



EXPERIENCE
YOUR
AMERICA

Strategies for Coastal Park Adaptation to Climate Change



Rebecca Beavers and Courtney Schupp
Geologic Resources Division
National Park Service
14 November 2013

NPS is developing new tools to support park adaptation efforts



- Coastal Adaptation Strategies Handbook
- Climate Change Scenario Planning

EXPERIENCE
YOUR
AMERICA



NPS Coastal Parks Adaptation

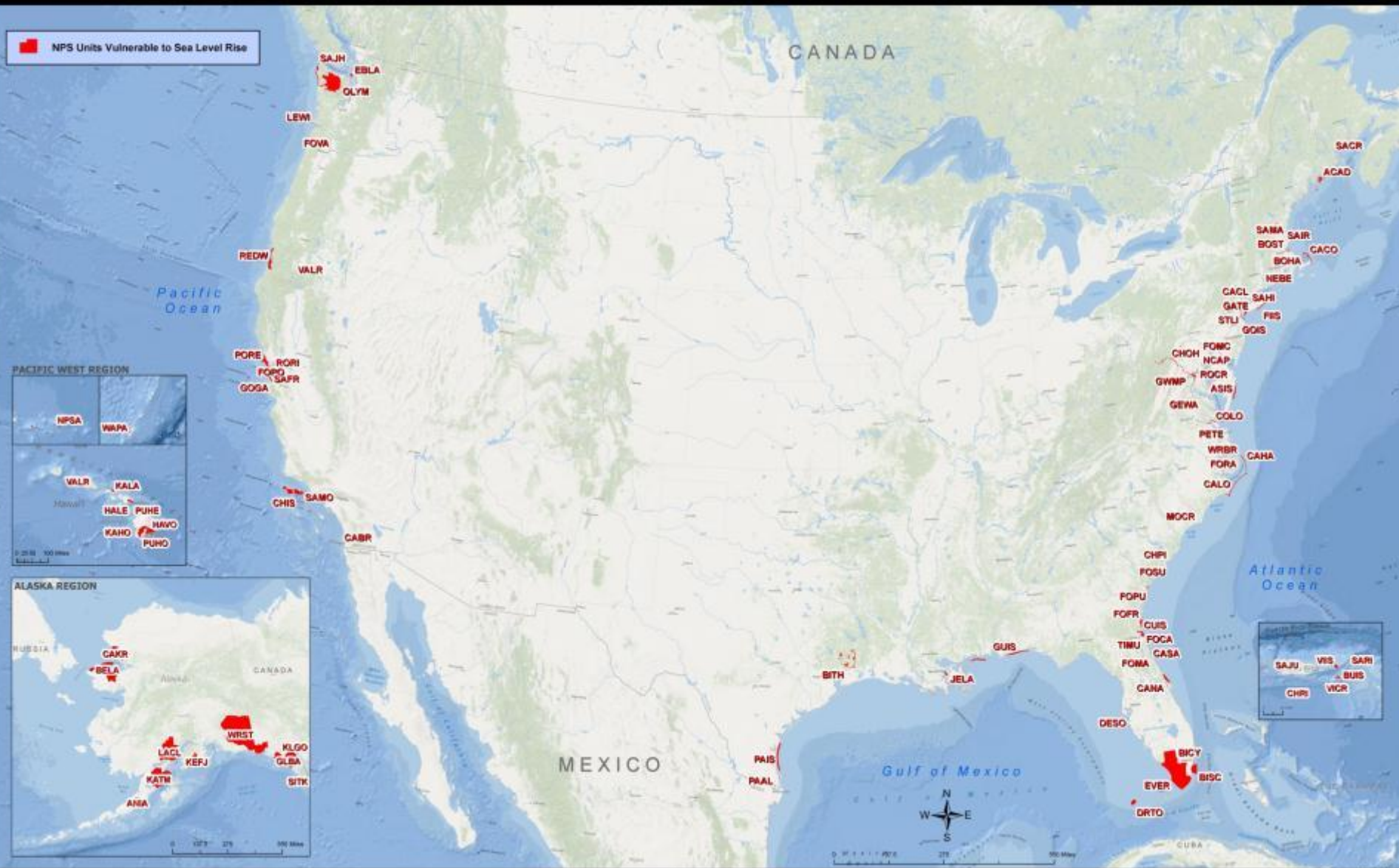
Actions Underway



EXPERIENCE
YOUR
AMERICA

- Determine* where are we vulnerable
- Develop* strategies to increase resiliency
- Implement* actions for dynamic environments
- Prepare* plans in advance; expect surprises
- Collaborate* integrated strategies are stronger





Produced by the Natural Resource Stewardship and Science Directorate, Water Resources Division, Ocean & Coastal Resources Branch

Revised May 2012

105 Parks Vulnerable to Sea Level Rise
Over 11,000 Miles of Shoreline & 2.5 Million Water Acres



Park resources and responses vary



- Inventory and monitor resources
- Incorporate changes and forecasts into policy and planning
- Increase infrastructure resilience
- Interpret resources and enhance stewardship

Climate variability increases management challenges



EXPERIENCE
YOUR
AMERICA

- At least 226 documented archaeological sites
 - Pictograph panels from nomadic hunter-gatherers (Archaic Period, 3000-4000 years ago)
 - American Indian Wars and railroad development (19th century)
- Reservoir levels fluctuate in response to precipitation, storms, and agricultural water use
- NPS has no management authority of the reservoir water, only the surrounding land



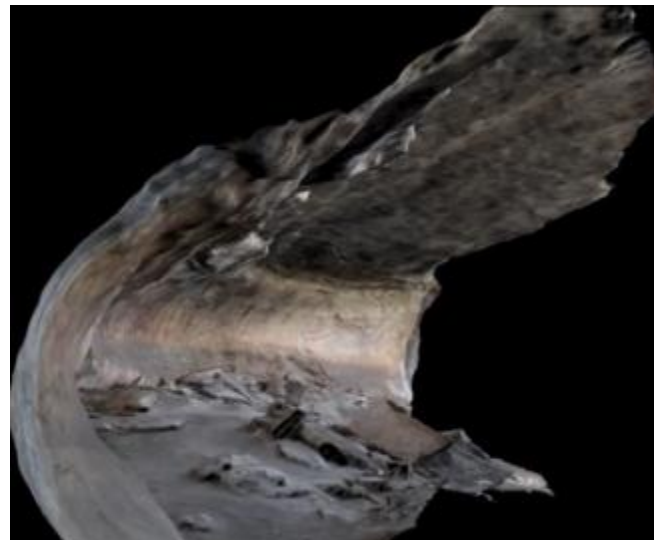
EXPERIENCE
YOUR
AMERICA

Changing water levels impact cultural resources

- Low lake levels →
 - Shoreline erosion (burial sites)
 - Increased visibility and looting
 - Human use impacts (campfires, cross-border law enforcement)
- High lake levels →
 - Silt accumulation in upper reaches of reservoir → reduced lake capacity → higher flash flood levels
 - Biological threats
 - Increase in mud-dauber wasp nests on Panther Cave pictographs, due to increased proximity of shoreline
 - Non-native clam (*Corbicula*) burrows into pristine archaeological sites



