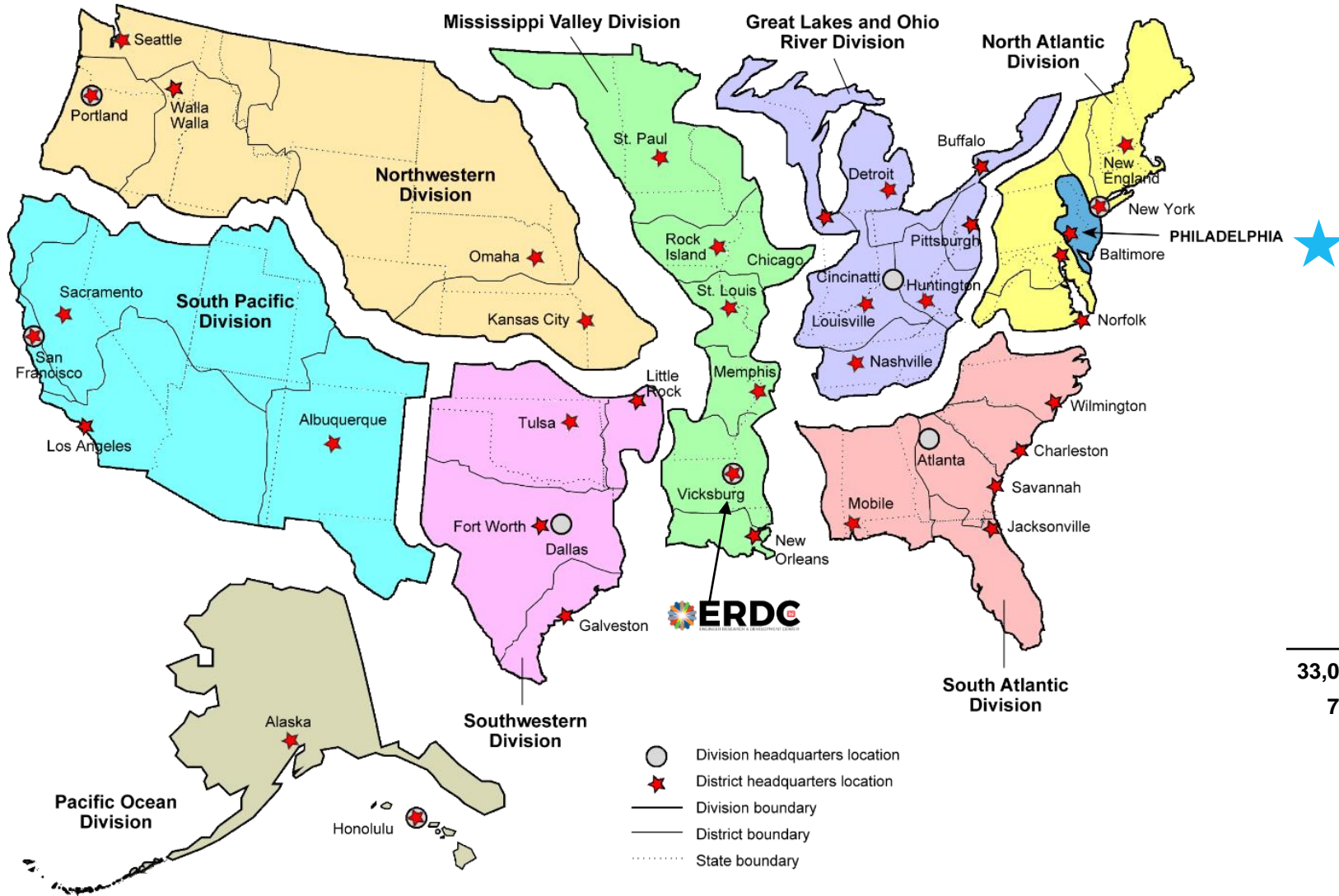


“A Partnership for our Planet”

- Persist, Innovate, Challenge, Advance, Evolve
- Illustrated Success: *Innovative Navigation Dredging and Placement Projects in New Jersey, USA*
- Research & Development Collaboration: *Engineering with Nature and Regional Sediment Management Programs*
- Building Momentum: *Evolving Practices and Scaling Up from Pilots to Solutions through the Seven Mile Island Innovation Lab (SMIIL)*



THE U.S. ARMY CORPS OF ENGINEERS (USACE)



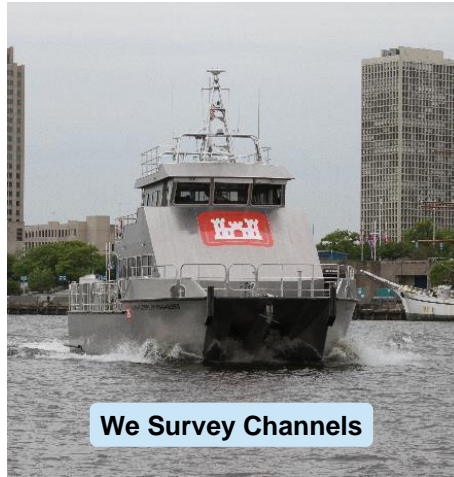
Overseas
 Far East District
 Japan District
 Europe District
 Middle East District
 Afghanistan District

9 Divisions
43 Districts
9 Centers & Labs
1 Active Duty Unit
2 USAR Engineer Commands

33,000 Army Civilians
700 Military



U.S. Army Corps of Engineers Navigation Mission



NJ Intracoastal Waterway (North terminus)

NJIWW (South terminus)

And we PLACE Dredged Channel Sediments!

