

# Natural and Nature-Based Features in the USACE North Atlantic Coast Comprehensive Study

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SWG Proving Ground Workshop

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# Hurricane Sandy

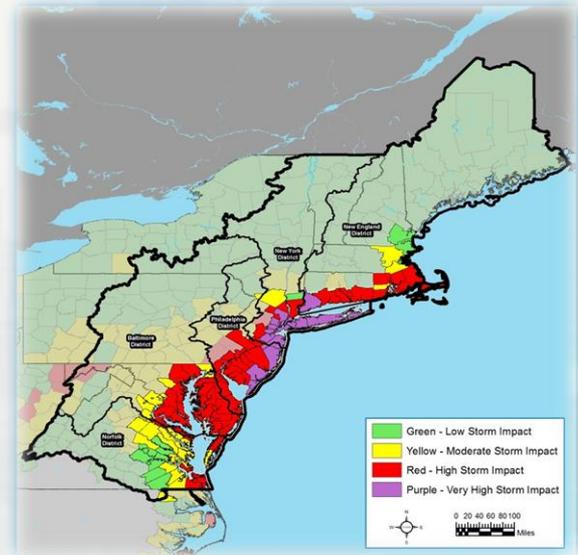
## Storm Impacts and Damages:

### ► Human

- 286 people killed (159 in the US)
- 500,000 people affected by mandatory evacuations
- 20,000 people required temporary shelter
- Extensive community dislocations  
– continuing today in some areas

### ► Economic

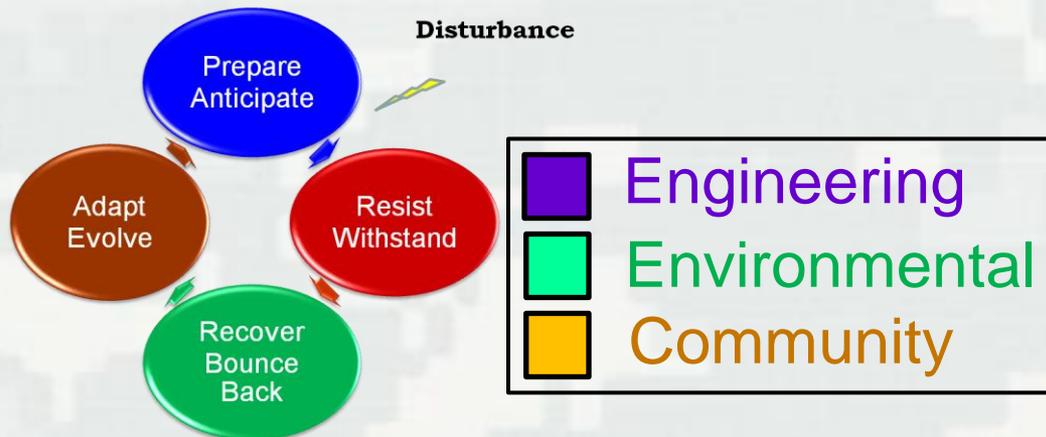
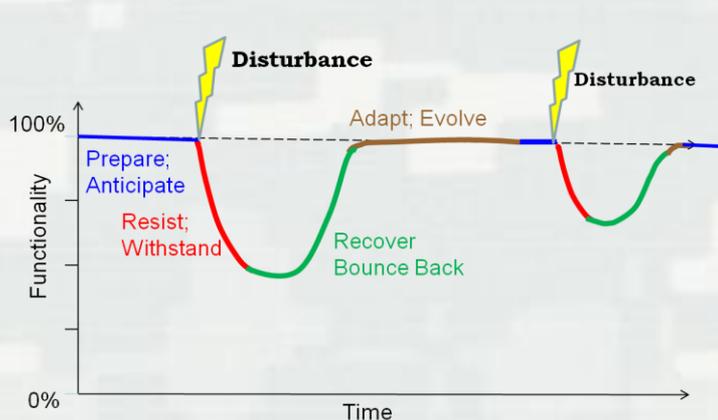
- \$65B in damages in the U.S.
- 26 states affected (10 states and D.C are in the NACCS study area)
- 650,000 houses damaged or destroyed



