North Atlantic Coast Comprehensive Study

Reducing Risk & Building Resiliency following Hurricane Sandy – Natural and Nature-based Infrastructure

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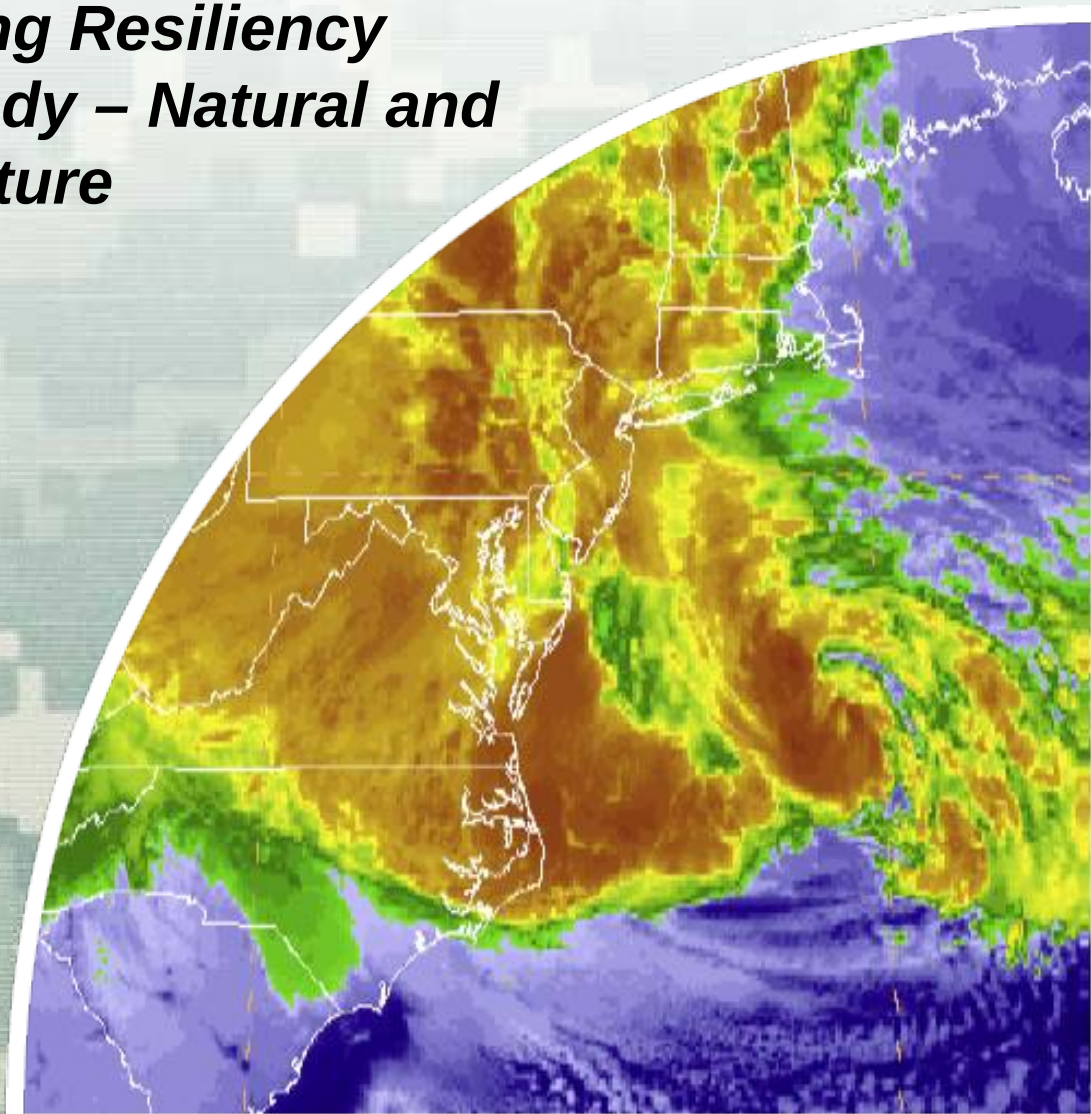
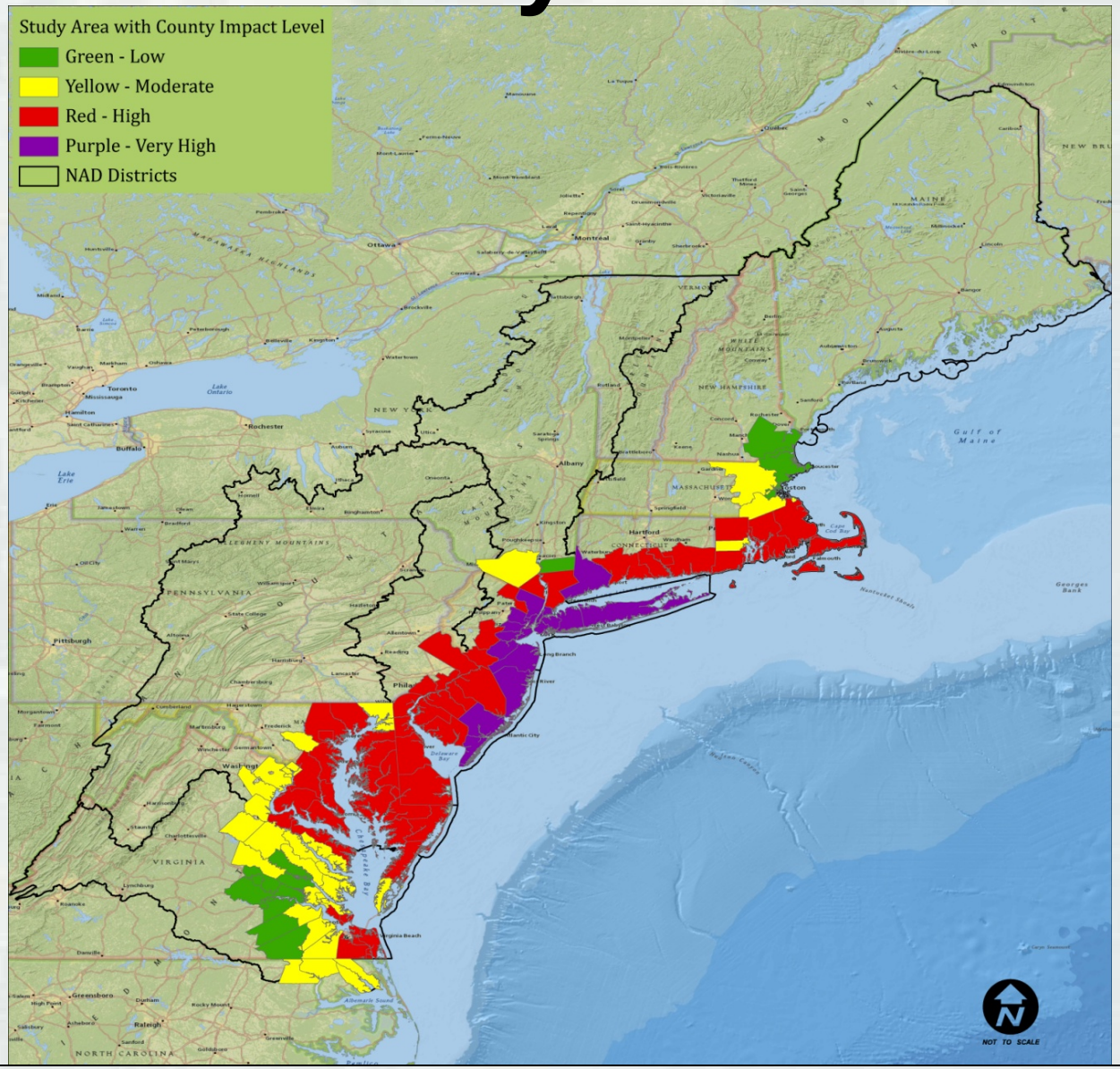