Nationally, the U.S. Army Corps of Engineers dredges between 150 and 225 Million cubic meters of sediment annually. Over 4 Billion cubic meters over the last 25 years



Philosophical Approach



- **“Sediment is the currency of marsh ecosystems”**
~ Dr. Lenore Tedesco, The Wetlands Institute
- The US Army Corps of Engineers is perhaps the largest national “sediment broker” due to navigation mission and dredging (we have the currency!)

Challenge to Change

- Can we improve our stewardship of that sediment “currency” and optimize system resilience?
- Need to challenge our thinking and continue to evolve benefits in progression from caution and risk-aversed *to* cost-effective, proactive and innovative
- And improve Design, Permitting, Construction, Monitoring, Adaptive Management, Predictability(?)



State endangered Black Skimmer at newly created habitat from dredged sediment, Ring Island, NJ





Beneficial Use of Dredged Material in USACE



- **70% Beneficial Use of Dredged Material** from USACE Channels is a new goal described by General Scott Spellmon, Chief of Engineers and Commanding General of USACE
- USACE Philadelphia District maintains federal channels, including the Delaware River & Bay, coastal inlets, and the 188-km long New Jersey Intracoastal Waterway
- Progression from 25% (pre-Sandy) to 60% (post-Sandy) to goal of **100% beneficial use** of CLEAN channel sediments in coastal NJ, setting the bar high!
- Navigation O&M is fast time scale!

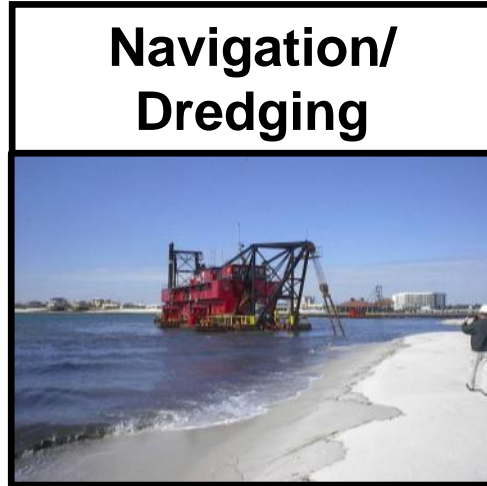




Regional Sediment Management (RSM)



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***



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®

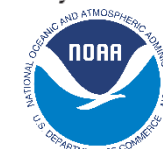
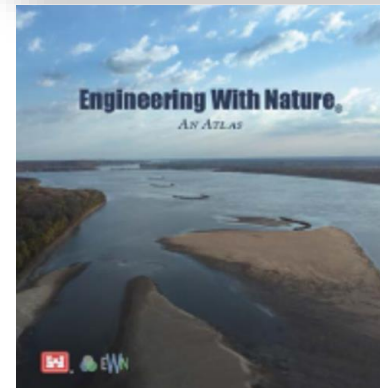
...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaborative processes.

Key Elements:

- Science and engineering that produces operational efficiencies
- Using natural process to maximum benefit
- Broaden and extend the benefits provided by projects
- Science-based collaborative processes to organize and focus interests, stakeholders, and partners



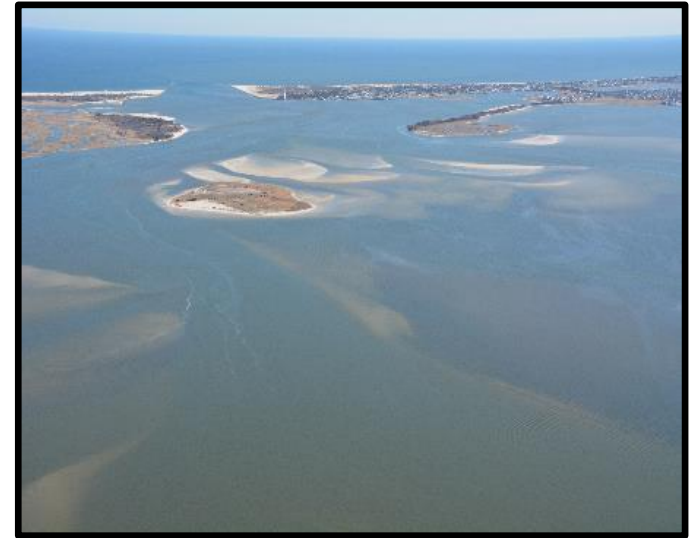
Philadelphia District is an EWN Proving Ground



And Many More!

