Ecomimicry of Coastal Habitats and Processes

New Jersey Coastal Resiliency Collaborative

September 11, 2025

Christopher Streb, PE

Biohabitats

00:14 / 00:31


Red Bull

Control of Nature

Biohabitats


The Worried Engineer

https://www.e-architect.com/wp-content/uploads/2018/12/hunters-point-south-long-island-city-ny-ba141218-bt2.jpg

Ralph Wilson Centennial Park, Buffalo (MVVA)

Ralph Wilson Centennial Park, Buffalo (Flickr)

Teaneck Creek, Bergen County, NJ

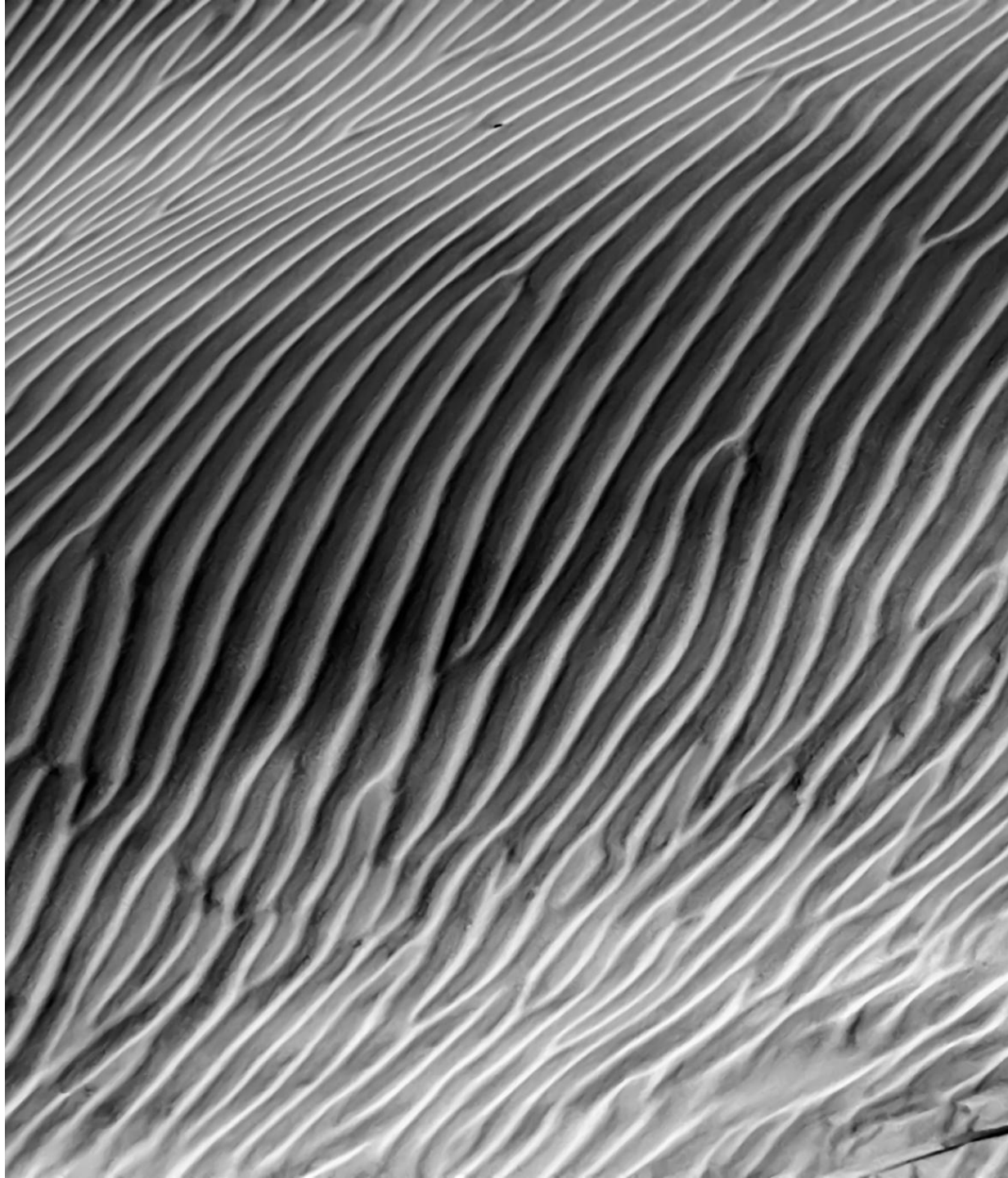
Regenerative Design

Biohabitats

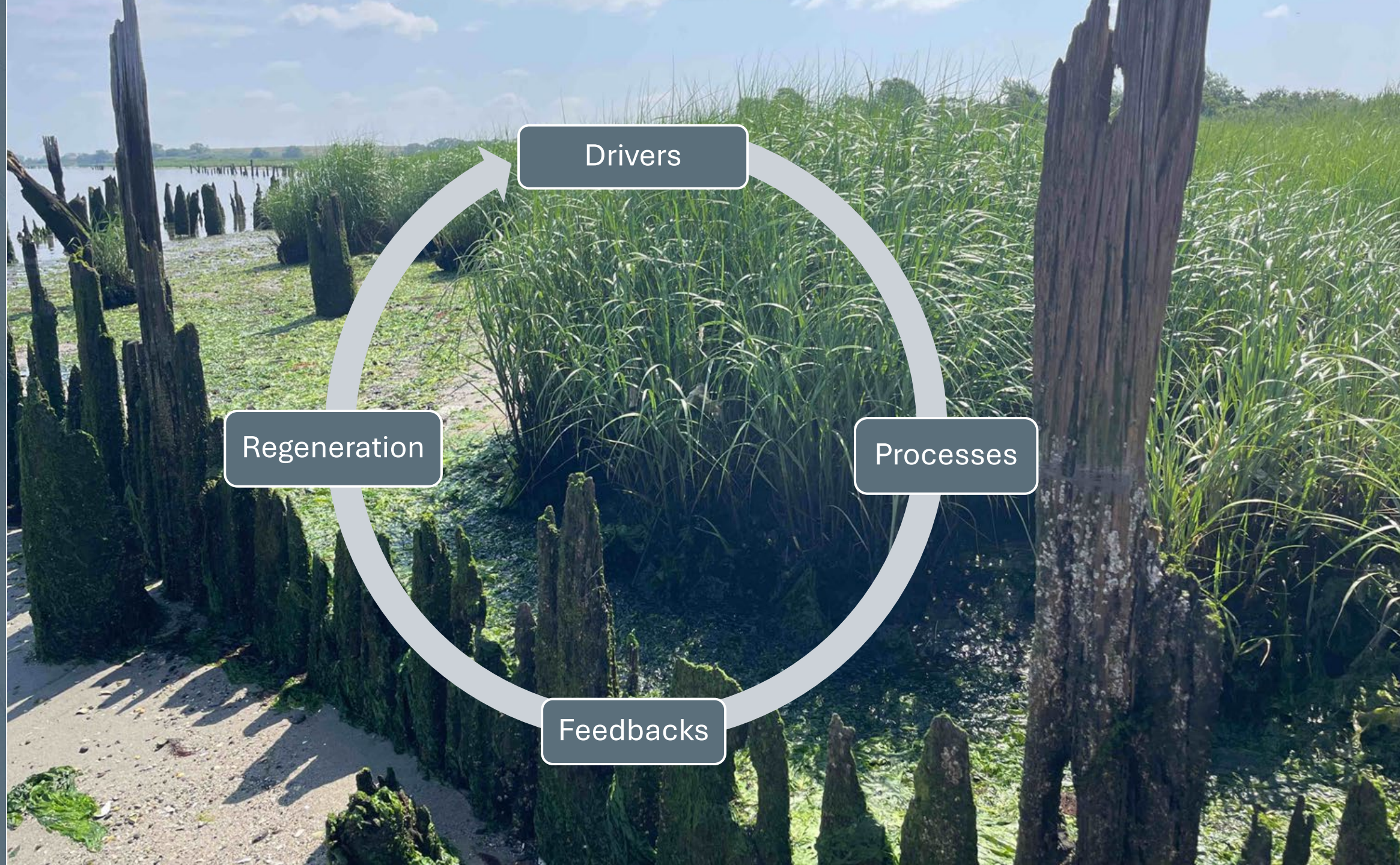
Maximize Process

Key questions

- Are nature-based solutions dynamic?
- Are we leveraging feedback mechanisms?
- Can we embrace complexity and change?
- How much control might we relinquish?



Ecomimicry



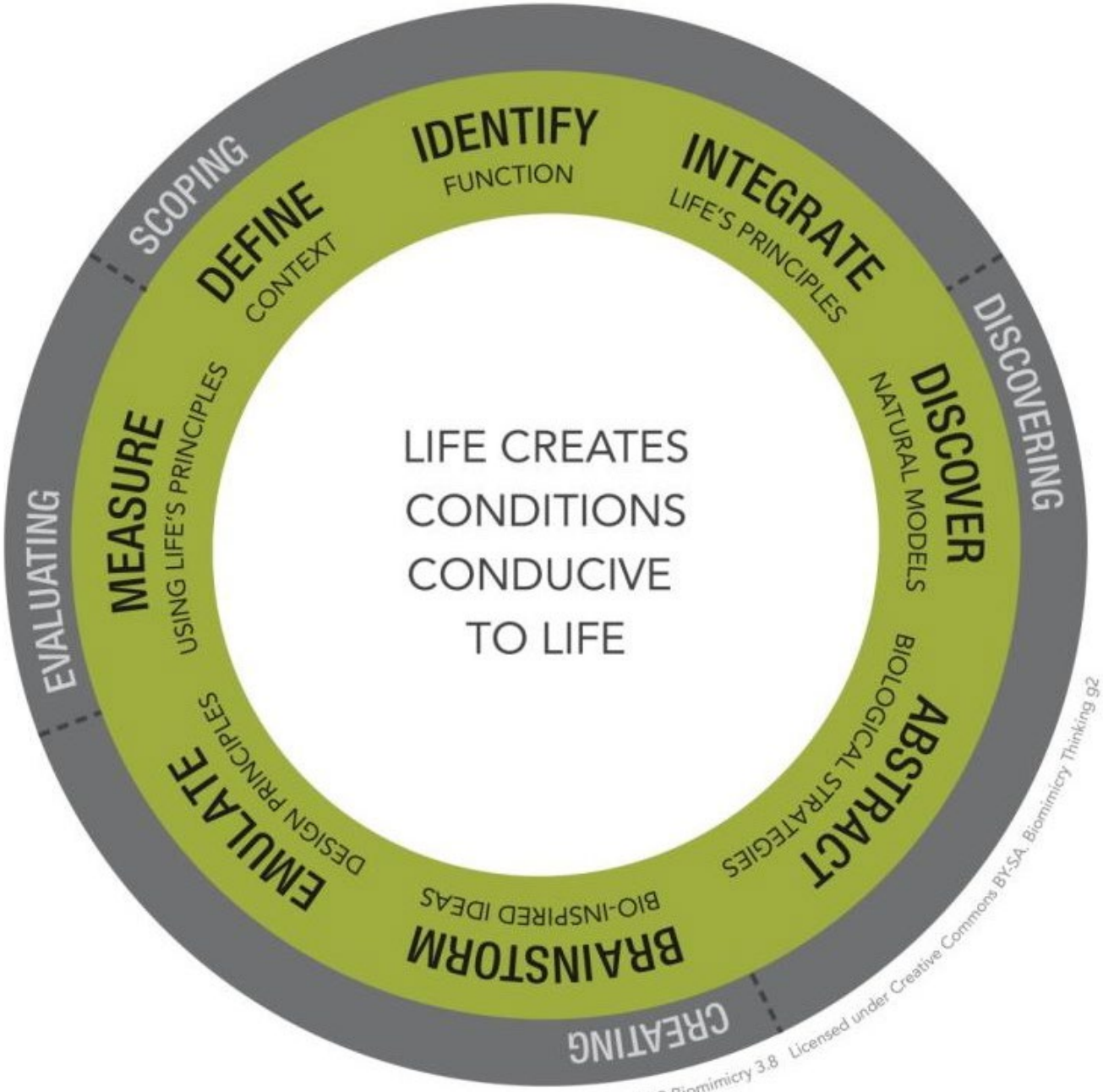
Cuyahoga Green Bulkhead

Reduce attrition and improve survival of larval and juvenile fish in navigation channel

Photo: Jim White

Cuyahoga Green Bulkhead

Biomimicry 3.8

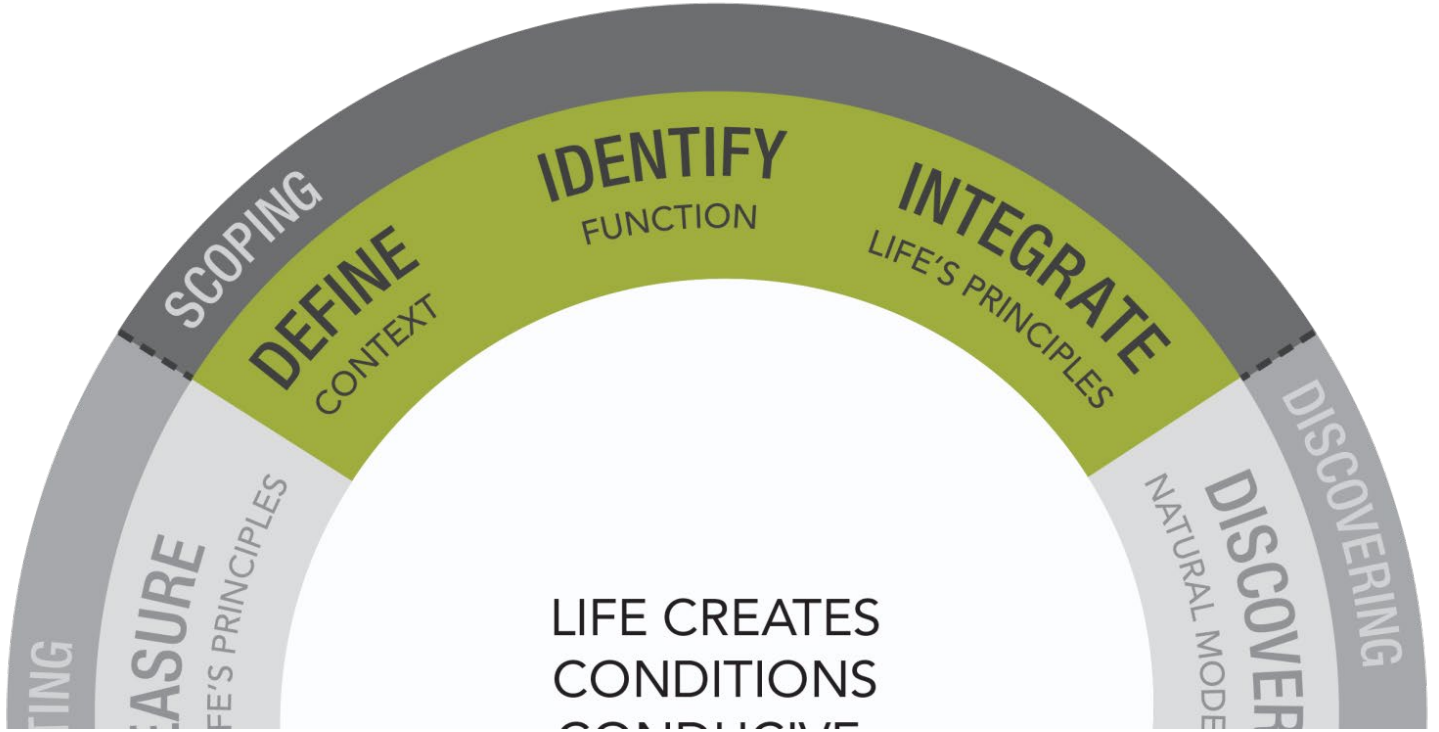


Cuyahoga Green Bulkhead

Scoping

Define Context

- Historical System
- Existing and Future River
- Life cycle of Lake Erie Fish
- Water Quality
- Shipping and Recreational Boater Conflict



