

Engineering With Nature for Project Benefits



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Engineers Australia

“Sustainable Dredging and Sediment Management: Assessing and Managing Environmental Effects and Benefits”

September 7-11, 2015

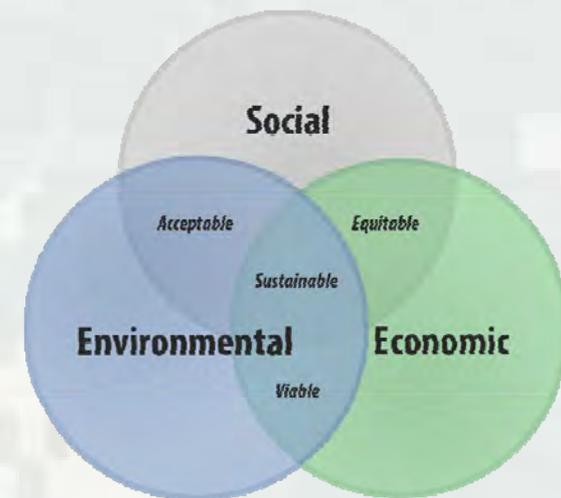


Engineering With Nature...

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

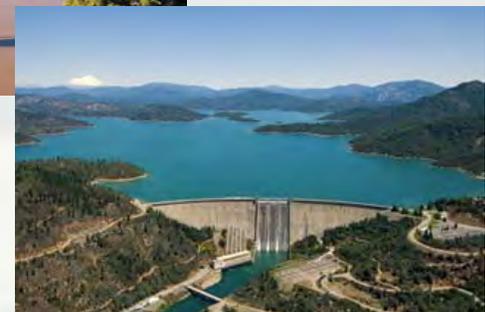
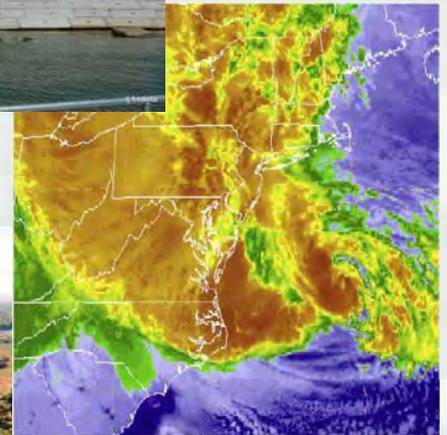
Key Elements:

- 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

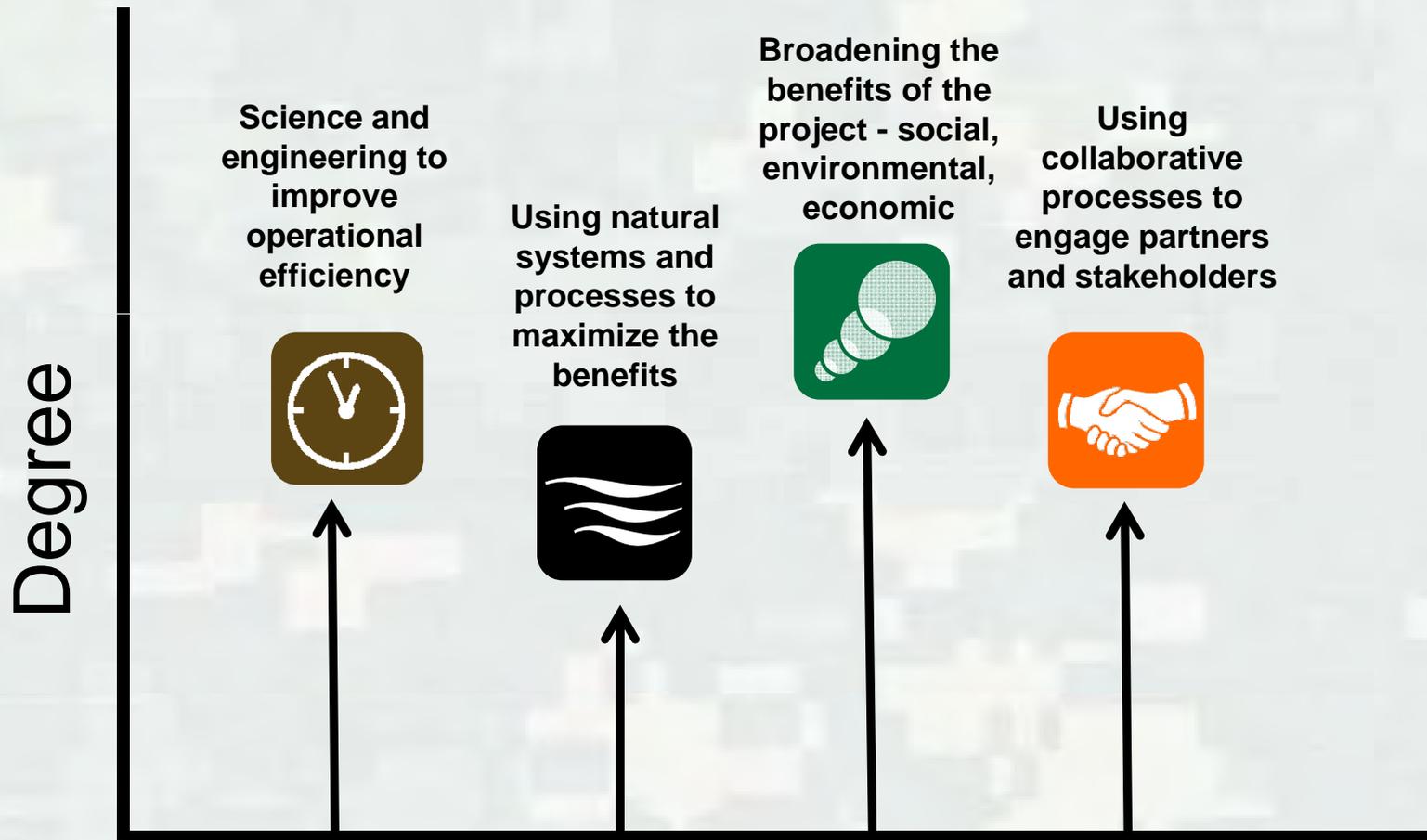


EWN Across USACE Mission Space

- Navigation
 - ▶ Strategic placement of dredged material supporting habitat development
 - ▶ Habitat integrated into structures
- Flood Risk Management
 - ▶ Natural and Nature-Based Features to support coastal resilience
 - ▶ Levee setbacks
- Ecosystem Restoration
 - ▶ Ecosystem services supporting engineering function
 - ▶ “Natural” development of designed features
- Water Operations
 - ▶ Shoreline stabilization using native plants
 - ▶ Environmental flows