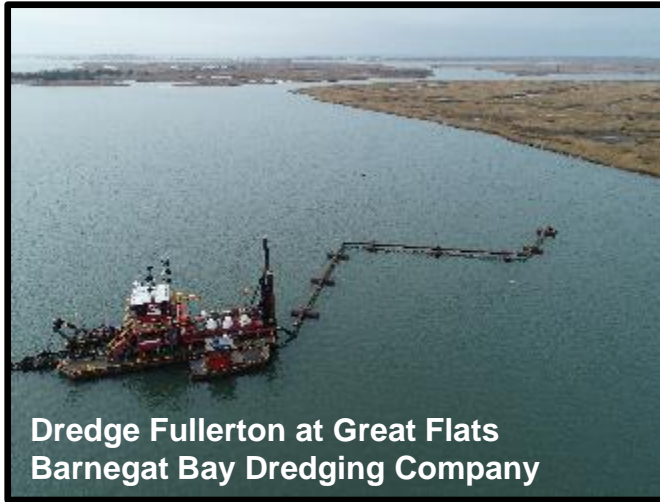


A Sediment Progression: From Confinement To Natural Infrastructure Creation

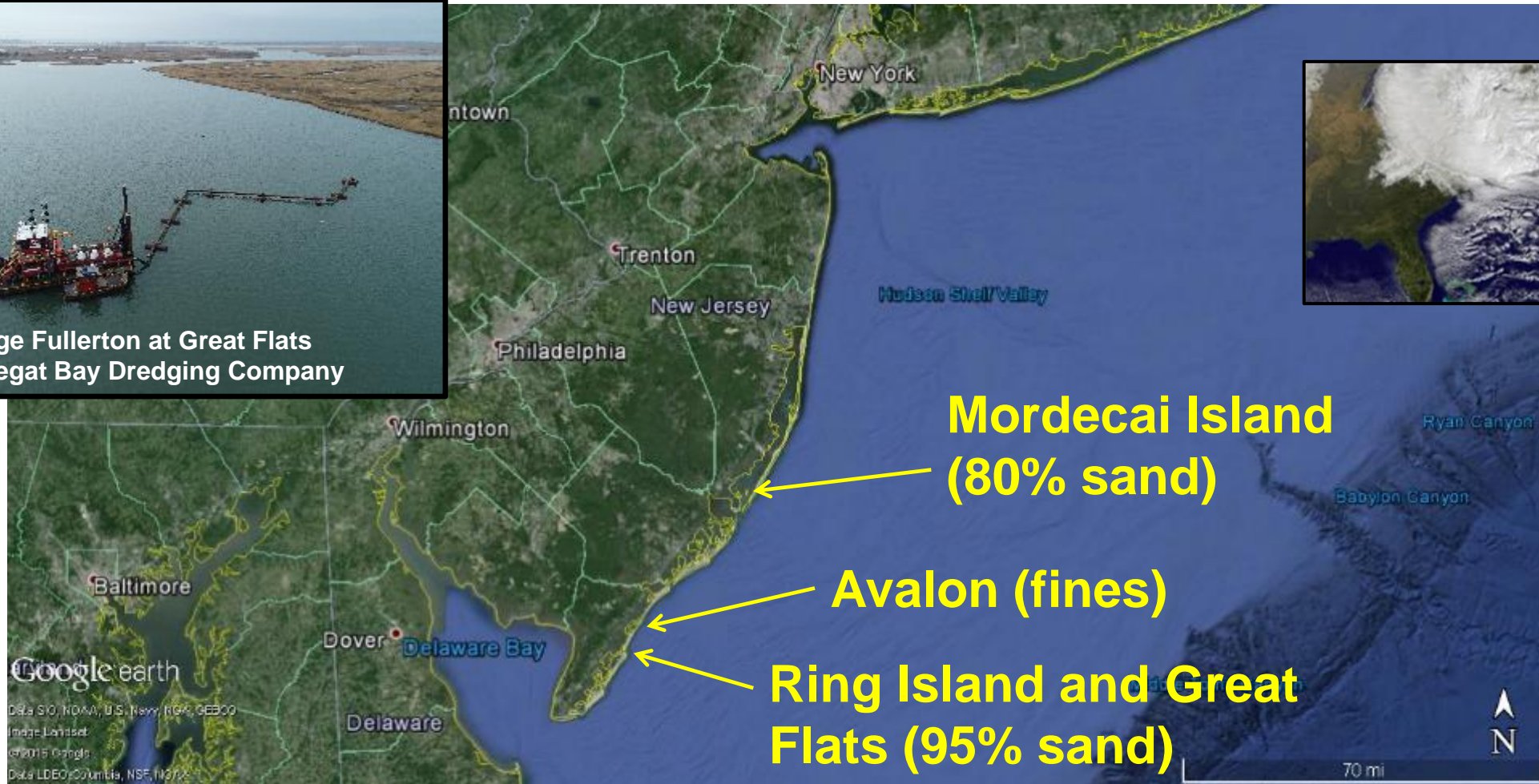




The Post-Superstorm Sandy “Pilots” Sediment Testing and Constructability Up Front!