# Chief's Charge to the CERB: Resilience

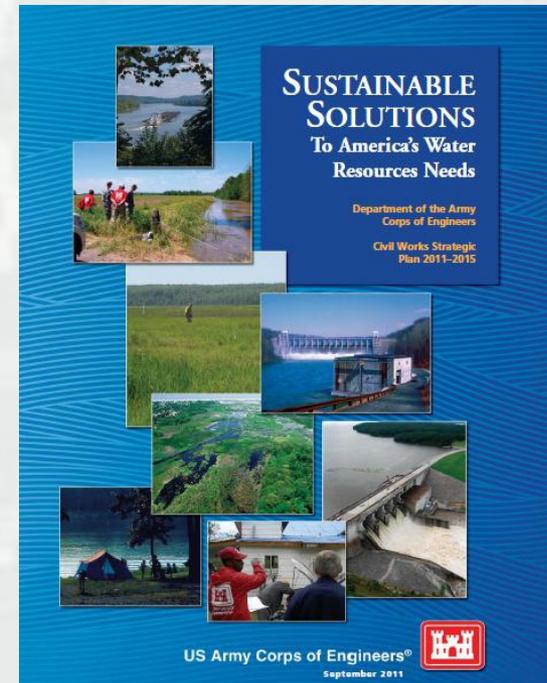
**Resilience:** the ability of a *system* to **Prepare for**, **Resist**, **Recover**, and **Adapt** to achieve functional performance under the stress of disturbances through time.

Study	Definition
NAS (2012)	"Resilience is the ability to <b>prepare and plan for</b> , <b>absorb</b> , <b>recover from</b> , and more successfully <b>adapt</b> to adverse events."
E.O. 13653 (2013)	"resilience means the ability to <b>anticipate</b> , <b>prepare for</b> , and <b>adapt</b> to changing conditions and <b>withstand</b> , respond to, and <b>recover</b> rapidly from disruptions."



# In the Context of Coastal Resilience...

- What opportunities are there for achieving better alignment of natural and engineered systems?
  - ▶ Can improved alignment reduce risks to life and property?
  - ▶ What additional services can be produced?
  - ▶ 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."



# Systems: Coastal Risk Reduction and Resilience

“The USACE planning approach supports an **integrated approach** to reducing coastal risks and increasing human and ecosystem community resilience through a combination of **natural, nature-based, non-structural and structural measures**. This approach considers the engineering attributes of the component features and the dependencies and interactions among these features over both the short- and long-term. It also considers the **full range of environmental and social benefits** produced by the component features.”

## Coastal Risk Reduction and Resilience: Using the Full Array of Measures



US Army Corps of Engineers

Directorate of Civil Works



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September 2013

CWTS 2013-3



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# ERDC

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# NACCS Natural and Nature-Based Features: Multi-Disciplinary Team

## Project Leaders:

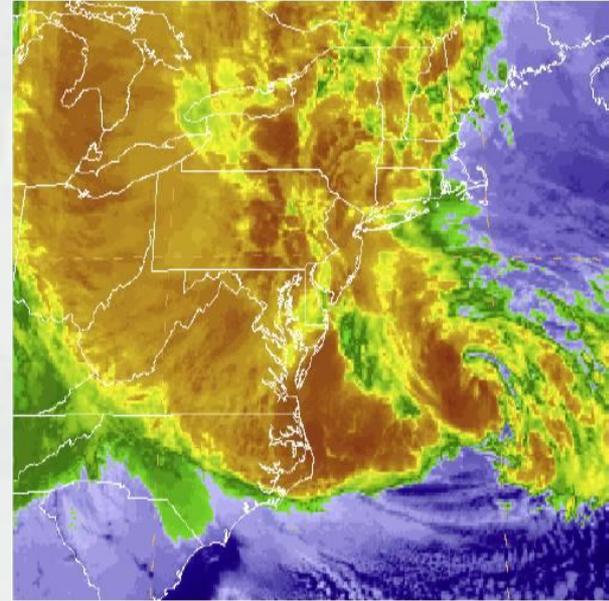
- Todd Bridges (EL)
- Paul Wagner (IWR)

