Wednesday Webinar
Coastal Protection: Infrastructure Strategies

December 11, 2013

Agenda

1. Welcome/Speaker introductions (5 min)
2. Presentation (40 min)
   - Risks and Coastal Typologies in NYC (Pippa Brashear)
   - USACE Historic Role and Evolving Approach/Projects (John Taylor)
   - The Range of Approaches (Cheryl Johnson)
     - "Engineered" Approaches (Cheryl Johnson)
     - Nature-based Approaches (Johannes Pointl)
   - Putting It All Together (Pippa)
3. Discussion/Q&A (45 min)

Wednesday Webinar: Coastal Protection Infrastructure Strategies

PRESENTERS (in order of appearance)

Pippa Brashear
Landscape Architect
Parsons Brinckerhoff

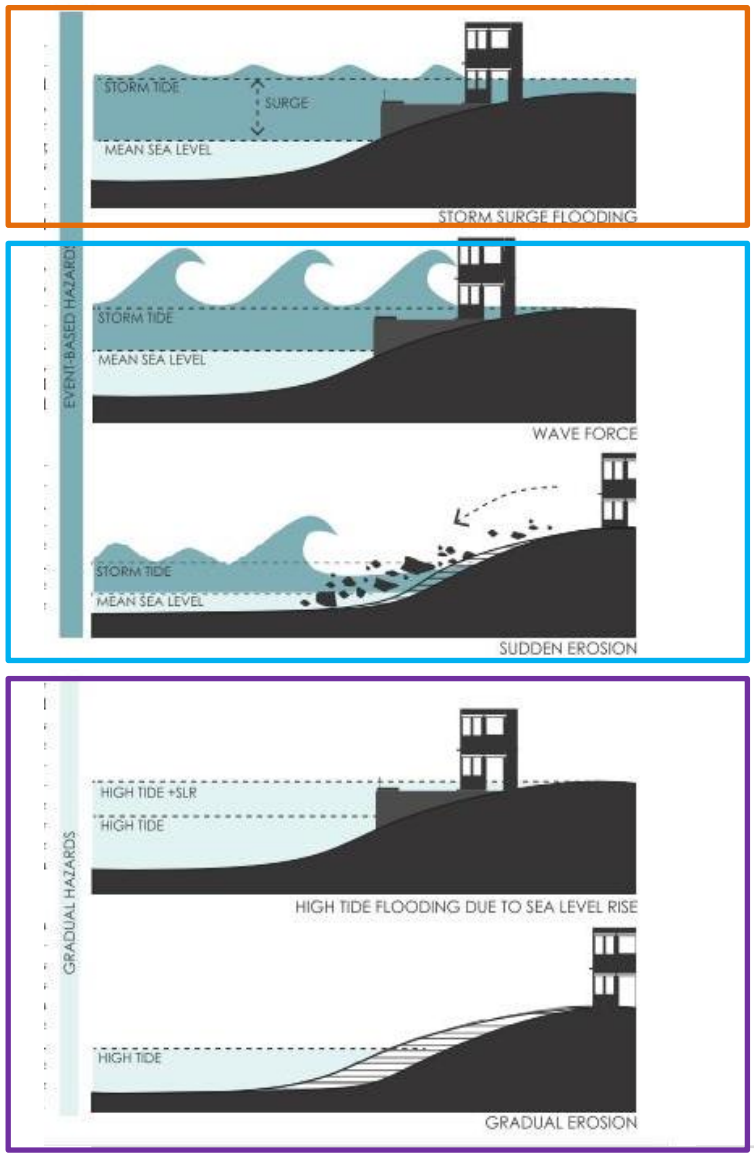
John Taylor
Civil Engineer
Parsons Brinckerhoff

Cheryl Johnson
Coastal Engineer/Program Manager
URS

Johannes Pointl
Landscape architect
SCAPE / LANDSCAPE ARCHITECTURE PLLC

Amy Ford-Wagner
Urban Planner
Parsons Brinckerhoff

What causes these hazards?



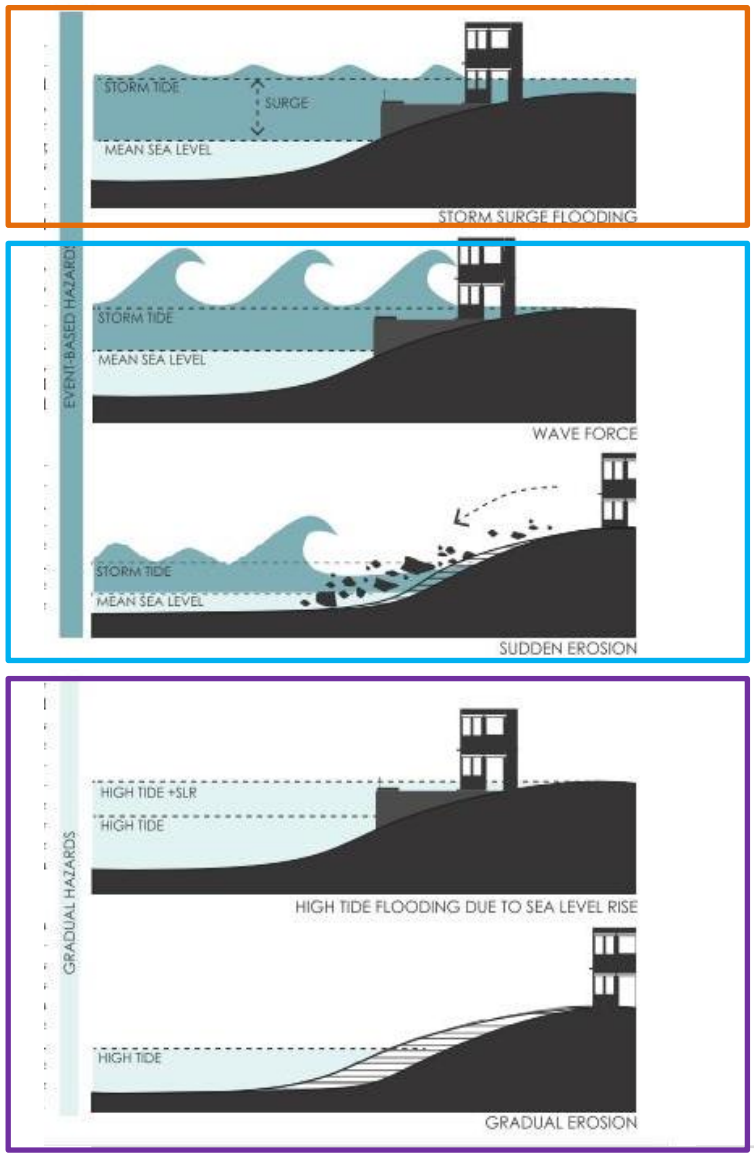
Storm Surge

Wave Action / Energy

High Tides, Sea Level Rise, Water Currents

Image Source: New York City Dpt. Of City Planning, “Urban Waterfront Adaptive Strategies” (2013)

