Utilizing Nature-Based Solutions to Enhance Flood Resilience & Recovery

October 24, 2017
Agenda

- Introduction to natural and nature-based solutions
- Approaches, case studies, and resources
- Considering natural and nature-based solutions for redevelopment and recovery
- How these approaches fit into FEMA programs
What are Nature-Based Solutions?

- Landscape
- Community and Site
- Shoreline
Benefits Provided

- Buffer wave action and storm surge
- Store floodwaters, recharge aquifers
- Reduce runoff, improve water quality and clarity
- Stabilize shorelines
- Provide habitat for fish and wildlife
- Offer recreational, job opportunities
- Protect property and improve property value (aesthetics)
- Many more!
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[coast.noaa.gov/digitalcoast/training/gi-benefits]
Using Nature-Based Solutions to Reduce Hazard Impacts

Harvey, Texas

Irma, St. Thomas

Maria, Puerto Rico

Sandy, New Jersey
Coastal Flood Exposure Mapper

Select the Flood Hazards Map or One of the Community Exposure Maps

Select a section below to view maps showing flood hazards or different aspects of community exposure to those flood hazards.

- **Flood Hazards**: Flooding events are among the more frequent, costly, and deadly hazards that can impact coastal communities. There are two types:
  - Short-term (episodic) – Temporary flooding caused by extreme conditions, including storm surge, tsunami, inland flooding, and shallow coastal flooding.
  - Long-term (chronic) – Flooding caused by a rise in relative sea level.

- **Societal Exposure**: Understanding the populations that live in or near coastal flood-prone areas is an important information need, since residents who are elderly, who live in high-density areas, or who are impoverished may merit special considerations.

- **Infrastructure Exposure**: Community infrastructure, including roads, bridges, and water and sewer systems, can be damaged by coastal flooding. Communities should first assess infrastructure vulnerabilities and associated environmental and economic issues to determine what steps are needed to protect these assets.

- **Ecosystem Exposure**: Natural areas provide important benefits to coastal communities, including hazard protection, flood storage, water quality maintenance, fisheries support, and recreational opportunities. Communities can increase resilience by protecting natural areas along the coast that are exposed to flooding and adjacent inland areas.

coast.noaa.gov/digitalcoast/tools/flood-exposure
Coastal Flood Exposure Mapper

- Shallow Coastal Flooding
- FEMA Flood Zones
- Storm Surge
- Sea Level Rise

Visit coast.noaa.gov/digitalcoast/tools/flood-exposure for more information.
Polling Question #1

Which of the following terms resonate most with you and your stakeholders?

A. Green Infrastructure

B. Natural and Nature-Based Solutions

C. Natural Capital

D. Nature-Based Infrastructure or Natural Infrastructure

E. Other

F. None. Not familiar with the topic.
Landscape Approaches

**Area**
- Better
- Worse

**Proximity**
- Better
- Worse

**Connectivity**
- Better
- Worse
Landscape Approaches
Resource: How To Map Open Space for Community Rating System Credit

How to Map Open Space for Community Rating System Credit

Coast.noaa.gov/digitalcoast/training/crs

FEMA
Low Impact Development Practices

Bioretention (Infiltration and Filtering)
- Rain gardens
- Bioswales
- Stormwater planters

Green Roofs (Storage and Evapotranspiration)
- Blue roofs
- Cisterns

Permeable Pavements (Infiltration)
- Porous asphalt or concrete
- Grass or gravel pavers
- Pavers
Community and Site Approaches

Green Streets

- Key linking component in green infrastructure network
- Design dependent on local conditions but generally includes
  - Alternative street widths
  - Swales
  - Bioretention
  - Permeable pavements
- Provides multiple benefits
Case Study: Toledo, OH
Building Momentum for Green Infrastructure Implementation

Guide - coast.noaa.gov/digitalcoast/training/gi-cost-benefit

Case Study - coast.noaa.gov/digitalcoast/training/toledo-green-infrastructure
Case Study: Toledo, OH
Building Momentum for Green Infrastructure Implementation

Community and Site Approaches
Resource: Green Infrastructure Effectiveness Database

cost.noaa.gov/digitalcoast/training/gi-database
Community and Site Approaches
Resource: Green Infrastructure Effectiveness Database

coast.noaa.gov/digitalcoast/training/gi-database
Shoreline Approaches

Natural

Dunes and Beaches
- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer

Salt Marshes, Wetlands, Vegetation, Submerged Aquatic Vegetation
- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer
- Increase infiltration

Oysters and Coral Reefs
- Break offshore waves
- Attenuate wave energy
- Slow inland water transfer

FEMA

RiskMAP
Increasing Resilience Together
Hybrid

- Blends both nature-based and structural approaches
- Dissipates wave energy from structural practices
- Ecosystem service benefits from nature-based practices
Green Infrastructure Techniques for Coastal Highway Resilience

FHWA encourages the use of ecosystem-based approaches in adapting to climate change (see FHWA and DOT policy orders). Ecosystems provide valuable services that help to build resilience and reduce the vulnerability of people, livelihoods, and infrastructure to climate change impacts.

