

## **Nature-Based Adaptation:** *Getting to Scale*

December 9, 2022

CDM Smith, Boston

*(Streaming on Zoom)*



**Sustainable  
Solutions Lab**

# WELCOME

## Kelly Knee

*Forum Organizer*

*Executive Director Ocean Science*

*RPS North America*

# FORUM CO-CHAIRS

**Nasser Brahim**

*Senior Climate Resiliency Specialist  
Woods Hole Group*

**Mark Costa**

*Senior Water Resources Engineer  
VHB*

**Melanie Gárate**

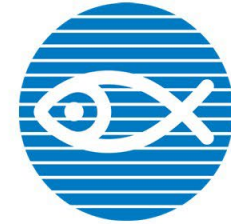
*Director of Climate Engagement  
Stone Living Lab & Boston Harbor Now*

**EBC** Environmental Business Council of New England

UMass Boston **B** Sustainable Solutions Lab

**AECOM**

Weston & Sampson<sup>SM</sup>



**New England Aquarium**



**RPS** MAKING COMPLEX EASY

**FOLEY HOAG** LLP

**EVERSOURCE**



**Nitsch Engineering**

**WOODS HOLE GROUP**  
A CLS COMPANY

**CDM 75<sup>th</sup> Smith**

**Tt TETRA TECH**



**Barr Foundation**

**Union of Concerned Scientists**  
Science for a healthy planet and safer world



**clf**  
conservation law foundation



**BOSTON HARBOR NOW**



**MASS ECAN**  
Massachusetts Ecosystem Climate Adaptation Network

**BSLA**  
Boston Society of Landscape Architects

**BSA**  
BOSTON SOCIETY OF ARCHITECTS/AIA

**CLEAN WATER ACTION | CLEAN WATER FUND**

**Mass Audubon**  
Protecting the Nature of Massachusetts

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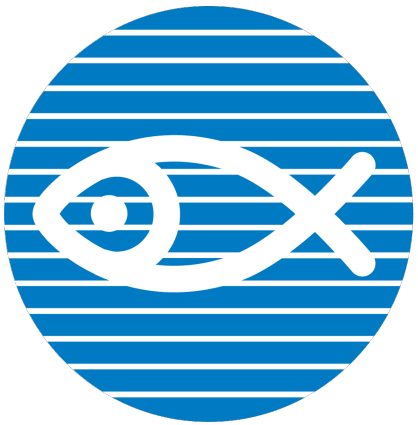


**Julie Eaton Ernst**

*Resilience Team Leader*

*Weston & Sampson*

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*Director of Community Relations  
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# WELCOME FROM HOST

**Lauren M. Miller**

*Associate, Discipline Leader – Climate Resilience  
CDM Smith*

# PROGRAM INTRODUCTION

**Melanie Gárate**

*Forum Co-Chair*

*Director of Climate Engagement  
Stone Living Lab & Boston Harbor Now*



# PROGRAM INTRODUCTION

## Nature-Based Approach at Scale: *Research, Planning, & Implementation*

# Transforming Urban Water: Multi-benefit Solutions for the San Francisco Bay

## Heidi Nutters

*Senior Program Manager  
San Francisco Estuary Partnership*

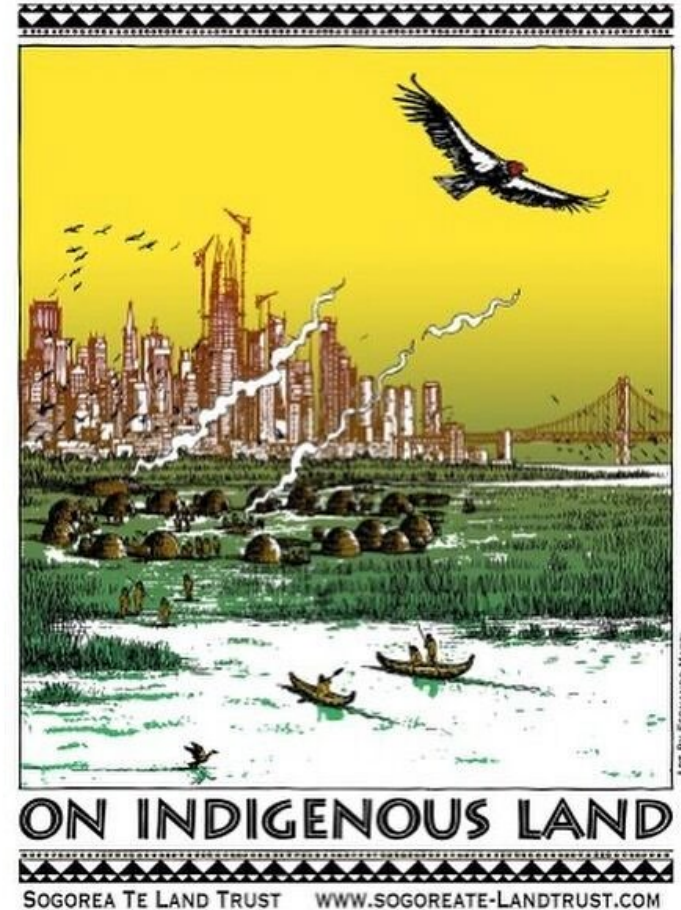
# Transforming Urban Water: Multi-benefit Solutions for the San Francisco Bay

Heidi Nutters, Senior Program Manager

with help from SFEP: Caitlin Sweeney, Darcie Luce, Liz Juvera, Sasha Harris-Lovett & Diana Fu

# Land Acknowledgement

We acknowledge that the San Francisco Bay is the unceded ancestral homeland of many indigenous people, including the **Him-R^n Ohlone Jalquin, Saclan Tribe, the Villages of Lisjan, the Karkin, Muwekma, Ramaytush, Tamien, and Yokuts Ohlone, Coast and Bay Miwok, Patwin, and the Amah Mutsun Tribal Band.** The broader San Francisco Estuary is also the homeland of the Plains Miwok, Wappo, Wintun, and Nisenan people. We recognize that we benefit from living and working in their traditional homeland. We wish to pay our respects by acknowledging the ancestors, elders, and relatives of these Tribal Communities and by affirming their sovereign rights as First Peoples of these Nations.



# Presentation Outline



Intro to the SF Estuary Partnership & Estuary Blueprint



How are we getting to scale on Nature-based Solutions (NBS)? – Local and Regional Initiatives

Key Questions  
Pilot Projects  
Regional Initiatives



# San Francisco Estuary Partnership

- A place-based EPA program
- Collaborative and non-regulatory
- Leverage federal, state, and regional resources to implement the Estuary Blueprint

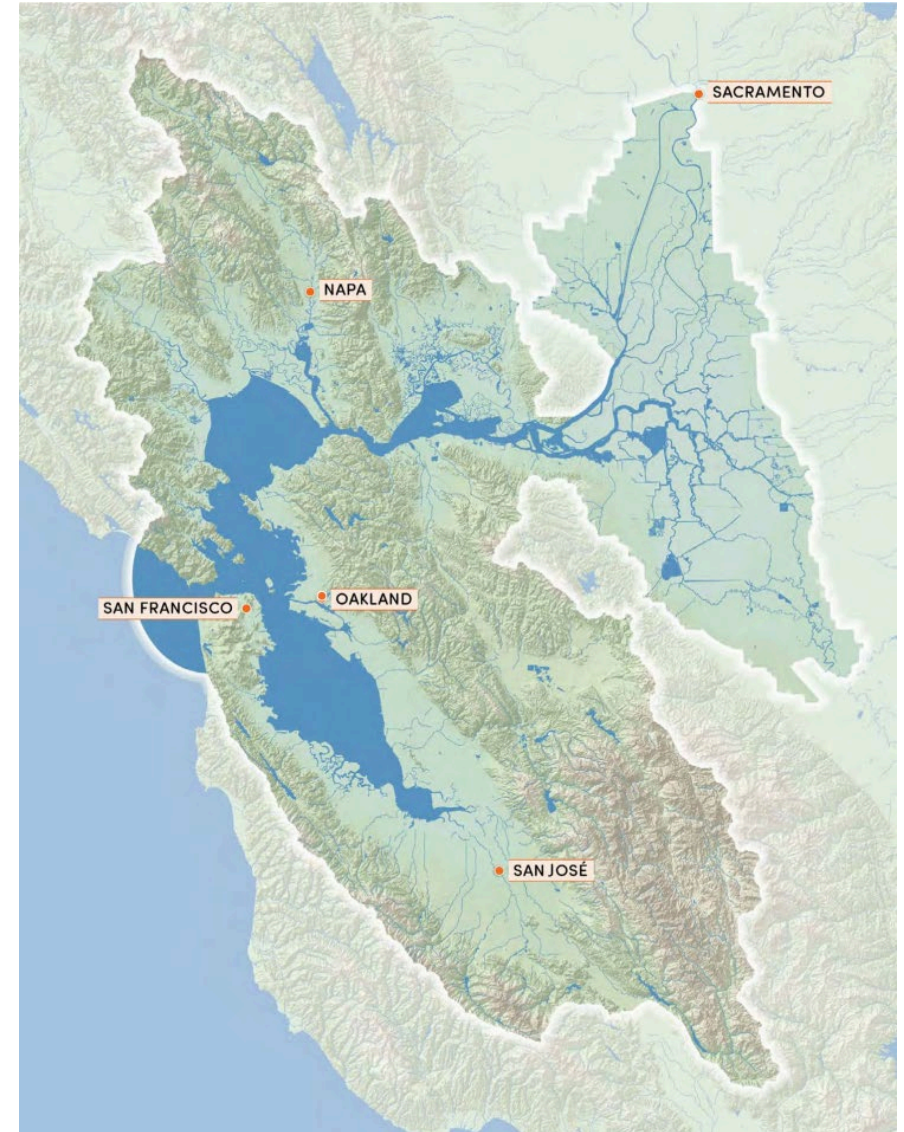


Partnership in Action



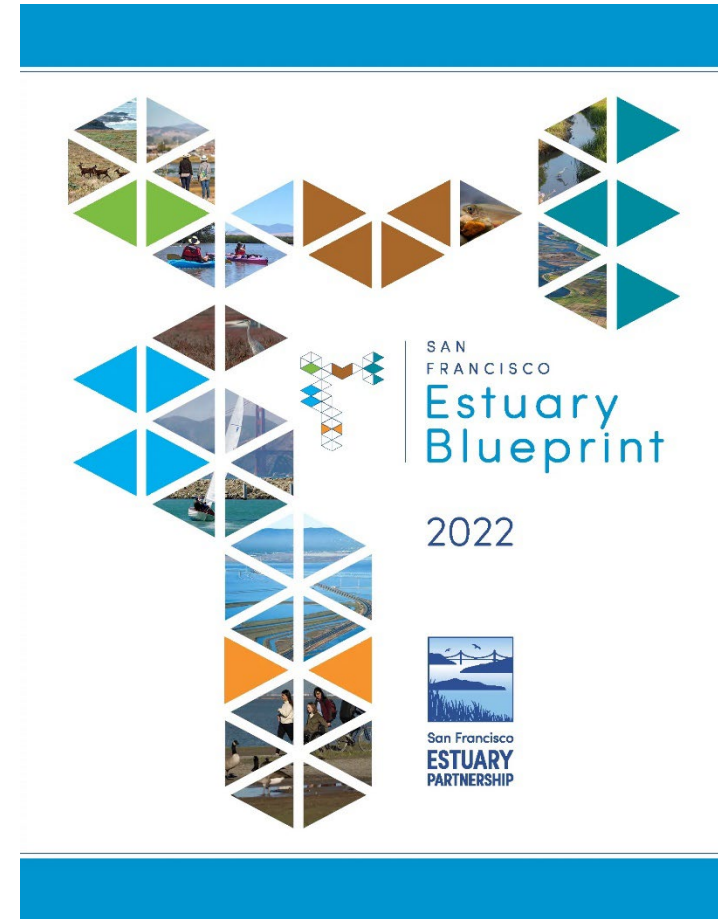
# About the SF Estuary

- 4 major cities – San Francisco, Oakland, San Jose, Sacramento
- Largest Estuary in Western North America
- Critical winter feeding habitat for migratory birds, a productive nursery for juvenile fish and shellfish, and a year-round home for a vast diversity of plants and animals.
- Half of California's surface water supply falls as rain or snow within this region.



# San Francisco Estuary Blueprint

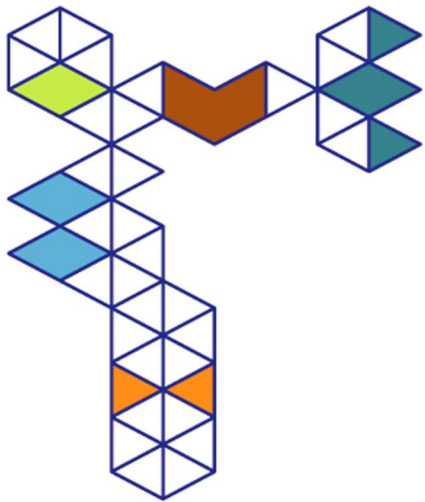
- The Clean Water Act calls for each National Estuary Program to develop and implement a Comprehensive Conservation and Management Plan (CCMP)
- First completed in 1993
- 2022 San Francisco Estuary Blueprint released in July 2022





*Where do we want to be in 2050?*

*What can we do over the next 5 years to get there?*



SAN  
FRANCISCO

Estuary  
Blueprint



# 2022 ESTUARY BLUEPRINT ACTIONS

Climate Resilience

Tidal Marsh

Recycled Water

Equity

Transition Zones

Stormwater

Adaptation Planning

Managed Wetlands

Nutrients

Adaptation Projects

Seasonal Wetlands

Emerging Contaminants

Watershed Connections

Creeks

Health Risks of Contaminants

Sediment

Invasive Species

Trash

Carbon Management

Freshwater Flows

Public Access

Wetland Monitoring

Water Conservation

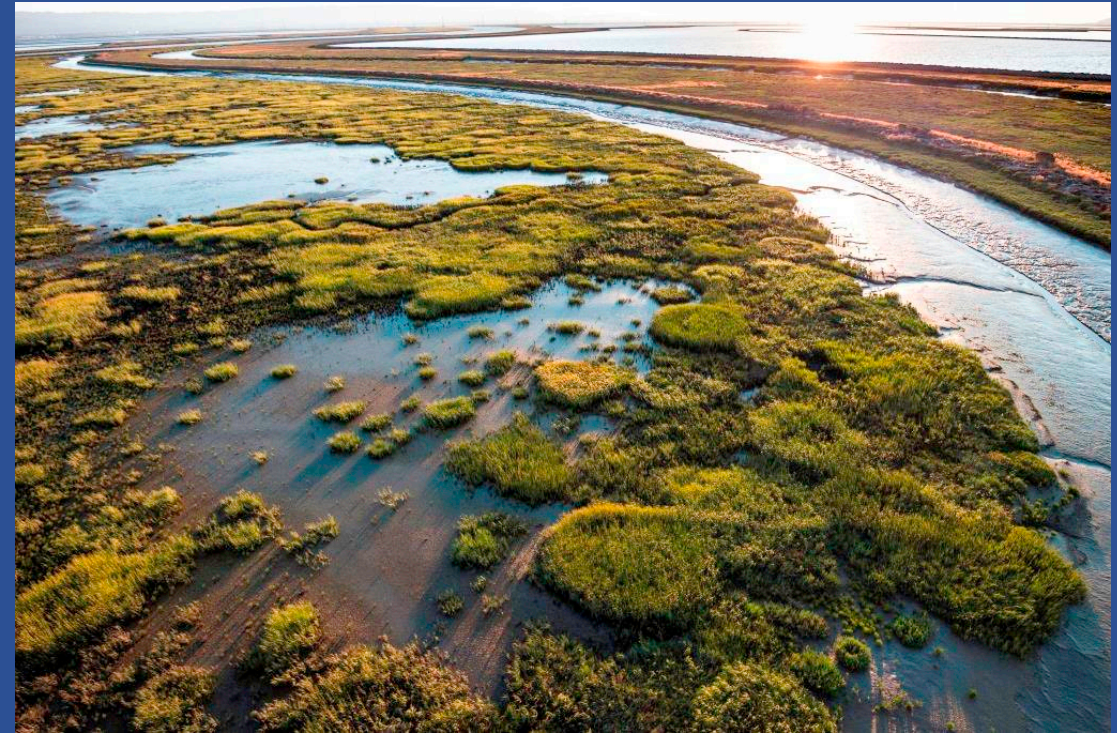
Champion the Estuary

# Estuary Blueprint: Climate Resilience

Advance natural resource protection while **planning** for increased climate resiliency

**Overcome challenges** to accelerate implementation of climate adaptation strategies that prioritize natural and nature-based strategies

**Implement** climate adaptation projects that prioritize natural and nature-based strategies



# Presentation Outline



Intro to the SF Estuary Partnership & Estuary Blueprint



How are we getting to scale on Nature-based Solutions (NBS)? – Local and Regional Initiatives

Key Questions  
Pilot Projects  
Regional Initiatives

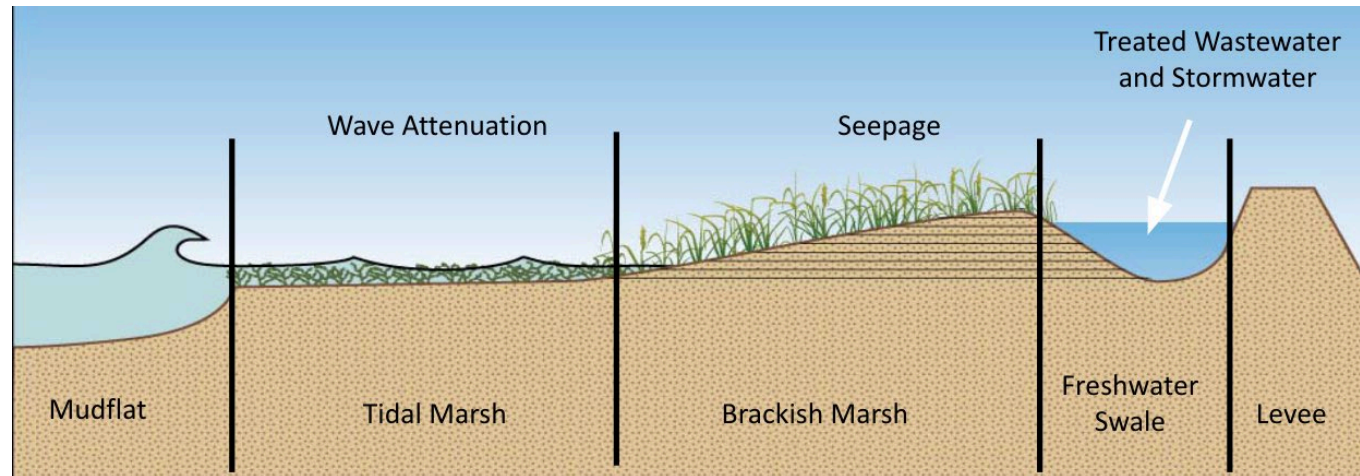


# Key Questions

- How can nature-based solutions help us to address multiple complex problems at once?
  - Water quality and changes in water reuse and infrastructure needs
  - Community-led adaptation to climate change
  - Monitoring and evaluation of projects
- How do we support innovation in design & engineering, stakeholder engagement, and co-creation of solutions?
- Can we address barriers to innovation together and build capacity along the way?

# Pilot Projects - Oro Loma Living Laboratory

- Proof of concept experimental design
- Beneficial reuse for treated wastewater discharged directly to Bay
- Freshwater input increases plant growth & can support diversity
- Brackish marshes build organic soils to help keep pace w/ SLR
- Monitoring in partnership with UC Berkeley and Valley Water



# Key Findings from Oro Loma



Horizontal Levees have incredible potential for water quality improvement

- Nutrients
- Contaminants of emerging concern
- Reverse Osmosis Concentrate
- Stormwater



Limitations: flow capacity, regulatory process, more complex planning process



Emerging Pilot Projects are looking at:

- Tribal consultation
- Community-based monitoring and evaluation
- Habitat and public access

# Transforming Shorelines Collaborative

*Advancing NBS projects together!*

The Transforming Shorelines Collaborative (TSC) comprises practitioners and experts on nature-based solutions, wastewater treatment, resiliency and nutrient management including regulators, landowners and stakeholders, individual wastewater treatment facilities, regional entities and practitioners/experts involved in habitat restoration, treatment wetlands, or shoreline resilience.

## Existing & Future Topics:

- Palo Alto Horizontal Levee
- Treatment Wetlands
- Utilizing Reverse Osmosis Concentrate in a Horizontal Levee
- East Bay Dischargers Authority Horizontal Levee
- Regulatory Pathways for NBS
- North Richmond Horizontal Levee



# Regulatory Pathways



**Issue:** Permitting complexity presents one of the largest hurdles to successful implementation of NBS projects



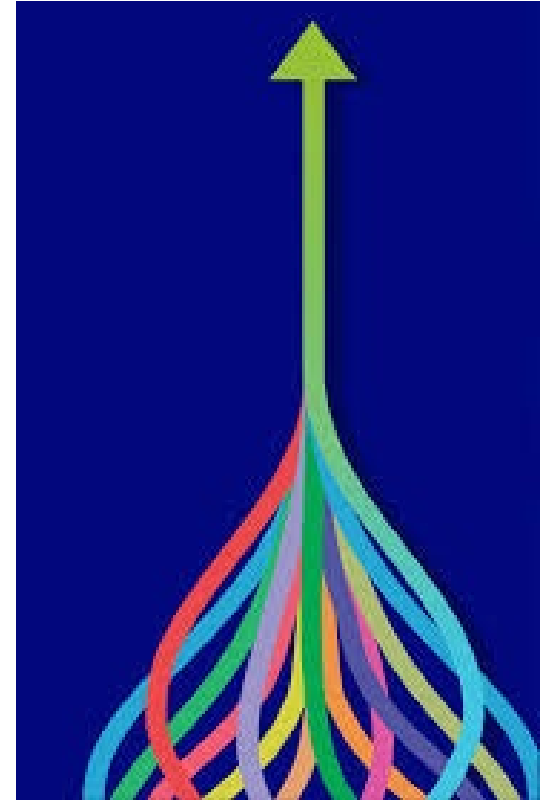
**Solution:** Work with regulatory and land management partners to develop solutions for permitting challenges associated with multi-benefit NBS projects

Develop **case studies** from existing horizontal levee projects

Engage with regulatory partners on challenges and co-create solutions



**Project timeline** – August 2022 – June 2023



# Leading with Equity, Tribes and Communities



Community Engagement can & should happen at all stages of NBS

- Project visioning & development
- Design
- Construction
- Monitoring

# Thank you!

Contact Info:

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# Living Breakwaters Billion Oyster Project

**Pippa Brashear**

*Resilience Principal  
SCAPE Studio*



# Nature-Based Adaptation: Getting to Scale

# LIVING BREAKWATERS

**Climate Adaptation Forum**

**Boston, MA**

**12/09/2022**

**Pippa Brashear**  
**Resilience Principal**

**SCAPE**

## VISION



2014

## DESIGN



2019

## MAKING IT A REALITY



2022

*Hurricane Sandy*  
**Rebuilding Task Force**

# HURRICANE SANDY **REBUILDING STRATEGY**

*Stronger Communities, A Resilient Region*



*August 2013*

# REBUILD BY DESIGN

“Climate change is presenting unprecedented threats to communities across the country. Rebuild By Design is a model for how we can use public-private partnerships to spur innovation, protect our communities from the effects of climate change, and inspire action in cities across the world.”

—

Shaun Donovan  
Chair of the Hurricane Sandy Rebuilding  
Task Force  
Secretary of the Department of Housing and  
Urban Development

# SCAPE / LANDSCAPE ARCHITECTURE PLLC

PARSONS BRINCKERHOFF

STEVENS INSTITUTE OF TECHNOLOGY

OCEAN AND COASTAL CONSULTANTS

SEARC CONSULTING

THE NEW YORK HARBOR SCHOOL

LOT-EK

MTWTF

PAUL GREENBERG



# Designing the Process

Our detour around existing-but-failing frameworks was only possible through the power of design, which has an unrivaled capacity to unify.

- Henk Ovink, TOO BIG, 2018

## 2 RESEARCH

**Objective** Establish the broadest possible understanding of the region's vulnerabilities to future risks and uncertainties, to enhance resilience.

**Process** Rebuild by Design's local partner organizations create an intensive, three-month program of field research to introduce teams to a variety of local stakeholders, providing a comprehensive view of the storm's effects — the damage it created as well as the long-standing problems it uncovered or exacerbated.

A Research Advisory Board leads the teams through the region to learn from a variety of perspectives, and teams conduct additional research to supplement this on-the-ground work. Research is collaborative across teams and focuses on typologies as well as locations.

**Result** A public presentation from each team that includes three to five "design opportunities" describing conceptual approaches for interventions and an overall compilation of research submitted by all teams.

## 3 DESIGN

**Objective** Develop implementable solutions that have support from local communities and governments.

**Process** HUD Secretary Shaun Donovan selects, on average, one design opportunity for each team to develop. Teams then gather diverse local stakeholders into community coalitions, with whom they begin a four-month process of co-designing the final interventions. Using meetings, colloquia, charrettes, and

non-traditional events to gain the broadest perspectives, they create solutions that not only address disaster scenarios, but also enrich the daily life of community members.

**Result** Ten fully developed, implementable resilience proposals champion communities' visions for future development and have support from the local governments.

## 4 IMPLEMENTATION

**Objective** Governments and community stakeholders work together to build the projects.

**Process** A jury evaluates the projects. HUD Secretary Shaun Donovan designates which are eligible to receive federal funds. HUD allocates disaster recovery funds to city and state governments for the implementation of the projects' first stages. HUD sets strong

guidelines for community involvement to ensure that the coalitions formed during the competition continue to be involved through implementation. Teams are poised to work with government and communities to refine the interventions.

**Result** A more resilient region achieved through collaboration and design.

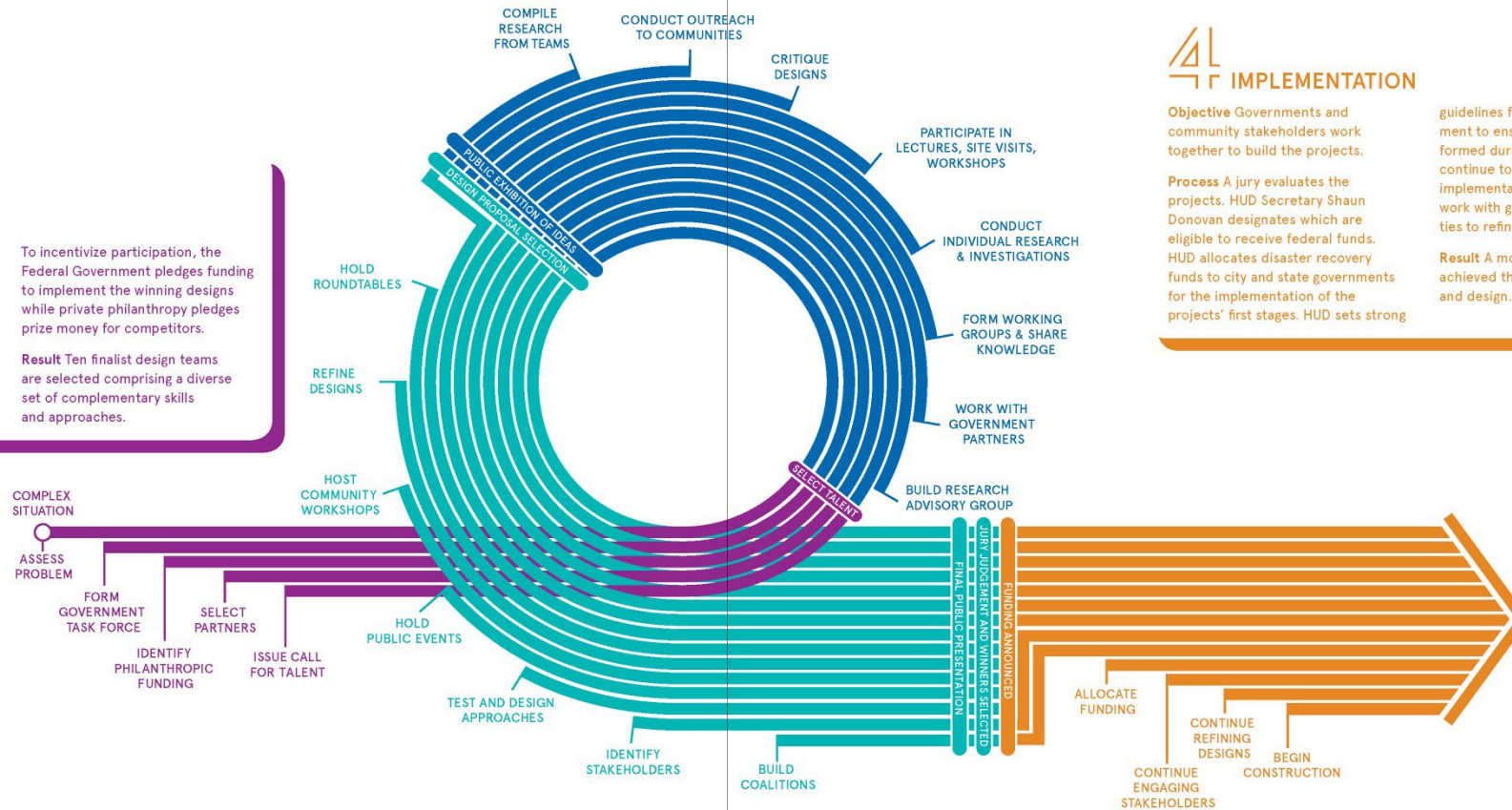
## 1 TALENT

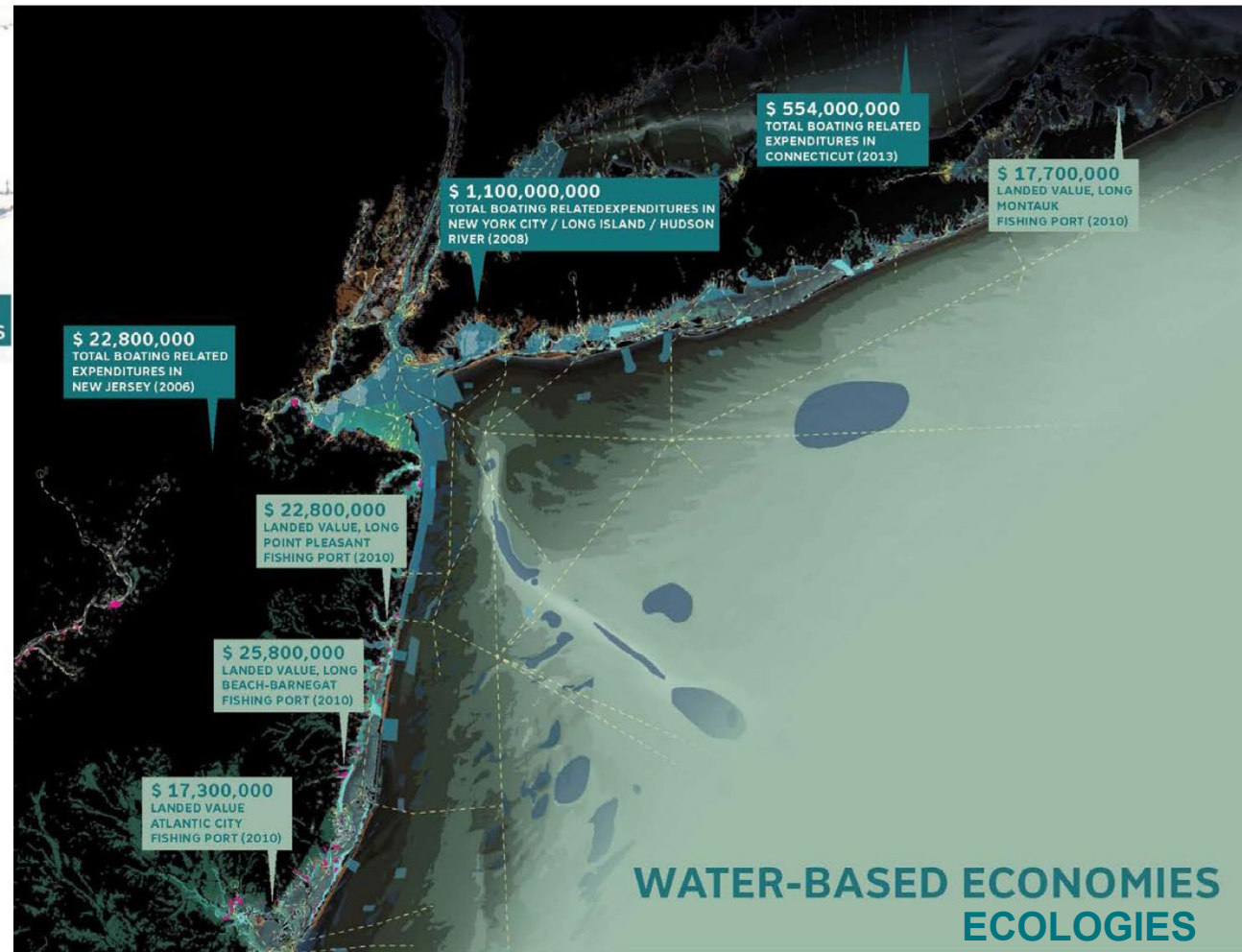
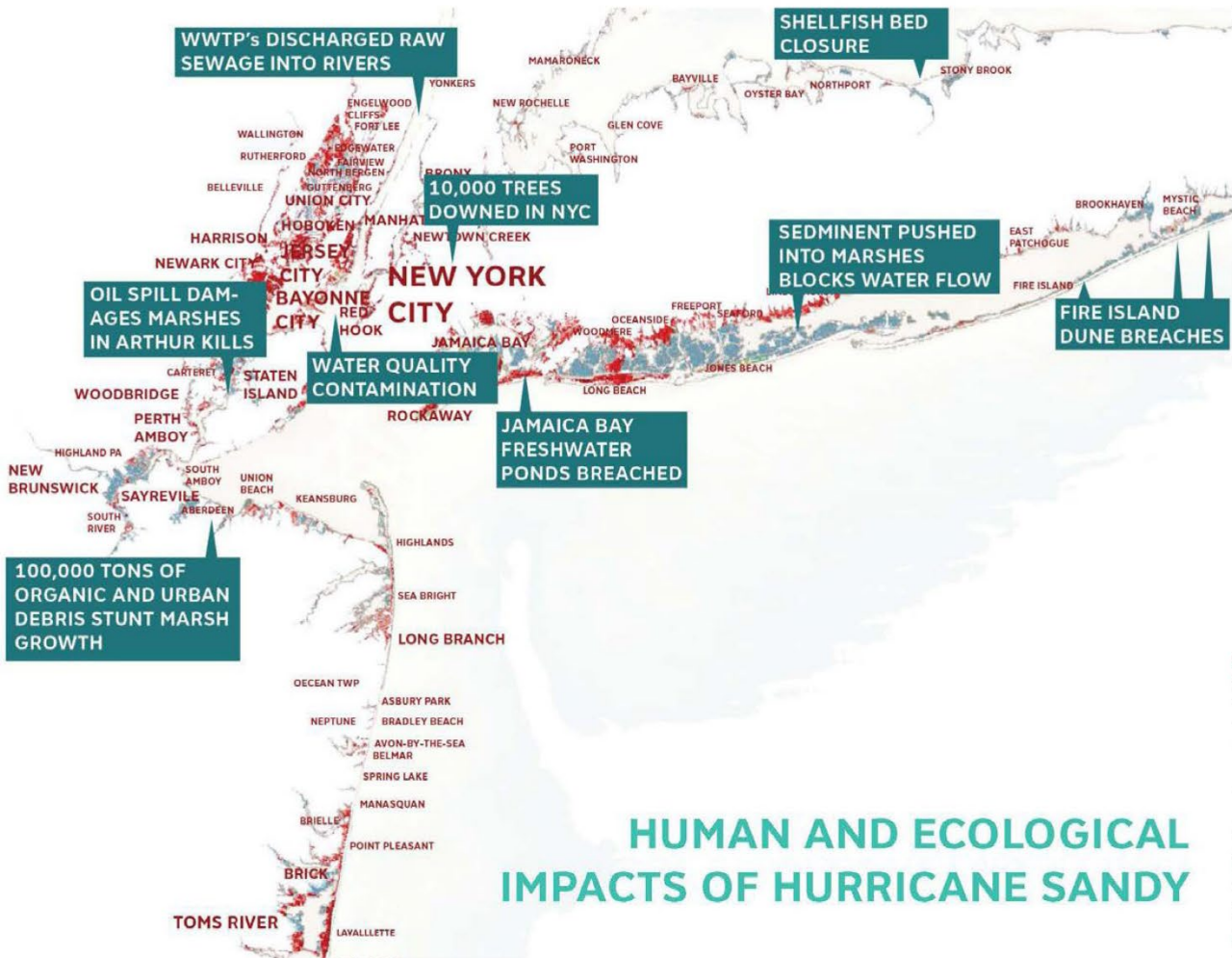
**Objective** Gather the talent of the world to work with the talent of the Sandy-affected region.

**Process** Task Force issues a Request for Qualifications and Approaches calling for teams to assemble themselves in interdisciplinary partnerships to tackle the region's physical and social vulnerabilities.

To incentivize participation, the Federal Government pledges funding to implement the winning designs while private philanthropy pledges prize money for competitors.