Response focuses on inventory and outreach



- Inventory archaeological sites when water is low
- Monitor resource conditions
- Salvage resources
- Assess and minimize human impacts
- Provide cultural resources orientation for law enforcement rangers

Northwest Alaska: Cape Krusenstern, Bering Land Bridge



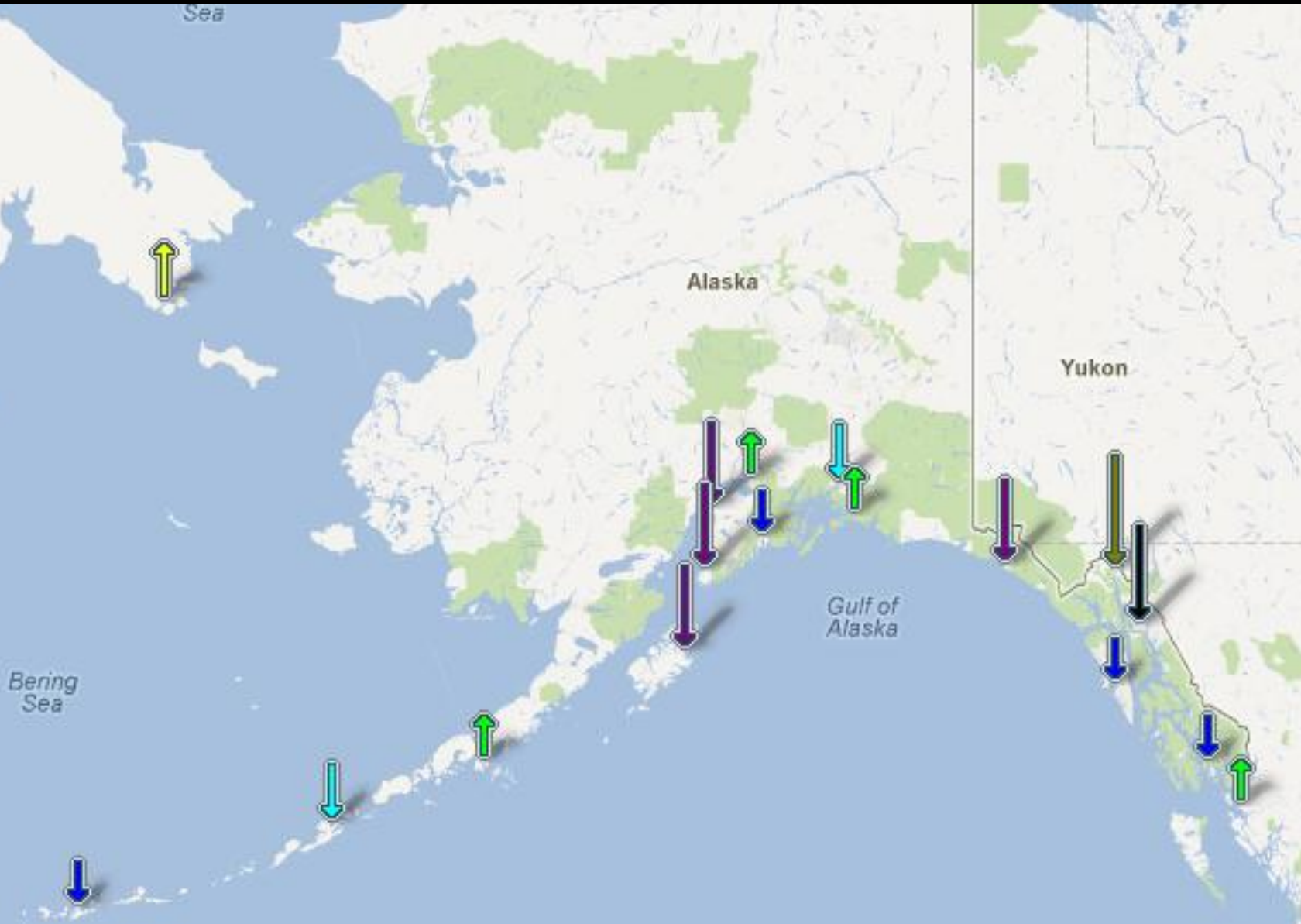
EXPERIENCE
YOUR
AMERICA



Northwest Alaska: Russian Data



EXPERIENCE
YOUR
AMERICA



Cultural resources are at risk in coastal Alaska



EXPERIENCE
YOUR
AMERICA



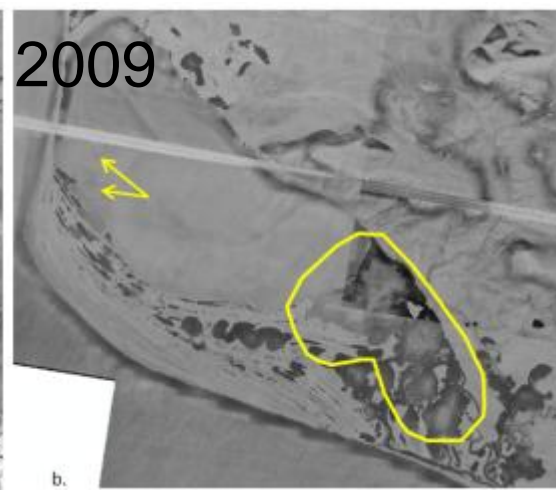
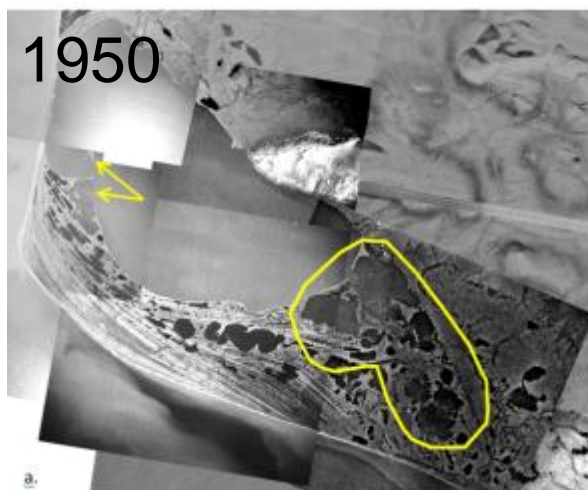
- Reduction in sea ice
 - Reduced protection against shoreline erosion
 - Increased marine traffic and oil development
 - Increased ocean exchange with lagoons
- Thawing permafrost
 - Accelerated shoreline erosion
 - Village relocation