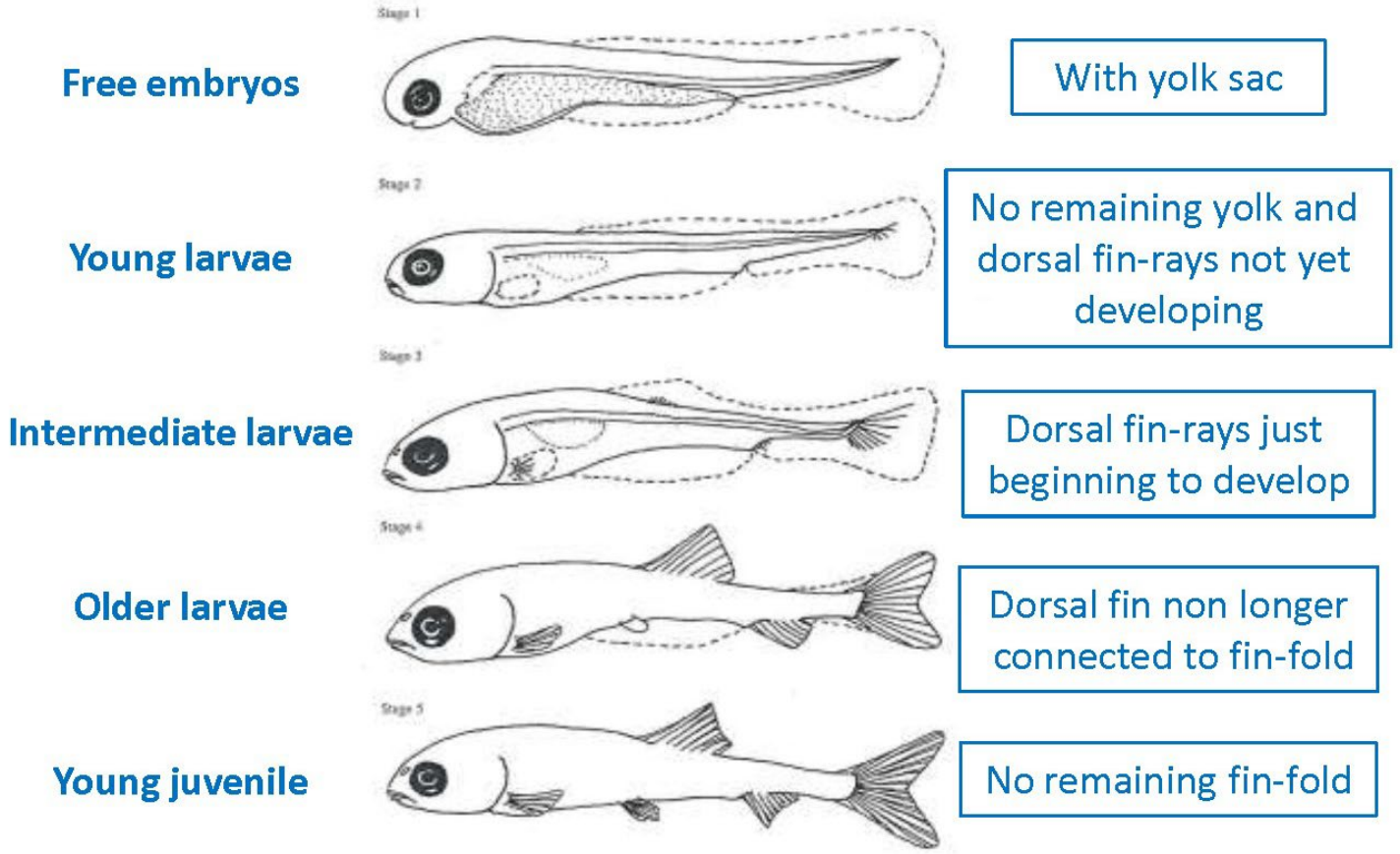
Biohabitats

Cuyahoga Green Bulkhead

Scoping

Define Context

- Historical System
- Existing and Future River
- **Life cycle of Lake Erie Fish**
- Water Quality
- Shipping and Recreational Boater Conflict

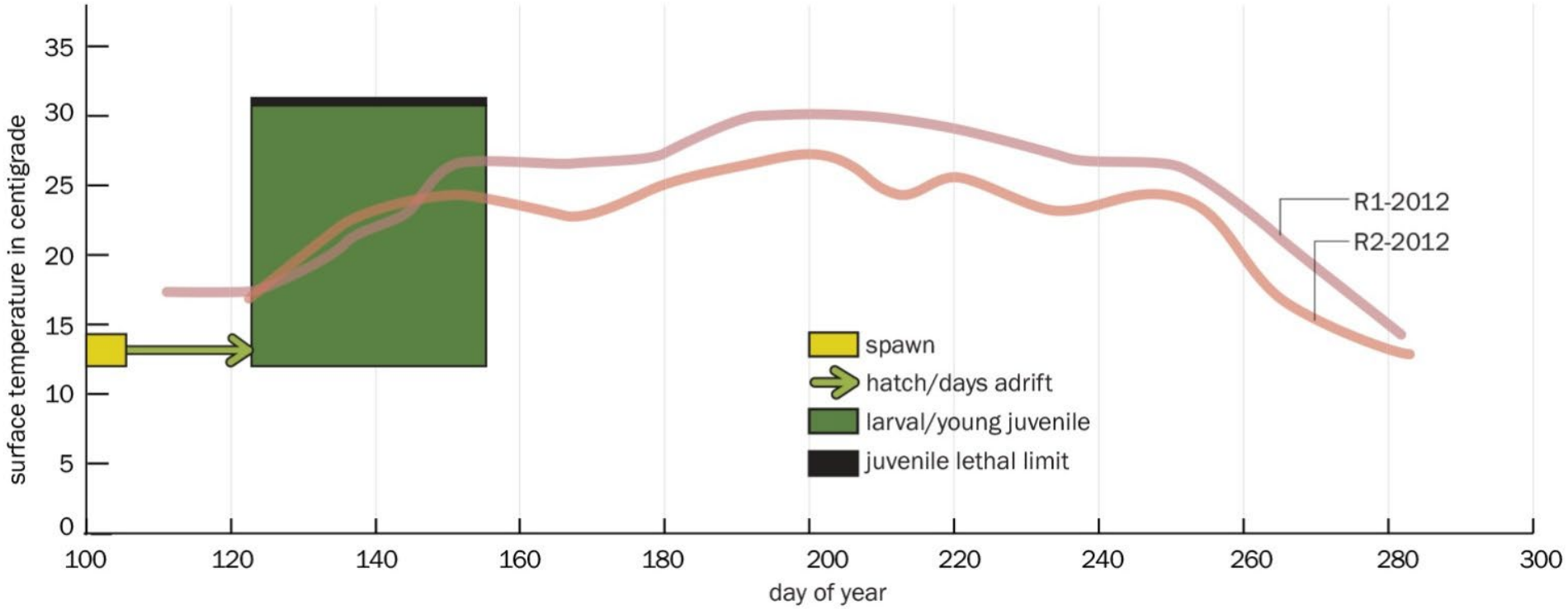


Biohabitats

Scoping

Common Name	Species	General Habitat
White Sucker	Catostomus commersonii	benthic, but varied
Shorthead redhorse	Moxostoma macrolepidotum	littoral
White bass	Morone chrysops	littoral
White perch	Morone americana	littoral
Walleye	Sander vitreus	pelagic
Lake sturgeon	Acipenser fulvescens	benthic
Muskellunge	Esox masquinongy	pelagic

Scoping



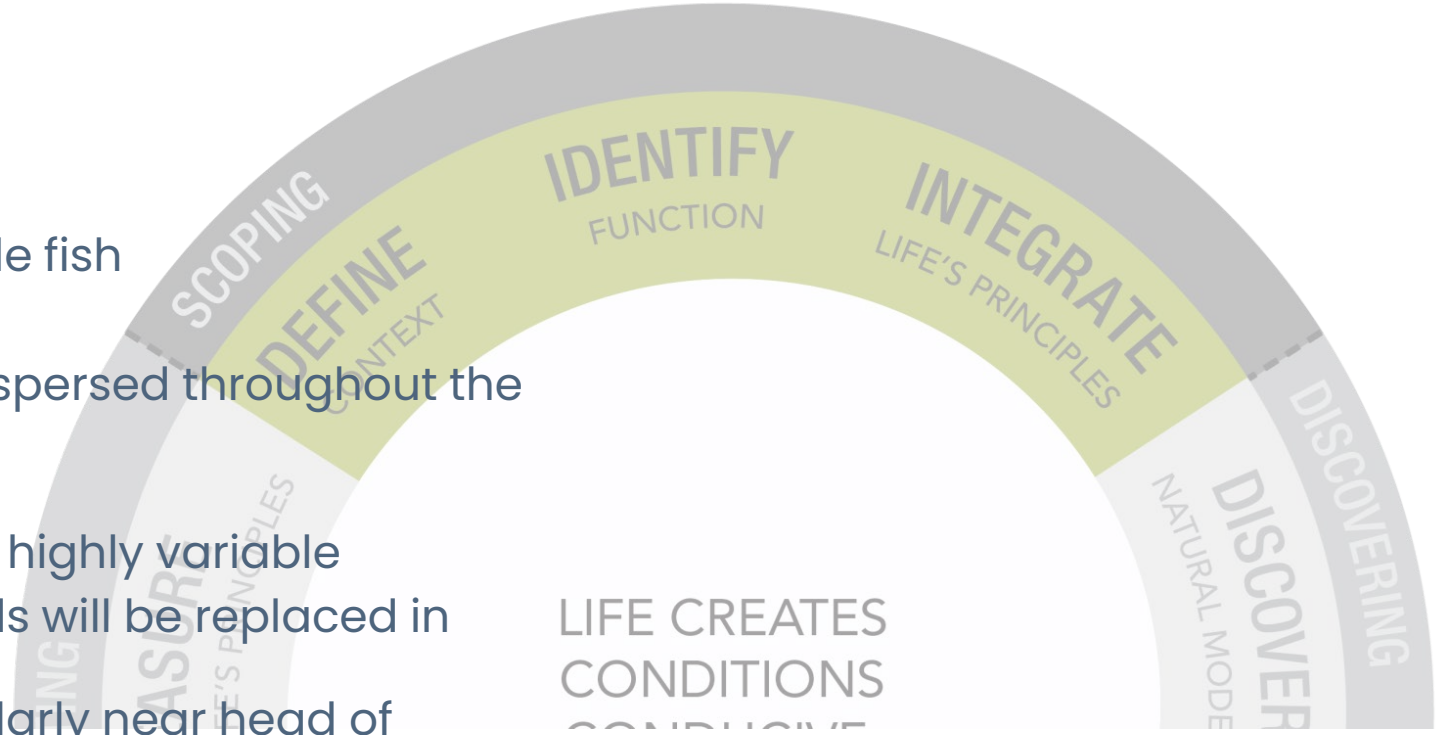
Temperature range and expected time of year for spawning, development and lethal temperatures for white bass using 2012 data at two stations in the Cuyahoga River navigation channel.