The FHWA Administrator dedicated a portion of the agency’s annual Strategic Initiatives research budget to a project that will provide state and local transportation agencies with research, outreach, and technical assistance on green infrastructure, ecosystem-based approaches for improving coastal highway resiliency. While green infrastructure can be used in both coastal and inland environments, this project focuses on coastal areas.

Coastal green infrastructure includes dunes, wetlands, living shorelines, oyster reefs, beaches, and artificial reefs. These features can protect coastal transportation infrastructure from the brunt of storm surges and open water waves. Some can adapt to sea level rise by accreting sediment or migrating inland.

This webpage contains:

- Information on the strategic initiatives project, Green Infrastructure Techniques for Coastal Highway Resilience.
- Current resources that can assist transportation agencies considering green infrastructure approaches to coastal resiliency.
- A compilation of examples of green infrastructure projects designed to protect coastal highways.

www.fhwa.dot.gov/environment/sustainability/resilience/ongoing_and_current_research/green_infrastructure/
Case Study: Coastal Maryland
Living Shorelines Projects to Protect Coastal Roadways

dnr.maryland.gov/ccs/Pages/livingshorelines.aspx
Case Study: Maryland Department of Natural Resources
Living Shorelines Projects to Protect Coastal Roadways

<table>
<thead>
<tr>
<th>Creek or Cove</th>
<th>Minor River</th>
<th>Major Tributary</th>
<th>Chesapeake Bay</th>
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<tr>
<td>Water depth (ft)</td>
<td>1</td>
<td>1 to 2</td>
<td>2 to 4</td>
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<tr>
<td>Fetch (miles)</td>
<td>0.5</td>
<td>1 to 1.5</td>
<td>2 or more</td>
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<tr>
<td>Erosion (ft/yr)</td>
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<td>2 to 4</td>
<td>4 to 8</td>
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<td>Wave energy</td>
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<td>medium</td>
<td>medium</td>
</tr>
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<td>Type</td>
<td>Non-structural:</td>
<td>Hybrid:</td>
<td>Structural:</td>
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<td></td>
<td>Beach replenishment</td>
<td>Marsh fringe with stone groins</td>
<td>Bulkheads</td>
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<td></td>
<td>Fringe marsh creation</td>
<td>Marsh fringe with stone sills</td>
<td>Revetments</td>
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<tr>
<td></td>
<td>Marshy Islands</td>
<td>Marsh fringe with stone breakwaters</td>
<td>Stone reinforcing</td>
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<tr>
<td></td>
<td>Coir logs edging and groins</td>
<td>Marsh edging with stone</td>
<td>Pre-case concrete units</td>
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<tr>
<td></td>
<td></td>
<td>Stabilization of streambanks with vegetation and stone</td>
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<tr>
<td></td>
<td></td>
<td>Stone breakwaters with beach replenishment and appropriate vegetation</td>
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<tr>
<td>Cost per linear foot</td>
<td>$100 - $200</td>
<td>$350-$400</td>
<td>$450-$600</td>
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http://dnr.maryland.gov/ccs/Pages/livingshorelines.aspx
<table>
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<tr>
<th>PROJECT NAME</th>
<th>COUNTY</th>
<th>ROADWAY LOCATION</th>
<th>LIVING SHORELINE PROJECT TYPE</th>
<th>LENGTH (L.F.)</th>
<th>PROJECT COST</th>
<th>DATE COMPLETE</th>
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<td>Bay Ridge SECD</td>
<td>Anne Arundel</td>
<td>Bay Drive</td>
<td>Breakwaters</td>
<td>2,250</td>
<td>$1,039,910</td>
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<td>Town of Vienna</td>
<td>Dorchester</td>
<td>Water Street</td>
<td>Stone Sill</td>
<td>305</td>
<td>$157,472</td>
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<td>Our Lady Star of the Sea</td>
<td>Calvert</td>
<td>Solomon’s Is. Road</td>
<td>Stone Groins</td>
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<td>$144,987</td>
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<td>Columbia Beach SECD</td>
<td>Anne Arundel</td>
<td>Crowner Road</td>
<td>Stone Sill</td>
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<td>$485,000</td>
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<td>Anne Arundel</td>
<td>Wiltshire Lane</td>
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<td>Gibson Road</td>
<td>St. Mary's</td>
<td>Gibson Road</td>
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<td>Town of Charlestown LS project</td>
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<td>Baltimore-Colonial &amp; Tasker Lane</td>
<td>Revetment/Groins</td>
<td>677</td>
<td>$319,900.00</td>
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<td>Dorchester County (tire recycling center) LS project</td>
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<td>Stone Sill</td>
<td>627</td>
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<td>Mid-Hoopers Island Rd</td>
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<td>Hoopers Island Road</td>
<td>Breakwaters</td>
<td>1200</td>
<td>$552,963.00</td>
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<td>McCready’s Point Rd</td>
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<td>McCready’s Point Rd</td>
<td>Breakwaters</td>
<td>330</td>
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<td><strong>TOTALS:</strong></td>
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<td><strong>9,747</strong></td>
<td><strong>$3,711,239.00</strong></td>
<td></td>
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</table>
Shoreline Approaches
Resource: Natural and Structural Measures for Shoreline Stabilization