EXPERIENCE
YOUR
AMERICA

Resource inventories are needed

- Lack of baseline information for sites at risk
 - Locations of cultural sites
 - Subsistence needs
 - Lagoonal water quality and characteristics
 - Difficulty in accessing remote sites



Alaska response focuses on data development



EXPERIENCE
YOUR
AMERICA



- Climate Change Scenario Planning
- Development of datasets related to climate change vulnerability
- Development of biological monitoring protocols



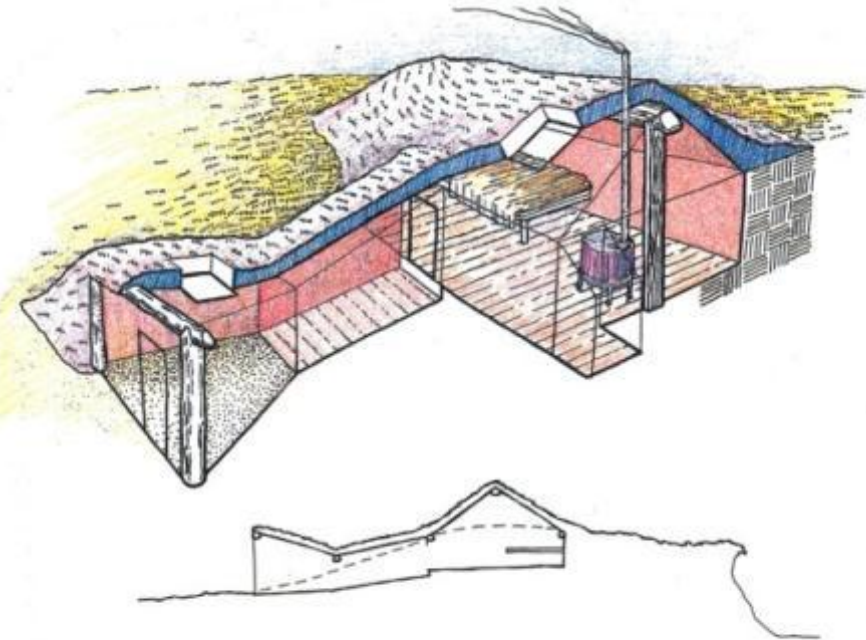
Drawing of Inupiat at time of European contact by Louis Choris, 1816, part of Otto Von Kotzebue's crew

Inupiat Home



EXPERIENCE
YOUR
AMERICA

Thomas Makaiqtaq
Barr's home at
Ublasaun



Gateway view of Thomas Makaiqtaq Barr's home at Ublasaun, showing details of construction. — Drawing by James Church.

Photo of boy at
entrance to house circa
1923





EXPERIENCE
YOUR
AMERICA



Salvage archeology

Intact tunnel entry to a house that had already been washed to sea



Island dynamics complicate management: Assateague Island National Seashore



- High vulnerability to sea-level rise and increased storm intensity
- Existing General Management Plan did not consider the significant climate change impacts on barrier island
- Many park neighbors were skeptical of future climate impacts, and resistant to management changes
- Three different agencies manage portions of Assateague Island

EXPERIENCE
YOUR
AMERICA

Management plan needs to address new challenges



EXPERIENCE
YOUR
AMERICA



- Facility sustainability and replacement
- Visitor access
- Response to natural processes (such as island breach)
- Balance of visitor use and wilderness values
- Cooperation with partner land management agencies

New projects and historic data inform development of management plan



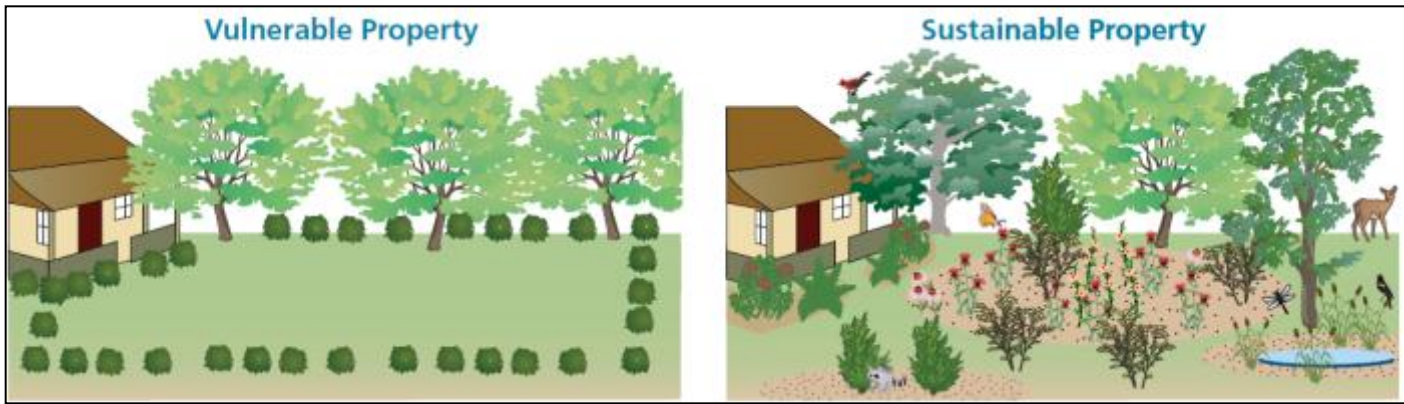
EXPERIENCE
YOUR
AMERICA

- Climate Change Scenario Planning
- Scaled sea-level rise projections to management time frame
- Analysis of coastal change trends using long-term datasets
- Modeling climate change impacts (USGS partnership)
- Monitoring salt marsh hydrology and change (USGS partnership)



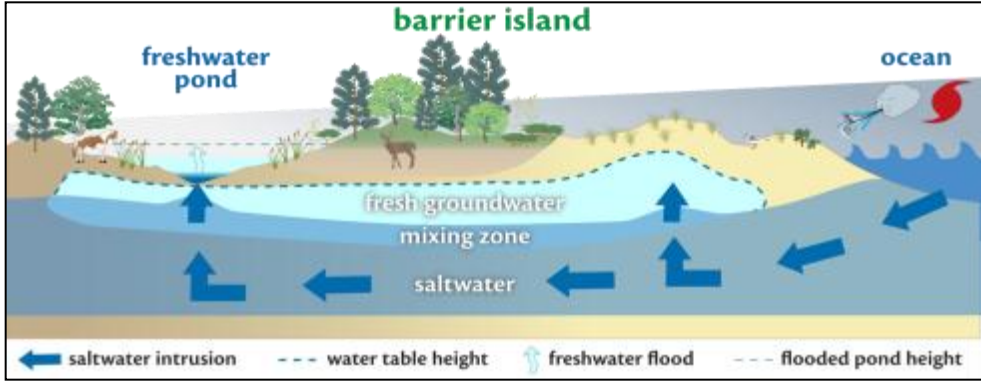
Outreach efforts target multiple audiences