## Task Leaders:

- Kelly Burks-Copes (EL)
- Craig Fischenich (EL)
- Edmond Russo (EL)
- Deborah Shafer (EL)
- Ty Wamsley (CHL)

## Study Team Members:

- Scott Bourne (EL)
- Pam Bailey (EL)
- Kate Brodie (EL)
- Zach Collier (EL)
- Sarah Miller (EL)
- Patrick O'Brien (EL)
- Candice Piercy (EL)
- Bruce Pruitt (EL)
- Burton Suedel (EL)
- Lauren Dunkin (CHL)
- Ashley Frey (CHL)
- Mark Gravens (CHL)
- Linda Lillycrop (CHL)
- Jeff Melby (CHL)
- Andy Morang (CHL)
- Cheryl Pollock (CHL)
- Jane Smith (CHL)
- Jennifer Wozencraft (CHL)
- Jae Chung (IWR)
- Michael Deegan (IWR)
- Michelle Haynes (IWR)
- Lauren Leuck (IWR)
- David Raff (IWR)
- Lisa Wainger (U. Maryland)
- Sam Sifleet (U. Maryland)



## 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

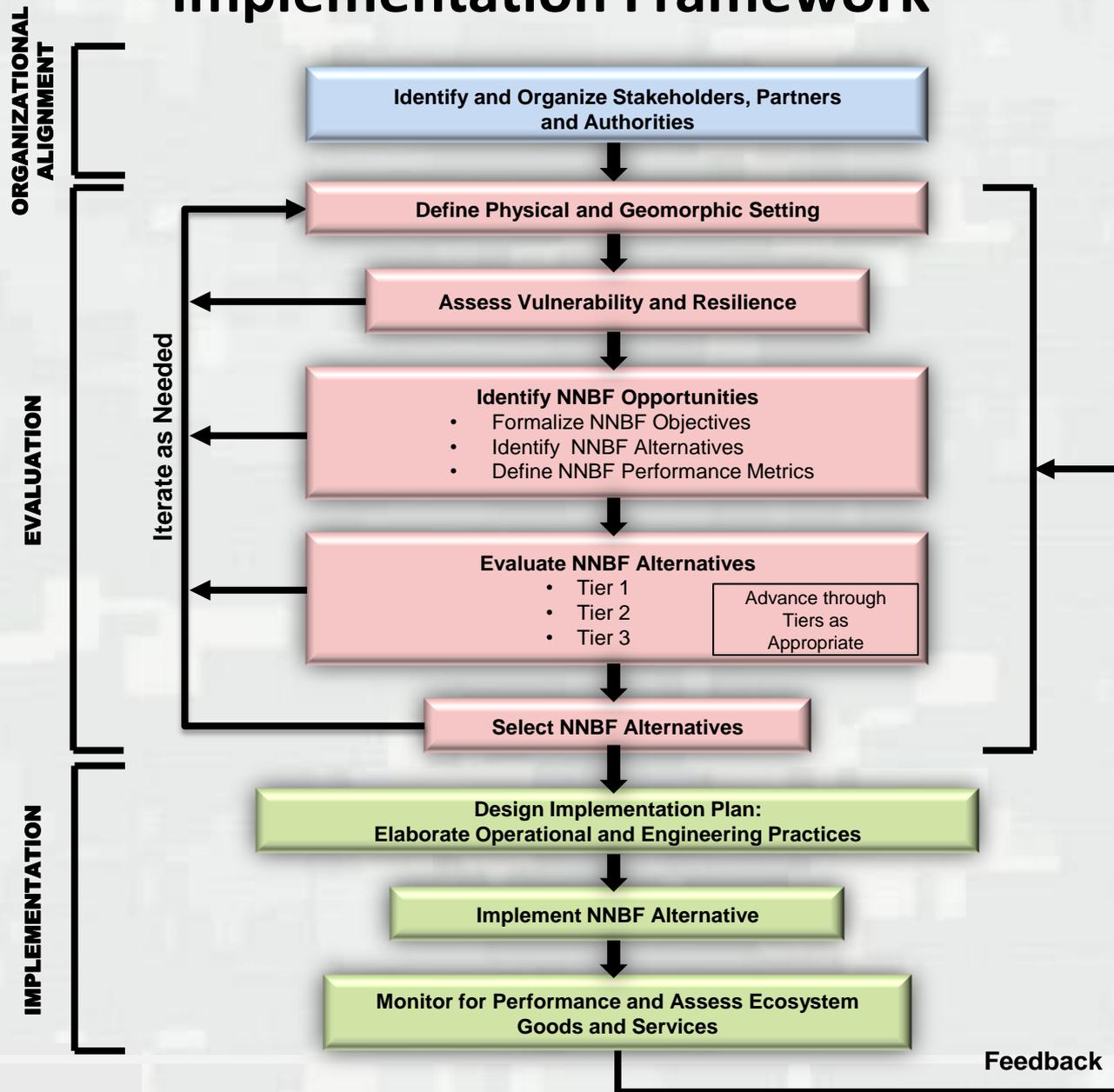
#### Benefits/Processes

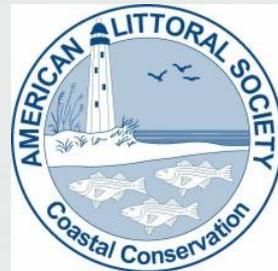
Wave attenuation and/or dissipation  
Shoreline erosion stabilization  
Soil retention

#### Performance Factors

Vegetation height and density  
Forest dimension  
Sediment composition  
Platform elevation

# Natural and Nature-Based Features Evaluation and Implementation Framework



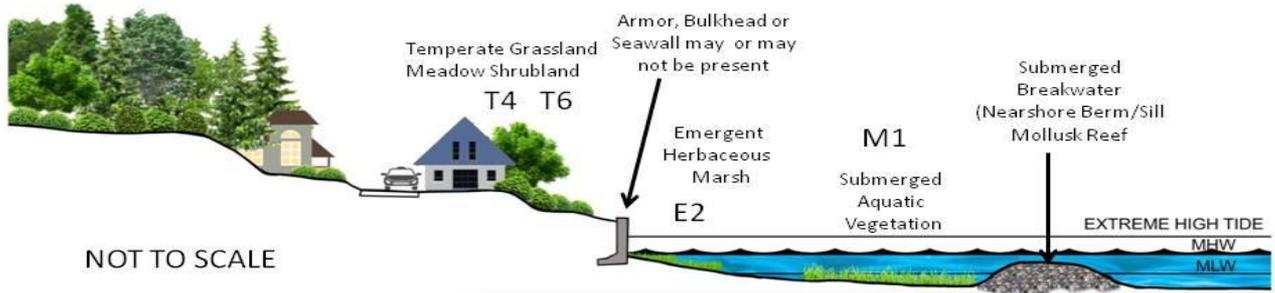


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# 1 A 1-1. Drowned River Valley