sagecoast.org/info/information.html
Shoreline Approaches
Resource: Introducing Green Infrastructure for Coastal Resilience Training

Introducing Green Infrastructure for Coastal Resilience

Course Description
Natural and nature-based green infrastructure practices can play a critical role in making coastal communities more resilient to natural hazards. In this introductory course, participants review fundamental concepts and examine various practices. Local speakers share their expertise and the ways these techniques have been integrated into local planning processes.

Course participants from land use planning, conservation planning, hazard mitigation, stormwater management, floodplain management, and local government departments will make valuable connections with new and experienced practitioners who are moving green infrastructure projects forward in their communities.

coast.noaa.gov/digitalcoast/training/green
Nature-Based Solutions
Redevelopment and Recovery

A VISION OF
SUSTAINABLE GROWTH

www.civicarena-redmap.com
Nature-Based Solutions
Considerations for Redevelopment
Nature-Based Solutions
Considerations for Recovery

http://www.naturebasedrecovery.com/2017/02/24/1.html

www.rivernetwork.org/case-study/green-streets-restoring-rivers-revitalizing-neighborhoods-making-streets-safer/

mic.com/articles/184365/emotions-are-mixed-as-florida-residents-assess-hurricane-irma-damage-returning-home-and-to-work#.1VGiP1hJG
Case Study: Meriden, CT
Combining Flood Control and Economic Revitalization

Image Source: Civil Engineering Magazine, June 2017
Case Study: Meriden, CT
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Nature-Based Solutions
Resource: Naturally Resilient Communities Website

EXPLORE THE DIFFERENT TYPES OF NATURE-BASED SOLUTIONS

WATERFRONT PARKS

Studies show parks increase property values and municipal tax revenues. LEARN MORE

COASTAL FLOODING & EROSION  RIVER FLOODING & EROSION  URBAN STORMWATER FLOODING

FIND YOUR SOLUTION

FEMA
nrcsolutions.org
COASTAL HAZARDS

Coastal flooding occurs either as a result of storms, causing wide ranging impacts, or regular tidal cycles, resulting in more frequent, low impact flooding in low lying areas. Coastal erosion is the collapse or loss of land along coastal areas as a result of floods or regular waves.
Nature-Based Solutions
Resource: Naturally Resilient Communities Website
nrcsolutions.org
How do Nature-Based Solutions Fit into FEMA Programs?

Resource: EPA Fact Sheet

• Fit under the category “Minor Localized Flood Reduction Projects”

• Eligible efforts include measures that reduce flood losses for single structures or facilities, utilities or roads and bridges, groups of structures, or entire neighborhoods.

• Hazard mitigation planning-related activities are also eligible for HMA funding.

• If the project on the property is being proposed for acquisition through FEMA funding, environmental benefits may be included in the benefit-cost analysis.

Polling Question #2

Have you or your office been involved in a project that has utilized nature-based solutions?

A. Yes and it was effective

B. Yes and it was ineffective

C. No, but would appreciate or look forward to more from FEMA on integrating these approaches.

D. No
Polling Question #3 *REQUIRED FOR ASFPM CEC*

What additional information do you need to move nature-based solutions forward in your work?

A. Training

B. Funding Mechanisms

C. Communications Products & Visualizations

D. Economic/Financial/Cost-Benefit Data

E. Other
Key Takeaways

- Be aware of the specific hazard of concern, the benefits different natural infrastructure techniques can provide, and the surrounding land use that will impact the technique implemented.

- Engage key stakeholders throughout the process so you are implementing natural infrastructure techniques that provide multiple benefits that stakeholders value.

- Redevelopment and recovery are opportunities. Be sure to promote proactive solutions such as modified zoning, strengthening building standards, and the implementation of nature-based solutions as part of the longer term vision of enhanced resilience.
Questions?

Lauren.Long@NOAA.gov

Bradley.Dean@MBakerIntl.com
Q&A and Discussion

Please use the chat box and send your questions to Victoria
In the chat box, send the following information to “Taylor Kennedy”:

Name, email address, and state
Ex: Jane Doe, jdoe@gmail.com, Georgia