

# Response to Climate Change in the New York City Area

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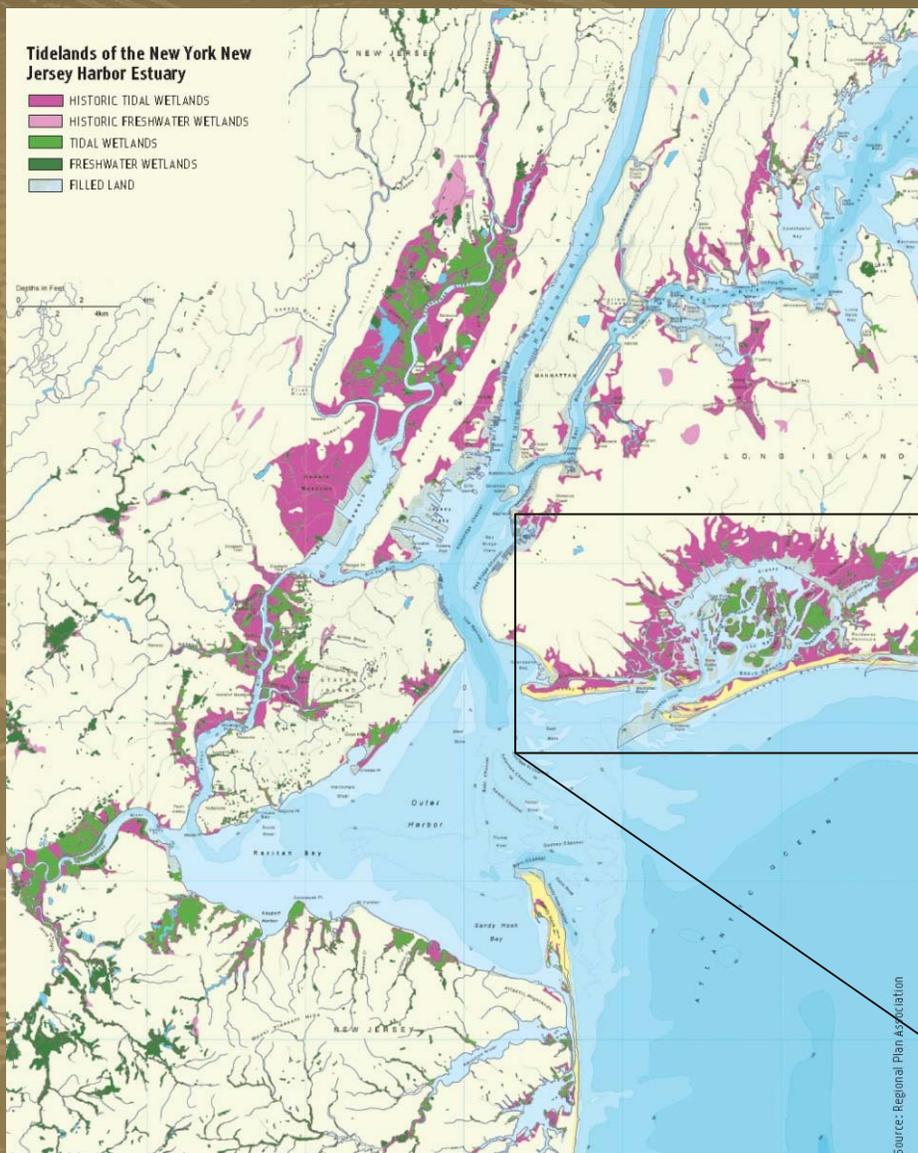


# Greater New York City Area



- Heavily Manipulated
- Cultural Landscape
- Marine Resources
- Role of Protected Areas
  - Protect Mainland (?)
  - Water Quality
  - Refugia/Species Mgmt

# Historic Wetland Loss



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# Restoration in Jamaica Bay (GATE)



