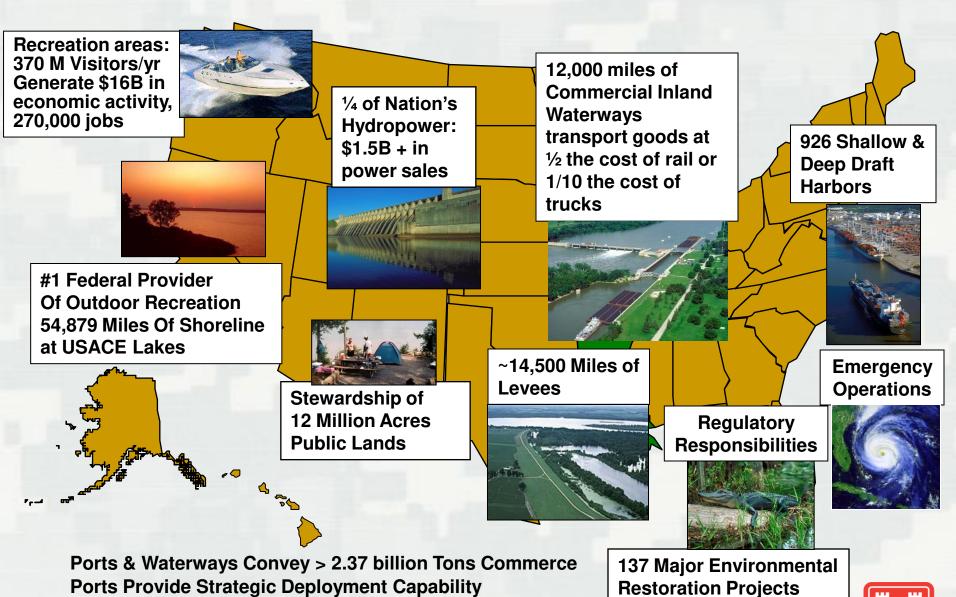
## **Engineering With Nature for Sustainable and Resilient Water Resources Infrastructure**



## **USACE Civil Works Value to the Nation**



Harbor Maintenance Trust Fund collects \$1.7 billion revenue

## **Advancing USACE Practice**

**US Army Corps** 



To America's Water Resource Needs
Civil Works Strategic Plan 2014-2018

Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."

## Goals:

- More efficient, cost effective engineering and operational practices.
- More collaboration and cooperation, less unproductive conflict.
  - Sustainable projects. Triple-win outcomes integrating social, environmental and economic objectives.

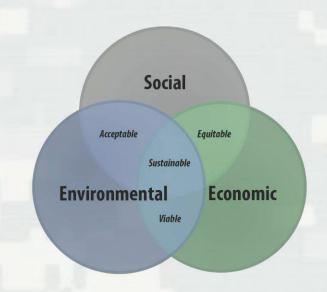


## **Engineering With Nature...**

...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















# **Engineering With Nature Elements**

**Broadening the** benefits of the Science and Using project - social, collaborative engineering to environmental, processes to improve economic **Using natural** operational engage partners systems and Degree efficiency and stakeholders processes to maximize the benefits

**EWN Elements** 

## Case Study #1

- Evia Island (Galveston Bay, TX)
- 6-acre island was constructed using sediment dredged during the deepening of the Houston Ship Channel in 1998
- Birds making use of habitat provided by the island
- Producing significant environmental benefits





## Case Study #2

- Horseshoe Bend Island Creation along the Atchafalaya River (Morgan City, LA)
- As placement sites continue to become exhausted, there was a need for more creative placement alternatives in the Gulf Coast.
- In 2002, strategic placement of the sediment dredged from Horseshoe Bend occurred at the mid-river open water placement area.
- Strategic placement of between 0.5 to 1.8 million cubic yards of sediment was conducted every 1-3 years developing an ~35 ha island midriver.
- Producing significant environmental and economic benefits

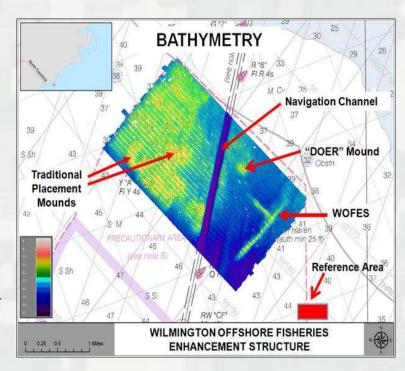






## Case Study #3

- Wilmington Offshore Fisheries Enhancement Structure (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 tournament participants





## **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
  - ▶ Awards
    - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
    - 2014 USACE National Award-Green Innovation
    - 2015 Western Dredging Association Environmental Excellence Award