**Result** Ten finalist design teams are selected comprising a diverse set of complementary skills and approaches.



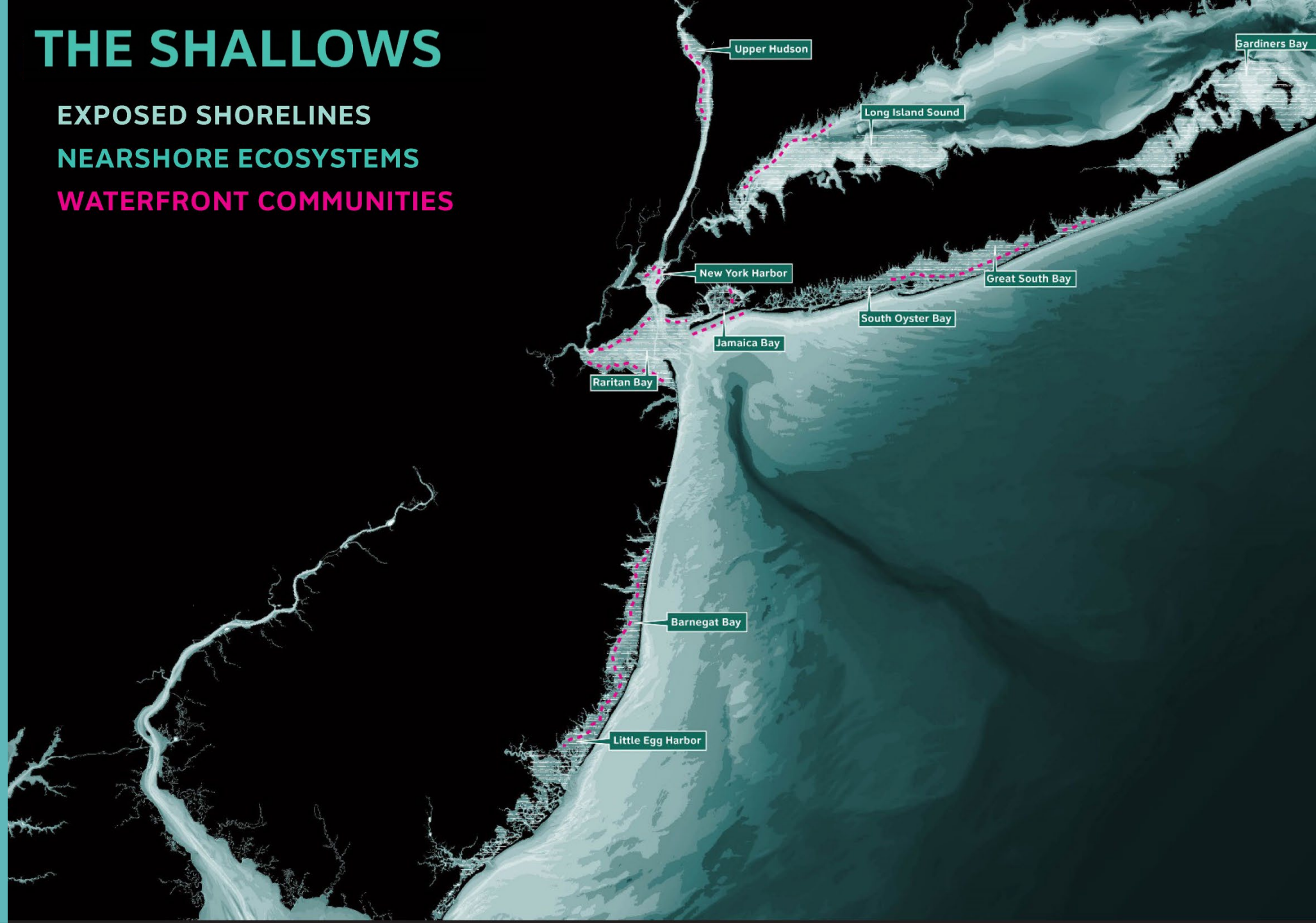
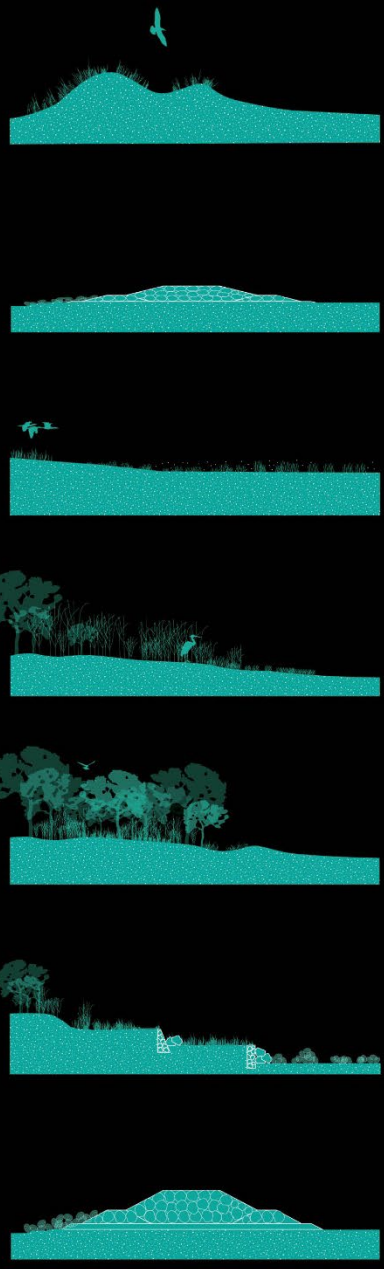


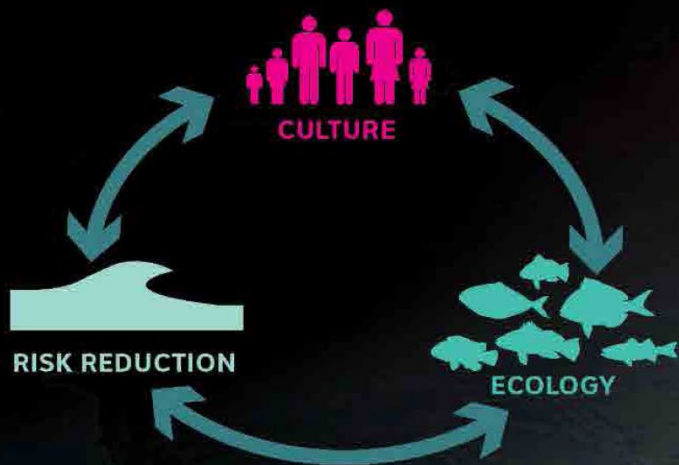
# THE SHALLOWS

EXPOSED SHORELINES

NEARSHORE ECOSYSTEMS

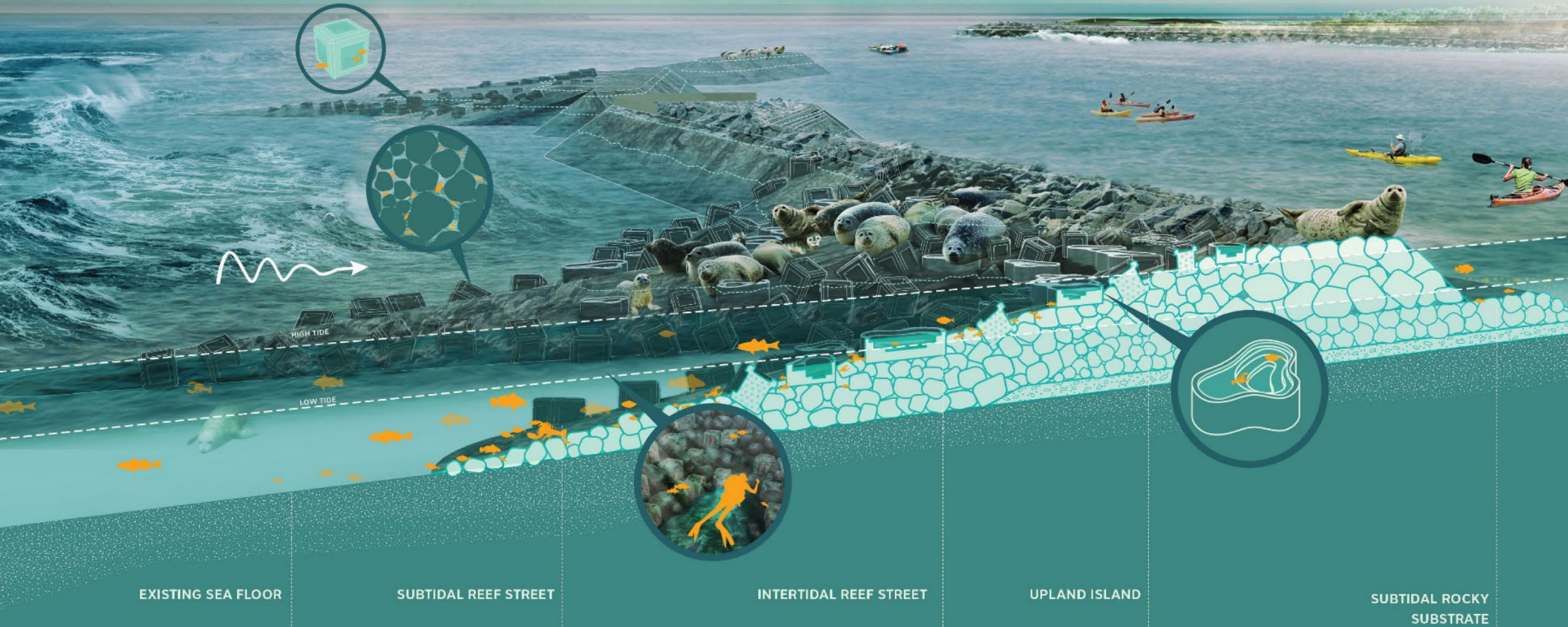
WATERFRONT COMMUNITIES



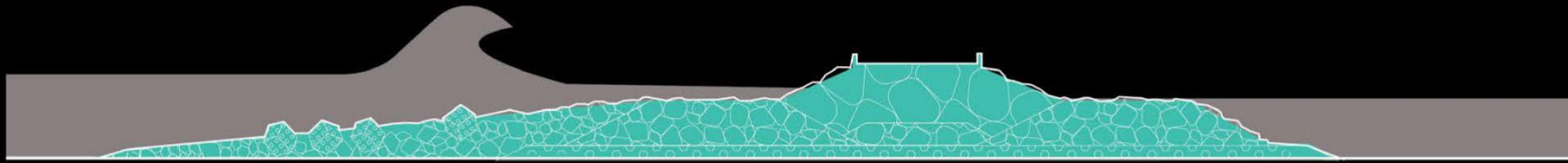


**REBUILD  
BY  
DESIGN**

# LIVING BREAKWATERS



# HABITAT BREAKWATERS



## DO:

- REDUCE EROSION
- LESSEN WAVE IMPACTS
- PROVIDE HABITAT
- ENCOURAGE RECREATIONAL FISHERIES
- BUILD BEACHES

## DO NOT:

- KEEP OUT FLOOD WATER

APRIL 30, 2015 | Albany, NY

# Governor Cuomo Announces \$60 Million Living Breakwaters Barrier to Protect Staten Island Shoreline and Habitat

STORM RECOVERY



**PROTECTIVE SEA FLOOR**  
Breakwaters reduce wave energy and provide habitat for marine life.

**NATURAL ROCK BARRIER**  
Natural rock structures provide habitat for marine life.



**IMPROVED SEA STREET**  
Sea street channels water flow and provides habitat for juvenile fish.



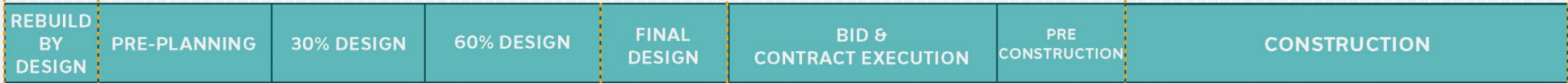
**UNPLANNED ISLAND**  
Exposed island habitat provides additional habitat for birds.

**VERTICAL ROCKY SUBSTRATE**  
Vertical substrate provides habitat for juvenile fish.



**MARE CLAN**  
Small island habitat provides habitat for birds.

2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024



REBUILD BY DESIGN (RBD) COMPETITION 11/2013

RBD WINNERS ANNOUNCED 06/2014  
NYS AWARDED \$60M FOR IMPLEMENTATION

START CONSTRUCTION 09/2021

END CONSTRUCTION 12/2024

PROJECT TIMELINE

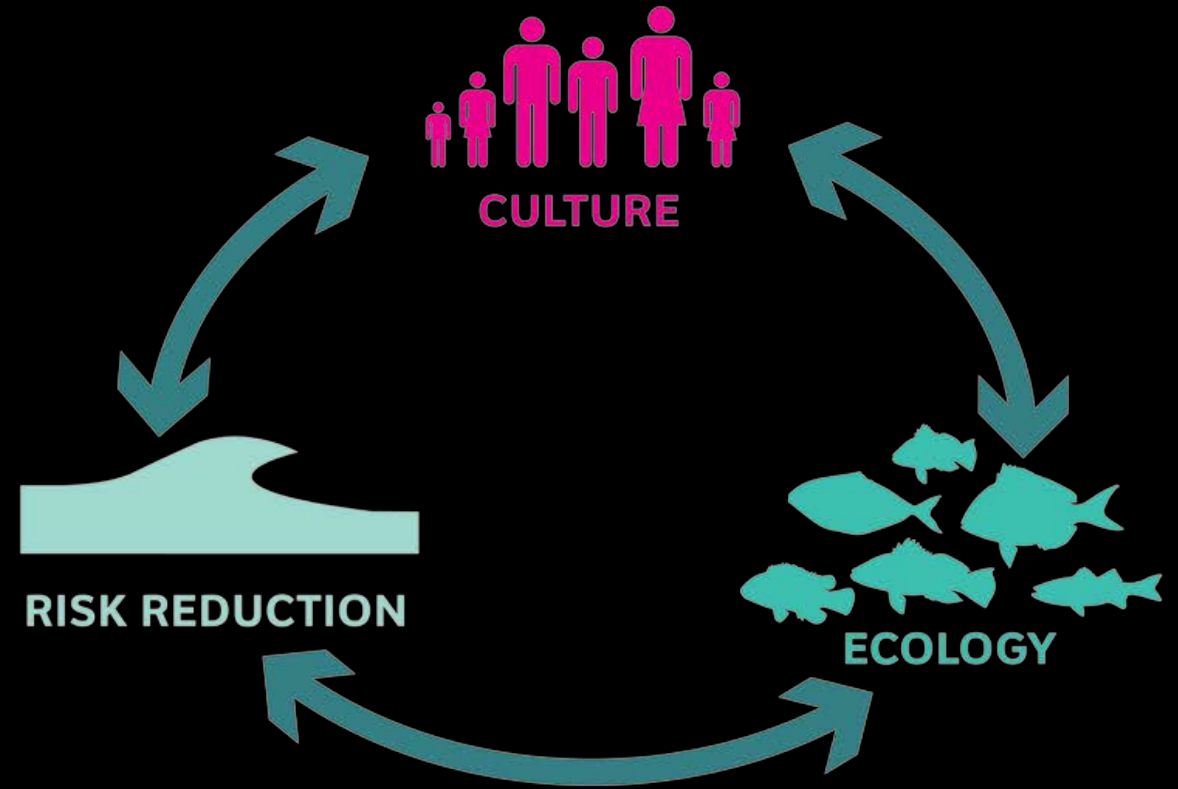


# LIVING BREAKWATERS ARE DESIGNED TO ...

**Reduce Coastal Risk**  
(erosion + storm waves)

**Enhance Ecosystems**  
(near-shore & shoreline habitats)

**Foster Social Resilience**  
(education, stewardship, public water access)



# LIVING BREAKWATERS

Designed to *reduce risk*

## STORM WAVE CONDITIONS

Statistical analysis of wave data from the past 30 years, show large waves (waves greater than 3 ft) coming predominantly from the east-south east.

## TYPICAL WAVE CONDITIONS

Everyday waves come from all directions within the project site. Collected ADCP data from the project area shows an increased percentage of large waves coming from the south-east and west.

## NORMAL TIDAL FLUSHING CONTINUES

With the breakwaters in place, water will be able to move through and around the structures, maintaining the tidal flushing within the project site.

## REDUCTION IN WAVE HEIGHTS BEHIND BREAKWATERS AND AT STRUCTURES

Resulting waves after breakwater attenuation range from 0 to 3 ft, significantly reducing the potential damage to structures on shore.

## SHORELINE ACCRETION OVER TIME

By decreasing everyday wave action, the breakwaters enable the shoreline to retain and accrete sand over time, reducing and in most places, reversing patterns of historic erosion.

## SHORELINE RESTORATION SAND PLACEMENT

## STORM WAVE ATTENUATION

Modeling shows the Living Breakwaters alignment attenuating waves from the 100 year storm with 30 inches of sea level rise—reducing the on shore waves to a height below 3 feet.

## POROUS MATERIALS DISSIPATE WAVE ENERGY

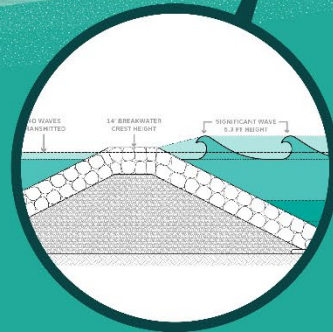
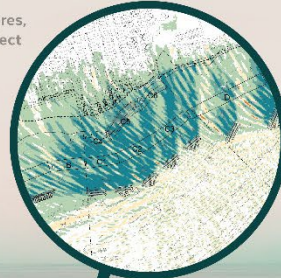
Spaces between armor units allow for the movement of water and absorption of energy by the breakwater structure.

## SUBSURFACE CONDITIONS

Geotechnical borings taken throughout the project site confirm the subsurface stability of the breakwaters.

## REDUCTION OF ON-SHORE RISK

With an increased beach width over time and reduction of wave energy reaching the shoreline, less damage will occur to buildings, dunes, and other on-shore structures.



**HOW DO WE PREVENT THIS  
FROM HAPPENING?**

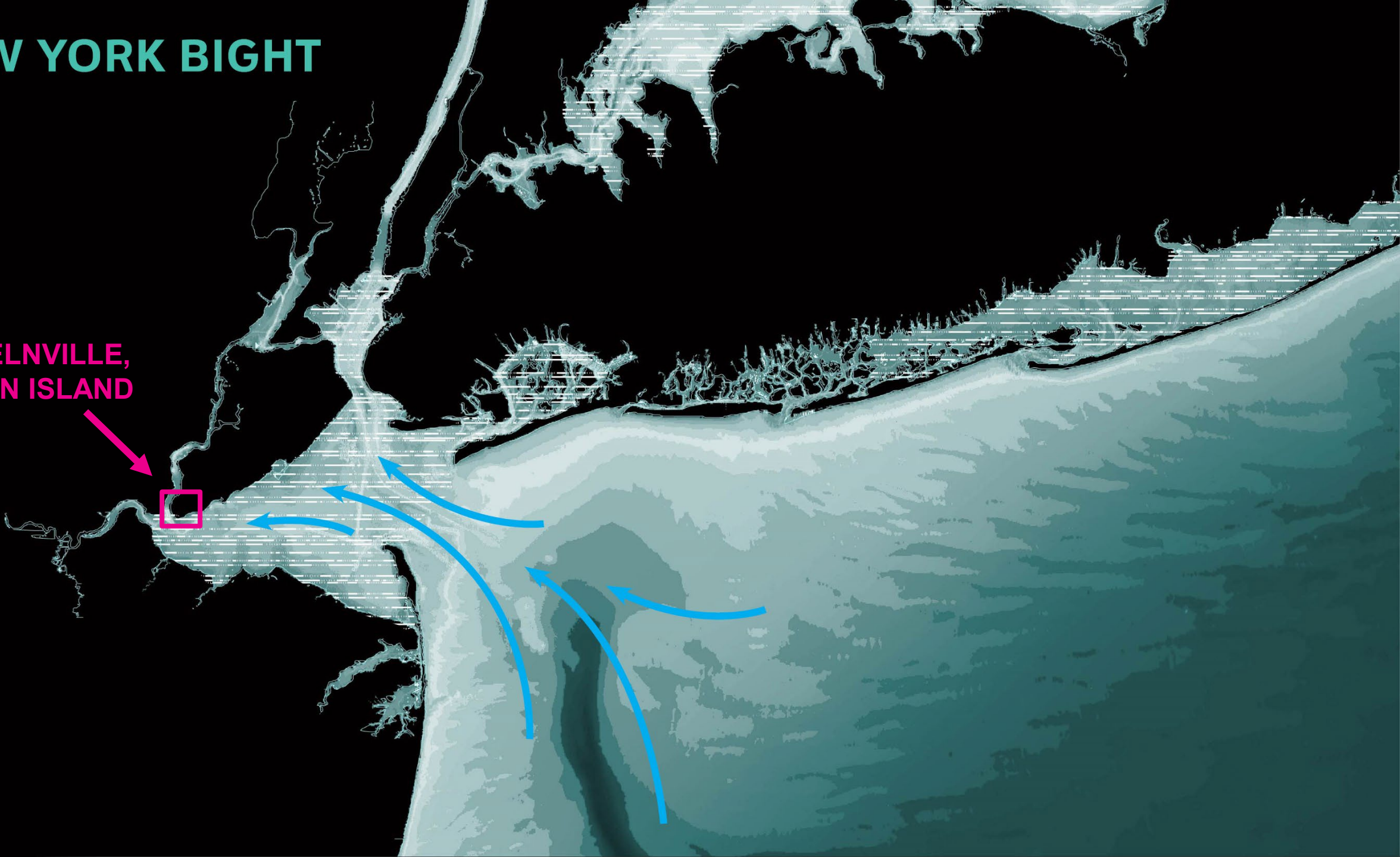


**HOW DO WE PREVENT THIS  
FROM HAPPENING?**

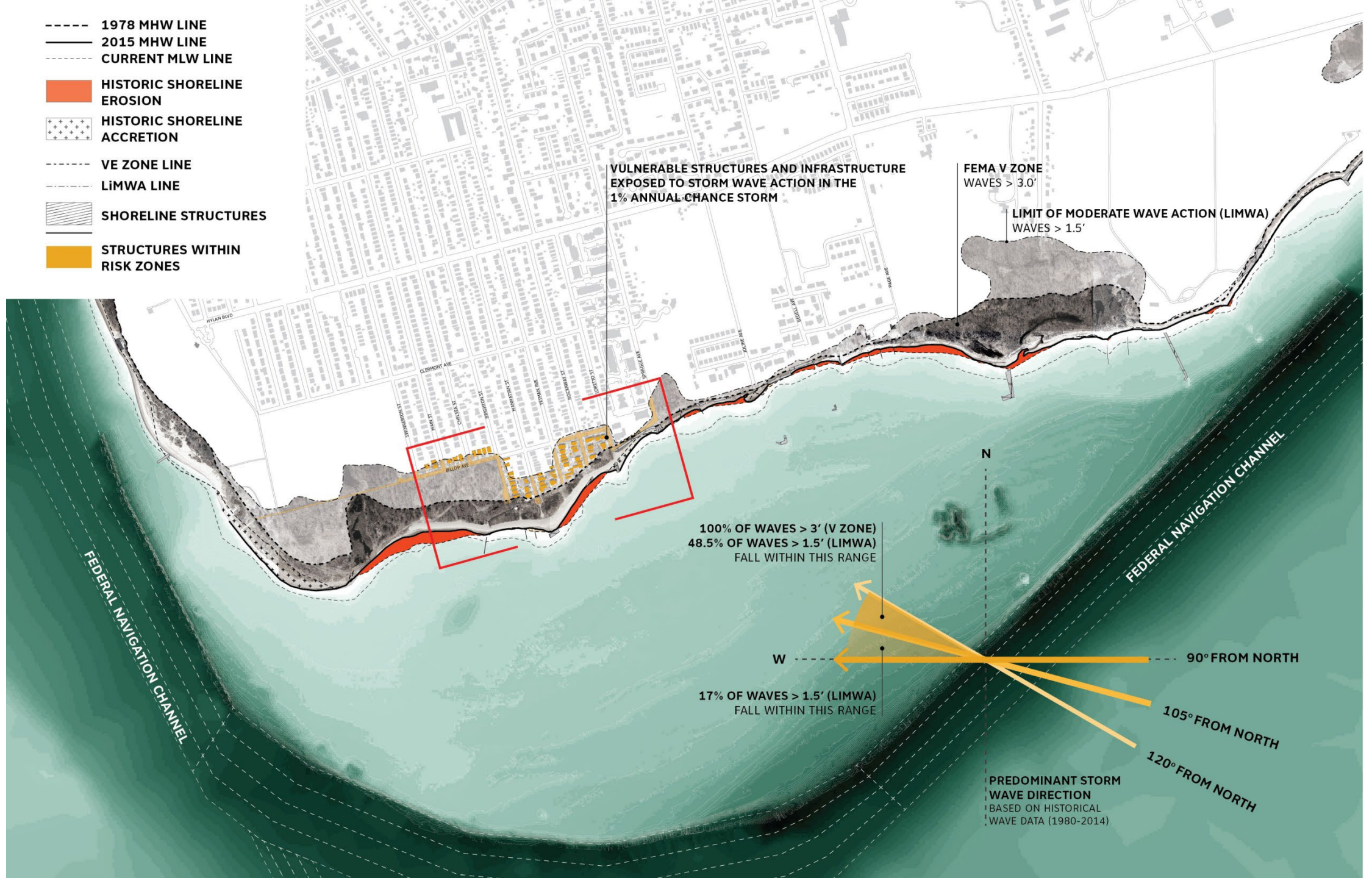


# NEW YORK BIGHT

TOTTELVILLE,  
STATEN ISLAND



- 1978 MHW LINE
- 2015 MHW LINE
- CURRENT MLW LINE
- HISTORIC SHORELINE EROSION
- HISTORIC SHORELINE ACCRETION
- VE ZONE LINE
- LIMWA LINE
- SHORELINE STRUCTURES
- STRUCTURES WITHIN RISK ZONES



**VULNERABLE STRUCTURES AND INFRASTRUCTURE EXPOSED TO STORM WAVE ACTION IN THE 1% ANNUAL CHANCE STORM**

**FEMA V ZONE WAVES > 3.0'**

**LIMIT OF MODERATE WAVE ACTION (LIMWA) WAVES > 1.5'**

HYLAN BOVD  
 CLERMONT AVE  
 SYDNEY ST  
 BAY ST  
 COLLEGE ST  
 BRIDGEMAN ST  
 WASHINGTON ST  
 LEONARD AVE  
 PEARSON ST  
 CANTON ST  
 SPANGLER AVE  
 BILLOW AVE

**100% OF WAVES > 3' (V ZONE)**  
**48.5% OF WAVES > 1.5' (LIMWA)**  
 FALL WITHIN THIS RANGE

**17% OF WAVES > 1.5' (LIMWA)**  
 FALL WITHIN THIS RANGE

**PREDOMINANT STORM WAVE DIRECTION**  
 BASED ON HISTORICAL WAVE DATA (1980-2014)

**FEDERAL NAVIGATION CHANNEL**

**FEDERAL NAVIGATION CHANNEL**

W

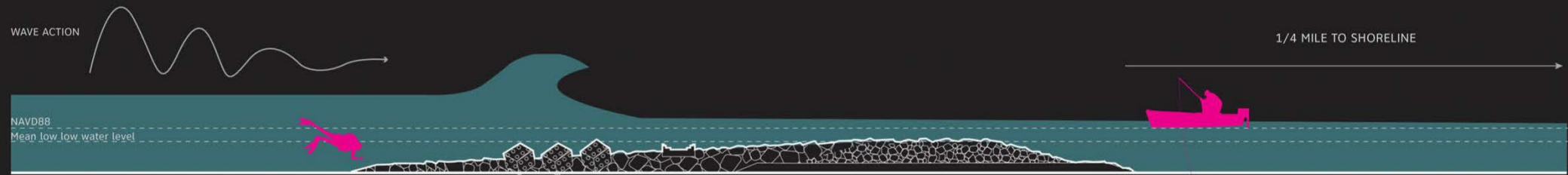
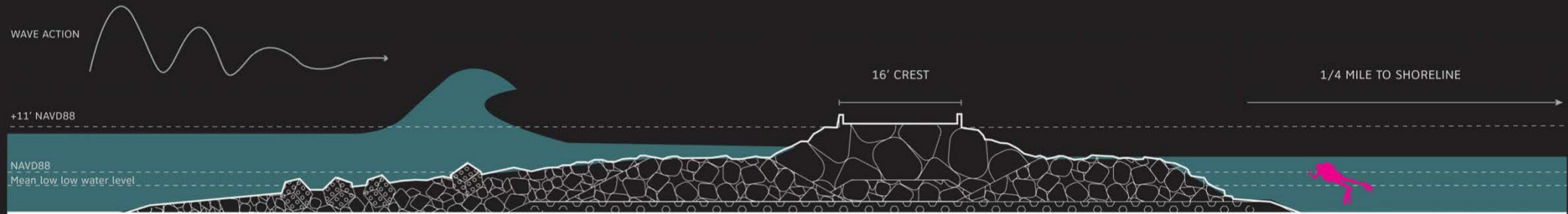
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90° FROM NORTH

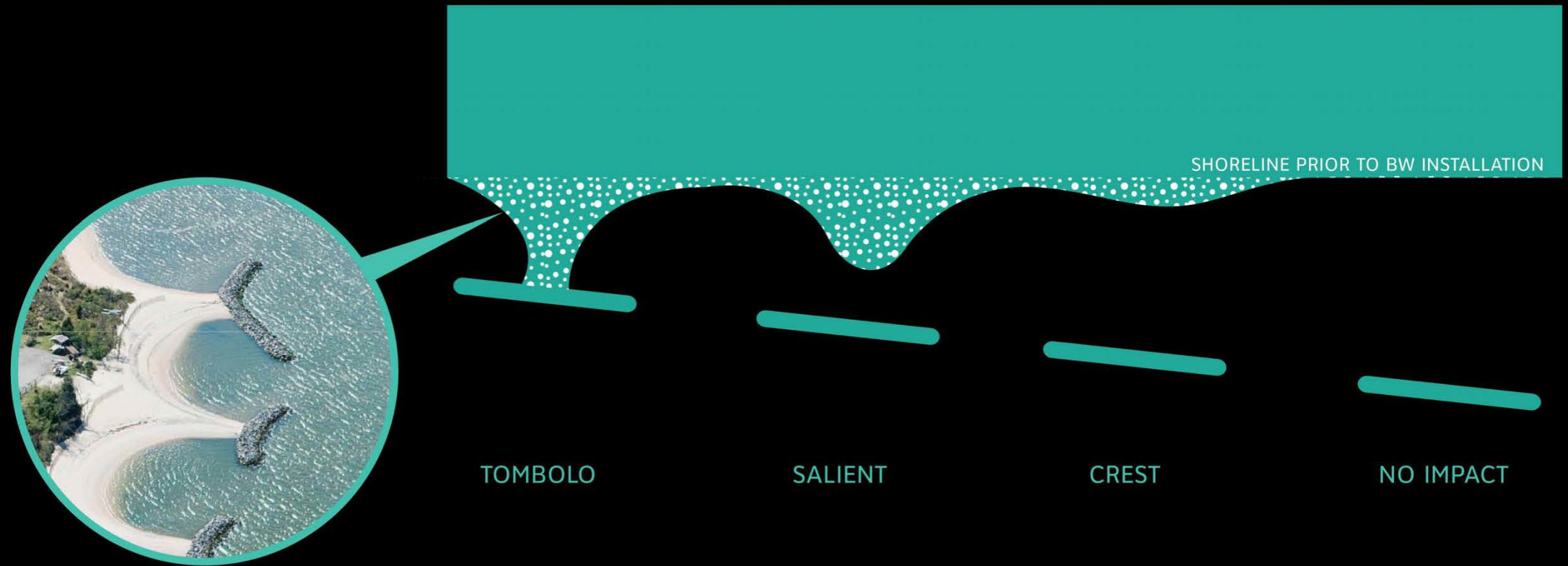
105° FROM NORTH

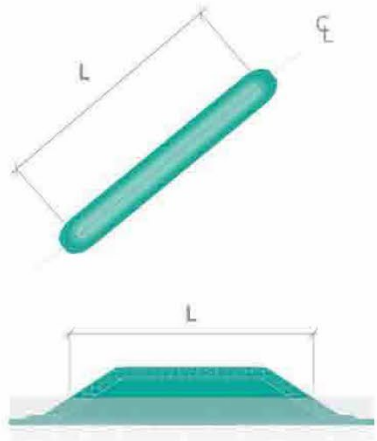
120° FROM NORTH

# BREAKWATERS REDUCE WAVE ACTION

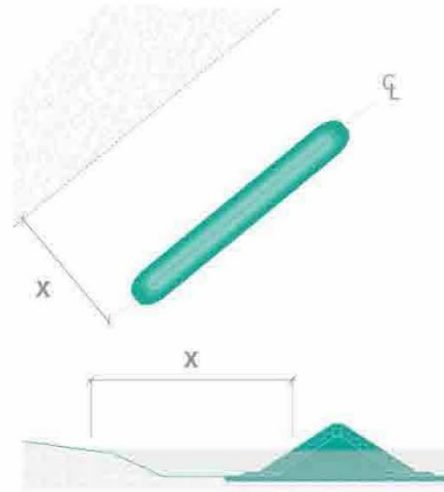


HABITAT CREATION  
**BREAKWATERS BUILD BEACHES**

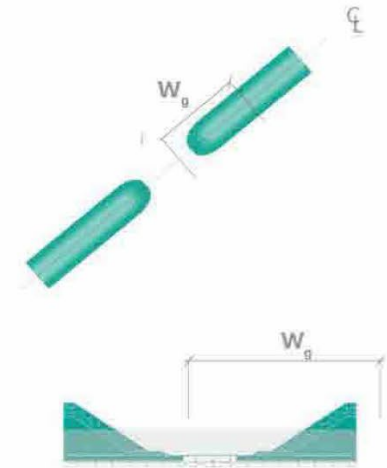




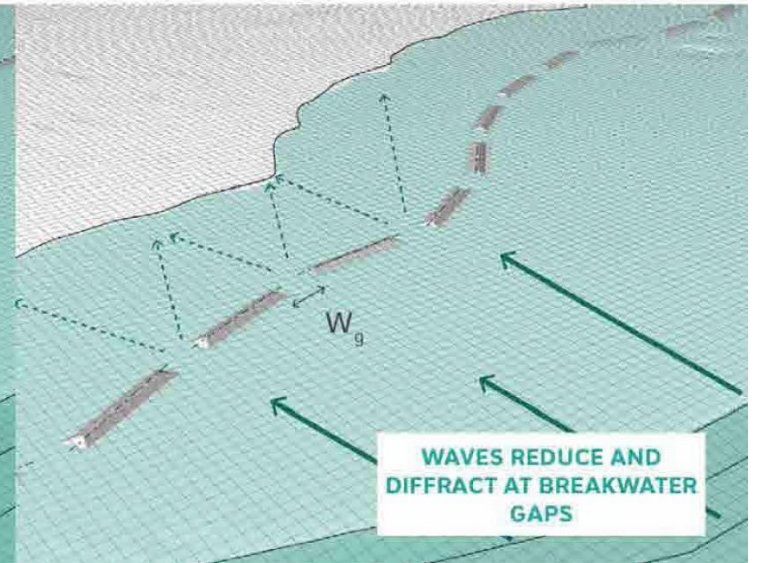
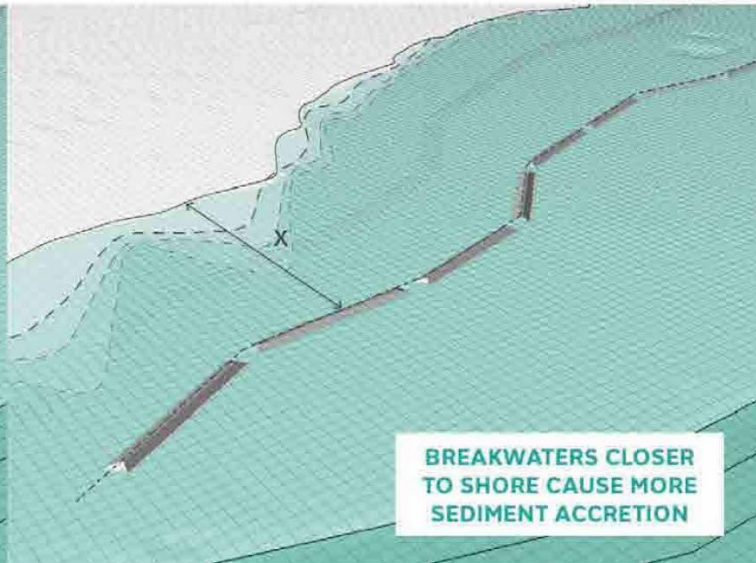
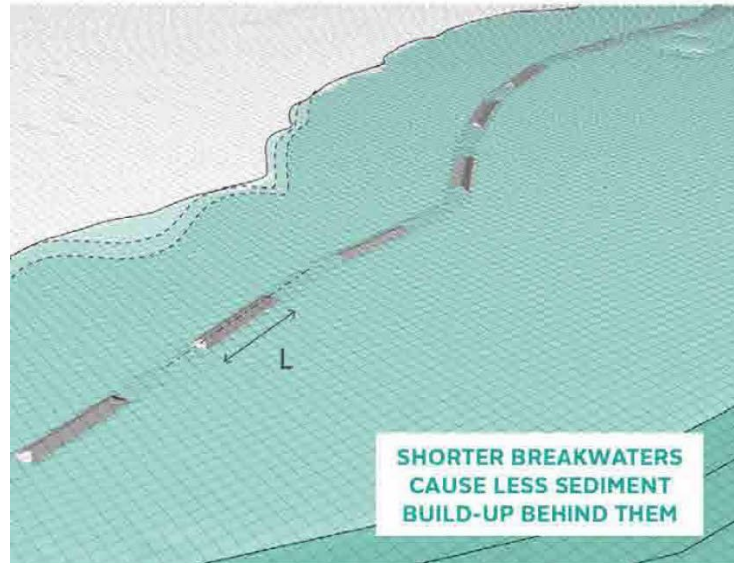
**LENGTH (L)**