Park neighbors

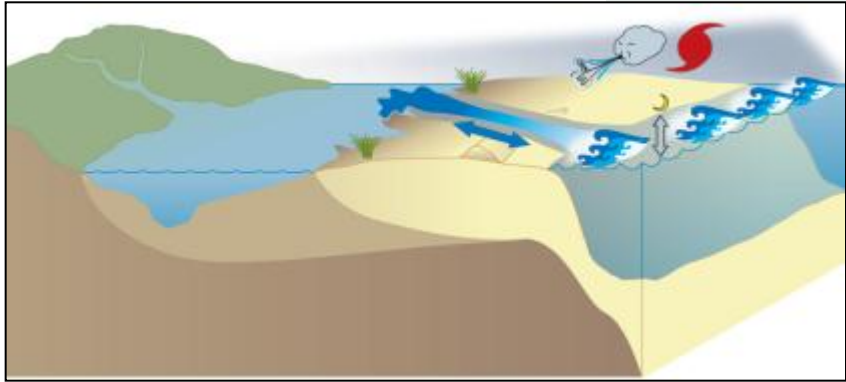


EXPERIENCE
YOUR
AMERICA

Visitors and stakeholders



Online education module



Employees and land management partners



Sandy: NPS Response & Recovery

EXPERIENCE
YOUR
AMERICA

- Incident Response (e.g., tree cutting, cleanup, hazard evaluation, project scoping)
- Hurricane Sandy Rebuilding Task Force (Interagency)
- NPS Rapid Review Team:
 - Park Planning Facilities and Lands
 - Cultural resources
 - Natural resources
 - Sustainability
 - Regional representative

Phase I Projects: Parks reopened Memorial Day – 4th of July

Phase II Projects: Park fully functional - Ongoing



Museum Emergency Response Team



Elis Island - Salvaging museum collections from Medical Exhibit

Museum Emergency Response Team



EXPERIENCE
YOUR
AMERICA



Museum Emergency Response Team



EXPERIENCE
YOUR
AMERICA



Salvaging, triage and air-drying artifacts from basement



GATE is a highly manipulated system: 36% of shoreline armored



EXPERIENCE
YOUR
AMERICA



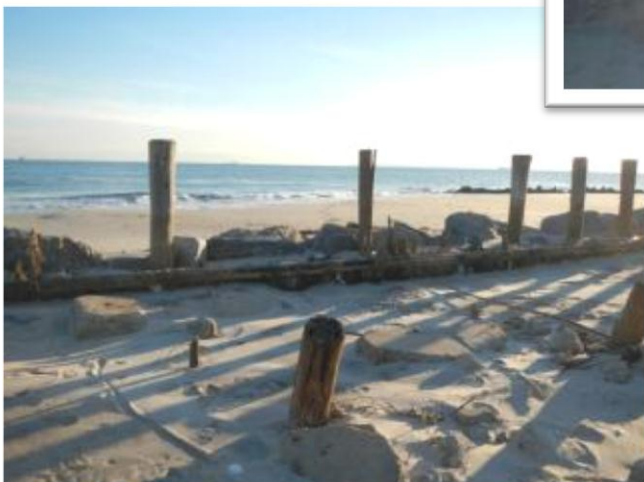
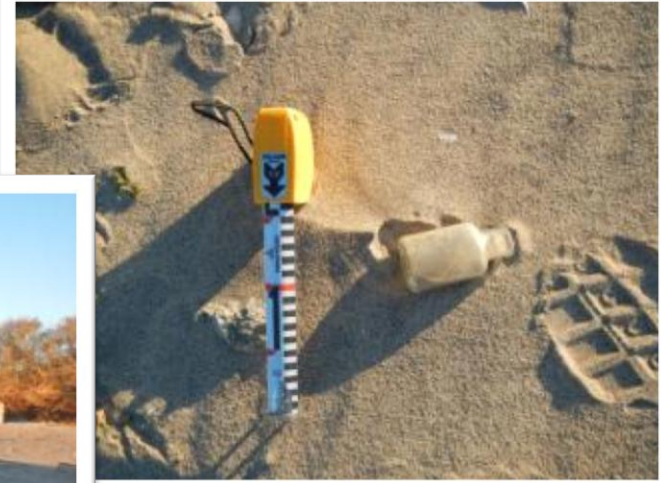
- 2013: Published CEI Report & GIS files for 8 parks
<https://irma.nps.gov/App/Reference/Profile/2193512>

Cultural Resources



Gateway National Recreation Area

- Fort Tilden



Natural Resources



Fort Tilden
Shore Road, Exposed
Timbers and Bulkhead



Fort Tilden/Jacob Riis Beaches Pre/Post-Sandy



West Pond Pre/Post-Sandy



2008 Imagery



11.3.2012 Imagery



Sandy Hook, NJ



Facility Impacts: Sandy



Hurricane Sandy Disaster Relief Supplemental Appropriations Spending Plan Department of the Interior



EXPERIENCE
YOUR
AMERICA

- “For all projects, construction must account for ABFE plus one foot. For critical infrastructure, such as a power supply or water treatment operations, there is a strong recommendation from the Task Force for application of ABFE plus two feet. Some exceptions to this standard are temporary facilities, green infrastructure, and facilities that are essential to access beaches and other recreational assets that need to be within the flood zone for their purpose and are designed to be sacrificed in a flood event.”

Hurricane Sandy Rebuilding Task Force



EXPERIENCE
YOUR
AMERICA

“On April 4, 2013, HUD Secretary Shaun Donovan joined then DOT Secretary Ray LaHood to announce a minimum flood risk reduction standard that protects investments in Sandy-affected communities. This minimum flood risk standard addresses the increased flood risk that results from rising sea levels, more intense storms, increased urbanization in floodplains, and other factors. This standard, which is in line with standards that many State and local jurisdictions have adopted, **requires all major rebuilding projects that rely on Sandy-related Federal funding to be elevated or otherwise flood-proofed according to the best available FEMA guidance plus one additional foot of freeboard.** Where State or local building codes or standards already require minimum elevations, the higher of the competing minimums apply.”