What Do We Do? Types of Reach Strategies



Storm Surge

Protect against storm surge

Wave Action

Reduce wave energy / Minimize upland wave zones

High Tides, Sea Level Rise, Water Currents

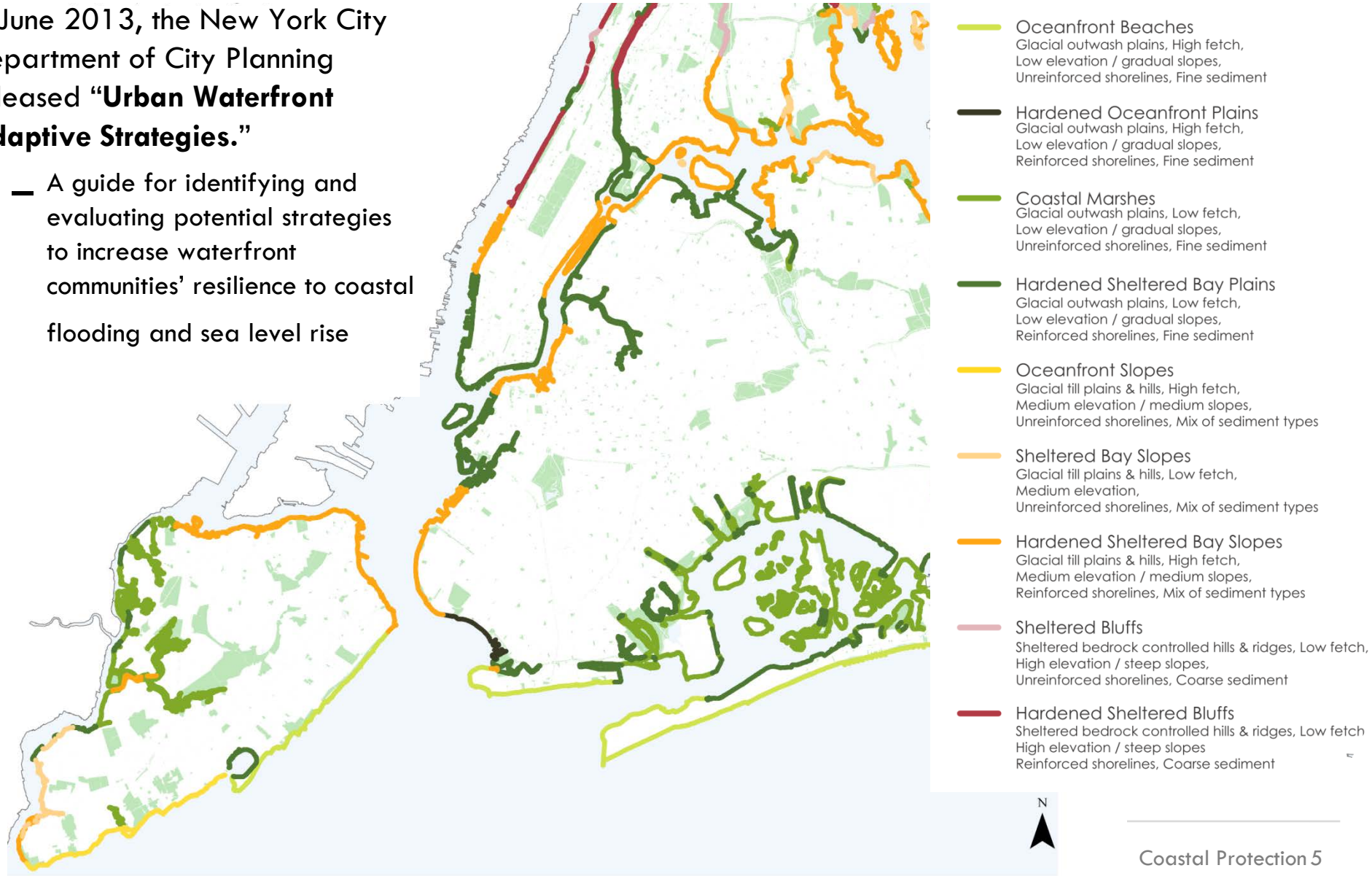
Raise coastal edge elevations

Image Source: New York City Dpt. Of City Planning, “Urban Waterfront Adaptive Strategies” (2013)

Current Conditions: Edge Type / Coastal Geomorphology

In June 2013, the New York City Department of City Planning released "**Urban Waterfront Adaptive Strategies.**"

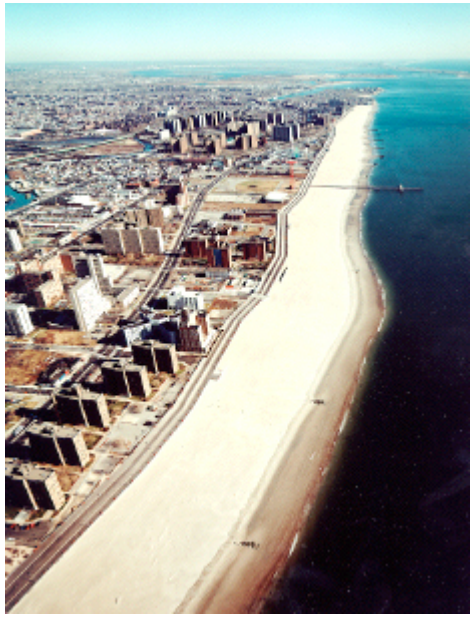
- A guide for identifying and evaluating potential strategies to increase waterfront communities' resilience to coastal flooding and sea level rise



Source: New York City Dpt. Of City Planning, "Urban Waterfront Adaptive Strategies" (2013)

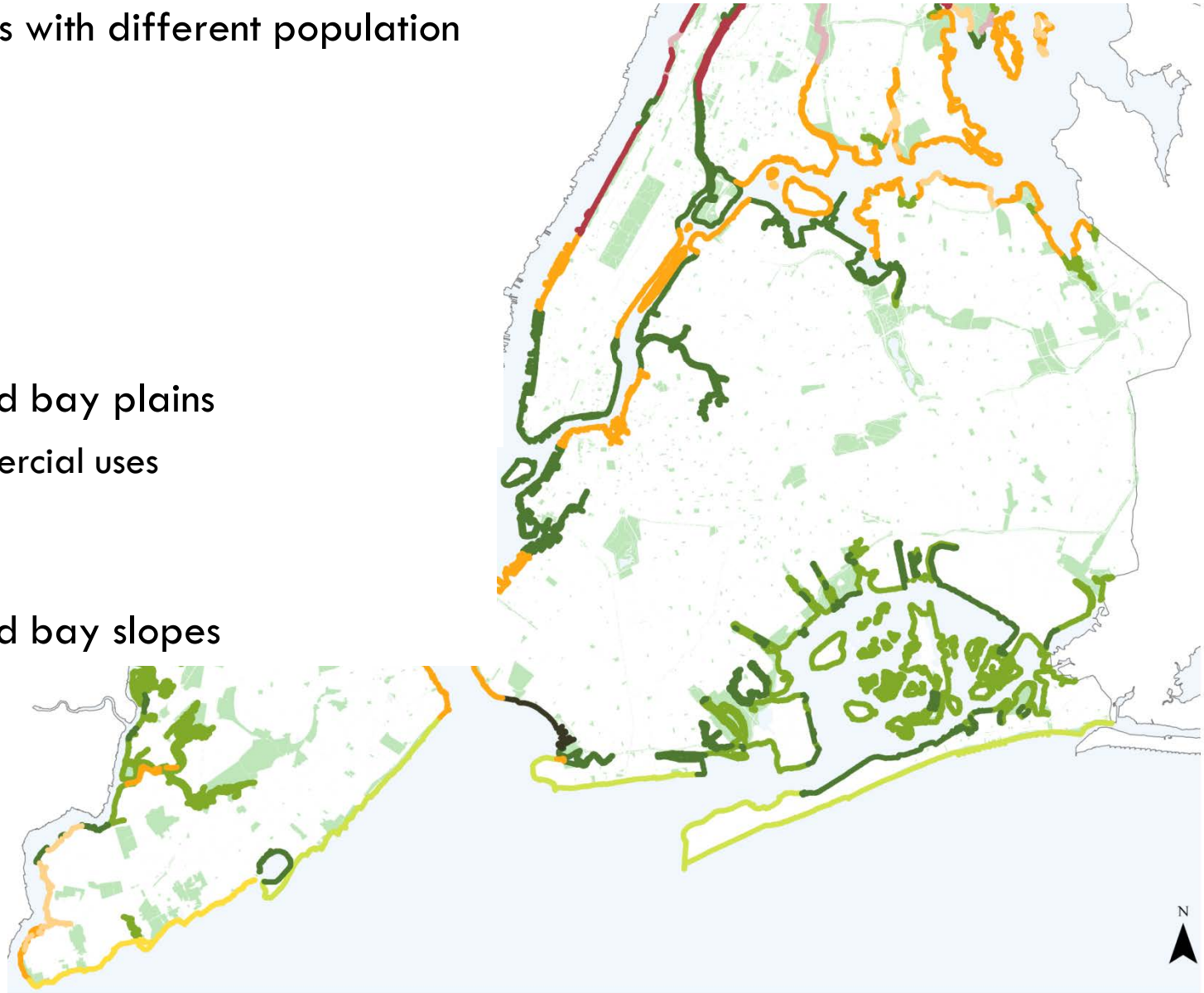
USACE Civil Works Missions

- Navigation
- Flood Risk Management
  - coastal storm damage reduction
  - flood risk
- Environmental Restoration
- *Environmental Remediation*
- *Project Operations*
- *Emergency Operations*



NYC Typologies and USACE Coastal Storm Damage Reduction

- Oceanfront beaches with different population densities
- Oceanfront slopes
- Coastal marshes
- Hardened, sheltered bay plains
  - Residential/commercial uses
  - Densities
- Hardened, sheltered bay slopes



