10-19-2018

Engineering with Nature and Use of Natural and Nature-Based Features to Reduce Risk and Provide Enhanced Coastal Protection

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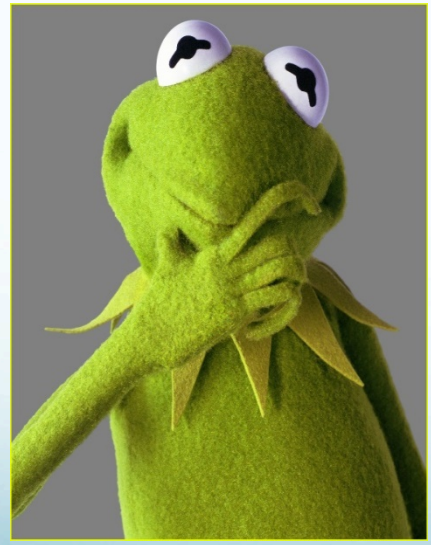
International Specialists in the Environment

Our Goal

- To help clients meet environmental challenges of the time by restoring natural resources and ecological functions focusing on nature-based solutions and sustainable communities



- Founded on Earth Day in 1970
- On forefront of national & international environmental issues for almost 50 years
- Provides sustainable solutions to address pressing environmental, social, and economic challenges
- Multi-disciplinary staff of about 1,000 respected environmental professionals,
- Experts in 85 scientific, planning and engineering fields
- Fully understands interactions between built and natural environment in order to develop creative and enduring solutions

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Natural and Nature-based Features for Coastal Protection

Hampton Roads Sea Level Rise/Flooding Adaptation Forum

October 19, 2018

Resilience and Environmental Quality

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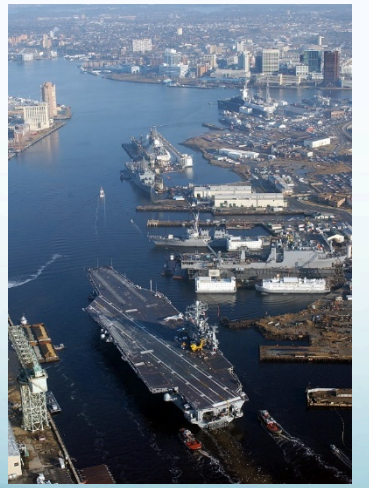
Port Cities-
Hampton Roads & Bolivar Roads



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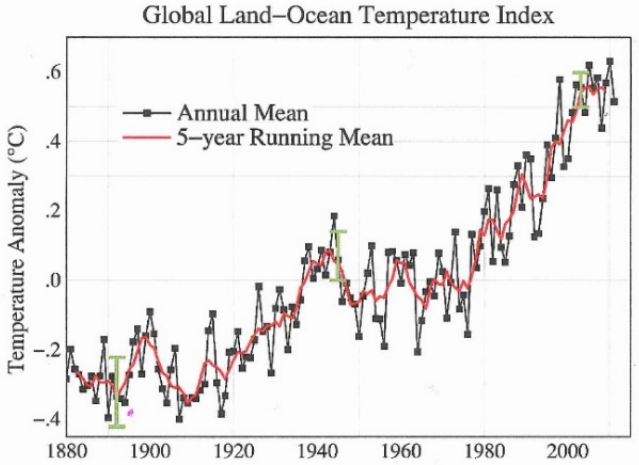
What is the Issue:
Global Temperatures Rising

Figure 1: NASA's Global Surface Temperature Record

Estimates of global surface temperature change, relative to the average global surface temperature for the period from 1951 to 1980, which is about 14° C (57° F) from NASA Goddard Institute for Space Studies show a warming trend over the 20th century. The estimates are based on surface air temperature measurements at meteorological stations and on sea surface temperature measurements from ships and satellites. The black curve shows average annual temperatures, and the red curve is a 5-year running average. The green bars indicate the margin of error, which has been reduced over time. Source: National Research Council 2010a

Source: NASA GISS (2010, based on Hansen, J., M. Sato, R. Ruedy, K. Lo, D. W. Lea, and M. Medina-Elizade. 2006. Global temperature change. Proceedings of the National Academy of Sciences of the United States of America 103(39):14288-14293. Updated through 2009 at http://data.giss.nasa.gov/gistemp/graphs/).