Examples: Chesapeake and Delaware Bays

Terrace  
Cool Temperate  
Forest  
T15

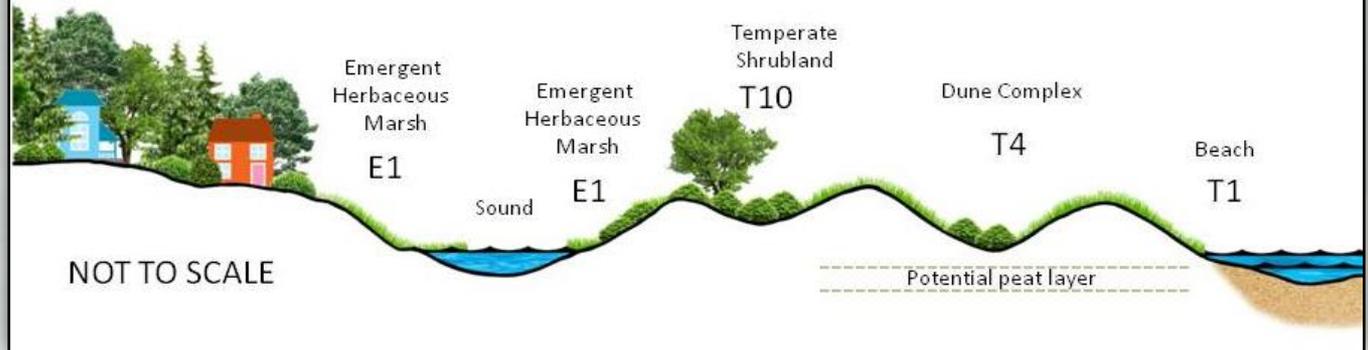


# II B 1. Marine Depositional Barrier Coast

Examples: Virginia coast

BARRIER ISLAND/SPIT COMPLEX

T6, T9, T10



# Assessing vulnerability and resilience over the long term: performance metrics

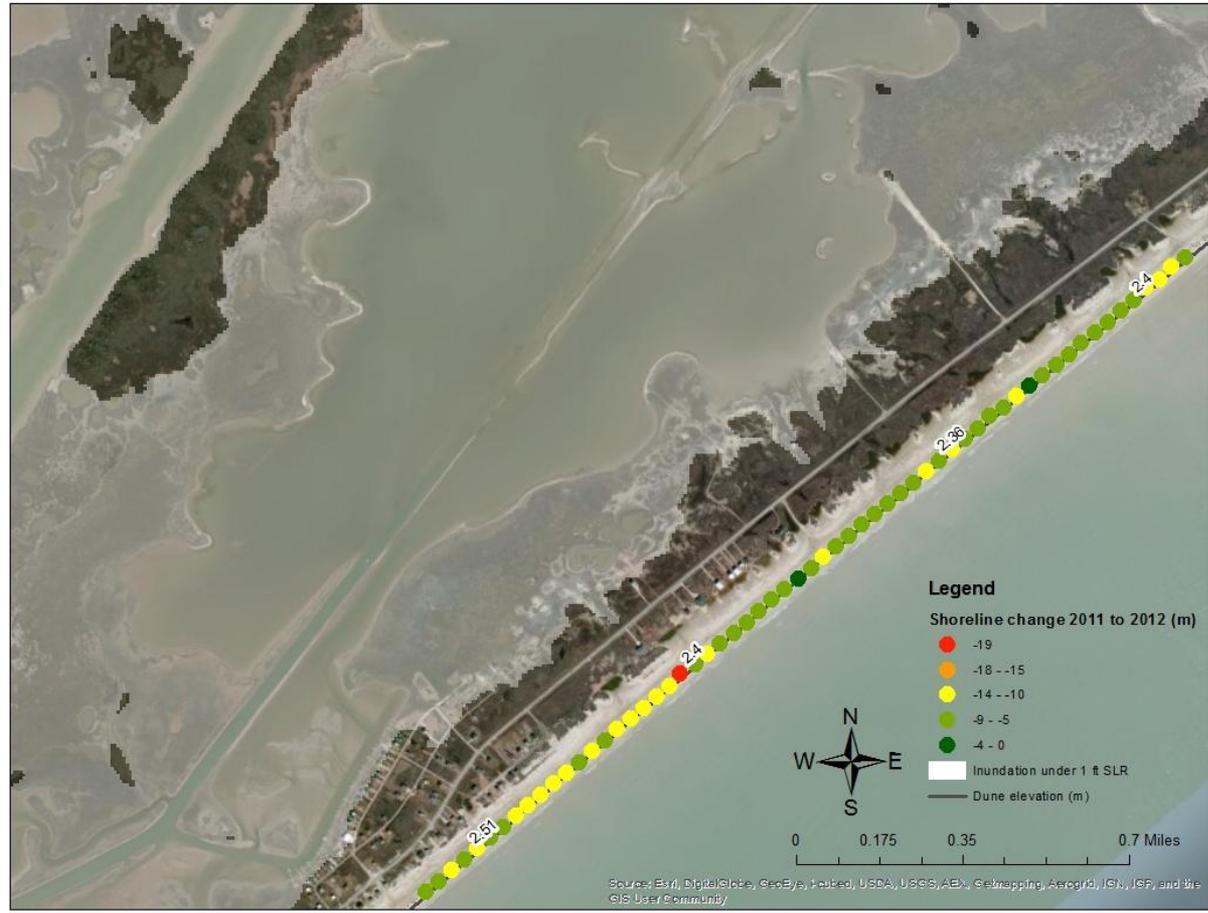


**Dunes and Beaches**  
 Benefits/Processes  
 Break offshore waves  
 Attenuate wave energy  
 Slow inland water transfer

