Evolving Dredging Practices to Engineer with Nature

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BUILDING STRONG®
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

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EWN Across USACE Mission Space

- **Navigation**
  - Strategic placement of dredged material supporting habitat development
  - Habitat integrated into navigation 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
**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
Engineering With Nature Elements

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

EWN Elements
Science and Engineering to Improve Operational Efficiency

- USACE operates a lot of navigation projects
  - 1,067 coastal navigation projects
  - 13,000 miles of coastal navigation channels
  - 27 inland river systems with 12,000 miles of channels
  - 236 lock chambers at 192 lock sites
  - 929 navigation structures
  - 844 bridges

- Hundreds of projects in maintenance backlog
Environmental Laws and Regulations Applicable to Dredging

- National Environmental Policy Act of 1969
- Federal Water Pollution Control Act of 1972 (amended and renamed the Clean Water Act in 1977)
- Marine Protection, Research, and Sanctuaries Act of 1972 (commonly called the Ocean Dumping Act)
- Coastal Zone Management Act of 1972
- Endangered Species Act of 1973
- Resource Conservation and Recovery Act of 1976
- Magnuson-Stevens Act as reauthorized by the Sustainable Fisheries Act of 1996
Environmental Restrictions

- The majority of our projects are restricted in terms of:
  - When we operate
    - i.e., dredging windows
  - The equipment we use
    - i.e., dredge type, barge size, etc.
  - How we operate the equipment
    - i.e., disposal site selection, overflow, decanting, discharge rates, etc.
- These restrictions increase operational costs and constrain execution
LONG-TERM CONTINUING ANALYSIS OF DREDGING
U.S. ARMY CORPS OF ENGINEERS DREDGING PROGRAM

- Dollars (in millions)
- Cubic Yards (in millions)

Fiscal Year (1963-2012)

* Includes PL 84-99 and FY 05 Hurricane Katrina Supplemental (PL 109-062) amounts
+ Includes Hurricane Supplemental Work (H5W) amounts
= Includes ARRA amounts

Source Data: http://www.navigationdatacenter.us/db/dredging/ddcost/
Advancing Operational Efficiency…

- More emphasis on the value produced by projects:
  - Economic
  - Social
  - Environmental

- More communication about cost implications associated with environmental restrictions
  - Unnecessary costs reduce project value
Using Natural Systems and Processes to Maximize Benefits

- A key element of sustainable projects
- Examples:
  - Strategic Sediment Placement
    - To support beaches, wetlands, mudflats etc.
  - Natural and Nature-Based Features
  - “Hydraulically Aided Dredging”
    - Water Injection Dredging
    - Agitation Dredging
North Atlantic Coast Comprehensive Study (NACCS)

- Explore opportunities to integrates structural, non-structural and Natural and Nature-Based Features (NNBF) to provide multiple lines of defense against future 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
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

1. Identify and Organize Stakeholders, Partners and Authorities
   - Define Physical and Geomorphic Setting
2. Assess Vulnerability and Resilience
   - Identify NNBF Opportunities
     - Formalize NNBF Objectives
     - Identify NNBF Alternatives
     - Define NNBF Performance Metrics
3. Evaluate NNBF Alternatives
   - Tier 1
   - Tier 2
   - Tier 3
   - Advance through Tiers as Appropriate
4. Select NNBF Alternatives
5. Design Implementation Plan: Elaborate Operational and Engineering Practices
6. Implement NNBF Alternative
7. Monitor for Performance and Assess Ecosystem Goods and Services

Feedback
Advancing the Use of Natural Systems and Processes...

- More emphasis on innovation as a component of project development
- Address uncertainties
  - Expand communication about successes
    - “Yes, it can be done”
    - “Here’s how we did it”
    - The power of the story to persuade
  - Operationalize adaptive management
- Overcome regulatory and procedural inertia
  - Invest in effective coordination and collaboration
  - Identify existing flexibility and make use of it
  - Use demos and pilots to get moving
Expand the Benefits Provided by Projects

- Navigation dredging provides value to the Nation!
  - How?
- Value creation is a key concept in sustainability
  - Economic
  - Social
  - Environmental
Atchafalaya River, Horseshoe Bend

Pre-Disposal (1998) – Natural Mid-River Sandbar

Initial Dredged Material Mounds (2002-2004)

Developed Island with Upriver Feeder Mounds (2010)
Habitat Development

100 acres of diverse wetland habitat
>80 plant species

Mature Forested & Scrub-Shrub Wetlands
Young Forested & Scrub-Shrub Wetlands
Emergent Wetland Transition Zone
Aquatic Bed Features
Avian community

- 9 species of wading birds
- >78% juveniles
- 0.27 birds/ transect m in rookery
- Island design favorable to rookery establishment
Navigation Benefit

Modeling: Implement LTFATE to characterize study area hydrodynamics
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
Collaborative Processes to Engage Stakeholders and Partners

- There are a lot of stakeholders!
  - News Flash: They don’t all care about the same things

- By investing more in stakeholder engagement we can:
  - Accelerate schedules
  - Reduce costs
  - Identify new opportunities to create value
**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
Philadelphia District: Coastal NJ

December 2014

Stone Harbor

Avalon
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
Advancing Collaborative Processes...

- Requires positive leadership within the project team
  - Vision, patience, persistence, commitment, transparency, trust-building...
- Professional help
  - This is more than public relations or meeting facilitation
    - Serious application of social science
- Biggest challenge: overcoming the attitude that dismisses stakeholder collaboration as hogwash
Evolving Practice by *Engineering With Nature*

- Value arguments resonate
- Diversifying project benefits (economic, social, environmental) provides more opportunities for identifying agreeable trade-offs
  - Basis for partnerships
  - Alternative financing
  - Productive negotiation
- Complementing sustainability policies with sound operational practice

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