



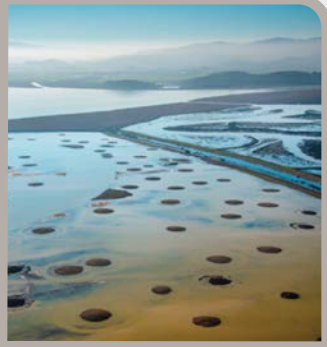
**U.S. ARMY**

# ENGINEERING WITH NATURE: TOWARD SUSTAINABLE SYSTEMS

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WEDA-Gulf; New Orleans, LA  
14 November 2018



**US Army Corps  
of Engineers**

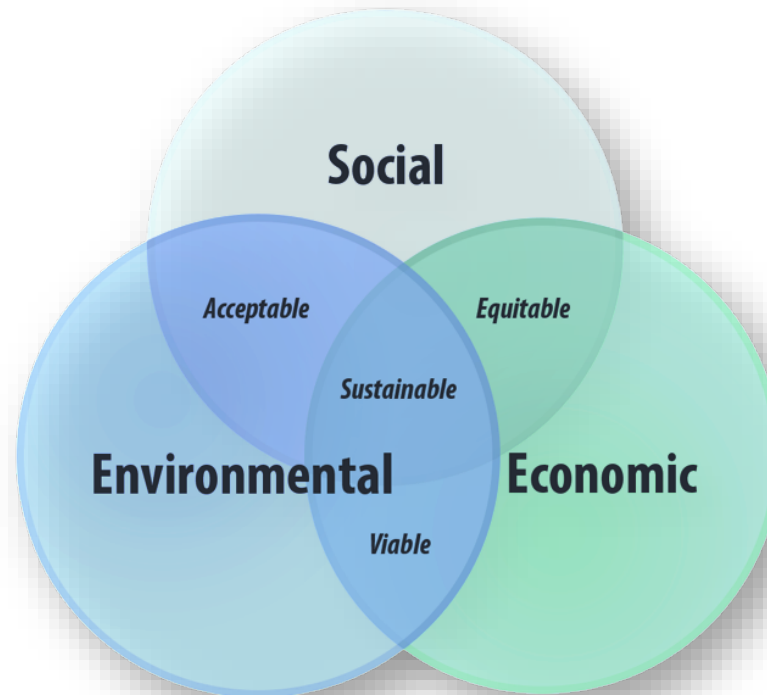


**ERDC**  
ENGINEER RESEARCH & DEVELOPMENT CENTER



# SUSTAINABILITY

Sustainability is achieved by efficiently investing resources to create present and future value



# 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



The Nature Conservancy 

And Many More!



[www.engineeringwithnature.org](http://www.engineeringwithnature.org)

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# EWN<sup>®</sup> OVERVIEW

*Engineering With Nature*<sup>®</sup> began in 2010

- Engaging across USACE, other agencies, NGOs, academia, private sector, international collaborators
- Guided by a strategic plan
- Established through Proving Grounds
  - Galveston, Buffalo, Philadelphia
- Informed by focused R&D
- Demonstrated with field projects
- Advanced through partnering
- Shared by strategic communications
- Marking progress
  - 2013 Chief of Engineers Environmental Award in Natural Resources Conservation
  - 2014 USACE National Award-Green Innovation
  - 2015, 2017 WEDA Awards; 2017 DPC Award



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# EWN<sup>®</sup> ACROSS USACE MISSION SPACE

## Navigation

- Strategic placement of dredged material supporting habitat development
- Habitat integrated into structures
- Enhanced Natural Recovery

## Flood Risk Management

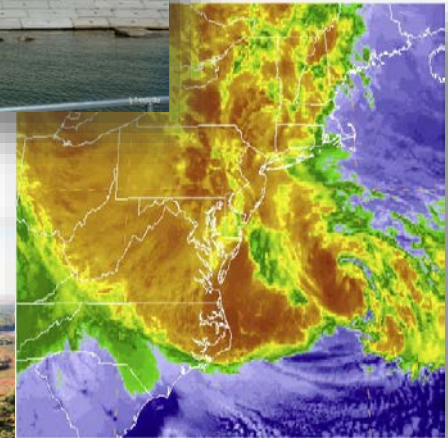
- Natural and Nature-Based Features to support FRM
- Levee setbacks

## Ecosystem Restoration

- Ecosystem services supporting engineering function
- “Natural” development of designed features

## Water Operations

- Shoreline stabilization using native plants
- Environmental flows and connectivity



# A “SUSTAINABILITY LEDGER” FOR SEDIMENT MANAGEMENT

## Efficiency

- Reducing sedimentation in channels & reservoirs
- Reducing transport distances for dredged material
- Reducing dredging time
- Expanding operational flexibility
- Linking multiple projects

## Value Creation

- Restoring natural sediment processes to sustain landscapes
- New nature-based features that reduce flood risks
- Budget space for additional infrastructure work
- New habitat for fish and wildlife
- New features that provide recreational and other social value