Cuyahoga Green Bulkhead

Scoping

Define Context

- Focus on both larval and juvenile fish
- Focus on the littoral zone
- Larvae and juveniles may be dispersed throughout the channel
- River edge is variable
- Condition of existing bulkheads highly variable
- A large percentage of bulkheads will be replaced in near future
- Many industrial outfalls, particularly near head of navigation
- Commercial and recreational use of the River significant
- Shipping industry in the Flats important to the local economy
- Multi-directional forces and flows in the River
- Several planned and on-going habitat restoration efforts



Biohabitats

Cuyahoga Green Bulkhead

Scoping

Identify Function

- Absorb and dissipate energy
- Transport larval and juvenile fish
- Nourish – provide food sources and trap carbon
- Provide shelter and cover
- Enhance dissolved oxygen
- Clean water
- Cool water
- Quiet noise from boat traffic and industry

Scoping

Design Functions

- Nourish – provide food sources and trap carbon
- Provide shelter and cover
- Enhance dissolved oxygen

Siting Criteria

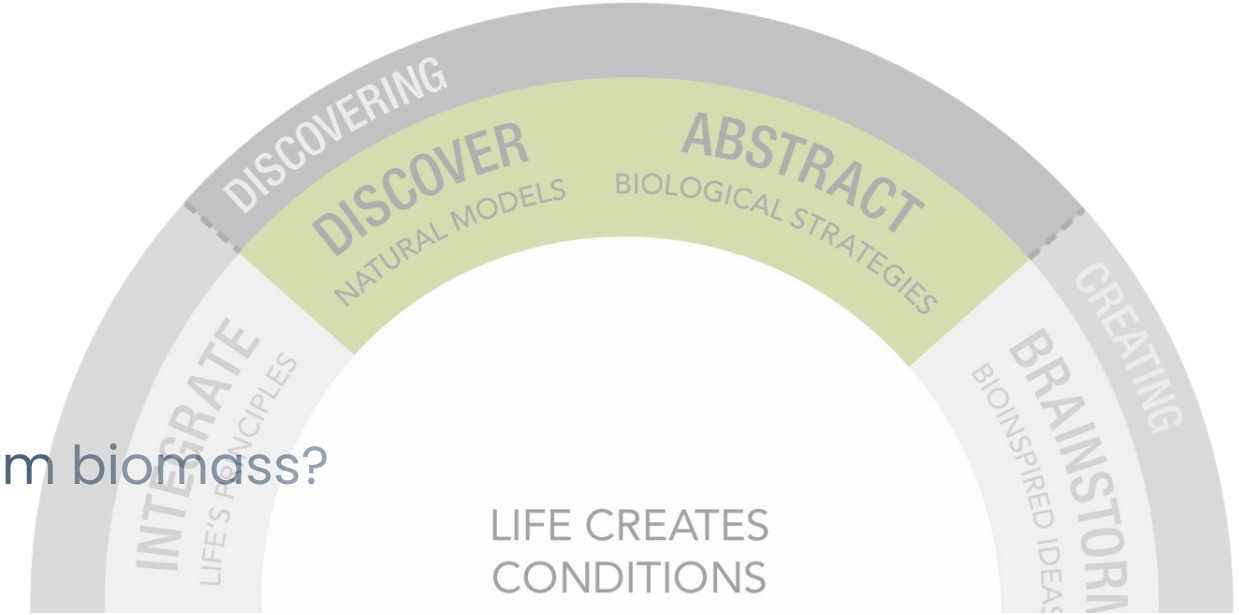
- Absorb & Dissipate Energy
- Cleanish water
- Cooler water

Systemic

- Transport larval and juvenile fish
- Clean water
- Cool water
- Quiet noise from boat traffic and industry

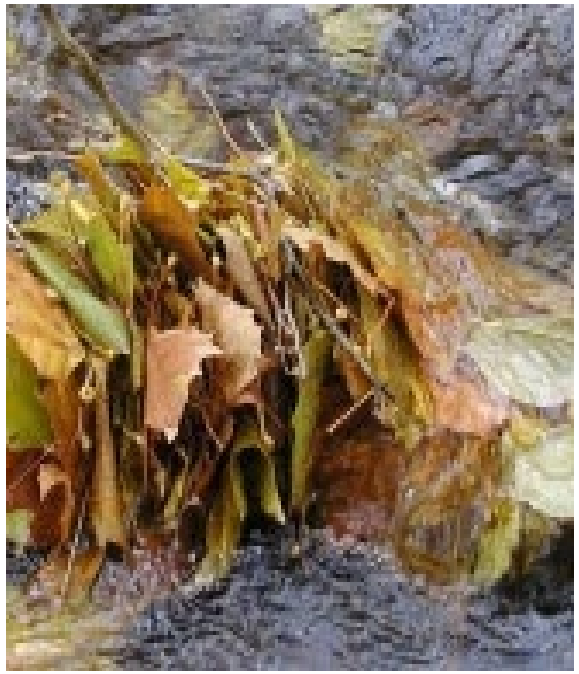
Cuyahoga Green Bulkhead

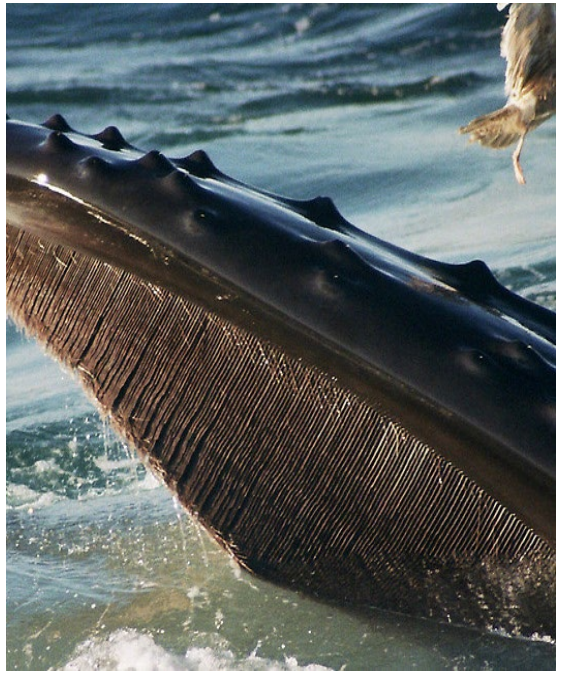
Discovering



Refined Functions

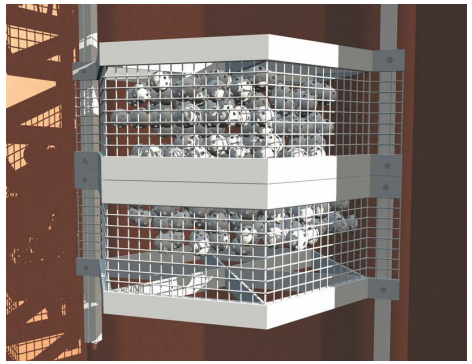
- How does nature shelter?
- How does nature trap or transform biomass?
- How does nature oxygenate?