Engineering With Nature Elements



EWN Elements



EWN Status

- *Engineering With Nature* initiative started within USACE Civil Works program in 2010. Over that period we have:
 - ▶ Engaged across USACE Districts (23), Divisions, HQ; other agencies, NGOs, academia, private sector, international collaborators
 - Workshops (>20), dialogue sessions, project development teams, etc.
 - ▶ Implementing strategic plan
 - ▶ Focused research projects on EWN
 - ▶ Field demonstration projects
 - ▶ Communication plan
 - ▶ District EWN Proving Grounds established
 - ▶ Awards
 - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
 - 2014 USACE National Award-Green Innovation



www.engineeringwithnature.org

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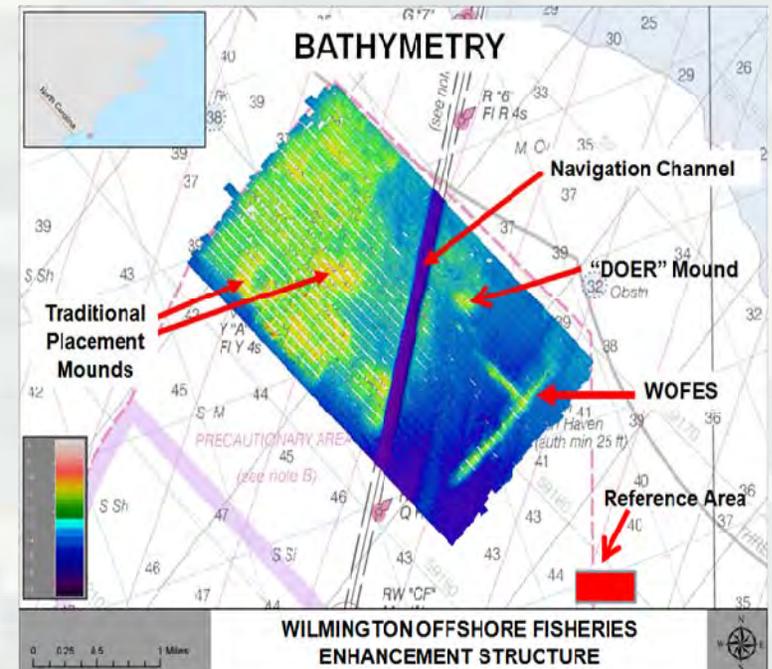
Evia Island, Galveston Bay, TX

- 6-acre island was constructed using sediment dredged during the deepening of the Houston Ship Channel in 1998
- Island provides substantial bird and other habitat
- Producing significant environmental benefits