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SLR at Hampton Roads

- Highest along Atlantic and second to New Orleans
- 3 ft would affect 60,000 - 176,000+ people
- 2008 resilience initiatives began

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ACCELERATING
Sea Level Rise

+

GREATER
Coastal Erosion

+

MORE
Severe Storms

=

GREATER
Vulnerability

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Increasing Coastal Vulnerabilities

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Disruption to Supply Chain Infrastructure

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Natural Systems for
Reducing Vulnerabilities
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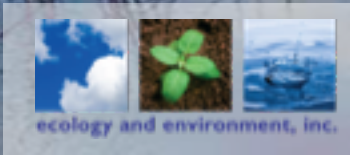
Natural Processes are Already at Work

- Provides added benefits
- Extends life span of structural approaches
- Reduces O&M costs
- Buys time before managed retreat



Opportunity: Use Coastal Ecosystems and Natural & Nature-based Features (NNBF) to Reduce Risk

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Natural and Nature-based

- Natural features evolved by geological, physical, biological, and chemical processes and include beach/dune complexes, coastal marshes and mudflats, barriers islands, mangroves and maritime forests, seagrass beds and reefs (Bridges et al 2013). These natural features provide coastal protection through various means
- Nature-based features are created by human planning, design, engineering, and construction such as constructed barrier islands and use of NNBF goes beyond traditional ecosystem restoration

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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

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Engineering With Nature
Nature-based Galveston Bay Example

- USACE EWN Program
- supports sustainable practices, projects, and outcomes
- by intentionally working to align natural and engineering processes
- to improve operational efficiency,
- use nature & nature-based features to maximize benefits, and
- sustainably deliver economic, environmental, and social benefits through collaborative means.

Evia Island

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NNBF International Guidelines for EWN Being Developed

- NNBF = Natural and Nature-based Features
- WRDA 2016 Sec. 181 The Corps of Engineers must ensure appropriate consideration is given to the use of natural and nature-based features in the design, construction, maintenance, repair, and rehabilitation of development projects.
- Went in as an approved amendment offered by Rep. Reid J. Ribble, (R-WI-8)
- Not just coastal, includes riverine systems and
- Watershed Approach
- Integrating World Bank Guidelines
- Integrating Landscape Architects

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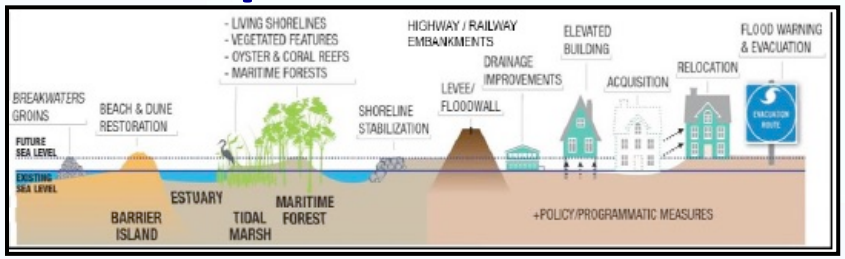
Multiple Lines Of Coastal Defense



- Structural (road raising, levees, surge gates, floodwalls, breakwaters, hardening of infrastructure, etc.)
- NNBF (dunes and beaches, salt marsh, oyster reef, barrier islands)
- Nonstructural (buyouts, structure raising, flood warning systems, floodplain management, regional sediment management, etc.)

NNBF Implementation Principles

1. start with system scale analysis
2. utilize thorough risk assessment
3. standardize performance evaluation
4. integrate w/ ecosystem conservation/restoration
5. anticipate adaptive management