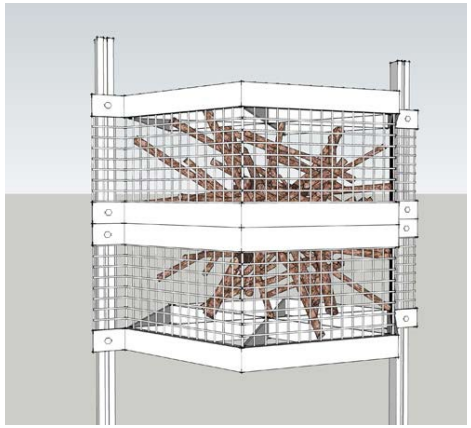


Cuyahoga Green Bulkhead

Creating

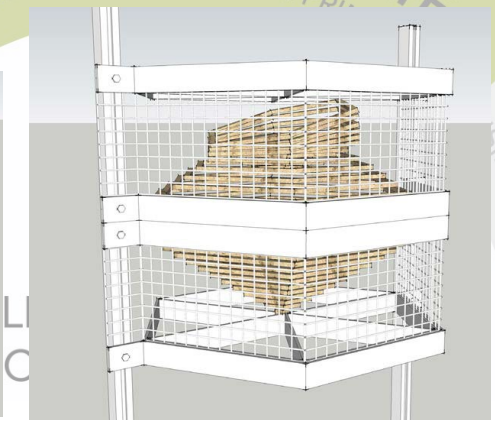


BioBalls

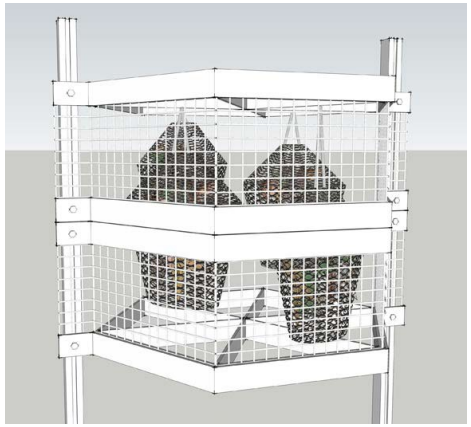


Sticks in a Basket

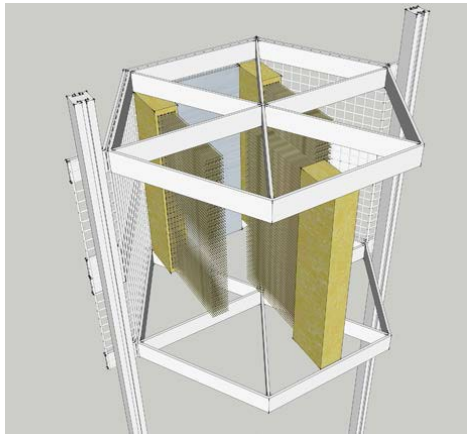
Dendrite



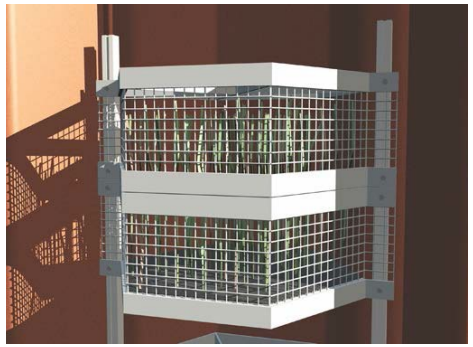
Debris Collector



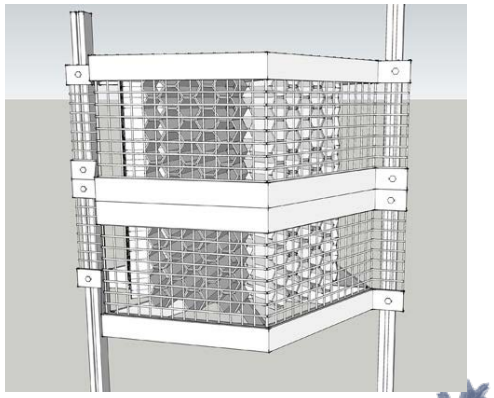
Leaf Packs



Brush Filter

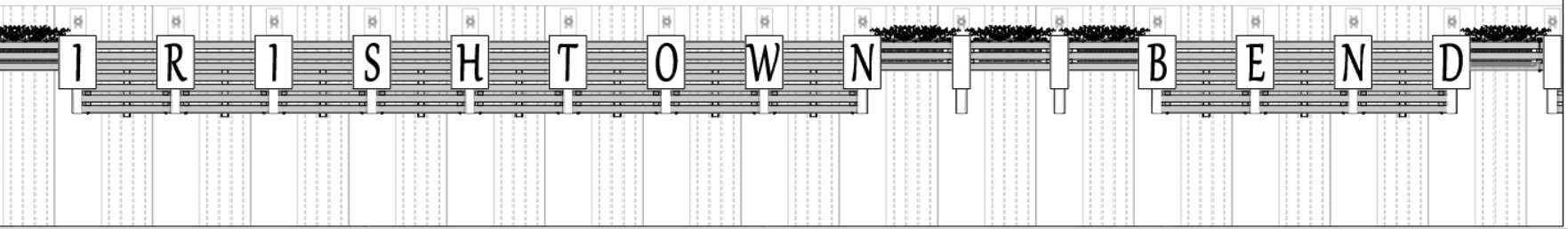


Seagrass



Fish Hive

Biohabitats


IRISHTOWN BEND

an artificial device that is built to replace a lost function

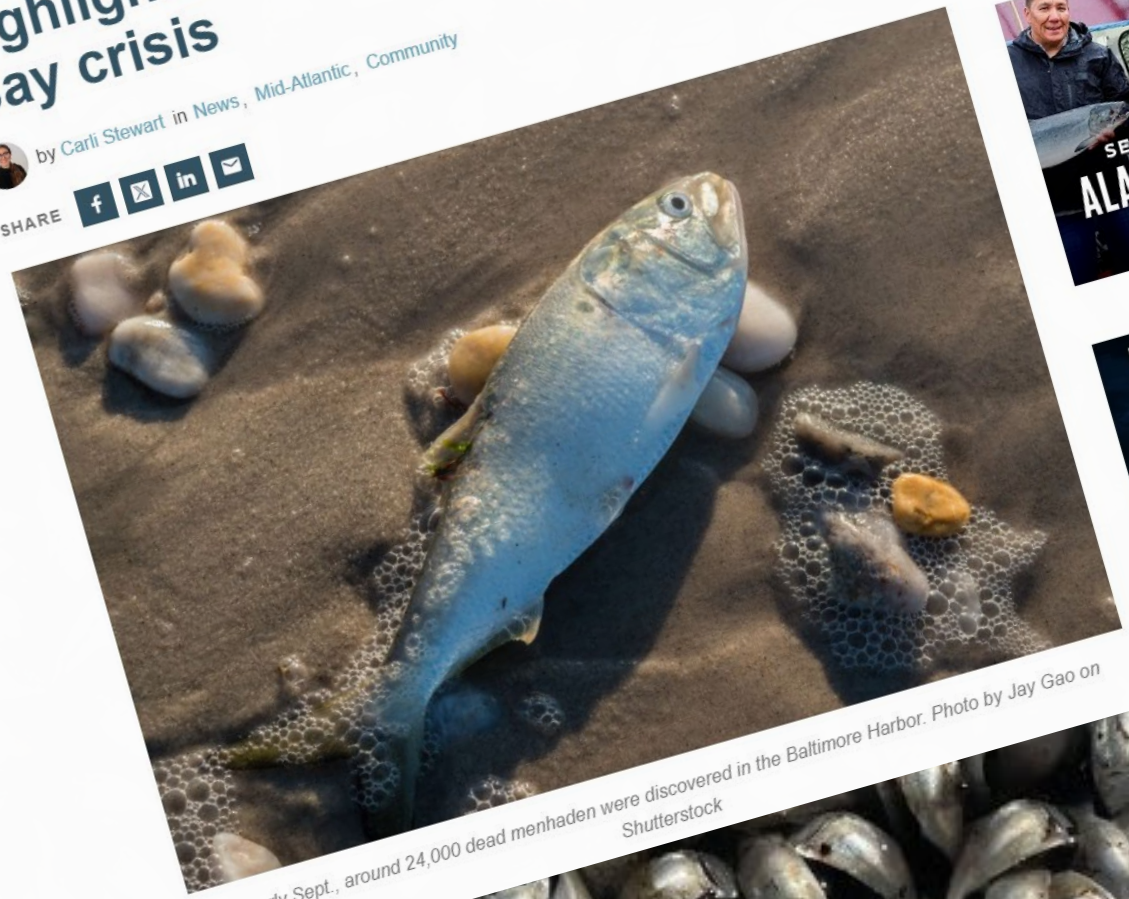
Ecosystem Prosthetics

September 9, 2024

Massive fish kill in Baltimore Harbor highlights deepening Chesapeake Bay crisis

by Carli Stewart in News, Mid-Atlantic, Community

SHARE

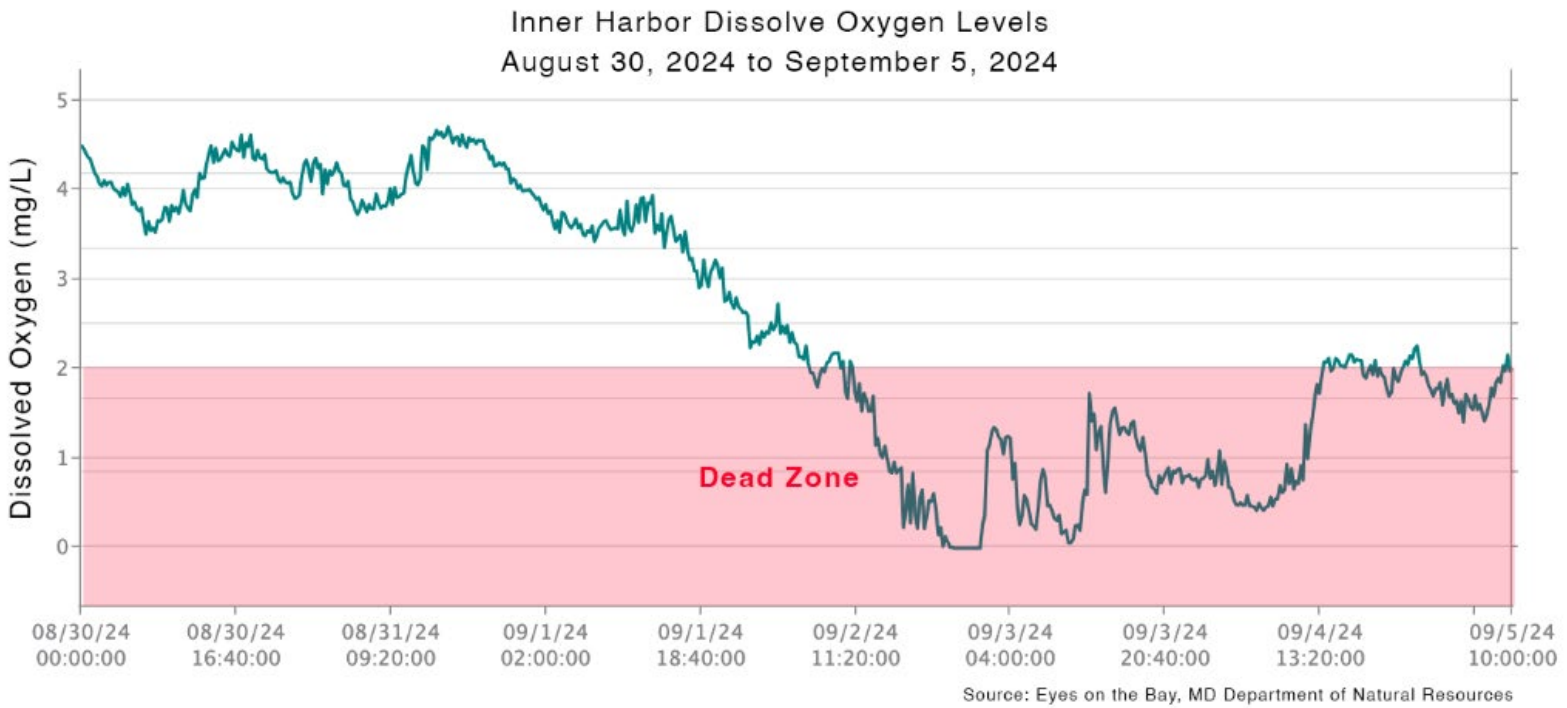


In early Sept., around 24,000 dead menhaden were discovered in the Baltimore Harbor. Photo by Jay Gao on Shutterstock

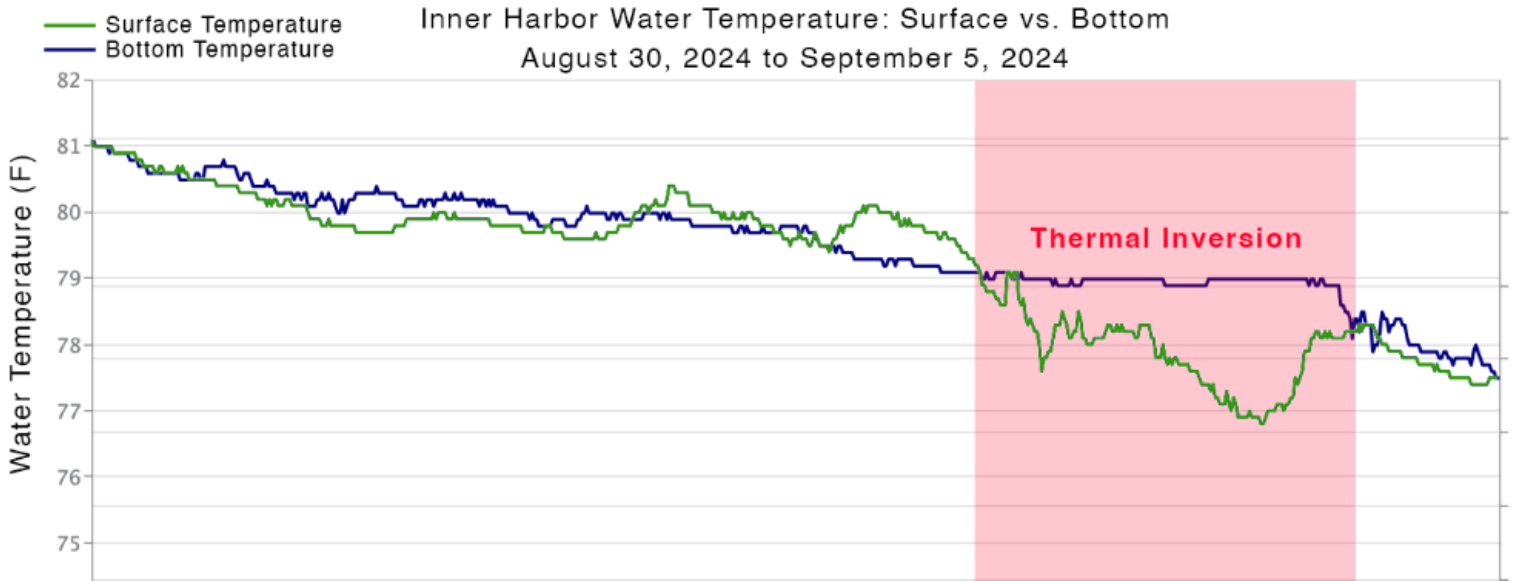
Read Next

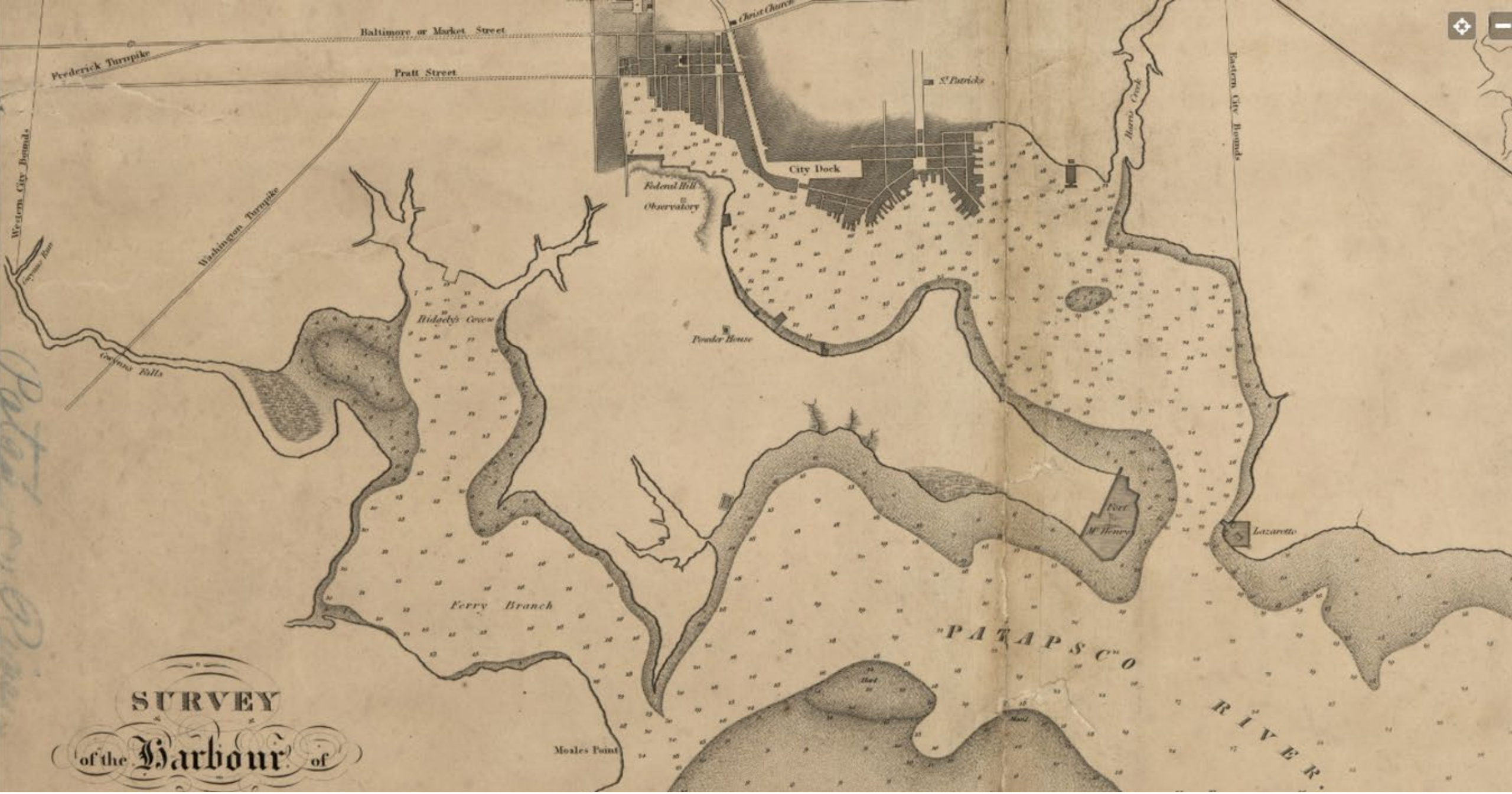
September 23, 2024
Tarpon Springs approv
new fish distribution fa

September 23, 2024
Rep. Vance calls for fe
disaster declaration du
low pink salmon returr



[Data Source: Eyes on the Bay]

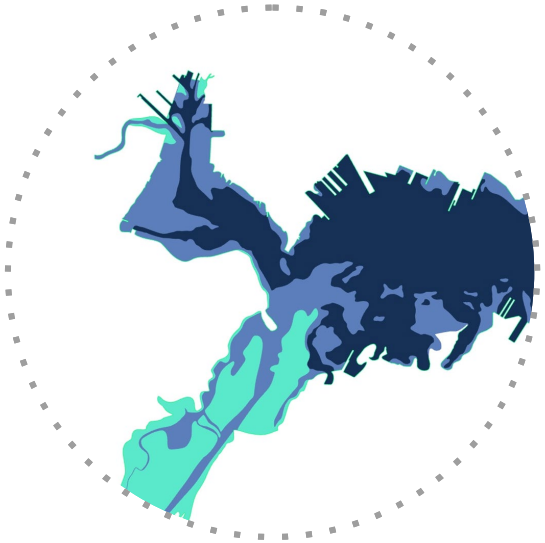



Baltimore or Market Street
Frederick Turnpike
Pratt Street
Christ Church
St Patricks
City Dock
Federal Hill
Observatory
Western City Bounds
Washington Turnpike
Gwynns Falls
Ridgely's Cove
Powder House
Harris Creek
Eastern City Bounds
Fort M.Henry
Lazaretto
Ferry Branch
PATAPSCO RIVER
Moales Point
SURVEY
of the Harbour of