Study Area



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Outline

- Study goals.
  - Meeting those goals with infrastructure.
- What is green infrastructure, natural and nature-based infrastructure, and how has our language evolved to help provide clarity?
- Specific goals for NBI team.
- NBI team tasks and progress.
- Recent meeting outcomes.
- Next steps.

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Goals

1. **Provide Risk Reduction Framework**– Reduce risk to which vulnerable coastal populations are subject.

2. **Promote Coastal Resilient Communities** – Ensure a sustainable and robust coastal landscape system, considering future sea level rise and climate change scenarios, to reduce risk to vulnerable population, property, ecosystems, and infrastructure.

*Consistent with USACE-NOAA Rebuilding Principles

Our Team needs to consider how natural and nature-based infrastructure (NBI), and green infrastructure (GI) can help meet these goals.

Green Infrastructure

- "'…is a **strategically planned** and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value that **supports native species, maintains natural ecological processes, sustains air and water resources, and contributes to the health and quality of life for America's communities and people**"'(2006).

… it is important to **avoid confusing green building and green infrastructure**…**[and] best management practices that are used in concert to achieve** a **low impact development** strategy(LID).

From: A Short History of the Term Green Infrastructure and Selected Literature, by Karen Firehock (January 2010).

Our Measures Meeting Definition

- …**the intentioned use of natural and engineered features to produce engineering functions in combination with ecosystem services and social benefits**.

- In the context of the NACCS, GI referred to features that produce engineering functions in the form of contributions to coastal resilience and storm risk reduction.

- Definition covered some traditional GI and some things not always thought of as GI; clarity needed.

Seeking Clarity and Avoiding Confusion

- *Natural and nature-based infrastructure** is part of the portfolio of risk management measures considered by USACE for risk reduction and includes a spectrum of features, ranging from those that exist due exclusively to the work of natural processes to those that are the result of human engineering and construction.

- Natural features are created through the action of physical, biological, geologic, and chemical processes operating in nature, whereas nature-based features are created by human design, engineering, and construction.

- Recent USACE whitepaper describes distinctions between natural, nature-based, nonstructural, and structural coastal risk reduction infrastructure that the USACE considers as parts of its portfolio of risk management measures. Other terminology has and will continue to be used by our partners and stakeholders to describe the use of environmental systems to accomplish multiple purposes.

*Draft of our proposed definition – not formally adopted.

Coastal Risk Reduction & Resilience Measures

Measure	Definition	Effect	Examples
Natural	Created through the action of biochemical and physical processes operating in nature	Shoreline erosion control, wave and surge attenuation, especially in low-energy environments; additional resilience benefits; performance difficult to quantify	Barrier islands, dunes, reefs, wetlands, and riparian corridors
Nature-Based	Products of planning, engineering design, and construction incorporating natural processes that contribute to coastal risk reduction and resilience	Shoreline erosion control, wave and surge attenuation, especially in low-energy environments; performance difficult to quantify	
Non-Structural	Products of public policy, management and regulatory practices; may include pricing schemes, planning, engineering design, and construction	Modify or avoid the impacts of the hazard (vs. modifying the hazard); quantifiable performance	Structure acquisitions or relocations, flood proofing of structures, implementing flood warning systems, flood preparedness planning, land use regulations, development restrictions within the greatest flood hazard areas, elevated development, managed retreat, evacuation, buyout and leaseback
Structural	Products of planning, engineering design, and construction	Shoreline erosion control, wave and surge attenuation, reduced flooding; quantifiable performance	Levees, storm surge barrier gates, seawalls, groins, revetments, and near-shore breakwaters

NBI Team Goals

- Evaluate the performance of NB & GI during Superstorm Sandy and other recent storms to identify features that were especially resilient to storms.

- Consider the use of NB & GI to reduce the impacts of coastal storm flooding, erosion, etc. at a larger scale and as a system.

NBI Tasks Under NACCS

- Define resilience with respect to NB & GI.
- Identify NB & GI characteristics of natural systems.
- Identify categories of NB & GI that can contribute to resilience.
- NB & GI data integration.
- Develop performance metrics for NB & GI.
- Develop vulnerability metrics.
- Develop NB & GI evaluation framework.
- Apply the NB & GI evaluation framework.
- Evaluation Framework for NB & GI: Ecosystem goods and services.