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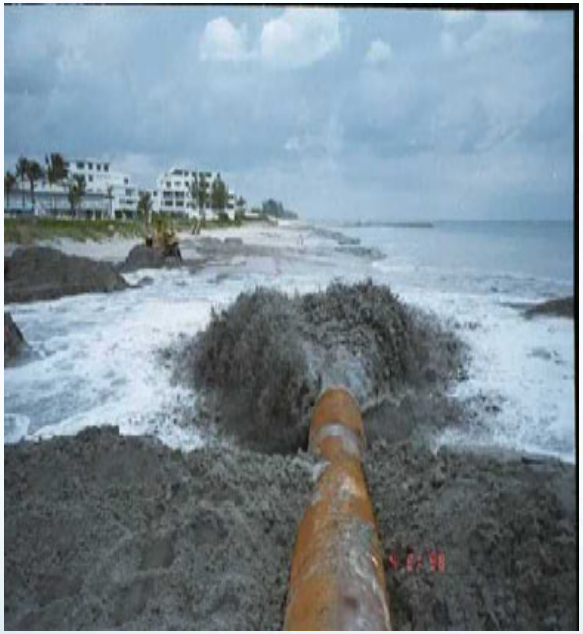
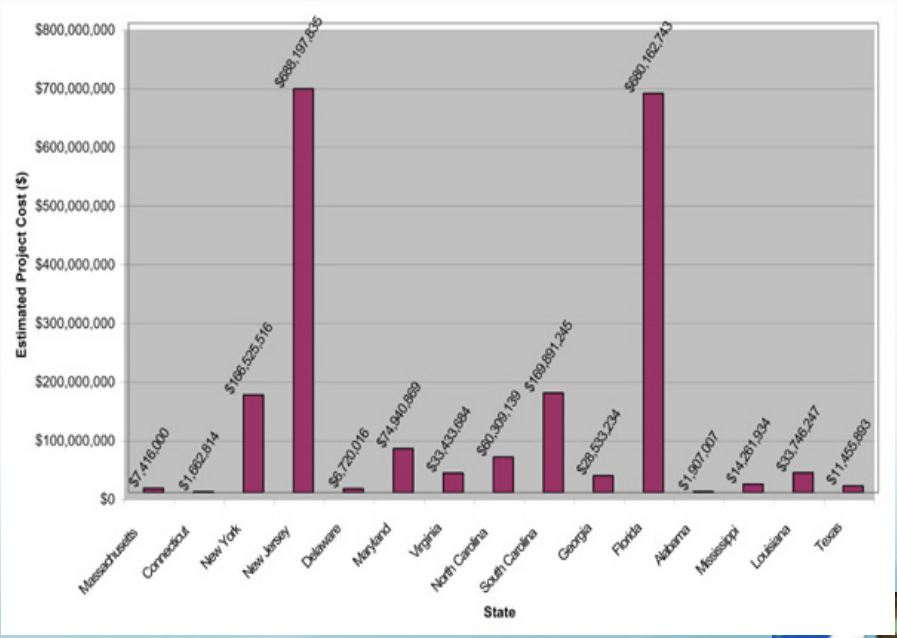
Beach Nourishment





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Beach nourishment alone not sufficient

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Eroding Coasts: Fight or Retreat?

Road closed

Cayo del Grullo

Clay dunes

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Eroding Coasts: Fight !

Galveston Bay

sand veneer gone, clay subsurface exposed

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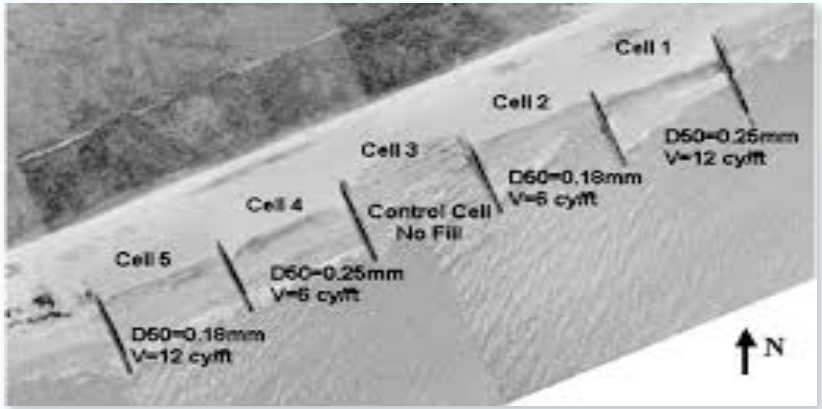
Natural Infrastructure: NNBF Clay Core Dunes



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NNBF Project Protecting Communities via Floodplain Restoration and Flood Reduction

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Multi-Purpose Multi-Benefits

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Living Shorelines and Green Breakwaters