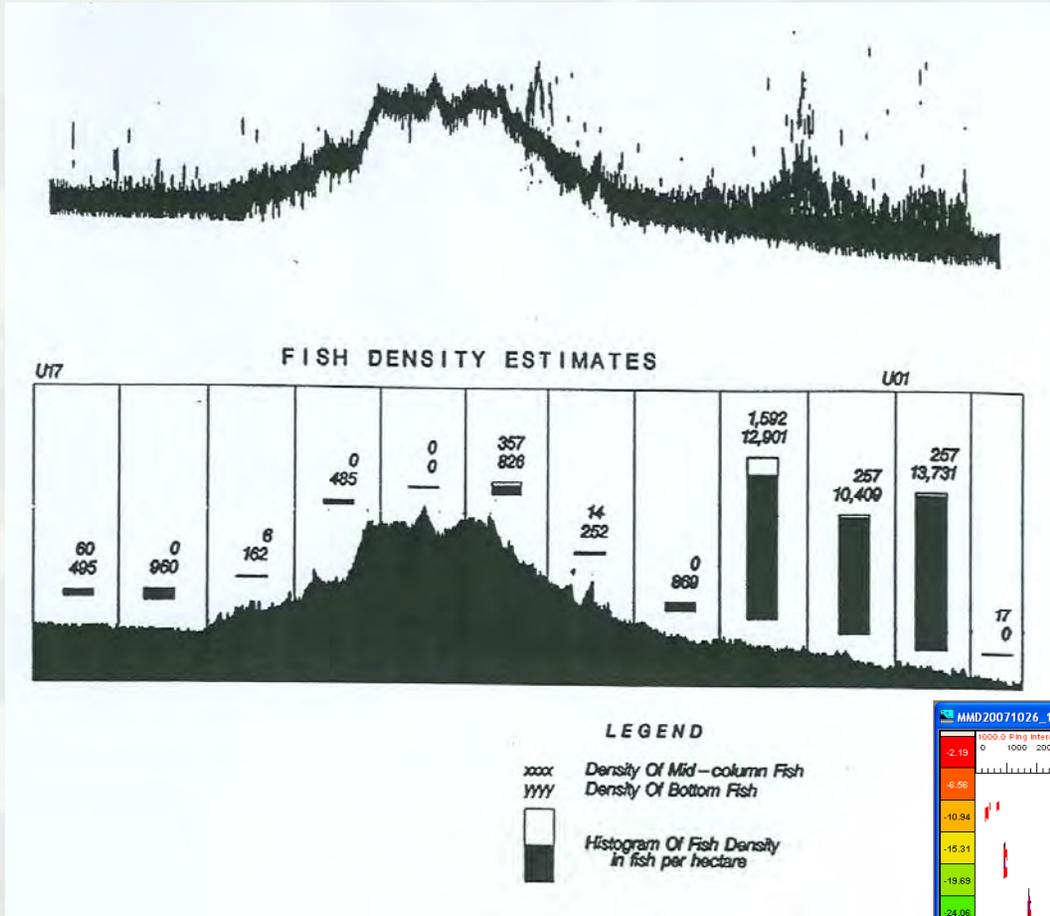


WOFES, Wilmington, NC

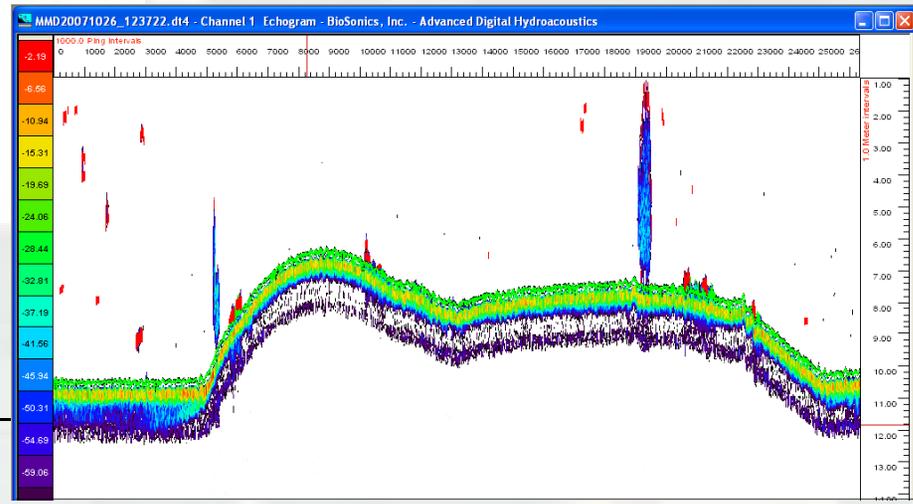
- Created in 1994-1997 from 764,600 cubic meters of limestone dredged as part of the Wilmington channel deepening
- Located three nautical miles off of the mouth of the Cape Fear River in North Carolina
- The location and design of the reef involved extensive participation by stakeholders, and the North Carolina Department of Environment and Natural Resources supported the project as a local sponsor
- Produced significant social benefits as a popular destination for fishing



Mobile Offshore Dredged Material Mound

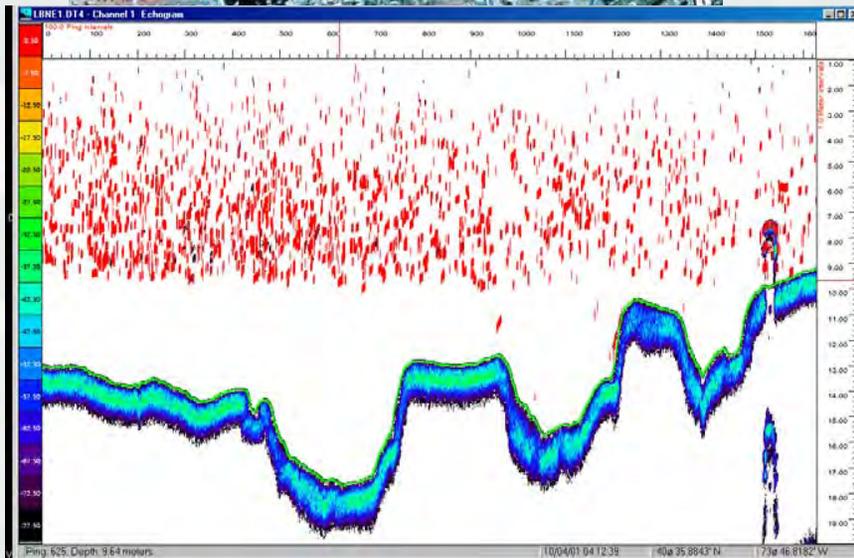
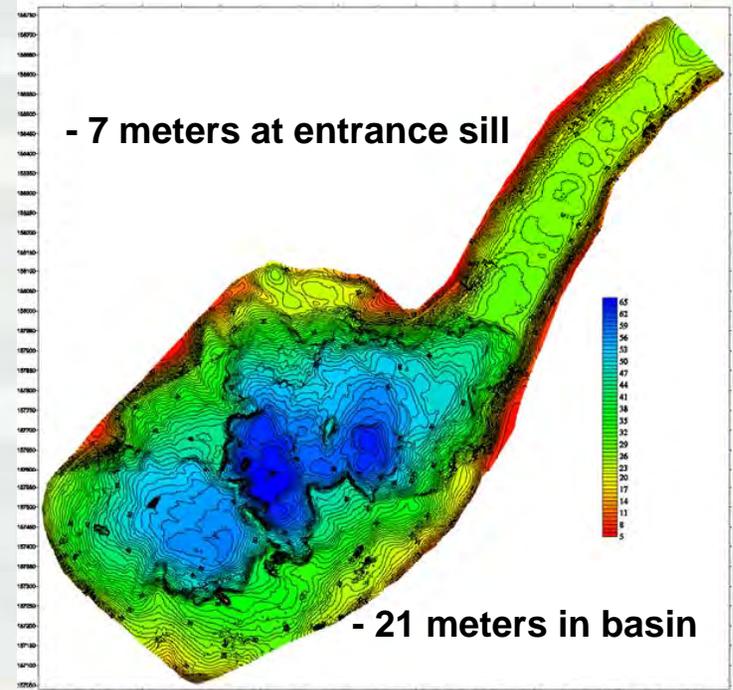


Hydroacoustics and trawling data used to document fisheries benefits provided by topographic relief created with dredged material