Biohabitats

1819

1931



Intertidal Zone
440
Acres

Shallow Water Zone
800
Acres

1:2
Intertidal to Shallow Water

1978

Intertidal Zone
320
Acres

Shallow Water Zone
985
Acres

1:3
Intertidal to Shallow Water

2018

Intertidal Zone
115
Acres

Shallow Water Zone
865
Acres

1:10
Intertidal to Shallow Water

Courtesy of James Corner Field Operations

CHANGING HABITAT THROUGH TIME

2018

Intertidal Zone
115
Acres

Shallow Water Zone
865
Acres

1:10
Intertidal to Shallow Water

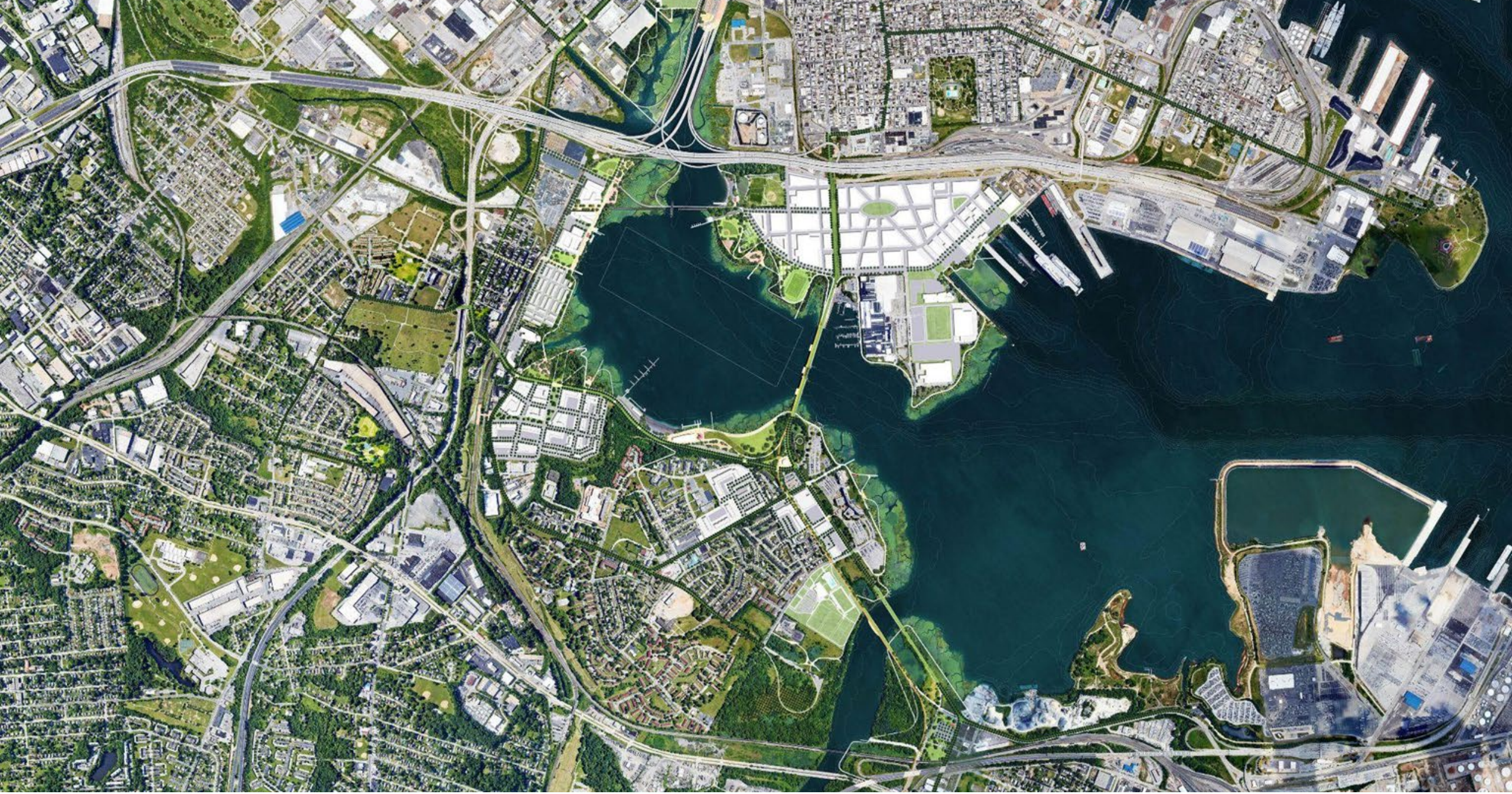
Proposed

Intertidal Zone
190
Acres

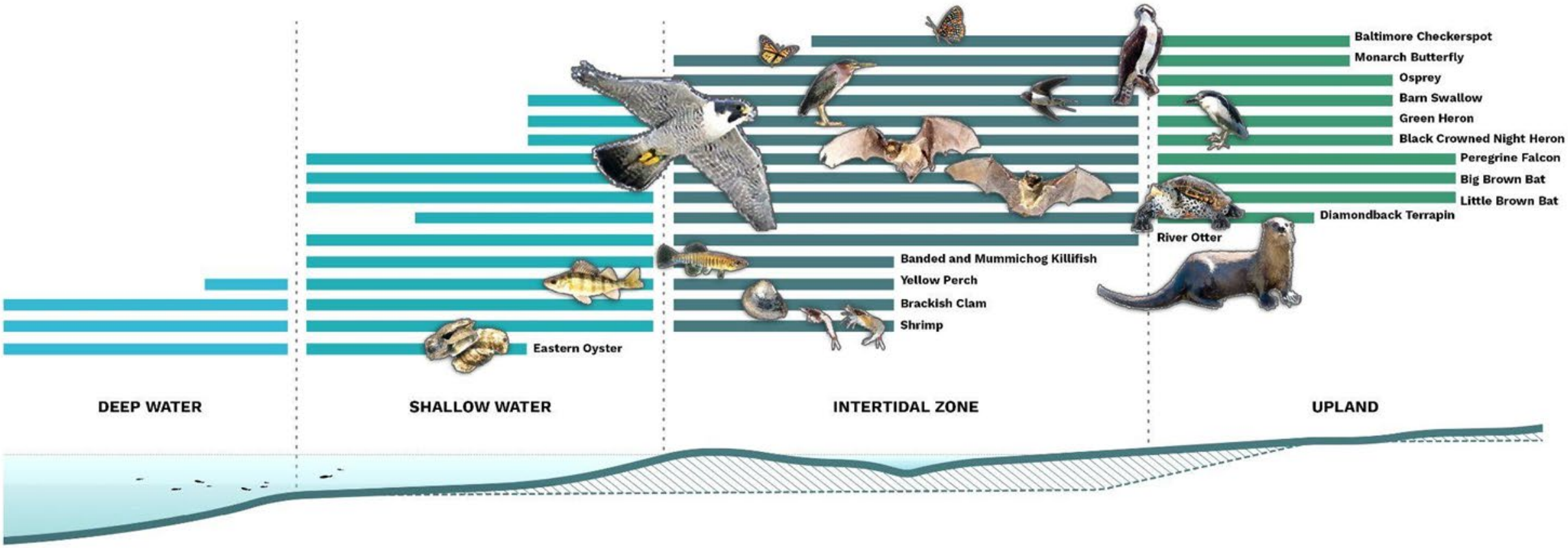
Shallow Water Zone
790
Acres

1:4
Intertidal to Shallow Water

Courtesy of James Corner Field Operations

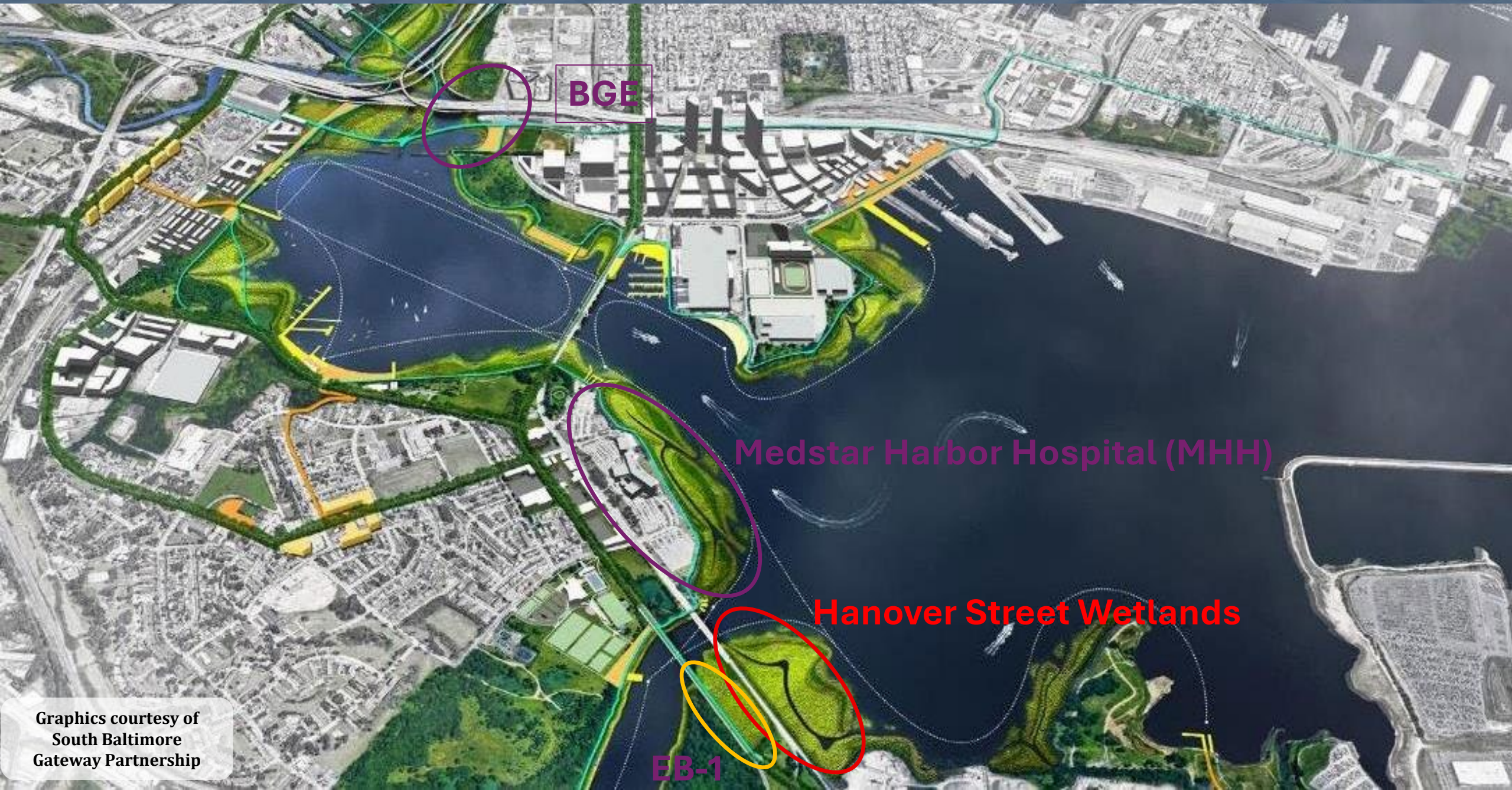


MIDDLE BRANCH FUTURE VISION



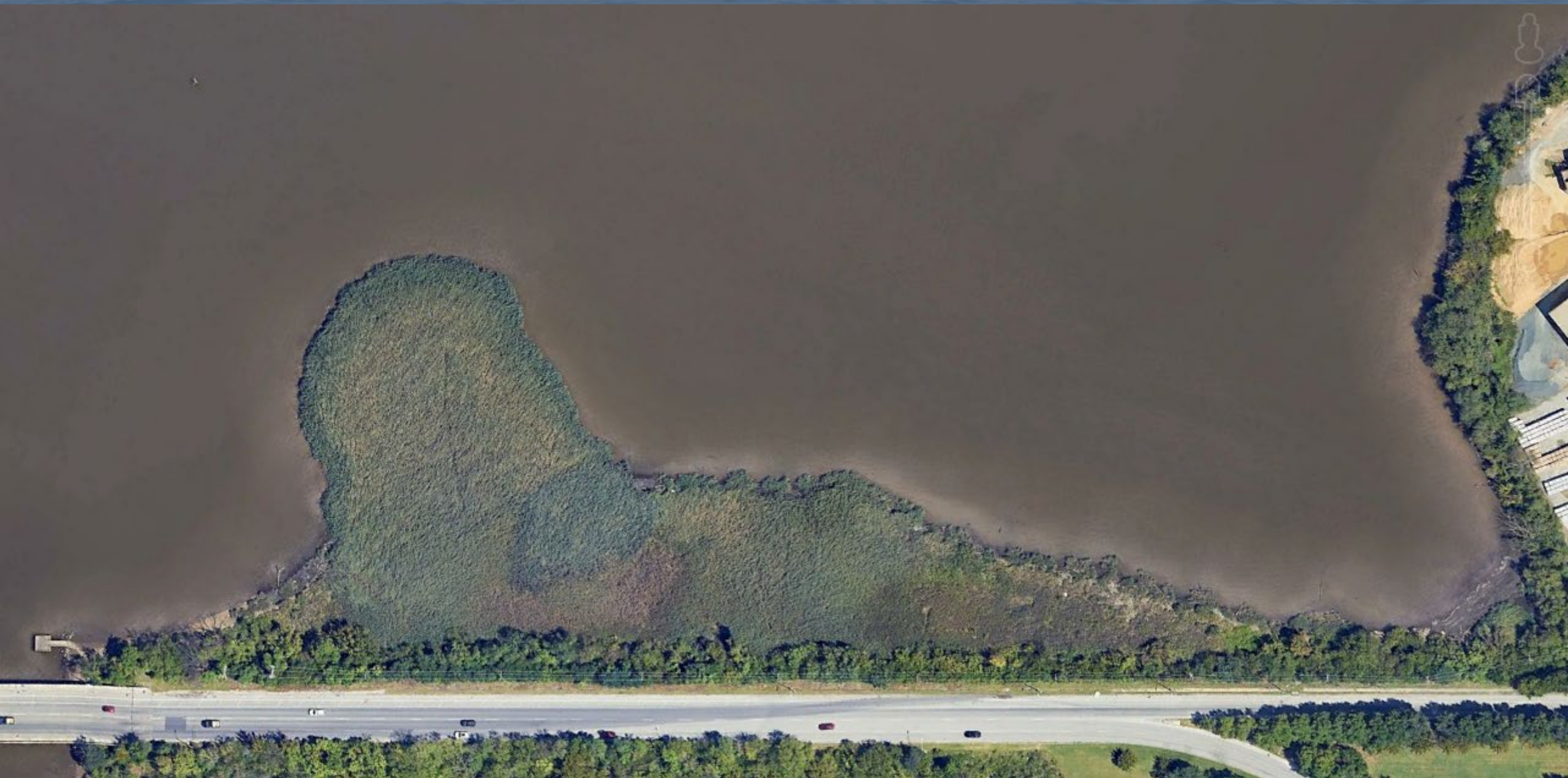
"Coastal habitats do not function in isolation when supporting secondary production but rather are integrated components of larger systems." (Litvin, 2018)

Four Sites under Middle Branch Resiliency Initiative

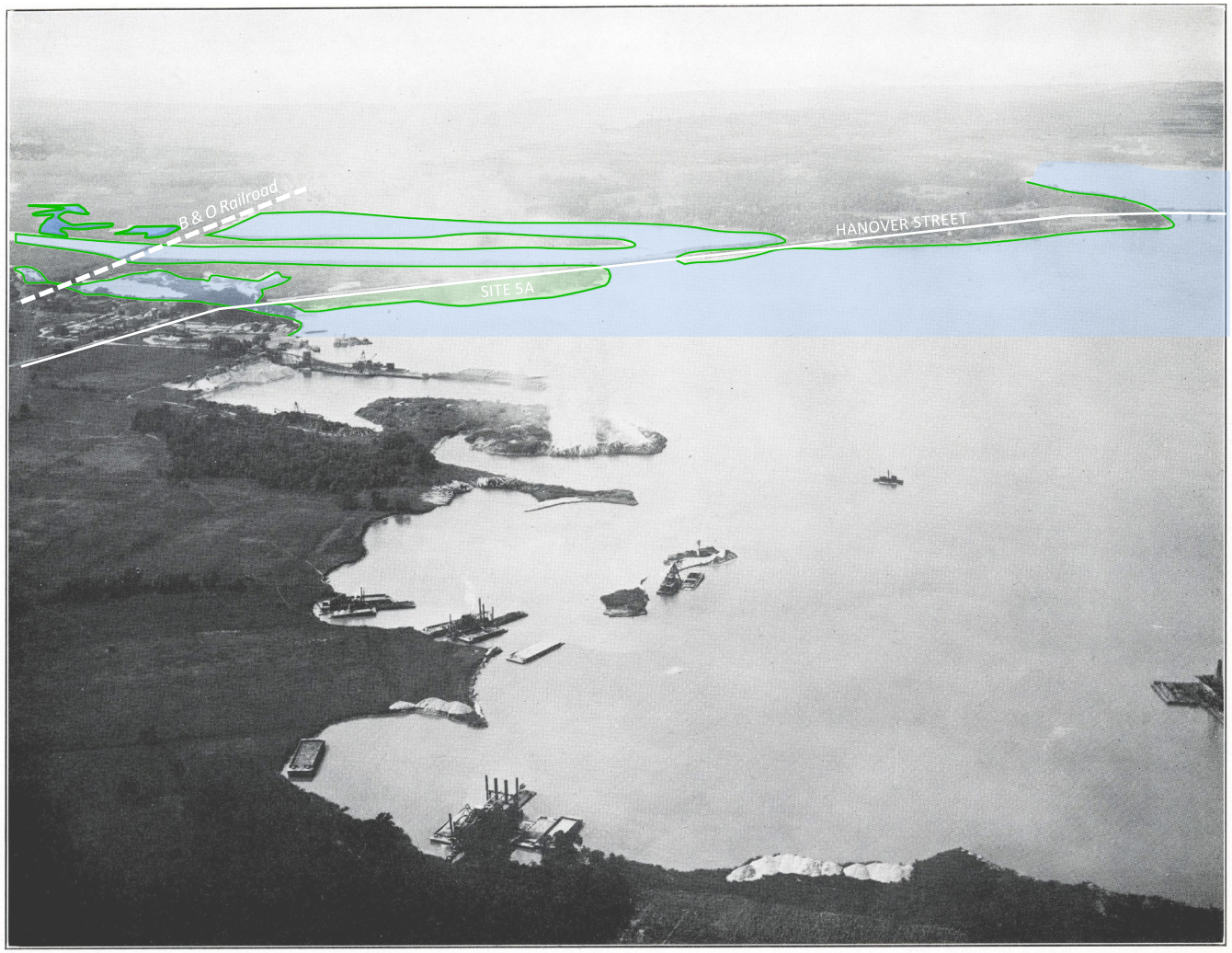


Graphics courtesy of South Baltimore Gateway Partnership

Hanover Wetlands: Restoration of 10 acres of tidal marsh and aquatic habitat providing a resilient shoreline along Hanover Street

