Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems

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Creating Value through Alignment...

- What opportunities are there for achieving better alignment of natural and engineered systems?
  - Can improved alignment reduce risks to life, property and ecosystems?
  - 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.”
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

www.engineeringwithnature.org
Value and Use of Natural Systems

Following Hurricane Sandy:

• Risk industry-based tools used to quantify the economic benefits of coastal wetlands
  • Temperate coastal wetlands saved more than $625 million in flood damages.
  • In Ocean County, New Jersey, salt marsh conservation can significantly reduce average annual flood losses by more than 20%.
The North Atlantic Coast Comprehensive Study

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
- **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
NACCS NNBF Framework

Organizational Alignment
- Identify and Organize Stakeholders, Partners and Authorities
  - Define Physical and Geomorphic Setting
  - Assess Vulnerability and Resilience
    - Identify NNBF Opportunities
      - Formulate NNBF Objectives
      - Identify NNBF Alternatives
      - Define NNBF Performance Metrics
    - Evaluate NNBF Alternatives
      - Tier 1
      - Tier 2
      - Tier 3
    - Select NNBF Alternatives
      - Design Implementation Plan:
        - Elaborate Operational and Engineering Practices
        - Implement NNBF Alternative
        - Monitor for Performance and Assess Ecosystem Goods and Services

Evaluation
- Feedback
  - Define Physical and Geomorphic Setting
  - Assess Vulnerability and Resilience
  - Identify NNBF Opportunities
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Implementation
- Feedback
The Private Sector: Caterpillar Corporation’s
*Restoring Natural Infrastructure Summit*
4 November 2015, New York City

Exploring nature-based solutions: the role of green infrastructure in mitigating the impacts of weather- and climate change-related natural hazards

“...instead of automatically defaulting to grey solutions like dikes and pipes for flooding, we first should look at restoring floodplains or wetlands. Rather than building sea walls, we need to think about conserving sand banks...Planners should compare green to grey and identify new opportunities for investing in nature, including a combination of green and grey approaches when nature-based solutions alone are insufficient. As planners explore how to accommodate infrastructure demands in the future, the lesson is clear: think about green before investing in grey.”

EEA Technical Report No 12/2015
World Bank Principles and Implementation Guidance for Nature-Based Flood Protection

NBFP Workshop, 11-13 April 2017
Laws and Mandates:
Water Infrastructure Improvements for the Nation Act (WIIN Act) 2016

SEC. 1184. Consideration of measures.
(a) Definitions.—In this section, the following definitions apply:
(1) NATURAL FEATURE.—The term “natural feature” means a feature that is created through the action of physical, geological, biological, and chemical processes over time.
(2) NATURE-BASED FEATURE.—The term “nature-based feature” means a feature that is created by human design, engineering, and construction to provide risk reduction in coastal areas by acting in concert with natural processes.
(b) Requirement.—In studying the feasibility of projects for flood risk management, hurricane and storm damage reduction, and ecosystem restoration the Secretary shall, with the consent of the non-Federal sponsor of the feasibility study, consider, as appropriate—

(1) natural features;
(2) nature-based features;
(3) nonstructural measures; and
(4) structural measures.
HIGH-LEVEL DECLARATION
Nature-based solutions for water under climate change

We, representatives of governments, international and national organizations, donors, national and transboundary basin organizations, local authorities, civil society and companies, research organizations, support the integration of nature-based solutions into the Marrakech Partnership for Global Climate Action.

We commit to:

- Include nature-based solutions in our international, regional, national, basin and local long-term strategies and policies on climate change and resources management.

- Raise awareness on the necessity to operationalize research works on nature-based approaches by promoting nature-based solutions and this declaration towards our peers.

- Make sure that nature-based solutions are providing co-benefits for human well-being and development as well as biodiversity.
Collaboration: USACE – NOAA Workshop on Natural and Nature-Based Features
Charleston, SC; 1-3 March 2016

www.engineeringwithnature.org (NNBF)
Fort Pierce City Marina, Florida
USACE Philadelphia District: Back Bay NJ

Mordecai Island

Stone Harbor

Avalon
Onehunga Bay Foreshore Restoration
Auckland, New Zealand
Humber Estuary; Alkborough, UK
(Increased Flood Storage Capacity)
Chehalis Basin Floodplain Restoration
Noordwaard, The Netherlands
International Guidelines on the Use of Natural and Nature-Based Features for Sustainable Coastal and Fluvial Systems

Purpose: Develop guidelines for using NNBF to provide engineering functions relevant to flood risk management while producing additional economic, environmental and social benefits.

- Publish NNBF technical guidelines by 2020:
  - Multi-author: government, academia, NGOs, engineering firms, construction companies, etc.
  - Addressing the full project life cycle: planning, design, engineering, construction, and maintenance
  - Guidelines in 4 Parts
    - Overarching
    - Coastal Applications
    - Fluvial Applications
    - Conclusions
Guidelines Table of Contents

Part 1: Informing the Use of NNBF
- Preface/Definitions
- Introduction
- Principles for Use of NNBF in Coastal and Fluvial Systems
- Community Engagement
- General NNBF Framework
- System Considerations and Combining Elements
- Analysis of NNBF Benefits
- Monitoring, Maintenance, and Adaptive Management

Part 2: Coastal Systems
- Introduction
- Beaches and Dunes
- Wetlands and Intertidal Areas
- Islands
- Reefs
- Sub-Aquatic Vegetation
- Upland Plant Communities
- Enhancing Environmental Value of Conventional Infrastructure

Part 3: Fluvial Systems
- Introduction
- Applying NNBF at Watershed Scale
- Applying NNBF at Sub-Watershed Scale
- Naturalizing Techniques

Part 4: Conclusion
- Summation and Future Directions
Development Approach

- Voluntary project team
- Editorial Board
- Individual Chapter Teams, with Co-Leads
- Peer review of final product
- Periodic, in-person working meetings combined with virtual engagement and drafting
International NNBF Guidelines:
Team Meeting #1; United States; Vicksburg, MS; 25-26 October, 2016
International NNBF Guidelines:
Team Meeting #2; United Kingdom;
10-13 July, 2017
The Pursuit of Resilience...

“I endeavor to keep their attention fixed on the main objects of all science, the freedom & happiness of man.”

Thomas Jefferson to Tadeusz Kosciuszko, 1810

The Battlefield at Saratoga

"The great tacticians of the campaign were hills and forests, which a young Polish engineer was skillful enough to select for my encampment.” Major General Horatio Gates