NYC Typologies and USACE Civil Works Mission Alignments

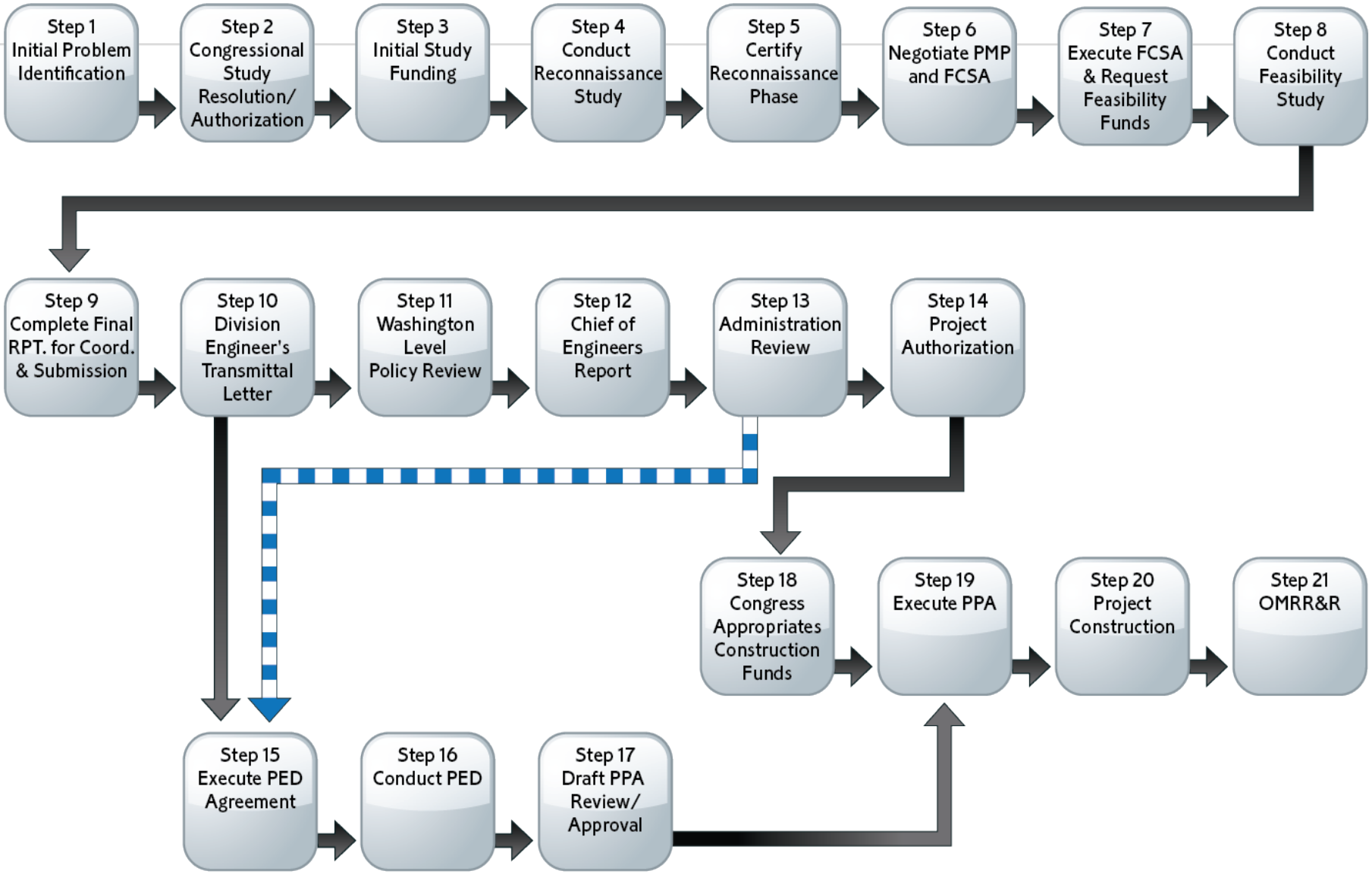
Typologies

- Oceanfront beaches/ Oceanfront slopes
- Coastal marshes

Civil Works Missions

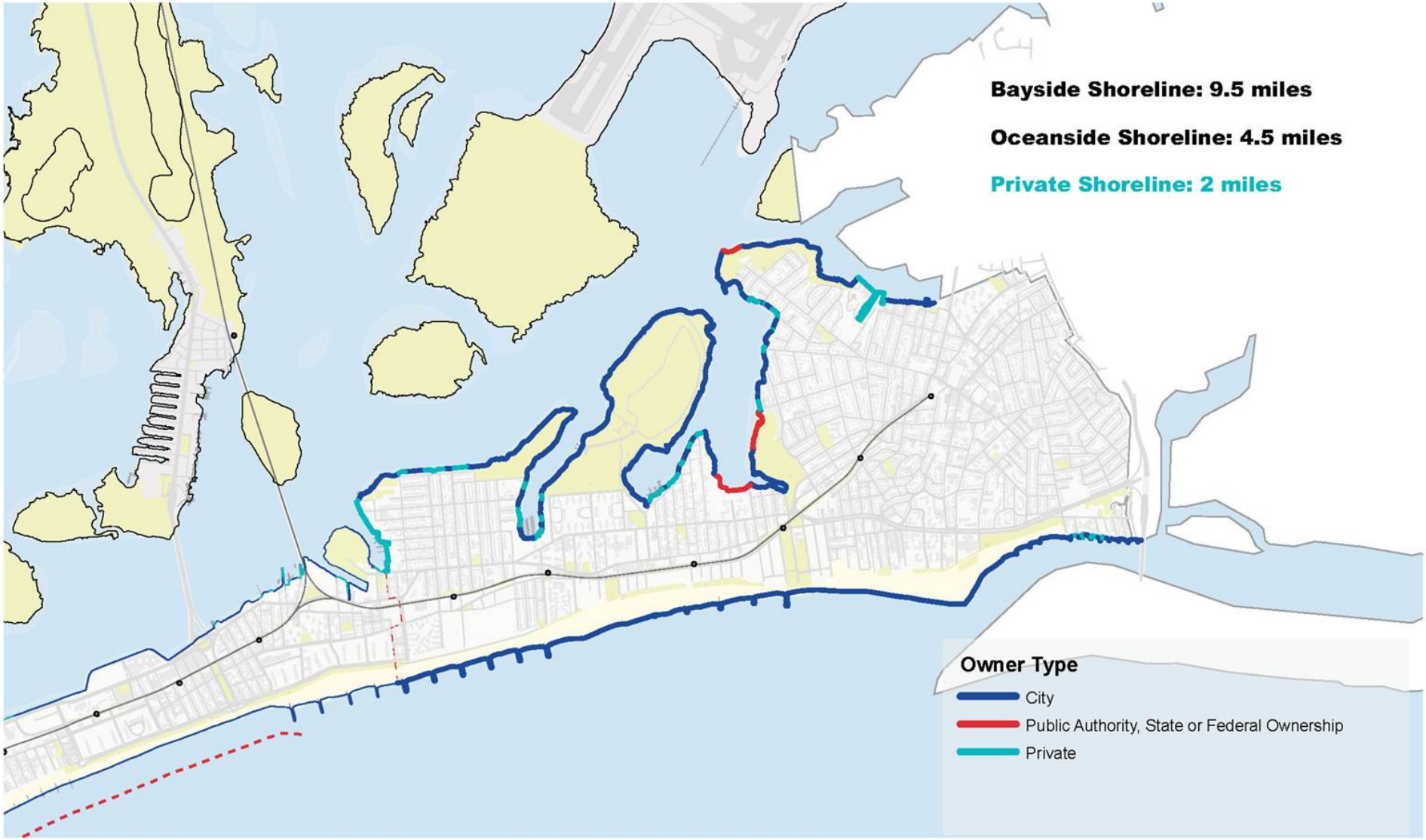
- Flood Risk Management
  - coastal storm damage reduction
  - flood risk
- Navigation
- Environmental Restoration

USACE Missions to Projects



For more details, see http://planning.usace.army.mil/toolbox/process/chart-regs.pdf

Property Ownership



Authorized USACE Projects and Disaster Relief Appropriations Act of 2013 (PL 113-2 or the Sandy Relief Bill) ***Repairs***

- Oceanfront beaches/Oceanfront slopes=USACE Coastal Storm Reduction (CSR) project areas that are authorized and funded for construction and/or studies:
  - East Rockaway Inlet to Rockaway Inlet (Rockaway Beach);
  - Plumb Beach, and Rockaway Inlet to Norton Point (Coney Island)

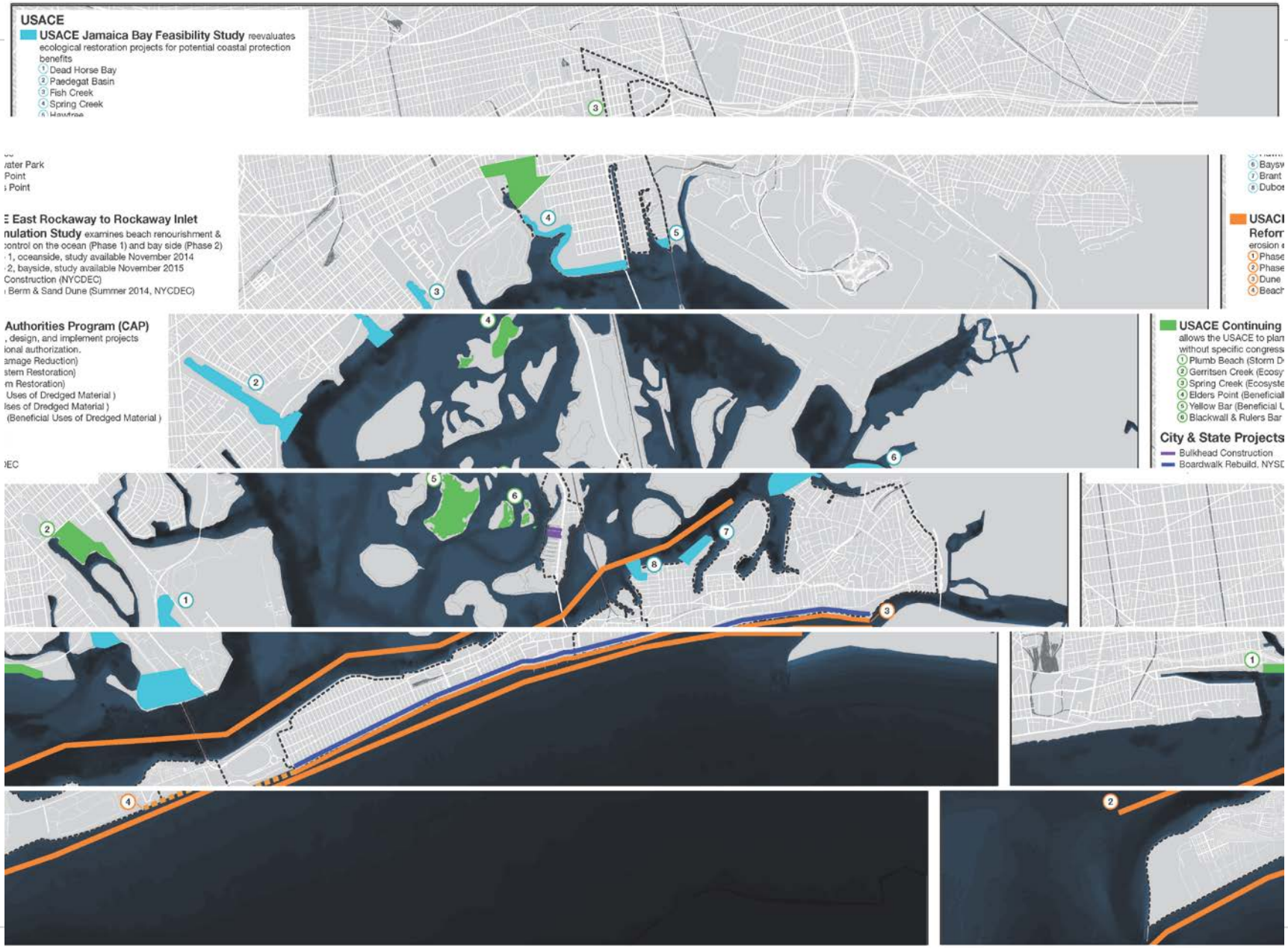
2013 Post-Sandy Army Corps NY District Coastal Project Repair and Restore