ABFE +1'/+2'



EXPERIENCE
YOUR
AMERICA

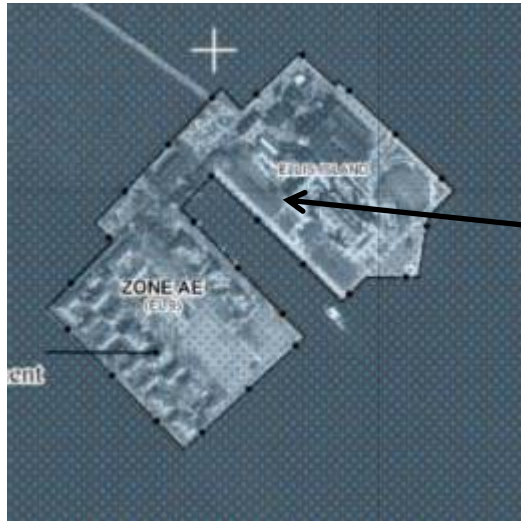
- Hurricane Sandy Rebuilding Task Force
- Use latest data (ABFE to Best Available Flood Hazard Data) versus published FIRM
- Build above 100-year (1%) floodplain by at least 1', 2' for critical
- Goal is resiliency – minimize reinvestment costs

FEMA: FIRM vs ABFE vs BAFH

(Example - Ellis Island)



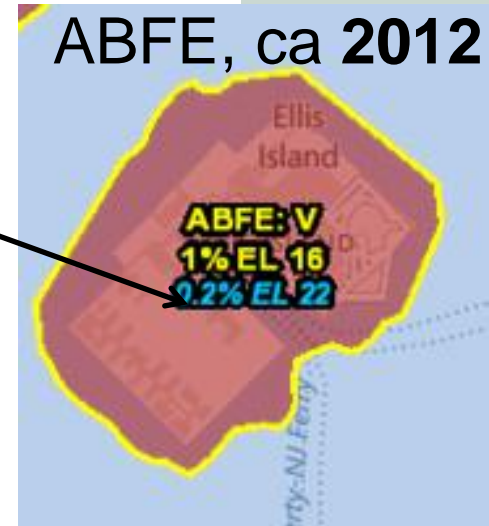
FIRM, ca 2006



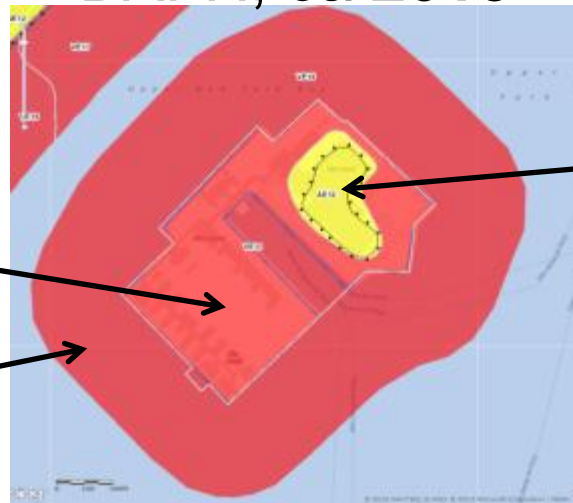
ZONE A
(EL 9)
(All of both islands)

ZONE V
(EL 16)
(All of both islands)

ABFE, ca 2012



BAFH, ca 2013



ZONE VE
(EL 13)

ZONE VE
(EL 16)

ZONE AE
(EL 12)

Ellis Island Miscellaneous Floor Elevations



(New?) Ideas



EXPERIENCE
YOUR
AMERICA

- Relocate primary electric and heating plants to central elevated site @ Statue of Liberty
- Adjust boardwalk railing spacing @ Sagamore Hill
- Condensers on platforms
- Great Kills docks (Design to float up w/out floating away)



Relocate Primary Electric and Heating Plants
to Central Elevated Site, Statue of Liberty



EXPERIENCE
YOUR
AMERICA

Liberty Island



Incinerator



Administration



Concessions

Pavillion (non-NPS)

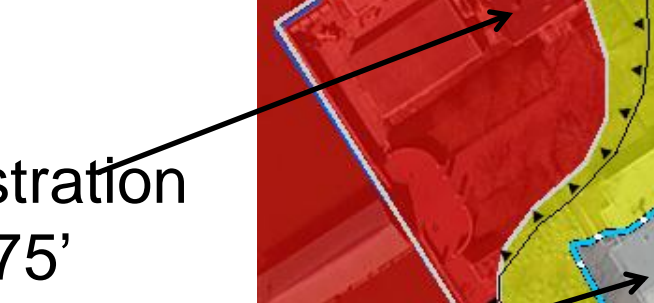


Incinerator



VE14

Administration
FF=10.75'



AE12

Concessions
FF=12.05'