Credit: U.S. Army Corps of Engineers

Elders East in Jamaica Bay before restoration

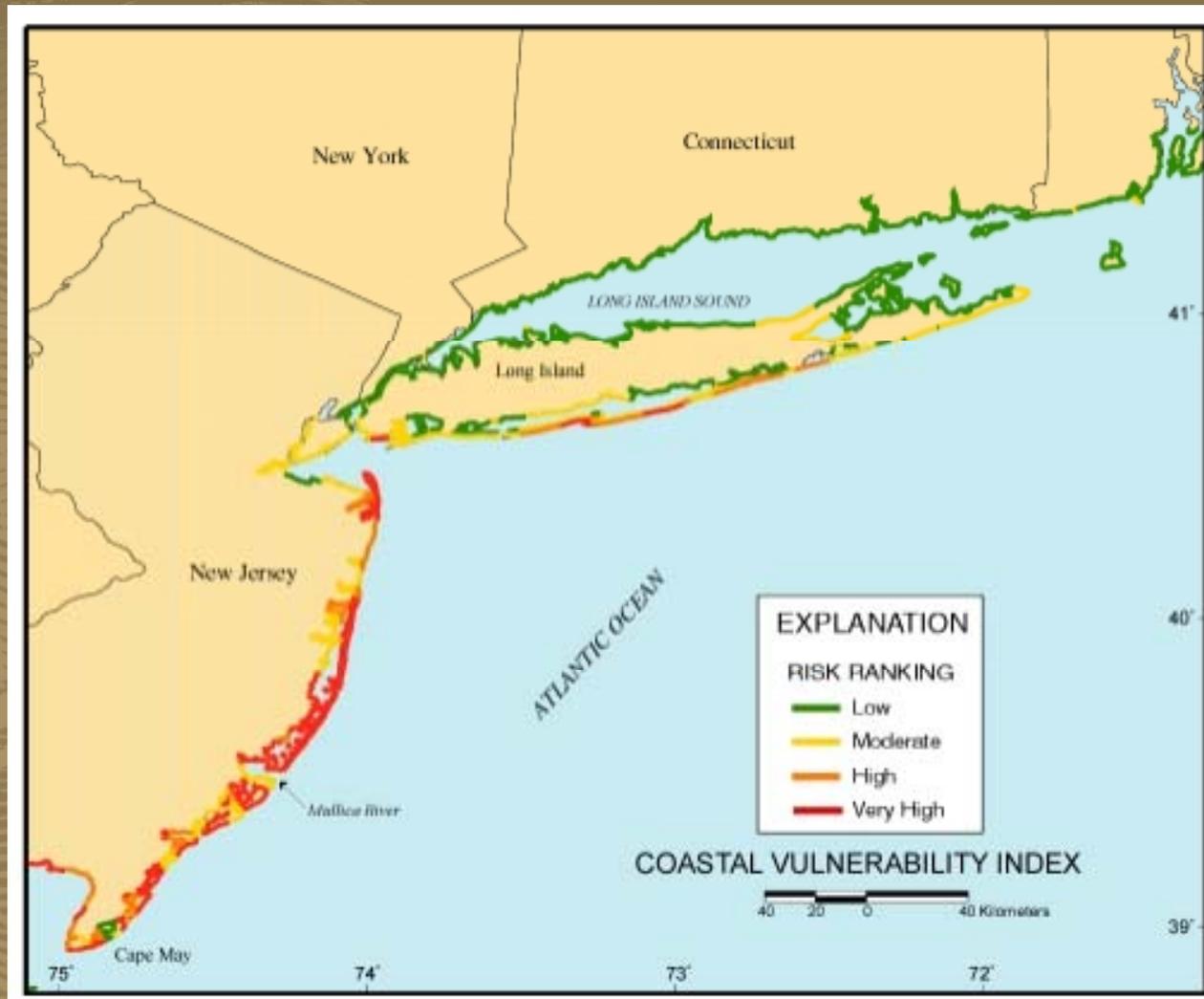


Credit: U.S. Army Corps of Engineers

Elders East in Jamaica Bay during restoration

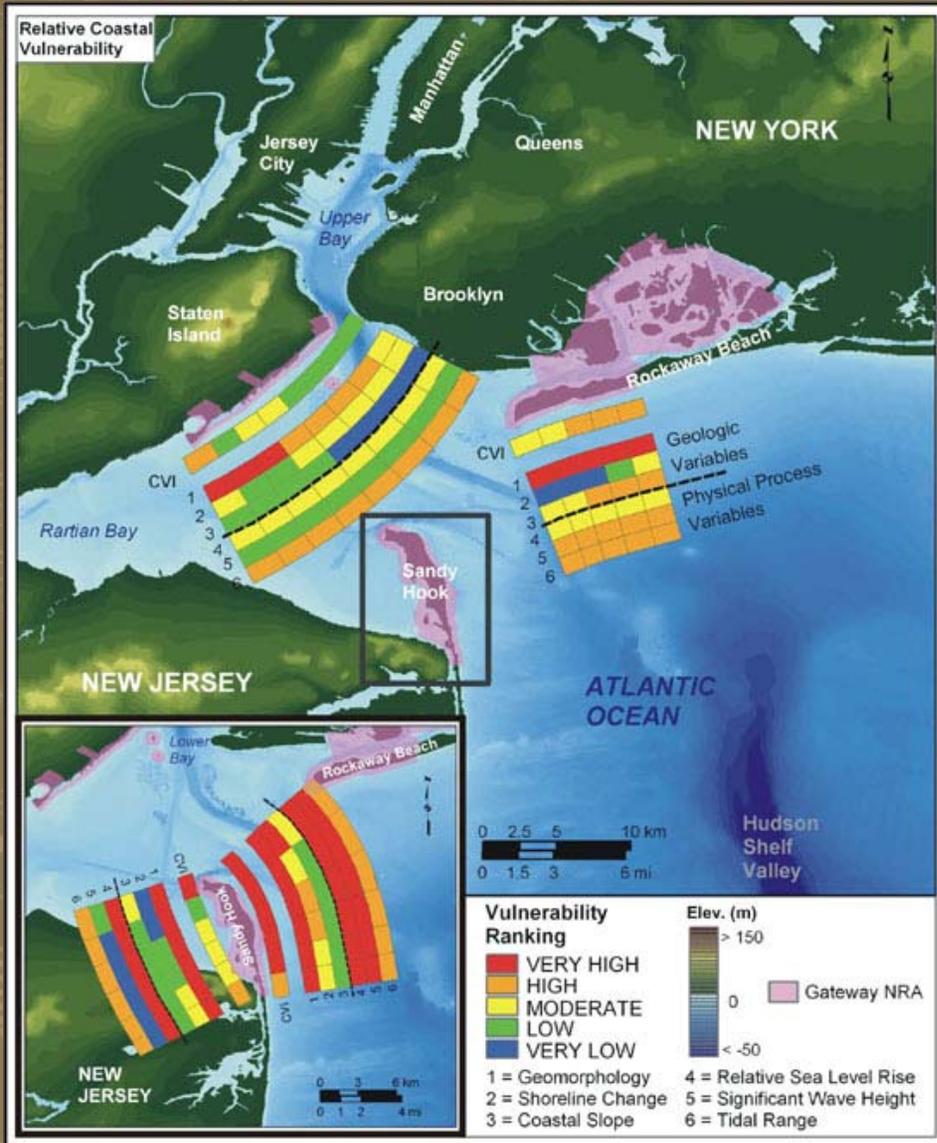
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# Coastal Vulnerability Index