**DISTANCE FROM SHORE (X)**



**GAP WIDTH ( $W_g$ )**



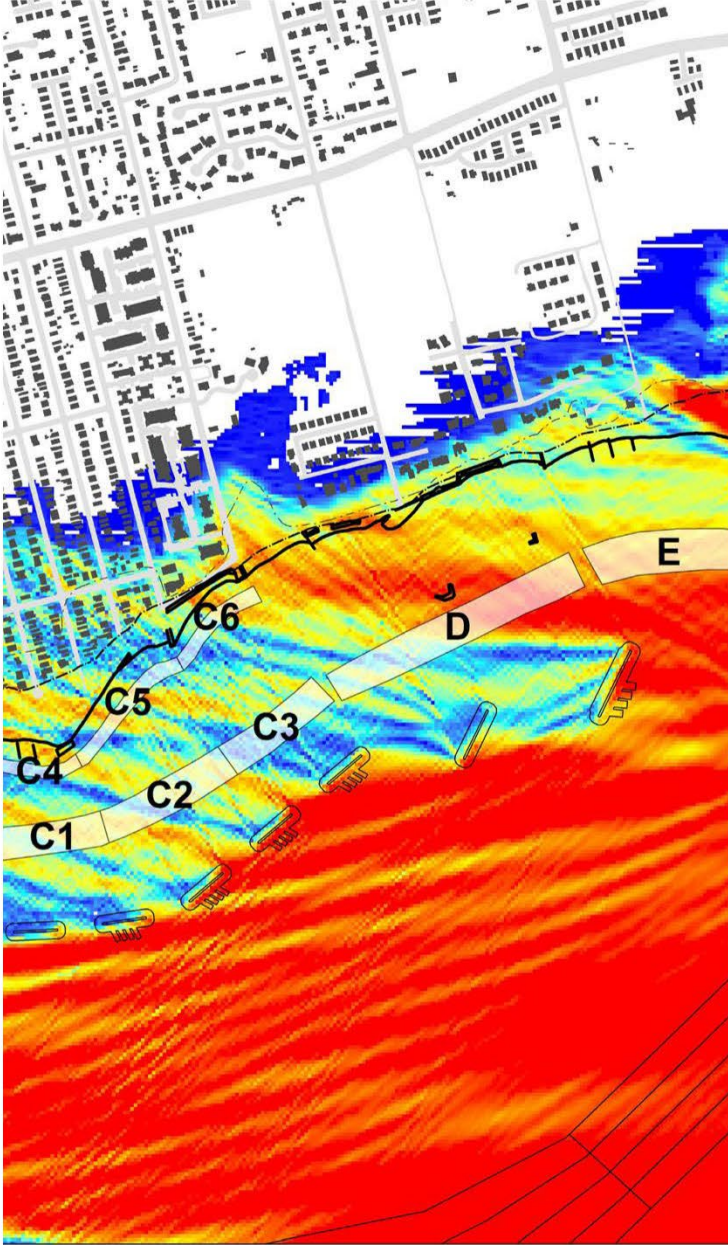


# WAVE MODELING

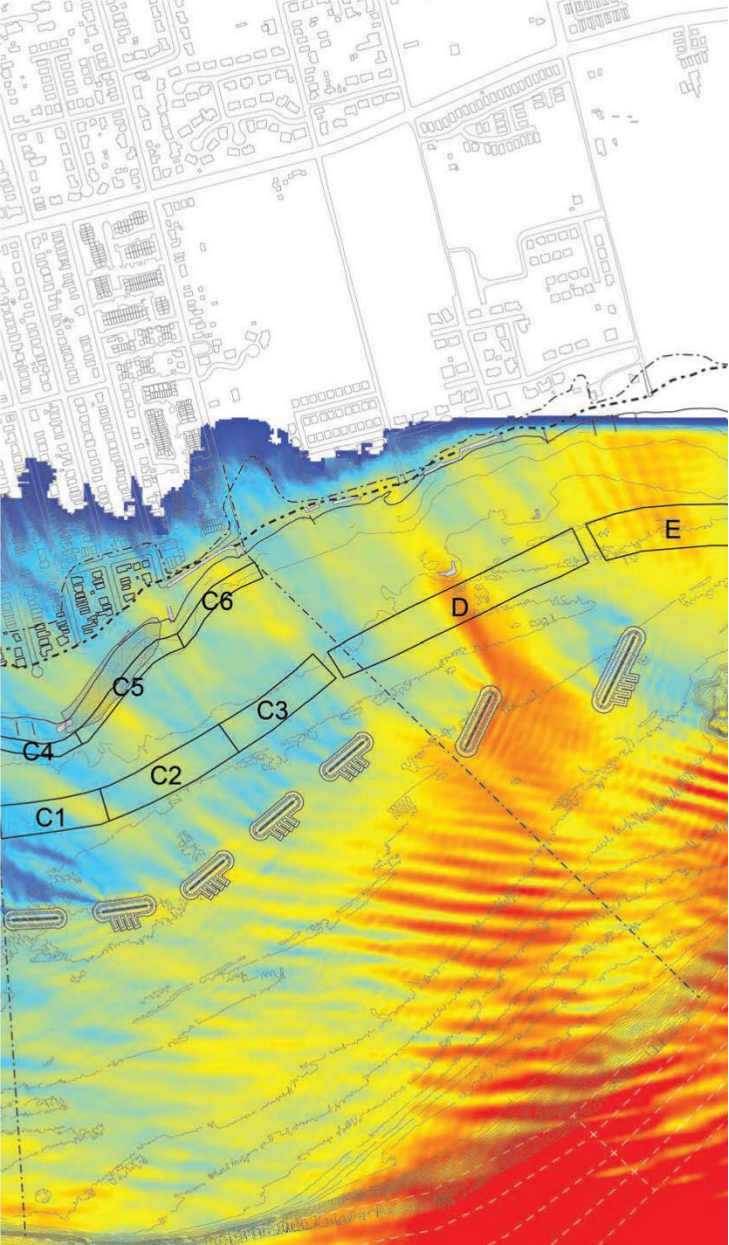
## GRAPHIC ANALYSIS



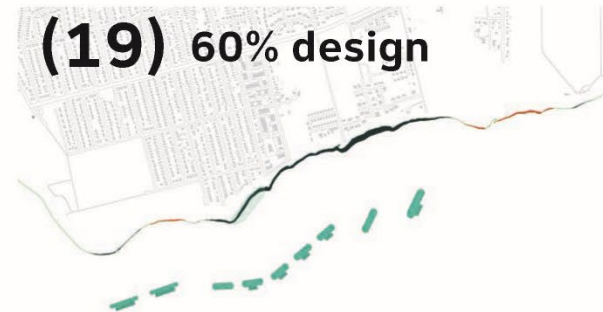
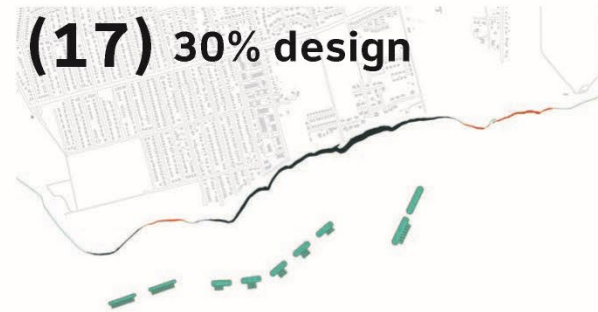
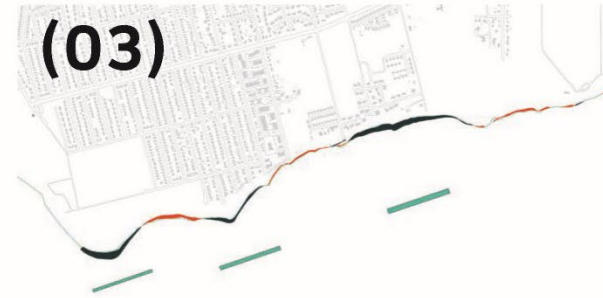
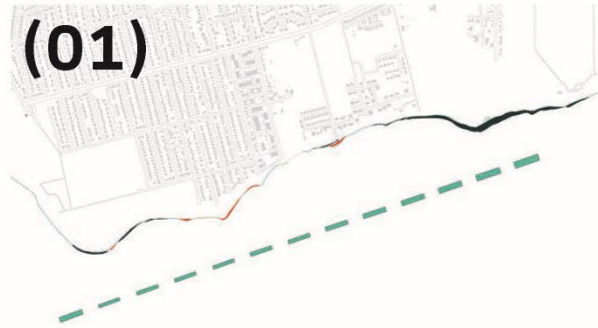
## REFDIF



## FUNWAVE



# SHORELINE CHANGE MODELING (GENESIS)



# PHYSICAL MODELING



# LIVING BREAKWATERS

Designed to *create habitat*

## ADJACENT SHELL HALO

Reef ridges were design at a maximum 1:10 slope and incorporate artificial tide pools that retain water between tides, introducing interstitial habitat communities.



## EMERGENT HABITAT AND LEE SIDE

Above MHW the breakwater side slopes and crest create opportunities for perching birds as well as haul out areas for harbor seals.



## WIDENED BEACHES

Reversal of shoreline erosion and accretion of sediment over time will create wider beaches. These beaches will act as an energy buffer and allow for the establishment of dune grasses

## SHALLOW SLOPING INTERTIDAL HABITAT

Reef ridges were design at a maximum 1:10 slope and incorporate artificial tide pools that retain water between tides, introducing interstitial habitat communities.

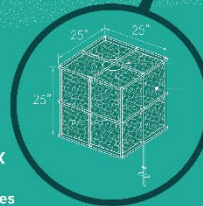
## STEEP SUBTIDAL HABITAT

Vertical and steeply inclined surfaces are placed within the subtidal zone and incorporate both bio- enhancing concrete armor units and stone armor units. The unit complexity, along with low sedimentation and light levels create prime opportunities for the colonization various aquatic organisms.



## REEF STREETS CREATE COMPLEX HABITAT

These rocky protrusions and the spaces between are formed by a range of stone sizes and bio- enhancing concrete units. Materials are strategically placed to facilitate complex structured habitat for fish and other aquatic species, particularly juveniles.



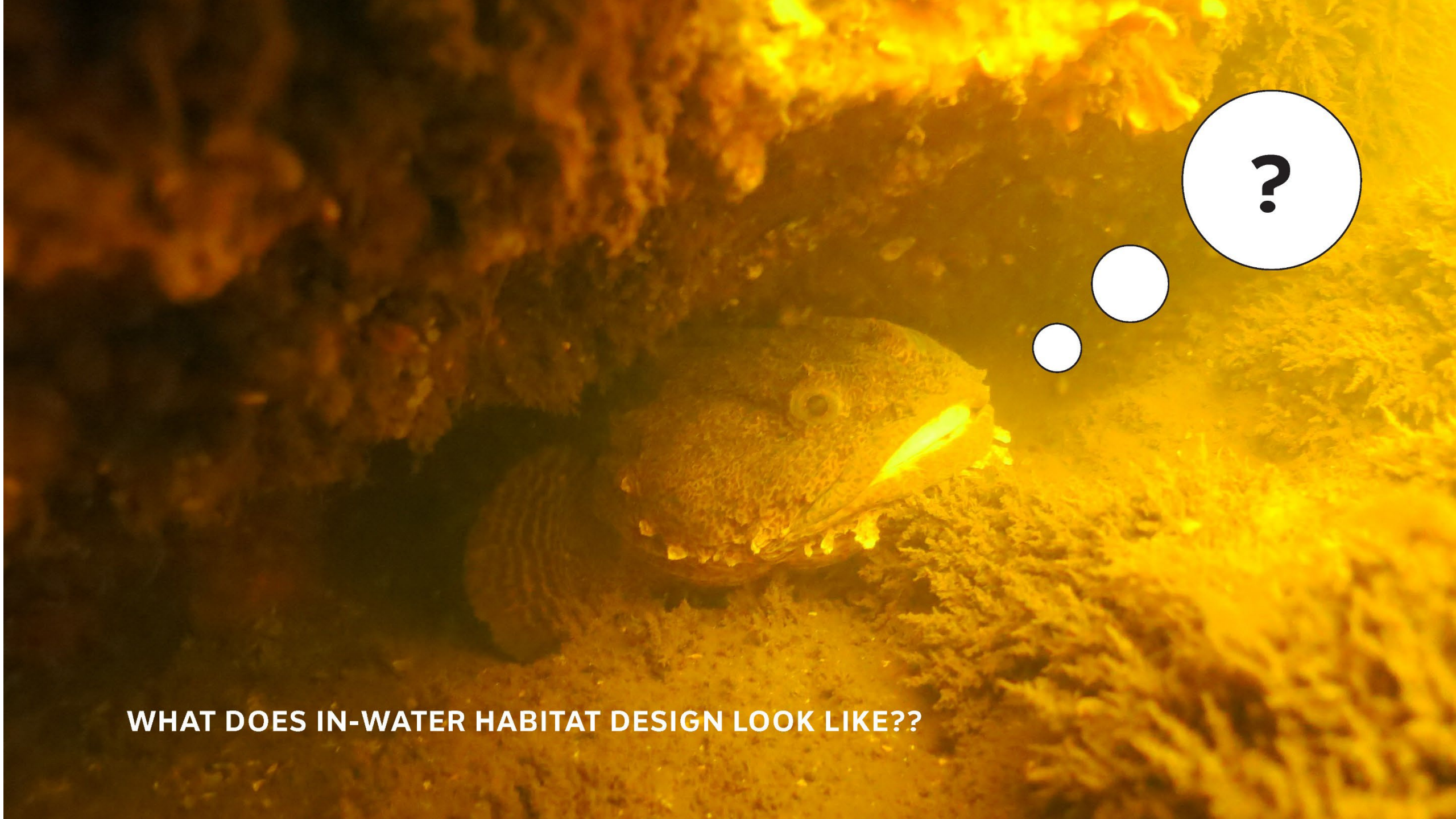
## OYSTER RESTORATION OPPORTUNITY

The Living Breakwaters create many opportunities for the restoration. Calmer waters on the lee side along with sustained water circulation within the reef streets are prime conditions for the setting and growth of oysters.

## HORSESHOE CRAB SPAWNING HABITAT

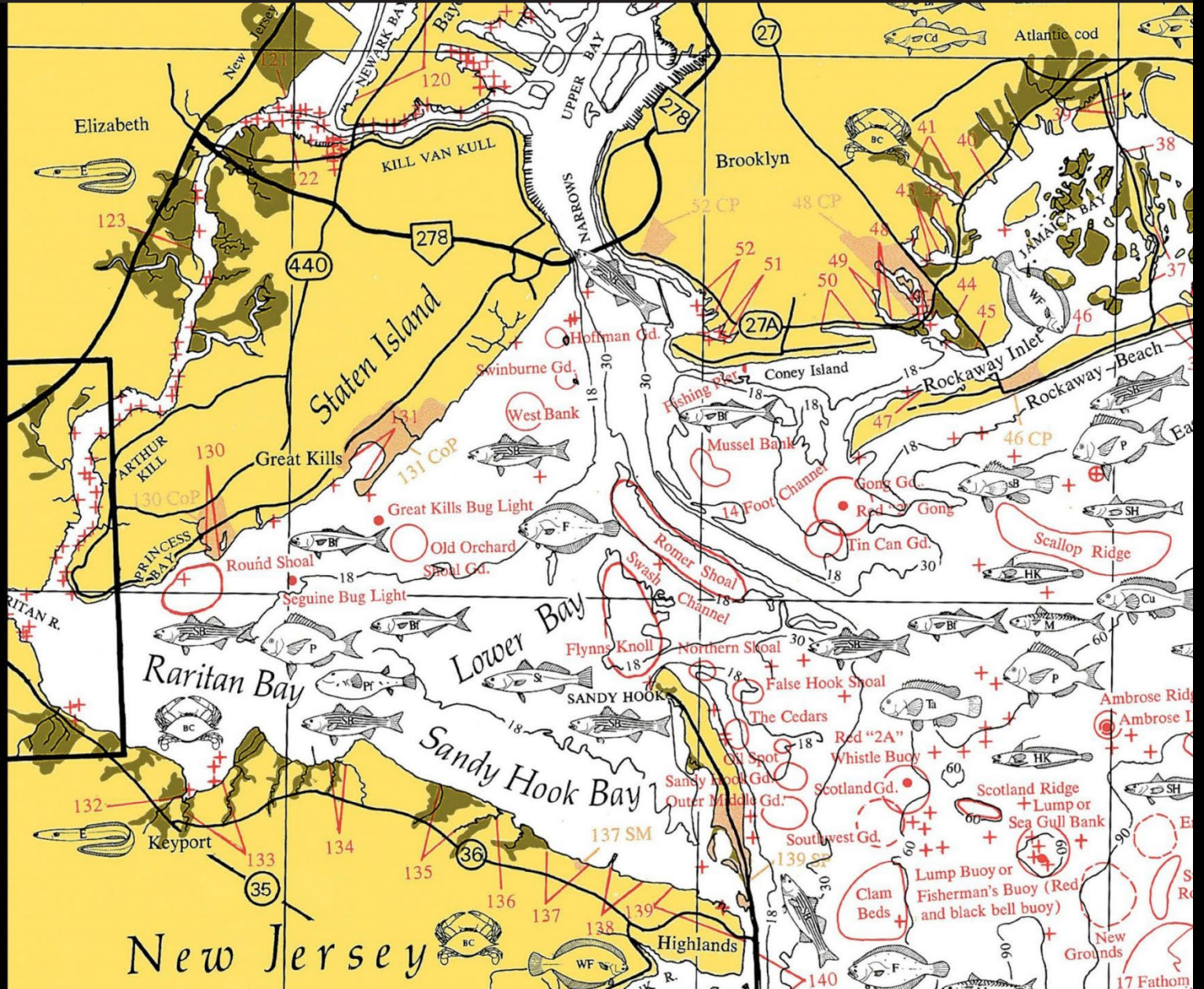
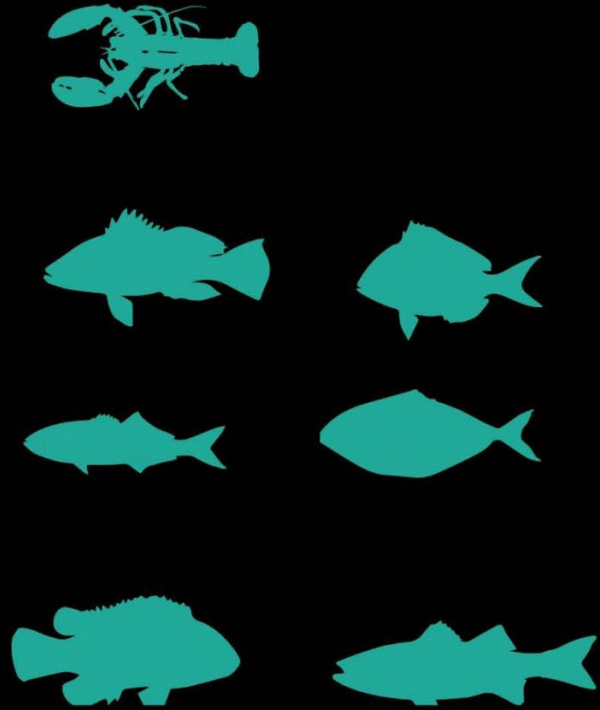
Additional sand placed for shoreline restoration or sand that accretes over time will provide additional habitat needed for horseshoe crab spawning.



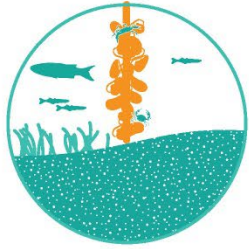


**WHAT DOES IN-WATER HABITAT DESIGN LOOK LIKE??**

PROVIDE  
STRUCTURE  
FOR JUVENILES



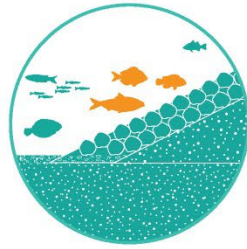
# TARGET SPECIES GROUPS & HABITATS



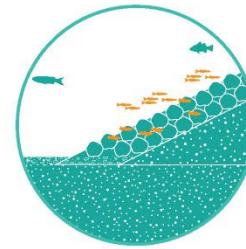
**HABITAT FORMING SPECIES**



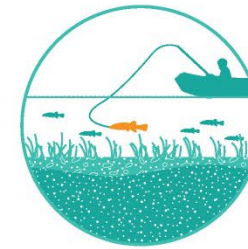
**MOTILE BENTHIC INVERTEBRATES**



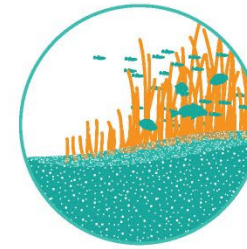
**STRUCTURE ORIENTED REEF FISH**



**FORAGE FISH**



**TRANSIENT RECREATIONAL AND COMMERCIAL FISHERY**



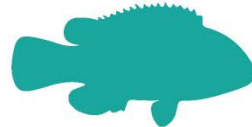
**VEGETATION**



**EASTERN OYSTER**  
*Crassostrea virginica*



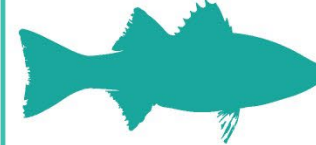
**BLUE CRAB**  
*Callinectes sapidus*



**TAUTOG**  
*Tautoga onitis*



**FEATHER BLENNY**  
*Hypsoblennius hentz*



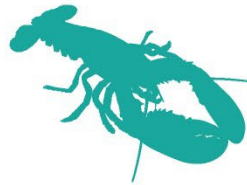
**ATLANTIC STRIPED BASS**  
*Morone saxatilis*



**EELGRASS**  
*Zostera marina*



**BLUE MUSSEL**  
*Mytilus edulis*



**AMERICAN LOBSTER**  
*Homarus americanus*



**BLACK SEA BASS**  
*Centropristis striata*



**ATLANTIC SILVERSIDES**  
*Menidia menidia*



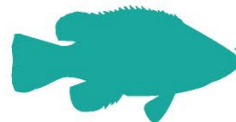
**BLUEFISH**  
*Pomatomus saltatrix*



**HARD CLAM**  
*Mercenaria mercenaria*



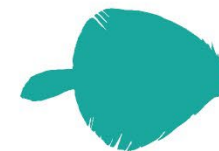
**HORSESHOE CRAB**  
*Limulus polyphemus*



**CUNNER**  
*Tautoglabrus adspersus*

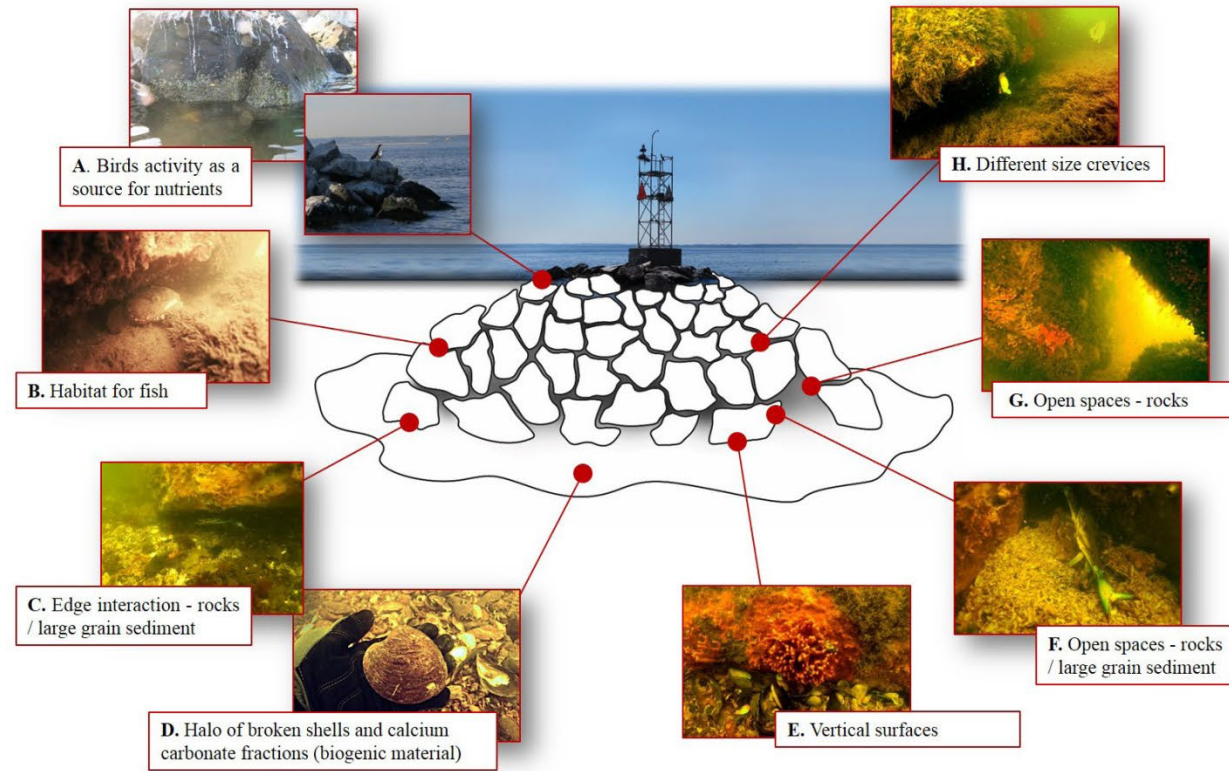


**NAKED GOBY**  
*Gobiosoma bosc*



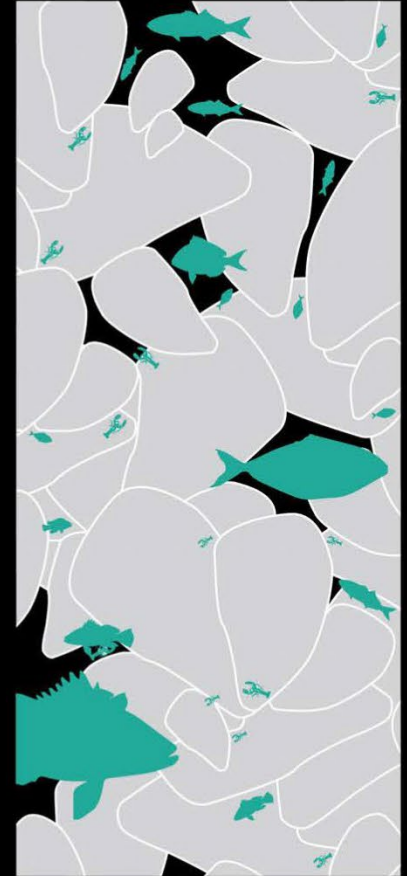
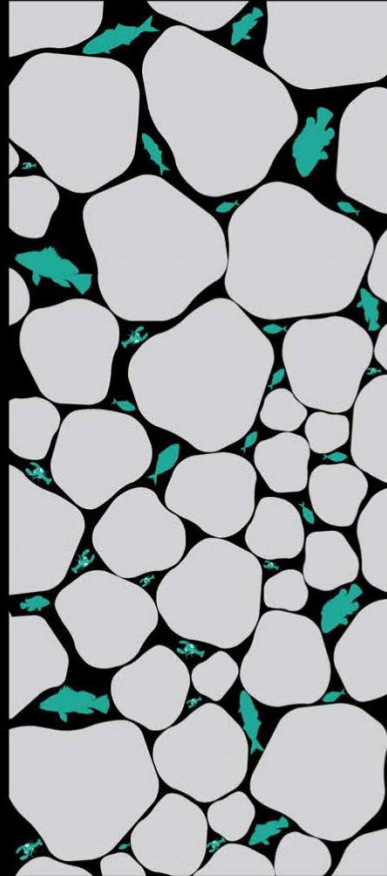
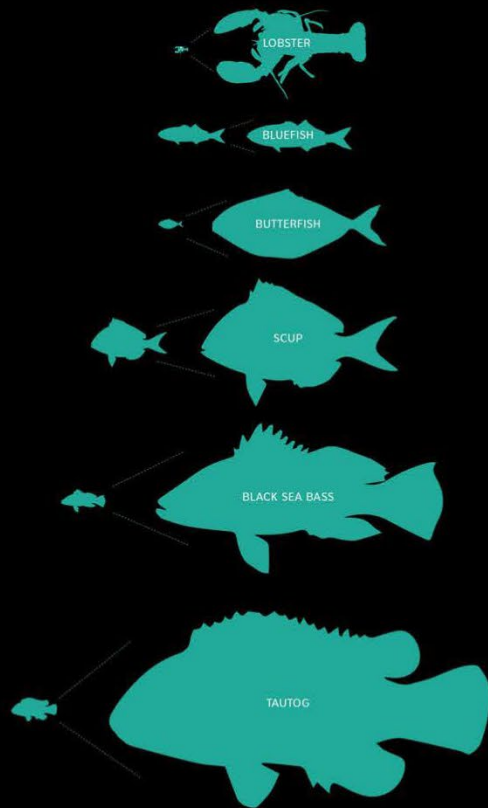
**WINDOWPANE**  
*Scophthalmus aquosus*

# ADJACENT ARTIFICIAL HABITAT SURVEY

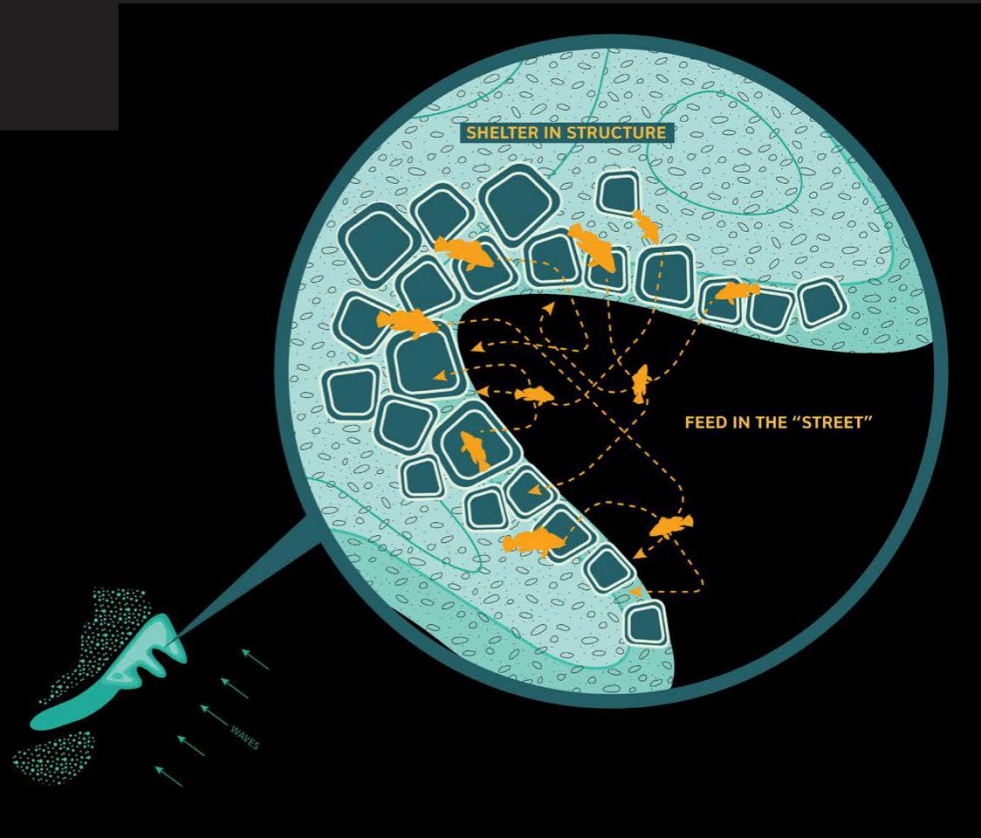




# CREATE NICHES AND COMPLEXITY



# REEF STREETS



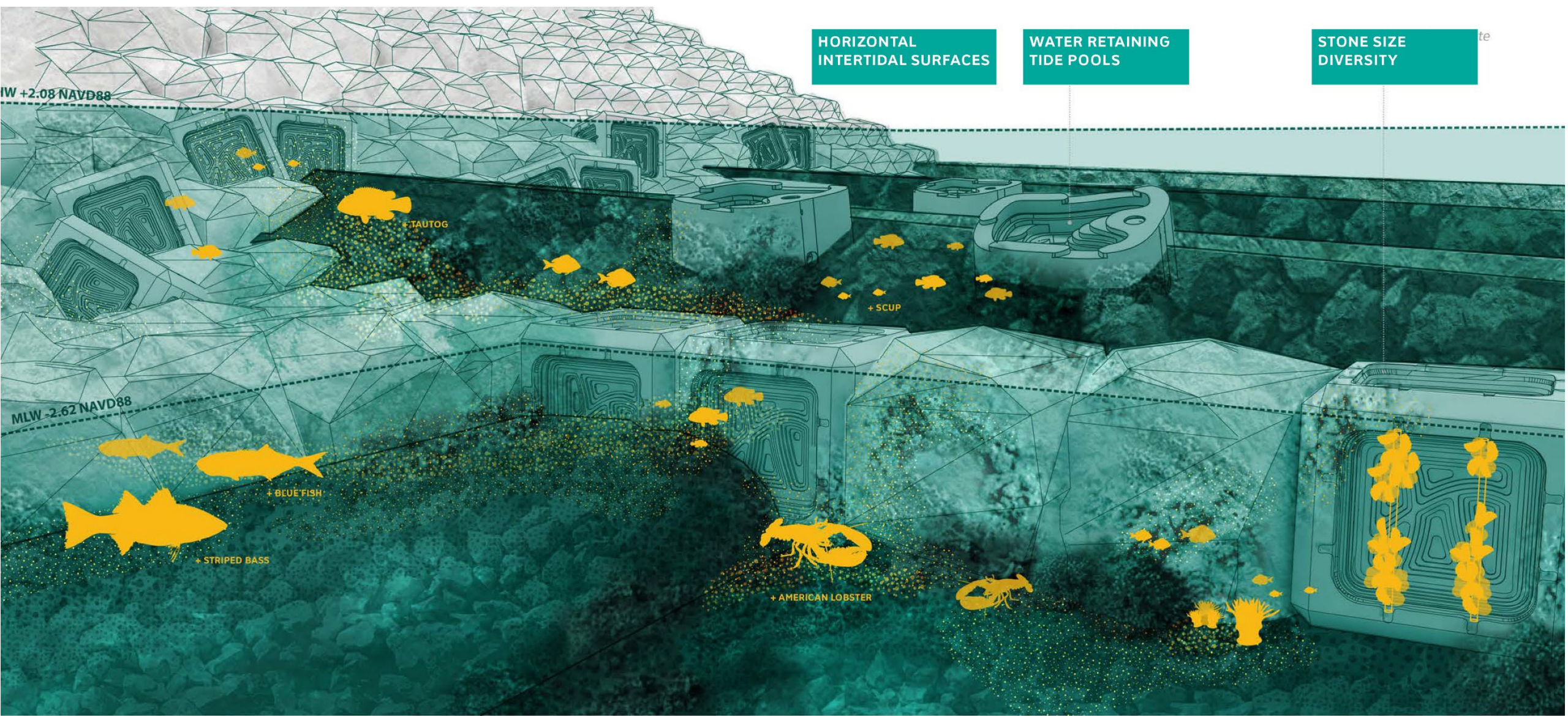
# BIO-ENHANCING CONCRETE ARMOR UNITS AND TIDEPOOLS (ECONCRETE)



BASE ARMOR UNIT



TIDEPOL UNIT



HORIZONTAL  
INTERTIDAL SURFACES

WATER RETAINING  
TIDE POOLS

STONE SIZE  
DIVERSITY

MLW +2.08 NAVD88

+TAUTOG

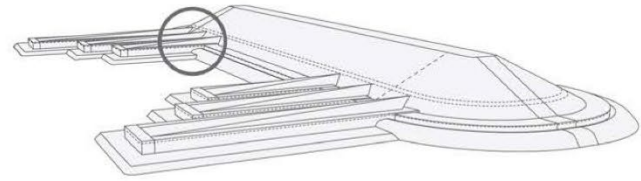
+ SCUP

MLW -2.62 NAVD88

+ BLUE FISH

+ STRIPED BASS

+ AMERICAN LOBSTER



STEEP SUBTIDAL  
SURFACES

POROSITY

SURFACE  
COMPLEXITY

# PILOTING OYSTER RESTORATION TECHNIQUES



# LIVING BREAKWATERS

*Designed to foster engagement, education, and stewardship*

## CONNECTING THE PAST AND THE FUTURE

Living Breakwater reef ridges and reef streets establish a new typology of habitat that is rooted in the history of oyster reefs within Raritan Bay.