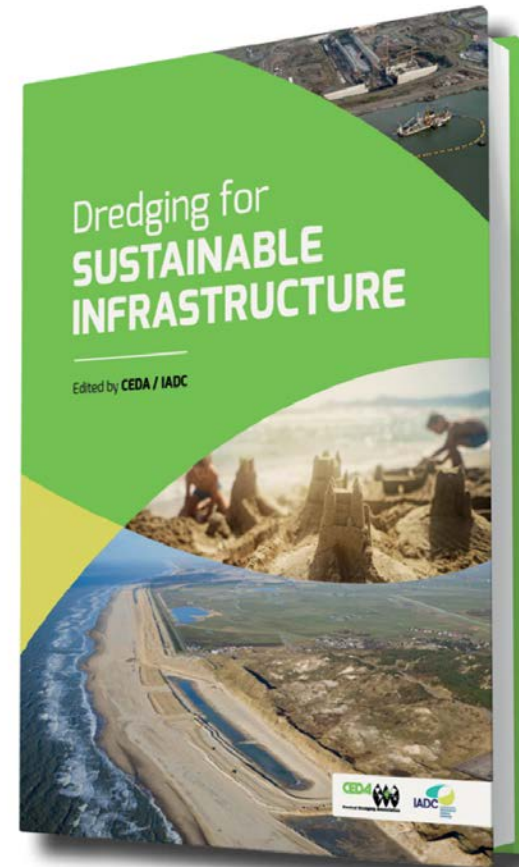
# ***Dredging for Sustainable Infrastructure***

Integrating Dredging with Sustainable Development

By Todd Bridges and Tiedo Velinga

## **Guiding Principles**

- 1. Comprehensive consideration and analysis of the social, environmental and economic costs and benefits of a project is used to guide the development of sustainable infrastructure.*
- 2. Commitments to process improvement and innovation are used to conserve resources, maximize efficiency, increase productivity, and extend the useful lifespan of assets and infrastructure.*
- 3. Comprehensive stakeholder engagement and partnering are used to enhance project value.*



# Middle Harbour Port of Oakland, USA

2018 PIANC *Working with Nature* Award Winner



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# NATURAL AND NATURE-BASED FEATURES

NNBF are landscape features that are developed to provide engineering functions relevant to flood risk management while producing additional economic, environmental and social benefits.



## 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  
Beach 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

# USACE PHILADELPHIA DISTRICT: EWN IN BACK BAY NEW JERSEY



Mordecai Island



Stone Harbor



Avalon

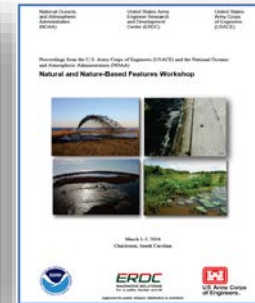
# HORSESHOE BEND ISLAND, ATCHAFALAYA RIVER

- Options for managing DM 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 Awards:
  - 2015 WEDA Award for Environmental Excellence
  - 2017 WEDA Award for CC Adaption
  - 2017 DPC Award for Working, Building, and Engineering with Nature



# COLLABORATION ACROSS GOVERNMENT

## USACE/NOAA Collaboration Workshop: Natural and Nature-based Features, Charleston, SC; 1-3 March 2016



## USACE/NOAA-NMFS Collaboration Workshop Engineering With Nature, Gloucester, MA; October 5-6, 2016

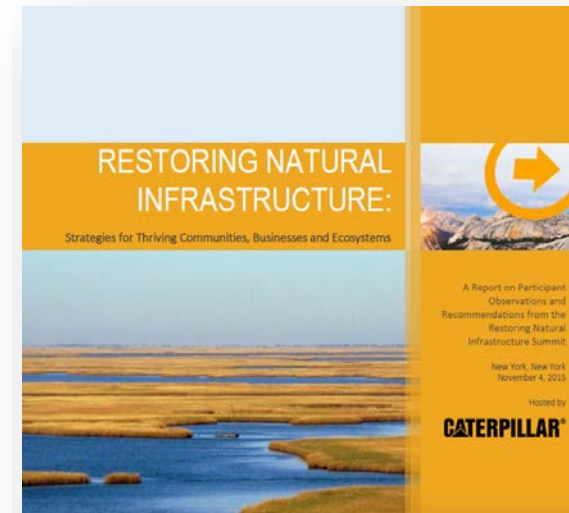


[www.engineeringwithnature.org](http://www.engineeringwithnature.org) (NNBF)

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# COLLABORATION WITH THE PRIVATE SECTOR

- Caterpillar Inc.
  - ▶ Restoring Natural Infrastructure Summit; November 4<sup>th</sup>, 2015; New York City
  - ▶ Natural Infrastructure Initiative – USACE Collaboration Work Streams
    1. NI Opportunity Evaluation Tool. Capitalizing on enterprise-level capability: CE Dredge DST
    2. Evaluation and Decision Making
    3. Field Application and Demonstration
- Western Dredging Association (WEDA)
  - ▶ Collaborative technical workshop on “Construction Methods Supporting Engineering With Nature”



<http://www.caterpillar.com/en/company/sustainability/natural-infrastructure.html>