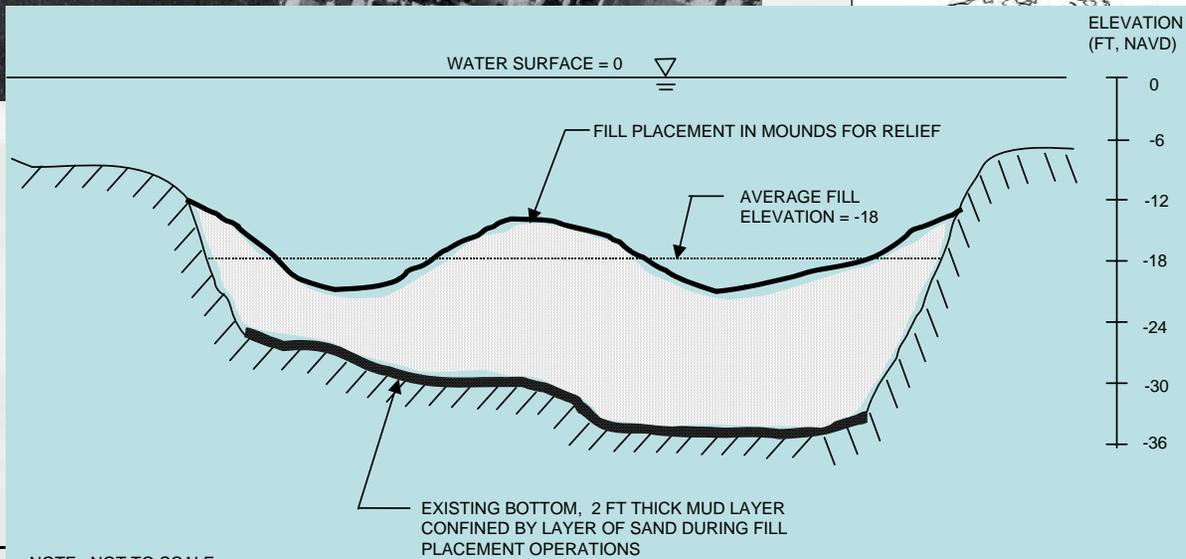
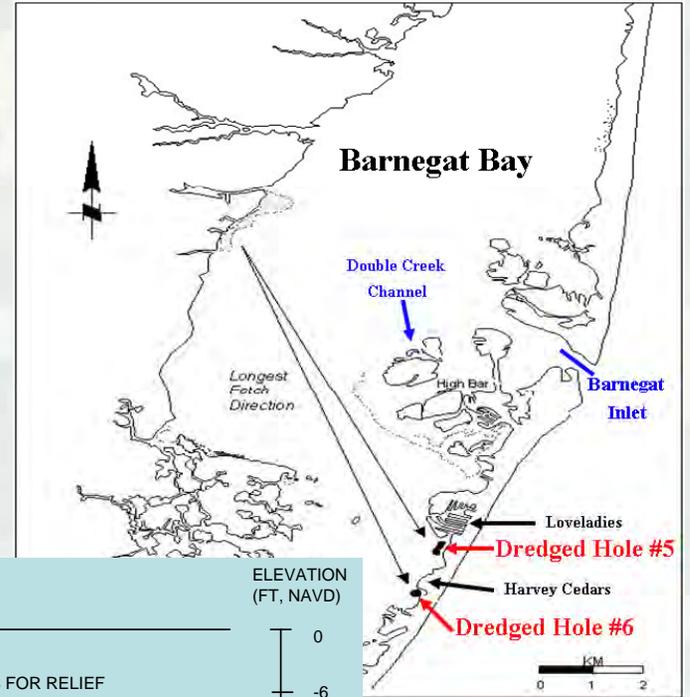
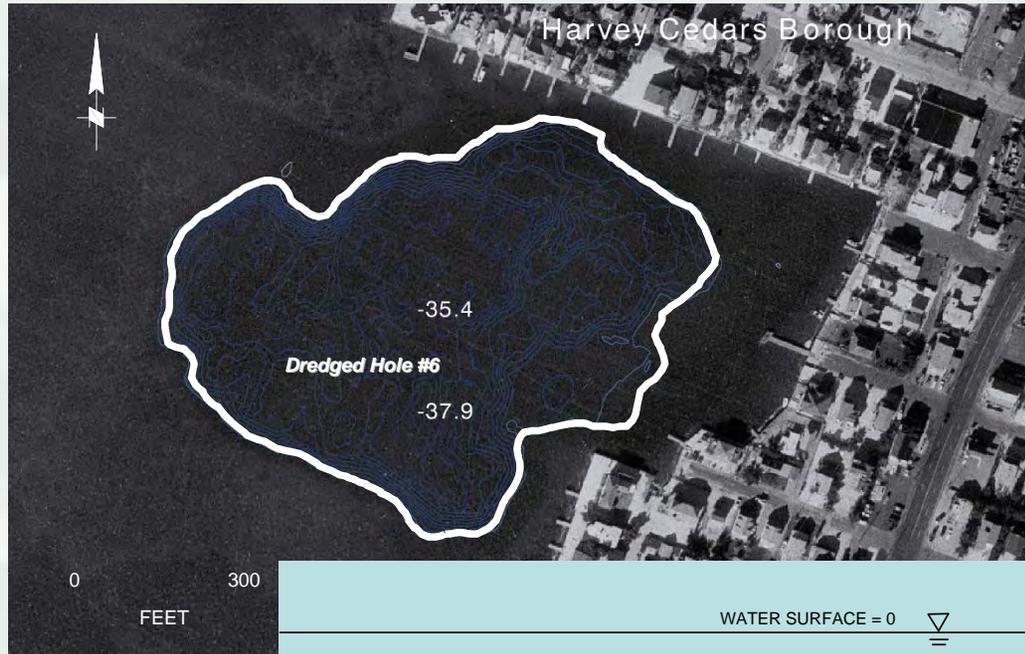


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Environmental Restoration of Holes/Pits



BARNEGAT BAY – HOLE #6



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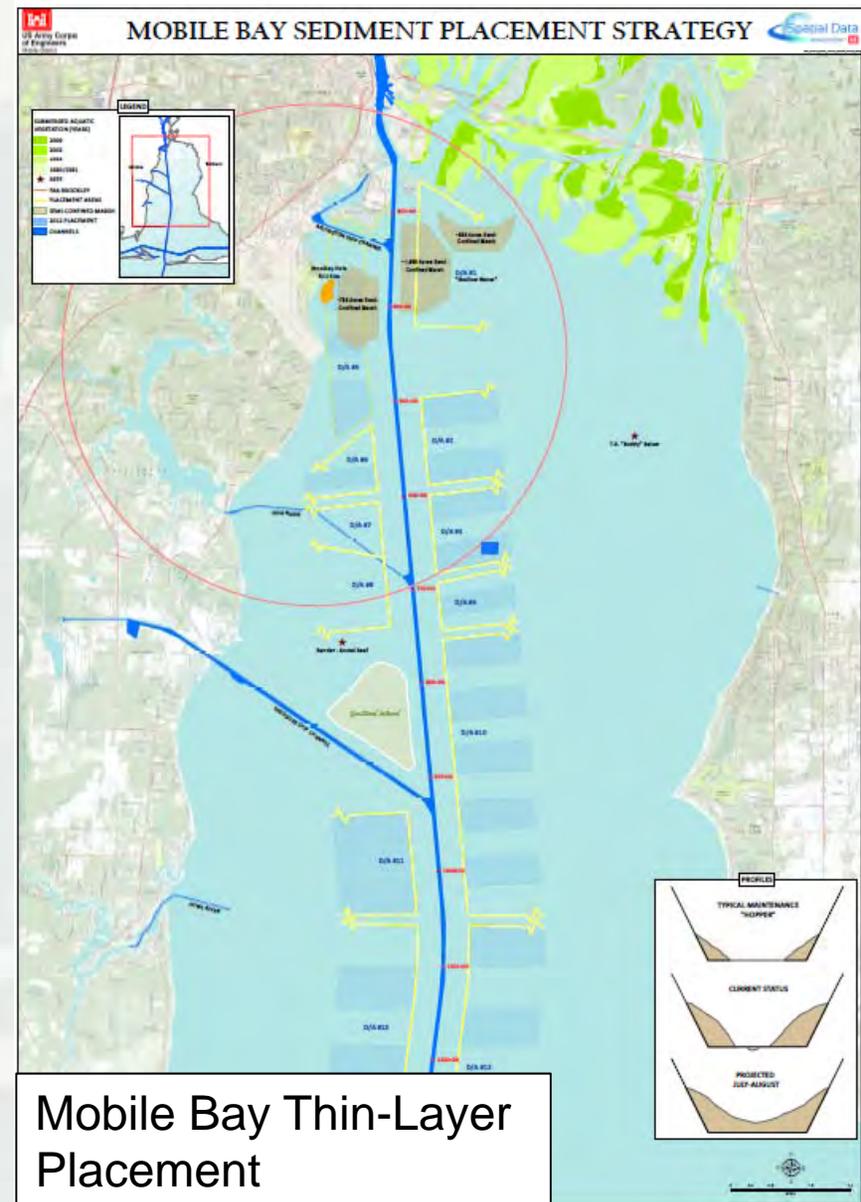
NOTE: NOT TO SCALE,
VERTICAL SCALE EXAGGERATED

