A Systems Approach Encompassing Natural Defenses and Resilient Structures: Innovative Funding Strategies

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Renewable Natural Resources Foundation Congress on Coastal Resilience and Risk

11-12 December 2013, College Park, MD

RNRF

Outline

- Sandy triggered increased urgency to better prepare coastal areas to meet future risks
  - Increasing sea level
  - Continued development in vulnerable areas
  - Potential changes in storm conditions
  - Constrained economic conditions
- Systems approaches encompass novel combinations of natural defenses and resilient structures
- Innovative funding strategies may be needed

What does the future hold for us?

Increased frequency and intensity of heat waves, along with health and worker safety impacts, drought, species disruptions, increased energy demand for cooling, altered material properties

Changing precipitation, including increases in very heavy precipitation and more intense droughts

Rising sea levels and associated waves, tides, and surges

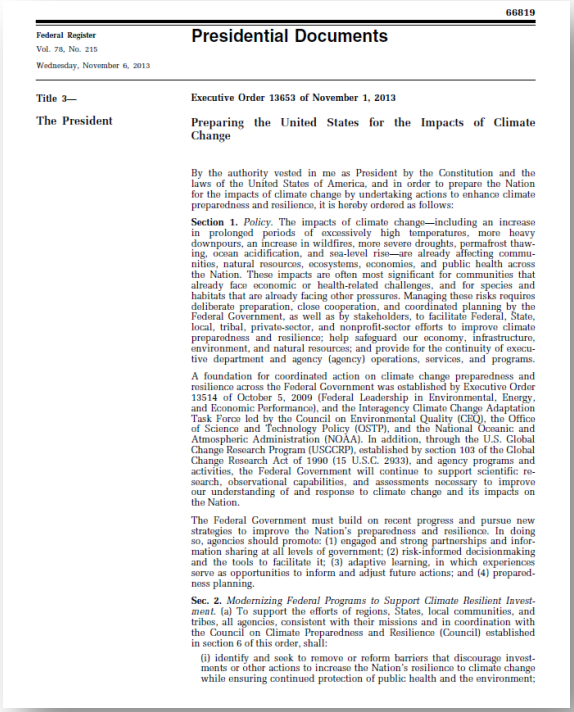
Continued development in increasingly more vulnerable areas

The Good News: Constraints Can Breed Creativity

- Opportunities for creative problem-solving exist where impacts and constraints are significant
  - Status quo for familiar challenges and constraints
  - We are forced to innovate when the problems are different and funds are tight
  - Solutions will likely involve novel application of existing technologies and materials, or combinations of existing and new technologies and materials
  - Innovative funding is needed as well as innovative engineering

EO 13653: Climate is Changing

- EO 13653:
  - Changes are already affecting communities, natural resources, ecosystems, economies, public health
  - Impacts are most significant for communities already facing economic or health-related challenges, and for species and habitats already facing other pressures



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Presidential Documents

Title 3—
The President

Executive Order 13653 of November 1, 2013

Preparing the United States for the Impacts of Climate Change

By the authority vested in me as President by the Constitution and the laws of the United States of America, and in order to prepare the Nation for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience, it is hereby ordered as follows:

Section 1. *Policy.* The impacts of climate change—including an increase in prolonged periods of excessively high temperatures, more heavy downpours, an increase in wildfires, more severe droughts, permafrost thawing, ocean acidification, and sea-level rise—are already affecting communities, natural resources, ecosystems, economies, and public health across the Nation. These impacts are often most significant for communities that already face economic or health-related challenges, and for species and habitats that are already facing other pressures. Managing those risks requires deliberate preparation, close cooperation, and coordinated planning by the Federal Government, as well as by stakeholders, to facilitate Federal, State, local, tribal, private-sector, and nonprofit-sector efforts to improve climate preparedness and resilience; help safeguard our economy, infrastructure, environment, and natural resources; and provide for the continuity of executive department and agency (agency) operations, services, and programs.

A foundation for coordinated action on climate change preparedness and resilience across the Federal Government was established by Executive Order 13514 of October 5, 2009 (Federal Leadership in Environmental, Energy, and Economic Performance), and the Interagency Climate Change Adaptation Task Force led by the Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA). In addition, through the U.S. Global Change Research Program (USGCRP), established by section 103 of the Global Change Research Act of 1990 (15 U.S.C. 2933), and agency programs and activities, the Federal Government will continue to support scientific research, observational capabilities, and assessments necessary to improve our understanding of and response to climate change and its impacts on the Nation.

The Federal Government must build on recent progress and pursue new strategies to improve the Nation's preparedness and resilience. In doing so, agencies should promote: (1) engaged and strong partnerships and information sharing at all levels of government; (2) risk-informed decisionmaking and the tools to facilitate it; (3) adaptive learning, in which experiences serve as opportunities to inform and adjust future actions; and (4) preparedness planning.

Sec. 2. *Modernizing Federal Programs to Support Climate Resilient Investment.* (a) To support the efforts of regions, States, local communities, and tribes, all agencies, consistent with their missions and in coordination with the Council on Climate Preparedness and Resilience (Council) established in section 6 of this order, shall:

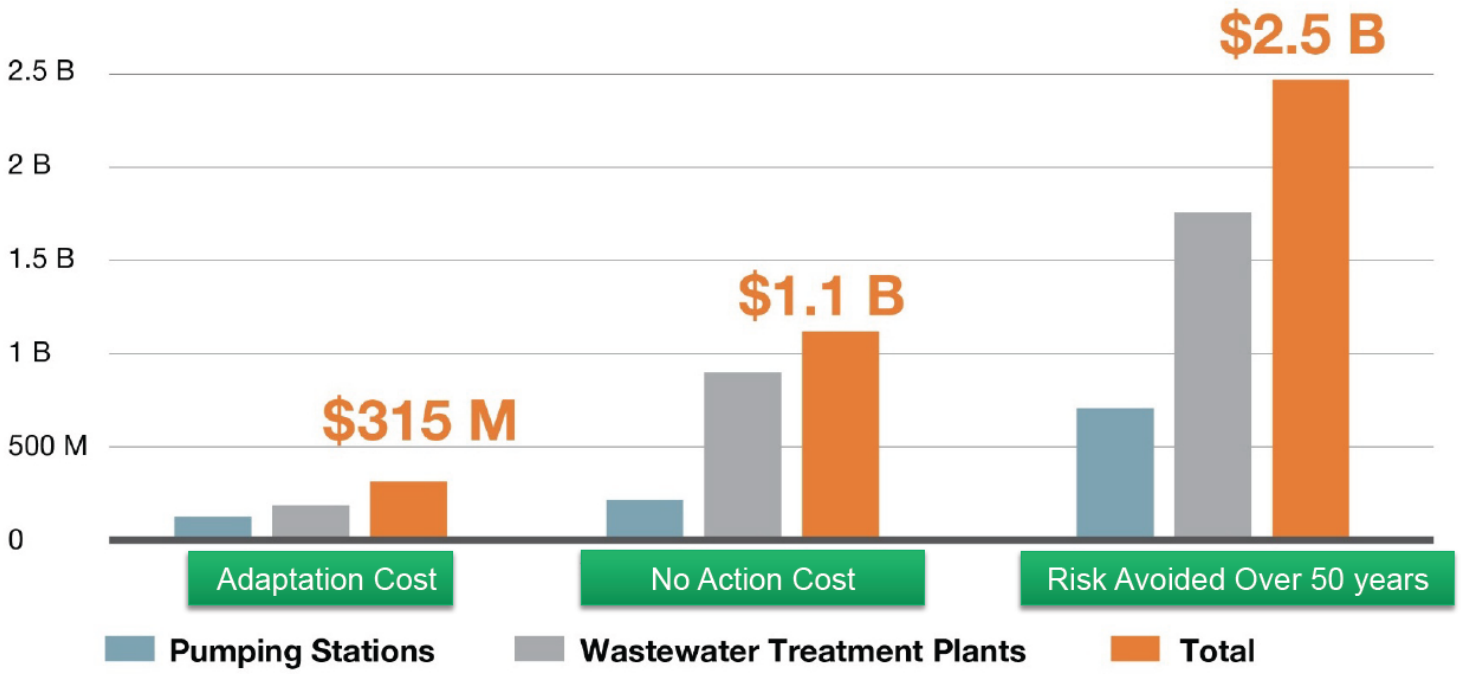
(i) identify and seek to remove or reform barriers that discourage investments or other actions to increase the Nation's resilience to climate change while ensuring continued protection of public health and the environment;