# COLLABORATION WITH ACADEMIA

- Texas A&M University
  - Partnering through the Coastal Science and Engineering Collaborative (CSEC)
  - Joint research on NNBF
  - EWN Seminar spring 2018
  - Developing graduate curriculum to support EWN



- University of Georgia
  - Institute for Resilient Infrastructure Systems (IRIS)
  - CRADA and Educational Partnering Agreement
  - Multiple levels of collaboration on EWN and NNBF
  - EWN curriculum development



*Institute for Resilient  
Infrastructure Systems*  
UNIVERSITY OF GEORGIA



# COMMUNICATING BEST PRACTICE

## National Large Wood Manual

Assessment, Planning, Design, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function, and Structure

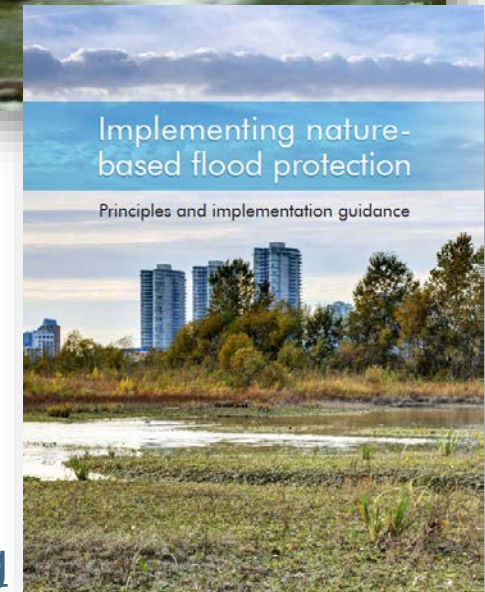
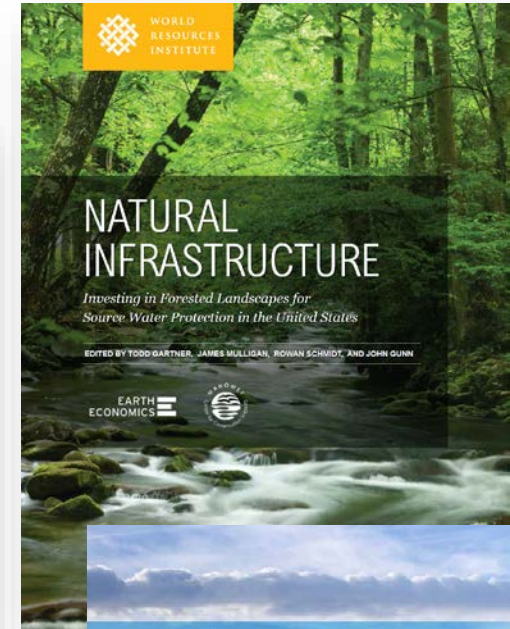
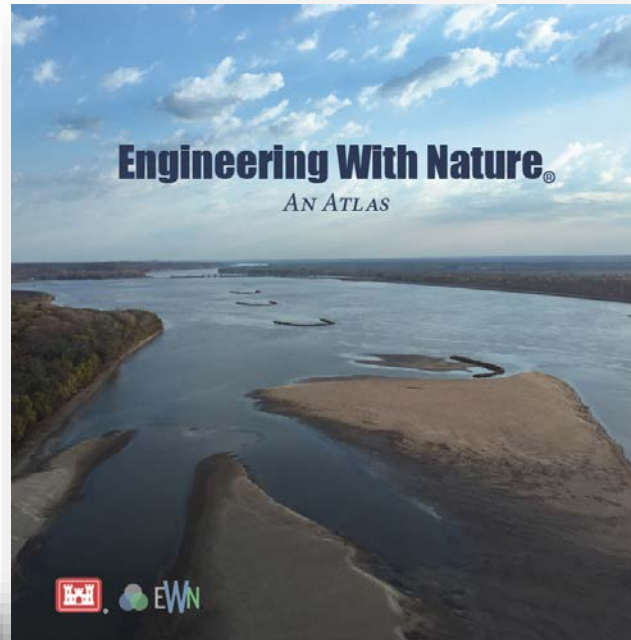
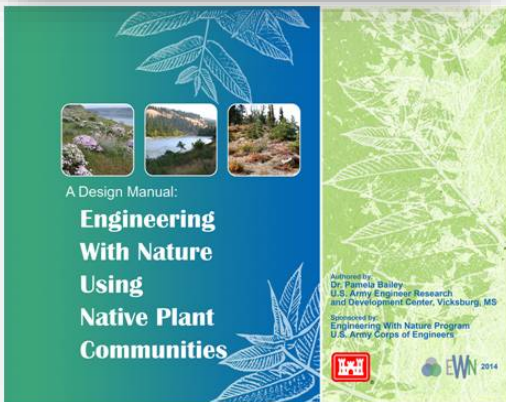
January 2016



U.S. Department of the Interior  
Bureau of Reclamation



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# THE WAY

- Look forward, not back!
  - Where will landscape features create the most value *in the future*?
- Keep it real!
  - Beware of over-design, over-constraint
  - Affordability is key!
  - Strategic placement presents a *real* opportunity
- Innovate!
  - What would it take to get to 100% beneficial use?