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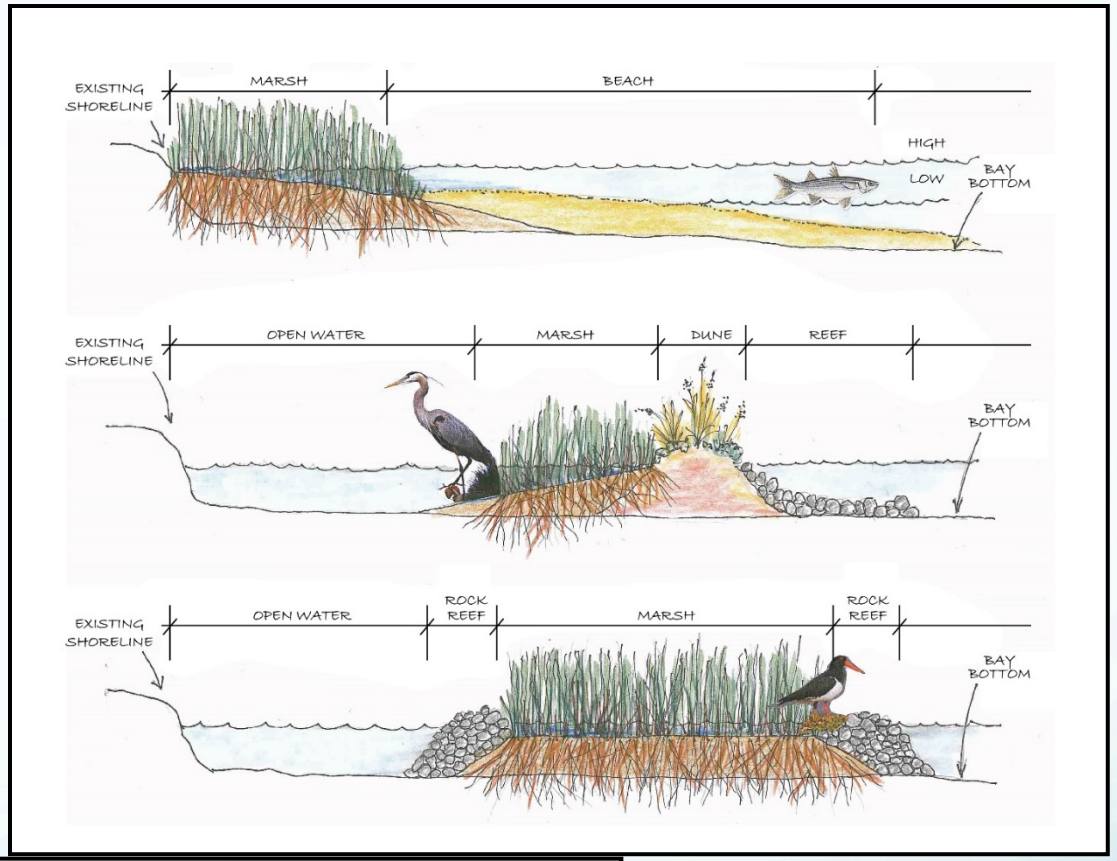
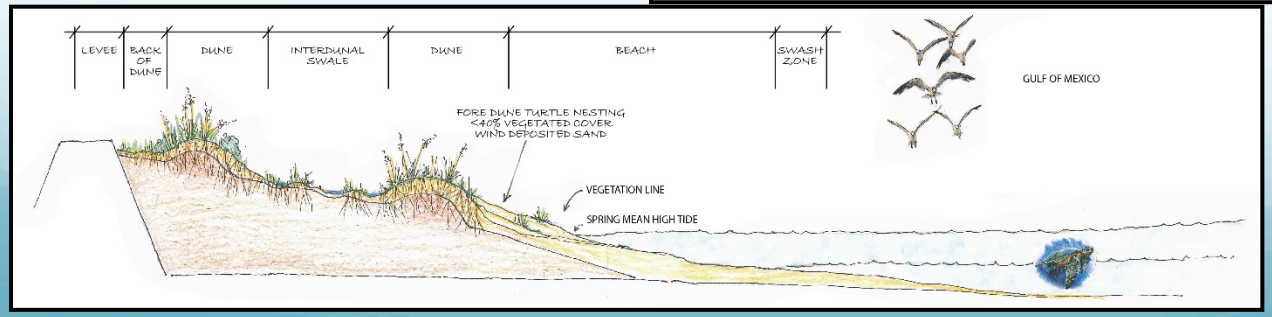
Various designs to suit site specifics & project needs





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Constructed Emergent Reefs

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Conserve Naturally Occurring Coastal Wetlands