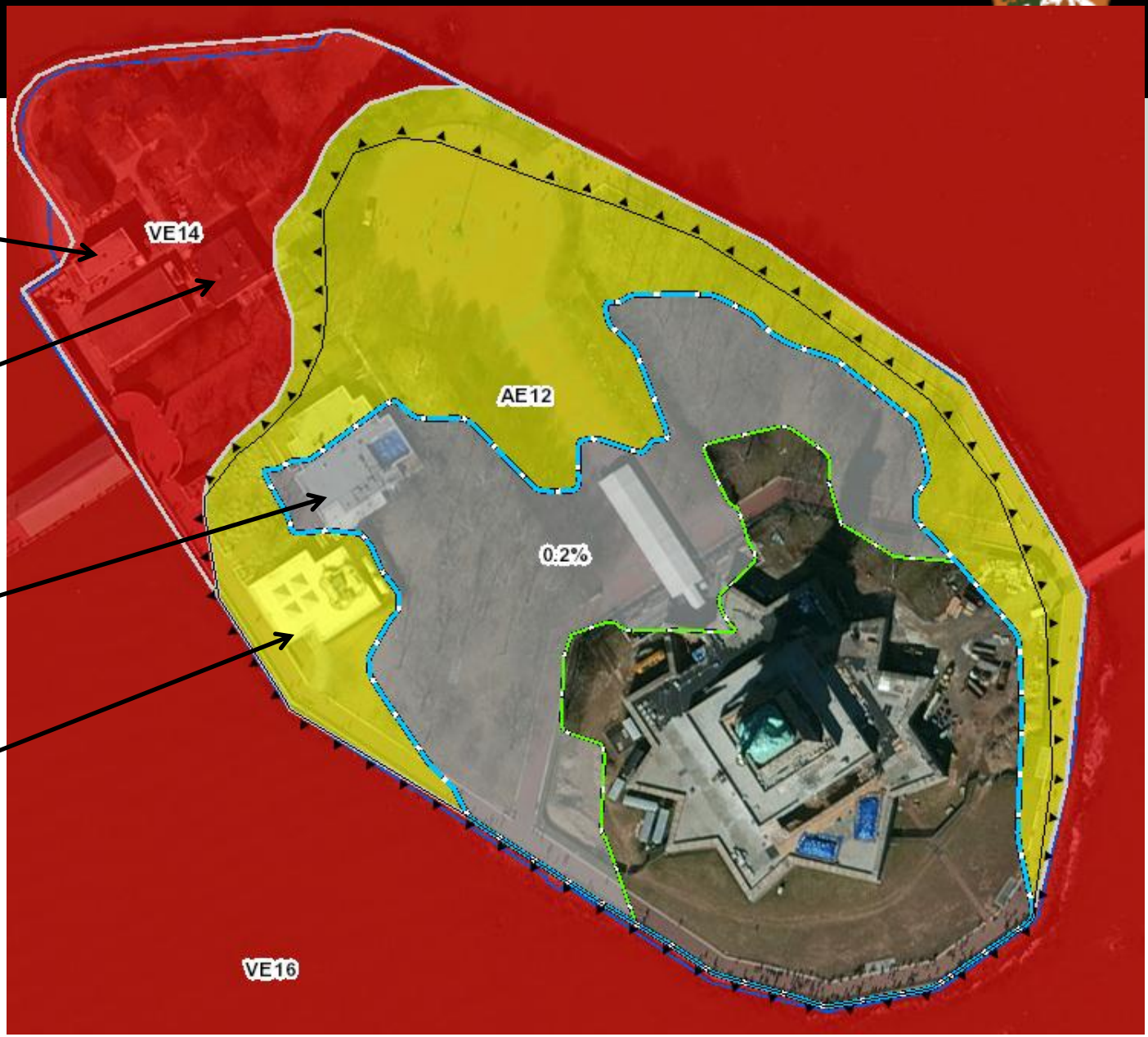


0.2%

Pavillion (non-
NPS)



VE16



Liberty Island Concessions Building



- Boilers and Electrical Switchgear (including high voltage) in basement
- Water level was to the ceiling



Administration Building



EXPERIENCE
YOUR
AMERICA



- Primary Switchgear behind building at grade
- Heating Plant and building electric panels in basement



Liberty Island Incinerator Building



EXPERIENCE
YOUR
AMERICA



Mainly used for storage pre-
Sandy



Choices for Resilience



EXPERIENCE
YOUR
AMERICA

- Elevate in each building
- Water proof equipment or basements
- Elevate in central location

Elevate in each building



- Administration Building – Possible but would require displacing sizable useful space
- Concession Building – One story building with floor just below design flood

EXPERIENCE
YOUR
AMERICA

NOT PRACTICAL

Waterproof Equipment or Basements



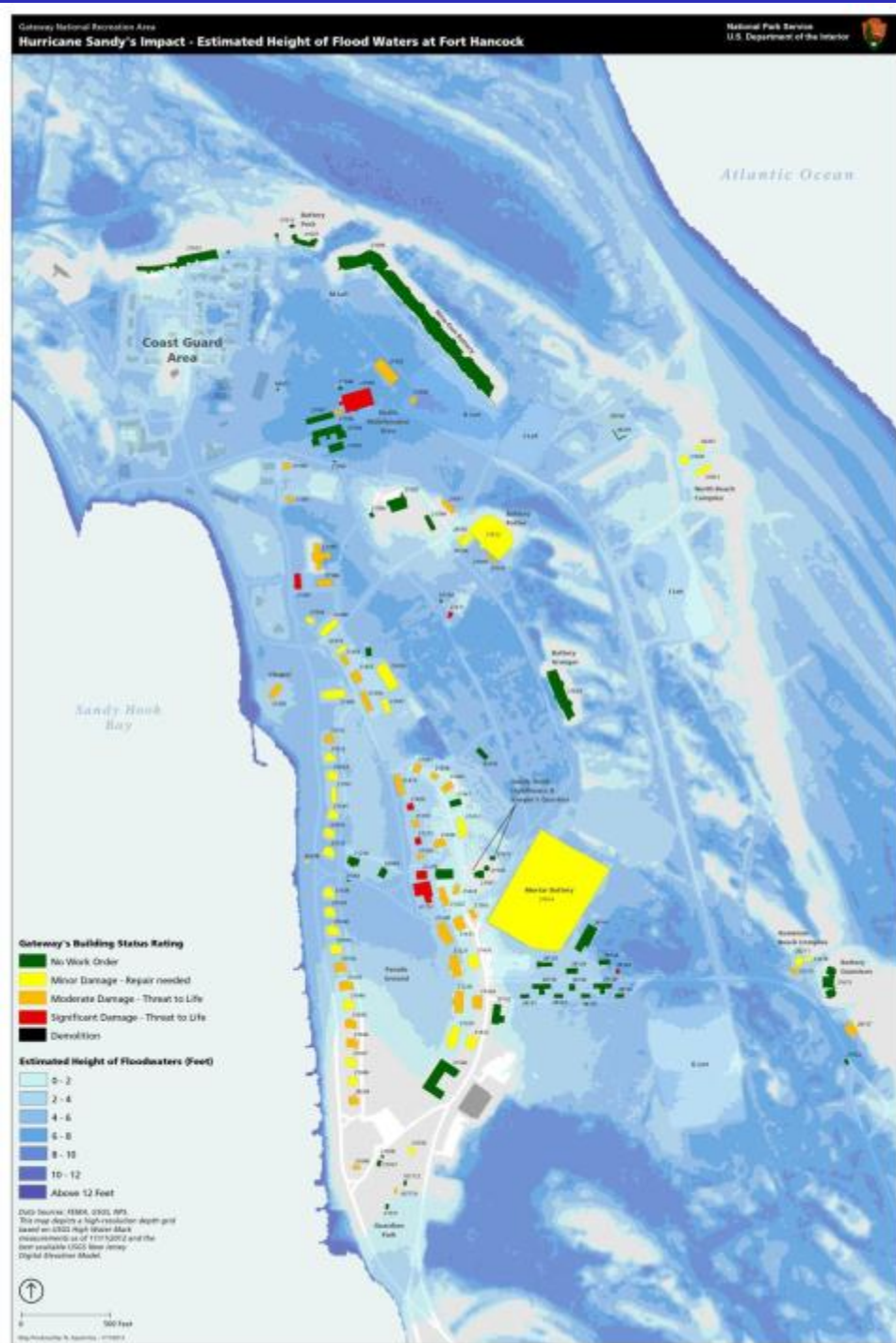
EXPERIENCE
YOUR
AMERICA

- Requires waterproofing basements and keeping them waterproof.
- Small breaches in waterproofing can exacerbate a flood by allowing water in – restricting its flow out.
- Buildings are historic.
- Waterproofing equipment is a challenge (boilers, electrical switchgear).