TASK - NBI Characterization

- Characterize NBI contribution to resilience and risk reduction:
  - **Define resilience with respect to NB & GI:** Develop the conceptual linkage between resilience and NB & GI. Clarify concepts and terminology. Summarize and analyze relevant literature and examples activities, efforts, and programs. Synthesize this information explaining the need and role of GI for risk reduction and coastal resilience.
  - **Identify NB & GI characteristics of natural systems:** Characteristics of natural systems that are associated with green infrastructure, to be identified and collected for use in developing the categorization and performance metrics.
  - **Identify categories of NB & GI that can contribute to resilience.** Develop a classification/categorization scheme for types of GI relevant to the region. Identify existing NBI & GI in the region. Capture examples of categories in a GIS database for the region. Develop information on representative costs for categories.

TASK – NB & GI Data Integration and Metrics.

- Support analysis and development of metrics; summarization and communication critical to promoting increased understanding of risks and consequences. Incorporate data from stakeholder.
  - **Data integration:** GIS ID/characterization of GI & NBI; including consideration of natural characteristics, type of infrastructure services (e.g., coastal vs. stream buffers) and land management context (e.g., conservation easements, refuges, etc).
  - **Develop performance metrics for NB & GI:** Produce matrix of performance metrics relevant to economic/engineering, environmental, and social objectives/benefits. Consider green infrastructure in reducing coastal storm flooding, erosion, etc. at a larger scale and as a system. Document examples.
  - **Develop vulnerability metrics:** Develop vulnerability metrics to determine and communicate relative vulnerability of the impacted coastline and green infrastructure systems under current and future conditions.

    Identify stressors that exacerbate or increase vulnerability.

TASK - Evaluation Framework

- Develop a framework for evaluating NBI performance with respect to resilience:
  - **Develop evaluation framework:** Tiered evaluation framework for analyzing the contribution of NB & GI categories to system resilience beginning with evaluation based on expert elicitation, progressing through tiers using greater levels of quantitative and engineering analysis.
  - **Apply the GI evaluation framework:** Apply framework to Task 1 categories of NBI/GI with respect to selected performance metrics developed in Task 2. Evaluate how existing regional NBI & GI performed in response to Sandy. Evaluation scenarios will be developed to represent a range of future conditions (e.g., storm conditions, sea-level rise, development patterns, etc.).
  - **Characterize Ecosystem Goods and Services:** Provide an organized, descriptive and numerical depiction of the level of ecosystem service benefits provided by selected coastal ecosystem restoration projects within the North Atlantic Division's Area of Responsibility.

TASK - Policy and Barriers Assessment

- Examination of policies and barriers to achieving green infrastructure actions to create resilience will be performed with collaboration from stakeholders.

- Will examine state and local policies that support GI/NBI preservation or restoration.

- Will ID hurdles to working with other agencies on the development and implementation of the resilience plan and investigate the use of other funds and resources to carry out green infrastructure actions that contribute to resilience of the region.

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TASK - Communication

- A communications team working across the above tasks will integrate NB and GI information, vulnerability analysis, and scenario analysis into a communications document for partners and stakeholders.

- The document will include an atlas that will identify the region's NB and GI , where it is, why it is important, and how additional NB and GI can help reduce vulnerabilities.

- Vulnerability maps and rankings will also be included for the various scenarios developed.

NACCS NBI/GI Progress

- NAD, ERDC, and IWR on schedule for task deliverables.

- Successful measures meeting held for multiple NACCS teams (beyond NBI).
  - Additional NBI meetings planned.

Objectives of June 26-27 Meeting

1. Bring together diverse groups to gather input and discuss how to reduce risk and promote resiliency for those areas affected by Hurricane Sandy.

2. Identify new, proven and innovative actions, measures and techniques that can reduce risk and promote resiliency along the coastline.
   - Compile measures and combinations of measures.
   - Diverse set of measures per shoreline type or geographic area/land use type.
   - Describe benefits, challenges, etc of measures and combinations of measures.
   - Identify likely set of appropriate measures per reach and resultant risk reduction.

* NBI was only one component of many.