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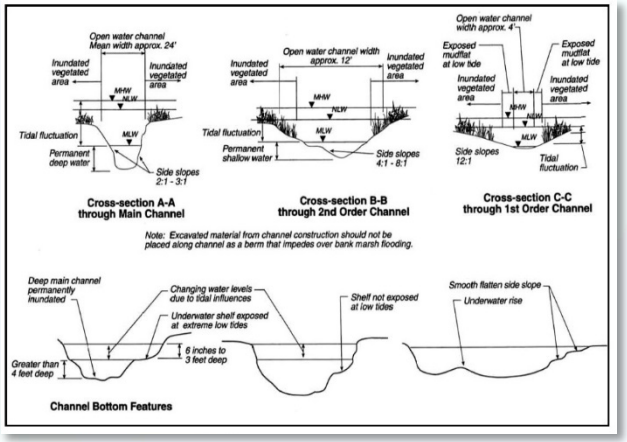
Construct Wetlands



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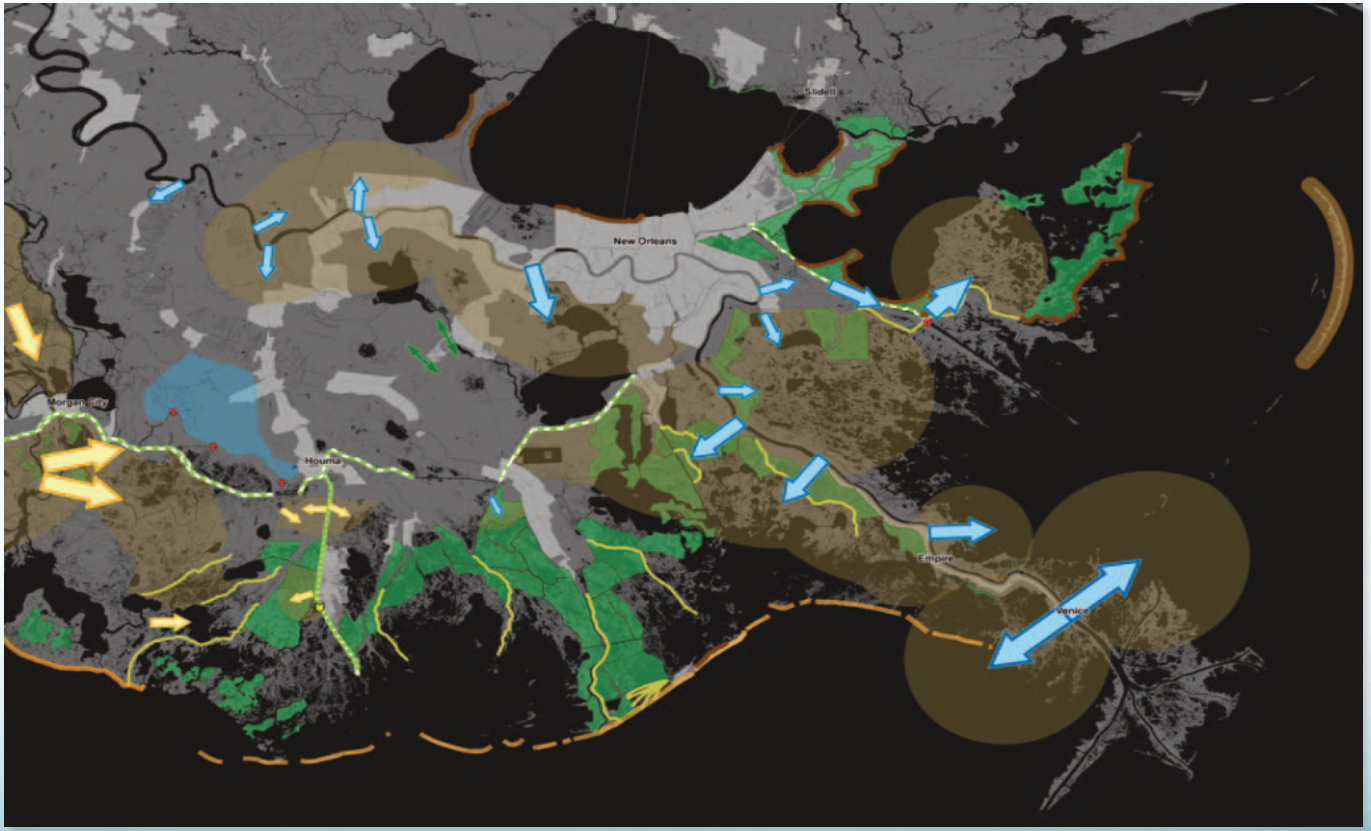
Increase Scale and Complexity