Project Name	Post-Sandy Sand Placement (Cubic Yards)	Initial Construction Completed	Awarded $	Current Activities
Rockaway 1A	1A - Up to 600,000 *Total ~3.5M*	1977	1A - $ 10M *Total - $36.4M*	1A - Work Complete
Rockaway 1B	1B - ~ 3 million *Total ~3.5M*	1977	1B - $26.4M *Total - $36.4M*	1B - Contract awarded, Winter Expected Work Start
Coney Island	~600,000	1995	$7.2 million	Work Complete
Oakwood Beach (not sand placement)	N/A	2000	$423,000	Work Complete

Disaster Relief Appropriations Act of 2013 (PL 113-2 or the Sandy Relief Bill) ***Reformulation, Existing Studies, New Studies***

- Oceanfront beaches/Oceanfront studies:
  - East Rockaway Inlet to Rockaway Inlet (Rockaway Beach);
    - Oceanside
    - Bayside
  - Plumb Beach, and Rockaway Inlet to Norton Point (Coney Island)
  - Study for the South Shore of Staten Island
- Coastal marshes
  - Selected sites of the Jamaica Bay Restoration Program
- Comprehensive Study
  - Mid-Atlantic through Northeast Coast to New England
  - Mayor Bloomberg February 2013 request for a reconnaissance study of "…flood risk reduction to cover the New York/New Jersey harbor area."

Jamaica Bay


USACE
USACE Jamaica Bay Feasibility Study reevaluates ecological restoration projects for potential coastal protection benefits
1 Dead Horse Bay
2 Paedegat Basin
3 Fish Creek
4 Spring Creek
East Rockaway to Rockaway Inlet
nulation Study examines beach renourishment & control on the ocean (Phase 1) and bay side (Phase 2)
1, oceanside, study available November 2014
2, bayside, study available November 2015
Construction (NYCDEC)
Berm & Sand Dune (Summer 2014, NYCDEC)
Authorities Program (CAP)
, design, and implement projects
ional authorization.
amage Reduction)
stem Restoration)
m Restoration)
Uses of Dredged Material)
Uses of Dredged Material)
(Beneficial Uses of Dredged Material)
USACE Continuing
allows the USACE to plan
without specific congress
1 Plumb Beach (Storm D
2 Gerritsen Creek (Ecosy
3 Spring Creek (Ecosyste
4 Elders Point (Beneficial
5 Yellow Bar (Beneficial U
6 Blackwall & Rulers Bar
City & State Projects
Bulkhead Construction
Boardwalk Rebuild, NYSD

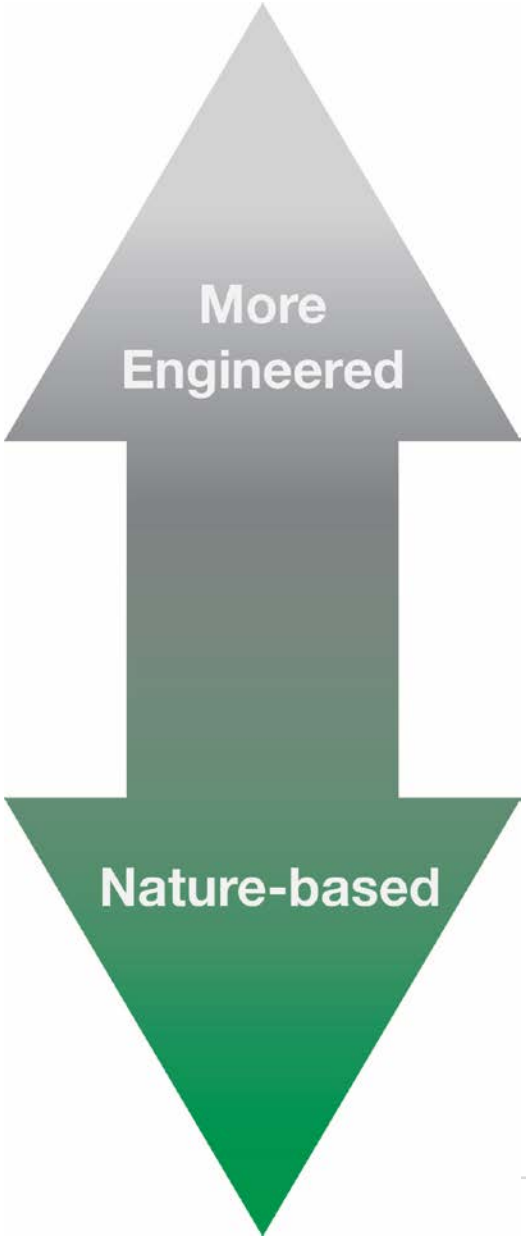
CAP Program

Continuing Authorities Program

- Section 14 Emergency Streambank Protection
- Section 103 Shoreline Protection
- Section 107 Navigation
- Section 111 Shoreline Mitigation
- Section 204 Beneficial Uses of Dredged Material
- Section 205 Flood Control
- Section 206 Aquatic/Estuary Restoration
- Section 3 Navigation Clearing & Snagging
- Section 208 Clearing & Snagging
- Section 1135 Restoration Associated With a Corps Project

Coastal Protection Infrastructure Strategies

A Range of Protection and Mitigation Approaches



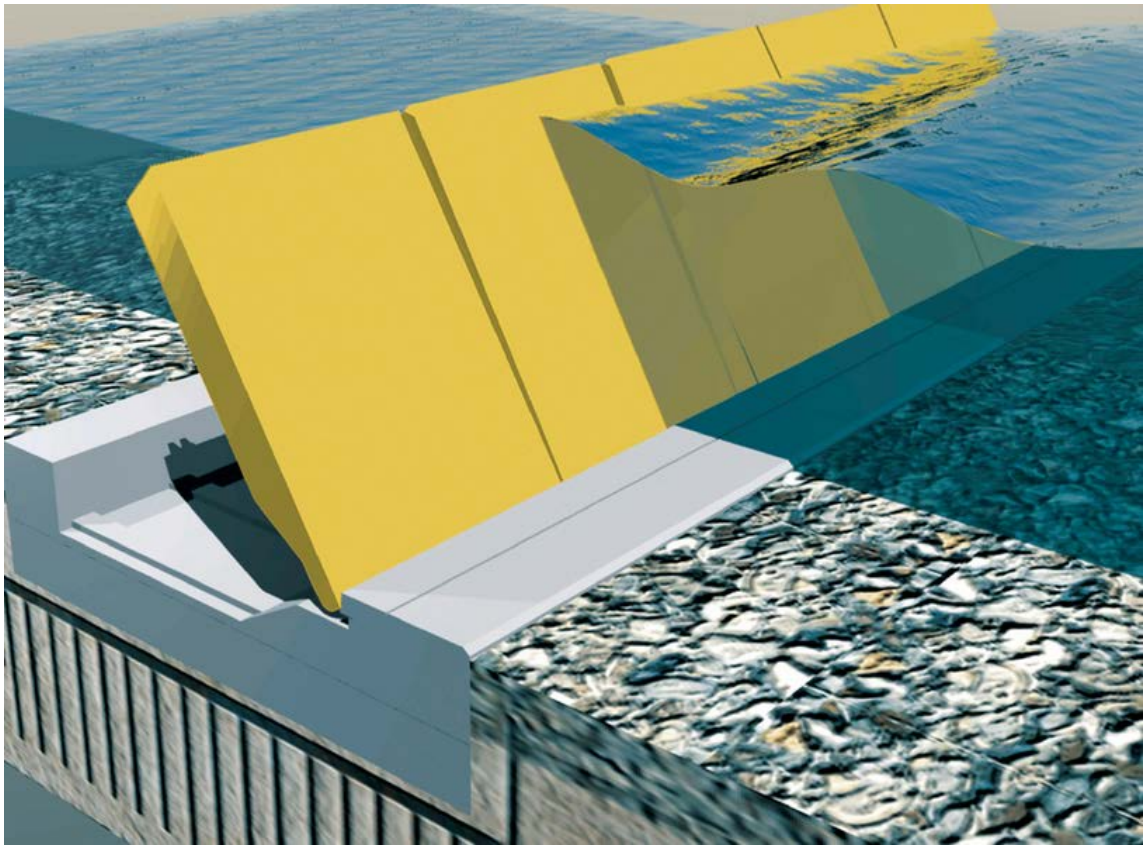
- Storm Surge Barriers/Floodgates
- Levees and Floodwalls
- Seawalls, Revetments and Bulkheads
- Flood Walls and Building Flood Protection
- Deployable Floodwalls
- Groins or Jetties
- Beach Nourishment and Dunes
- Breakwater Islands
- Constructed Reefs
- Tidal Flats
- Wetlands
- Maritime Forests
- Absorptive Edges

Solutions Address Different/Multiple Risks

	Storm Surge	Wave Action/ Energy	High Tides/Sea Level Rise/ Water Currents
Storm Surge Barriers/ Floodgates	√	√	√
Levees and Floodwalls	√	√	√
Seawalls, Revetments and Bulkheads	√	√	√
Deployable Floodwalls	√	?	
Flood Walls and Building Flood Protection	√	?	
Groins or Jetties		?	
Beach Nourishment and Dunes	√	√	√
Breakwater Islands		√	
Constructed Reefs		√	
Wetlands	√ (min)	√	?
Absorptive Edges		√	
Tidal Flats	√ (min)	√	
Maritime Forests		√	?