**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**  
 Berm height and width  
 Beach Slope  
 Sediment grain size and supply  
 Dune height, crest, width  
 Presence of vegetation

**Performance Factors**  
 Marsh, wetland, or SAV elevation and continuity  
 Vegetation type and density

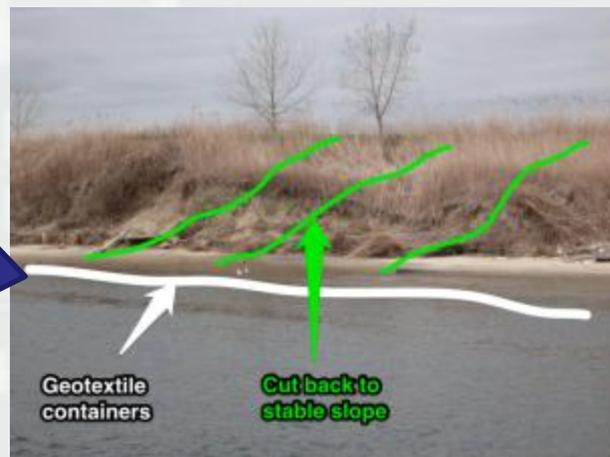


**Inundated under 1 ft of RSLR**

Drum Bay, Follets Island



# Identifying Opportunities



Manasquan Inlet, NJ



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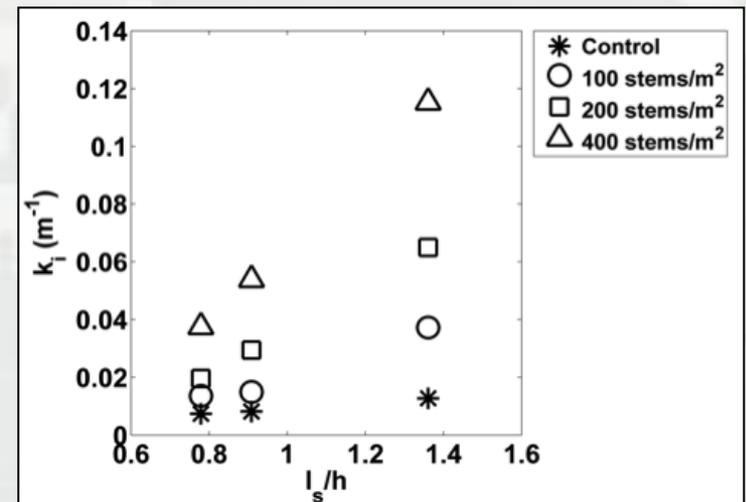