Source: <http://pubs.usgs.gov/of/1999/of89-593/pages/disc.html>

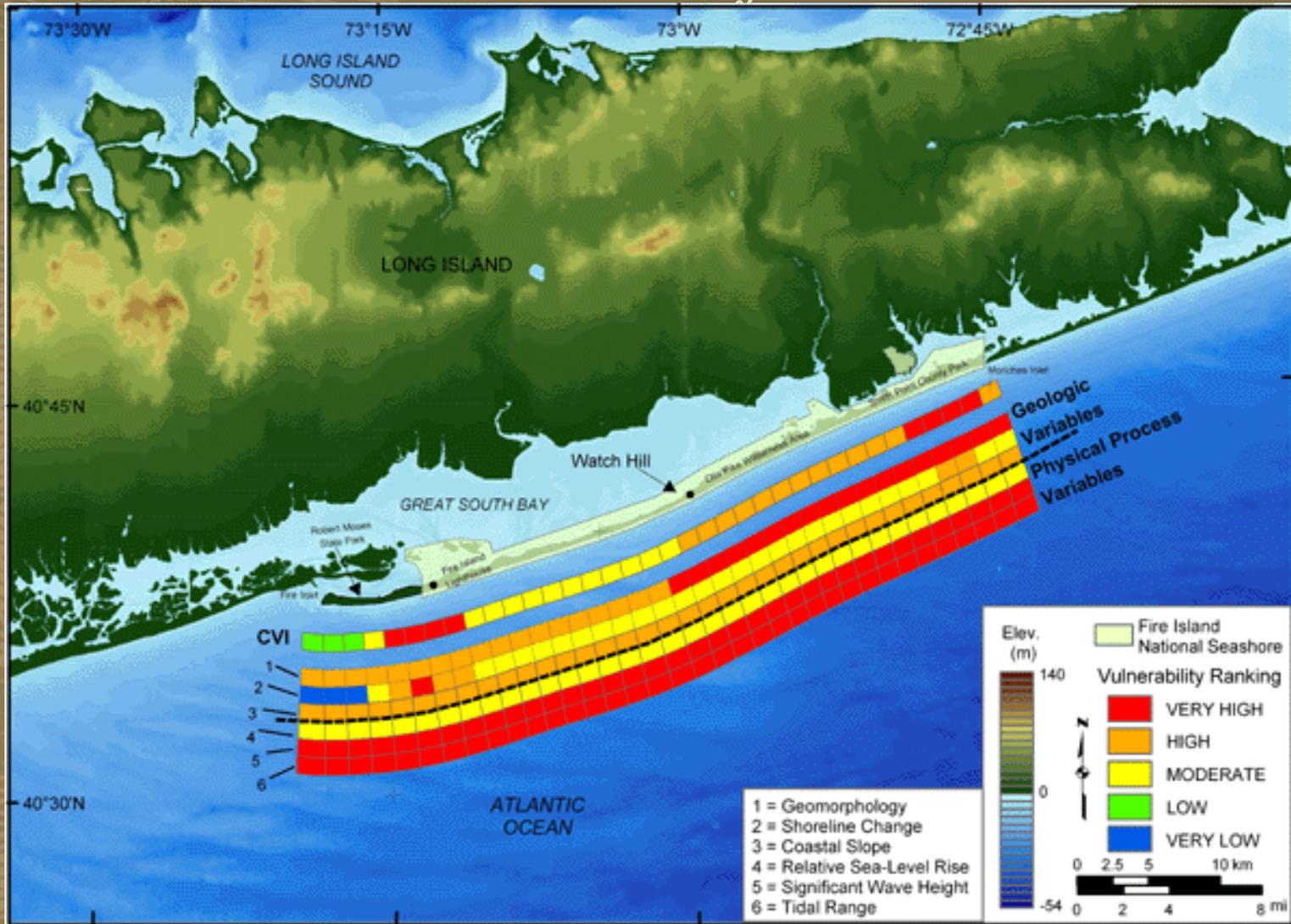
# Coastal Vulnerability Index



Source: <http://woodshole.er.usgs.gov/project-pages/mps-cvi/parks/GATE.htm>

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# Coastal Vulnerability Index



Source: <http://woodshole.cr.usgs.gov/project-pages/nps-cvi/parks/FIIS.htm>

# Case Study: Barrier Thresholds

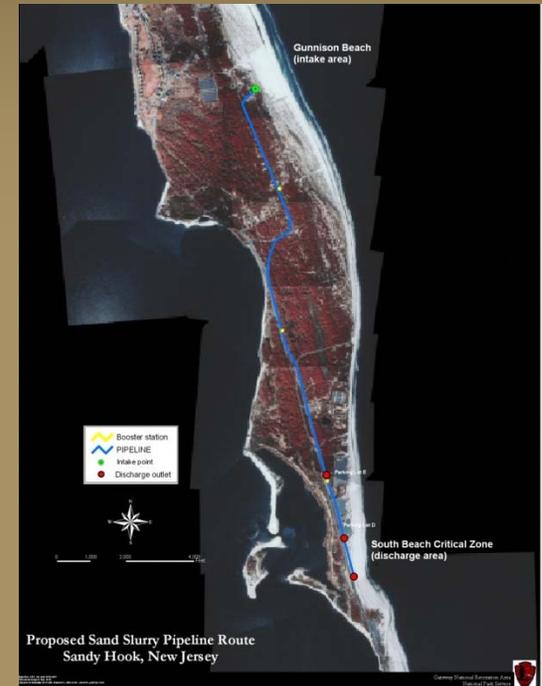


Piping Plover Chick



Seabeach Amaranth

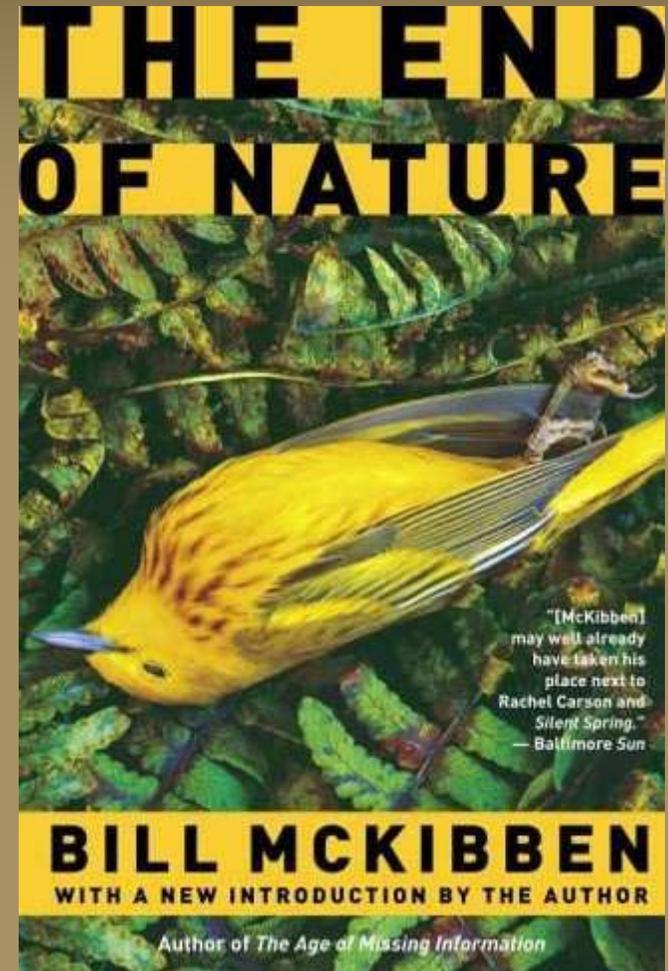
- Storms in this region can cause island breaching and overwash
- These processes provide habitat for threatened species



Coastal erosion may exceed the islands threshold for maintaining its current configuration

## Predicting near-future conditions

- Can we use data to predict what the future (25-50 year) island will look like?
- Under what conditions would a lasting breach or inlet form, and where?
- Is there a threshold rate of sea level rise that would outpace the ability of marshes to retreat upland?
- Will storm intensity build up the island interior, or will storms be too frequent to allow island recovery?
- Under what conditions will saltwater intrusion into freshwater aquifers impact animal and plant communities?