Storm Surge Barrier System

- Storm Surge/Tidal Barrier, Lock or Gate
- Can be Local (close to an inlet) or Regional



Venice Floodgates (MOSE), Venice, Italy
(Modulo Sperimentale Elettromeccanico)

- A 10 year, $7.3 billion water barrier system construction project in progress to protect from extreme flooding and sea level rise.
- More than 1 Mile Long, 78 Metal Flap Gates across 3 inlets that connect the Venice Lagoon to the Adriatic Sea
- Gates are 92 Feet Long, 65 Feet Wide and Weigh 300 Tons
- Integrated with other coastal reinforcement measures, the raising of the quaysides and paving, and improvements to the lagoon environment

Example of “Moses” tide gate project in Venice, Italy (http://www.npr.org/templates/story/story.php?storyId=112995748)

Large-scale Tide Gate

Figure 42. Aerial photograph of Stamford hurricane barrier (photograph courtesy of New England District).

Figure 43. Stamford hurricane barrier (photograph courtesy of New England District).

Hurricane Barriers in New England and New Jersey — History and Status After Four Decades

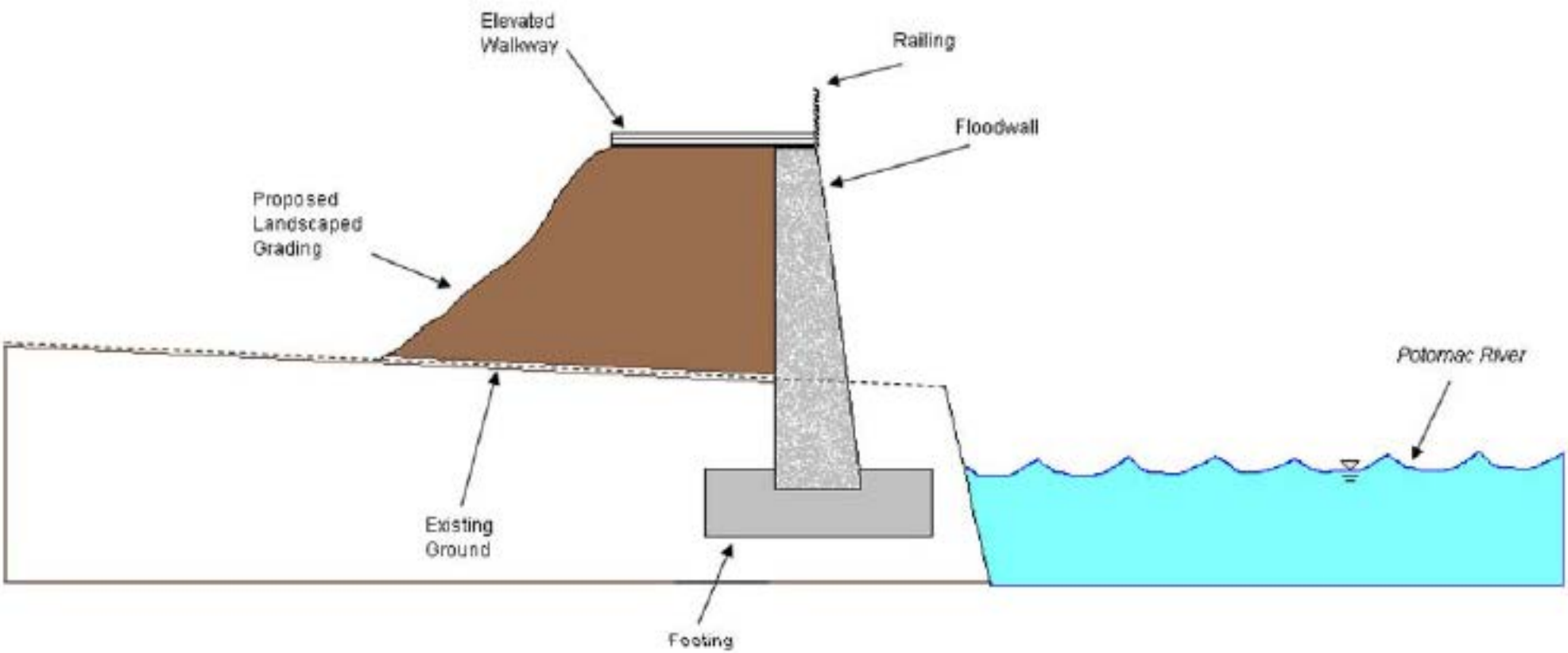
Smaller-scale Tide Gates

Navigable Tide Gate,
Shinnecock Locks, Ray Kelly

A tide gate (non-navigable) installed in the NJ Meadowlands

Levees and Floodwalls

- Large flood control structures, such as levees and floodwalls, provide protection against inland flooding



Example of conceptual floodwall design from City of Alexandria, VA Potomac River Waterfront Flood Mitigation Study

Seawalls, Revetments, Bulkheads, Riprap

- Smaller structures such as seawalls, revetments, bulkheads can stabilize the shoreline and provide erosion control.
- Armored shorelines (e.g. massive stones or rip-rap) can be used to provide erosion control
- Existing structures can be raised to provide additional protection

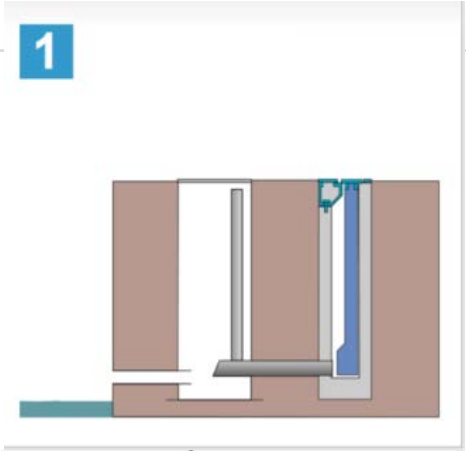
Waterfront Retaining Wall Restoration, Avalon, California

Flood Walls and Building Flood Protection

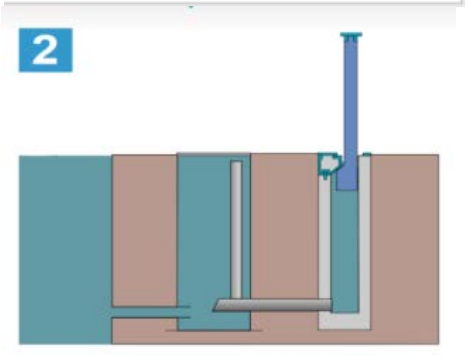
- Flood Walls and Barriers
- Protection of Key Areas and Assets

Self Closing Flood Barriers

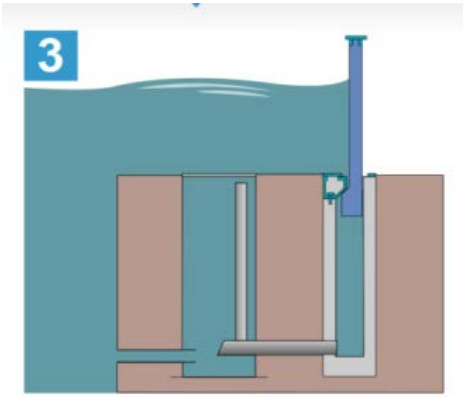
Install floating entrenched wall and reinforcement by laminated steel strips and protected by Kevlar for impact strength.



As soon as the basin is totally filled up with water, the closing surface will "lock" the barrier into a watertight position.



Once the water level subsides to a normal level, the basin is drained through a drain pipe with non return valves or by a pump.



Deployable Floodwalls

- Temporary floodwalls are less expensive than permanent floodwalls, but need to be actively deployed.