http://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change

EO 13653 Definitions

- Preparedness:
  - Actions taken to plan, organize, equip, train, and exercise to build, apply, and sustain the capabilities necessary to prevent, protect against, ameliorate the effects of, respond to, and recover from climate change related damages to life, health, property, livelihoods, ecosystems, and national security
- Resilience:
  - Ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions

Economic Case for Preparedness: NYC Wastewater



Investing **$315 Million** in strategic fortification can safeguard **$1.1 Billion** of vital infrastructure and save the city **$2.5 Billion** in emergency response costs over the next 50 years.

It's Not All About Extremes → Continuum of Opportunities

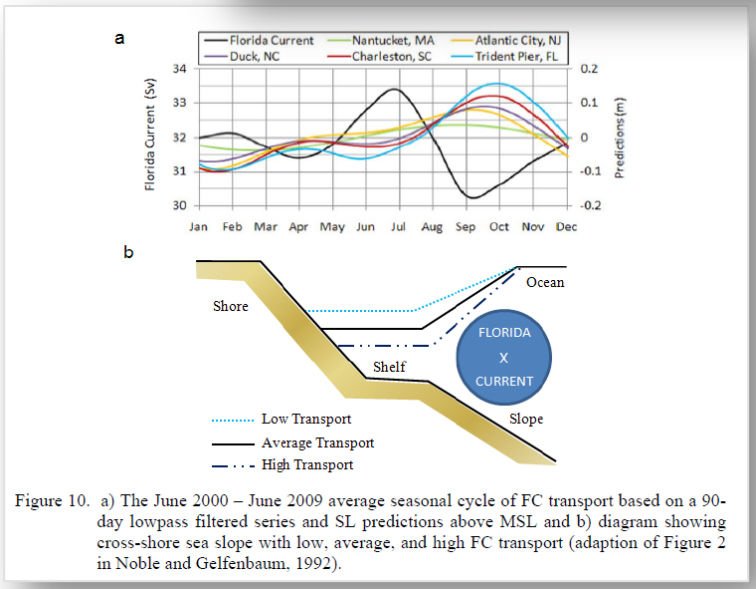


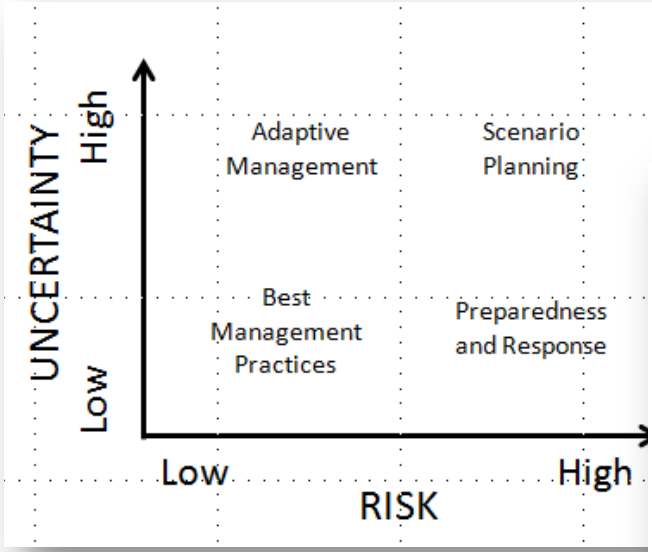
Figure 10. a) The June 2000 – June 2009 average seasonal cycle of FC transport based on a 90-day lowpass filtered series and SL predictions above MSL and b) diagram showing cross-shore sea slope with low, average, and high FC transport (adaption of Figure 2 in Noble and Gelfenbaum, 1992).