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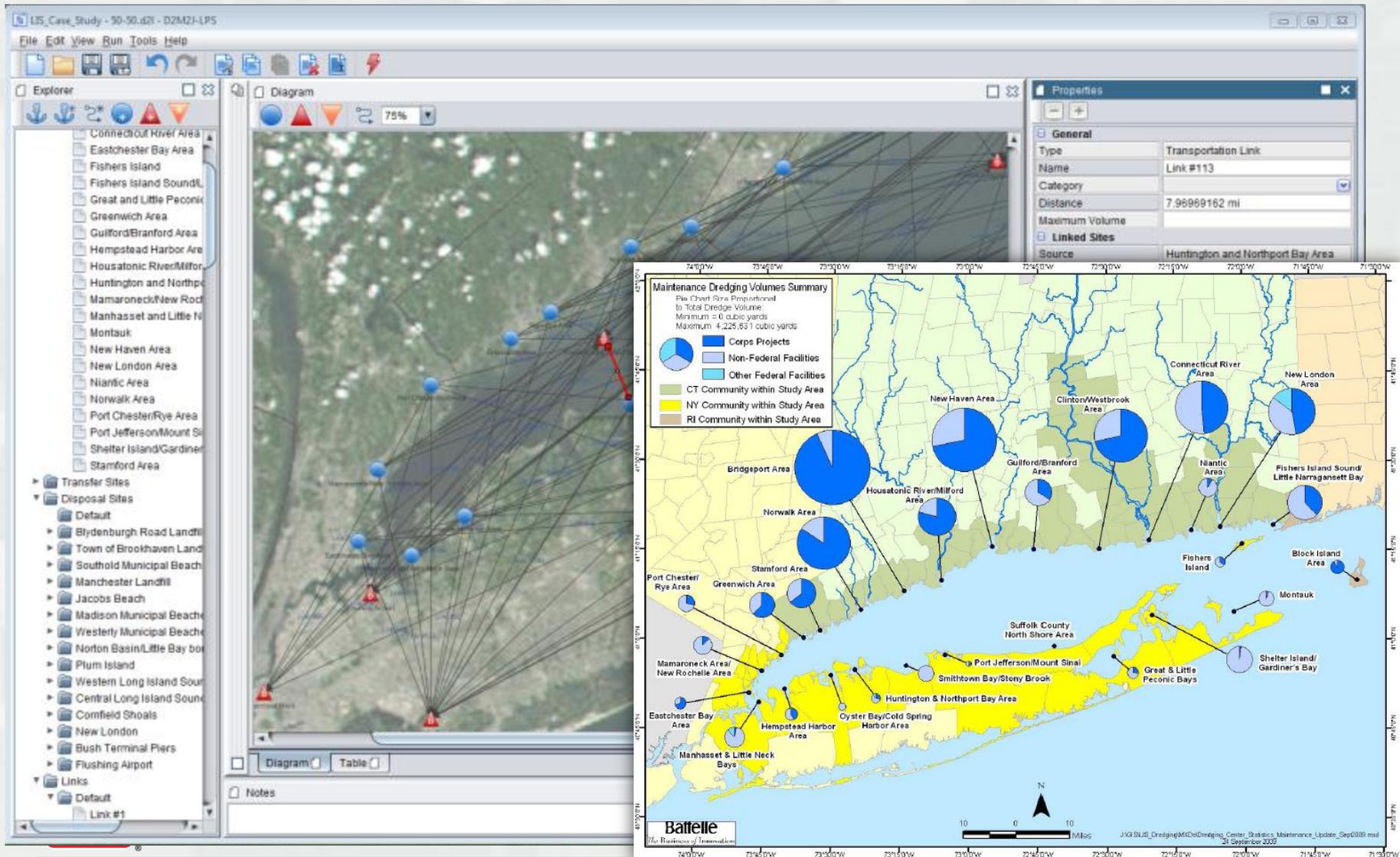


# Example: Wave Dampening by Wetlands

- What are the engineering benefits of wetlands with respect to waves?
- Flume studies being performed in the 10 ft flume
  - Complemented by examination of sediment processes and field studies
- Wave attenuation was found to:
  - increase with stem density
  - increase with submergence ratio
  - slight increase with incident wave height
- Results used to update STWAVE



# D2M2: Dredged Material Management Decisions



# Moving Forward...

- Organize and expand science and engineering related to natural processes and features
  - ▶ Reduce uncertainties regarding design and performance of NNBF
  - ▶ Understand dynamic performance of NNBF
  - ▶ How to effectively integrate NNBF with other measures
- Integrating expertise across disciplines and organizations
  - ▶ Planning, designing, constructing, operating, monitoring, and maintaining integrated systems