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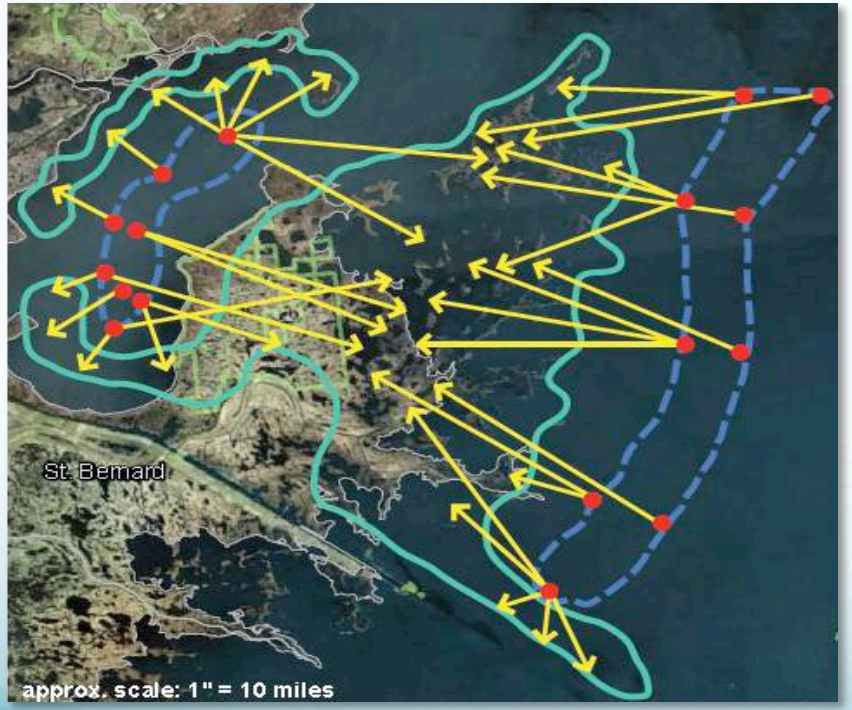
Link Protection and Restoration



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Resiliency Projects
Comprehensive Assessment

- See Louisiana's Comprehensive Master Plan Coastal Protection and Restoration Authority

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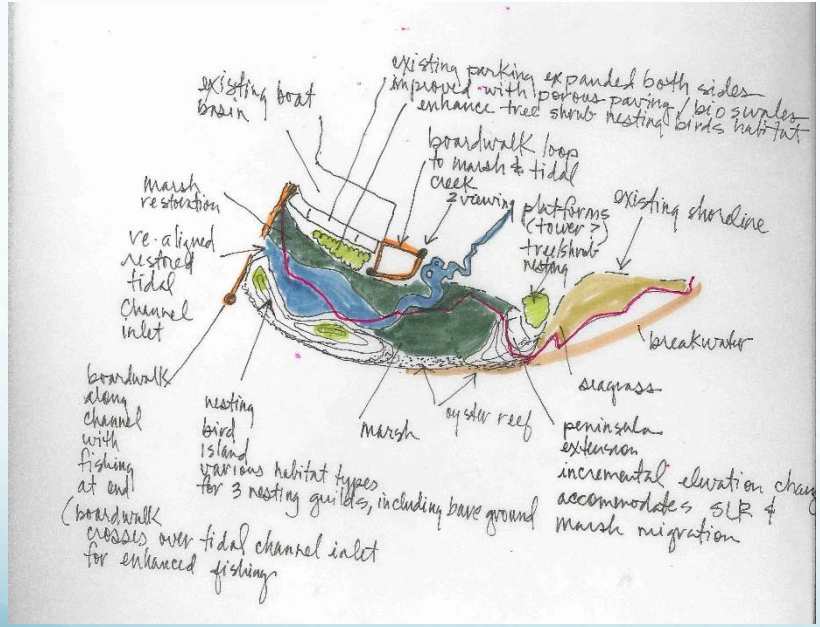
Example
Multiple Lines of Defense