# Identify likely climate changes and impacts

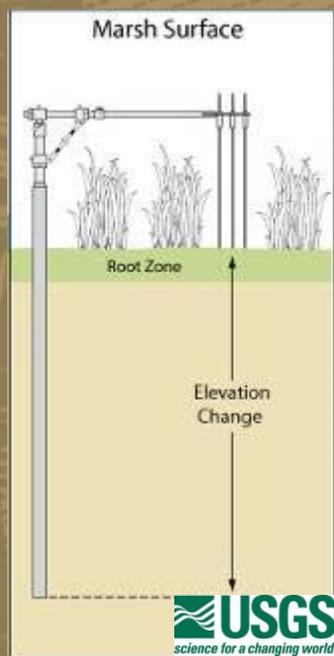
- Likely changes in climate:
  - Sea level rise
  - Increased storm intensity
  - Increase in extreme temperature events
  - Changes in patterns of precipitation and drought



- Possible resource responses:
  - Dynamic physical landscape
  - Decreased habitat diversity
  - Geographic shift of species and habitats
  - Degraded estuarine water quality
  - Reduced freshwater availability
  - Human response



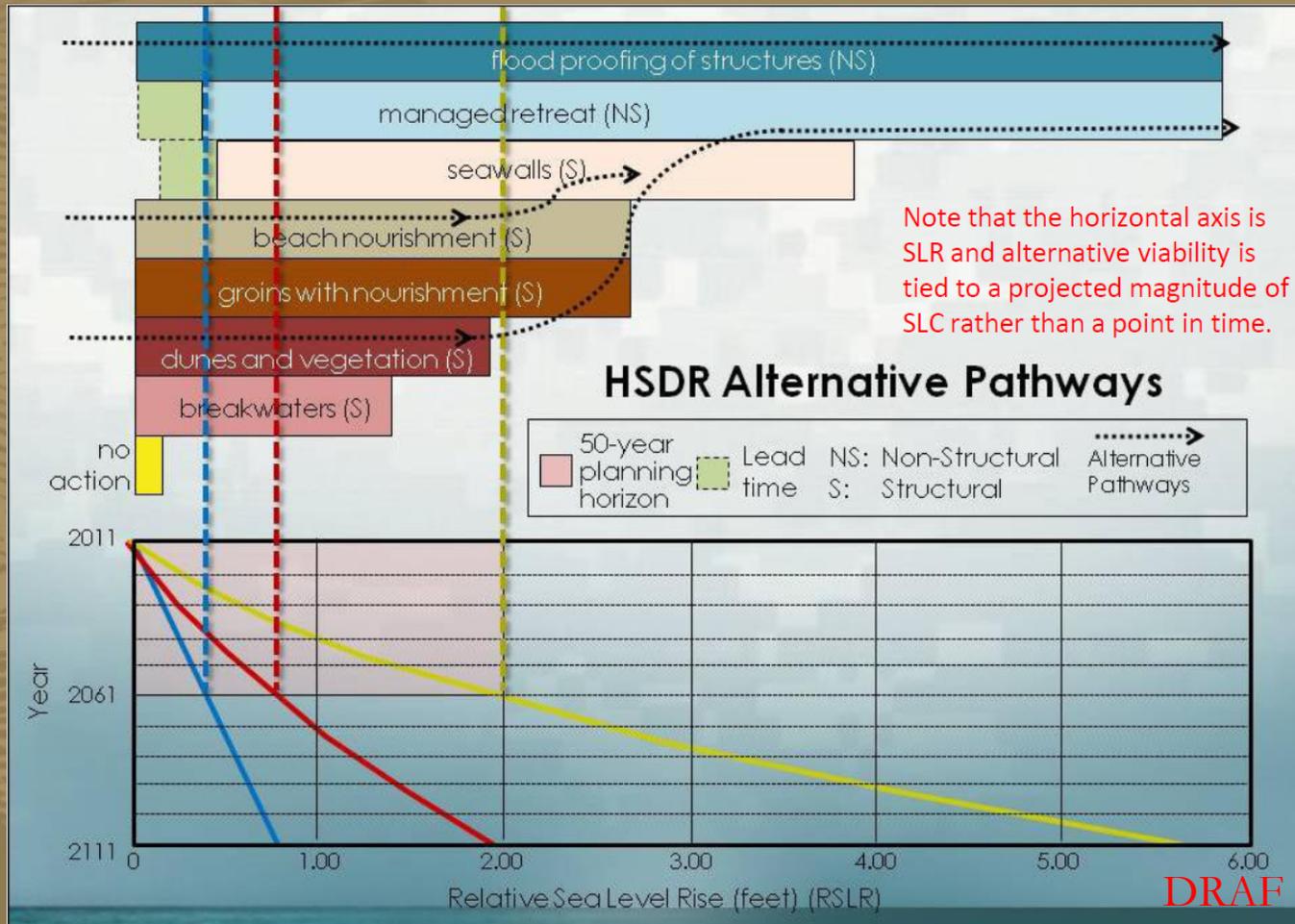
# Scenario planning leaves parks with questions



- Improving monitoring and response
  - How should we monitor to detect threshold conditions?
- Managing realistically
  - Can we predict ecosystem changes and vulnerabilities in specific (within-park) locations, in order to triage the areas that are possible to protect?
  - Should we define undesired conditions (to avoid) instead of desired conditions (target rates or numbers)?

# CWTL Decision Framework

- Evaluating alternatives – example from Hurricane Storm Damage Reduction team



DRAFT

# Coastal Engineering History



Ocean Beach Groin at Fire Island NS.



Timber/Rock groin, Riis Park  
(GATE)

# Coastal Engineering Inventory – 10 Parks

Coastal Engineering Project Type*	Number of Projects Identified
Revetment	96
Bulkhead	103
Seawall	33
<b>SHORELINE STABILIZATION STRUCTURES</b>	<b>232</b>
Groin	62
Jetty	20
<b>SEDIMENT TRAPPING STRUCTURES</b>	<b>82</b>
<b>DREDGE AND FILL PROJECTS</b>	<b>52</b>
<b>BEACH NOURISHMENT / DUNE CONSTRUCTION</b>	<b>17</b>
Breakwater	8
Dike	7
Levee & Floodwall	4
<b>OTHER STRUCTURES</b>	<b>19</b>
<b>TOTAL</b>	<b>402</b>

