

Coastal Salt Marsh Symposium

Protecting, Restoring & Monitoring Salt Marsh
Change in Pleasant Bay & Beyond

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FEATURING



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Protecting Nature for Our Community



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Friends of Pleasant Bay



SPEAKERS:

Carole Ridley
Sophia Fox, PhD
Katie Castagno, PhD
Greg Berman
Catherine Ricks
Tom Keras

Pleasant Bay Alliance
Cape Cod National Seashore
Center for Coastal Studies
Town of Chatham, MA
Town of Chatham, MA
Orleans Conservation Trust



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Protecting Nature for Our Community



Salt Marsh Is Key To A Resilient Pleasant Bay Estuary

Carole Ridley – Pleasant Bay Alliance

Salt Marsh Is Key To A Resilient Pleasant Bay Estuary

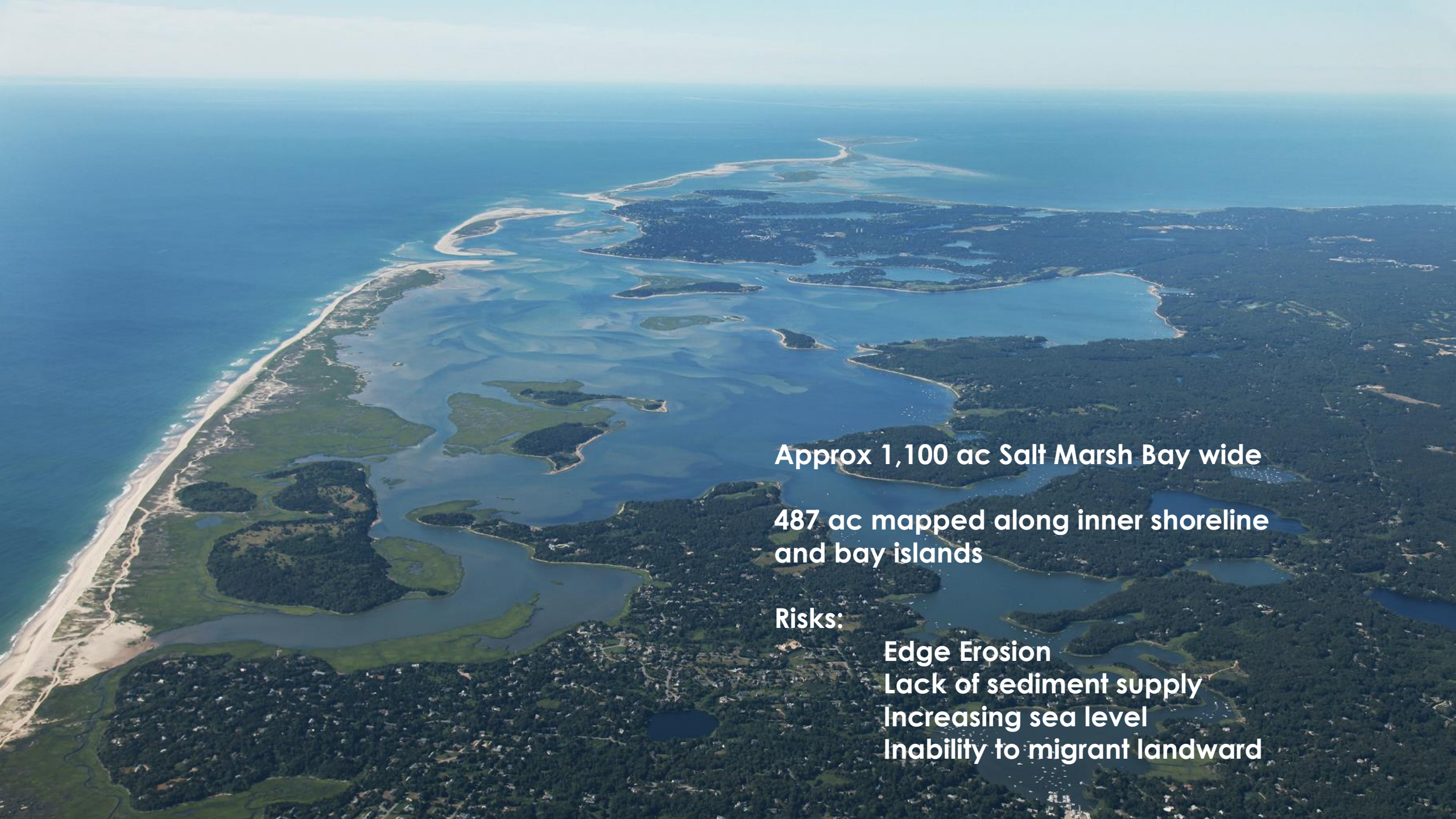
March 30, 2026



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What's At Stake?