Dredge Fullerton at Great Flats
Barnegat Bay Dredging Company



The New Jersey Intracoastal Waterway is a 188-km long federal channel that runs through the NJ Back Bays from Manasquan to Cape May



**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)**





BUILDING MOMENTUM: EVOLVING THE PRACTICE THROUGH SMIL





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 Laboratory

Established 2019





Coastal Navigation in the Philadelphia District: Evolving Practice in the Seven Mile Island Innovation Lab



- **Persistent, Collaborative Approach** Across USACE & Others:
Based on working together through the Regional Sediment Management and Engineering with Nature Programs
- **Illustrated Success:** *Innovative Dredging and Placement Projects Enhancing Coastal Resilience*
- **Why Seven Mile Island?** *NJIWW fed channel & TWI bisect region; WMA, ongoing & previous projects (beach & navigation)*
- **SMIL Timeline:**
 - 2013: “New” collaboration with State of NJ and others starts post-Irene & Sandy w/ pilots (Mordecai, Ring, Avalon)
 - Spring 2019: Created Seven Mile Island Living Lab with primary partners (USACE NAP & ERDC, NJDEP, TWI)
 - Dec 2019: Rebranded to **“Innovation”** Lab
- **SMIL Purpose:** *Advance and improve dredging and marsh restoration techniques in coastal New Jersey through innovative research, collaboration, knowledge sharing and practical application*
- **SMIL Goals:** *Maintaining safe navigation channels while retaining dredged sediment in the system to benefit natural ecosystems and coastal communities*
- **Building Momentum:** *Evolving Practice through SMIL; Started w/ Seven Mile Island but now expanding in regions, scale & concepts*