Phase 2: GATE- 145 structures in Jamaica Bay; Sandy Hook unit has more than 60

# NE Region – Coastal Structures Project



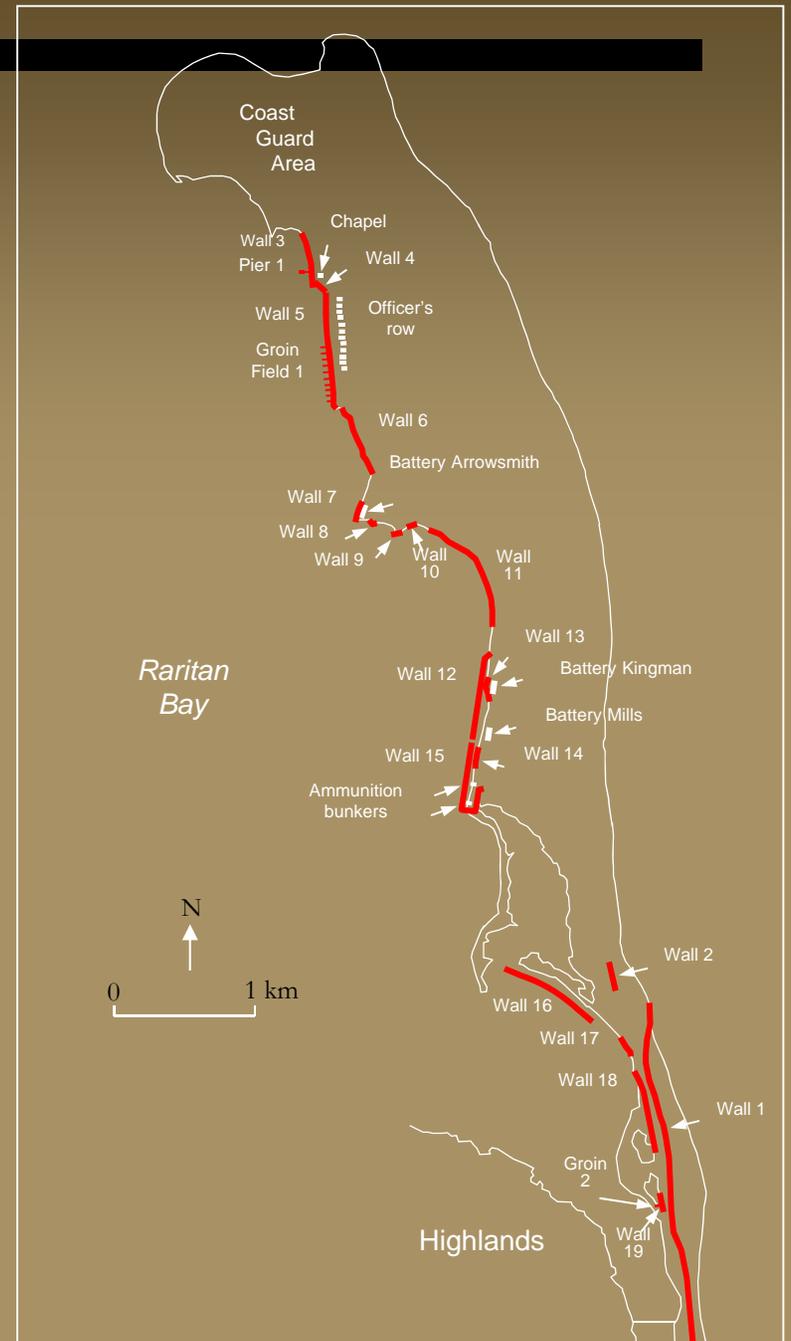
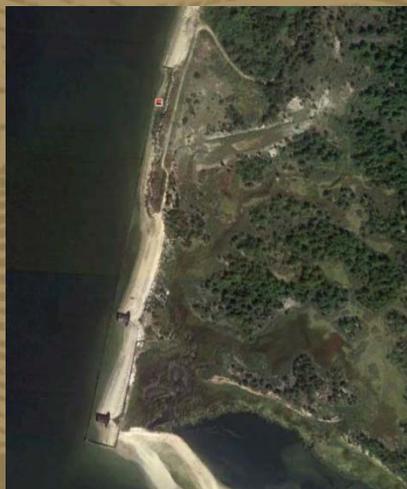
- Partnership with Rutgers Univ.
- 3-Year project to identify:
  - Structures in selected parks that are barriers to landform migration in response to SLR
  - Original structure purpose and function
  - Opportunities for removal or mitigation
  - Priorities for removal without adversely affecting existing infrastructure

*Contact: Charley Roman, NPS CESU Research Coordinator*

## Methods

### Task 1 (Identify barriers to natural migration)

- Use aerial photography, mapped inventories and field reconnaissance.
- Identify existing structures and habitats with presentation as (GIS) database.
- Provide summary statistics and interpretation of findings.



**Effect of bulkhead and riprap removal**

Active foreshore reestablished  
 Overwash limited due to high ground  
 Sediment delivered to beach to south

Overwash onto marsh and creek

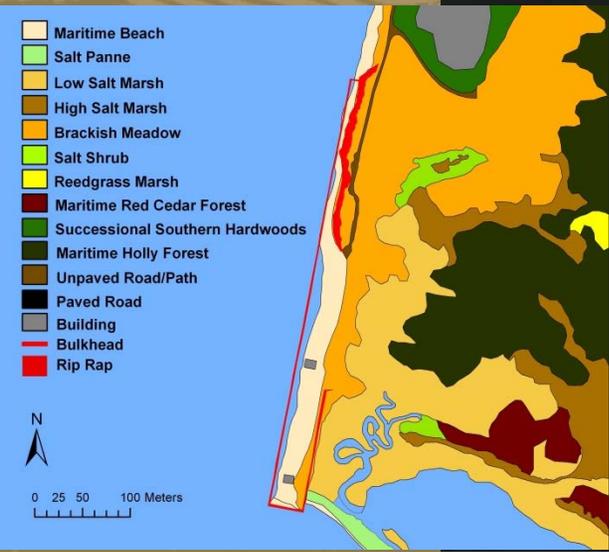
Marsh invades brackish meadow with rising sea level

Elevation at forest limits marsh migration (and eventually creek)