NOT PRACTICAL

Strategy: Liberty Island Incinerator Building w/ Mezzanine





Post- Sandy:
Hundreds of
facilities needed
repairs

Fire Island National Seashore Breach

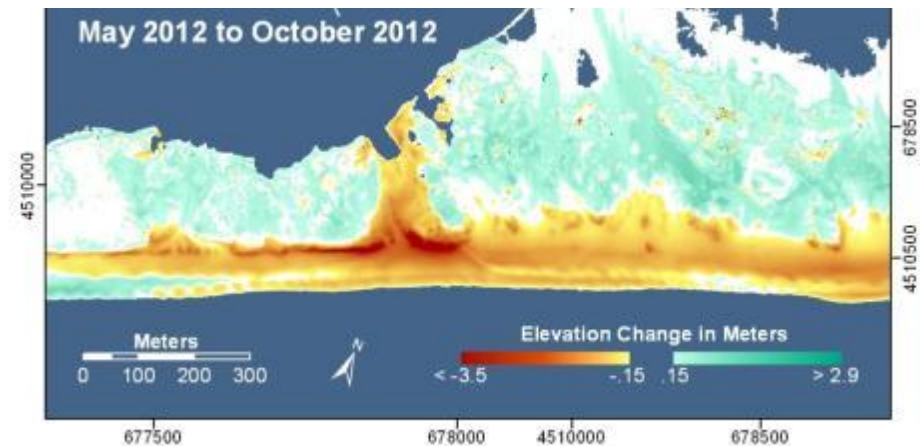
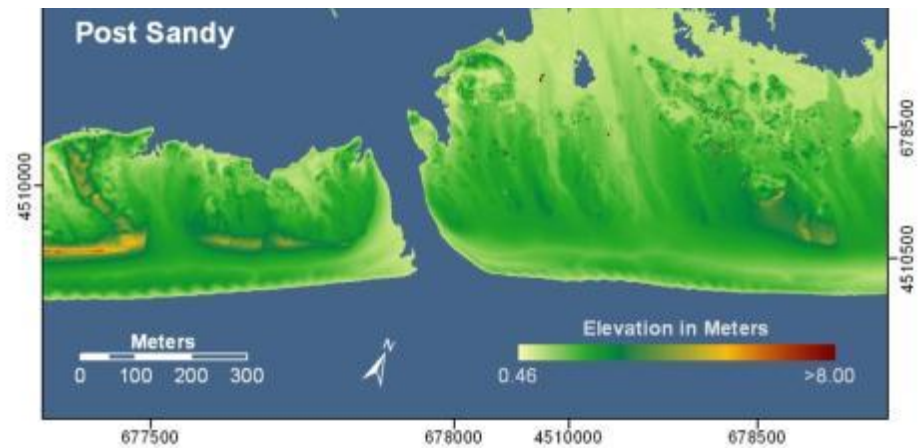
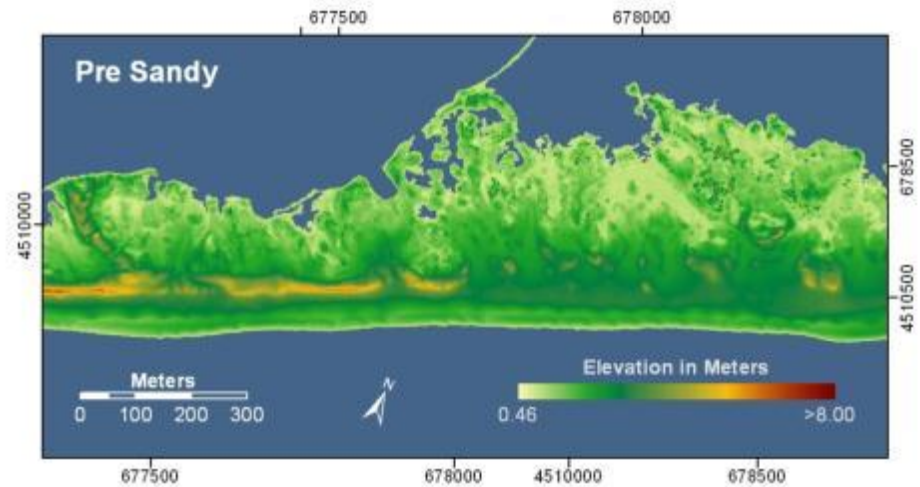


EXPERIENCE
YOUR
AMERICA



- In Wilderness 60 miles from Manhattan
- Breaches deposit sediment = platforms for future salt marsh
- Increased Island Width = more resilient to future storms

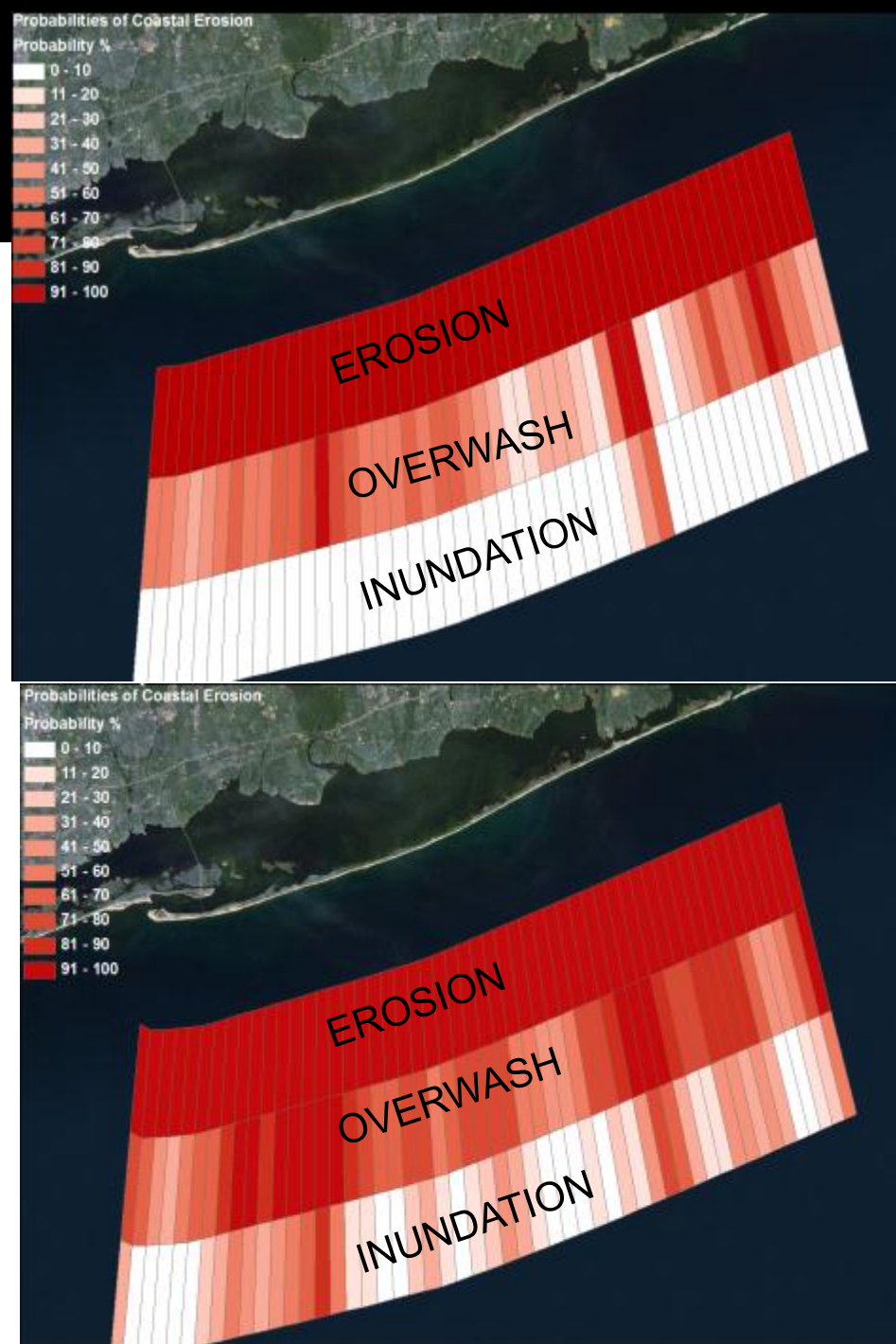
Oblique aerial photography and lidar-based measurements of beach elevation confirm prediction of barrier island inundation at western end of Fire Island, New York.