## FLOATING WATER HUB

Billion Oyster Project along with the Harbor School will use the vessel as a classroom to learn about marine ecosystems and monitor ecological success of the breakwaters.

## HISTORIC NATIVE AMERICAN OYSTER SHELL MIDDENS

Stabilization of the shoreline will preserve archaeological artifacts of the Lenape Native Americans who settled in Tottenville.

## REVITALIZING THE TOTTEVILLE SHORE EXPERIENCE

Points along the shore of Conference house park will be developed to provide recreational and education opportunities for both visitors and residents.

## CONFERENCE HOUSE PARK VISITORS CENTER

## MONITORING AND ADAPTIVE MANAGEMENT

The Living Breakwaters will create opportunities for citizen scientists to engage with the breakwaters and monitor their ecological performance.

## RECREATIONAL FISHING HOTSPOTS

Rocky structures provide habitat and foraging opportunities for fish species. As a result, recreational fishermen can use these structures to find the best catch.

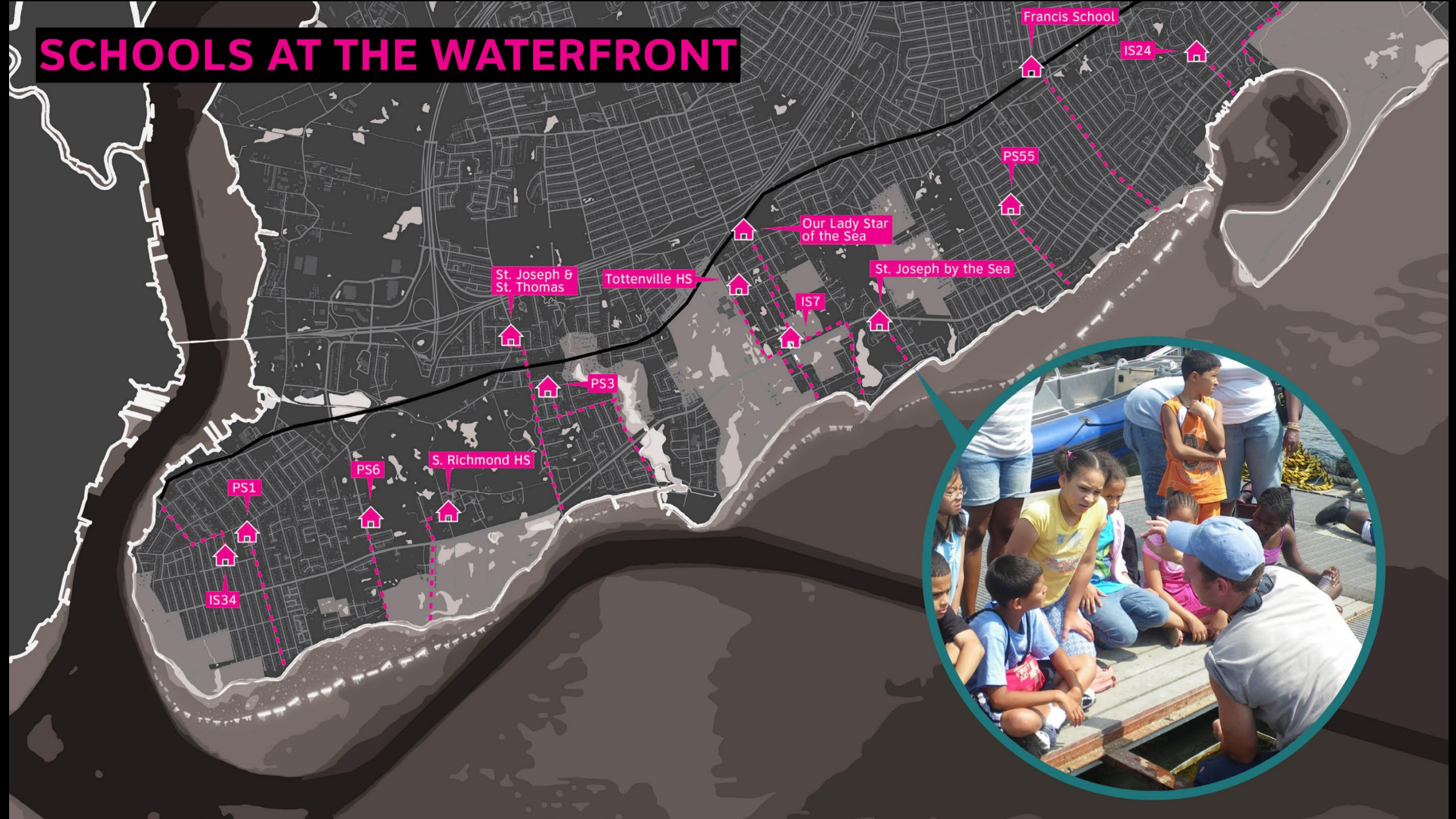
## CALM WATERS FOR KAYAKING

As breakwaters attenuate waves, areas on the lee side establish new water sports opportunities, including kayaking, windsurfing, and canoeing.





# SCHOOLS AT THE WATERFRONT



Francis School

IS24

PS55

Our Lady Star of the Sea

St. Joseph by the Sea

St. Joseph & St. Thomas

Tottenville HS

IS7

PS3

S. Richmond HS

PS6

PS1

IS34







### THE BOP OYSTER SHELL LIFE CYCLE

1. Fresh oysters go from farms to restaurants.
2. Once 90 BOP restaurant partners and event organizers start and share their washed oyster shells after serving.
3. The BOP Shell Collection Truck operated by Earth Matters picks up shells and transports them to a loading dock.
4. Once a month, shells are transported to a sorting site at the NYC Arthur Kill (Queensboro) Station, where they are prepared for reuse.
5. After a year, shells are moved to Governor Island where they are sorted with larvae produced at the Harbor Island Hatchery.
6. Shells are "seeded" and are transported to BOP partner restaurants where they can grow into adult oysters.
7. Adult oysters and pearl shell will be transferred to the Living Resources Project where they will eventually help with increasing populations.

To date, over 520+ cubic yards of shell has been collected.

Government's Office of Marine Economy

Billion Oyster Project Shell Collection Program

BILLION OYSTER PROJECT

BILLION OYSTER PROJECT

# OYSTER GARDENING MANUAL



ROSS

"On Spaceship Earth, there are no passengers, only crew."  
-Wallof-Wishes, Blogger

Voyager

Spaceship Earth Directives  
Respectful of people, property, and ideas.  
Follow the rules the first time.  
Be prepared.

Essential Questions

- How does the Earth's environment influence human life?
- What are the impacts that human beings have on the Earth's Environment?
- How can design impact the environment?
- How do various perspectives influence design engineering decisions?



MRS FARM



5/15/16 Mission 7 Water Quality Design Challenge  
Challenge # 6: I can design the Lowes Explorade at Gowanus Canal

Economic  
Risk  
Culture

99 probe  
GARBAGE  
LOW PUBLIC ACCESS  
FLOODING  
NO PLANTS  
AIR QUALITY  
POLLUTION  
WATER QUALITY

DAUGER TO  
LOW BIODI  
BORING



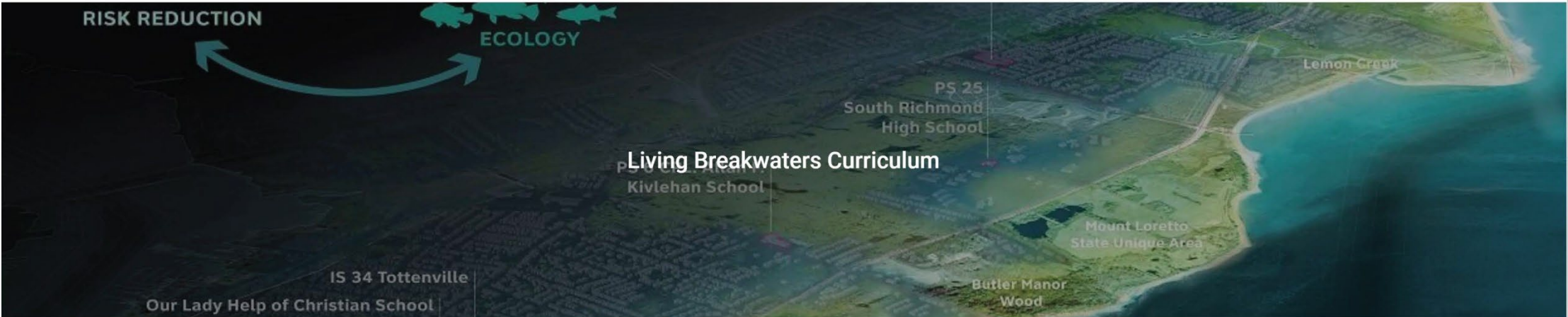


# BUILD LASTING SOCIAL INFRASTRUCTURE AS WELL AS PHYSICAL INFRASTRUCTURE

The Billion Oyster Party is SOLD OUT!



OUR WORK GET INVOLVED ABOUT US MEMBERSHIP & GIVING DONATE



## Living Breakwaters Curriculum

The Living Breakwaters is a series of physical breakwaters that will be built in Raritan Bay, off the south shore of Staten Island. It is designed to break waves and enhance habitat. In this curriculum, students investigate the ecosystems supported by the different habitats in Raritan Bay, with and without the Living Breakwaters.



Governor's Office of Storm Recovery

This curriculum is funded by the U.S. Department of Housing and Urban Development and implemented by the Governor's Office of Storm Recovery.

\*Header image provided by SCAPE

## CHAPTERS



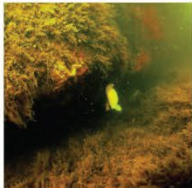
Living Breakwaters: Introduction

[VIEW CHAPTER](#)



Living Breakwaters: Life Cycles

[VIEW CHAPTER](#)



Living Breakwaters: Habitats

[VIEW CHAPTER](#)



Living Breakwaters: Energy Webs

[VIEW CHAPTER](#)

**Chapter One** introduces the Living Breakwaters and asks what we can learn about coastal resilience from the demise of Raritan Bay's once-thriving oyster industry.

The Living Breakwaters are designed to provide habitat for organisms at many stages of their development. **Chapter Two** spotlights the life cycles of several organisms that spend part or all of their lives in places like Raritan Bay.

**Chapter Three** zooms in on organisms' micro-habitats, from their position in the water column to the sizes of the crevices in the Living Breakwaters.

In **Chapter Four**, students consider who eats what in these habitats, and use that information to predict which organisms they think they can find when they visit the breakwaters (or other parts of NY Harbor's coastline).



**Governor's Office of Storm Recovery**



**LIVING BREAKWATERS**

**OYSTER RESTORATION**

**ENVIRONMENTAL REVIEW**

# SCAPE

**COWI, COASTAL ENGINEERING**

**ARCADIS, HYDRODYNAMIC MODELING**

**SEARC, MARINE ECOLOGY**

**WSP, GEOTECHNICAL ENGINEERING**

**MFS ENGINEERS, SURVEYING & COST ESTIMATING**

**PRUDENT ENGINEERING, IN-WATER SURVEYING**

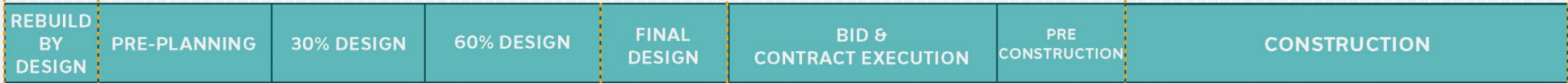
**NY/NJ BAYKEEPER, DATA COLLECTION**

**LOTEK, ARCHITECTURE**

**SILMAN, STRUCTURAL ENGINEERING**



**UPDATE WITH SLIDE THAT INCLUDES THE CONSTRUCTION TEAM TOO**



**WE ARE HERE!**

REBUILD BY DESIGN (RBD) COMPETITION 11/2013

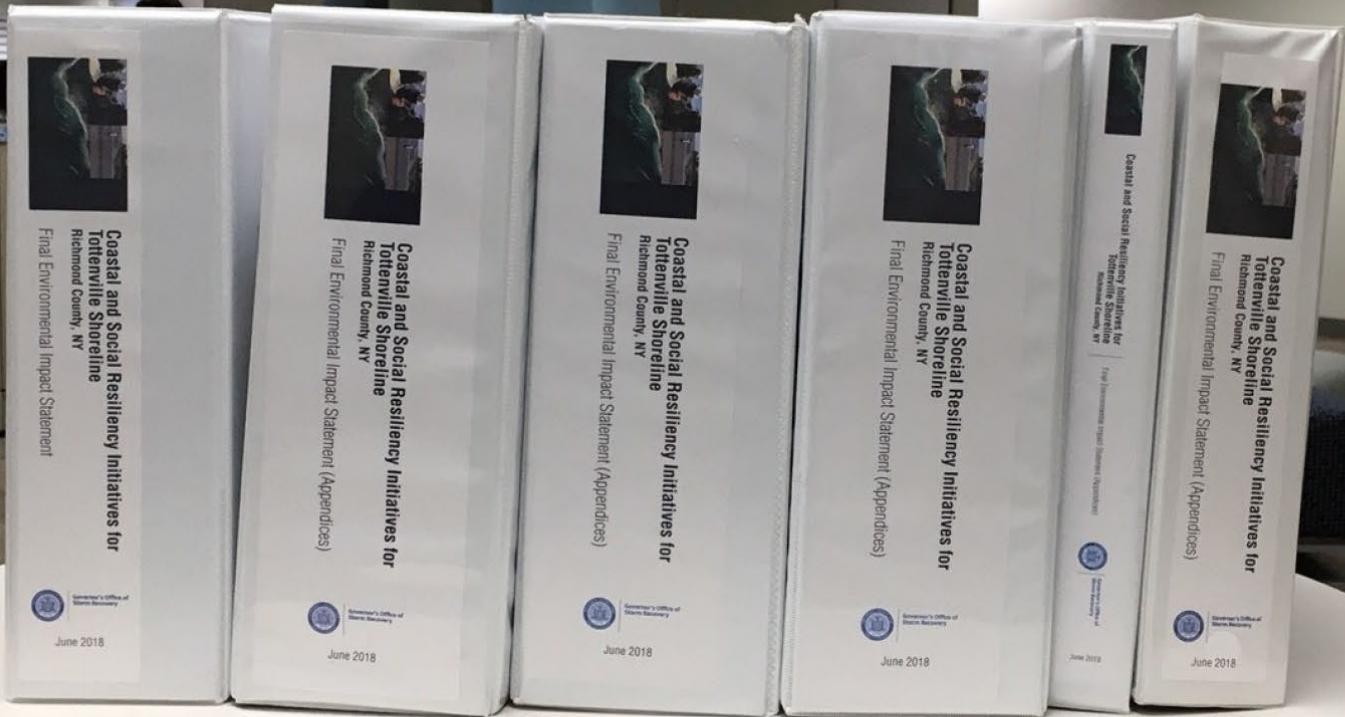
RBD WINNERS ANNOUNCED 06/2014  
NYS AWARDED \$60M FOR IMPLEMENTATION

START CONSTRUCTION 09/2021

END CONSTRUCTION 12/2024

**PROJECT TIMELINE**





**Coastal and Social Resiliency Initiatives for  
Tottenville Shoreline  
Richmond County, NY**  
Final Environmental Impact Statement

June 2018

**Coastal and Social Resiliency Initiatives for  
Tottenville Shoreline  
Richmond County, NY**  
Final Environmental Impact Statement (Appendices)

June 2018

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Coastal and Social Resiliency Initiatives for  
Tottenville Shoreline  
Richmond County, NY

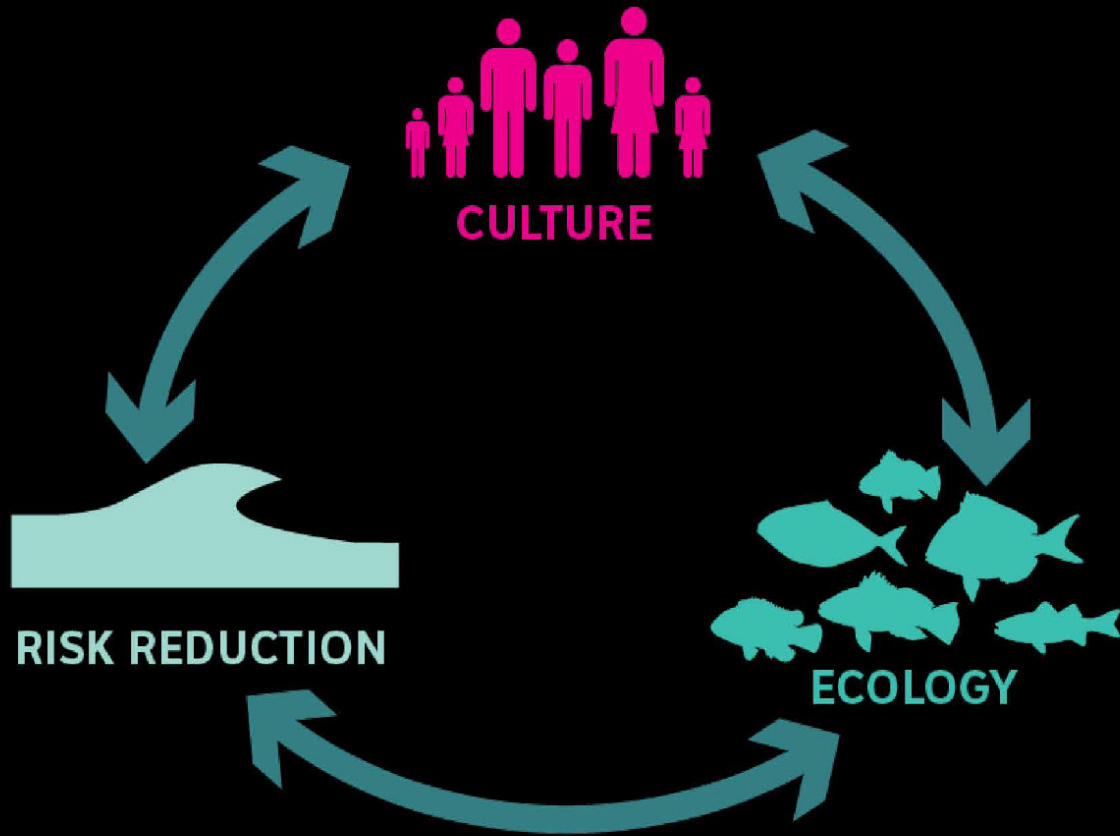
Final Environmental Impact Statement (Appendices)

June 2018

**Coastal and Social Resiliency Initiatives for  
Tottenville Shoreline  
Richmond County, NY**  
Final Environmental Impact Statement (Appendices)

June 2018

# DESIGN OBJECTIVES = PURPOSE & NEED



## PURPOSE AND NEED

The project design objectives are directly related to the project purpose and need as documented in the Final EIS scoping document. It should be noted that a single EIS is being prepared for the combined Living Breakwaters and Tottenville Shoreline Protection projects. The purpose and need is laid out in the Coastal and Social Resiliency Initiatives for Tottenville Shoreline, Staten Island, NY - Environmental Impact Statement Final Scope of Work, released on April 1, 2016, and states:

Specifically, the goals and objectives related to the Proposed Actions' purpose and need are listed below:

### ***Risk Reduction***

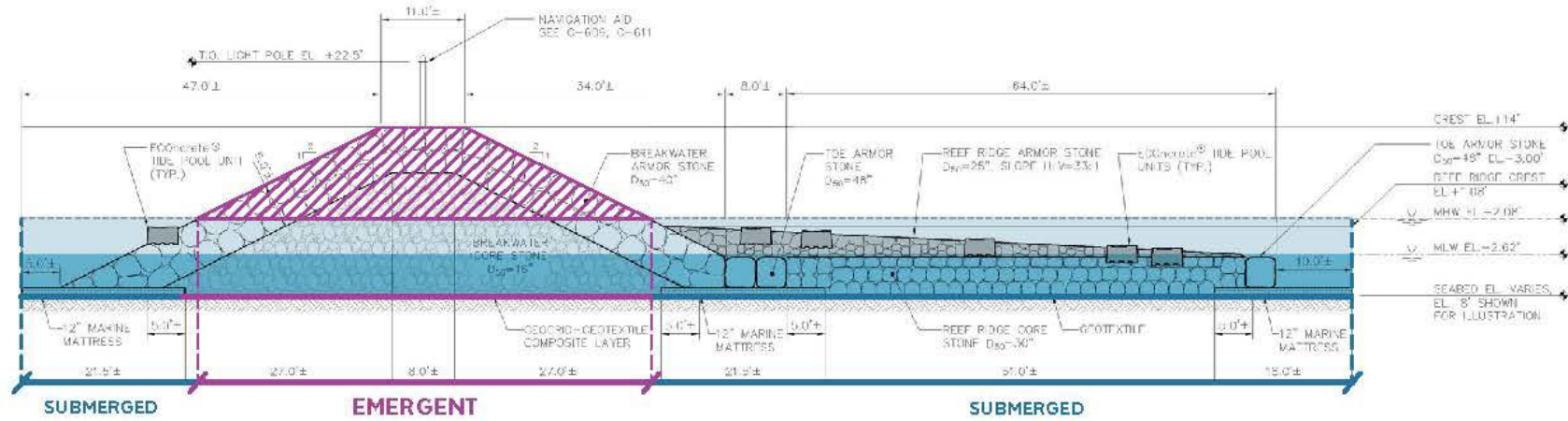
- Attenuate wave energy;
- Address both event-based and long-term shoreline erosion / preserve beach width; and
- Address the impacts of coastal flooding [note: refers to TSPP only].

### ***Ecological Enhancement***

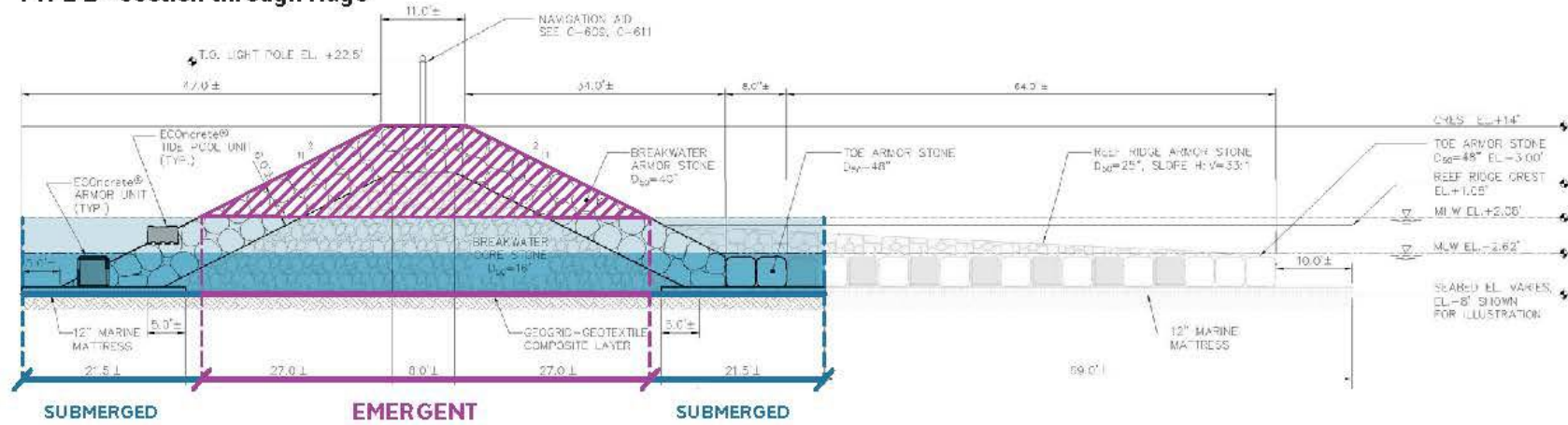
- Increase diversity of aquatic habitats consistent with the Hudson-Raritan Estuary plan priorities (e.g., oyster reefs and fish and shellfish habitat).

### ***Social Resiliency***

- Foster community education on coastal resiliency directly tied to and building off the structural components of this resiliency initiative;
- Increase physical and visual access to the water's edge;
- Enhance community stewardship of on-shore and in-water ecosystems; and
- Increase access to recreational opportunities.



**TYPE B - section through ridge**



**TYPE B - section through street**

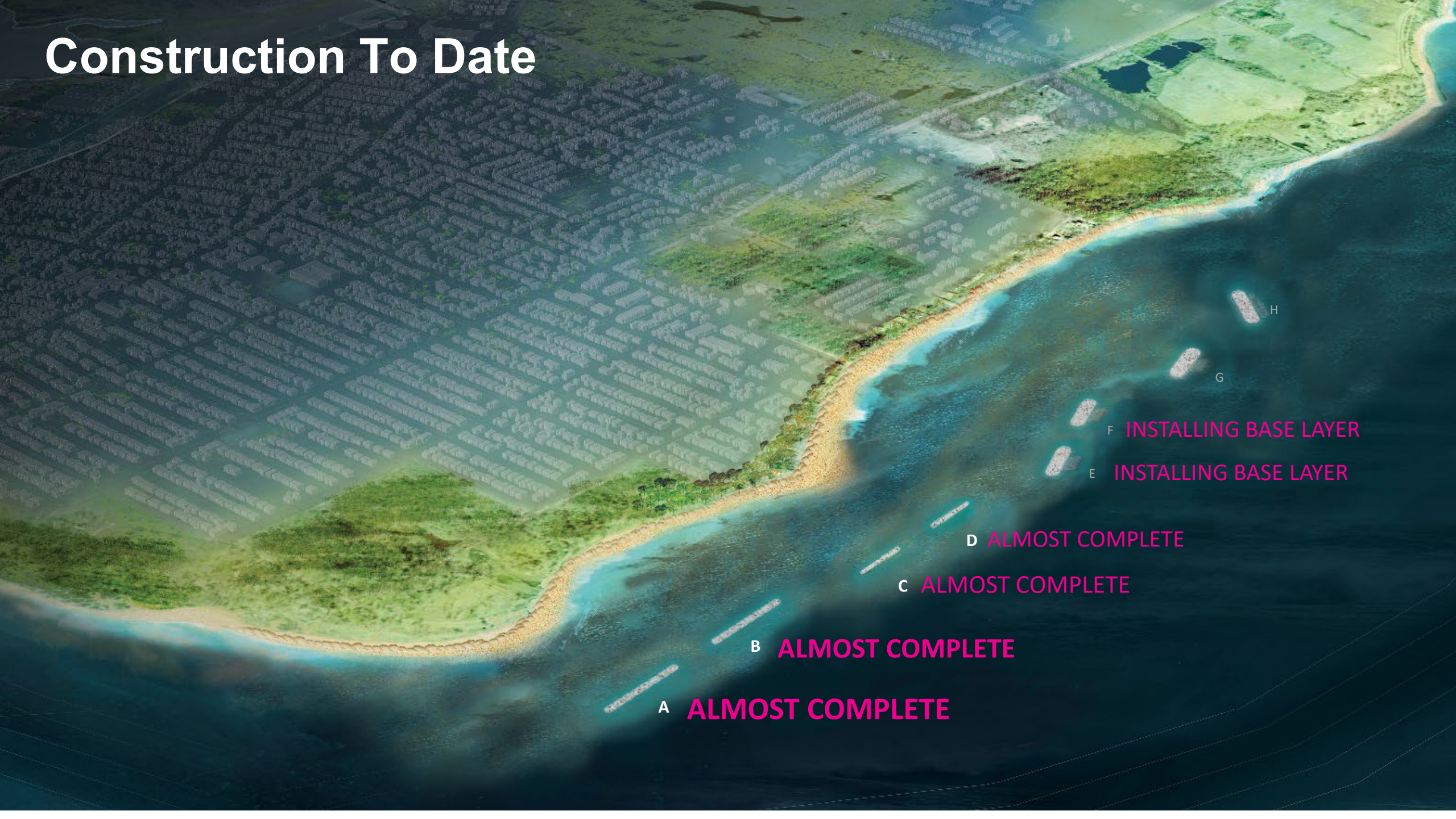
- 1 **Design/Permitting/Planning:**  
\$21 million
- 2 **Construction:**  
\$78.7 million
- 3 **Social Resiliency:**  
\$5.2 million
- 4 **Program Administration:**  
\$2.1 million



**Total Cost:**  
**\$107 million**

\$60 million – HUD CDBG-DR  
\$47 million – New York State

# Construction To Date



A **ALMOST COMPLETE**

B **ALMOST COMPLETE**

C **ALMOST COMPLETE**

D **ALMOST COMPLETE**

E **INSTALLING BASE LAYER**

F **INSTALLING BASE LAYER**

G

H

# Work is taking place across 6 locations



**CARVER STONE QUARRY**  
Johnstown, NY



**PORT OF COEYMANS**  
Ravena, NY



**NJ PRECAST PLANT**  
Ewing Township, NJ



**NORTH AMERICAN AGGREGATES**  
Perth Amboy, NJ

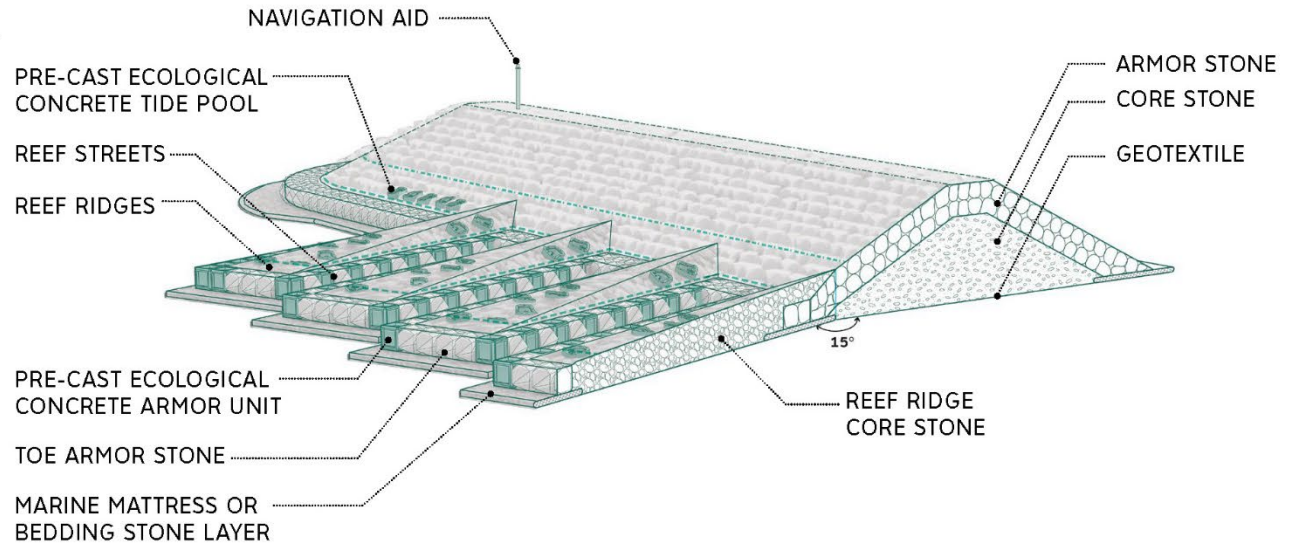
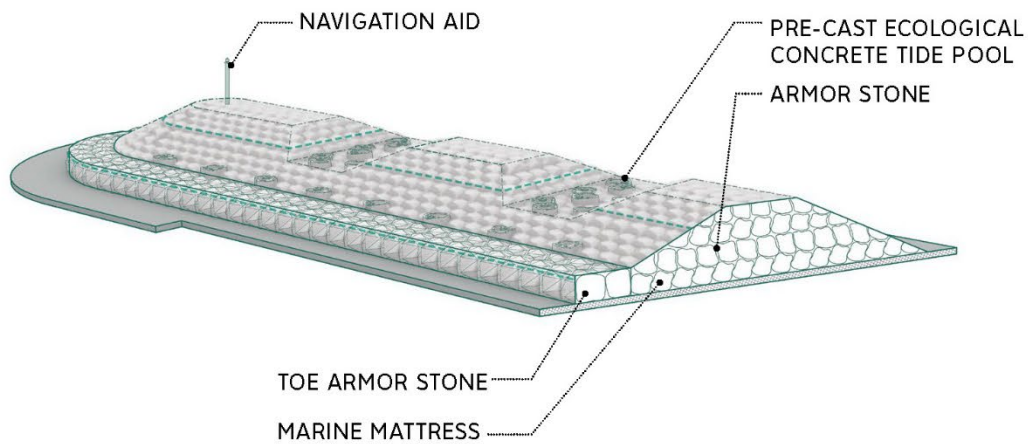


**GREENVILLE YARD**  
Jersey City, NJ



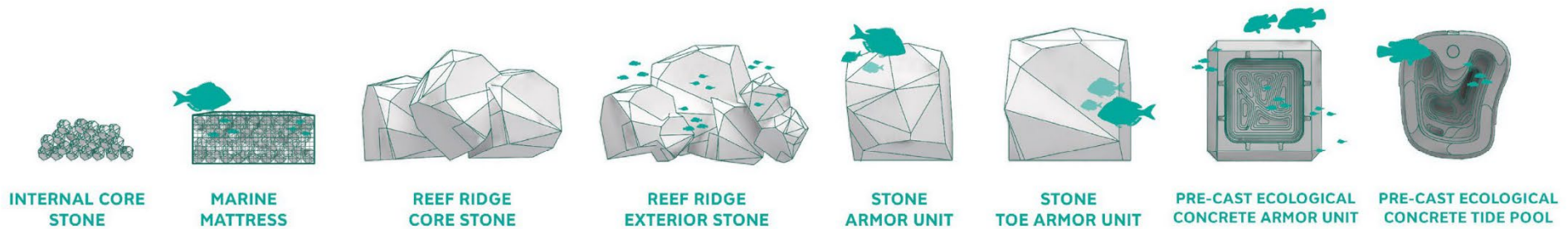
**LBW PROJECT SITE**  
Tottenville, Staten Island, NY





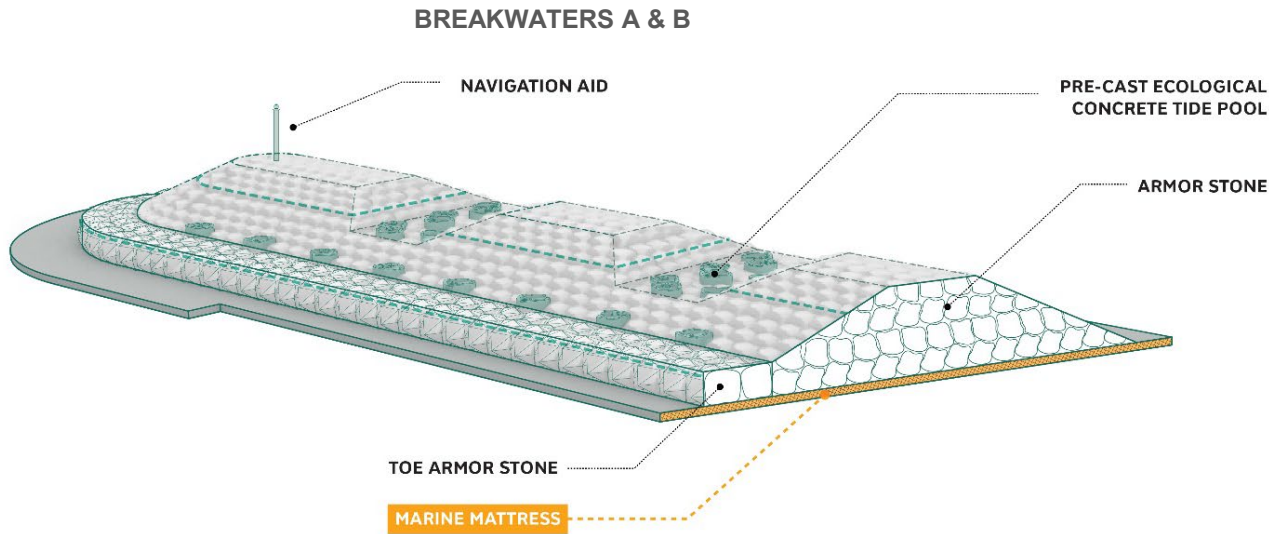
**BREAKWATER A AND B**

**BREAKWATER E, F, G, H**



# BASE LAYER CONSTRUCTION (BW A, B, C, D)

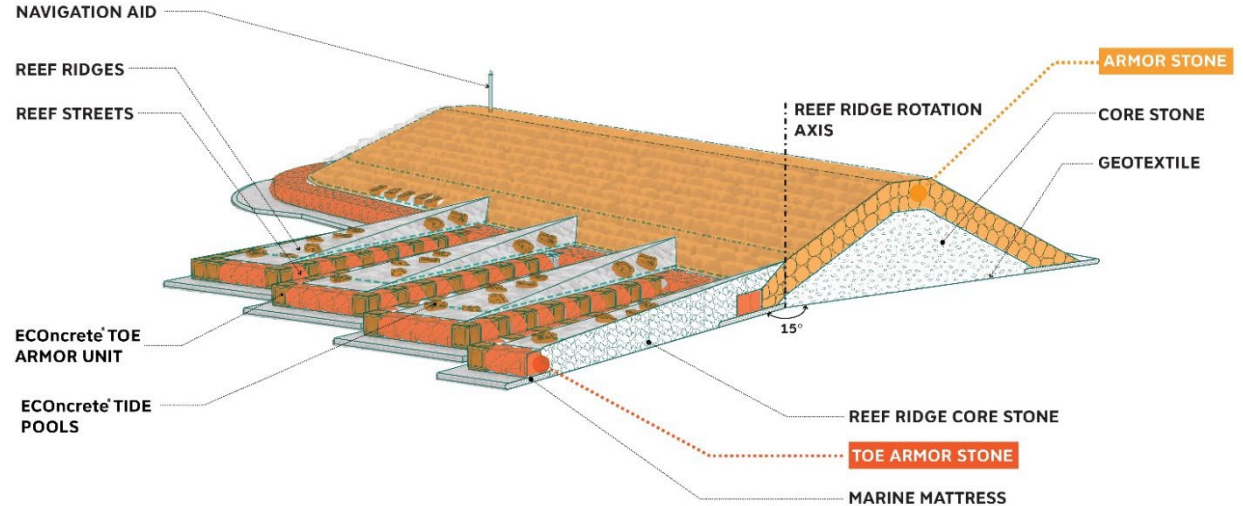
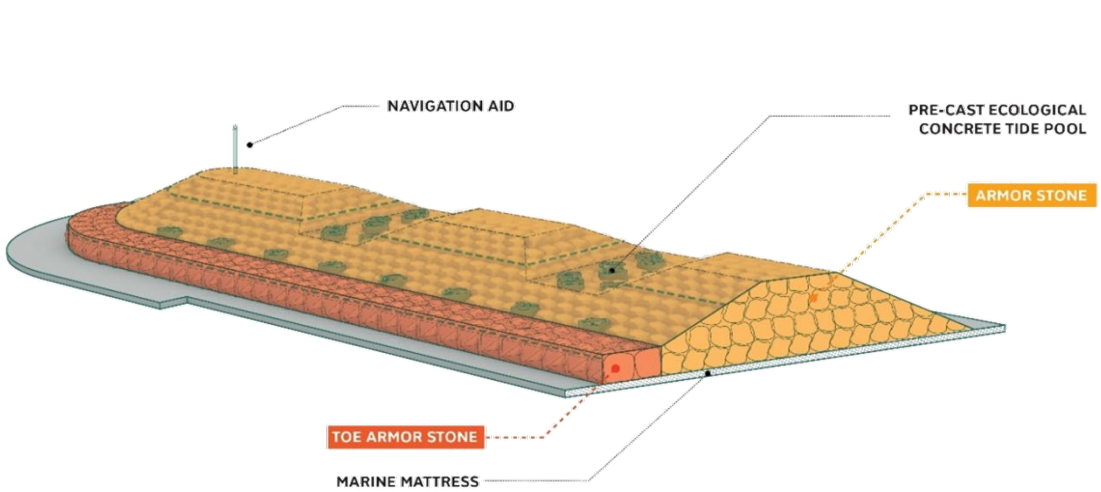
SEPTEMBER - DECEMBER 2021 (COMPLETE)