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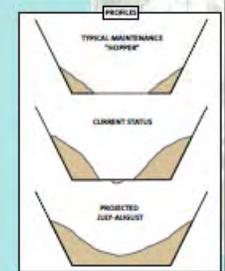
a safer, better world

Strategic Sediment Placement in Mobile Bay

- 25 years ago, in-bay disposal of dredged material was banned
 - Shoreline erosion and loss of habitat followed
- Thin-layer placement was demonstrated on full-scale to restore sediment processes
- Many opportunities for in-water beneficial use
- Ecosystem benefits being documented



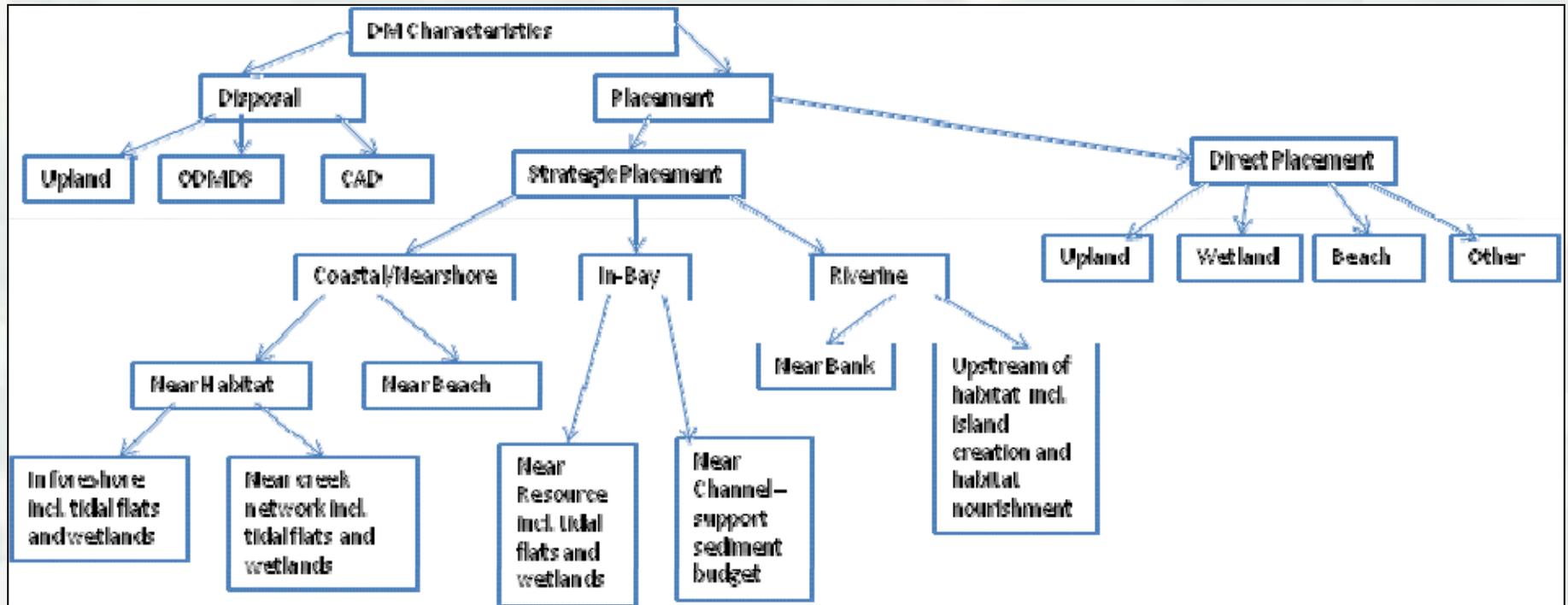
Mobile Bay Thin-Layer Placement



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Strategic Sediment Placement



Horseshoe Bend, Atchafalaya River

- Options for managing dredged material via shore-based wetland creation were exhausted
- Strategic placement of sediment (0.5-1.8 mcy/1-3 yrs) was used to create a ~35 ha island
- Producing significant environmental and engineering benefits
- Project won WEDA's 2015 Award for Environmental Excellence

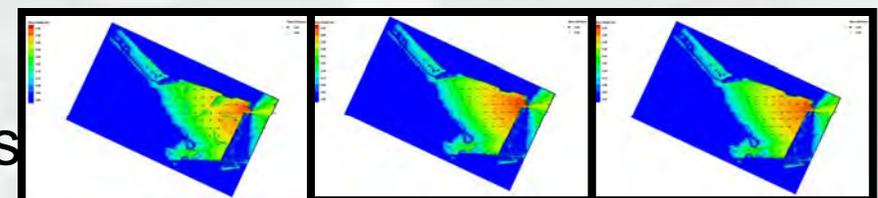


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Hamilton Wetland, San Pablo Bay

- Beneficial use of dredged material to restore army air field to wetlands
- Dredged material was placed directly to contour wetland
- ERDC monitoring of new wetland to quantify waves, other physical processes and accretion
- ERDC modeling wave generation and dissipation, testing different shapes for barriers to fetch
- Plants will volunteer in tidal areas as sufficient accretion occurs



Linear Berms (As-Built)

No Berms (Control)

Mounds (ala Sears Pt.)