Migration of tidal creek as artificial headland is removed

Rapid erosion

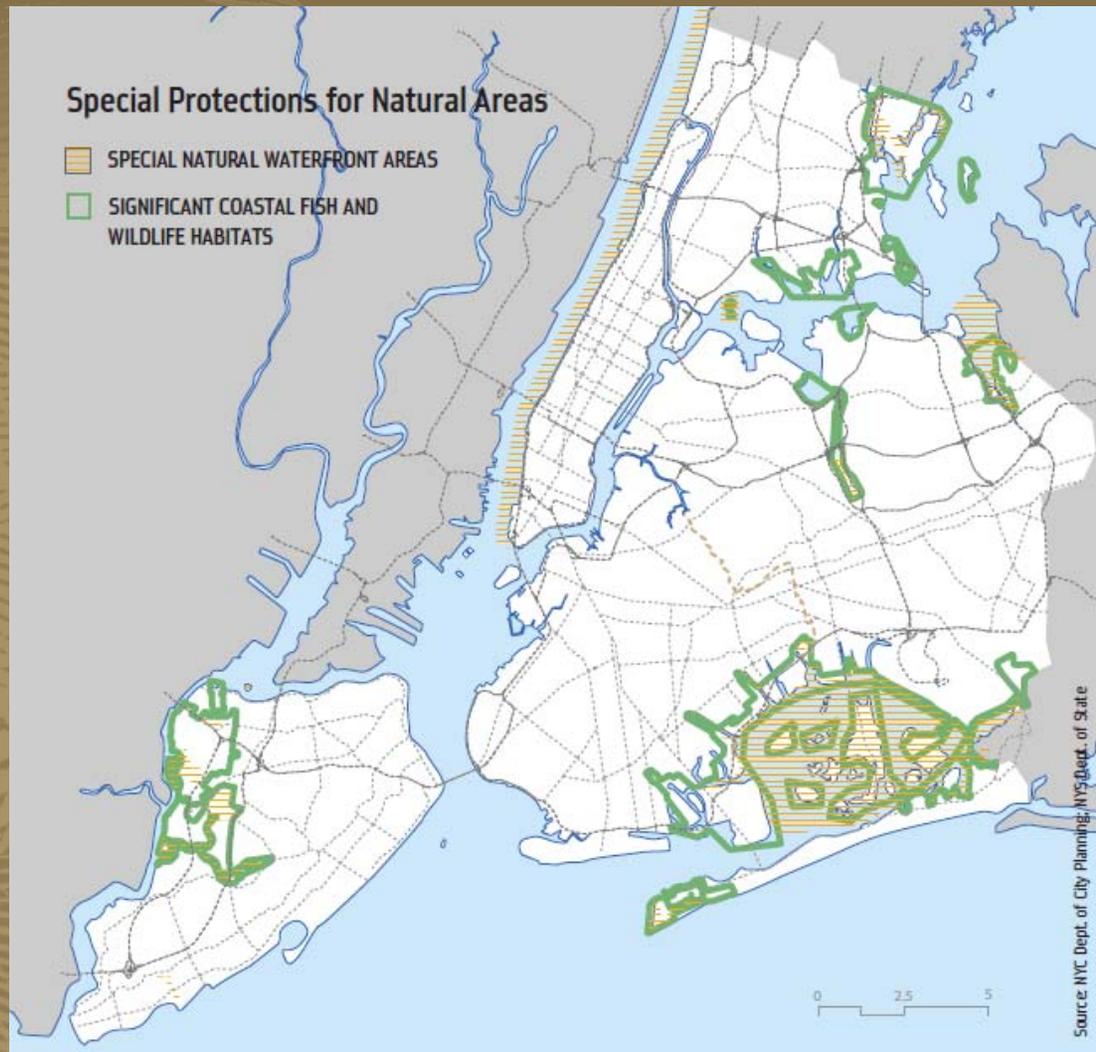
Spit growth





Sunset in a National Seashore

# PlaNYC Wetlands Strategy, 2012

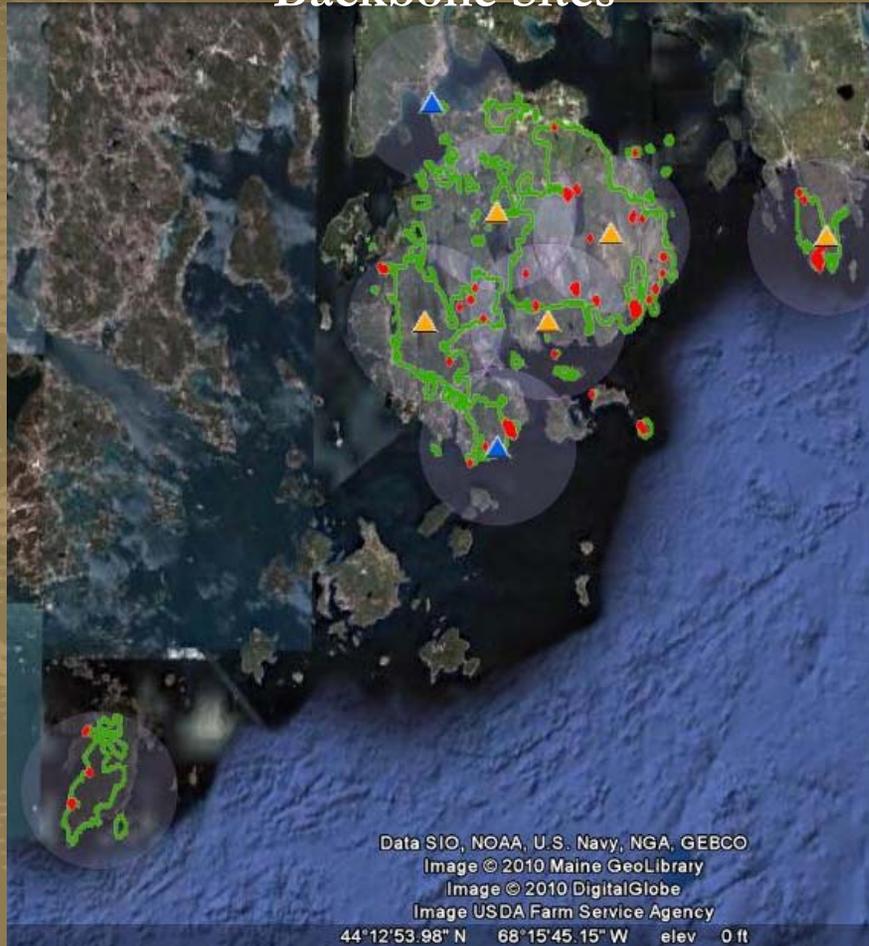


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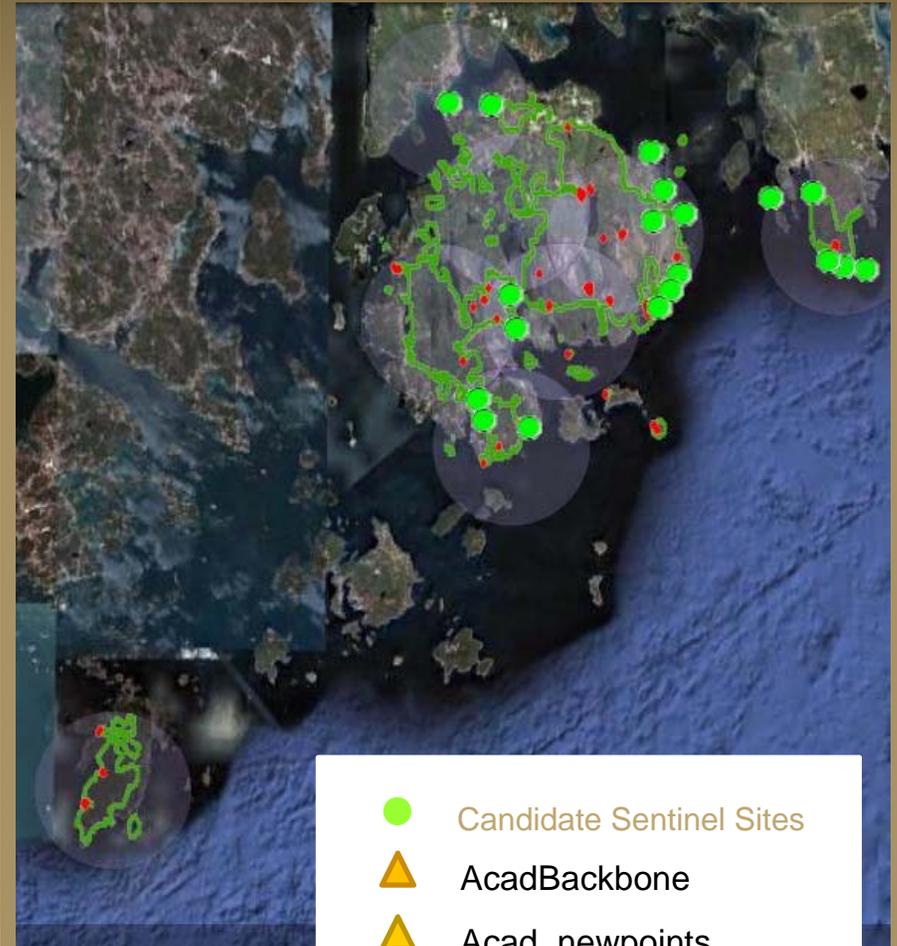
# Monitoring Infrastructure – NE