Developing Measures List

Measure Category	Measure	Benefits					Feasibility				
		Carbon capture	Ecological / env benefit	Socio-economic	Flood risk management	Shoreline stabilization	Cost	Technical	Ease of permitting	Neg env impacts	Property ownership
Green Infrastructure	**Protection creation and management of buffering habitats:**										
Green Infrastructure	Creation of current and future buffering habitats: wetland, coastal wetlands, tidal flats, sea Grass- and other submerged aquatic vegetation, maritime	H	H	M - H	L-M	M	H	L	M-H	0	H
Green Infrastructure	Beneficial use of dredged material for wetland restoration	L	H	L-H	L	L- M	H	M	M-H	L	L
Green Infrastructure	Soft solutions to bulkheads- Greening Sills and Berms	L-H	M	L	L	H	M	M	L-M	L	L
Green Infrastructure	Feeder beach	L	L	M-H	L-M	M	H	L	L-H	L-M	L
Green Infrastructure	Protection of current and future buffering habitats: wetland,	H	H	M - H	L-M	M	L-M	L	M-H	0	H
Green Infrastructure	Acquisition (policy) of current and future buffering habitats: wetland, coastal wetlands, tidal	H	H	M - H	L-M	M	M-H	L	M-H	1	H

Protection creation and management of buffering habitats:	**Protection creation and management of buffering habitats:**	**Sediment management:**
Creation of current and future buffering habitats: wetland, coastal wetlands, tidal flats, sea Grass- and other submerged aquatic vegetation, maritime forests, river banks, shorelines, barrier islands	Restoration of current and future buffering habitats: wetland, coastal wetlands, tidal flats,	Inlet/Sediment Management
Beneficial use of dredged material for wetland restoration	Near shore reefs	Strategic placement of sediment
Soft solutions to bulkheads- Greening Sills and Berms	Oyster/Mussel Reefs	**TBD:**
Feeder beach	**Water storage/ Stormwater management:**	Recover and Release- Appropriate for archeological and historic areas
Protection of current and future buffering habitats: wetland, coastal wetlands, tidal flats,	Flume Repair/ Fish Passage Dual Use	Landscaping filling onshore
Acquisition (policy) of current and future buffering habitats: wetland, coastal wetlands, tidal flats,	Upper Watershed Capacity Improvement	Geotube berms
Enhancement of current and future buffering habitats: wetland, coastal wetlands, tidal flats,	GI- low impact devt in urban, stormwater BMPs	Zoning/designating/designing interior with flood storage to enable coping with levee overtopping
	Acquire Open Space and Conservation Land- in upper watershed and urban env	Culverts, bridges, allowing for exchange and connectivity- & removal of...

Products

1. Coastal Framework (31,000 miles):
   - ~36 reaches by shoreline type.
   - Identify likely future conditions.
   - Identify flood risk, and vulnerable populations & infrastructure including with sea level rise.
   - Identify range of measures to reduce risk
     - Structural
     - Non-structural
     - Programmatic
   - Screen and combine measures for minimal, moderate & aggressive approaches.
   - Identify planning-level costs, risk reduction and benefits/concerns for each measure.
2. Institutional barriers and strategies to comprehensive implementation.
3. Identification of activities and actions warranting further analysis.
4. Geodatabase of coastal data.

NBI Team Products

- White Paper documenting categorization scheme. GIS database input for regional GI that includes data layers capturing key attributes and spatial context.
- Report summarizing performance metrics and their derivation.
- Matrix of relevant vulnerability metrics documented in reference to past and current uses.
- Report describing the GI evaluation framework and process, including descriptions and references for available, supporting tools and methods.
- Report summarizing the evaluation of relevant GI. Results incorporated into a database.

Work and Opportunities Remain

- Tasks and associated deliverables.
- Additional meetings with stakeholders and partners.
  - Policy:
    - Federal agencies will discuss their perspectives and roles in NBI & GI-related policies. Challenges and barriers to the implementation of NBI & GI, and methods of overcoming these obstacles, will be identified for future action.
  - Technical:
    - Experts with knowledge and experience in creating NBI & GI will be convened to discuss the methods, benefits, and challenges to implementation. NBI & GI solutions will be further explored and knowledge gaps will be identified.

Questions