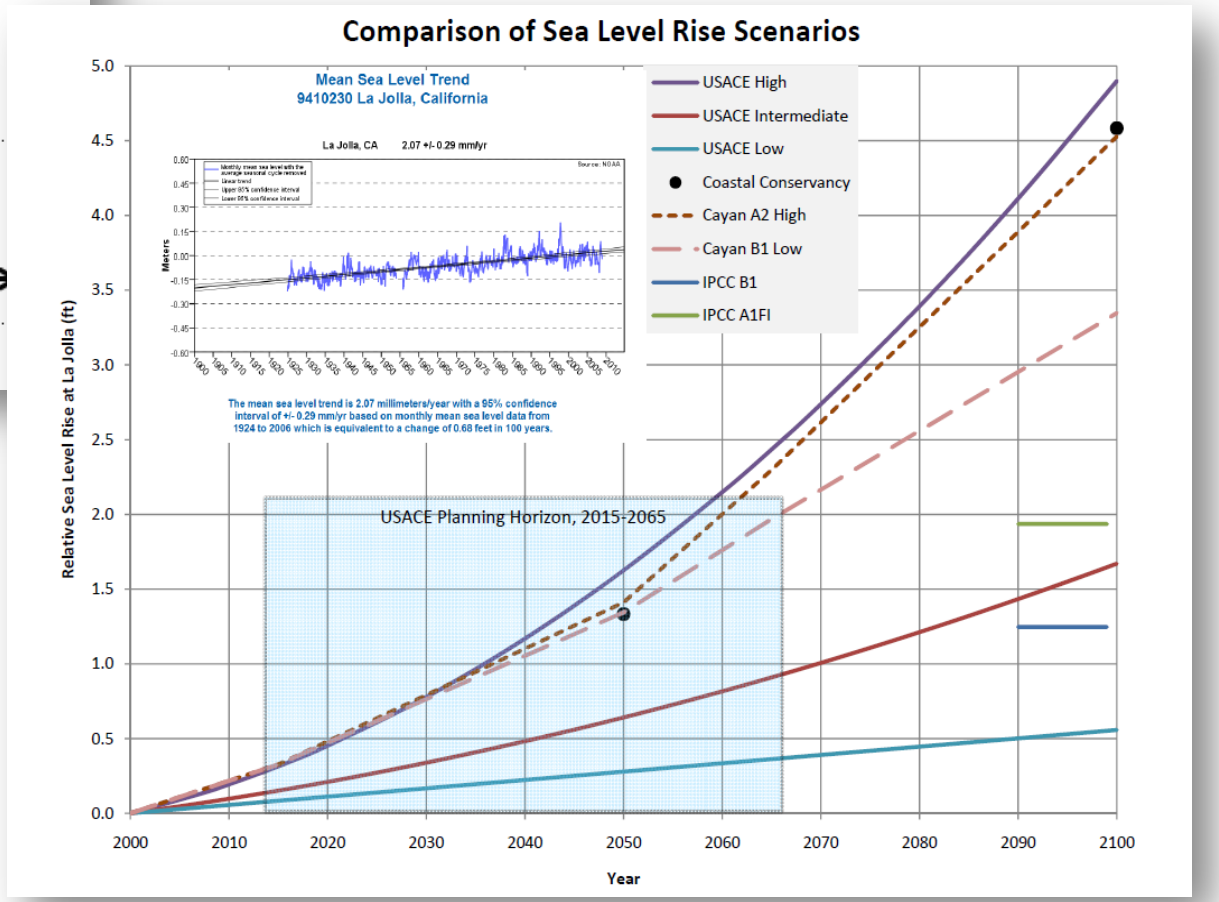
http://tidesandcurrents.noaa.gov/publications/EastCoastSeaLevelAnomaly_2009.pdf

"Sea level along much of the eastern U.S. was higher than normal for much of June and July 2009, enough to cause significant attention from coastal communities because of the lack of coastal storms that normally cause such anomalies...."

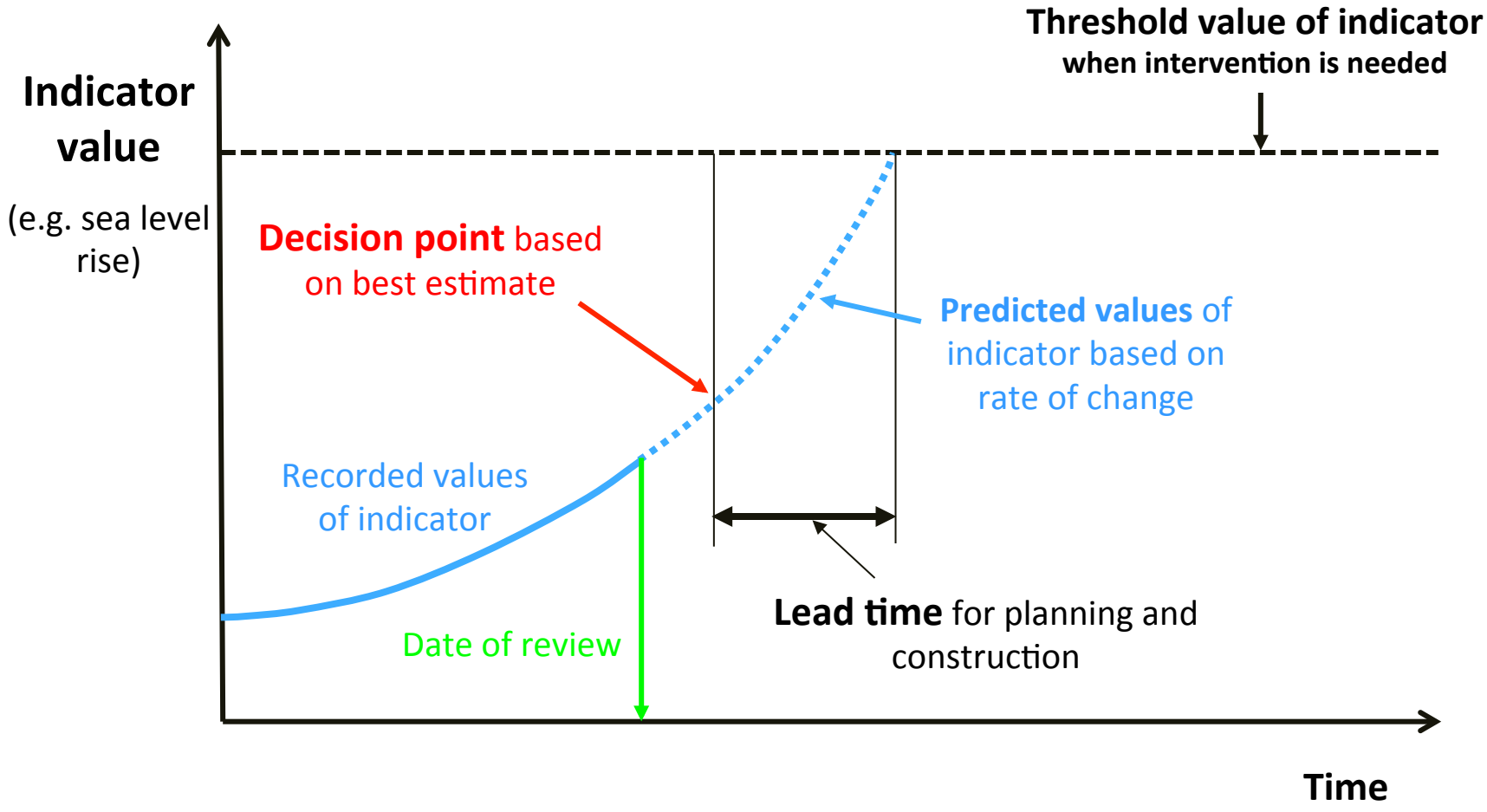
"… unique in that the NE winds were not at a multi-year high or the Florida Current transport at its low. But the coupled effect of the two forces created SL residuals that were at highest levels all along the East Coast."