## **Hurricane Sandy**

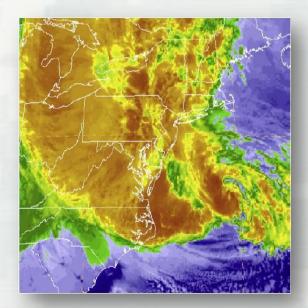
### **Storm Impacts and Damages:**

#### ▶ Human

- > 286 people killed (159 in the US)
- ➤ 500,000 people affected by mandatory evacuations
- ➤ 20,000 people required temporary shelter
- Extensive community dislocationscontinuing today in some areas

#### ▶ Economic

- > \$65B in damages in the U.S.
- ➤ 26 states affected (10 states and D.C are in the NACCS study area)
- ▶ 650,000 houses damaged or destroyed







### In the Context of Coastal Resilience...

- What opportunities are there for achieving better alignment of natural and engineered systems?
  - Can improved alignment reduce risks to life and property?
  - ▶ What range of services can be produced through such alignment?
  - ▶ What are the science and engineering needs in order to achieve better alignment?



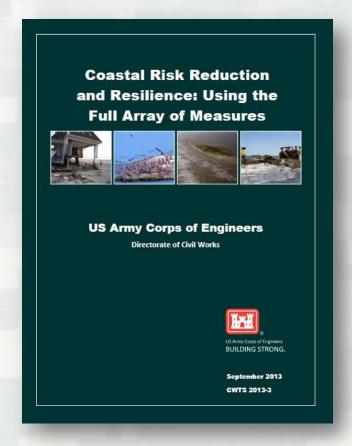


Sustainable Solutions Vision: "Contribute to the strength of the Nation through innovative and environmentally sustainable solutions to the Nation's water resources challenges."



## Systems: Coastal Risk Reduction and Resilience

"The USACE planning approach supports an **integrated approach** to reducing coastal risks and increasing human and ecosystem community resilience through a combination of natural, nature-based, nonstructural and structural measures. This approach considers the engineering attributes of the component features and the dependencies and interactions among these features over both the short- and long-term. It also considers the full range of environmental and social benefits produced by the component features."





#### 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** 

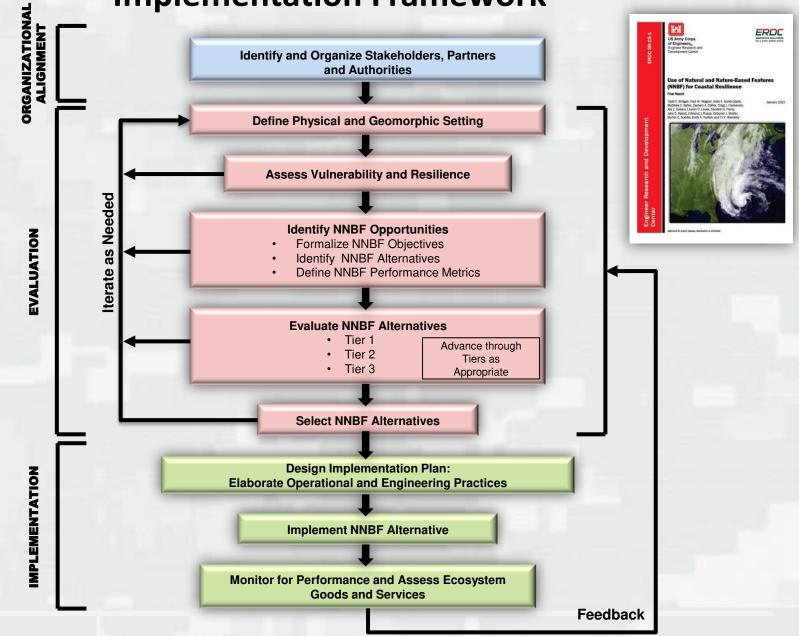
Island elevation, length, and width Land cover Breach susceptibility Proximity to mainland shore Maritime Forests/Shrub Communities

Benefits/Processes

Wave attenuation and/or dissipation Shoreline erosion stabilization Soil retention

Performance Factors

Vegetation height and density Forest dimension Sediment composition Platform elevation Natural and Nature-Based Features Evaluation and Implementation Framework



## 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: <a href="http://el.erdc.usace.army.mil/ewn/workshop.cfm?List=14MayCR">http://el.erdc.usace.army.mil/ewn/workshop.cfm?List=14MayCR</a>



## Communication







d Ports Must Promote

PIANC and IRPT



## **Technical Articles**

and the 33" PLANC World Congress

#### ERDC environmental research supports USACE civi

#### ABSTRACT

With Nature" (EWN) initiative supports stainable development of infrastructure by advancing technical and communication practices in order to intentionally align natural and engineering processes to efficiently and ustainably deliver economic, environmental and social benefits through collaborative processes. The tools and projects that have en developed through EWN support. planning, engineering, and operational engineering and natural systems to produce ore socially acceptable, economically viable,

**Engineering** 

**With Nature** 

**Native Plant** Communities

Using

practical methods provides an achievable path toward an ecosystem approach to navigation infrastructure development. By combining sound science and engineering with advanced ommunication practices, the EWN initiative is oviding a robust foundation for collaborati project development. Engineering With Nature being pursued through innovative research, estrations, communicating lesso learned, and active engagement with field practitioners across a wide range of organisations. The objectives of EWN are

World Association for Waterborne Transport nfrastructure (PIANC) and the "Building with Nature" initiative of EcoShape Foundation, Netherlands.