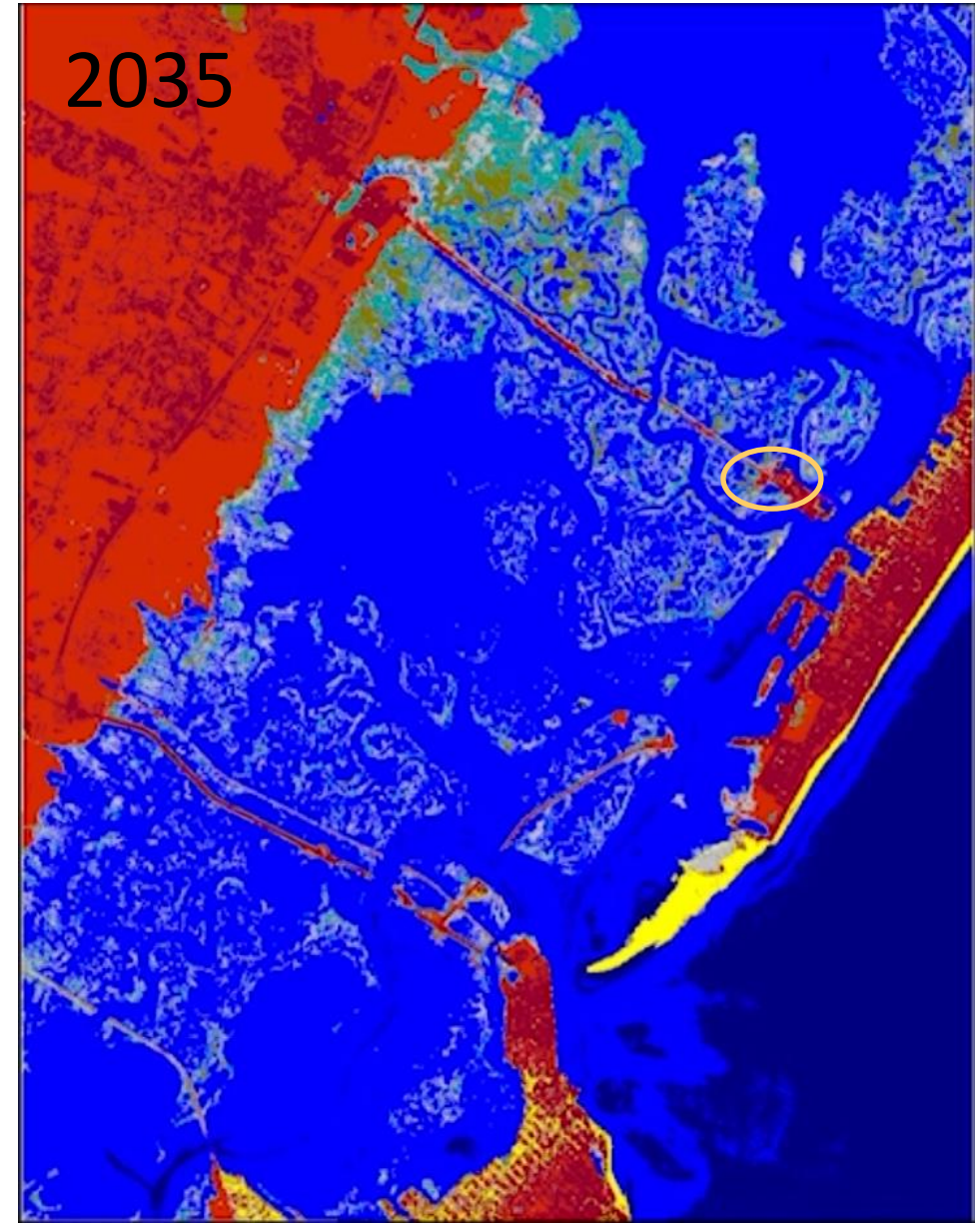


Seven Mile Island Innovation Laboratory Background



- ▶ Encompassing 24 mi², and 15,000 acres of Back Bay Tidal Marshes, Shallow Bays, and Inlets
- ▶ Bisected by the NJ Intracoastal Waterway
- ▶ Part of the Cape May Wetlands Wildlife Management Area
- ▶ Home of The Wetlands Institute

- Federal Beach Fill and Navigation Projects
- Confined Disposal Facility (CDF)
- Prior Placement Sites (PP)
- Elevated Nesting Habitat (ENH)
- Thin Layer Placement (TLP)
- Marsh Enhancement (ME)
- Intertidal Shallows (IS)
- Marsh Edge Protection (MEP)
- Tidal Flat Enhancement (TFE)



High Tide Flooding (MHW SLAMM) and Coastal Resilience

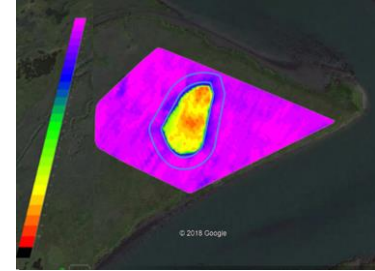


Advancing Dredging & Placement Techniques in SMILL

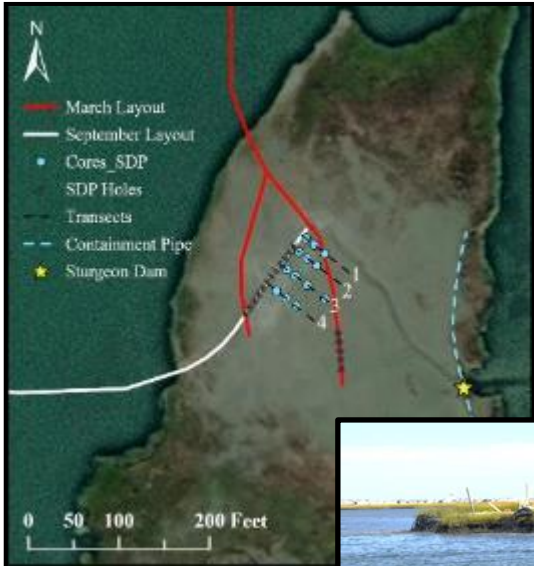
Learning from the Past, Innovating Now and Evolving to the Future



The Original Pilots & Beyond



Great Flats and a System of Solutions for the NJIWW



Taking it to the Next Level at Gull and Sturgeon Islands



Landscape Approach at Gull Island, RSM/EWN!