Multiple Scenarios for Sea Level Change

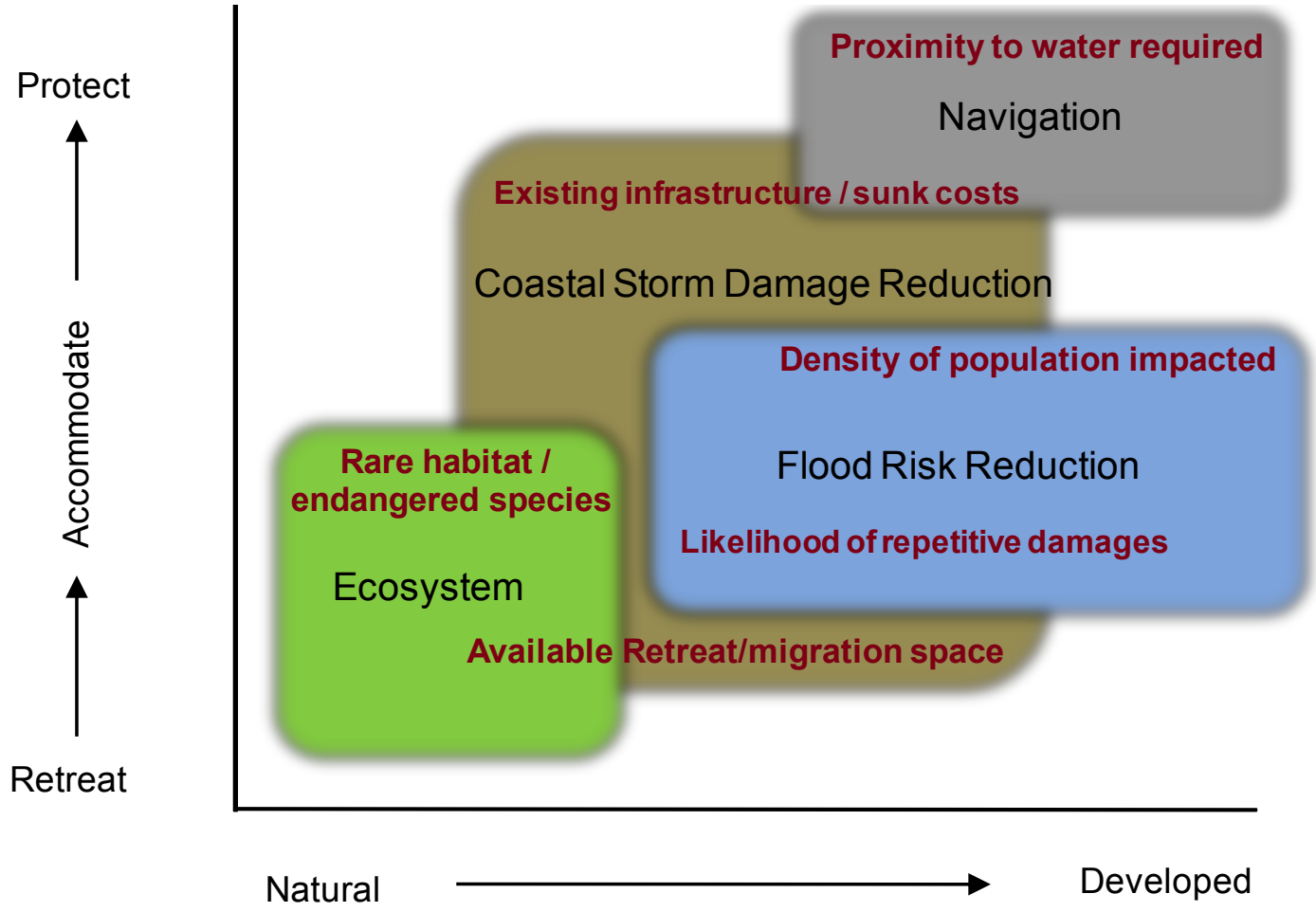




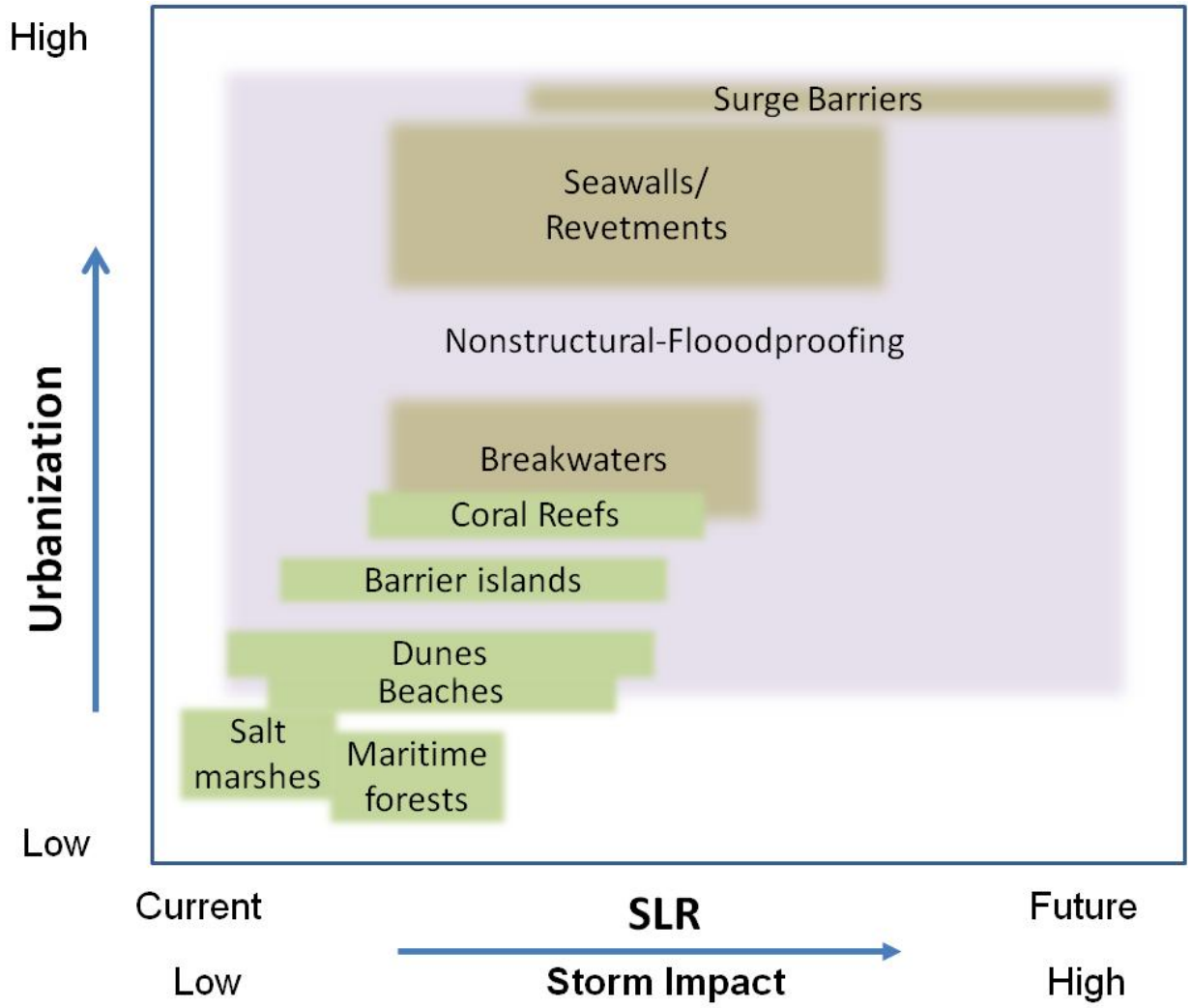
Tipping Points: Thresholds, Lead Times, Decision Points