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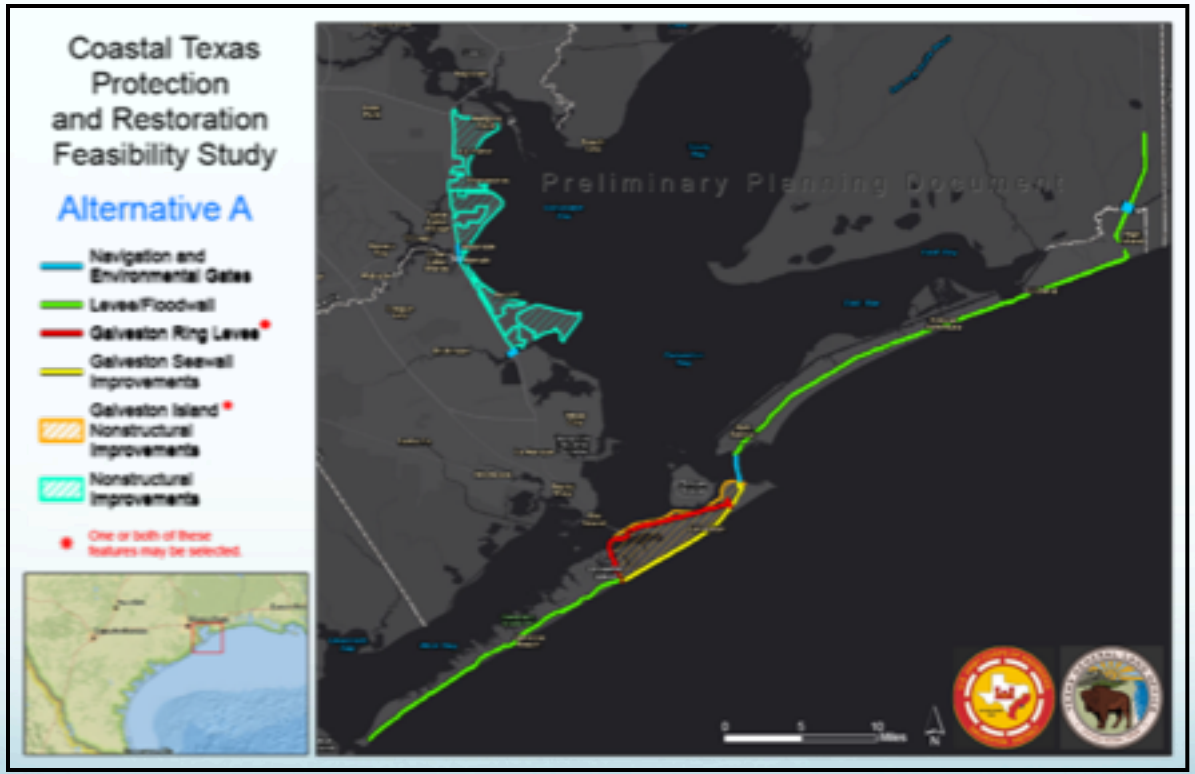
Bolivar Roads & upper Texas coast Storm Surge Protection Plan