- 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



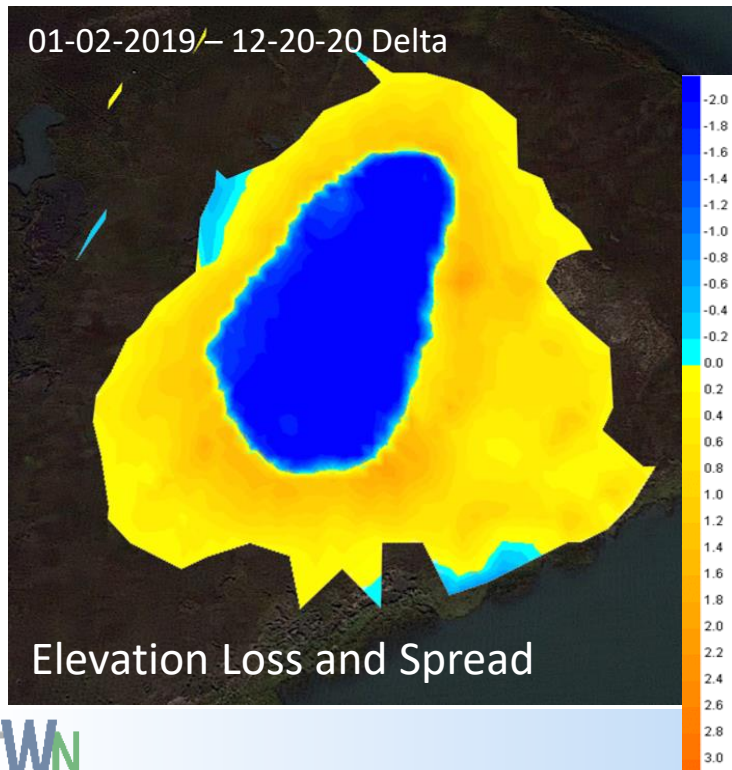
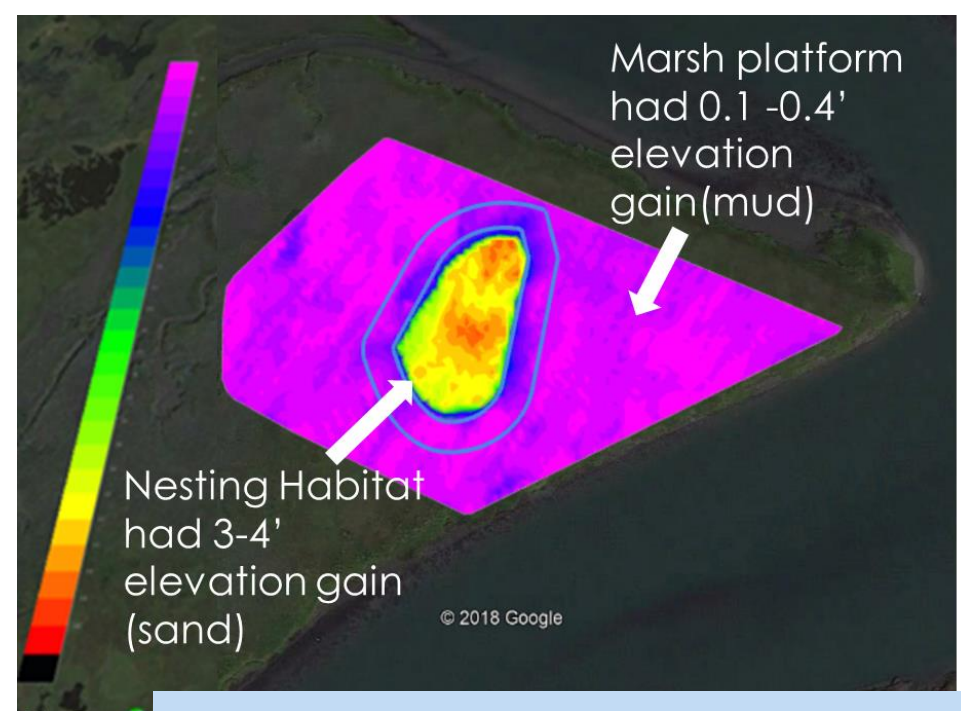
INITIAL ASSESSMENT GULL ISLAND PROJECTS



2018 Placement



2021 Placement



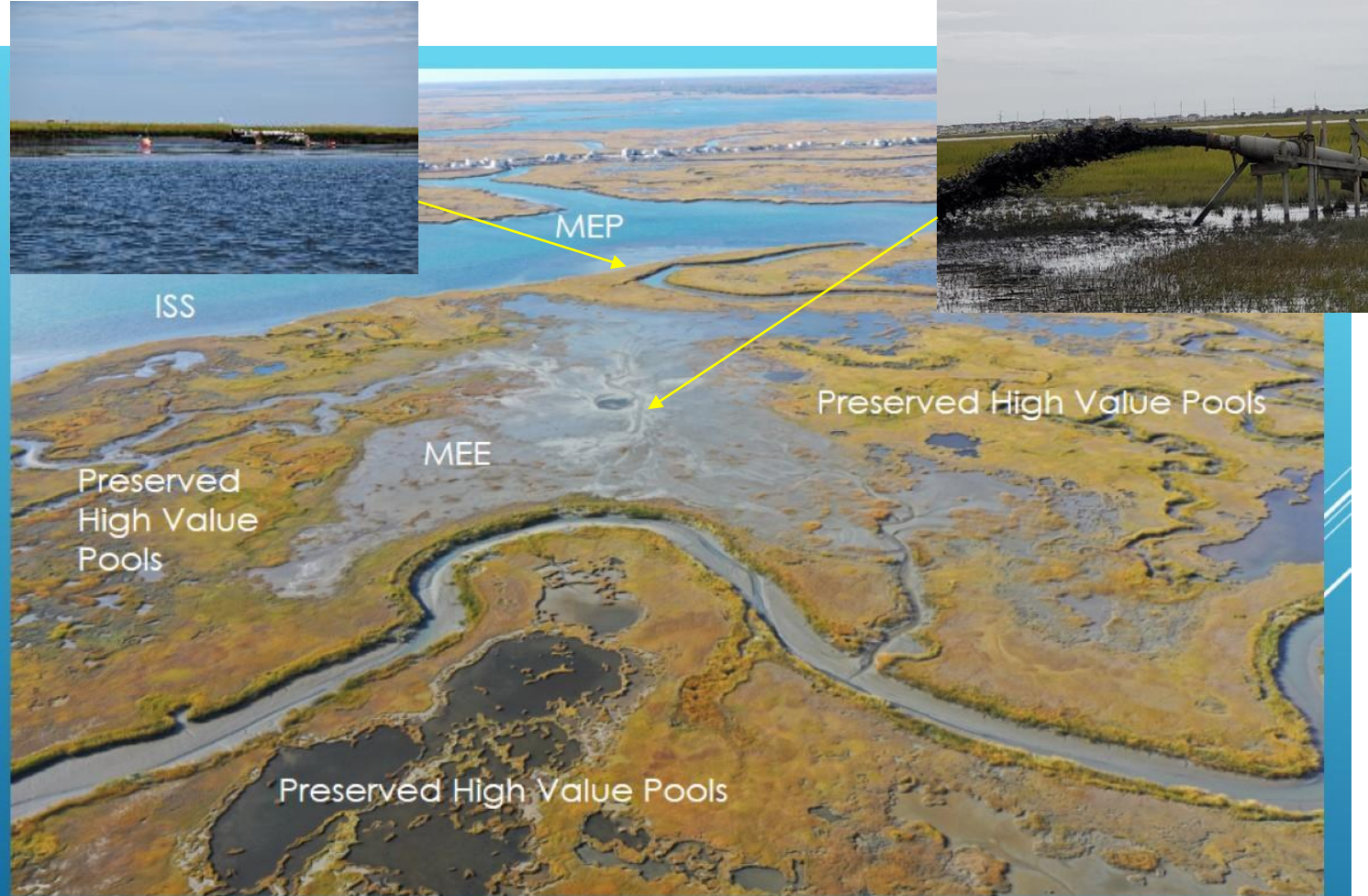
Construction then Repetitive Adaptive Management