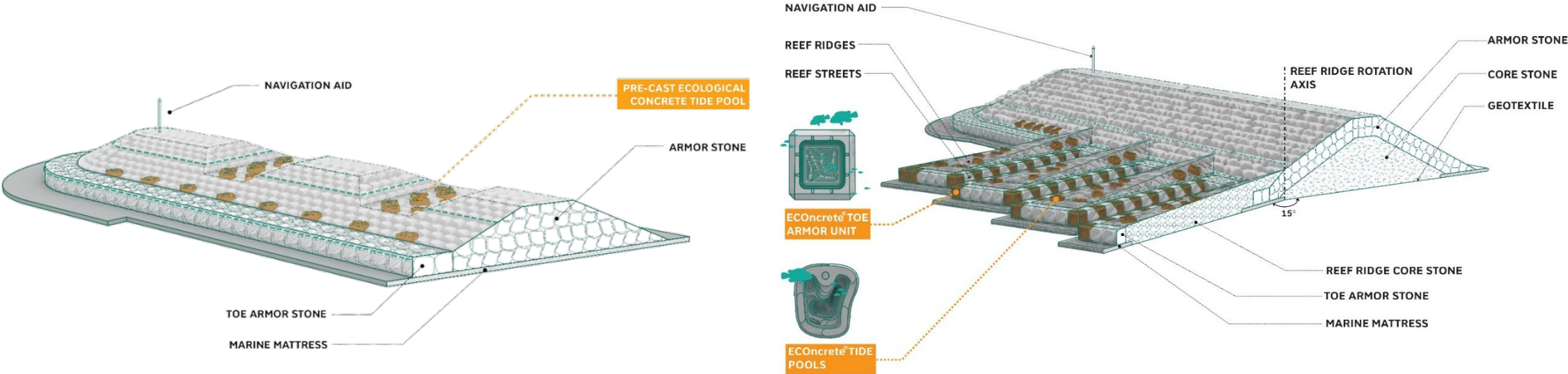
# ARMOR & TOE ARMOR STONE

PRODUCTION: SEPTEMBER 2021 - ONGOING, PLACEMENT: FEBRUARY 2022 - ongoing



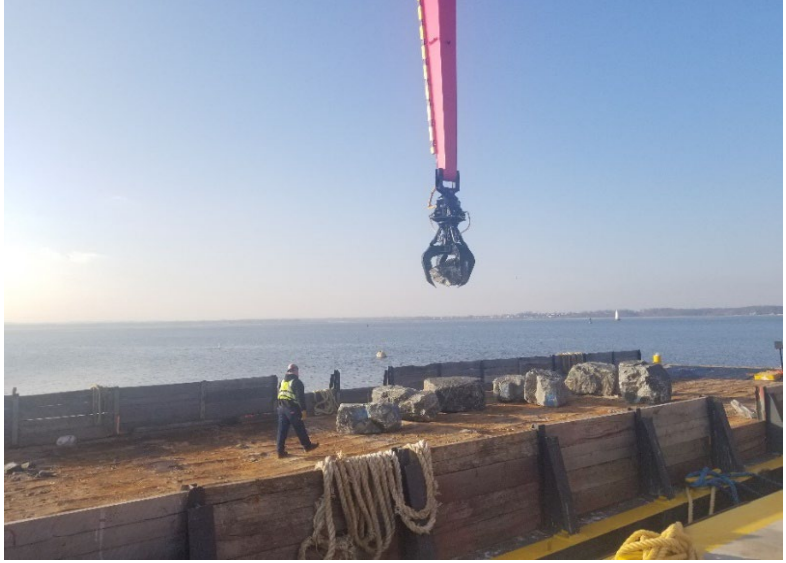
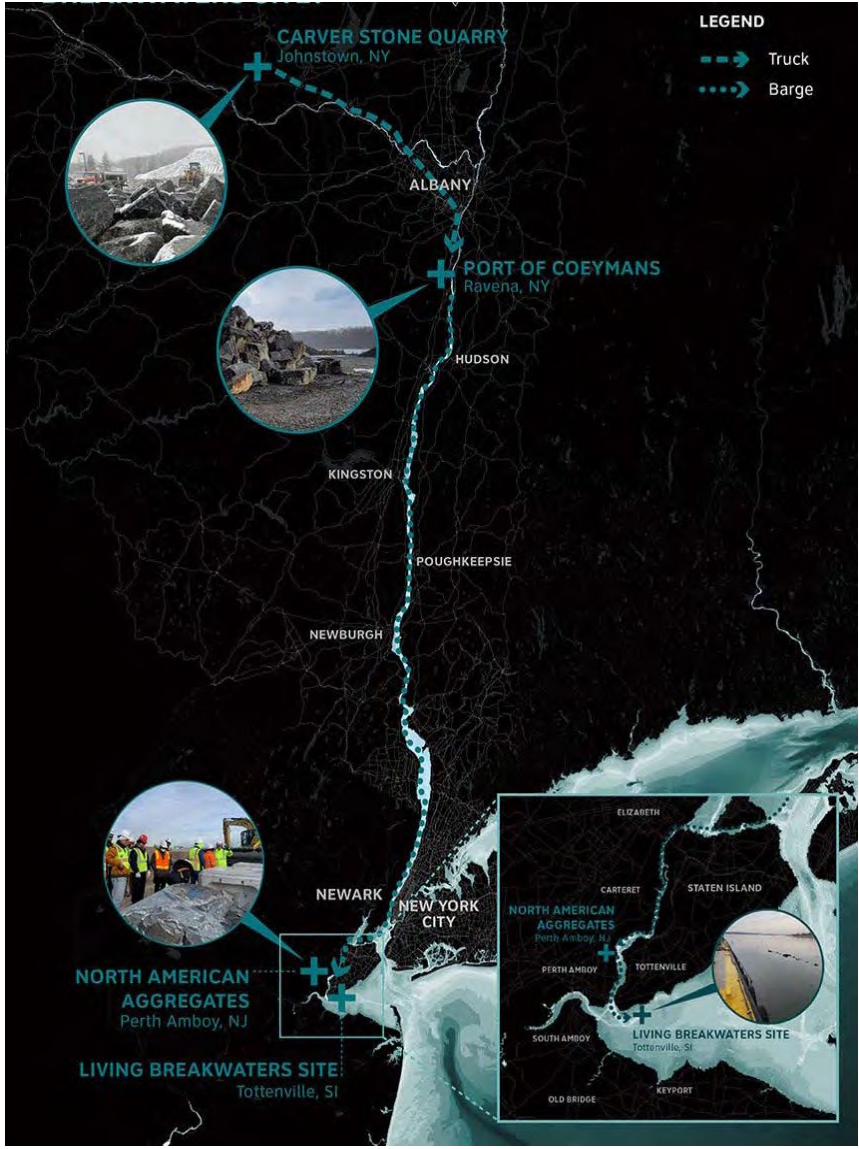
# ECONCRETE (TIDEPOLS & ARMOR UNITS)

PRODUCTION: SEPTEMBER 2021 - ONGOING, TIDEPOL PLACEMENT: FEBRUARY 2022 - ongoing



# ARMOR & TOE ARMOR STONE

PLACEMENT: FEBRUARY 2022 - ONGOING



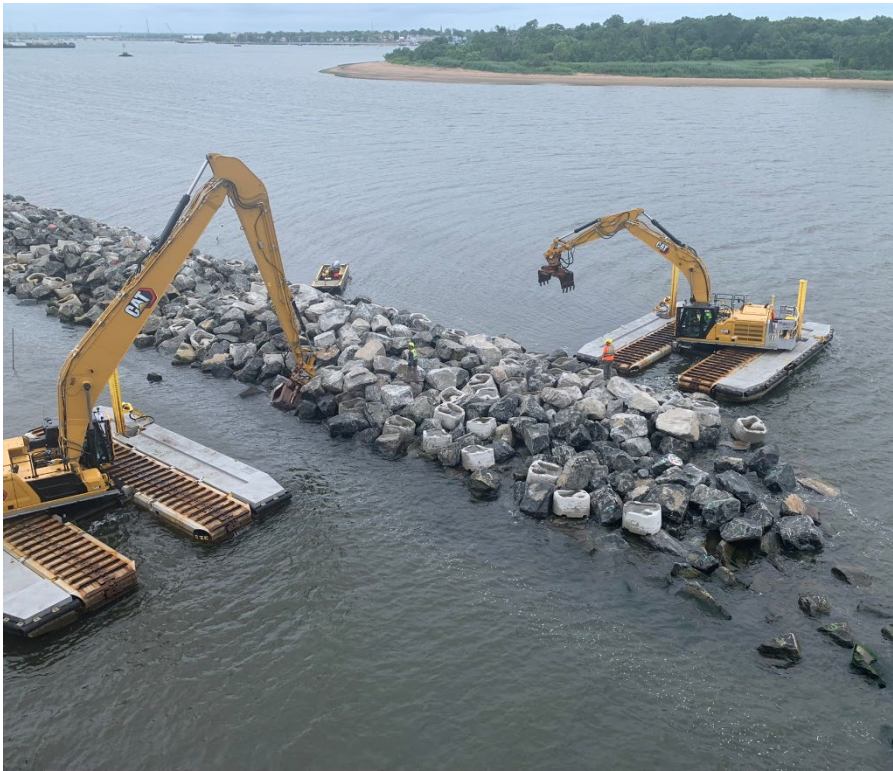
# ECONCRETE TIDEPOLS

PLACEMENT: FEBRUARY 2022 - ONGOING

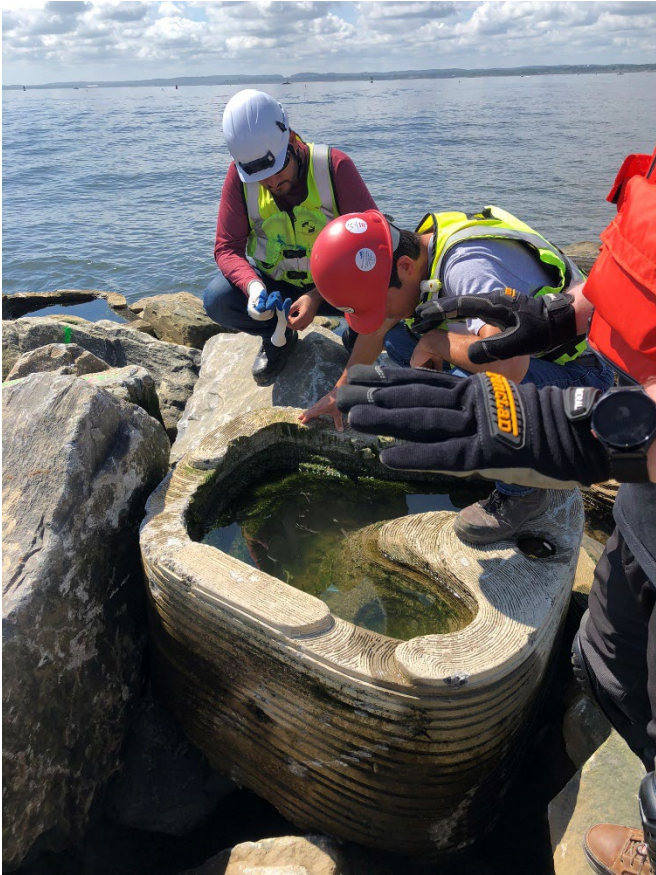


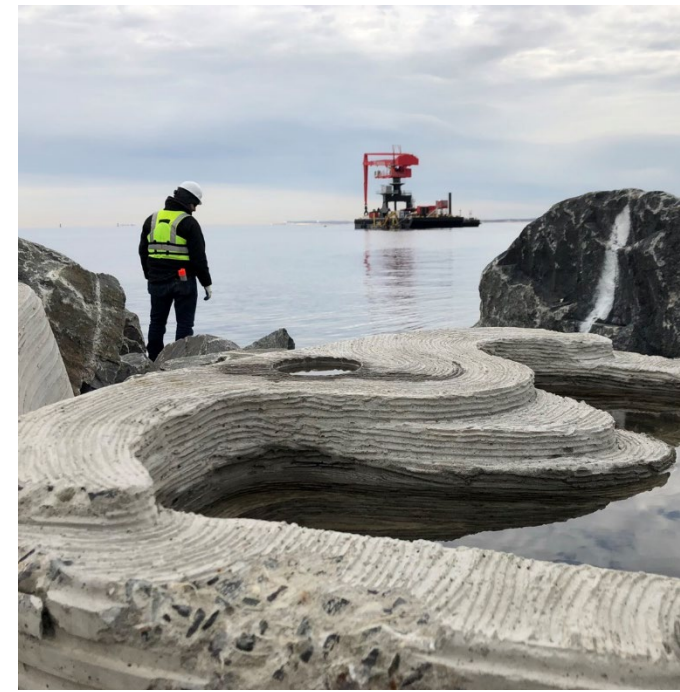
# ADJUSTING ARMOR STONE & TIDEPOOL PLACEMENT

ONGOING



# CONSTRUCTION OBSERVATION





# MARINE LIFE OBSERVED



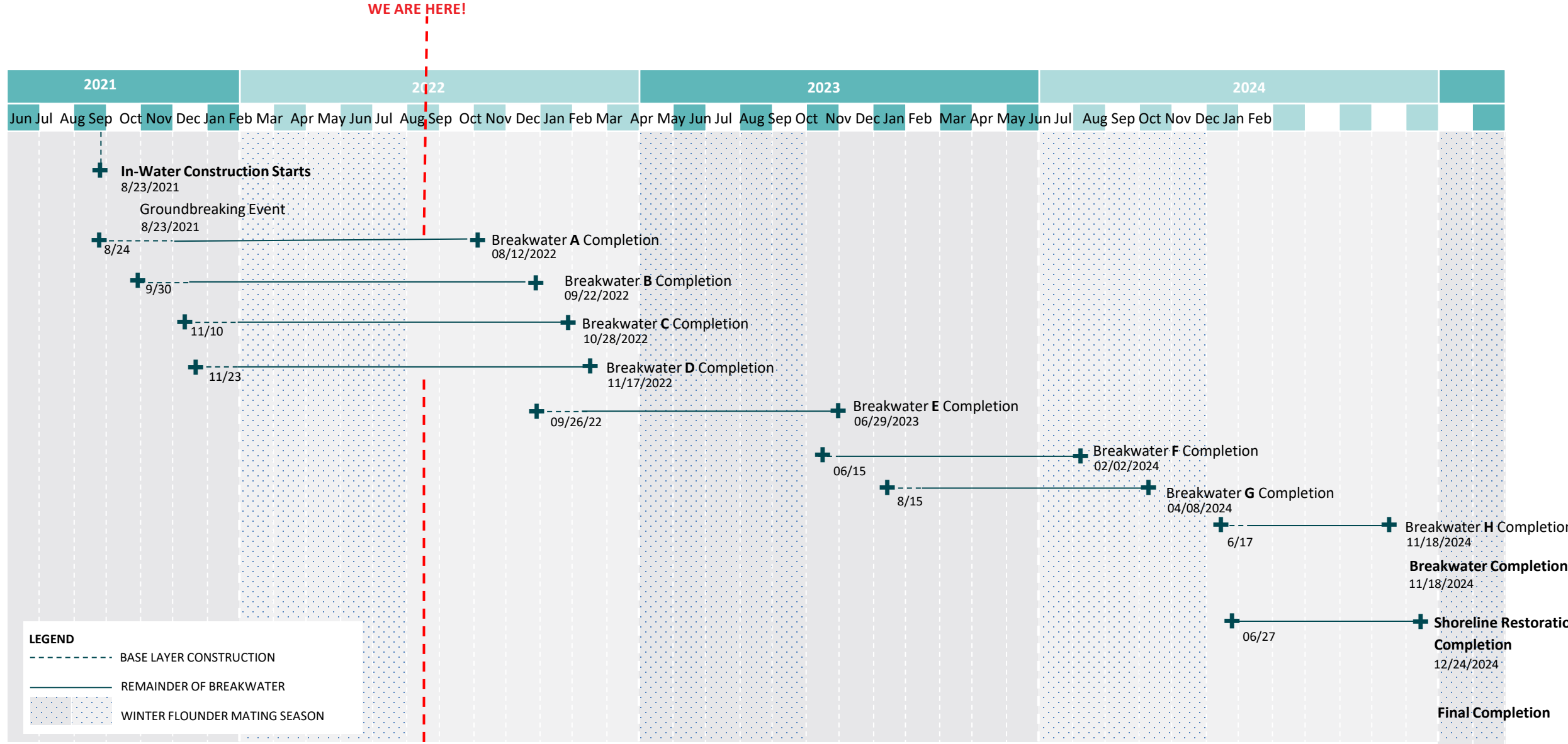




CONSTRUCTED  
TIDE POOL

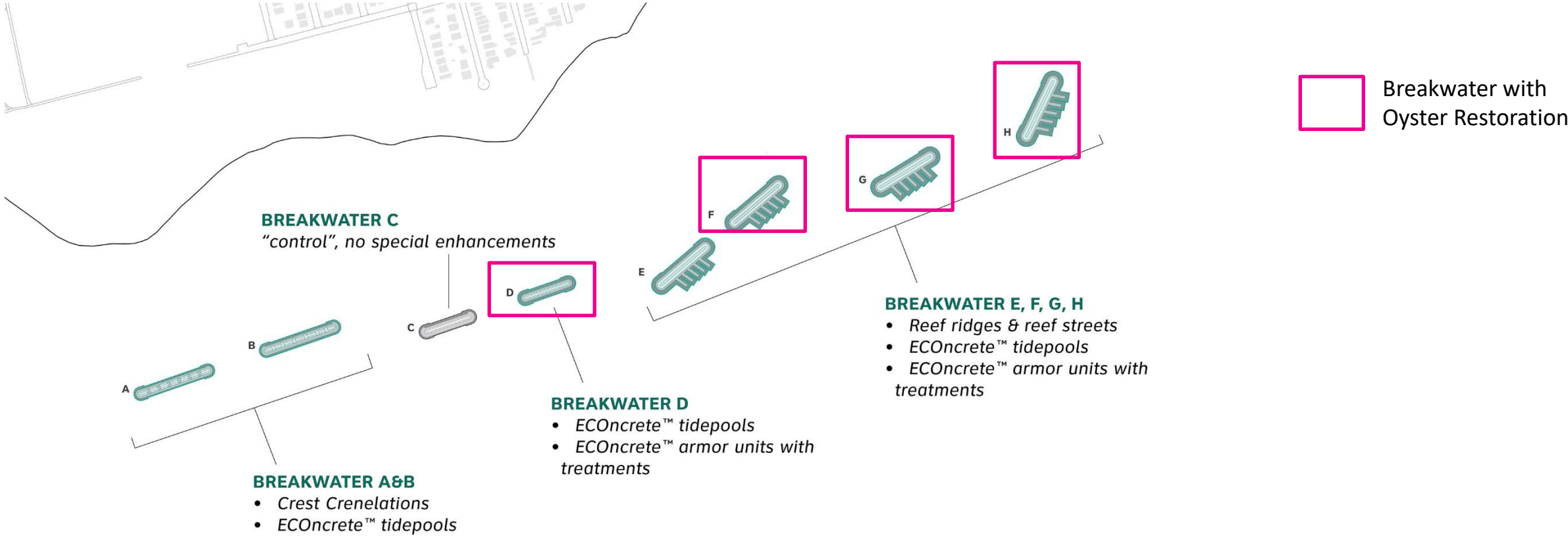


# ANTICIPATED CONSTRUCTION TIMELINE



\*Schedule update 4/30/2022

# FUTURE: OYSTER RESTORATION



Crest Crenelations



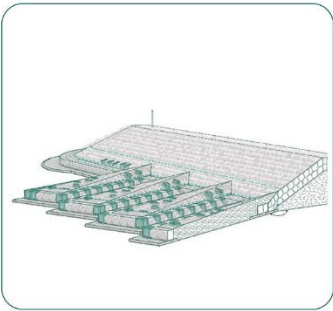
EConcrete™ tidepools



EConcrete™ armor unit with mesh treatment

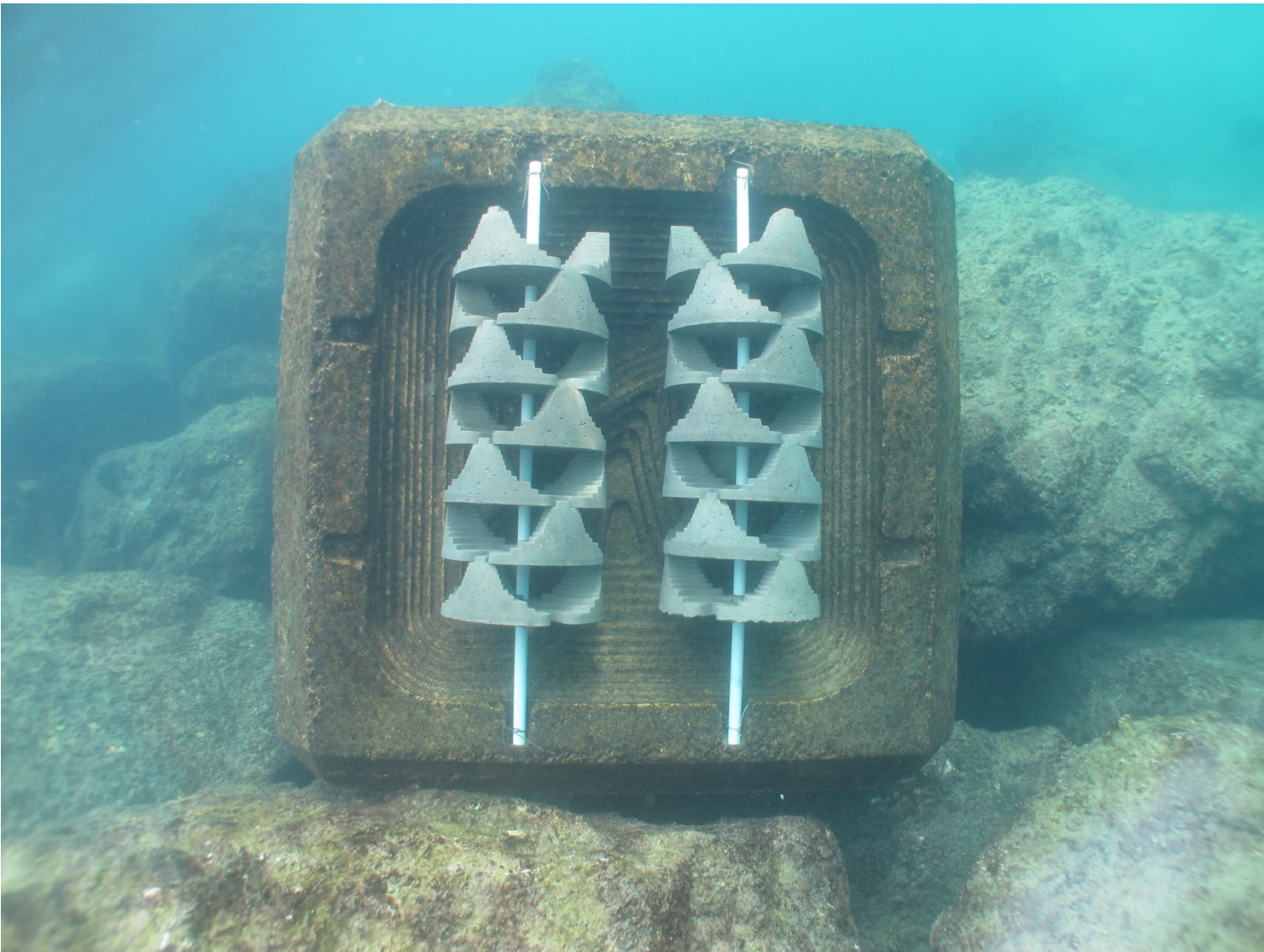


EConcrete™ armor unit with mesh and rock treatment



Reef ridges & reef streets

# OYSTER DISK TREATMENT

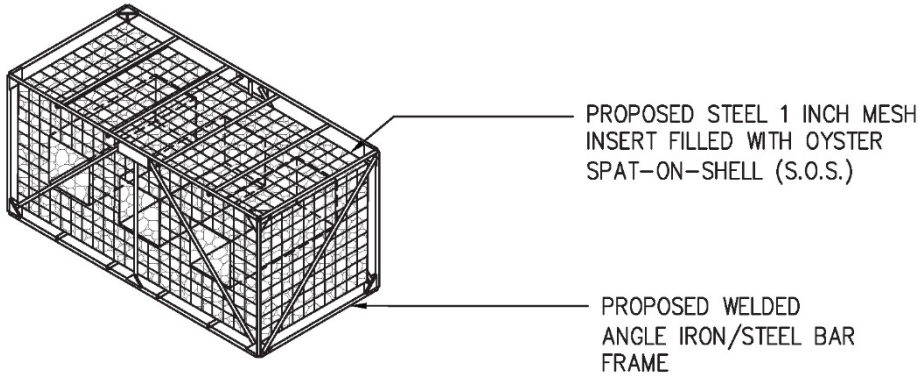


# SPAT-ON-SHELL TREATMENT



OYSTER HUB 2 (MESH+ SHELL)

# GABION



# THANK YOU!

## LIVING BREAKWATERS

<https://stormrecovery.ny.gov/living-breakwaters-construction-updates>

<https://www.scapestudio.com/projects/living-breakwaters/>





# The Evolution of Dredged Sediment in New Jersey

## Stephen Rochette

*Chief of Public Affairs*

*U.S. Army Corps of Engineers (USACE) Philadelphia District*

# Evolution of Dredged Sediment in New Jersey

**Steve Rochette**  
**U.S. Army Corps of Engineers**  
**Philadelphia District**  
**12/9/2022**



**US Army Corps  
of Engineers®**





# Agenda



- Introduction & National Context
  
- Project Examples
  - Mordecai Island
  - Seven Mile Island
  
- “USACE Philly Approach” & Lessons Learned
  
- Questions





# National Context



- Navigation = oldest civil works mission for Army Corps

- Maintain:

- 12k miles of inland waterways w/ 209 locks
- 13k miles of coastal waterways

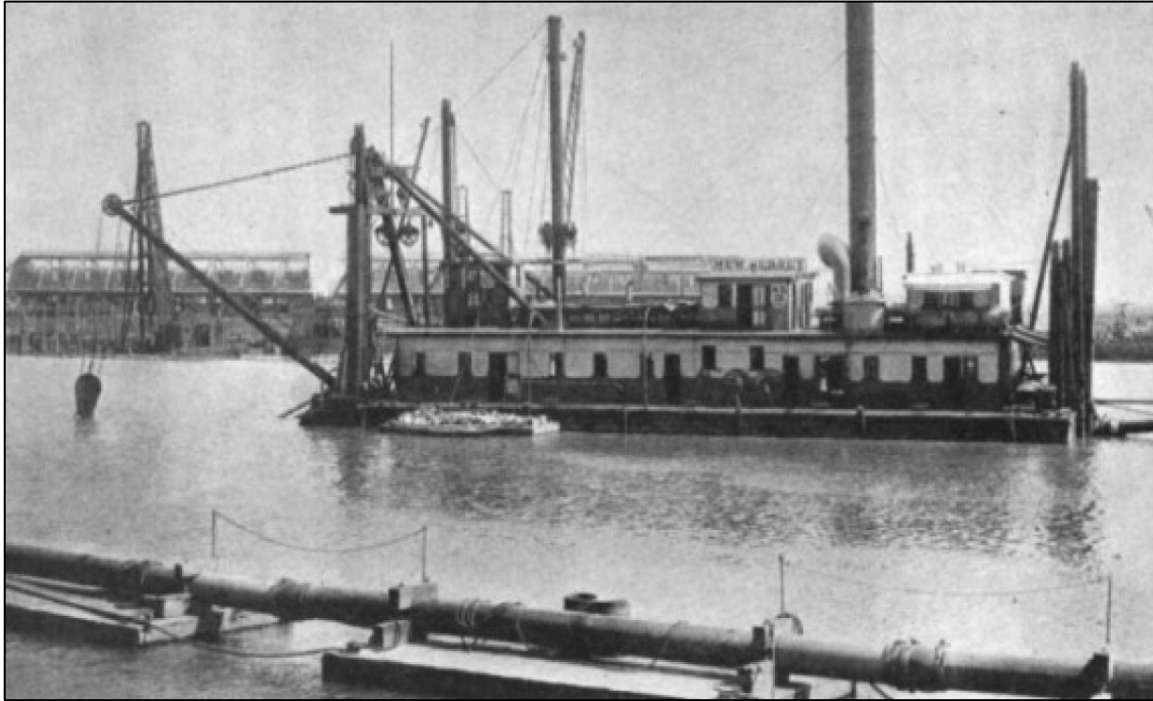
- How do we maintain federal navigation channels?

- Surveying + dredging





# National Context



1912



December 2022



# National Context



- Each year, USACE dredges 220 million cubic yards of sediment
- 70% beneficial use goal by 2030
- Premise:
  - “Sediment is the currency of salt marsh ecosystems” ~ Dr. Lenore Tedesco, Exec. Director of The Wetlands Institute
  - USACE is perhaps the largest national “sediment broker” due to navigation mission and dredging
  - Question - how do we be good stewards of that sediment “currency”?