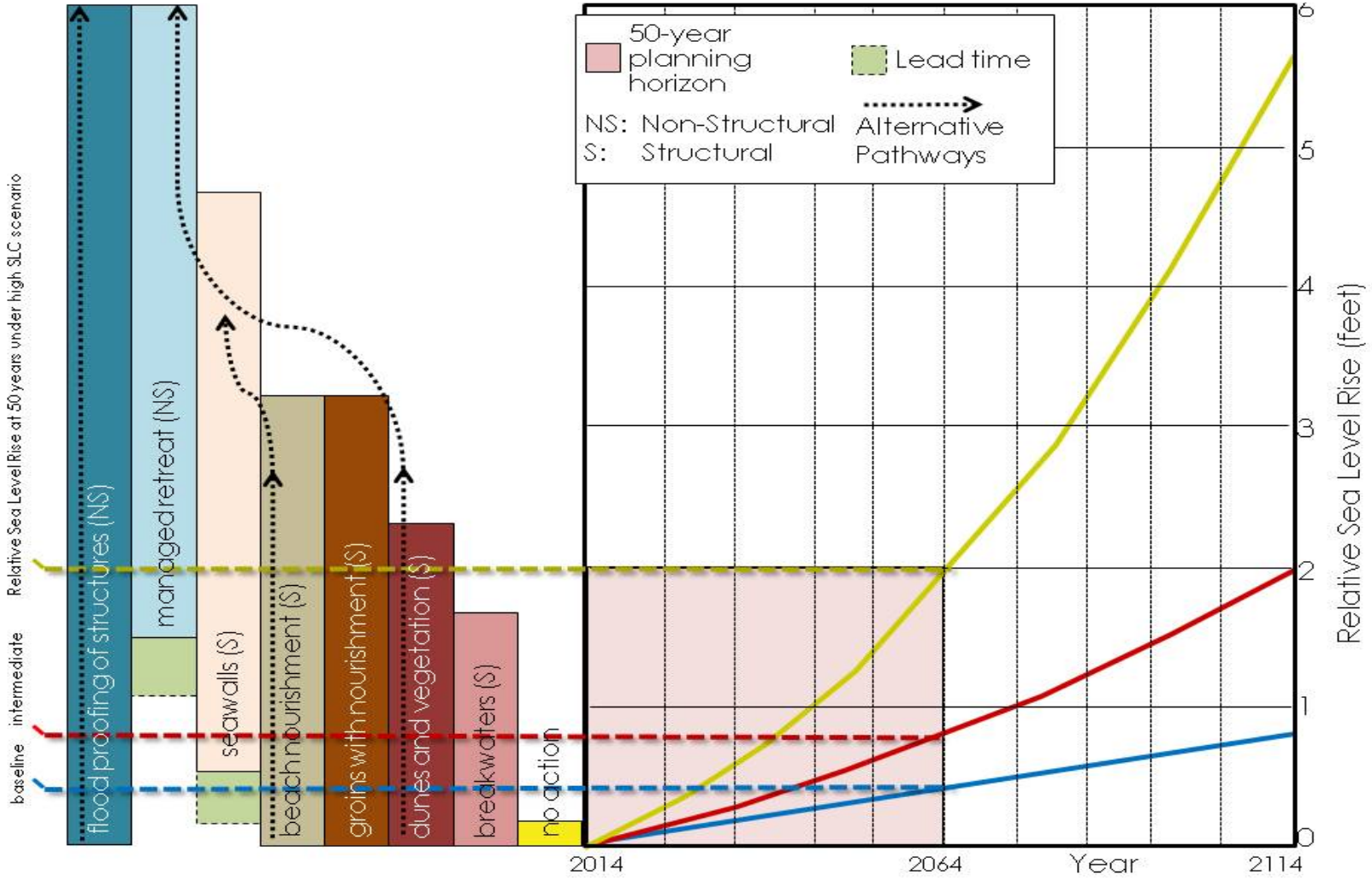
Purpose-Driven – Illustration Only



Performance Ranges: Example for Coastal Storm Damage Reduction



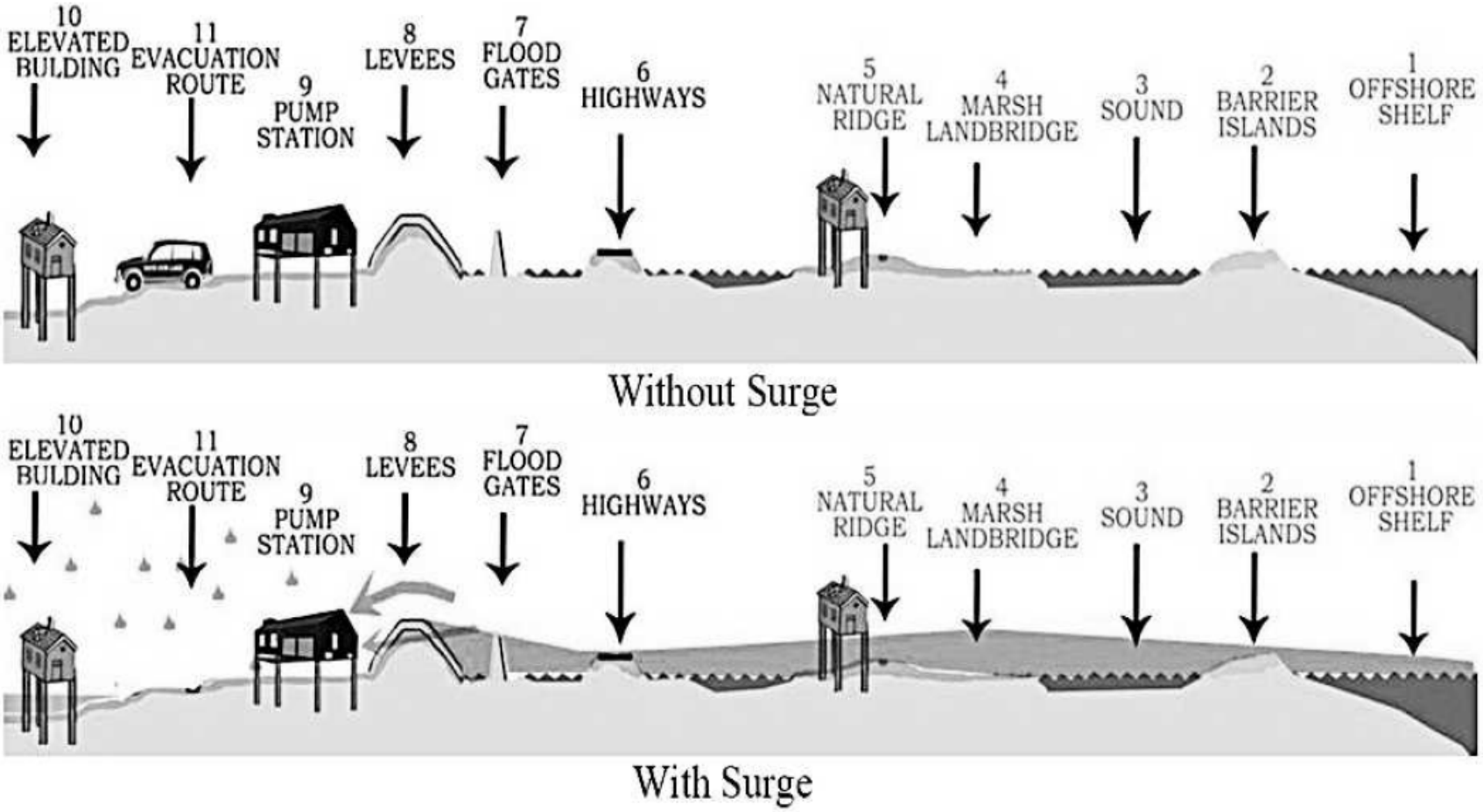
Example of Alternative Pathways



Integrated Approaches Aren't New

- Jadwin Report after Flood of 1927
  - Require floodplains to carry flow, robust to floods of 2011
- Mississippi Coastal Improvement Project after Katrina
  - Increased coastal community resiliency
  - Restoration of barrier and near-shore islands enhances protection of mainland areas.
  - Moving private lands into the public sector reduces impacts of future storms and hurricanes and increases resiliency and sustainability