#### INTRODUCTION

"ENGINEERING WITH NATURE

Pursuing the objective of sustainable both challenges and opportunities for the US rmy Corps of Engineers (USACE). Advancing best practices will involve identifying the practical actions that can be taken to bette align and integrate engineering and natural terns to produce more socially acceptable. economically viable and environmentally sustainable projects. Engineering With Nature (EWN) is a USACE initiative that supports more sustainable practices, projects, and outcomes engineering processes to efficiently and

and social benefits through collaborative Above: Aerial photo of the wetlands at the Mississipp River Gulf Outlet taken in November 2013 as part of the Reneficial Use of Drestand Material Monitoring

Figure 1). The EWN initiativ veloping practical metho achievable path toward an e perations that is applicable

#### projects within the EWN initia

operational efficiencies sup 2) natural processes to maxifootprint of projects, and

quality of project bene 3) approaches that will brose include substantiated eco

4) science-based collaboration organise and focus into and partners to reduce s producing more broadly a

oustomers that balance social, economic and environment factors as part of a

Jelcome Yazmin Seda-Sanabria. High Water Mark Program Brings Awareness & Spearheads Action.

1964 Christmas Flood Awarenes Flood Rarrier Testion and Resilience App Challenge.....

nd resilience of USACE's Civil experiment Station - now U.S. Army Engineer Research and Developsent Center (ERDC) -- as a research ructural engineer in the Geoscience

implementation of risk management

trategies for enhancing the security

By Katie Noised, USACE MR The USACE Office of Homeland Se-curity is pleased to welcome Yazmin Seda-Sanabria as the acting deputy

hief. Ms. Seda-Sanabria is on tem-

elated to Flood Risk Management

orary assignment for the next three

and Structures Division, Geotechn

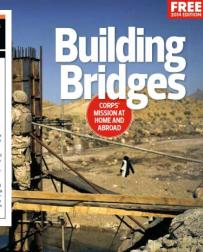
quarters in 2006 as the Executive Direction and Management, genera Division. In 2007, Ms. Seda-Sanabria joined the Office of Homeland Secu-

Ms. Seda-Sanabria holds a bachelor' degree and master's degree in Civil Engineering from the University of Puerto Rico at Mayaguez, She

remment and Defense Award f for her efforts leading to the devel

Dams, and the Sigma Xi Researc

PRIME POWER



TEAM STEM

**U.S. ARMY CORPS OF** 

# **Engagement and Solution Co-Development**



## 2013 EWN Action Demonstration Projects

- 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



## 2014 EWN Action Demonstration Projects

- 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)





# USACE Engineering With Nature Across USACE

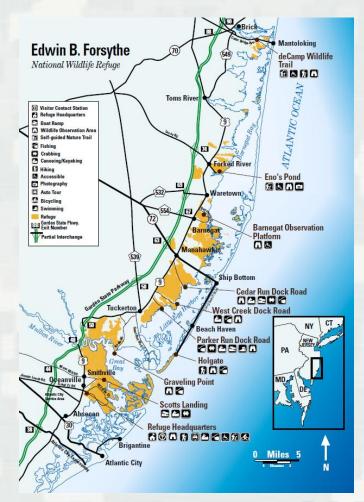
- Collaborating with Philadelphia, Detroit, San Francisco, New Orleans Districts on using sediment to enhance coastal resilience





## Forsythe National Wildlife Refuge

- Forsythe NWR:
   >40,000 acres of wetlands and other habitat in coastal NJ
- Objective: Enhance ecosystem resilience through engineering and restoration
- Means: Apply EWN principles and practices





## Science, Engineering, Technology Research Targets

- Advance understanding of important, fundamental processes
  - ► E.g., sediment transport through wetlands, environmental goods and services provided by engineered features, engineering performance of NNBF
- Improved modeling systems that engage users, stakeholders and decision-makers
  - ► E.g., rapidly deployed, visual interfaces to engage stakeholders in the process, amenable to "what if" evaluation
- Reliable, cost-efficient monitoring technologies for measuring system evolution and infrastructure/feature performance
- Demonstration/pilot project opportunities to innovate, evaluate, and learn at relevant field scales
  - ► Facilitating necessary collaboration
  - Evolving organizational culture and practice
  - ► Producing credible evidence of success







## **Creating Value by Engineering With Nature**

- Value arguments resonate
- Moderate the hyper-focus on environmental risks/impacts from conventional infrastructure
  - NNBF can produce multiple benefit streams
  - ► There are potentially valuable allies in "unlikely" places
- Need for complementing sustainability policies with education and research