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Coastal NJ, Philadelphia District



December 2014



Stone Harbor



Avalon

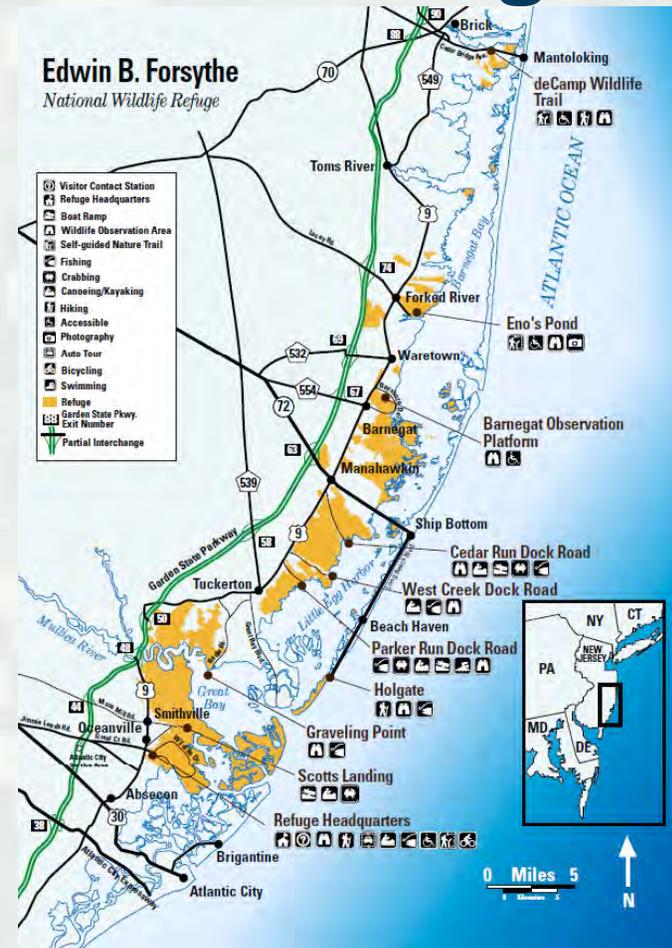


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US Fish and Wildlife Service Forsythe National Wildlife Refuge

- Forsythe NWR: >40,000 acres of wetlands and other habitat in coastal NJ
- Collaboration objective: Enhance ecosystem resilience through engineering and restoration
- Means: Smart use of sediment resources and EWN principles and practices



Thin-Layer Placement Website

Coming soon to
www.engineeringwithnature.org

The homepage features a circular logo with 'TLP THIN LAYER PLACEMENT' and a navigation menu with links: 'Welcome', 'What Is Thin Layer Placement?', 'Resources', 'Case Studies', 'Points of Contact', and 'Photo Gallery'. The main image shows two people in a field, one holding a surveying instrument. Below the image are three columns: 'Thin-Layer Placement' with a sub-image of a dredger, 'A Living Resource' with a sub-image of birds, and 'Searchable Resources' with a sub-image of a field. A 'Welcome' section at the bottom contains introductory text.

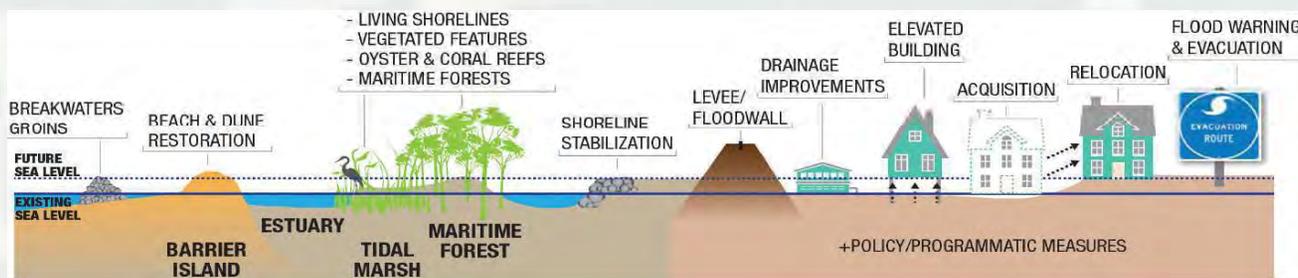
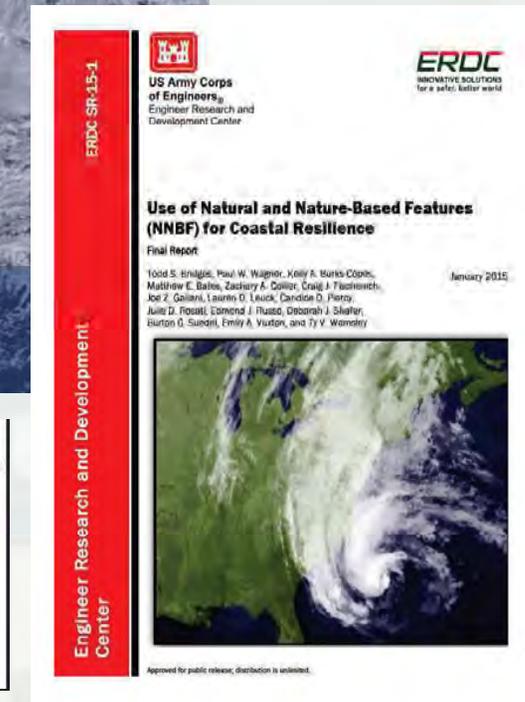
This page has a header with the same logo and navigation menu. The main heading is 'What Is Thin Layer Placement?'. Below it is a large image of a dredger. To the right, a blue box contains the text 'Thin Layer Placement' and a brief description. Below this are four small thumbnail images. At the bottom, a large image of a green field is shown with a caption 'and the natural benefits of birds.'

This page features the same header and navigation menu. The main heading is 'Case Studies'. It includes a list of case studies with bullet points: 'Anacostia River Fringe Wetland Creation', 'New Jersey Intertidal Wetland', 'Cedar City Inshore Pine and Cypress Bay', 'Horn of Antelope Coastal Ecosystem', 'Pine Point Marine', 'Cedar Point', 'Salt Pond', 'Jamaica Bay', 'Mississippi Sound', 'Piscataway Creek', 'Lake Smith', and 'West Cove'. A large image of a wetland is shown with a caption 'and the natural benefits of birds.'