- Natural and nature-based measures can improve the quality and resilience of economic, ecologic, and social systems
- Multiple lines of defense with components addressing different threats support creative and comprehensive approaches

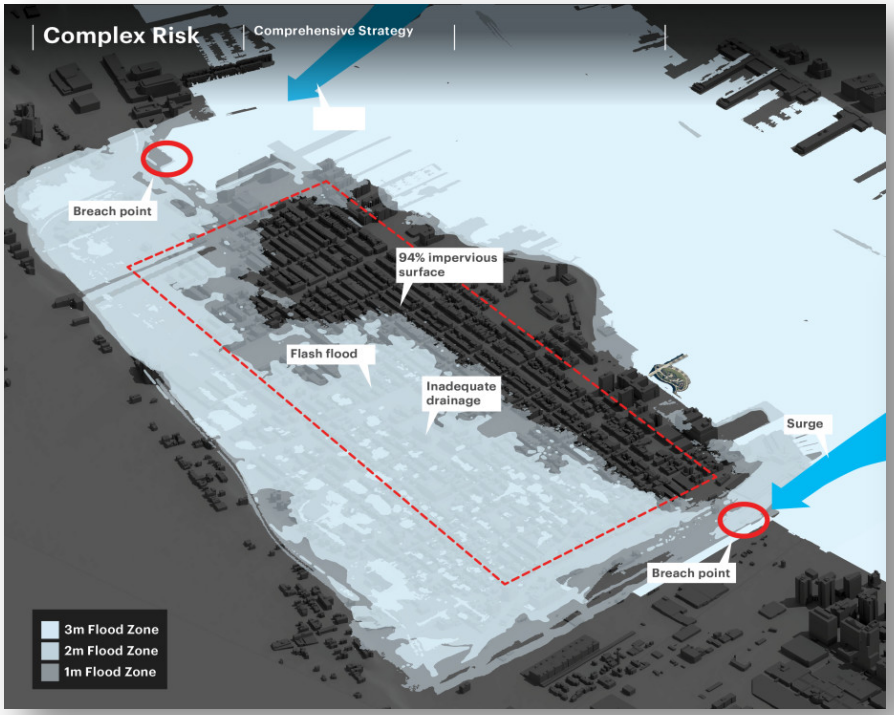
Multiple Lines of Defense

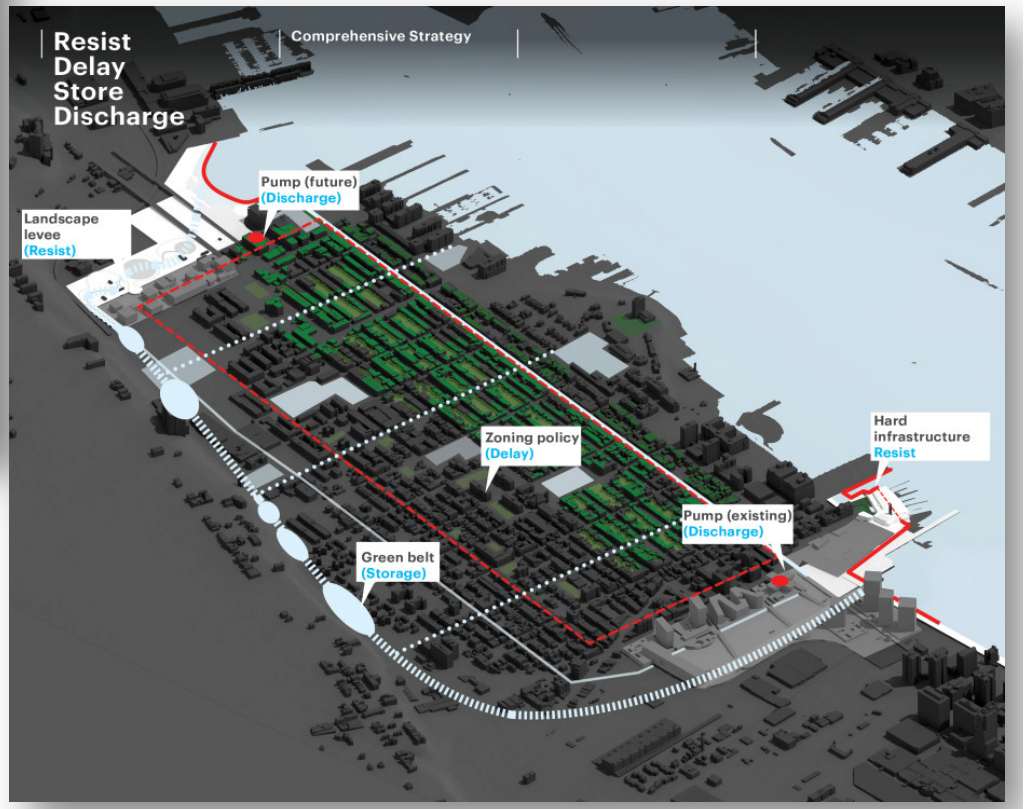


- Quantification of performance of natural and nature-based coastal risk reduction measures is a critical knowledge gap

Lopez, J.A. (2009) JCR The Multiple Lines of Defense Strategy to Sustain Coastal Louisiana