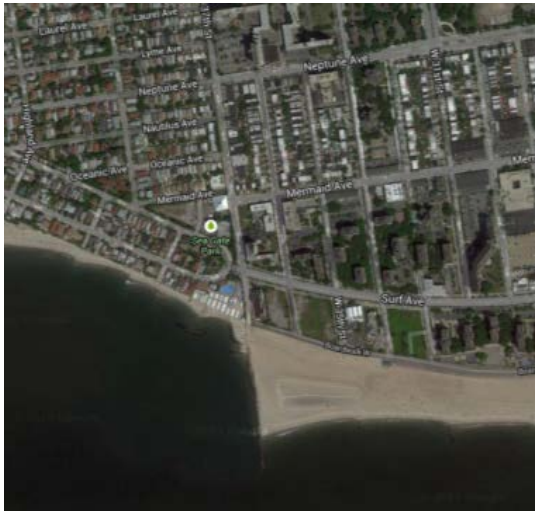
Example of temporary floodwall deployment from
FEMA Publication #551 Selecting Appropriate Mitigation Measures for Floodprone Structures
http://www.fema.gov/media-library-data/20130726-1608-20490-6445/fema551_ch_05.pdf)

Groins or Jetties

- Groins or Jetties are familiar structures installed perpendicular to shorelines to protect beach sands and beach nourishment projects.
  - Interrupt "littoral" drift and "preserve" beaches
  - Trap sand upstream but scour sand downstream
  - Debatable effectiveness and utility in reducing risk
  - Require maintenance fill (forever)
  - DEC regulatory permitting issues

Groins at Pacific Palisades. The beach is wider on the near side of the groins than on the far side. Longshore transport of sand is from the lower right to the upper left, deposited on the near side of the groins and eroded from the downcurrent side due to longshore current eddies. ©AGS1963. geol.ucsb.edu

Hardened beach structures on the North Carolina shore built before the passage of the current ban.
Photo: Program for the Study of Developed Shorelines



Beach Nourishment and Dunes

- Replenishing beach sands provides an increased buffer between the waterfront and upland areas.
  - Taller and wider sand dune creation provides greater protection.
- Dunes may be "Natural" or "Created"
  - Both require stabilization, plantings and protection from excessive foot and vehicular traffic
  - "Created" man-made dunes require proper engineering and installation
  - "Created" man-made dunes require time to develop and stabilize until which they are more vulnerable

Example of beach restoration in-progress from FEMA's Beach Nourishment and Dune Construction Fact Sheet http://www.fema.gov/media-library-data/1380817703193-db852b9457140501bd6a873c94569e2c/Beach+Nourishment+Fact+Sheet_FINAL.pdf

Nature-based Approaches

Discussed further:

- Breakwater Islands
- Constructed Reefs
- Wetlands
- Absorptive Edges

Not discussed:

- Maritime Forests
- Tidal Flats

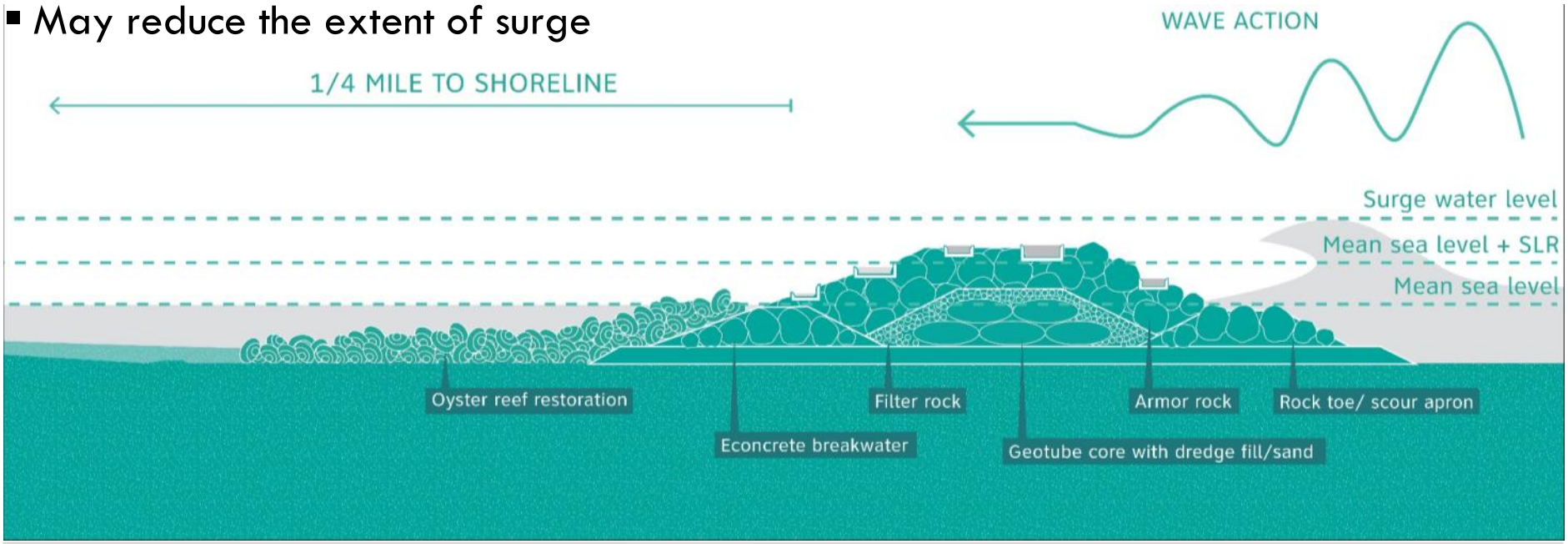
Breakwater Islands

PROS

- Reduce risk by absorbing wave energy above sea level
- Recreational opportunities
- Create calm, slow water zones that allow safer interaction with water
- Habitat enhancement opportunities
- Improve water quality
- May reduce the extent of surge

CONS

- Does not totally eliminate surge
- May interfere with existing maritime activity
- Impact on existing ecological habitat needs to be studied



Breakwater Island Example: Ft. Pierce Marina, FL

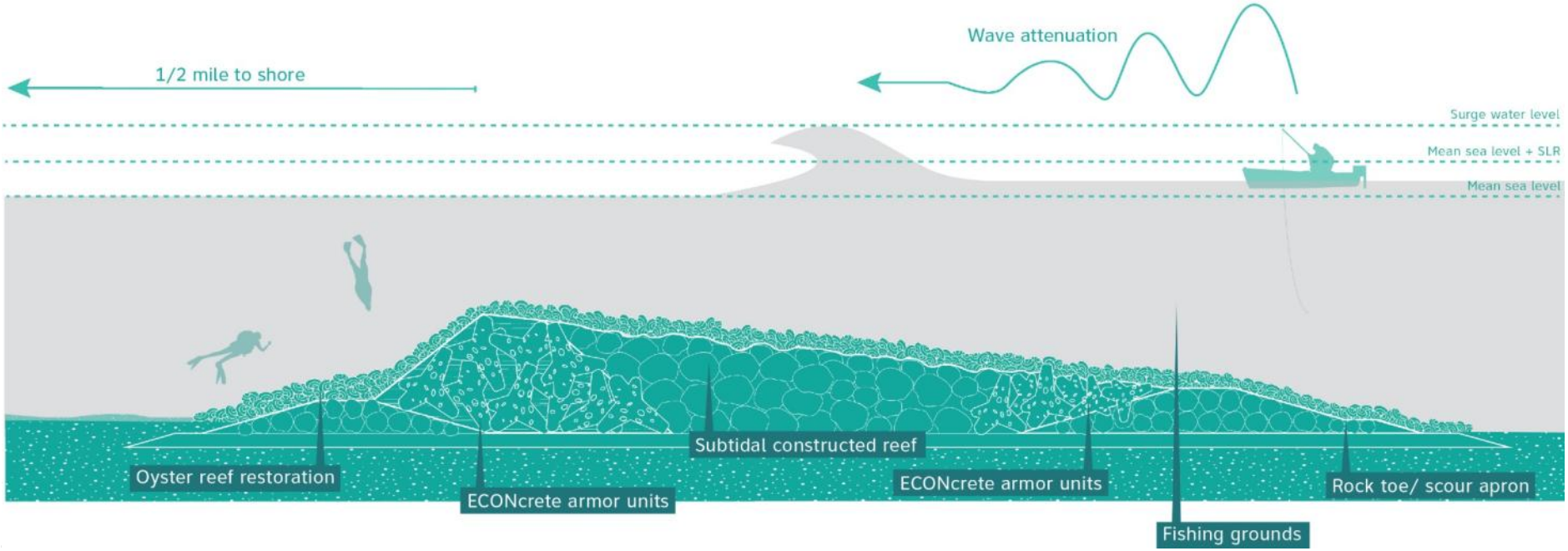
Constructed Reefs

PROS

- Reduce wave energy on-shore
- Structural integrity improves as biogenic matter builds up
- Mimic historic ecosystems
- Attract fish and larger maritime species
- Possibility of integrating wave energy generators

CONS

- Reduce smaller portion of wave than breakwater islands
- Difficult and time consuming to permit & construct in the water



Constructed Reef Example: Gold Coast, Queensland, Australia

Constructed Reef Example: Alligator Reef - Dare County, NC

Constructed Reef Example: Eastern Scheldt, The Netherlands

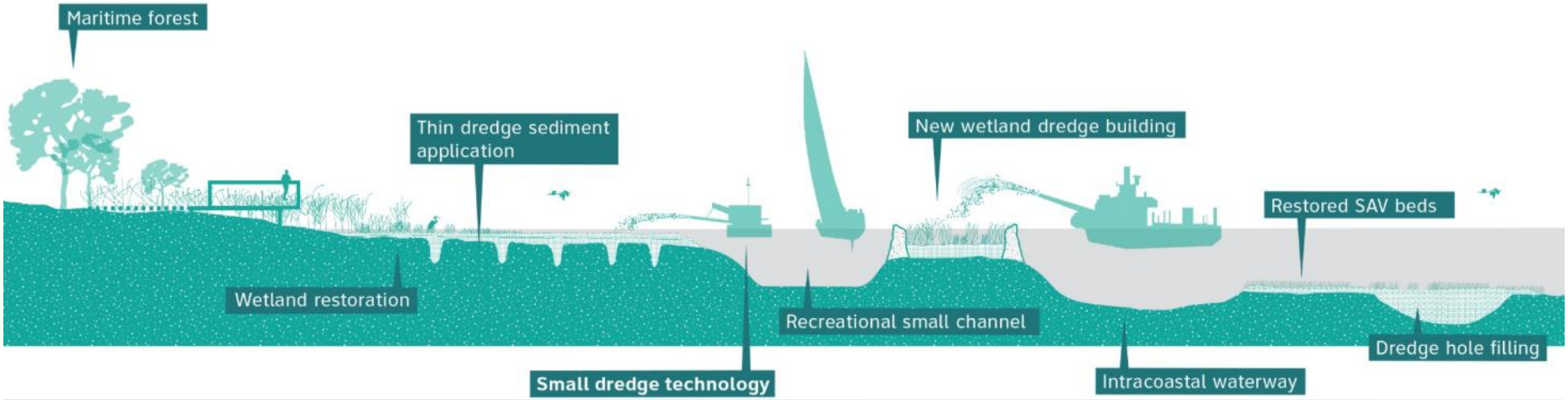
Wetlands

PROS

- Absorb surge waters and reduce wave impacts
- Adapt to sea level rise by means of natural accretion
- Clean dredge material as a potential source of sediment for marshes
- Ease the economic burden of dredge management for small businesses