Natural and Nature-Based Features: North Atlantic Coast Comprehensive Study

- Opportunities to integrate Natural and Nature-Based Features (NNBF) with structural and non-structural measures to provide multiple lines of defense against storms and sea level rise, generating a full array of relevant economic, environmental and social ecosystem goods and services.



See Bridges et. al., 2015
<http://www.nad.usace.army.mil/CompStudy>



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Natural and Nature-Based Infrastructure at a Glance

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:
STORM INTENSITY, TRACK, AND FORWARD SPEED, AND SURROUNDING LOCAL BATHYMETRY AND TOPOGRAPHY



Dunes and Beaches

Benefits/Processes

Break offshore waves
Attenuate wave energy
Slow inland water transfer

Performance Factors

Berm height and width
Beach Slope
Sediment grain size and supply
Dune height, crest, width
Presence of vegetation



Vegetated Features:

Salt Marshes, Wetlands, Submerged Aquatic Vegetation (SAV)

Benefits/Processes

Break offshore waves
Attenuate wave energy
Slow inland water transfer
Increase infiltration

Performance Factors

Marsh, wetland, or SAV elevation and continuity
Vegetation type and density



Oyster and Coral Reefs

Benefits/Processes

Break offshore waves
Attenuate wave energy
Slow inland water transfer

Performance Factors

Reef width, elevation and roughness



Barrier Islands

Benefits/Processes

Wave attenuation and/or dissipation
Sediment stabilization

Performance Factors

Island elevation, length, and width
Land cover
Breach susceptibility
Proximity to mainland shore



Maritime Forests/Shrub Communities

Benefits/Processes

Wave attenuation and/or dissipation
Shoreline erosion stabilization
Soil retention

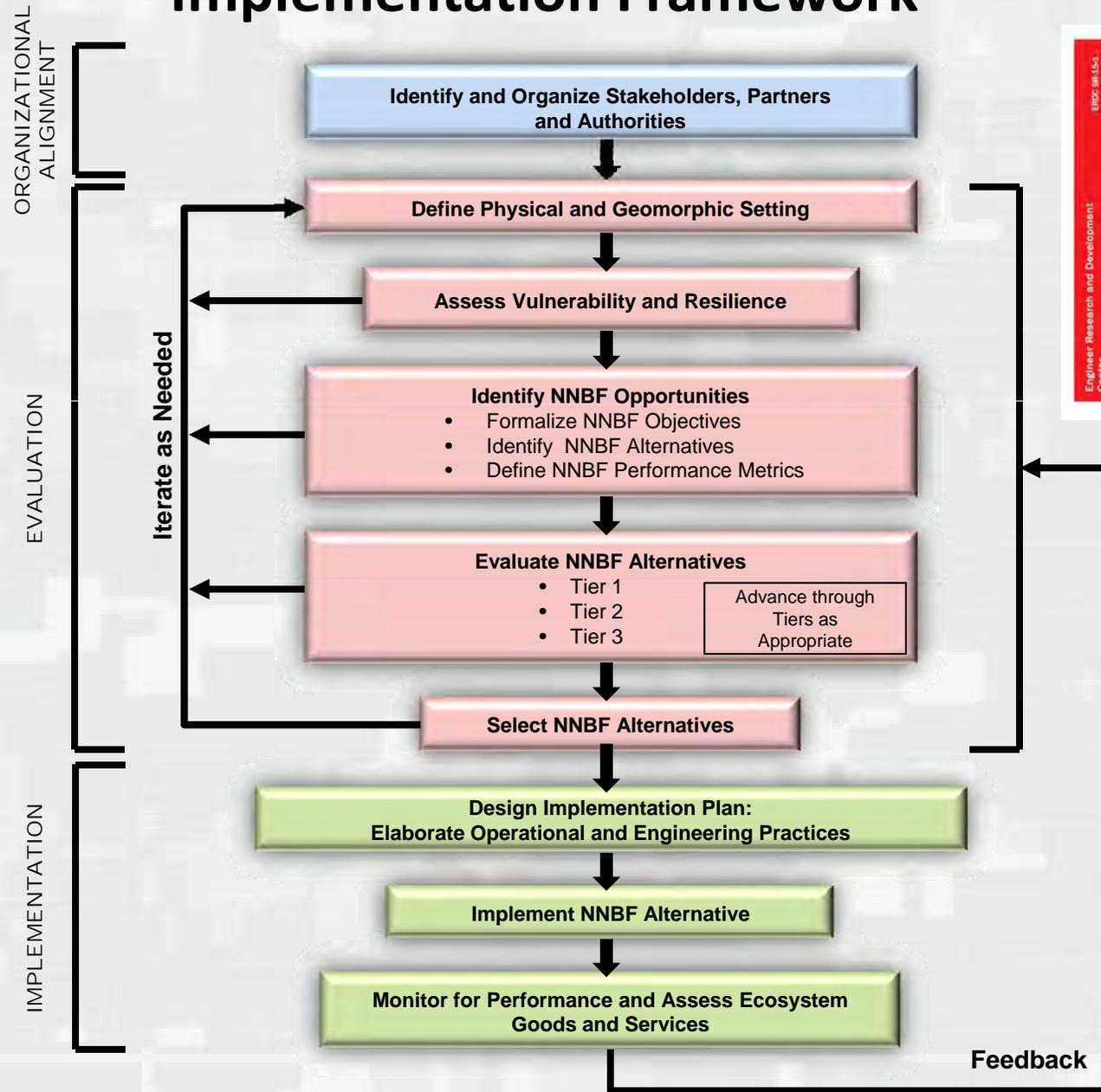
Performance Factors

Vegetation height and density
Forest dimension
Sediment composition
Platform elevation



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Natural and Nature-Based Features Evaluation and Implementation Framework