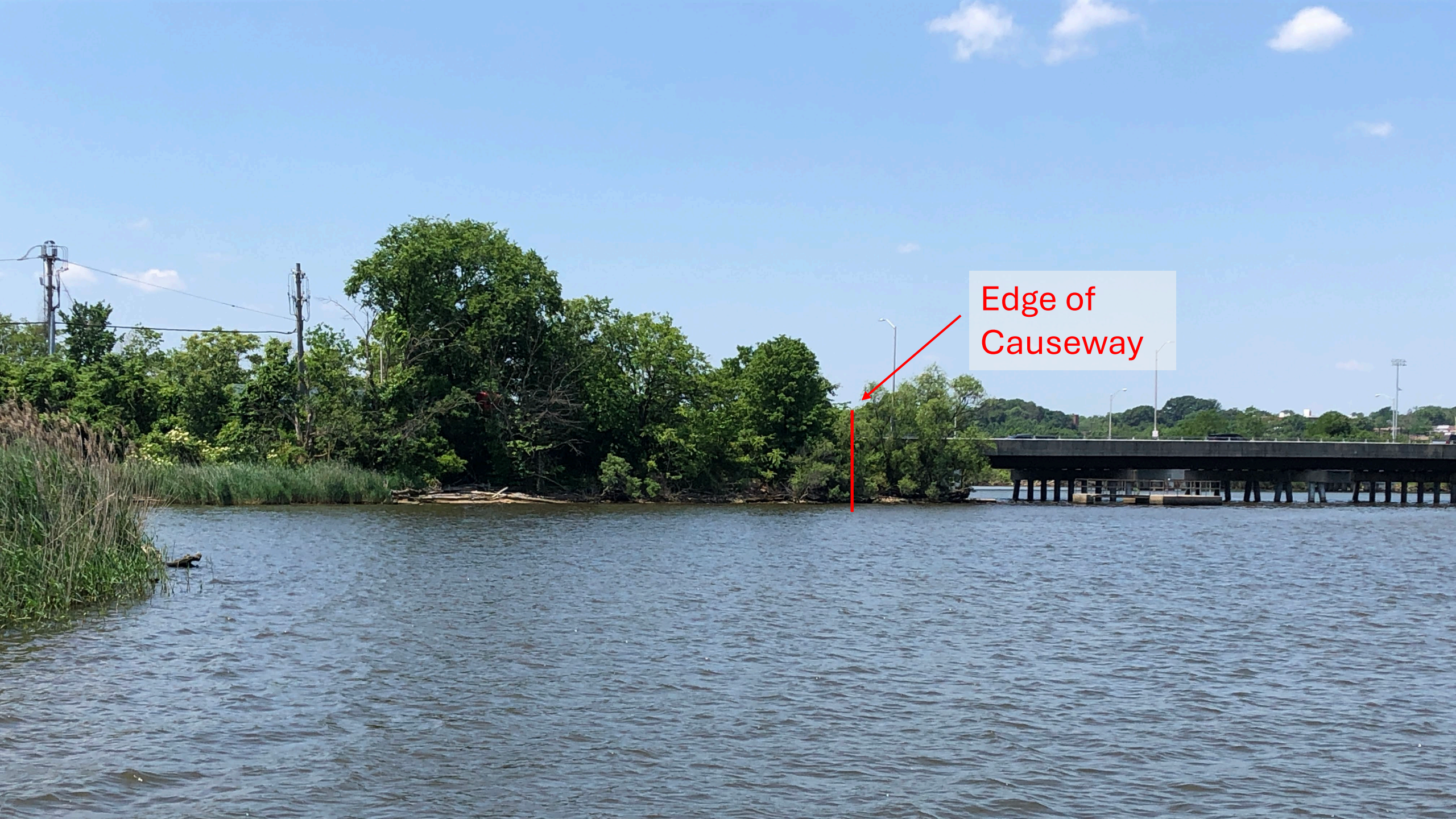


1920 Mouth of Patapsco River



26. WEST SIDE OF PATAPSCO RIVER. BROOKLYN AND HANOVER STREET. SITE OF PROPOSED BROENING PARK TERMINALS.


Edge of
Causeway


Edge of
Causeway

Erosion of road embankment


Phragmites australis


Plastic and
debris

Hanover Street Wetlands

Project Goals

- Primary – Water quality
- Resilience - Abate the erosion
- Enhance diverse microhabitats
- Support native tidal marsh flora
- Create mosaic of shallow, intertidal refugia
- Demonstrate innovative practices
- Beneficial use of dredge
- Dynamic, self-adjusting given sea level rise
- Design to Budget

Representative Landscape Cross-section

HARDWOOD FOREST

Successional Coastal Plain Forest

RIPARIAN BUFFER

Brackish Tidal Creek Shrubland - This is an oligohaline tidal shrubland of brackish tidal waters in Mid-Atlantic on firm, partially decomposed peat. This vegetation forms linear stands along tidal channels between freshwater tidal marshes and adjacent swamp forests.

SUPRATIDAL

Brackish Meadow - This brackish meadow of the Atlantic coast from New Hampshire to North Carolina occurs at the upland border of high salt marshes. It occurs on freely drained, shallow, sandy peat that is moist from upland seepage and brackish from irregular tidal flooding.

HIGH MARSH

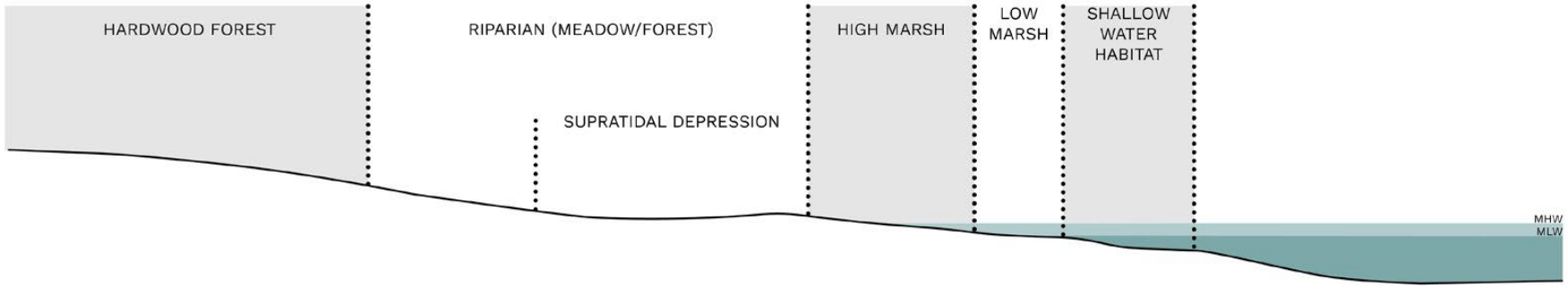
Irregularly Flooded Eastern Tidal Salt Shrub - This maritime shrubland of the eastern states occurs in association with salt marshes, occurring along the upper edges of the marsh, at the transition to uplands.

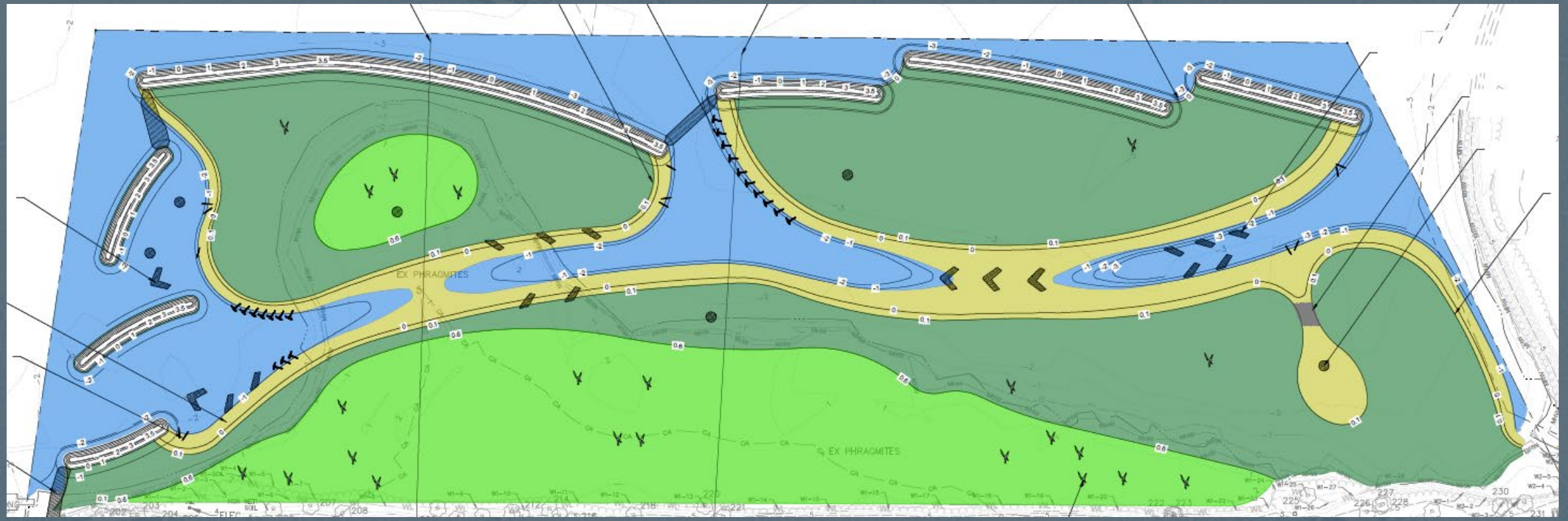
LOW MARSH

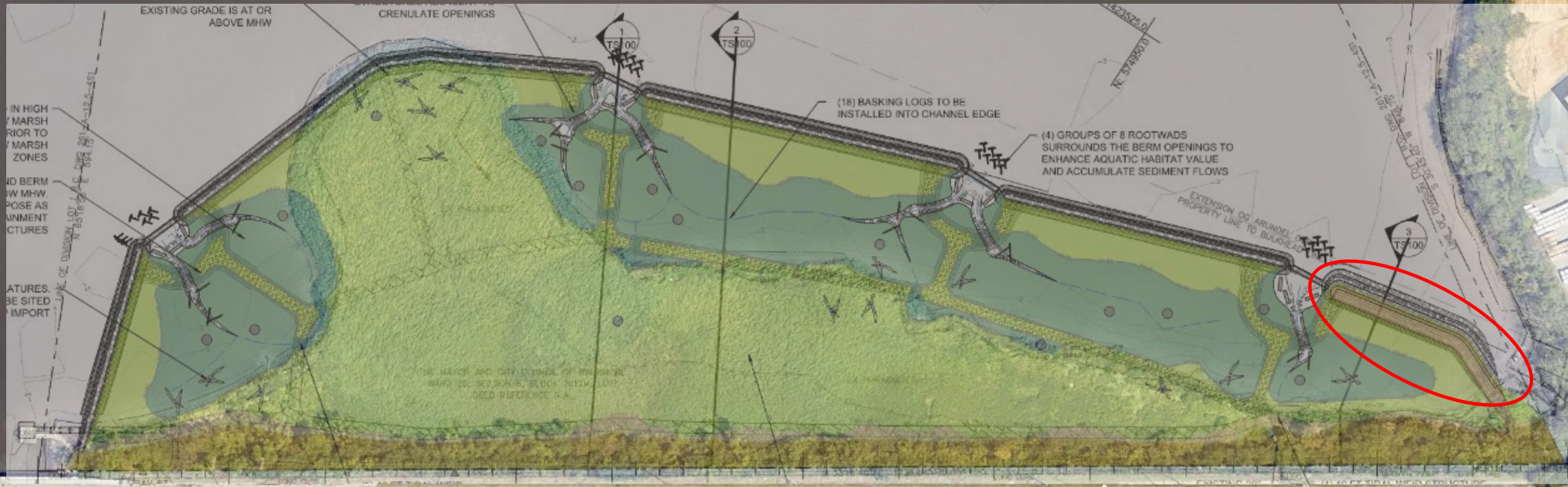
Freshwater Tidal Mixed High Marsh - These are mixed, dense, and often diverse marshes with highly variable species composition and patch dominance.