CONS

- Only protects against low-level coastal flooding



Wetlands Example: Evia Island, Galveston Bay, TX

Wetlands Example: Times Beach Nature Preserve - Buffalo, NY

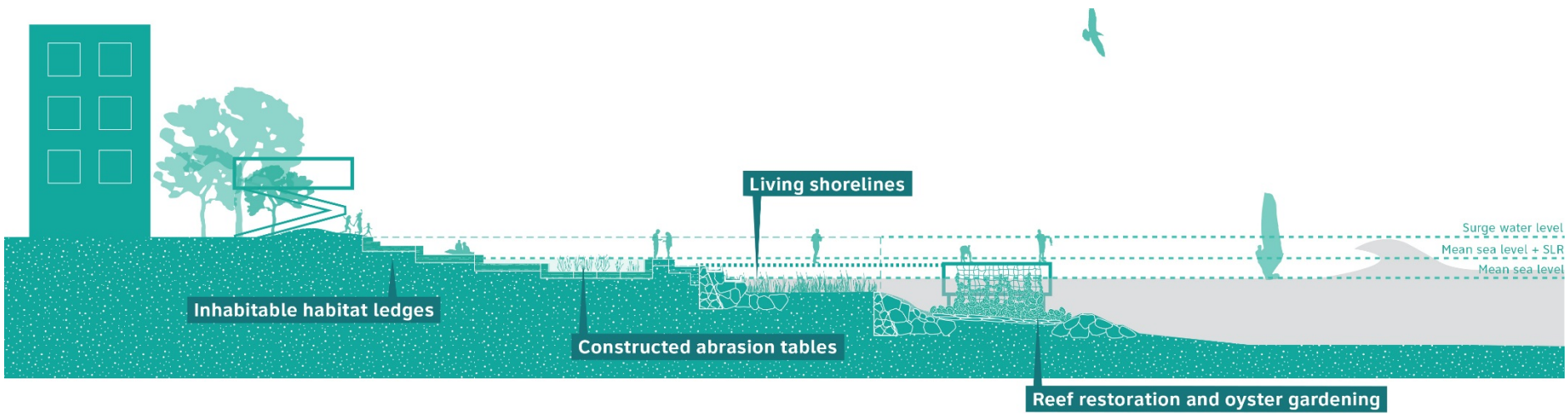
Absorptive Edge

PROS

- Reinforce the shoreline and minimize coastal erosion
- Maintain coastal processes
- Protect, restore, enhance and create natural habitat for fish and aquatic plans and wildlife
- Can use plants, sand, stone, oyster reefs as protective elements

CONS

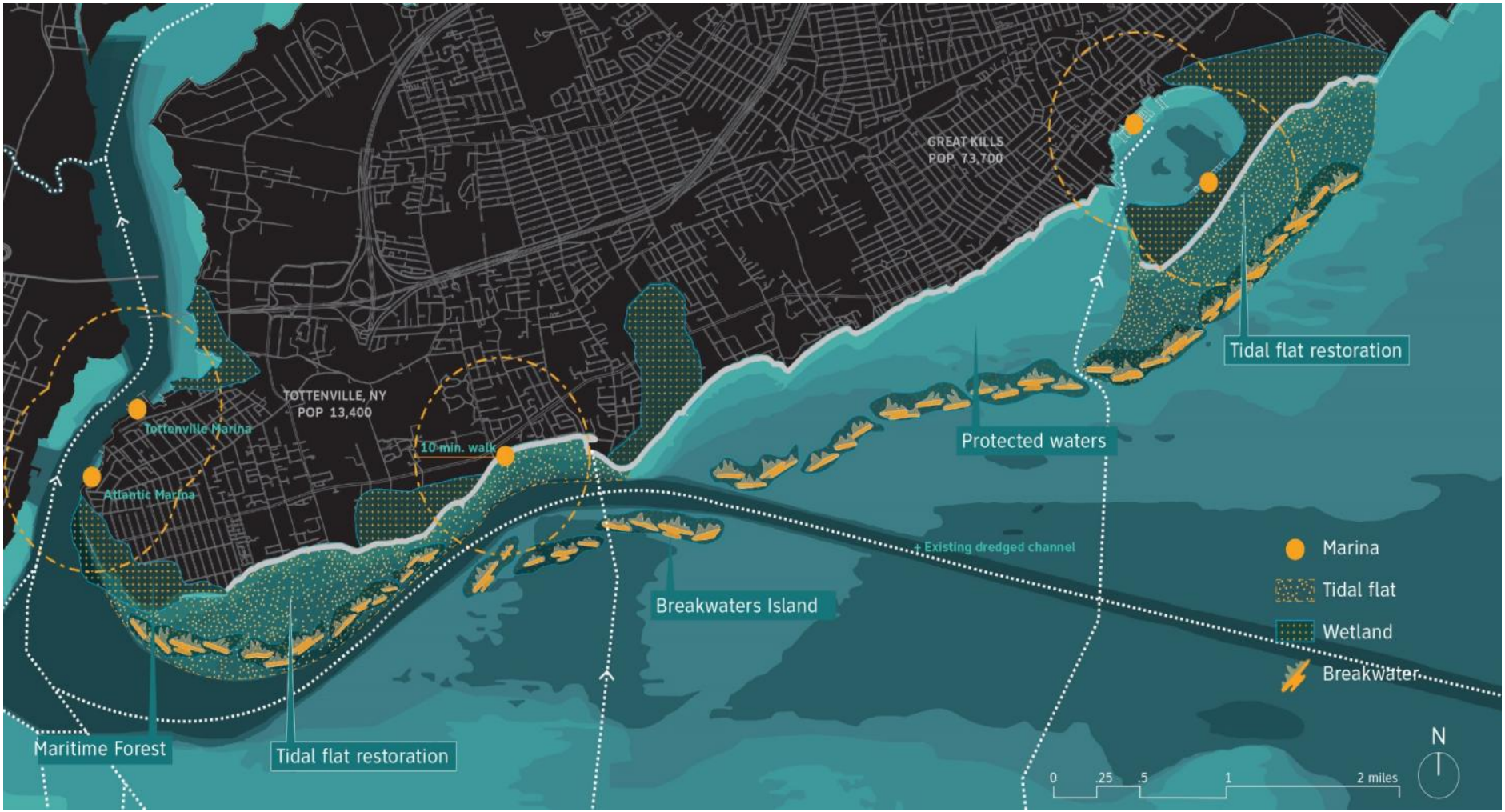
- Only protects against low-level coastal flooding



Absorptive Edges Example: Tide pools, Israel

Absorptive Edges Example: Step-type seawall as habitat

Combined Wave Attenuation Strategies: Staten Island

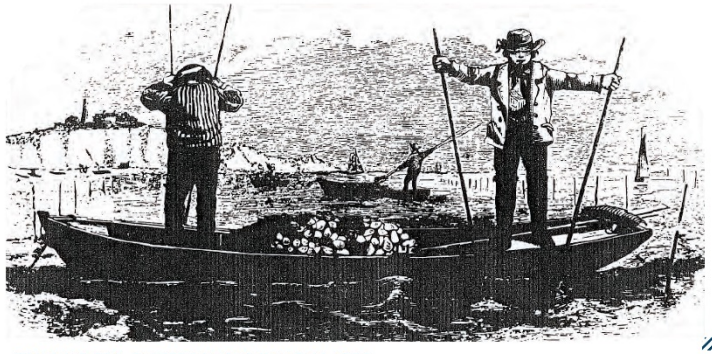


Conceptual strategies have been developed in the framework of the HUD Rebuild by Design competition.

Historic Oyster Beds in Raritan Bay

Eastern oysters were harvested from native beds, primarily Great Beds and Chingarora beds in Raritan Bay. Oysters were tonged and dredged by hand. By the 1800's native oyster beds were already in decline.

Soft and hard clam harvest limited to wading depths and intertidal shorelines.