# Organizational Perspective USACE Philadelphia District



- **Navigation Mission:** USACE Philadelphia District maintains federal channels, including the Delaware River & Bay, coastal inlets, and the 117-mile New Jersey Intracoastal Waterway
- When dredged sediment is CLEAN, District strives to find opportunities to use 100% of it beneficially.
- Moving toward this goal has been an evolution over many years
- Hurricane Sandy = paradigm shift





# Mordecai Island New Jersey Intracoastal Waterway



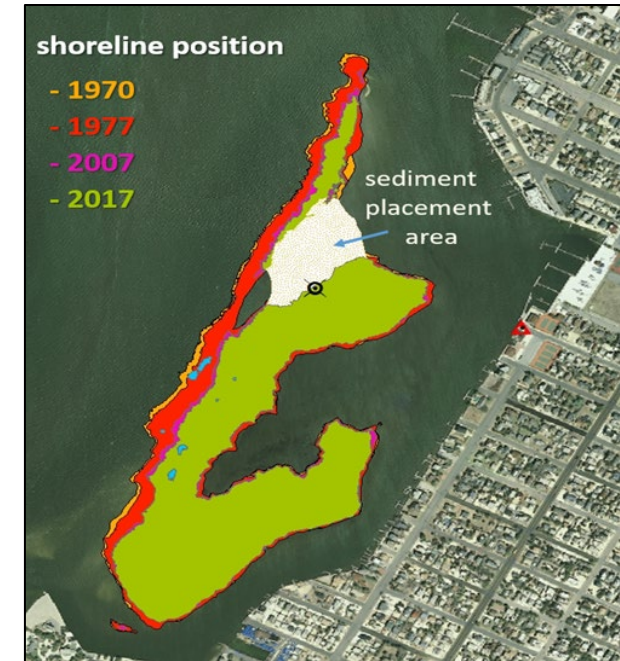




# Mordecai Island Restoration Location & Placement



- 45-acre uninhabited coastal salt marsh island
- 25,000 cubic yards of sediment dredged from a critical shoal in the federal channel. Placement in eroded section of island
- Island = important habitat and fetch buffer for Beach Haven, NJ/Long Beach Island





# Mordecai Island Restoration: Planting & Adaptive Management

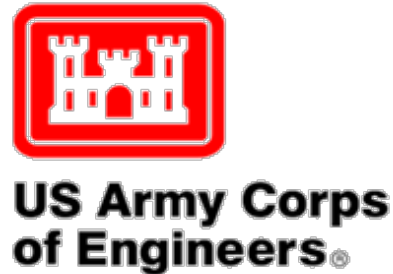
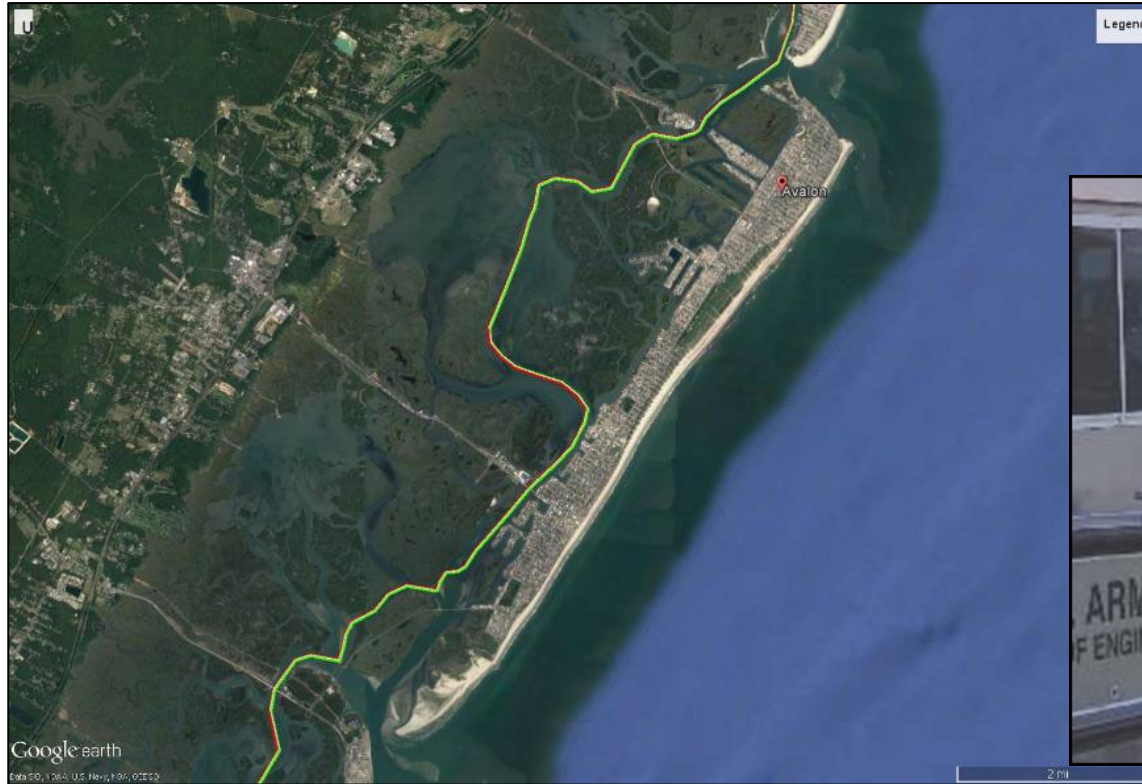


- Planted different varieties of marsh grass based on site topography
- Adaptive management: placed additional sediment on site in 2017
- Monitoring and R&D collaboration (NOAA, ERDC, Land Trust)
- Multi-prong approach –
  - Operations dredging/placement;
  - Non-profit activities



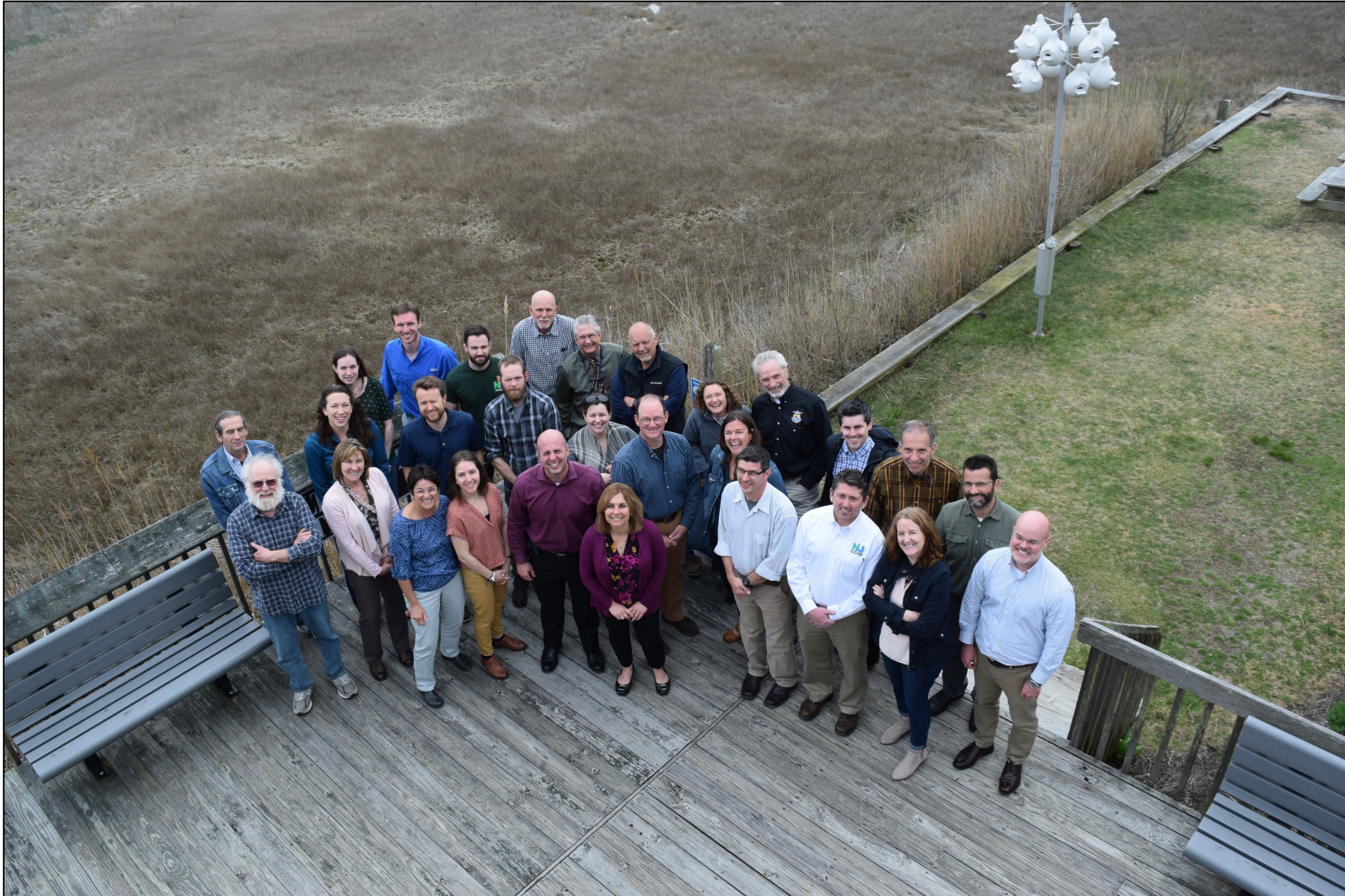


# Seven Mile Island Innovation Laboratory





# Seven Mile Island Innovation Laboratory





# Seven Mile Island Innovation Laboratory

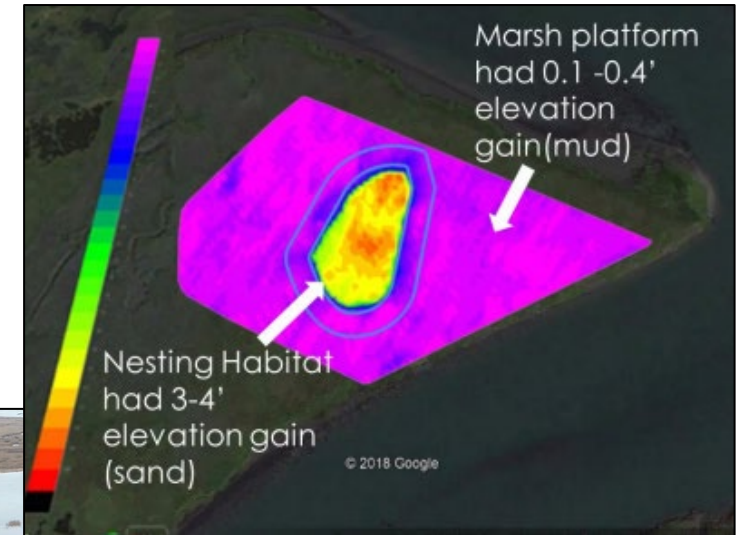


## Great Flats and Ring Island

- Two 1-acre elevated nesting habitats at with sandy material
- Multiple placements with monitoring and adaptive management
- Signs of success with colonial nesting bird species

## Gull and Sturgeon Island

- Historic placement sites only suitable habitat for wading birds
- Sought to raise elevation at different zones and enhance intertidal and subtidal areas
- Tested distribution pipe and different placement methods for mix of sandy/fine grained sediment
- Developing lessons learned





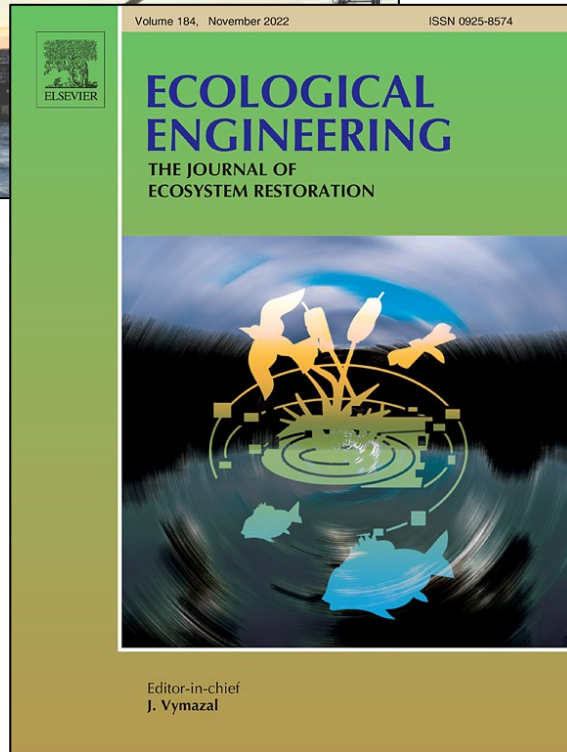
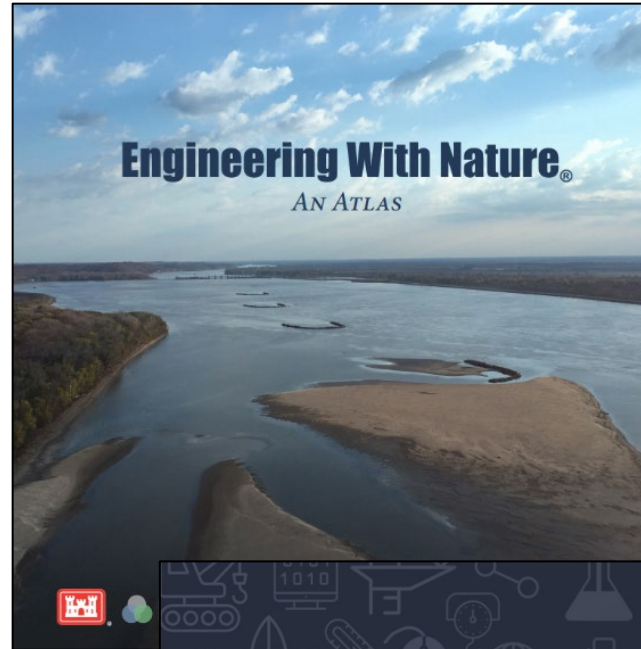
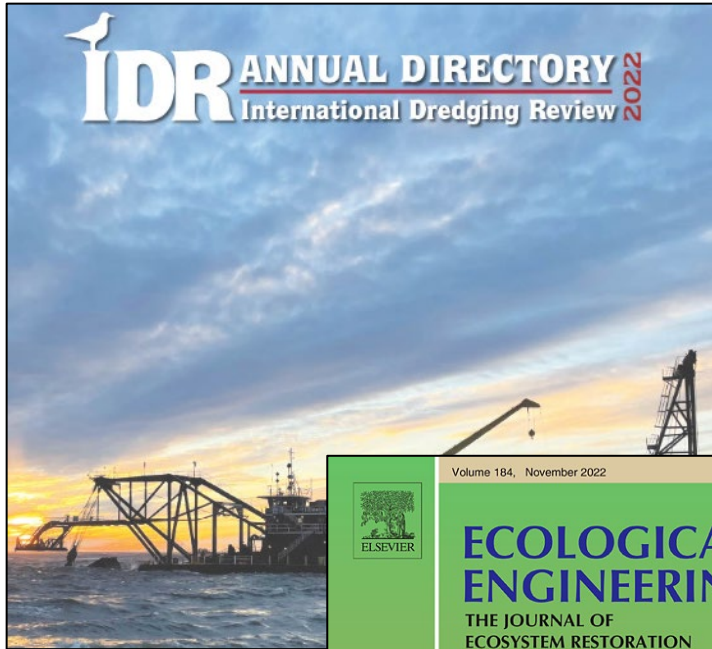
# USACE Philly Approach



- Practical application
- Characterize sediment early
- Use of both GOV'T dredging plant & private industry
- Leverage expertise of partners
- Share knowledge and lessons learned
- Engineering with Nature Proving Ground – expand beyond coastal dredging to other mission areas



# Sharing Information



<https://www.nap.usace.army.mil/Missions/Civil-Works/Coastal-Dredging-Beneficial-Use/>

# PROGRAM INTRODUCTION

## Nasser Brahim

*Forum Co-Chair*

*Senior Climate Resiliency Specialist*

*Woods Hole Group*



# PROGRAM INTRODUCTION

## **Local Implementation:** *Regulatory & Engineering Challenges and Opportunities*

# Large-Scale Dune and Beach Restoration on the Massachusetts South Shore

## Jason Burtner

*South Shore Regional Coordinator  
Massachusetts Office of Coastal Zone Management  
(CZM)*

# Large-Scale Dune and Beach Restoration on the Massachusetts South Shore



Jason D. Burtner  
South Shore Regional Coordinator

# South Shore towns were “Beach Towns”

PEGGOTTY BEACH, SCITUATE, MASS.



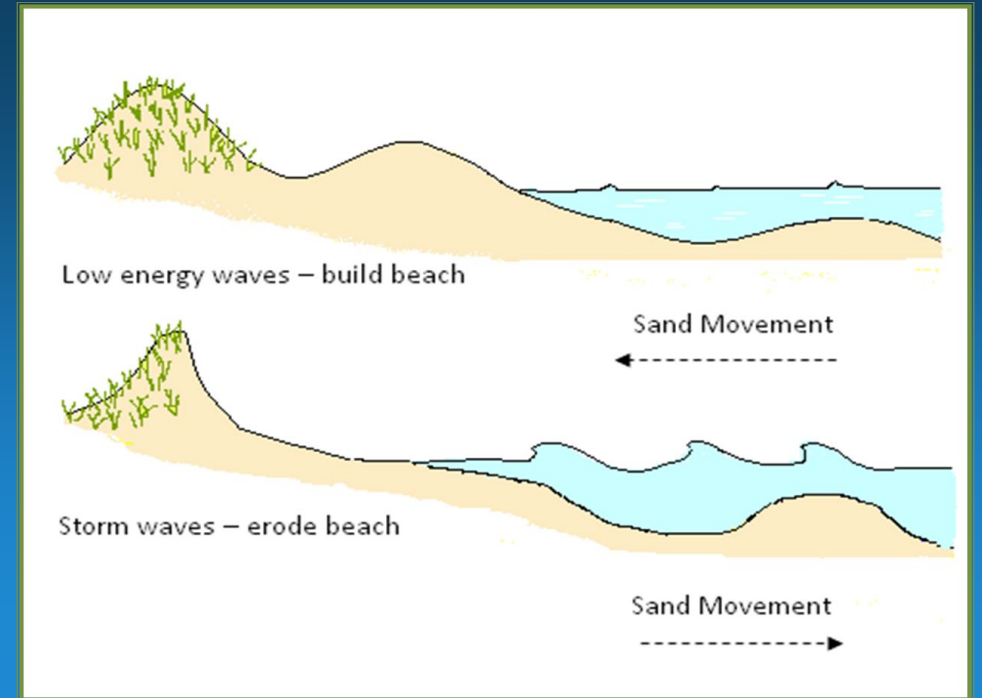
5863:—North Scituate Beach, Mass.



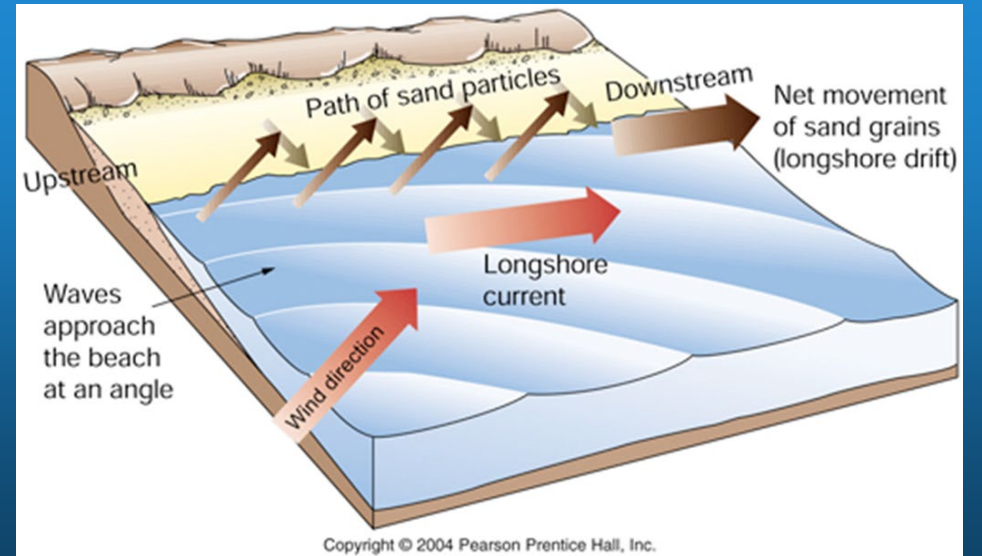
# Waves and wind erode and redistribute material along the coast through cross-shore and long-shore sediment transport



Source: MA CZM



Source: MA CZM



Copyright © 2004 Pearson Prentice Hall, Inc.

## Unintended consequence of “hard” engineering structures:

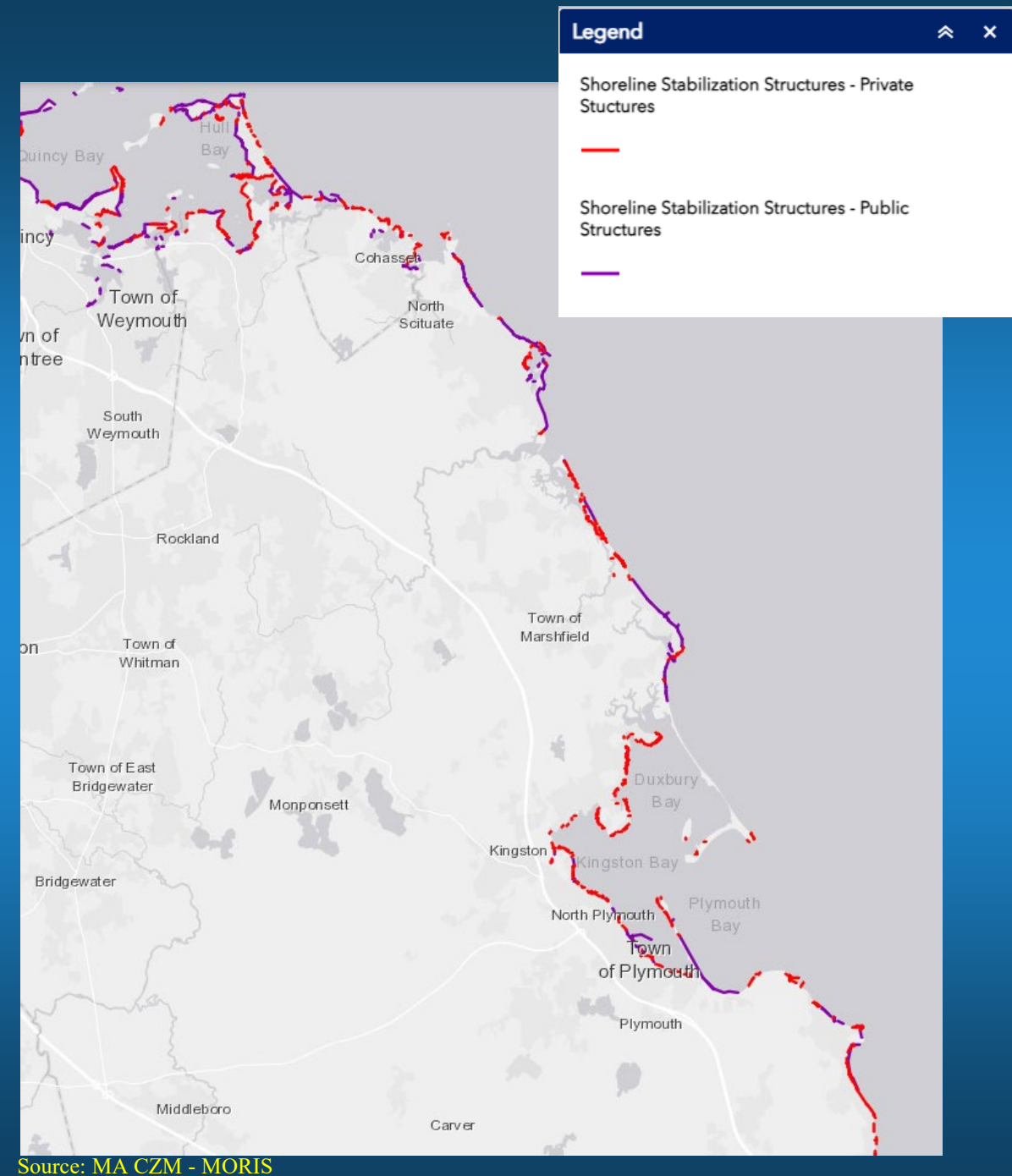
- Sediment is cut off from the fronting beaches
- Beach width narrows and beach elevation drops
- Waves reflect off hard structures exacerbating erosion



Source: MA CZM



Source: MA CZM



Source: MA CZM - MORIS



Source: MyCoast



Source: CZM



Source: Dave Laroche



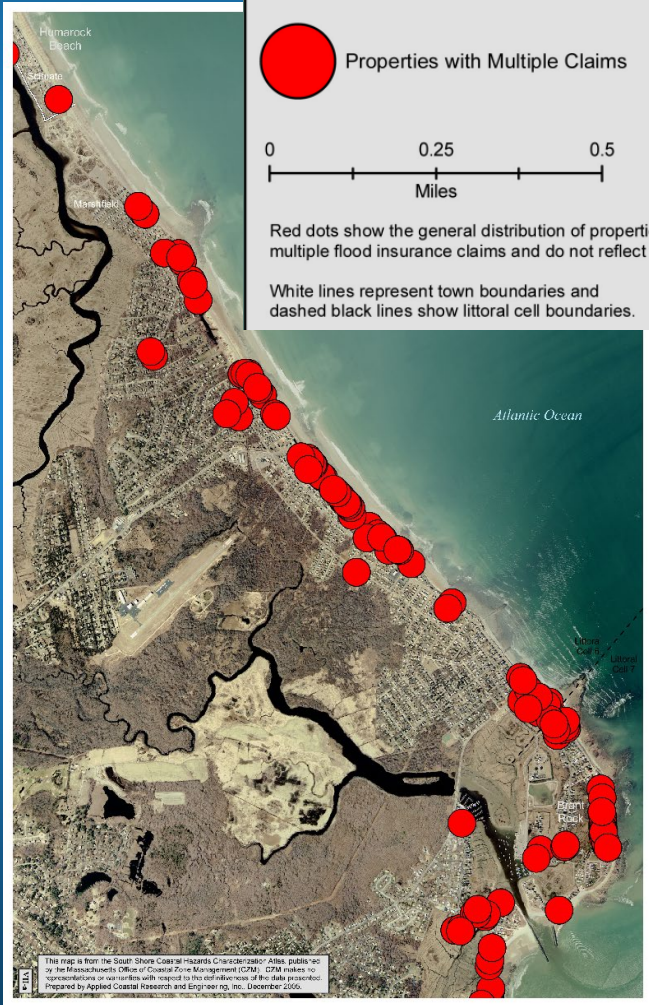
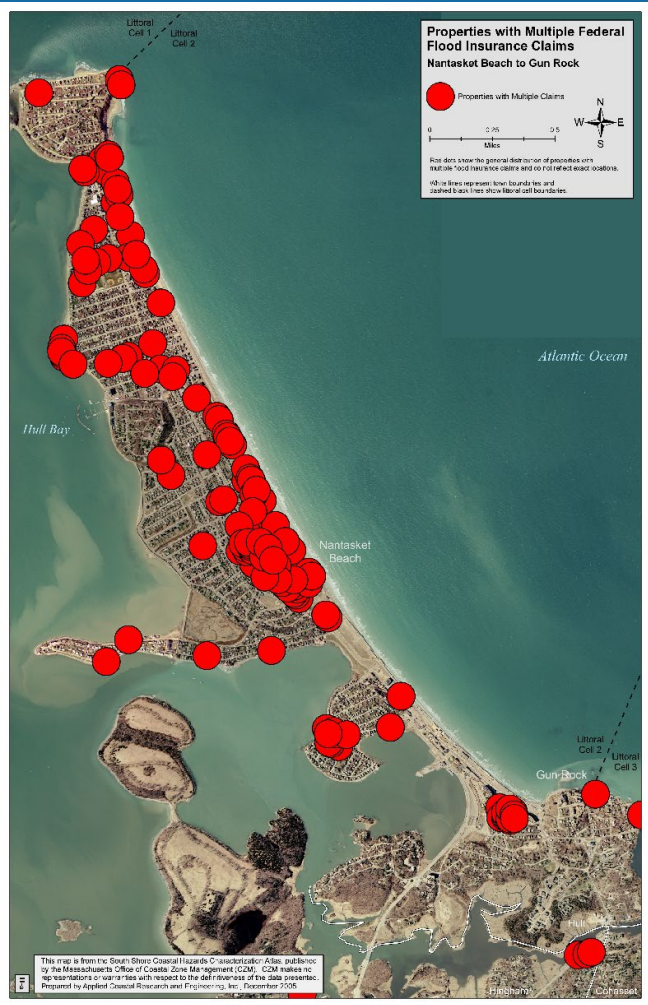
Source: MyCoast



Source: MyCoast

# South Shore Coastal Hazards Characterization Atlas - 2005

## High Risk Flood and Storm Damage Areas



Source: Applied Coastal Research and Engineering

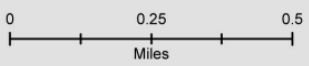


# South Shore Coastal Hazards Characterization Atlas - 2005

## Dominant Coastal Processes

### Dominant Coastal Processes Stony Beach to Nantasket Beach

- Longshore Sediment Transport
- Cross-Shore Sediment Transport
- Aeolian Transport
- Tidally Induced Transport
- Bank Erosion
- Barrier Beach Overwash



- The dominant coastal process is mapped closest to the shoreline. Other important coastal processes that influence local sediment transport are shown seaward of the dominant process.
- Where appropriate, the long-term direction of longshore sediment transport has been depicted with an arrow. Arrows indicate only the net direction of transport, arrow length does not indicate the relative magnitude of transport.

Dashed black lines show littoral cell boundaries.



# Duxbury Beach Reservation (DBR) and Plymouth Long Beach Dune and Beach Nourishment Initiatives



Image © 2022 TerraMetrics  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google Earth

# Coastal Processes Study and Resiliency Recommendations -2017

## Overarching Recommendation – Regional Adaptation

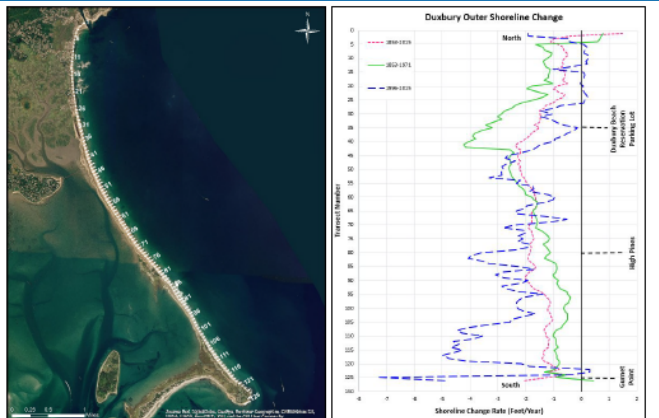


Figure C-1. Analysis transects (left) and shoreline change rates (right) along the Atlantic Ocean Duxbury Beach shoreline.

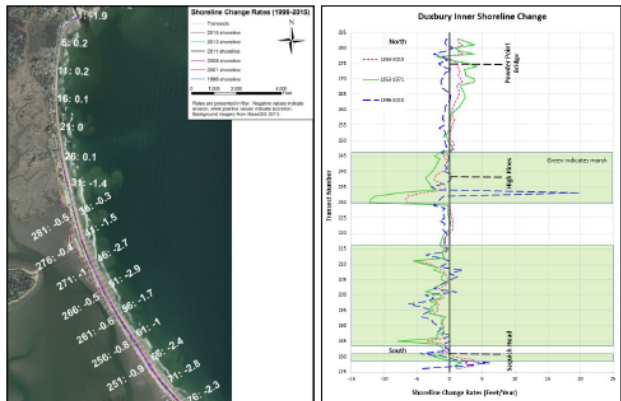


Figure C-2. Analysis transects and short-term (1996-2015) shoreline change rates (left) and shoreline change rates (right) along the bayside shoreline of Duxbury Beach.

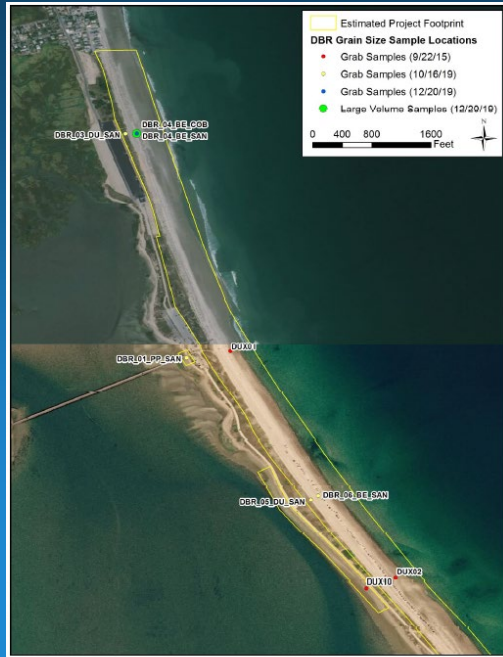


Figure C-17. Sediment sample location details - north portion of DBR property.

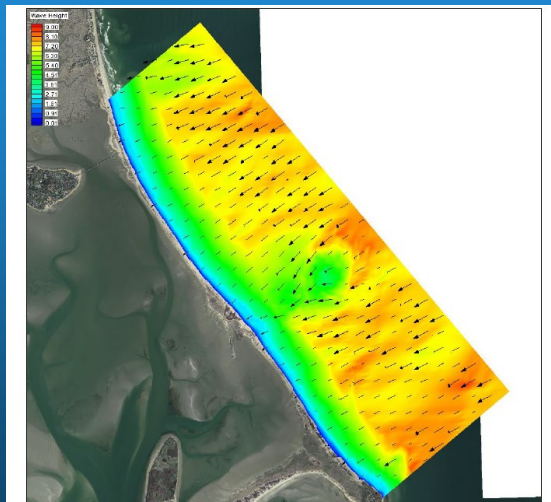


Figure C-15. Small-grid spectral wave modeling results for a 50-year return period storm (wave height unit in meter).

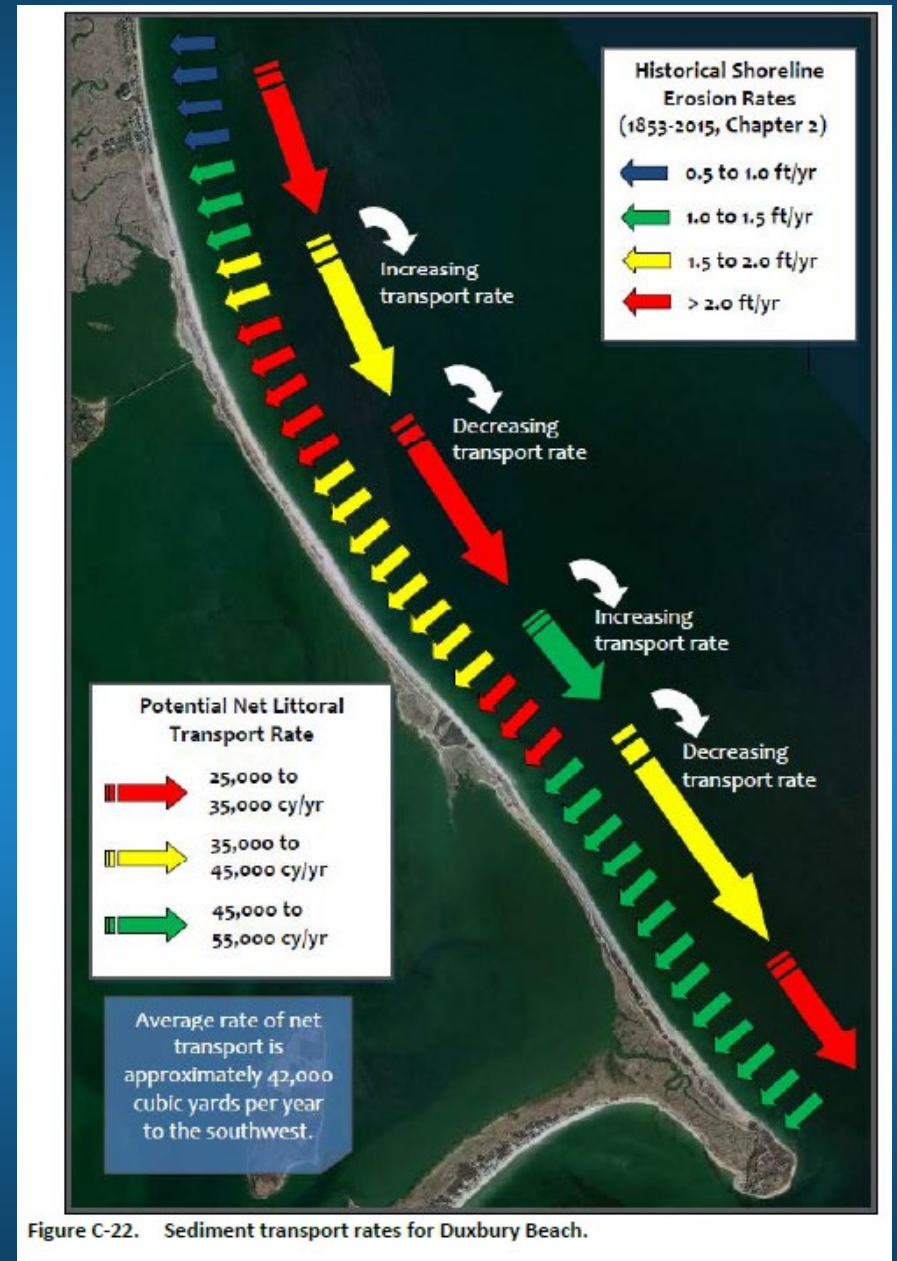


Figure C-22. Sediment transport rates for Duxbury Beach.

# Dune Restoration Project - 2019

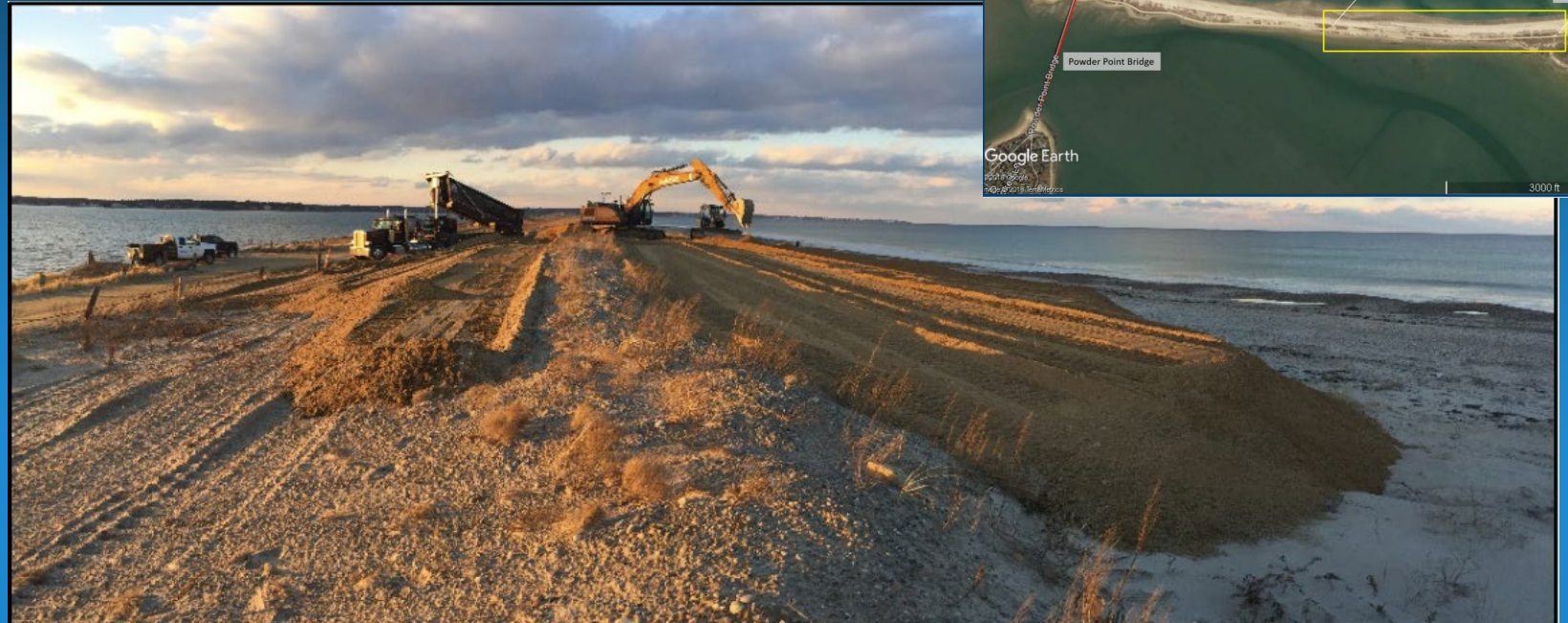
76,633 tons of sand was placed along 3,500 linear feet of dune

Crest of the dune was raised to elevation El 17 NAVD 88 with a 45 ft width

80,000 culms of American Beach grass and 100 woody shrubs were planted to stabilize nourishment material

Slopes were designed to address wildlife considerations

Dune was designed to prevent overtopping from a 50-yr storm event



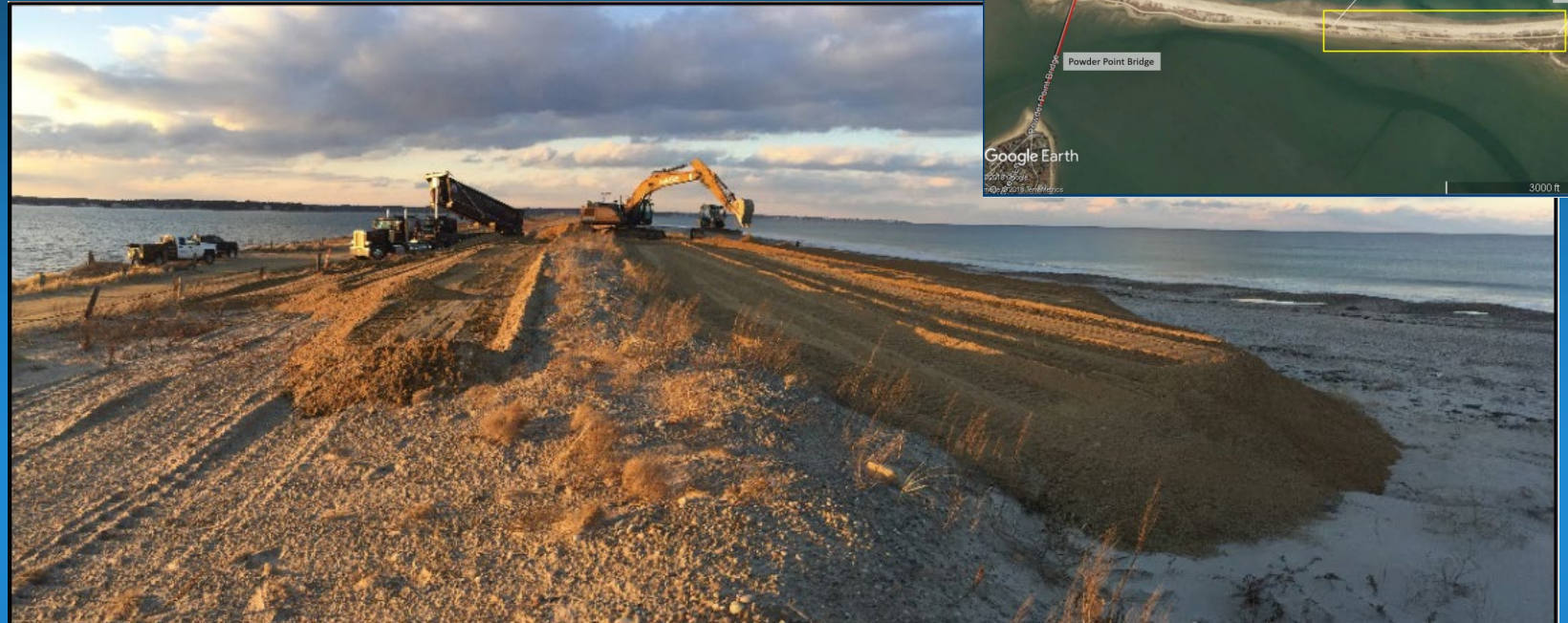
Source: DBR



Source: CZM

# Dune Restoration Project - 2019

Duxbury Beach  
named one of  
the 2022 Best  
Restored  
Beaches by the  
American Shore  
and Beach  
Preservation  
Association!!