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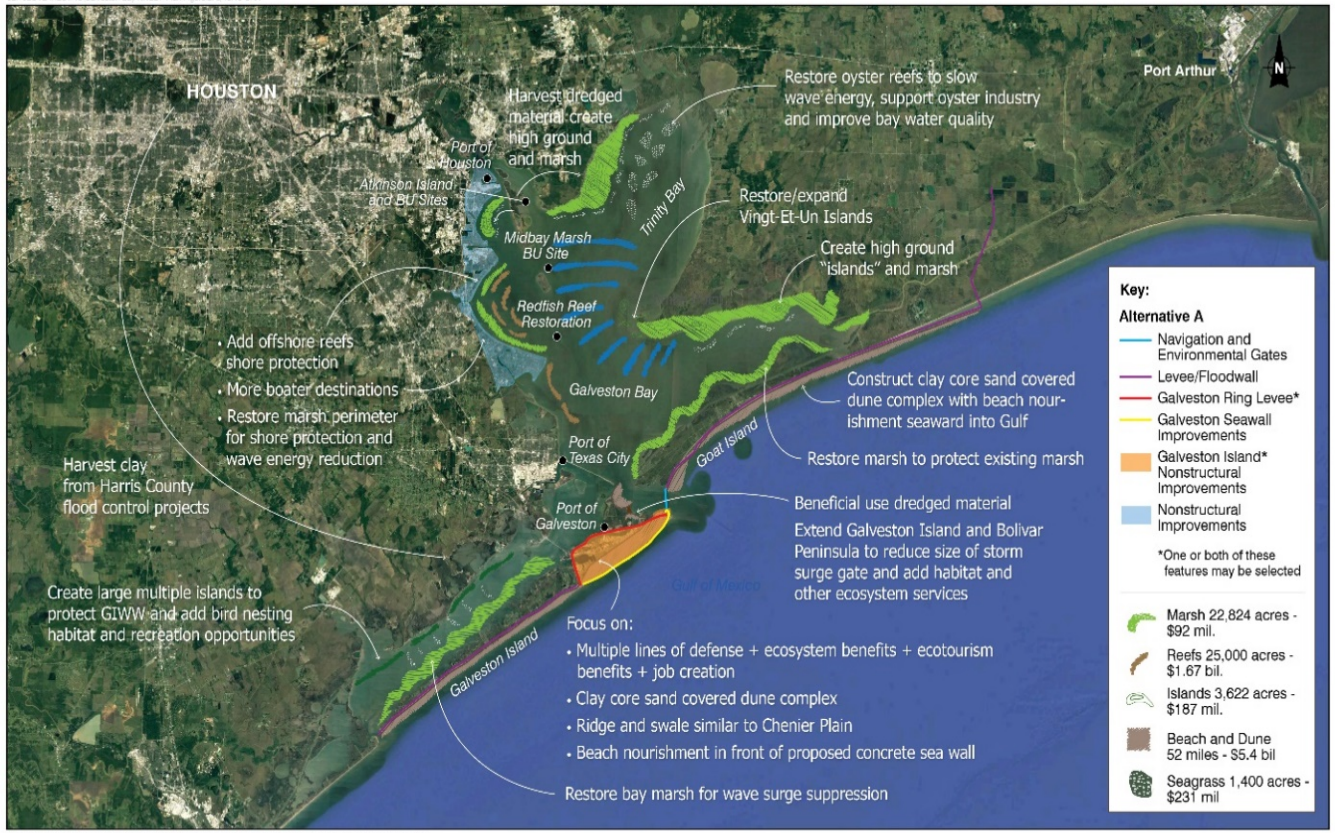
Example Linking Protection with Restoration: Protection Plan with NNBF added



Coastal Texas Protection and Restoration Feasibility Study - Alternative A with NNBF

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Lesson Learned: Act Early

- Acting early offers an opportunity to cost effectively design resilient systems instead of reacting to problems.
- Its too expensive to wait
- $1 preparation =$6-10 response

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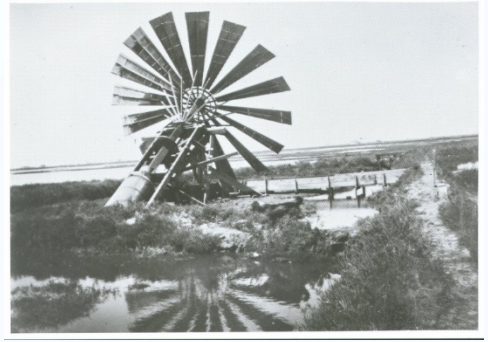
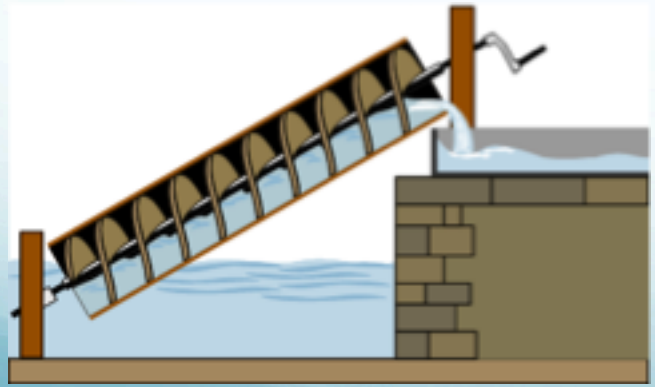
SLR: Levee + Wind + Archimedes Screw





- Source: Hayward Area Historical Society

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Recap NNBF Opportunities and Other Lessons Learned

- Clear understanding of all the issues
- Multiple added values
- Have sound process, think creatively, large scale, one size does not fit all
- Leverage previous successes
- Know the client, site, stakeholders to match your proposal to their vision/mission/budget
- A picture is worth a thousand words

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Local Opportunities

- Policy recommendations- NNBF as a strategy for added coastal protection and resilience
- Coordination –USACE
- Advocacy –federal support-WRDA 2016
- Project implementation with regional benefits

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Questions?

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