- ▶ 1 acre sites – 6,000 CY initial placement
- ▶ 3 year return cycle refurbished with 4,000 CY each time
- ▶ Free pump until enough material to create containment berms
- ▶ Match maintenance dredging of small sandy shoals with ecological goals for at risk species



Gull Island Implementation

- ▶ September 2020
 - ▶ Placed 40,000 cubic yards of mixed fine sand and mud
- ▶ 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

(slide credits, Gary Paul & The Wetlands Institute)

30,000 cu meters of mixed fine sand and silts from the NJIWW Mkrs 388 to 397 placed on Gull Island within New Jersey State Wildlife Management Area in late 2020

▶ Turbidity Monitoring

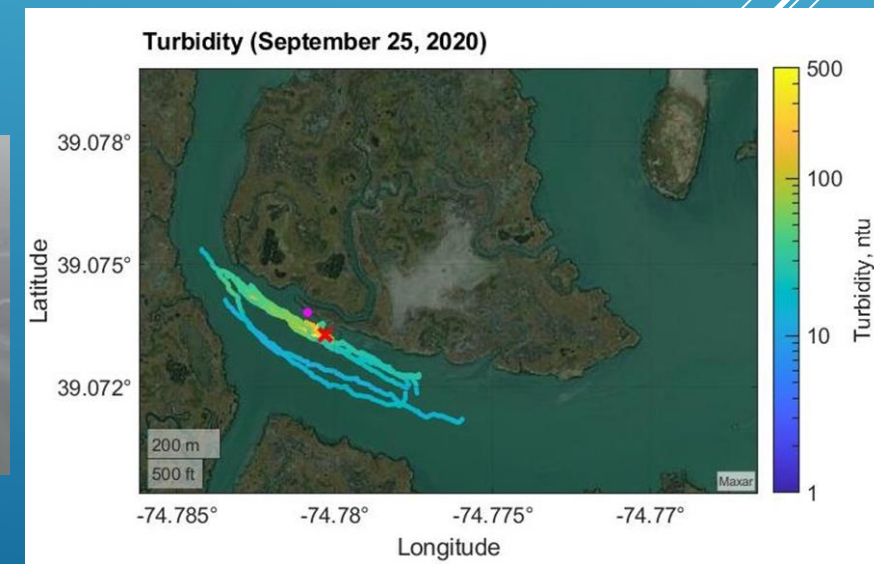
- ▶ Turbidity plume localized, only extending ~50 m off marsh edge and <200 m along shore.
- ▶ Was at similar levels (250-380 ntu) to those measured during passage of Nor'easter and southerly wind events (>5 m/s).

▶ Berm Monitoring

- ▶ Placed ~9000 cy and ~8700 cy on two subtidal features and gained 1 – 2.5' of elevation gain
- ▶ Documented ~4700 and 4100 cy after 16 months and 1-1.5' of elevation gain so ~50% reduction in volume
- ▶ Measured wave height and energy reduction along marsh edge during May Nor'easter (Perkey et al.)