## Coastal Parks

Backbone Sites



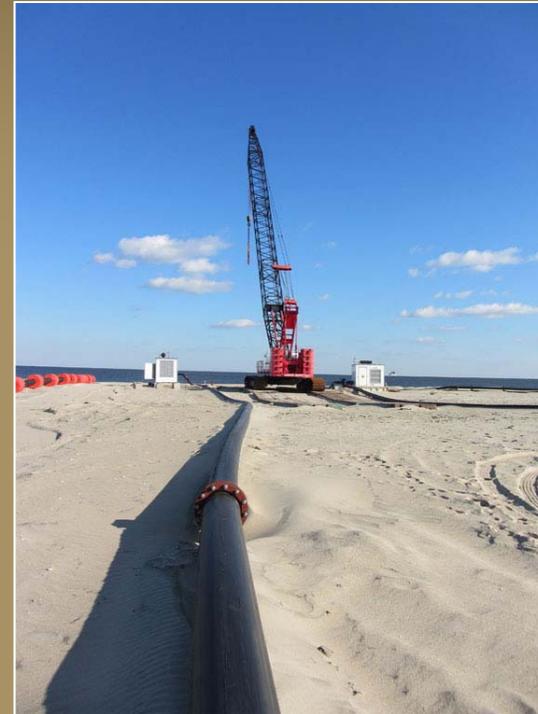
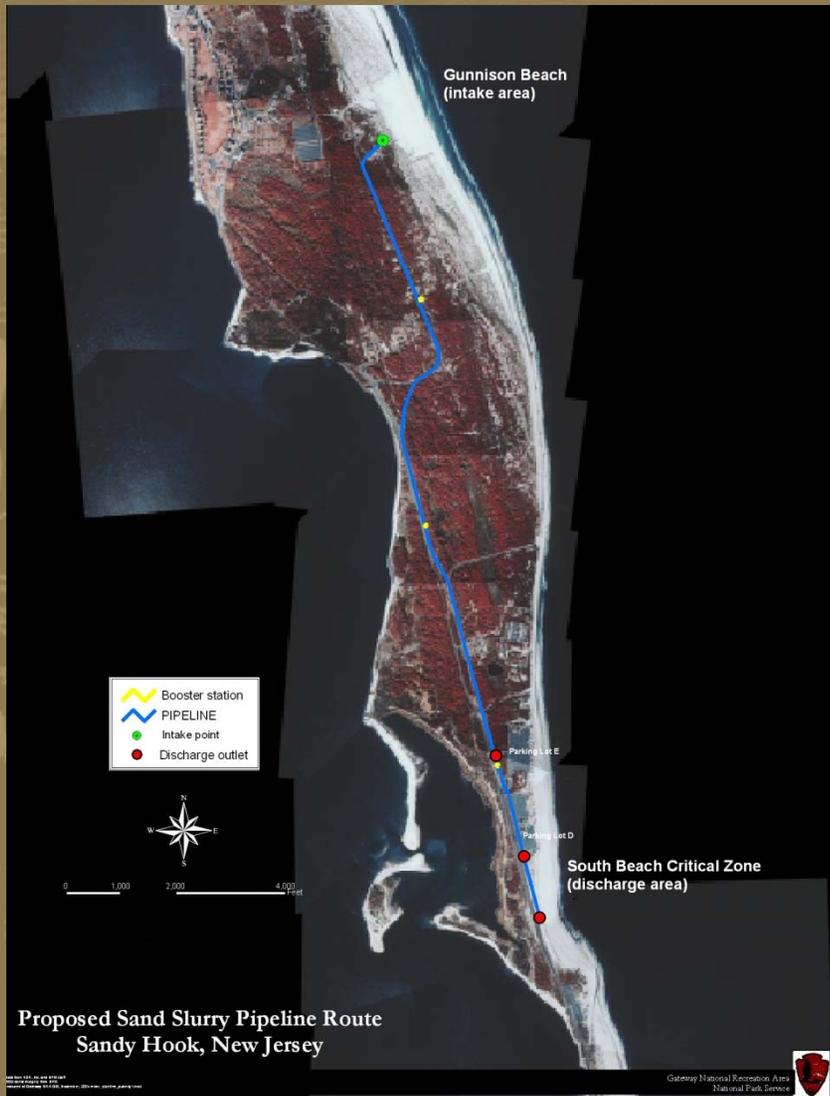
Proposed Sentinel Sites



- Candidate Sentinel Sites
- ▲ AcadBackbone
- ▲ Acad\_newpoints
- Acad\_Circle\_FiveKM
- Park boundary
- Park facilities

University of Rhode Island, Environmental Data Center  
<http://www.edc.uri.edu/monumentation/default.html>