Increased vulnerability to coastal erosion during future storms

Pre-Sandy (2010) vulnerability
20% of Fire Island was likely to
overwash during Hurricane
Sandy.

Post-Sandy (2012) vulnerability
70% of Fire Island is likely to
overwash during conditions similar
to Sandy.



Sandy Lessons Learned



EXPERIENCE
YOUR
AMERICA

Low lying coastal areas are more vulnerable to inundation during future storms.

- Museum Collections
- Historic Structures
- Habitat



Sandy = Adaptation Opportunity



EXPERIENCE
YOUR
AMERICA

- As sea level rise accelerates, funds for adaptation and recovery will flow to major metropolitan areas.
- NPS and other federal land management agencies may have a difficult time competing for funds.
- Initiating adaptation is important now.
- Recovery from Hurricane Sandy is an excellent opportunity for an integrated, reasoned approach, using resilience, not “business as usual” strategies.

ADAPTATION TO SEA LEVEL RISE IN COASTAL PARKS



EXPERIENCE
YOUR
AMERICA

Goal:

provide practical & actionable options for adaptation to long-term SLR & storm impacts in coastal parks

Focus:

infrastructure, cultural resources, & natural resources

Deliverables:

quantitative analysis of coastal park assets vulnerable to SLR, final report & workshop

Final Report:

- “Adaptation Handbook”
- practical & detailed options for SLR adaptation
- divide assets into broad groups, discuss adaptation options for each, with examples

Quantitative Analysis:

- Analyze assets vulnerable to SLR from 41 coastal parks

Coastal Adaptation Strategy



Coastal Adaptation Strategy



Coastal Adaptation Strategy

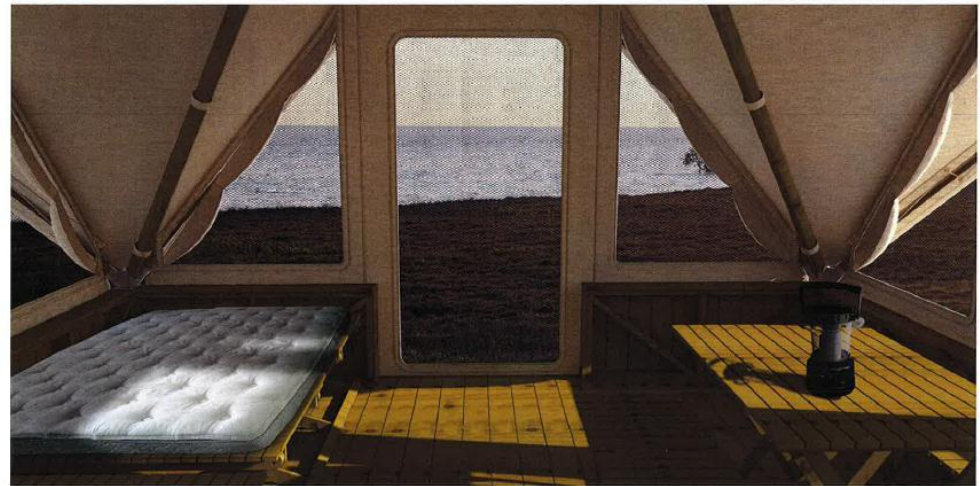


Coastal Adaptation Strategy



EXPERIENCE
YOUR
AMERICA

Eco-Tents,
Everglades
(designed with
local university
partnership)



Coastal Adaptation Strategy



EXPERIENCE
YOUR
AMERICA



Maintaining visitor access and opportunities on vulnerable shorelines



- Parking lots made of crushed oyster shells
- Moveable bathhouses

The Cape Lookout N.S. Storm Recovery Plan



EXPERIENCE
YOUR
AMERICA

- Focus on Natural and Cultural Resources
- Includes Pre-Storm Preparedness and Phased Post-Storm Response Actions
- Works with Existing Hurricane Preparedness Plan
- Intended to Aid Incident Commanders and Teams
- Uses GPS Data, GIS and Photos to Guide Response Teams
- Discusses Long-Range Adaptation Efforts for Major Resources



National Park Service
U.S. Department of the Interior



Thank you



EXPERIENCE
YOUR
AMERICA

- Jack Johnson and Brenda Todd, Amistad National Recreation Area
- Trish Kicklighter and Ish Ennis, Assateague Island National Seashore
- Frank Hays, Western Arctic Parklands
- Tahzay Jones and Dael Devenport, Alaska Regional Office
- Mike Eissenberg, Denver Service Center
- Mark Christiano, Gateway National Recreation Area
- NPS Incident Management Teams for Sandy Response
- Patti Rafferty & Mary Foley, Northeast Region Office
- Rob Thieler, Cheryl Hapke, Hilary Stockdon, U S Geological Survey
- Rob Young, Western Carolina University
- Maria Caffrey, University of Colorado Boulder
- Eric Bardenhagen, Texas A& M University



EXPERIENCE
YOUR
AMERICA

Contact us for more information

- Rebecca_Beavers@nps.gov
- Courtney_Schupp@nps.gov

Coastal Geology website:

<http://www.nature.nps.gov/geology/coastal/index.cfm>

Oceans & Coastal Website:

<http://www.nature.nps.gov/water/oceancoastal/index.cfm>

Climate Change Planning:

<http://www1.nrintra.nps.gov/climatechange/planning.cfm>