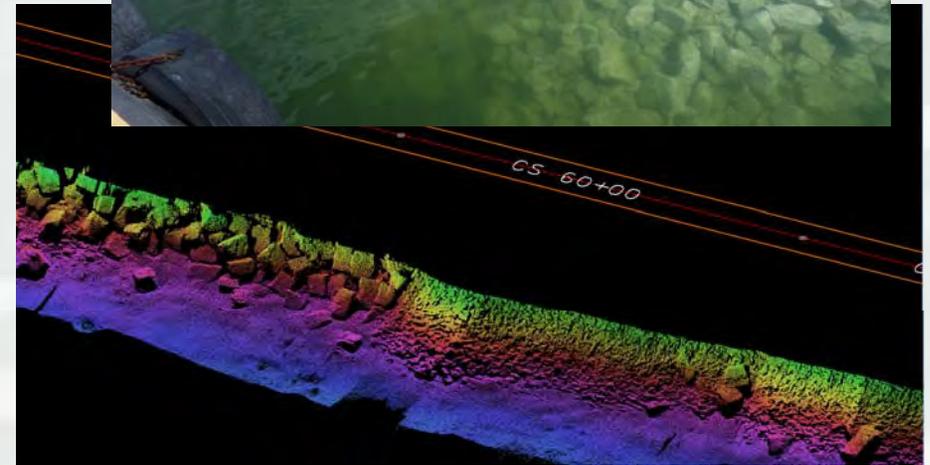


Example EWN Solutions: Green Breakwaters

Ashtabula Harbor



Milwaukee Harbor



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Coastal Resilience: The Environment, Infrastructure, and Human Systems

- USACE was the primary sponsor and host (USEPA and USDOE were co-sponsors)
 - ▶ Dr. Todd Bridges, Conference Chair
 - ▶ Ms. Cynthia Banks, Conference Organizer
- 85 participants from 8 countries (Barbados, Fiji, Mexico, The Netherlands, South Africa, South Korea, United Kingdom, and United States)
 - ▶ Diversity of organizational perspectives:
 - USACE, NOAA, USEPA, USFWS, OMB, CEQ, DOE, US Navy, Treasury Department, State Department, TNC, AAPA, Water Institute of the Gulf, National Wildlife Federation, Great Lakes Dredge & Dock Company, Environ Corp., Dewberry, several universities, and many other organizations
- Conference consisted of a series of plenary presentations and panel discussions
 - ▶ Share information about science and engineering relevant to coastal resilience



The audio and visuals for each presentation are at:
<http://el.erd.c.usace.army.mil/ewn/workshop.cfm?List=14MayCR>



USACE Galveston and Buffalo Districts: EWN “Proving Grounds”

- EWN Proving Ground Kick-Off Workshops
 - ▶ October (SWG) and December (LRB) 2014
 - ▶ ~70 participants
 - ▶ SWG, SWD, LRB, ERDC, IWR and HQ
- Identified opportunities to implement EWN within current and future programs and projects
- Emphasis on solution co-development

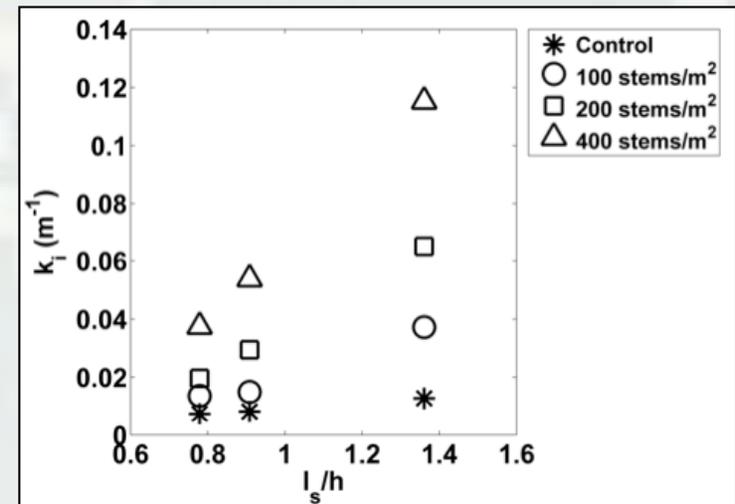


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R&D Example: Engineering Performance of NNBF

- What are the engineering benefits of wetlands with respect to waves?
- Flume studies being performed in the 10 ft flume
 - Complemented by examination of sediment processes and field studies
- Wave attenuation was found to:
 - increase with stem density
 - increase with submergence ratio
 - slight increase with incident wave height
- Results used to update STWAVE



EWN Action Demonstration Projects, 1

- Sediment Retention Engineering to Facilitate Wetland Development (San Francisco Bay, CA)
- Realizing a Triple Win in the Desert: Systems-level Engineering With Nature on the Rio Grande (Albuquerque, NM)
- Atchafalaya River Island and Wetlands Creation Through Strategic Sediment Placement (Morgan City, LA)
- Portfolio Framework to Quantify Beneficial Use of Dredged Material (New Orleans and New England)
- Engineering Tern Habitat into the Ashtabula Breakwater (Ashtabula, OH)
- Living Shoreline Creation Through Beneficial Use of Dredged Material (Duluth, MN)
- A Sustainable Design Manual for Engineering With Nature Using Native Plant Communities



EWN Action Demonstration Projects, 2

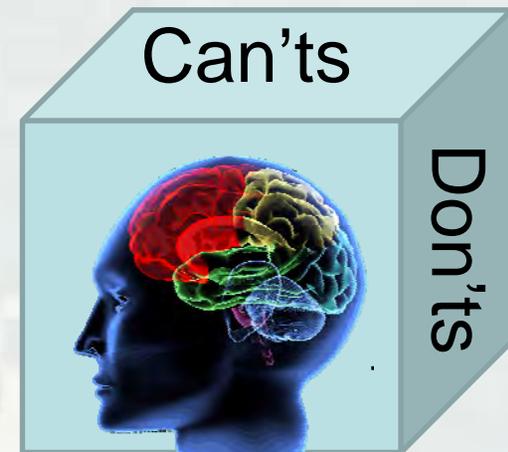
- Landscape Evolution of the Oil Spill Mitigation Sand Berm in the Chandeleur Islands, Louisiana
- Guidelines for Planning, Design, Placement and Maintenance of Large Wood in Rivers: Restoring Process and Function (Collaboration with BoR)
- The Use and Value of Levee Setbacks in Support of Flood Risk Management, Navigation and Environmental Services (a strategy document)
- Strategic Placement of Sediment for Engineering and Environmental Benefit (an initial guide to opportunities and practices)



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Advancing Expanded Benefits...

- More visioning about what benefits the project could produce
 - ▶ Developing a robust value proposition
- More partnering with others
- Less focus on historical constraints
- Document the benefits that are produced



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High Points



- Focus energy to motivate and facilitate innovation in both technical and business processes
- Accelerate progress through co-development of solutions!
- Important to elevate communication about advancing practice
 - ▶ Creating project value