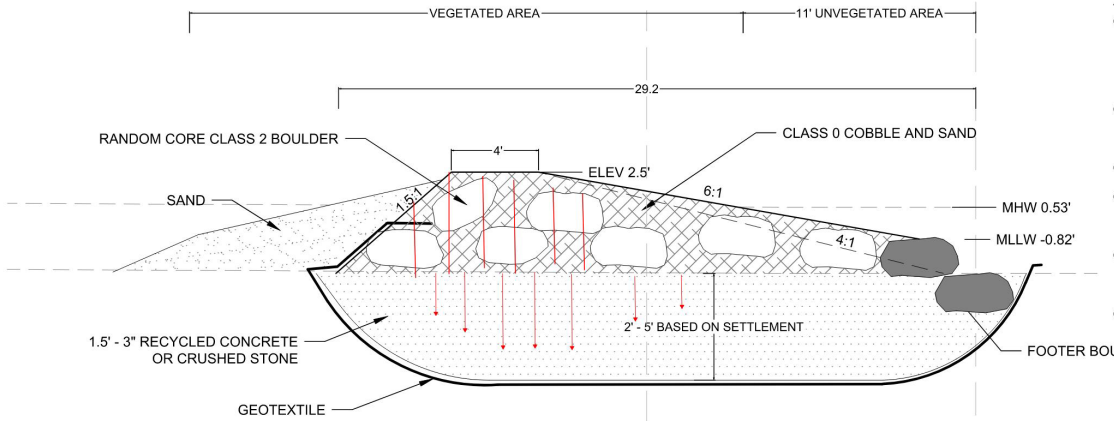
SHALLOW WATER HABITAT

Mixed Freshwater Subtidal Marsh - This association comprises mixed freshwater subtidal aquatic beds of the mid-Atlantic coast. It occurs in fresh reaches of upper bays and tributaries within estuarine systems. Species composition is variable




EX PHRAGMITES
EX PHRAGMITES


EXISTING GRADE IS AT OR ABOVE MHW
CRENULATE OPENINGS
(18) BASKING LOGS TO BE INSTALLED INTO CHANNEL EDGE
(4) GROUPS OF 8 ROOTWADS SURROUNDS THE BERM OPENINGS TO ENHANCE AQUATIC HABITAT VALUE AND ACCUMULATE SEDIMENT FLOWS
1 TS 00
2 TS 00
3 TS 00



TYPICAL BERM SECTION
BIOHABITATS

NOT TO SCALE

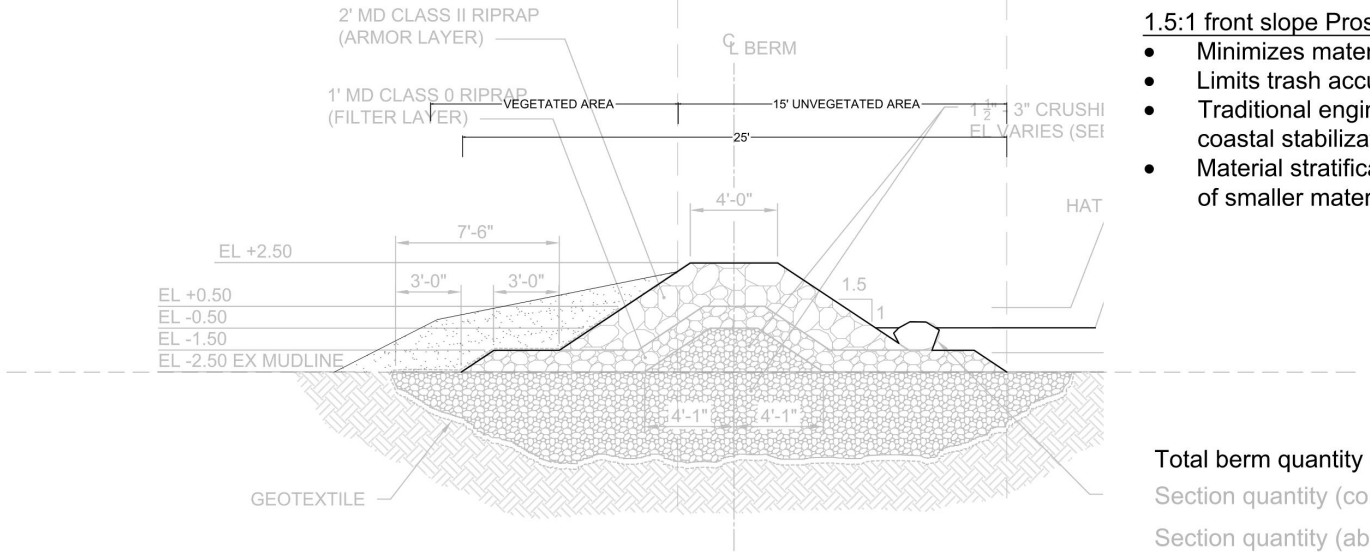
6:1 front slope Pros

- Lower slope attenuates incoming wave energies rather than deflect and cause erosion on unprotected shorelines
- Ecological uplift for invertebrate and forage fish species
- Natural shoreline aesthetic
- Blending stone classes interlocks larger sizes
- Potential cost savings from cross- section construction (blending sizes)
- Reduces overall marsh fill volume by setting crest closer to existing shoreline

6:1 front slope Cons

- 45% increase in material quantity compared to eng design
- Less conventional option - fewer project examples
- May accumulate debris (trash, natural materials)
-

Total berm quantity (1,530 lf): 14,850 cuyd
Section quantity (combined): 9.8 cuyd
Section quantity (above grade): 4.2 cuyd
Section quantity (below grade): 5.6 cuyd



TYPICAL BERM SECTION
MOFFATT & NICHOL

NOT TO SCALE

1.5:1 front slope Pros

- Minimizes material quantity/cost
- Limits trash accumulation
- Traditional engineering approach to coastal stabilization - proven
- Material stratification limits mobilization of smaller material

1.5:1 front slope Cons

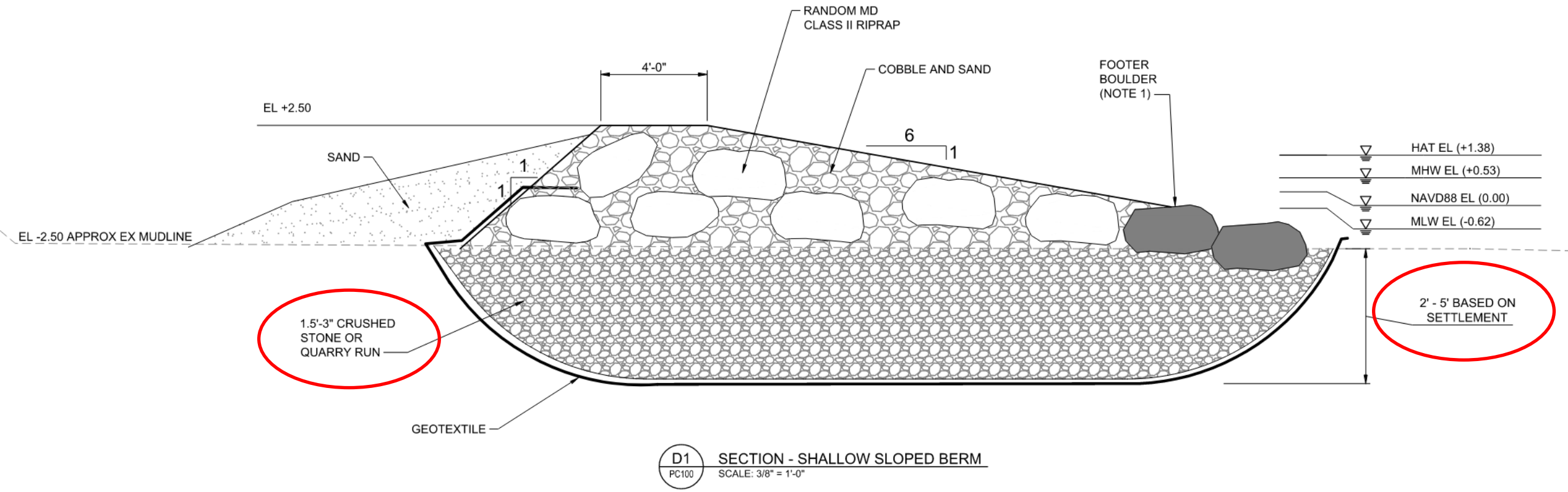
- Greater hydraulic energy requires larger stone size
- Energy is deflected vesus dampened by shallow slope
- Limits habitat/planting opportunity along front edge
- Less natural looking
- Defined layers require presettlement to ensure accurate quantities (stratification)

Total berm quantity (1,530 lf): 10,200 cuyd
Section quantity (combined): 6.6 cuyd
Section quantity (above grade): 2.4 cuyd
Section quantity (below grade): 4.2 cuyd


KOMATSU
Remu
BIG FLOAT
E22
E22

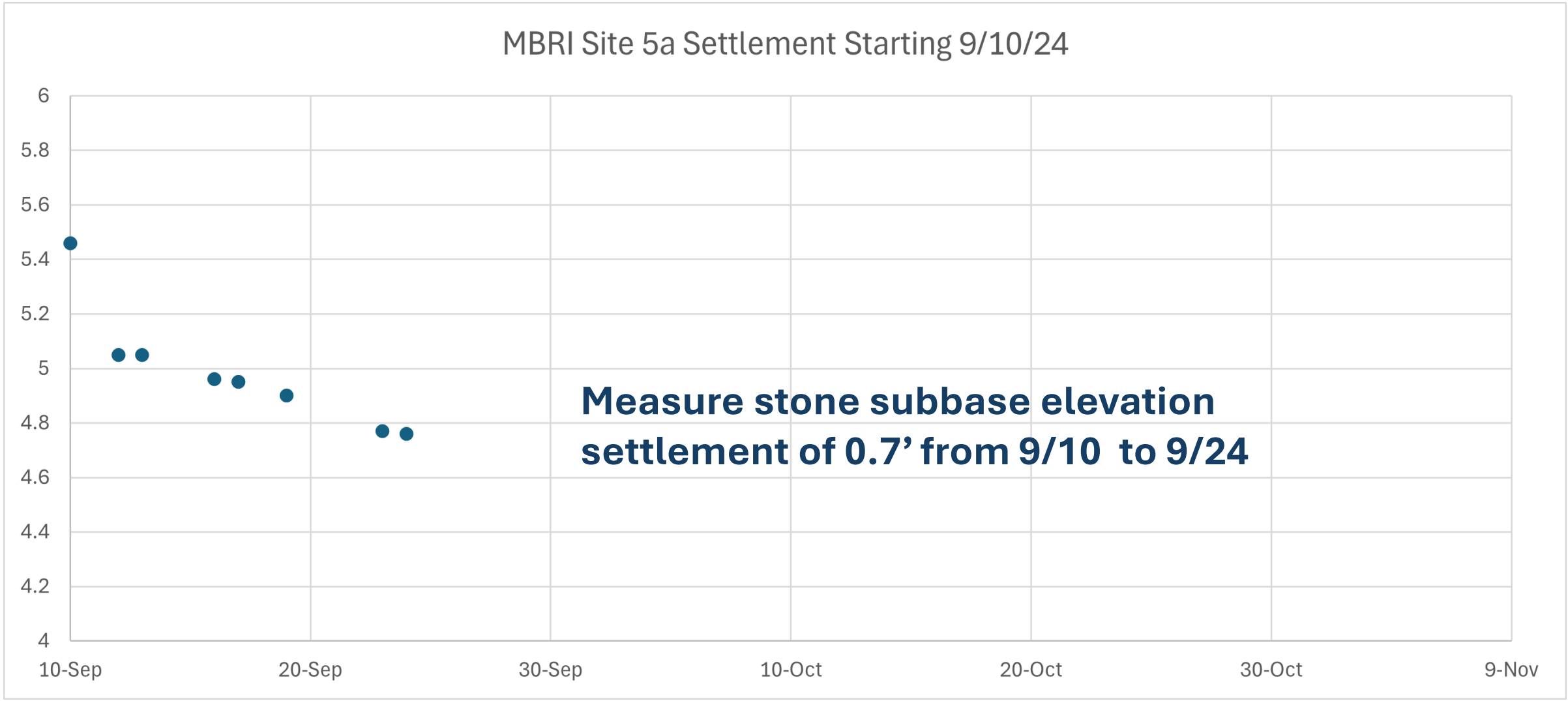

Tensar geotextile fused to
geogrid to minimize settlement

Item	Design	Constructed (current)
Stone subbase material quantity	2,000 tons	1,900 tons
Stone subbase top elevation	-2.5 NAVD88	+1.0 NAVD88
Settlement	Up to 5’	1.5’ (0.8’ initial, 0.7’ primary)




Settlement plate to measure elevation change of stone subbase due to consolidation of in-situ soils

Approximate initial elevation (not part of settlement plate data set)



Hanover Street Wetlands

Project Goals

- Primary – Water quality
- Resilience - Abate the erosion
- Enhance diverse microhabitats
- Support native tidal marsh flora
- Create mosaic of shallow, intertidal refugia
- Demonstrate innovative practices
- Beneficial use of dredge
- Dynamic, self-adjusting given sea level rise
- Design to Budget

The Regeneration Principle

Assure the maximum return of ecological function, habitat and ecosystem services to natural capital invested

Biohabitats

ECOSYSTEM SERVICES
RETURNED

CARBON SEQUESTRATION
BIODIVERSITY GAINS
CULTURAL & COMMUNITY

NATURAL CAPITAL
INVESTED & IMPACTS

EXTRACTION
DUST
NOISE
TRAFFIC
CARBON EMISSIONS
AIR QUALITY

Biohabitats

RESTORATIVE OUTCOMES

ECOSYSTEM SERVICES RETURNED

CARBON SEQUESTRATION
BIODIVERSITY GAINS
CULTURAL & COMMUNITY

NATURAL CAPITAL INVESTED & IMPACTS

NATIVE SEED PRODUCTION
BENEFICIAL REUSE
WOOD DIVERSION
CIRCULAR ECONOMY

REGENERATIVE SUPPLY

Biohabitats


Baltimore City Camp Small
3000-5000 Tons/yr of wood

Analysis | Published: 25 June 2025

Large CO_2 removal potential of woody debris preservation in managed forests

Yiqi Luo ✉, Ning Wei, Xingjie Lu, Yu Zhou, Feng Tao, Quan Quan, Cuijuan Liao, Lifen Jiang, Jianyang Xia, Yuanyuan Huang, Shuli Niu, Xiangtao Xu, Ying Sun, Ning Zeng, Charles Koven, Liqing Peng, Steve Davis, Pete Smith, Fengqi You, Yu Jiang, Lailiang Cheng & Benjamin Houlton

Nature Geoscience **18**, 675–681 (2025) | Cite this article

"if the U.S. buried 66% of the wood debris from its managed forests, net-zero emissions could be reached by 2050."