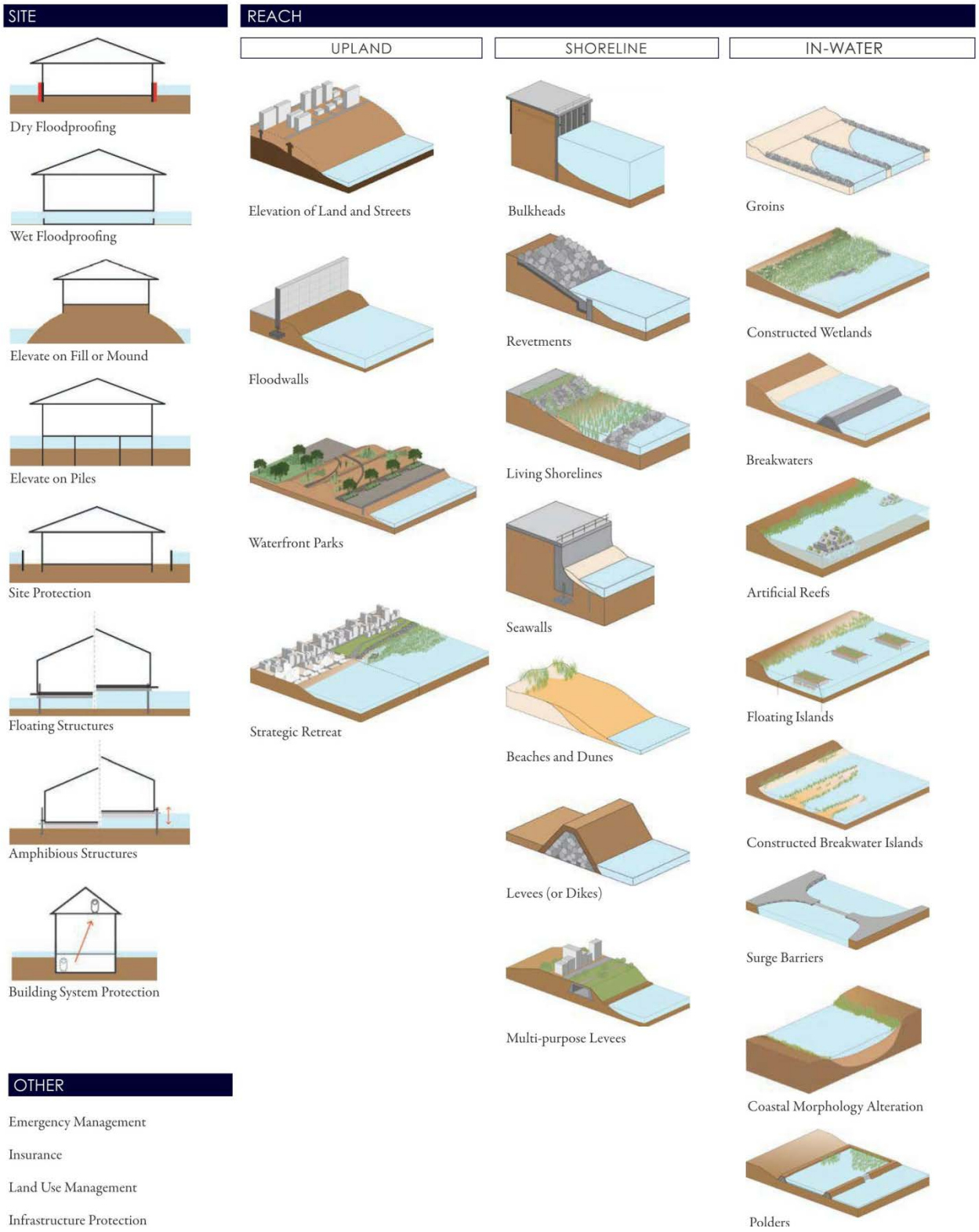
TONGING FOR OYSTERS IN RARITAN BAY, 1855

1800-1850s

RARITAN BAY OYSTER AND CLAM INDUSTRY

Combined Wave Attenuation Strategies: Jamaica Bay

Conceptual strategies have been developed in the framework of the HUD Rebuild by Design competition.

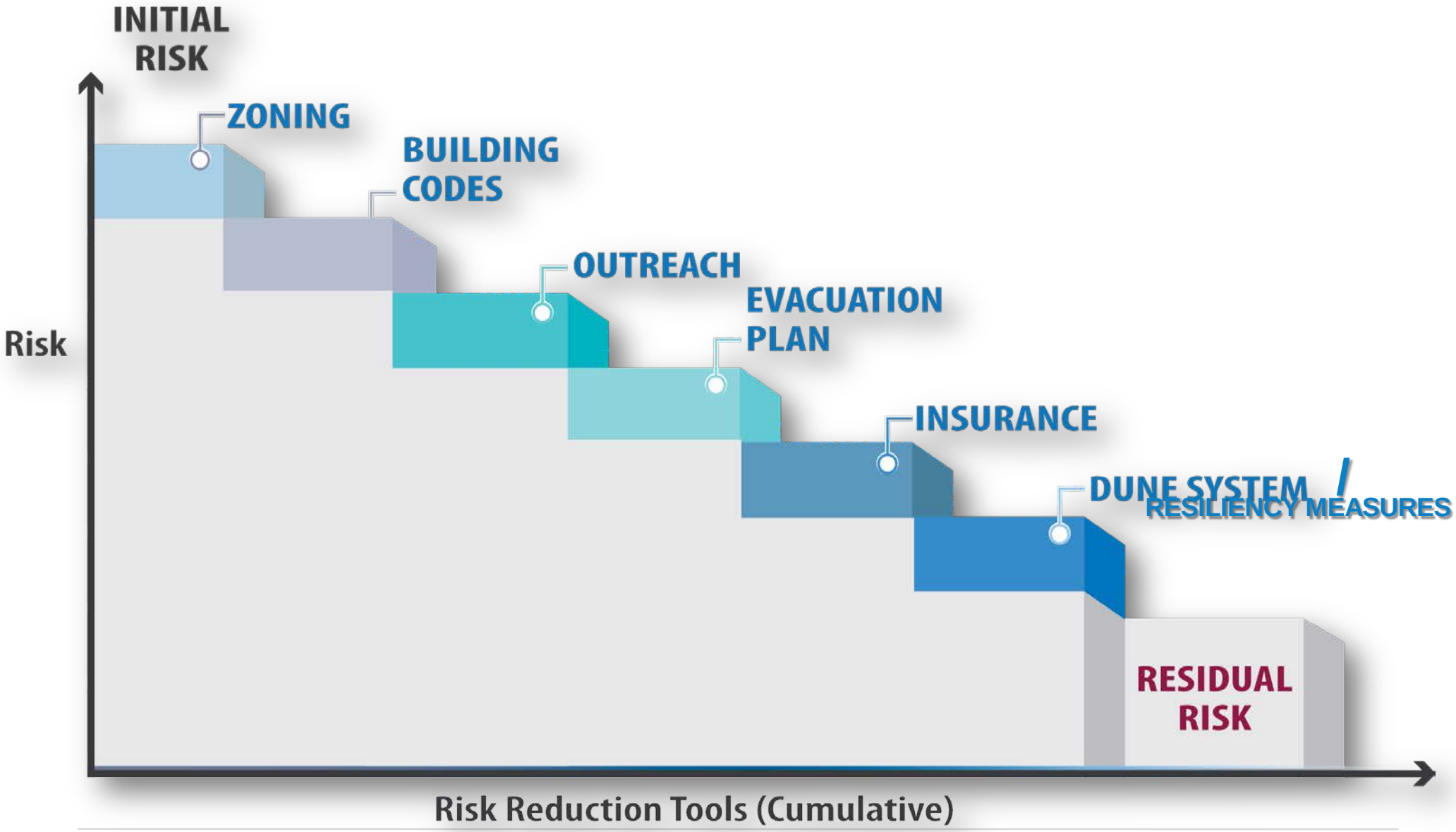


Source: New York City Dpt. Of City Planning, "Urban Waterfront Adaptive Strategies" (2013)

Building Multiple Layers of Defense

- Coastal protection is not one size fits all.
- The majority of places can benefit most from a coordinated set of layered strategies which combine two or more types of the approaches discussed.
- Coastal protection measures should, no matter what, be combined with individual site and building floodproofing and resiliency strategies to be most effective.
- Remember, risk is never 0; know how each intervention is likely to reduce risk, and by how much.

Stepping Down Risk – All Hands In



Key Resources for NYC

- NY Rising State Community Resilience Techniques (October 2013)
  - A compilation of approaches to increase resilience, including case studies
  - http://www.stormrecovery.ny.gov/sites/default/files/documents/Community_Resilience_Techniques_October_2013.pdf
- NYC Mayors Office, "A Stronger, More Resilient New York" (2013)
  - Chapter 3: Coastal Protection: Identifies city-wide issues and considerations regarding coastal protection and lays out the city's comprehensive coastal protection plan
  - Additionally, Chapter 1: Sandy and its Impacts, and Chapter 2: Climate Analysis provide useful background on coastal flooding and coastal flood risk as it applies to New York City
  - http://www.nyc.gov/html/sirr/html/report/report.shtml
- NYC Department of City Planning, "Urban Waterfront Adaptive Strategies" (2013)
  - Studies and categorizes NYC's coastal neighborhoods by coastal geomorphology and land use / density and profiles a large number of coastal protection strategies and their applicability to the coastal and built environment of various NYC neighborhoods.
  - http://www.nyc.gov/html/dcp/html/sustainable_communities/sustain_com7.shtml
- NYC Department of City Planning, "Designing for Flood Risk" (2013)
  - Identifies key design principles to guide flood-resistant construction in urban areas
  - http://www.nyc.gov/html/dcp/pdf/sustainable_communities/designing_flood_risk.pdf
- NYC Panel on Climate Change, "Climate Risk Information 2013"
  - Analysis and estimates on climate change and its impacts, including sea level rise.
  - http://www.nyc.gov/html/planyc2030/downloads/pdf/npcc_climate_risk_information_2013_report.pdf

Discussion/Questions

- Thank you!