Source: DBR



Source: CZM

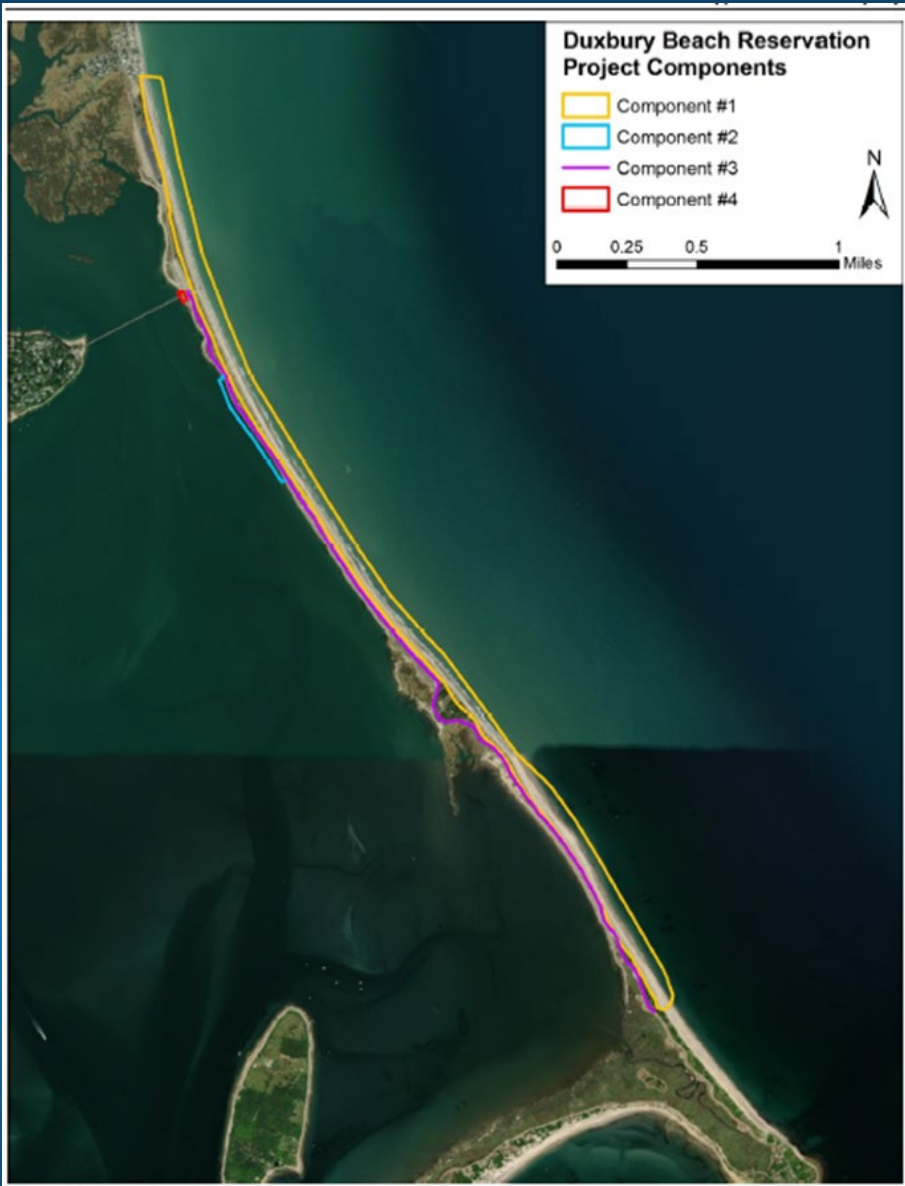
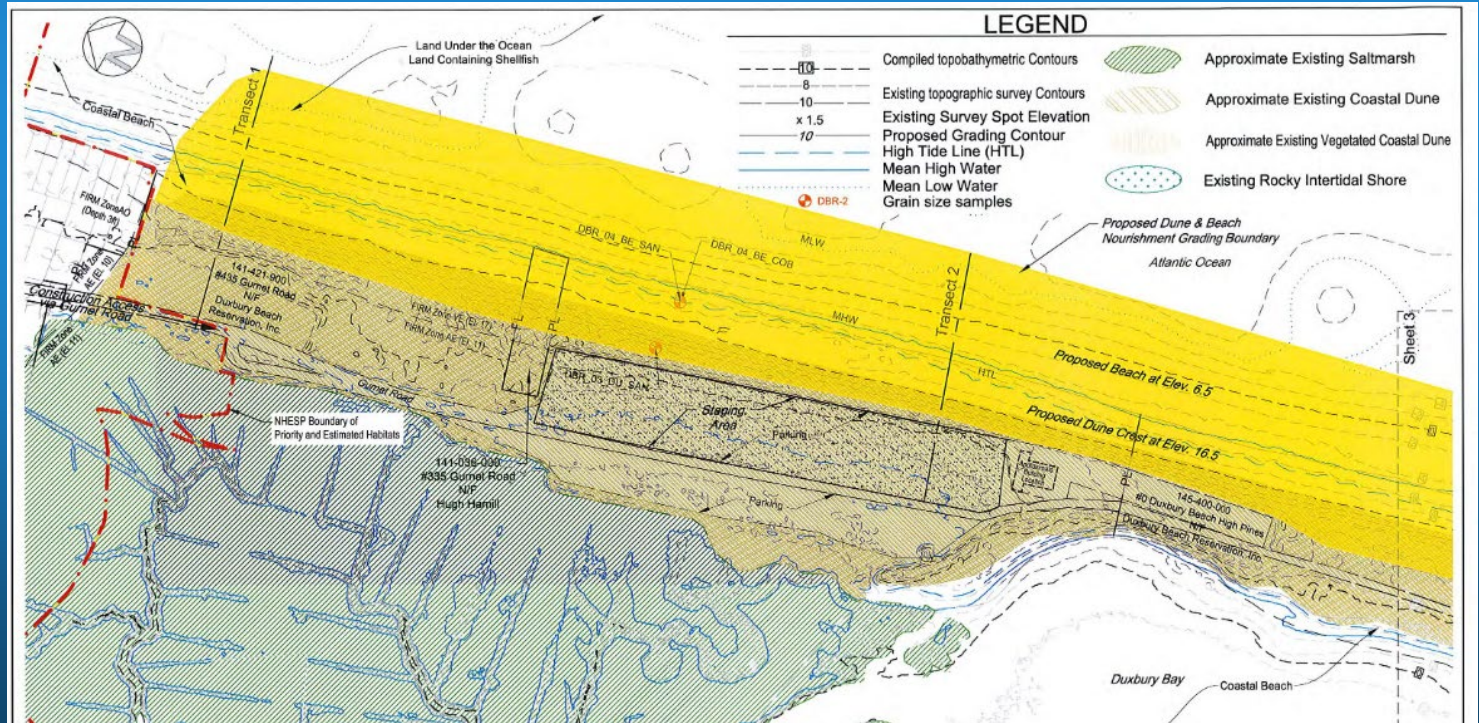
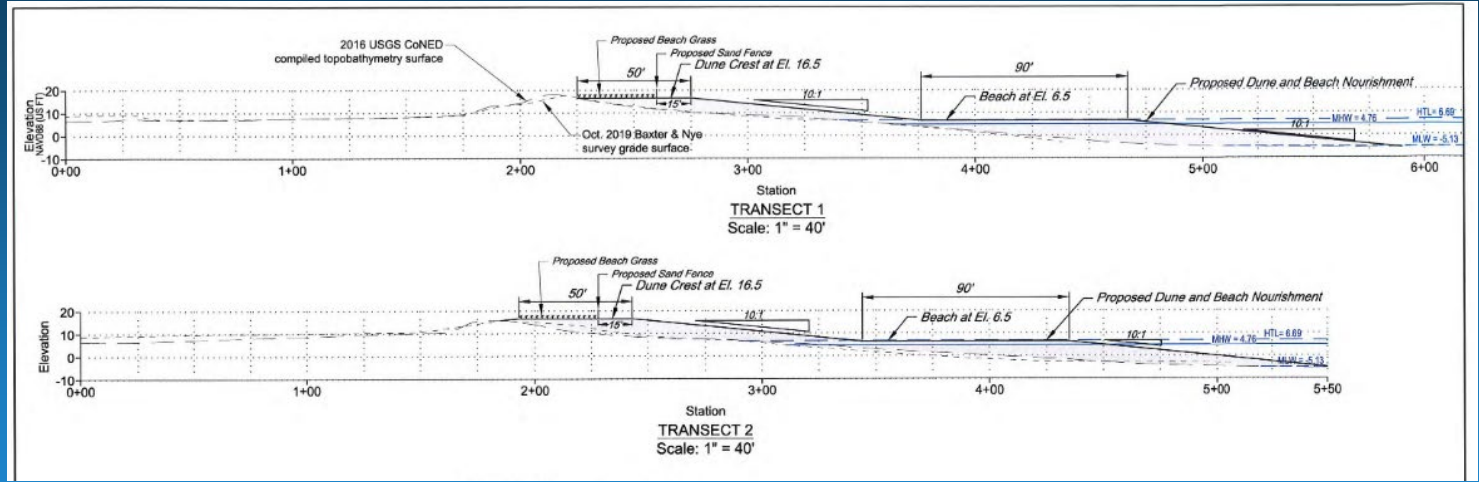
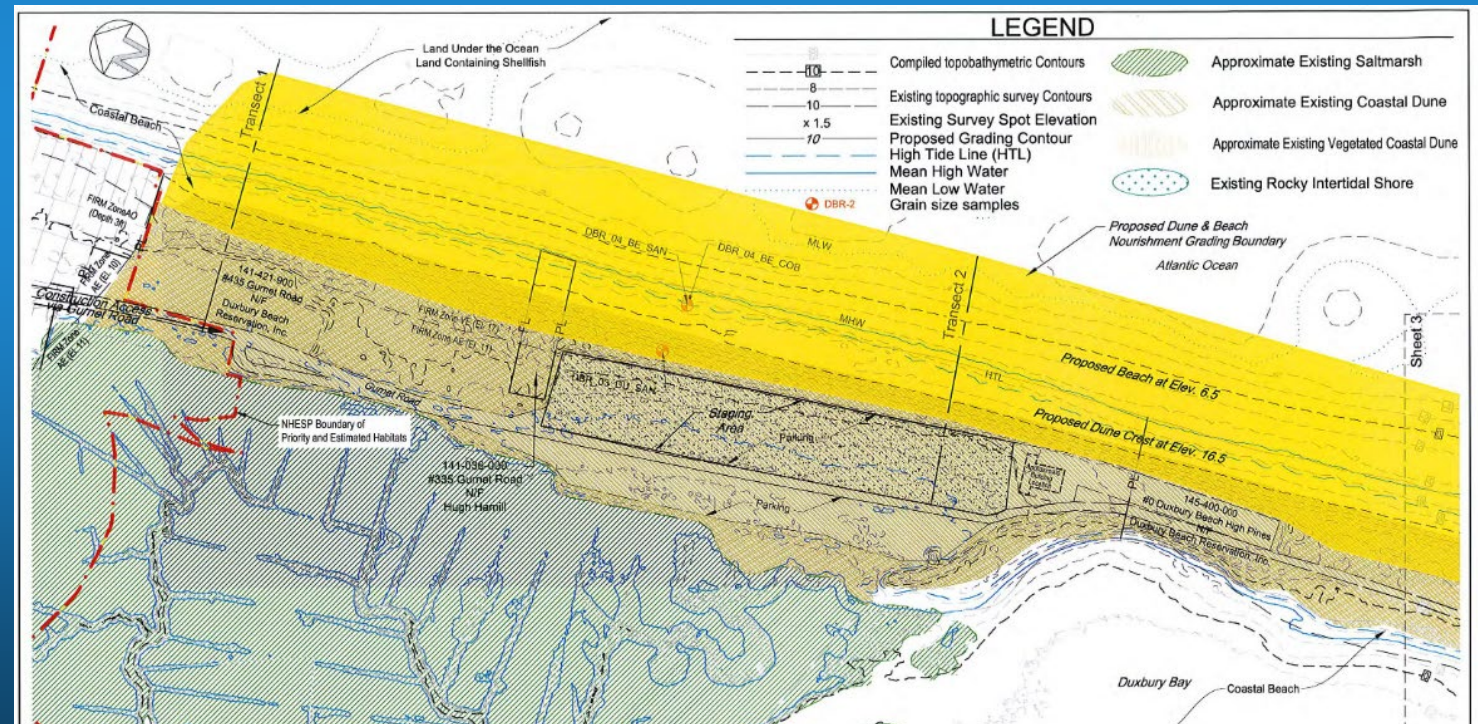
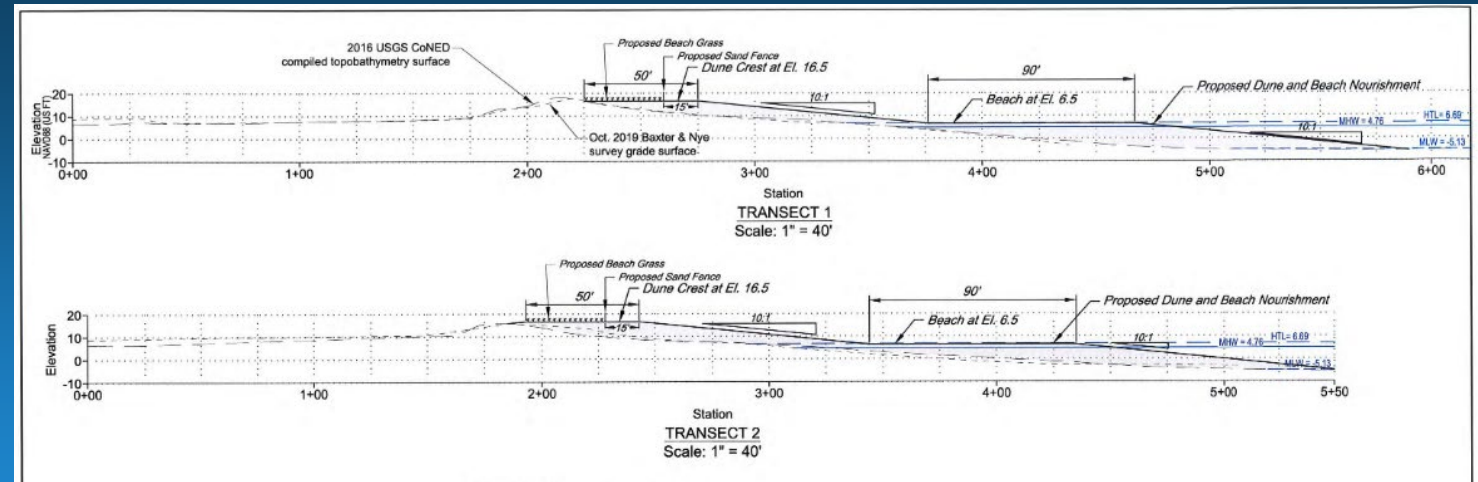


Figure D-1. Map showing locations of the key project components.



# Large Scale Beach and Dune Nourishment Design

- Beach and dune nourishment along the 3.8 miles of the Duxbury Beach Reservation property
- Dune crest elevation of 16.5 feet (NAVD88) and width of 50 feet
- Beach berm elevation of 6.5 feet (NAVD88) and width of 90 feet
- Dune will be planted with low-density beach grass, in areas where woody vegetation already exists, woody shrubs
- Would require approximately 997,600 cubic yards of sediment
- Designed to provide protection from a 50-yr storm event



# Plymouth Long Beach Mixed Sediment Nourishment



Source: Town of Plymouth

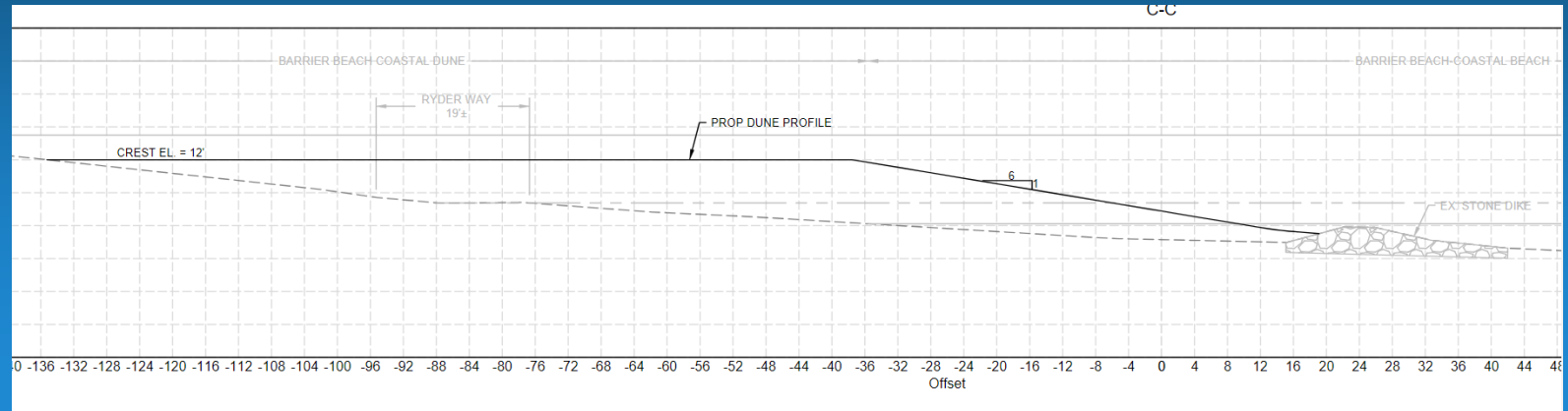


Source: Town of Plymouth

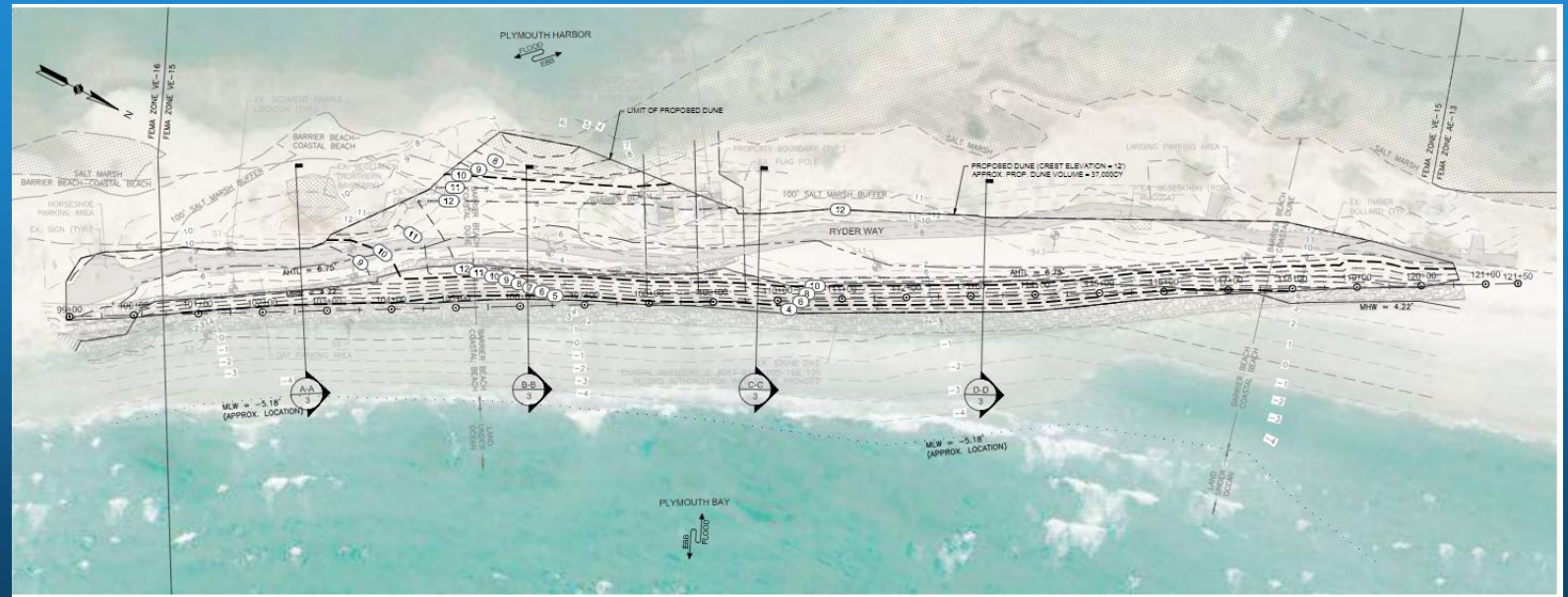


# Plymouth Long Beach Mixed Sediment Nourishment Project

- Footprint of the mixed sediment nourishment will be 2,000 linear feet.
- Dune will be constructed landward of existing stone dike.
- Dune will slope up from the base of the dike, 1:6 (V:H) slope, to an elevation of 12.0 NAVD 88
- Will require approximately 35,600 cubic yards of sand and cobble sediment
- Designed to provide protection from a 50-yr storm event



Source: FOTH



Source: FOTH

# Beach and Dune Nourishment for the Towns of Marshfield and Duxbury



Figure D-15. Beach/dune nourishment alternatives considered for Rexhame Public Beach.



Figure D-24. Nourishment alternatives considered for Fieldston and Sunrise Beaches.



Figure D-20. Dune nourishment alternatives considered for Winslow Ave. Beach.



Figure D-36. Nourishment alternatives considered for Bay Ave. and Gurnet Rd. Beaches.

Source: WHG

# North Scituate Beach Nourishment



Source: Town of Scituate

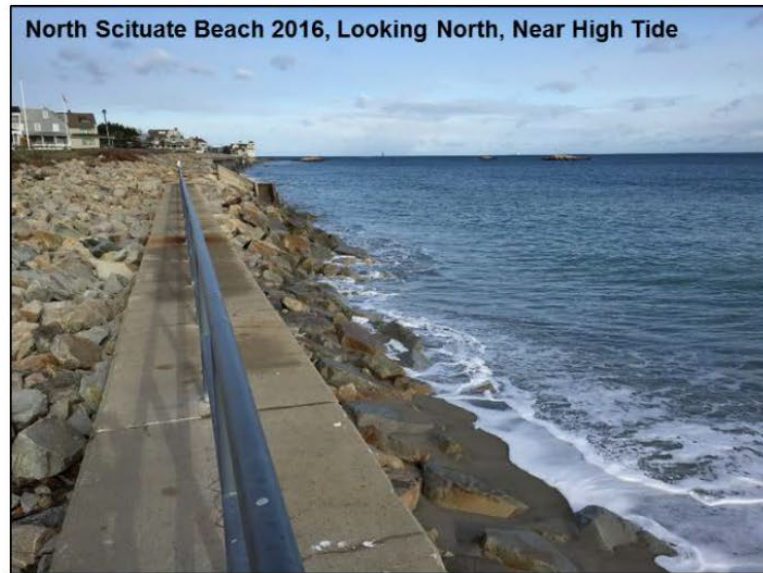
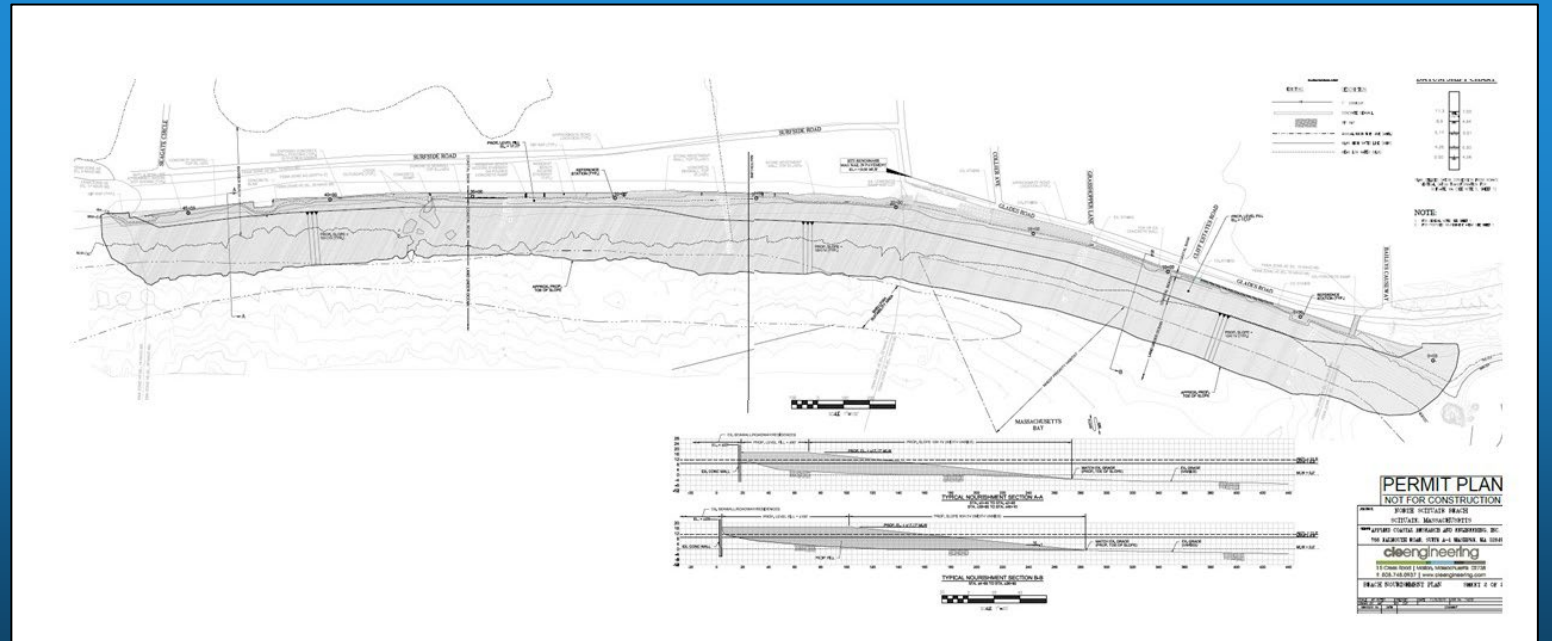


Figure 2.1 Photographs of North Scituate Beach from 2016 (left) at the time of high tide and likely in the early 1900s (right) indicating the location of the high water line. As shown, significant landward migration of the high water line has occurred over the past 100 years.

Source: Applied Coastal Research and Engineering

- Preliminary design is for a beach nourishment project will have a total length of 4,900 linear feet
- The northern section of the project area will have a 100 lf wide beach crest and the southern section will have a 50 lf wide beach crest.
- Beach berm elevation of 12 feet (NAVD88)
- Seaward face of nourishment will have a 1:10 (V:H) slope
- Will require approximately 392,000 cubic yards of sediment
- Designed to provide protection from a 50-yr storm event



Source: cleengineering

- Landscape scale beach and dune nourishment restores the functions of the landform for storm damage prevention and flood mitigation benefits
- These functions and values have frequently been degraded by previous activities
- Significant site characterization and feasibility analysis needs to be performed to determine if landform restoration is viable and to inform design – can have a multi-year timeline
- Requires significant outreach in order to build public support
- Need to address potential private property considerations
- Potentially extensive environmental review and permitting timeline
- Scale of larger projects may necessitate phased construction due to cost and logistics

# Thank you!

Jason Burtner

CZM South Shore Regional Coordinator

[jason.burtner@mass.gov](mailto:jason.burtner@mass.gov)

[www.mass.gov/czm](http://www.mass.gov/czm)



# Narragansett Bay – Rose Larissa Park

## Leah Feldman

*Coastal Policy Analyst*

*Rhode Island Coastal Resource Management Council  
(CRMC)*

# Living Shoreline Erosion Control Project at Rose Larisa Park in East Providence, RI

A partnership between the Coastal Resources Management Council, The City of East Providence, The Nature Conservancy, NOAA, and 11<sup>th</sup> Hour Racing

**Leah Feldman**

Coastal Policy Analyst, Coastal Resources Management Council

Presentation for the Climate Adaptation Forum

December 9<sup>th</sup>, 2022



# Overview of the Presentation

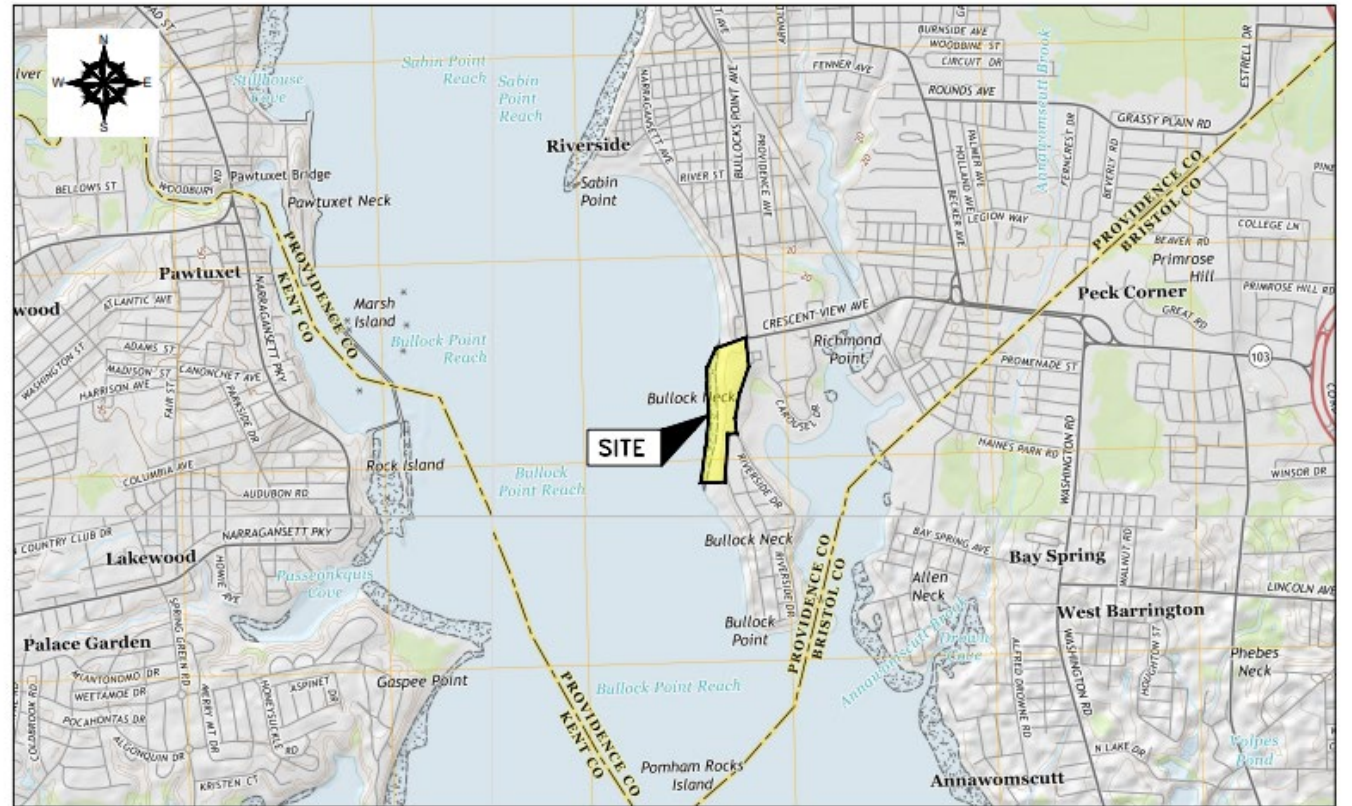
- 1) Overview of the site location, Crescent Park / Bullocks Point / Rose Larissa
- 2) Overview of the agencies involved & their roles
- 4) Overview of the hybrid (“hard” and “soft” elements) project design concepts
  - Phase I: construction of intertidal sill
  - Phase II: bluff treatment
- 5) Overview of the “living shoreline” landscape in RI
- 6) Monitoring Plan
  - Topographic surveys, photographic documentation, and vegetation monitoring

# ROSE LARISA LIVING SHORELINE PROJECT

Lat: 41.754329°N

Long: -71.361472°E

Plat number 414, Lots  
7, 8, 8.1)



## PROJECT LOCUS MAP

SOURCE: USGSSTORE.GOV

0 1000' 2000' 4000' 6000'

SCALE: 1 INCH = 2000 FEET

BASE MAP FROM THE FOLLOWING RHODE ISLAND  
USGS QUADRANGLE MAPS:

EAST PROVIDENCE (2015), PROVIDENCE (2015),  
BRISTOL (2015), EAST GREENWICH (2015)

DIGITAL TOPOGRAPHIC MAPS PROVIDED BY USGSSTORE.GOV.

CONTOUR ELEVATIONS REFERENCE NAVD 88.  
CONTOURS ARE SHOWN IN FEET AT 10 FOOT INTERVALS



QUADRANGLE LOCATION

# 1) Overview of the site location, Crescent Park / Bullocks Point / Rose Larissa Park

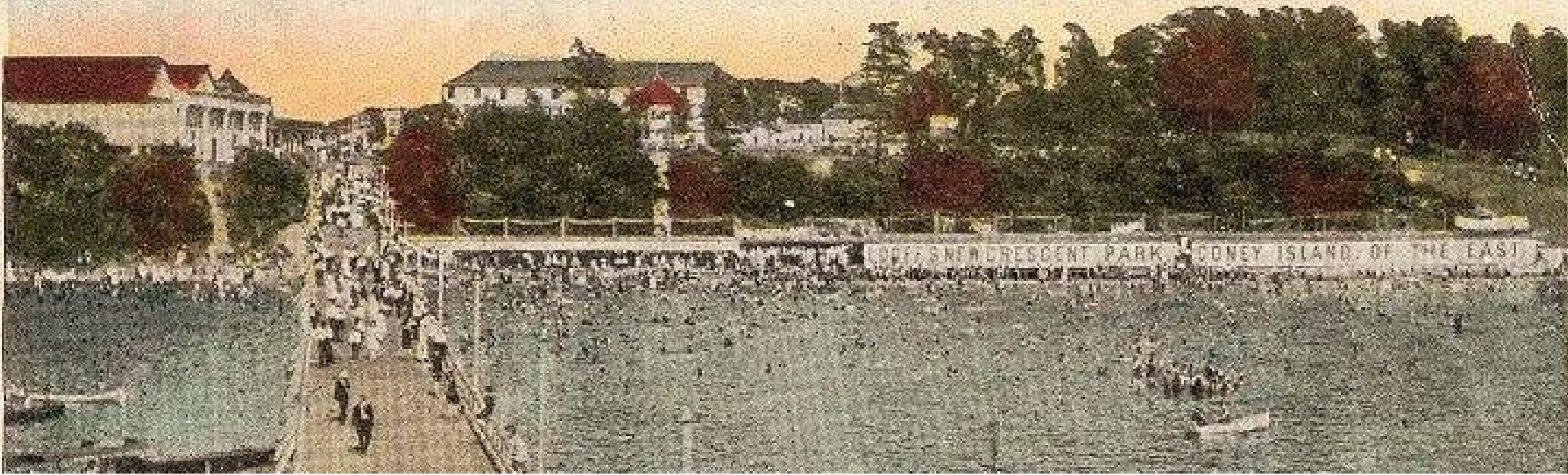
Steep Coastal Bluffs rise 20 to 30 feet above the narrow beach. Erosion has carved out the lower third of the bluff in several areas.