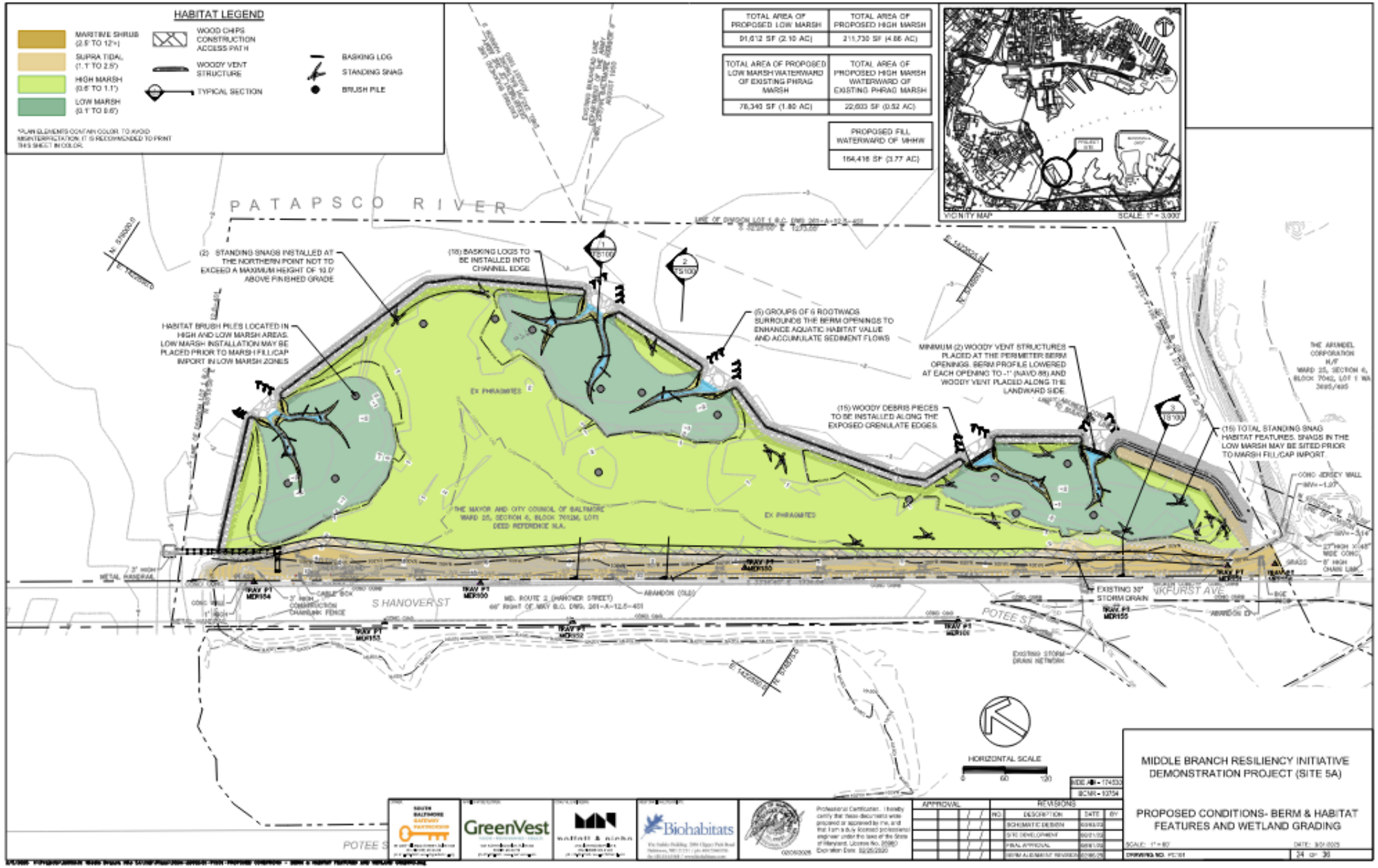
LOCAL NEWS

Firefighters battled gale force winds, piles of tinder, to contain massive Woodberry fire

Lillian Reed, Abby Zimmardi and Clara Longo de Freitas

12/6/2024 7:34 a.m. EST, Updated 12/6/2024 10:26 a.m. EST

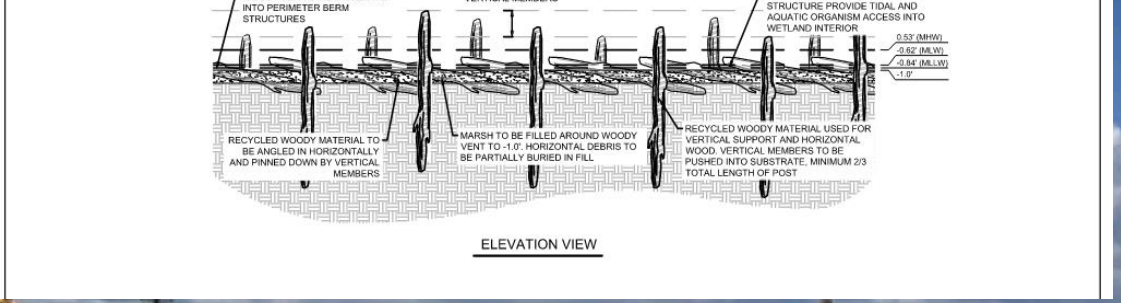
Firefighters spray water on the smoldering wood piles as an excavator moves logs at the Camp Small city wood recycling facility Friday morning. (Jerry Jackson/The Baltimore Banner)


HABITAT LEGEND
MARITIME SHRUB (2.5' TO 12'+)
SUPRA TIDAL (1.1' TO 2.5')
HIGH MARSH (0.6' TO 1.1')
LOW MARSH (0.1' TO 0.6')
WOOD CHIPS CONSTRUCTION ACCESS PATH
WOODY VENT STRUCTURE
TYPICAL SECTION
BASKING LOG
STANDING SNAG
BRUSH PILE
*PLAN ELEMENTS CONTAIN COLOR. TO AVOID MISINTERPRETATION, IT IS RECOMMENDED TO PRINT THIS SHEET IN COLOR.
TOTAL AREA OF PROPOSED LOW MARSH
91,612 SF (2.10 AC)
TOTAL AREA OF PROPOSED HIGH MARSH
211,730 SF (4.86 AC)
TOTAL AREA OF PROPOSED LOW MARSH WATERWARD OF EXISTING PHRAG MARSH
78,348 SF (1.80 AC)
TOTAL AREA OF PROPOSED HIGH MARSH WATERWARD OF EXISTING PHRAG MARSH
22,603 SF (0.52 AC)
PROPOSED FILL WATERWARD OF MHHW
164,416 SF (3.77 AC)
VICINITY MAP
SCALE: 1" = 3,000'
PATAPSCO RIVER
(2) STANDING SNAGS INSTALLED AT THE NORTHERN POINT NOT TO EXCEED A MAXIMUM HEIGHT OF 10.0' ABOVE FINISHED GRADE
(18) BASKING LOGS TO BE INSTALLED INTO CHANNEL EDGE
HABITAT BRUSH PILES LOCATED IN HIGH AND LOW MARSH AREAS. LOW MARSH INSTALLATION MAY BE PLACED PRIOR TO MARSH FILL/CAP IMPORT IN LOW MARSH ZONES
(5) GROUPS OF 6 ROOTWADS SURROUNDS THE BERM OPENINGS TO ENHANCE AQUATIC HABITAT VALUE AND ACCUMULATE SEDIMENT FLOWS
MINIMUM (2) WOODY VENT STRUCTURES PLACED AT THE PERIMETER BERM OPENINGS. BERM PROFILE LOWERED AT EACH OPENING TO -1' (NAVD 88) AND WOODY VENT PLACED ALONG THE LANDWARD SIDE
(15) WOODY DEBRIS PIECES TO BE INSTALLED ALONG THE EXPOSED CRENULATE EDGES.
(15) TOTAL STANDING SNAG HABITAT FEATURES. SNAGS IN THE LOW MARSH MAY BE SITED PRIOR TO MARSH FILL/CAP IMPORT
EX PHRAGMITES
THE MAYOR AND CITY COUNCIL OF BALTIMORE WARD 25, SECTION 6, BLOCK 7012M, LOT1 DEED REFERENCE N.A.
THE ARUNDEL CORPORATION H/F WARD 25, SECTION 6, BLOCK 7042, LOT 1 WA 2695/485
S HANOVER ST
MD. ROUTE 2 (HANOVER STREET) 66' RIGHT OF WAY B.O. DWG. 261-A-12.5-401
POTEE ST
OAKHURST AVE
EXISTING 30" STORM DRAIN
EXISTING STORM DRAIN NETWORK
METAL HANDRAIL
3' HIGH CHAINLINK FENCE
CABLE BOX
ABANDON (TYP)
CONC JERSEY WALL
27"HIGH X 48" WIDE CONC
8' HIGH CHAIN LINK
HORIZONTAL SCALE
0 60 120
MIDDLE BRANCH RESILIENCY INITIATIVE DEMONSTRATION PROJECT (SITE 5A)
PROPOSED CONDITIONS- BERM & HABITAT FEATURES AND WETLAND GRADING
SIDE ABI - 174530
BCMR - 10754
APPROVAL
REVISIONS
NO. DESCRIPTION DATE BY
SCHEMATIC DESIGN
SITE DEVELOPMENT
FINAL APPROVAL
BERM ALIGNMENT REVISION
SCALE: 1" = 60'
DATE: 8/31/2020
DRAWING NO. PC101
24 OF 36
SOUTH BALTIMORE GATEWAY PARTNERSHIP
GreenVest
walter & sicka
Biohabitats
Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland. License No. 20980 Expiration Date: 02.25.2020
02/05/2020


KOMATSU

- Buried Wood reduced sand by 25%
- Lowered VMT
- Diverted wood from landfill


RANDOM CORE CLASS 2 BOULDER
4'
CLASS 0 COBBLE AND SAND
ELEV 2.5'
SAND
1.5:1
6:1
MHW 0.53'
4:1
MLLW -0.82'
2' - 5' BASED ON SETTLEMENT
1.5' - 3" RECYCLED CONCRETE
OR CRUSHED STONE
FOOTER B
GEOTEXTILE



ELEVATION VIEW

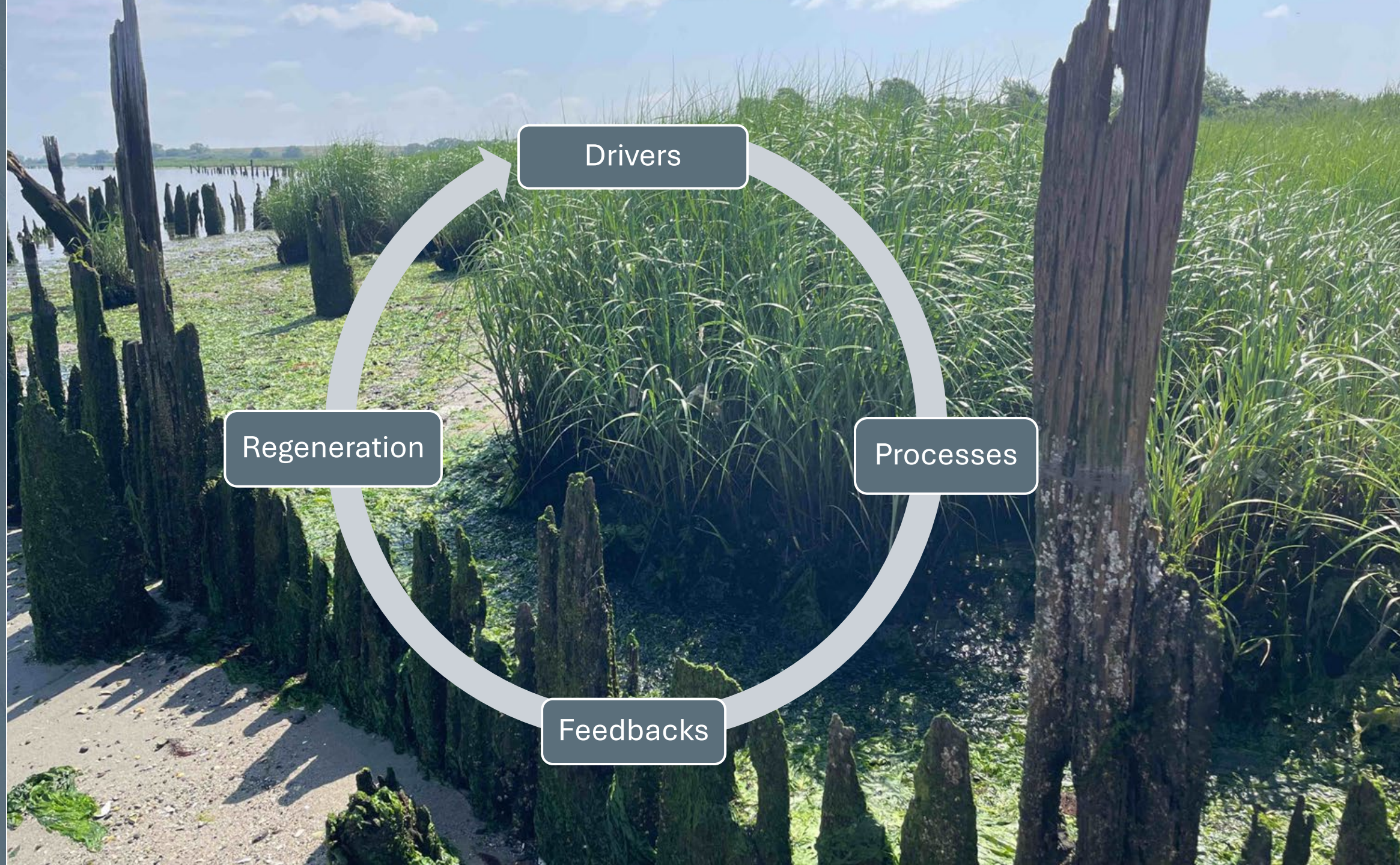

2' MD CLASS II RIPRAP
(ARMOR LAYER)
℄ BERM
1' MD CLASS 0 RIPRAP
(FILTER LAYER)
VEGETATED AREA
15' UNVEGETATED AREA
25'
1½"
3" CRUSHI
EL VARIES (SEE
4'-0"
HAT
7'-6"
EL +2.50
3'-0"
3'-0"
1.5
1
EL +0.50
EL -0.50
EL -1.50
EL -2.50 EX MUDLINE
4'-1"
4'-1"
GEOTEXTILE

Hanover Street Wetlands

Project Goals

- Primary – Water quality
- Resilience - Abate the erosion
- Enhance diverse microhabitats
- Support native tidal marsh flora
- Create mosaic of shallow, intertidal refugia
- Demonstrate innovative practices
- Beneficial use of dredge
- Dynamic, self-adjusting given sea level rise?
- Design to Budget

Ecomimicry



Answer Key

- Nature-based solutions can be dynamic, but often limited by:
  - Spatial and temporal constraints
  - Narrow project goals
  - Risk
  - Financial
- Feedback mechanisms are not always understood and difficult to model
- We expect complexity and change but fear the unknown

How much control might you relinquish?

LinkedIn

Christopher Streb, PE
cstreb@biohabitats.com

Biohabitats