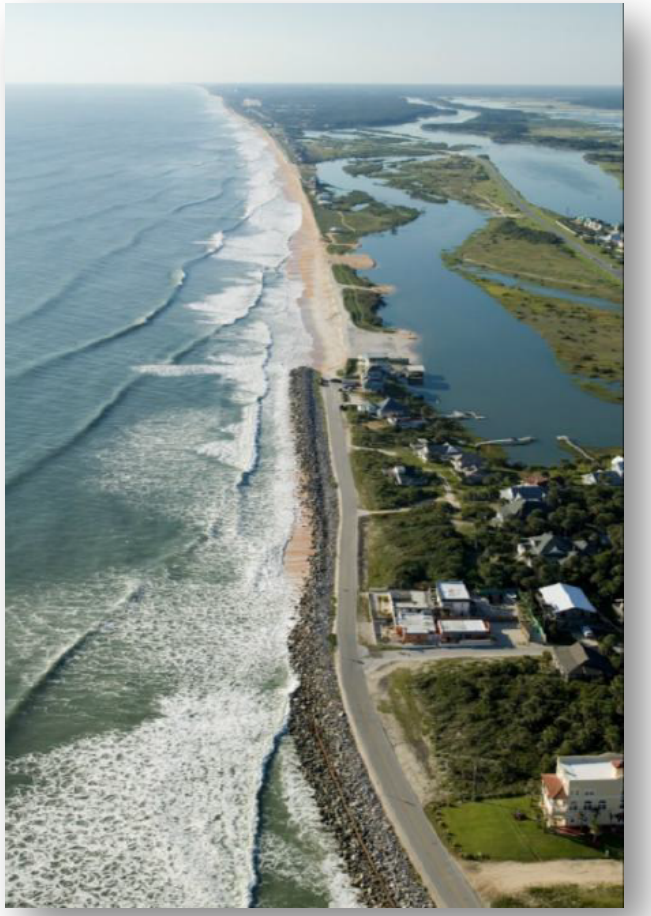
Sandy's Rebuild By Design Effort: Hoboken





SAGE – Systems Approach to Geomorphic Engineering

- Collaborative:
  - USACE, NOAA, FEMA, The Nature Conservancy, The Conservation Fund, Virginia Institute for Marine Sciences, University of New Orleans, University of Rhode Island
  - Additional experts from states, academia, NGOs, private sector
- Focuses on innovative approaches to coastal landscape transformation
  - Comprehensive view of shoreline change
  - Integrate hybrid approaches in coastal communities and shorelines to slow, prevent, mitigate, and adapt to the impacts and consequences of changing weather and climate patterns



Natural and Nature-Based Infrastructure at a Glance

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:
STORM INTENSITY, TRACK, AND FORWARD SPEED; SURROUNDING LOCAL BATHYMETRY AND TOPOGRAPHY

Dunes and Beaches

Benefits/Processes

Breaking of offshore waves

Attenuation of wave energy

Slow inland water transfer

Performance Factors

Berm height and width

Beach slope

Sediment grain size and supply

Dune height, crest, and width

Presence of vegetation

Vegetated Features

Benefits/Processes

Breaking of offshore waves

Attenuation of wave energy

Slow inland water transfer

Increased infiltration

Performance Factors

Marsh, wetland, or SAV elevation and continuity

Vegetation type and density

Oyster and Coral Reefs

Benefits/Processes

Breaking of offshore waves

Attenuation of 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

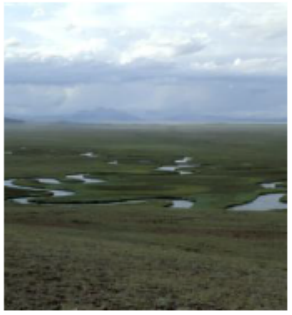
Forest dimension

Sediment composition

Platform elevation

Nonstructural and Floodproofing Measures at a Glance

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:
COLLABORATION AND SHARED RESPONSIBILITY FRAMEWORK, WAVE HEIGHT, WATER LEVEL, STORM DURATION



Floodplain Policy & Management

Benefits/Processes

Improved and controlled floodplain development

Reduced opportunity for damages

Improved natural coast environment

Performance Factors

Wave height

Water level

Storm Duration

Agency Collaboration

Floodproofing and Impact Reduction

Benefits/Processes

Reduced opportunity for damages

Increased community resiliency

Does not increase flood potential elsewhere

Performance Factors

Wave height

Water level

Storm Duration

Floodproofing and Impact Reduction

Benefits/Processes

Reduced opportunity for damages

Increased community resiliency

Does not increase flood potential elsewhere

Performance Factors

Wave height

Water level

Storm Duration

Relocation

Benefits/Processes

Reduced opportunity for damages

Does not increase flood potential elsewhere

Improved natural coast environment

Performance Factors

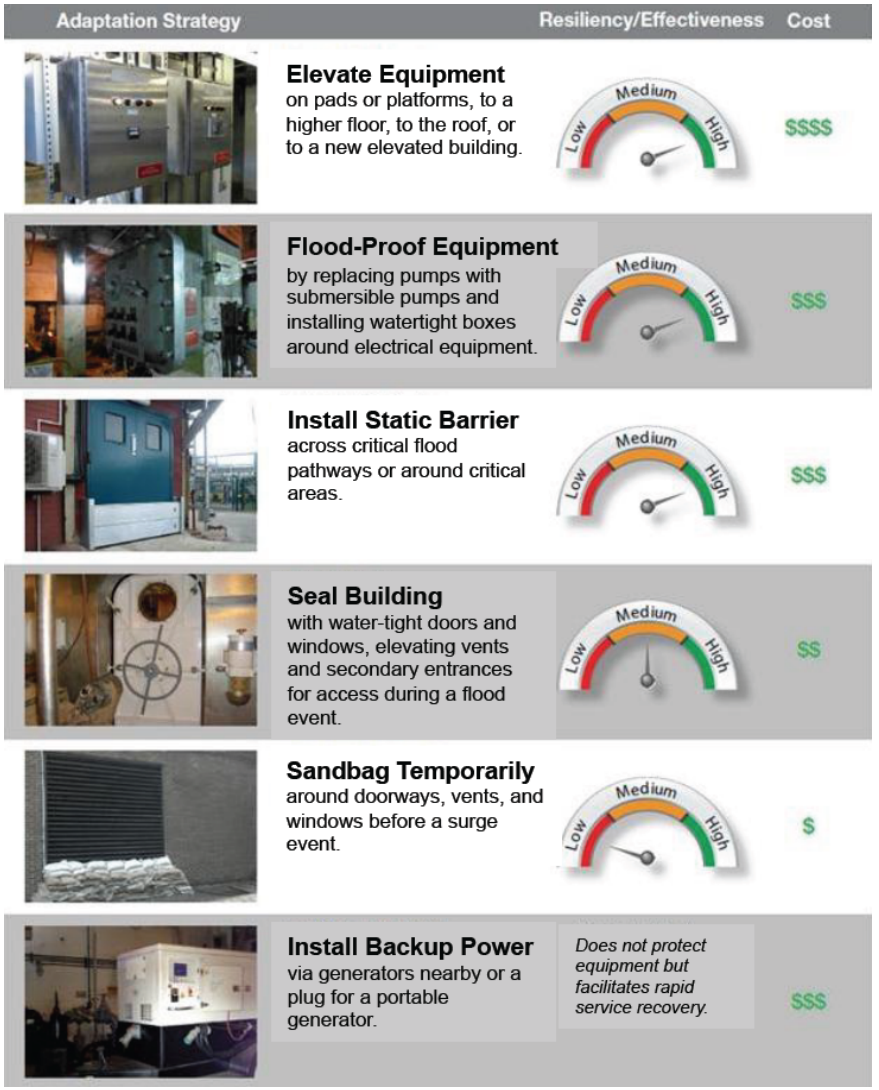
Wave height

Water level

Storm Duration

Nonstructural and Floodproofing

- Nonstructural and floodproofing measures, including coastal zone management, can have a high return on investment and are a valuable part of a systems approach