# Sand Bypassing



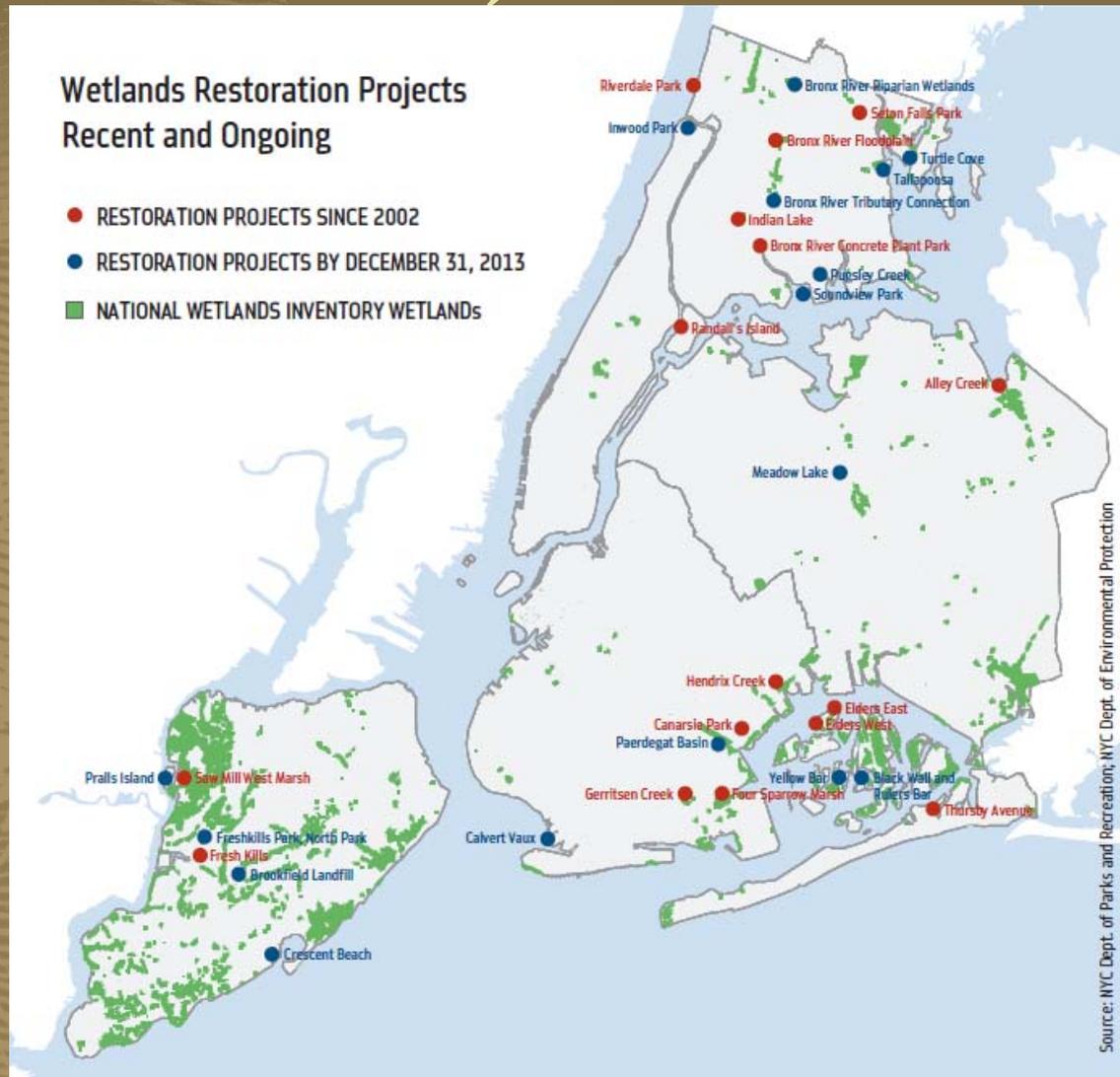
Route and equipment used for Sand Bypass system at GATE

# Natural Conditions

The region has lost wetlands due to urbanization and other human activities



# Restoration Projects



# Wetland Ownership

AREA BY ENTITY (ACRES)	TIDAL WETLANDS	FRESHWATER WETLANDS	TOTAL
New York City Department of Parks and Recreation	1,483	721	2,204
New York City Department of Environmental Protection	18	96	114
New York State Department of Environmental Conservation	142	46	188
United States National Park Service	1,448	71	1,519
Other Public Agencies	69	143	212
<b>Total Public Ownership</b>	<b>3,160</b>	<b>1,077</b>	<b>4,237</b>

Source: NYC Dept. of Parks and Recreation; National Wetlands Inventory

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# Restoration in Jamaica Bay (GATE)



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## Identifying at-risk resources requires SLR modeling



- Goals:
  - Identify resources that are at risk under various sea level rise / coastal change scenarios
  - Identify nature and degree of impacts (e.g., inundation) on specific resources at specific locations
  - Use local information
  - Provide very specific results for park managers
- NPS Northeast Region will resurvey geodetic monumentation and elevations
- NPS needs help in modeling local sea level rise and impacts

# Develop baseline data and Establish monitoring protocols



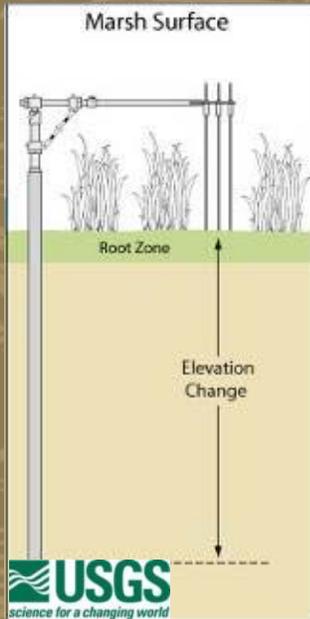
Marsh Surface

shoreline  
position

meteorology

topography

tide



surface  
elevation

water quality

salt marsh  
vegetation & nekton

health of  
beach/overwash habitat

# PlaNYC 2009

AREA	THREATS	UNCERTANTIES	NEXT STEPS
Freshwater wetlands and related upland areas	<ul style="list-style-type: none"> <li>• Gaps in regulatory protection exist for smaller freshwater wetlands and leave an unknown number of wetlands at risk</li> <li>• Non-point source pollution</li> <li>• Funding for restoration and maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• The number and extent of vulnerable freshwater wetlands</li> <li>• Funding to meet restoration and maintenance needs of existing inventory under City control</li> </ul>	<ul style="list-style-type: none"> <li>• Infrared satellite and other aerial images to be taken in April 2009</li> <li>• Mapping of wetlands vegetation areas to be completed by December 2009</li> <li>• Complementary mapping efforts for impermeable areas to be completed by December 2009</li> <li>• Explore innovative funding mechanisms, including mitigation banking, and coordinate plans with Federal, State, and private entities</li> </ul>
Tidal wetlands and related upland areas	<ul style="list-style-type: none"> <li>• Sea level rise creates the need for inland wetlands migration and policies for submerged land</li> <li>• Non-point source pollution</li> <li>• Funding for restoration and maintenance, especially in Jamaica Bay</li> </ul>	<ul style="list-style-type: none"> <li>• The number and extent of vulnerable tidal wetlands and adjacent floodplains</li> <li>• Funding to meet restoration and maintenance needs of existing inventory under City control</li> </ul>	<ul style="list-style-type: none"> <li>• Infrared satellite and other aerial images to be taken in April 2009</li> <li>• Mapping of wetlands vegetation areas to be completed by early 2010</li> <li>• Other relevant climate change adaptation information to be completed by December 2009, including floodplain maps, inventories of at-risk wetlands and flood areas, and adaptation plans</li> <li>• Explore innovative funding mechanisms, including mitigation banking, and coordinate plans with Federal, State, and private entities</li> </ul>