Marsh Edge Protection Feature 1 Month Post-placement



Sturgeon Island Placements

- ▶ Placed in Two Phases in 2020
 - ▶ March & September 2020
 - ▶ Approx. 15,000 cu m
 - ▶ Mixed fine sand and mud
- ▶ Marsh Elevation Enhancement (MEE)
 - ▶ 3.5 acres of enhancement
- ▶ Marsh Edge Protection (MEP)
 - ▶ Placed small sand ridge along toe of erosional slope
- ▶ Enhanced Intertidal Shallows (ISS)
 - ▶ Shallowed above MLLW along eastern island to extend flats northward
- ▶ Returned in Fall 2022 for Phase 3



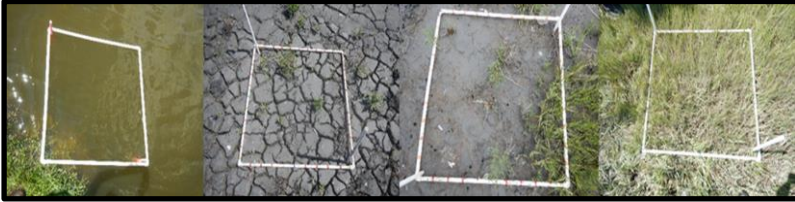
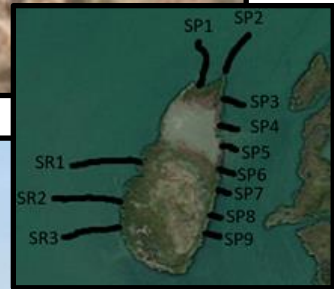
Sturgeon Island Phase 3 – Fall 2022

- Placed 24,000 cu yd (18,000 cu m) of fine sand to create sandy marsh edge protection features
- Used containment to elevate 0.4 acre for elevated bird nesting habitat
 - Placed more than 3 ft (1 m) of material
 - Built to 4.0 ft NAVD88
- Employed Y-valve to switch between containment and subtidal features
 - Maintain dredging efficiency
 - Allow time for contained area to dewater
 - Slow and manage flow volumes and velocities





Importance of Monitoring & Research in SMIL USACE, State of NJ, TWI, UPENN, BC and Others





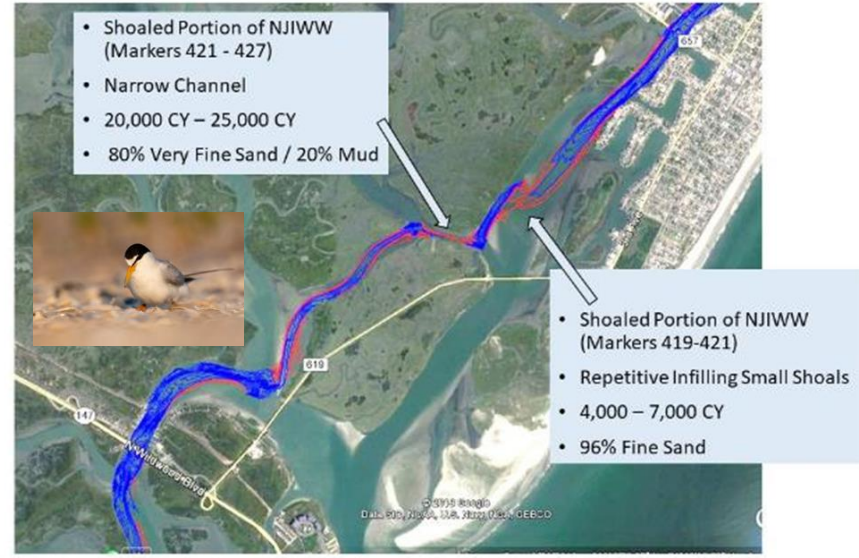
Monitoring & Research in the Seven Mile Island Innovation Lab



Marsh Vegetation Surveys	ERDC: Piercy/Russ
Hydrodynamic and Suspended Sediment within the SMILL	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
Sediment Distribution Pipe: Sturgeon-Gull	ERDC: Beardsley, et al., WEDA Journal of Dredging, Volume 20, No. 1
Sturgeon/Gull Sediments/Consolidation	ERDC: Tyler/Harris
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 (Work Group)



What's Next in SMILL?



NJIWW in Southern Seven Mile Island Living Lab

- Pilot to clear shoals with sidecast Government Dredge Merritt using “Fertilizing the Garden” approach
- Track shoaling rates and patterns for long-term EWN strategies that are nature-based and less “big” construction efforts
- Risk acceptance and adaptive management, take “fail” out of language
- Agricultural & dredging industry coordination
- Leverage SMILL with communities
- Utilize techniques in remaining portions of NJIWW
- Scale Up and Over (Maurice & Salem Rivers, NJ)





Seven Mile Island Innovation Lab

Primary References



- American Shore and Beach Preservation Association National Conference, Sept 2022, Long Beach, Presentation, “Advancing Navigation Dredging and Innovative Placements to Support Coastal System Resilience in USACE's Philadelphia District”
- 37th International Conference on Coastal Engineering, December 2022, Sydney, Australia, “Advancing Sediment Solutions in the Seven Mile Island Innovation Lab”
- Coastal Sediments 2023, March 2023, New Orleans, Paper and Presentation, “Seven Mile Island Innovation Laboratory: Advancing Beneficial Use Practices to Support Coastal System Resilience”
- *Additional Info and Fact Sheets:*

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

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