Previous efforts to reduce erosion through traditional practices such as riprap, bulkheads and seawalls, have failed, and their remnants are still very much a feature of the beach. Debris comprised of large concrete slab sections over 20 feet long sit at the bottom of the bluff.

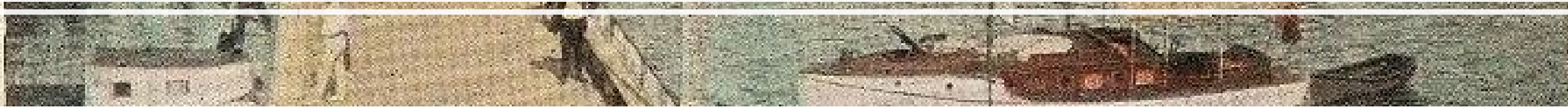
- These erosion control methods do offer protection against storm-induced erosion, but to the detriment of beach and bluff habitat.



Looff's New Crescent Park C.1923  
Coney Island of the East



Former site of "Crescent Park"





Former site of "Crescent Park"

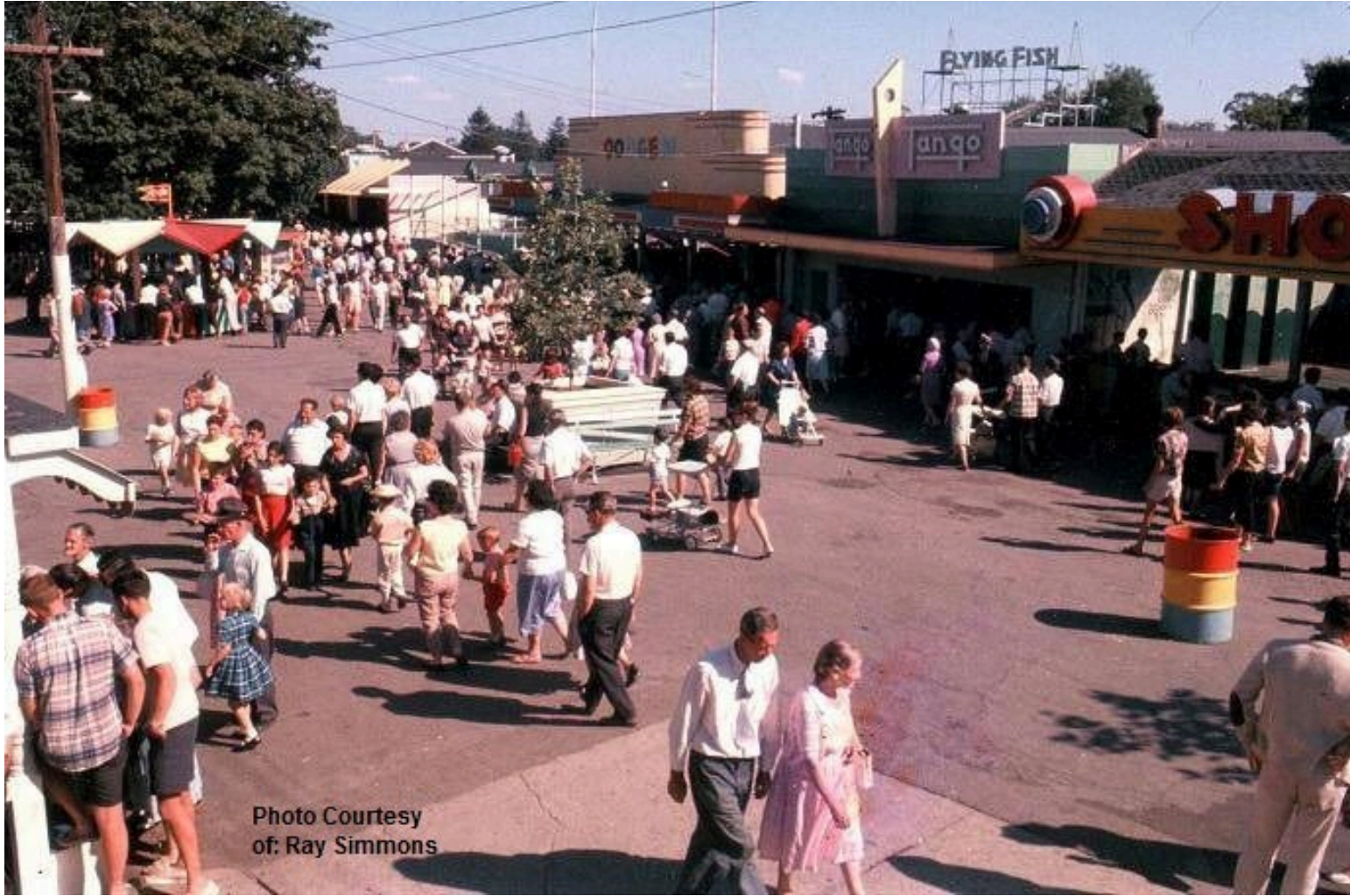


Photo Courtesy  
of: Ray Simmons

Photo Courtesy of:  
Ray Simmons

# The New Crescent Park

NARRAGANSETT BAY R.I.

G. B. BOYDEN,  
PROPRIETOR

REEVES AMERICAN BAND

STEAMBOAT & RAIL ROAD EVERY HALF HOUR

BEST OF SHORE DINNERS  
EXTENSIVE PARADE GROUNDS  
FOR MILITARY OR OTHER ORGANIZATIONS

MADE WITH THE PATENTED "REVEALING" PROCESS

## 2) The Agencies Involved & Their Roles

**NOAA** – this project was part of a larger regional initiative, funded by NOAA and managed by the Nature Conservancy, to learn how living shorelines perform in New England.

**GZA** – provided engineering design, permitting support, and construction services for the design and construction of two bluff erosion control treatments

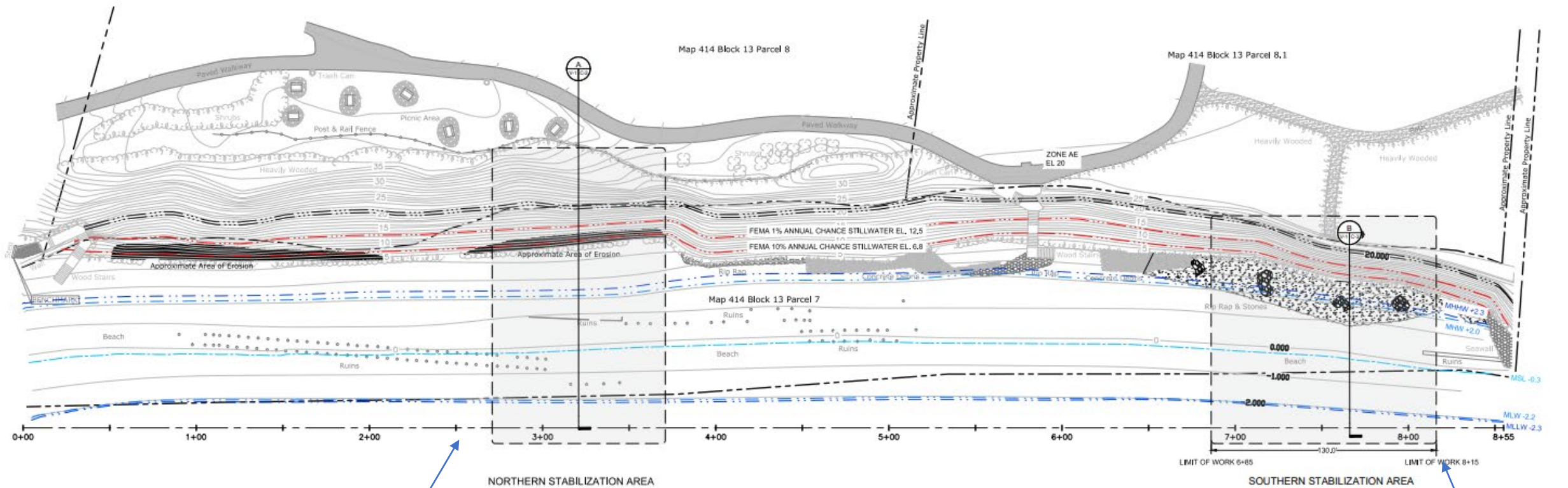
**CRMC** – permitting agency and administrator of the Coastal and Estuarine Habitat Restoration Trust Fund, which helped fund the project

**The Nature Conservancy** – lead funding agency and project lead

**11<sup>th</sup> Hour Racing** - Additional matching funds for the project were provided by 11<sup>th</sup> Hour Racing for two years of construction and maintenance

**SumCo Eco-Contracting** – performed construction and maintenance of the project

# 4) Overview of the hybrid (“hard” and “soft”) project design concepts



Phase II: Bluff Treatment

Phase I: Intertidal Sill





## 4) Overview of the hybrid (“hard” and “soft” elements) project design concepts

---

- Phase I: construction of intertidal sill
  - Low stone structures topped by seawater at high tide, about 3 feet high at low tide
  - Sand fill added landward of the sill and planted in order to create saltmarsh.



May 2020



# May 2020



May 2020



May 2020





July 2020



August 2020



Present Day





## 4) Overview of the hybrid (“hard” and “soft” elements) project design concepts – Phase II

---

- Phase II: bluff treatment
  - Stone at the base and logs made of coconut fiber father up the slope
  - Planted with native vegetation

# April 2020







April 2020

July 2020





August 2020



Present Day



Present Day



# Avoidance, Minimization and Mitigation

- Grading took place over the entire project area landward and was limited to the minimum amount of fill needed to establish a flat surface to complete the sill and subsequently plant the area behind the sill
- Work was completed at low tide in order to limit turbidity
- Work was completed after the sill was put in place in order to limit turbidity landward of the sill
- 25 cubic yards of concrete from a 500 square foot area were removed and disposed of at a legal offsite location in order to offsite the sill placement in the intertidal area.



## 5) Overview of the Landscape for Living Shorelines in RI

- Increasing demand for erosion control and protection from area homeowners and businesses.
  - 2020 Staff Report indicated 47 applications for shoreline protection projects within a mile of Rose Larisa Park. Ten of these applications were for new shoreline protection structures, 36 were to maintain or replace existing structures, and one was for a non-structural treatment.



## 6) Monitoring Plan

- Topographic surveys, photographic documentation, and vegetation monitoring are to be done for 5 years post-installation.
- Visual inspection and photo documentation
- Vegetation Surveys





# Thank you!

Leah Feldman

Coastal Policy Analyst

Coastal Resources Management Council

[lfeldman@crmc.ri.gov](mailto:lfeldman@crmc.ri.gov)

[www.crmc.ri.gov](http://www.crmc.ri.gov)

Crescent Park Images: <https://www.crescent-park-ri.com/lifestyle>



# Regulatory Challenges and Opportunities for Living Shorelines in New England

**Alison Bowden**

*Director of Science & Strategy  
The Nature Conservancy (TNC)*

# Regulatory Challenges and Opportunities for advancing Living Shorelines in New England



**Alison A. Bowden (she/her)\*<sup>1</sup>** **Stephen J. Kirk<sup>1</sup>,** **Theresa M. Davenport\*<sup>1,2</sup>**

<sup>1</sup>The Nature Conservancy – Massachusetts

<sup>2</sup>Current: Louisiana State University AgCenter

Former: Northeastern University, TNC Massachusetts

The Nature Conservancy 

 Northeastern  
Marine Science Center

 @alison\_bowden



Maquoit Bay Conservation Lands,  
Brunswick, ME, USA (P. Slovinsky)

## THE NATURE CONSERVANCY'S 2030 GOALS

**3Gt CO<sub>2</sub>e**

AVOIDED OR  
SEQUESTERED  
PER YEAR

### TACKLING CARBON EMISSIONS

**WHAT:** We will avoid or sequester 3 billion metric tons of carbon dioxide emissions (CO<sub>2</sub>e) annually—the same as taking 650 million cars off the road every year.

**HOW:** Using the power of nature and strength of policy and markets to store carbon, support the renewable energy build-out, and reduce emissions equivalent to nearly 10% of global emissions from fossil fuels.

**100M**

PEOPLE  
BENEFITTED

### HELPING PEOPLE ON THE FRONT LINES OF THE CLIMATE CRISIS

**WHAT:** We will help 100 million people at severe risk of climate-related emergencies such as floods, fires and drought.

**HOW:** Protecting and restoring the health of natural habitats—from mangroves and reefs to floodplains and forests—that help protect communities from storm surge, extreme rainfall, severe wildfire and sea level rise.

**4B**

HECTARES  
CONSERVED

### DEEPENING SOLUTIONS FOR OUR OCEAN

**WHAT:** We will conserve 4 billion hectares of ocean—more than 10% of the world's ocean area.

**HOW:** Making sure the ocean thrives through new and better-managed protected areas, global-scale sustainable fishing, innovative financing and positive policy changes to how the world governs the seas.

**650M**

HECTARES  
CONSERVED

### SAVING HEALTHY LANDS FOR A HEALTHIER PLANET

**WHAT:** We will conserve 650 million hectares of lands, such as forests and grasslands—an area twice the size of India.

**HOW:** Partnering with communities across the globe to restore and improve management of working lands, support the leadership of Indigenous Peoples as land stewards, and conserve critical forests, grasslands and other habitats rich in carbon and biodiversity.

**1M**

KM OF RIVERS  
CONSERVED

### CONSERVING THE WORLD'S FRESHWATER

**WHAT:** We will conserve 1 million kilometers of river systems and 30 million hectares of lakes and wetlands—enough river length alone to stretch across the globe 25 times.

**HOW:** Engaging in collaborative partnerships and promoting innovative solutions and policies that improve the quality and amount of water available in freshwater ecosystems and to communities.

**30M**

HA OF LAKES &  
WETLANDS  
CONSERVED

**45M**

PEOPLE  
SUPPORTED

### WORKING ALONGSIDE LOCAL LEADERS WHO ARE LIGHTING THE WAY

**WHAT:** We are supporting the leadership of 45 million people from local and Indigenous communities whose well-being and livelihoods depend on healthy ocean, freshwater and lands.

**HOW:** Partnering with Indigenous Peoples and other communities to learn from and support their leadership in stewarding the environment, securing rights to resources, improving economic opportunities, and shaping their future.

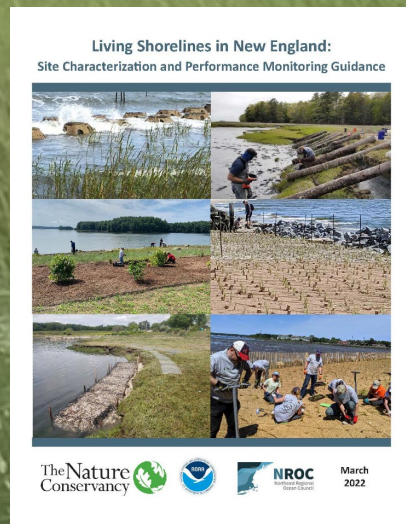
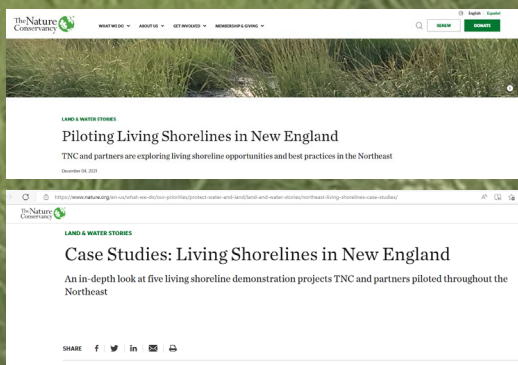
# Today's talk mirrors this report



[https://bit.ly/NROC\\_LSGGroup](https://bit.ly/NROC_LSGGroup)  
case sensitive

Links to all living shorelines reports and stories:

- Case studies
- Monitoring Guidance



Stratford Point, CT, USA (J. Mattei)



## Regulatory Challenges and Opportunities for Living Shorelines in New England

**Suggested citation:** Davenport, T.M., S.J. Kirk., and A.A. Bowden. 2022. Regulatory Challenges and Opportunities for Living Shorelines in New England. Boston, MA: The Nature Conservancy.

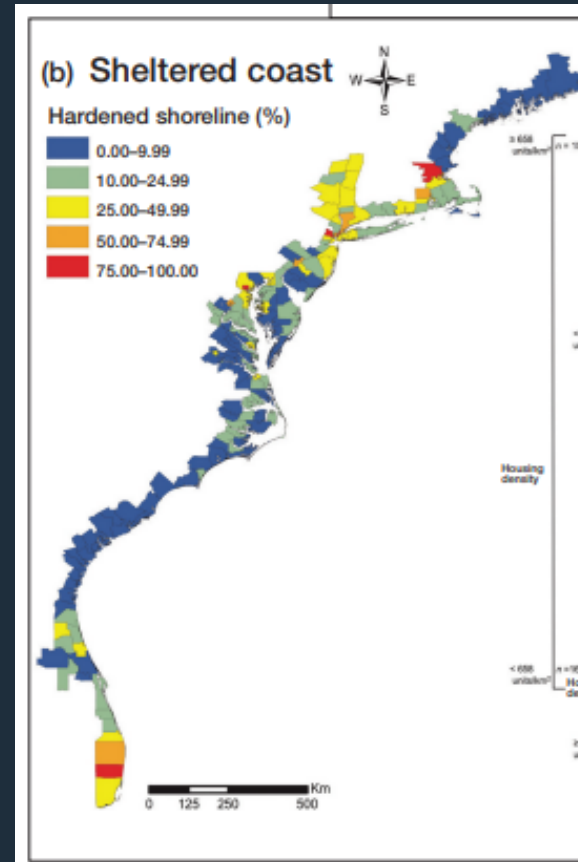


March  
2022



# Coastal hazards threaten resilience

- Coastal erosion and flooding – exacerbated by sea level rise
- Concentrated human activities near the coasts
- Tend to lead to shoreline hardening



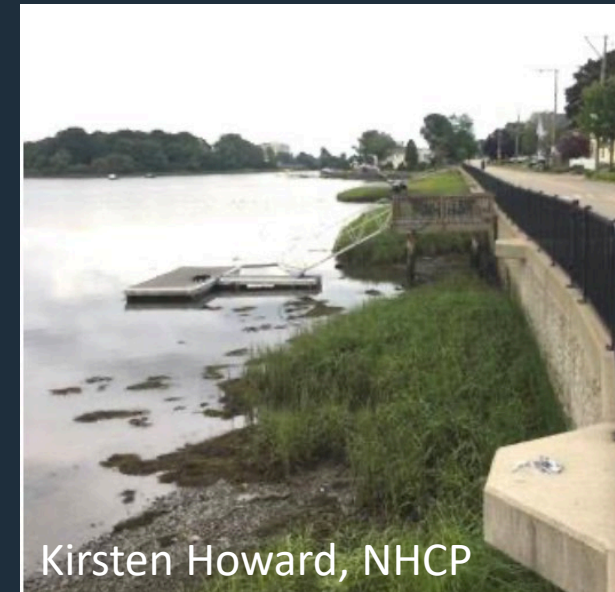
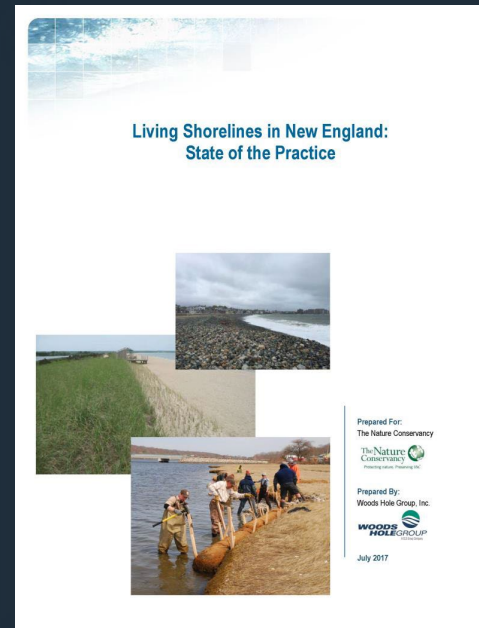
Wagon Hill Farm, Durham, NH;  
NHDES/NHCP; Pre-LS construction

Maquitt Bay Conservation Lands,  
Brunswick, ME, MGS; July 2018

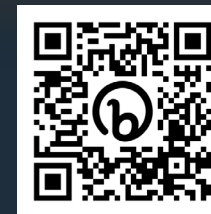
Adapted from Gittman et al. (2015)

# Living Shorelines in New England

- New England salt marshes subject to high development and reduced sediment supply
  - **Coastal squeeze:** Habitat migration from rapid SLR + armored shorelines
- 2017 State of the Practice Report
  - [https://bit.ly/NROC\\_LSGroup](https://bit.ly/NROC_LSGroup)
- Living shorelines a potential strategy to reduce coastal squeeze and maintain a dynamic land-water interface



Kirsten Howard, NHCP



# Clean Water Act: a match for living shorelines?

- The Clean Water Act of 1972 (CWA): prevent environmental degradation to waters of the U.S. caused by development
  - primary federal law that regulates living shorelines
- U.S. Army Corps of Engineers (USACE) federal permitting process / regulations
  - Sequential minimization: avoid, minimize, mitigate
    - Prefer resource avoidance
  - Higher regulatory scrutiny for projects with any impacts below jurisdictional boundaries
  - Consultations (NOAA/NMFS, USFWS)

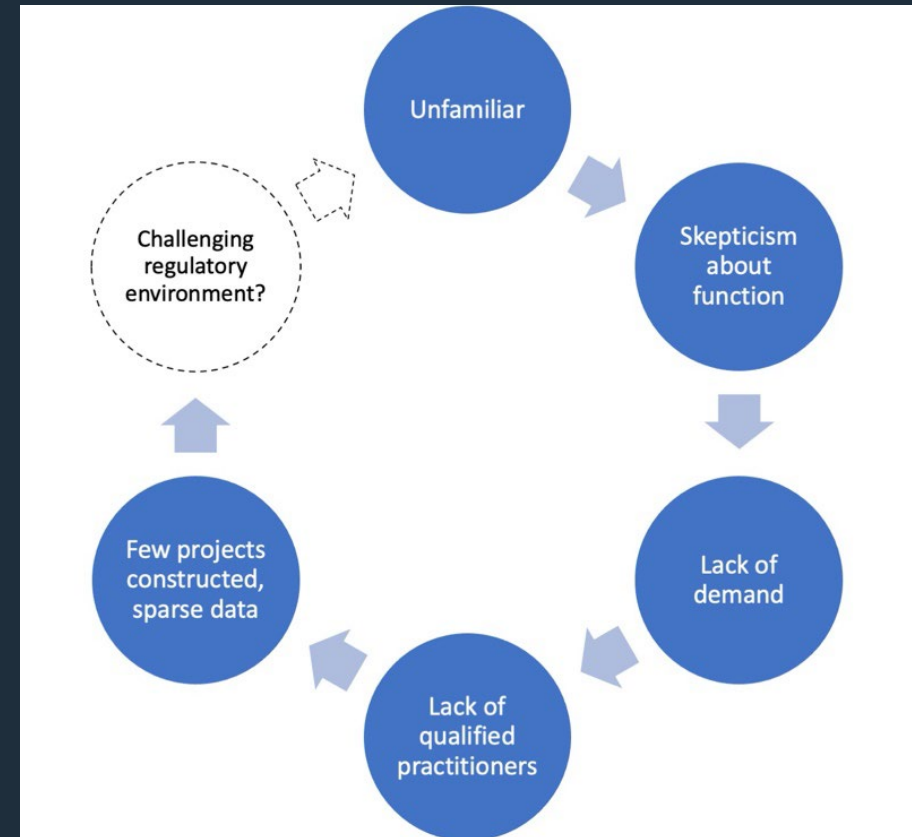



Collins Cove, MA, Mass CZM

Replanting marsh grasses in the intertidal zone

# Living shorelines in New England lag other regions

- Newer techniques in New England – few examples in this region
- Northeast Regional Ocean Council Coastal Hazards Group interested in using living shorelines to increase coastal resilience
  - To do this, identify why adoption of living shorelines in New England is low compared to other regions
  - part of a reinforcing feedback cycle?



The background of the slide is a photograph of a coastal area. In the foreground, there are several large, grey, cylindrical concrete structures with circular openings, arranged in a line. These structures are partially submerged in the water. The water is a light blue color, and the sky is a pale, hazy blue. The overall scene suggests a coastal defense or erosion control project.

# Does a challenging regulatory environment limit the adoption of living shorelines in New England?

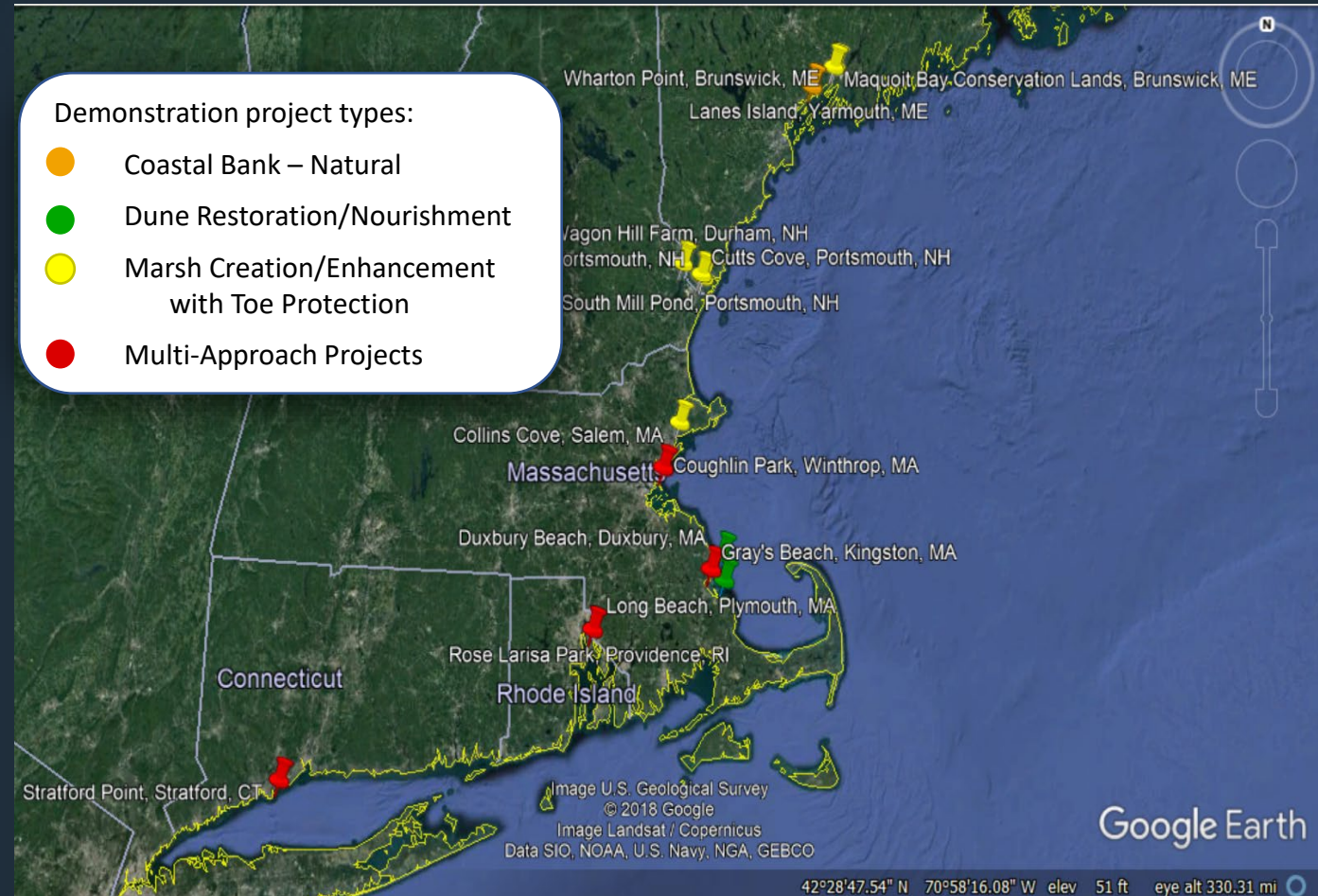
3 objectives:


1. Document permitting experiences
2. Regulatory requirements for living shorelines: state, region, federal
3. Synthesize challenges and opportunities for advancement



# Methods: Leveraging a Coastal Resilience Grant

- **Coastal Resilience Grant (2017-2022):** Construct and/or support living shorelines demonstration projects in each coastal New England state
  - Grant project team: > 15 partners, including coastal managers, scientists and/or academics from each state
- Examine the regulatory and permitting environment:
  - Conduct interviews on permitting experiences (Obj 1)
  - Summarize regulatory requirements for living shorelines: federal, region, state (Obj 2)
  - Identify challenges and opportunities for advancement (Obj 3)






Objective 2:  
summarize  
regulatory  
requirements

## Appendix 2: Regulatory processes and guidance for living shorelines in New England, USA

<b>Appendix 2: Regulatory processes and guidance for living shorelines in New England, USA.....</b>	<b>55</b>
<i>Federal environmental regulatory requirements for living shorelines.....</i>	<i>55</i>
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Each New England state has its own USACE General Permit – an uncommon approach



Objective 3:  
synthesize  
regulatory  
successes,  
challenges and  
opportunities

A section in the report:

## Regulatory Successes, Challenges, and Opportunities

---

### Successes:

- All 5 states list some regulatory preferences for living shorelines
- Require consideration of sea level rise impacts on projects
- Interviewees already had high familiarity with their state permitting processes and regulatory personnel

### Challenges:

- Interviewees identified some common threads
- Often, challenges were related to the federal regulatory process



# Challenge 1: The current process was not designed for living shorelines and may disincentivize their use

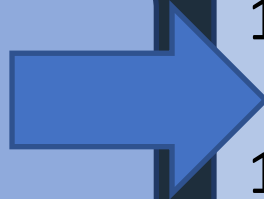
- 1.1 Strict **resource avoidance** favors structural approaches to shoreline stabilization
- 1.2 Lack of review **consistency**
- 1.3 Lack of review **capacity**
- 1.4 **Cumulative impacts** of projects are inadequately considered

**Resource avoidance:** may be easier to avoid impacts in the intertidal zone with hardening

Without **design standards**, rely on individual reviewer interpretation

# Opportunity 1: Adjust regulatory content and processes to better account for living shorelines/NBS

- 1.1 Strict **resource avoidance** favors structural approaches to shoreline stabilization
- 1.2 Lack of review **consistency**
- 1.3 Lack of review **capacity**
- 1.4 **Cumulative impacts** of projects are inadequately considered



- 1.1 Document cumulative impacts: fuller understanding of project impacts
- 1.2 Enhance review consistency: establish a shared understanding of how to minimize resource impacts, develop design standards
- 1.3 Increase review capacity: hire staff, provide permitting process guidance

- NBS were not conceived when Clean Water Act was written
- Cumulative impacts assessment – inform decisions around habitat conversion

## Challenge 2: Consideration of future conditions is not prioritized in the permitting process.


- 2.1 **Trade-offs** are inherent among avoiding resource impacts under **current** environmental conditions and sustaining those same resources under **future** conditions
- 2.2 **Documentation and consideration of trade-offs** among present and future conditions is needed

Projects that avoid impacts to the intertidal zone under current conditions may contribute to **coastal squeeze** and **resource loss** or degradation as sea levels rise

## Opportunity 2: Document the assessment of trade-offs when considering cumulative impacts and future conditions.

2.1 **Trade-offs** are inherent among avoiding resource impacts under **current** environmental conditions and sustaining those same resources under **future** conditions

2.2 **Documentation and consideration of trade-offs** among present and future conditions is needed



2.1 Develop **cumulative** impacts assessments under **future** conditions

2.2 Incorporate **future conditions and design standards into decision-making**: develop a process for trade-off assessment

**Make explicit the decision-making around trade-offs – e.g. coastal squeeze**

# Implications and Next Steps

- The challenging regulatory environment likely contributes to lagging adoption of living shorelines in New England
  - Explicitly assess trade-offs under current and future conditions
  - Clarify the use of cumulative resource impacts in decision-making
- Need additional stakeholder perspectives
  - Project partners mostly state scientists and/or academics
  - Need federal regulators, private institutions and individuals
- More widespread adoption of living shorelines in New England
  - where appropriate and in collaboration with federal partners
- Opportunities via infrastructure funding?
  - Develop more projects in New England
  - Increase demand from property owners
  - Raise awareness/knowledge of coastal engineers



# Coastal Hazards Resilience Committee – Projects (11/22)

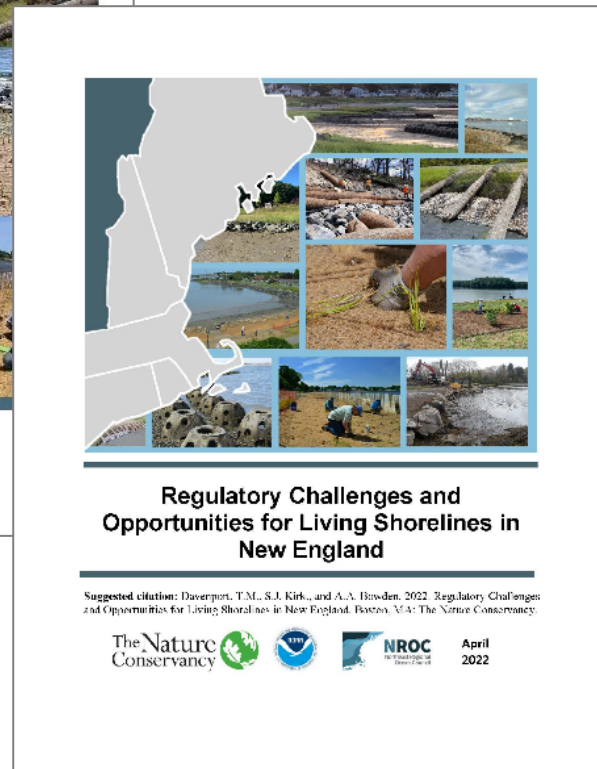
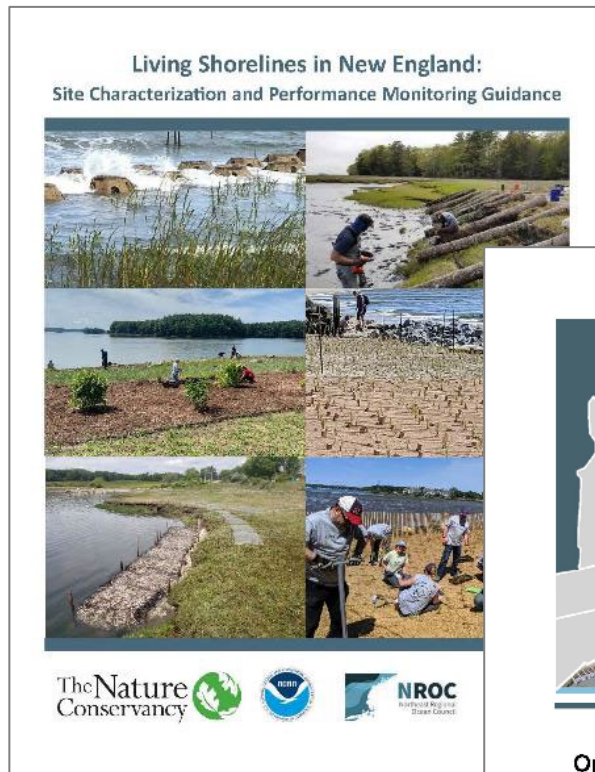
## *Advancing living shorelines in New England - Phase 3*



- Purpose: continue to advance implementation of effective living shoreline projects
- Tasks:
  - Host a forum on regulatory challenges and mitigation opportunities
  - Host a workshop on climate change impacts & potential for habitat conversion for shoreline stabilization/flood control
  - Assess the success of pilot projects & identify best practices
  - Conduct outreach & engagement with property owners, communities, engineers, contractors, etc. to share products of Phase 2 & identify additional lessons learned

# Coastal Hazards Resilience Committee – Projects (11/22)

## *Advancing living shorelines in New England - Phase 3*



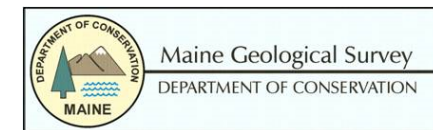
- Contract: The Nature Conservancy
- Possible Partners: USACE & USFWS
- Products:
  - Refined regulatory guidance
  - Workshop summary with potential suitable habitat tradeoffs
  - Updated guide on monitoring techniques
  - Possible fact sheet on effective design & construction tips

# Thank you!

- Project Team interviewees
- Report Reviewers
- Funding:
  - NSF INTERN grant to Dr. Randall Hughes
  - NU PhD Network
- TNC/NU Coastal Sustainability Institute

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tdavenport@agcenter.lsu.edu

## Project partners\*



[https://bit.ly/NROC\\_LSGGroup](https://bit.ly/NROC_LSGGroup)  
case sensitive

\*and others in each state



# PANEL DISCUSSION

**Panel Moderator:** Nasser Brahim, Woods Hole Group

**Panelists:**

- Alison Bowden, TNC
- Leah Feldman, CRMC
- Jason Burtner, CZM
- Stephen Rochette, USACE

# CLOSING REMARKS

**Mark Costa**

*Forum Co-Chair*

*Senior Water Resources Engineer*

*VHB*