Flood Risk Management

- Gilbert F. White, PhD, pioneer in the field of flood risk management:
  - "Floods are 'acts of God,' but flood losses are largely acts of man."
  - "Dealing with floods in all their capricious and violent aspects is a problem in part of adjusting human occupance to the floodplain environment so as to utilize most effectively the natural resources of the plain, and, at the same time, of applying feasible and practicable measures for minimizing the detrimental impacts of floods."

1945. Gilbert F. White. University of Chicago Department of Geography.

Structural Measures at a Glance

GENERAL COASTAL RISK REDUCTION PERFORMANCE FACTORS:
STORM SURGE AND WAVE HEIGHT/PERIOD, WATER LEVEL

Levees

Benefits/Processes

Surge and Wave attenuation and/or dissipation

Reduce Flooding

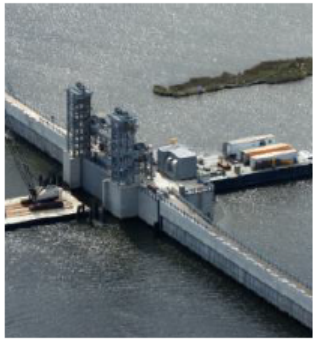
Risk Reduction for vulnerable areas

Performance Factors

Levee height, crest width, and slope

Wave height and period

Water level



Storm Surge Barriers

Benefits/Processes

Surge and Wave attenuation

Reduced Salinity Intrusion

Performance Factors

Barrier height

Wave height

Wave period

Water level

Seawalls and Revetments

Benefits/Processes

Reduce flooding

Reduce wave overtopping

Shoreline stabilization behind structure

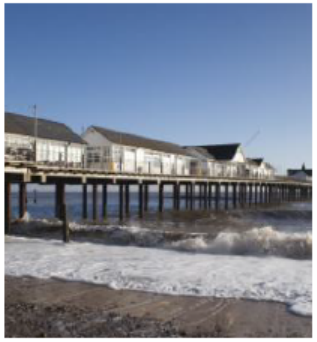
Performance Factors

Wave height

Wave period

Water level

Scour protection



Groins

Benefits/Processes

Shoreline stabilization

Performance Factors

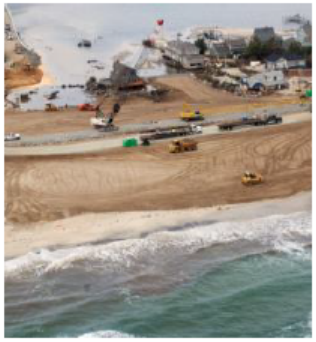
Groin length, height, orientation, permeability and spacing

Depth at seaward end

Wave height

Water level

Longshore transportation rates and distribution



Detached Breakwaters

Benefits/Processes

Shoreline stabilization behind structure

Wave attenuation

Performance Factors

Breakwater height and width.

Breakwater permeability, proximity to shoreline, orientation and spacing

USACE Infrastructure Strategy

- Manage USACE infrastructure portfolio to be resilient, reliable, and meet the Nation's current and future water resource needs
  - Life Cycle Portfolio Management:
    - Maximize effectiveness of investments to optimize performance over the full lifecycle, including initiation, sustainment, restoration, modernization, and disposition
  - Comprehensive Watershed Planning:
    - Link with federal and non-federal objectives and investments within a watershed or system context
  - Alternative Financing:
    - Leverage alternative financing to sustain CW mission services for existing infrastructure systems and enhance as needed to meet national and regional objectives
  - Strategic Communications:
    - Working relationships with Congress and effective dialogue with traditional and non-traditional stakeholders and partners

Alternative Financing Options

- Existing Authorities
  - Contributed funds
  - Hydropower Power Marketing Agreements and Customer Direct Funding
  - Outgrants
- New Authorities
  - Federally authorized dedicated taxes and user fees
  - Special experimental program
  - Public-Private Partnerships (P3)
- Deauthorize, dispose/transfer and/or place in caretaker status

Alternative Financing: Initial Existing Authority Pilots

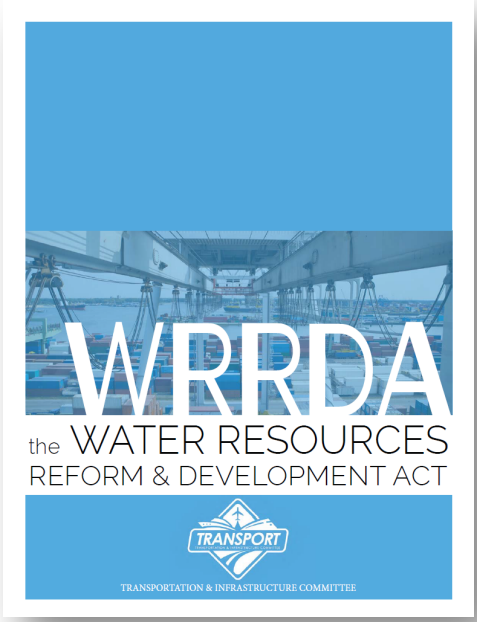
- Pilot-test projects and project actions for which there is non-federal interest and support to use alternative project delivery, funding, or financing under existing authorities
  - Document and evaluate current processes for contributed funds
  - Consider how processes might be streamlined to decrease the time from initial proposal to approval
  - Identify and help implement policy changes to expand opportunities for the use of contributed funds
  - Identify and help secure project actions under current authorities that must be undertaken before proposed alternative processes could move forward
- Pilots cover spectrum of planning, design, construction and O&M

Alternative Financing Pilot Examples

- Planning phase: Los Angeles River Ecosystem restoration feasibility study
- Construction Phase: Folsom Dam accelerated funds agreement
- O&M phase: five-year multi-project maintenance dredging
- More to come

Public-Private Partnership (P3) Requires New Authority

- Examine the potential use of P3 and other alternatives that alter the traditional distribution of project responsibilities
- Evaluate potential to leverage scarce federal resources
  - Identify general project characteristics that are best suited for P3 opportunities
  - Identify current barriers and challenges for employing P3
  - Develop and apply project screening criteria



Summary

- Preparedness is more cost-effective than response/recovery
- Constrained environment can result in creative and innovative engineering approaches
- Employ the full portfolio of measures over a range of potential future conditions
- Consider multiple lines of defense
- Innovative financing can improve speed and effectiveness