Approx 1,100 ac Salt Marsh Bay wide

**487 ac mapped along inner shoreline
and bay islands**

Risks:

**Edge Erosion
Lack of sediment supply
Increasing sea level
Inability to migrant landward**

Alliance Efforts to Understand Climate Threats & Protect Salt Marsh

- Tide gauge monitoring since 2005
- Sea Level Rise: Assessment of Impacts on Nauset Barrier Beach and Pleasant Bay (2017)
- Guidelines for Managing Erosion in Pleasant Bay (2018)
- Assessment of Marsh Shoreline Vulnerability (2021)
 - Rated vulnerability of 487 ac salt marsh along inner shore and Bay Island
- Town Municipal Vulnerability Preparedness Plans
- Pleasant Bay Climate Adaptation Action Plan (2024)
- Salt marsh restoration and protection
 - Modeling, resource impact assessment and conceptual design for Muddy Creek restoration
 - Jackknife Harbor Beach Living Shoreline Project



Climate Resilience Concerns

- Loss of public access to the waters
- Threats to near shore infrastructure
- Loss of estuarine function
 - Barrier beach vulnerability
 - With 4' SLR by 2100, loss of intertidal resources:
 - 40% decrease (164 ac) 2021-50
 - 47% decrease (130 ac) 2050-2100
 - Drowning/erosion of salt marsh, eelgrass



TABLE 5. Intertidal area in Pleasant Bay.

Pleasant Bay	2021	2050	2100
Total Area (acres)	412.2	247.9	117.9

Pleasant Bay Climate Adaptation Action Plan

Identify/Quantify Climate threats and resilience opportunities:

- Barrier Beach - Center for Coastal Studies
- Intertidal Resources – Center for Coastal Studies
- Public access - Wright-Pierce
- Water protection infrastructure - Wright-Pierce
- Eelgrass – Alyssa Novak, Ph.D., Boston University & Holly Plaisted, NE Coastal Barrier Network (NPS)
- Salt marsh vulnerability and restoration potential- Sophia Fox, Ph.D., Cape Cod National Seashore

Engage stakeholders:

- Survey and public forums
- Priorities for Climate Adaptation Action Plan



MVP

Municipal Vulnerability
Preparedness

Prioritize Salt Marsh Restoration and Conservation

Under Predicted Sea Level Rise of 100 cm (3.3 ft)

- 131 acres suitable for protection
- 565 acres suitable for restoration
- 437 acres suitable for monitoring
- 31 acres not worth saving

Public Support for salt marsh protection measures

- 90% - concern about loss of salt marsh
- 80% - purchase land for salt marsh migration
- 75% - restricting shoreline access to protect salt marsh



Climate Adaptation Action Plan

- Municipal Resilience Capacity Building
- Monitoring and Technical Assessments
- Regulatory Measures to Enhance Resilience
- Resilience Planning
- Restoration and Rehabilitation of Salt Marsh and Eelgrass
- Community Engagement





Salt Marshes: past, present, and future

Sophia E. Fox, PhD
Cape Cod National Seashore

Salt Marshes: past, present, and future

Sophia E. Fox

Cape Cod National Seashore



Why do we care about healthy salt marshes?

- Provide important habitat for wildlife: mammals, reptiles, birds, fish, etc.
 - Habitat supports important fishery resources, both finfish and shellfish



Why do we care about healthy salt marshes?

- Store atmospheric carbon – reduce harmful greenhouse gases contributing to warming air temperatures and sea level rise
- Protect coastline – storm surge and wave reduction
- Improve coastal water quality – coastal filter



Why do we care about healthy salt marshes?

- Extensive recreation opportunities
- Aesthetics – vistas and beauty of quintessential Cape Cod



Threats to salt marshes?

- 4 million acres of salt marsh in USA – approx. half could be lost by end of century
- Gulf of Maine region is a global hotspot for both sea level rise and warming waters
 - SLR – permanently flooding marshes
 - Warming is altering marsh function – biogeochemistry



Threats to salt marshes?

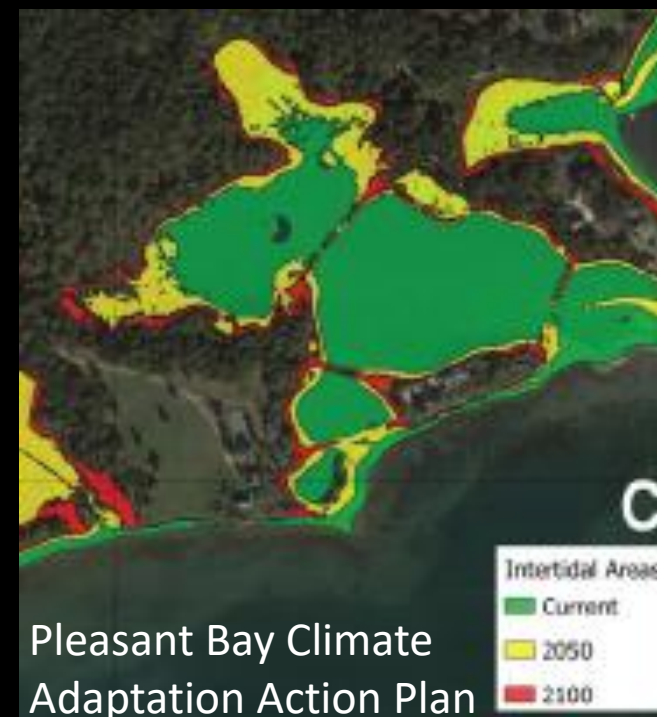


- Tidal restrictions – culverts, roads, berms
- Fragmentation
- Armoring and adjacent land uses – restrictions to marsh migration

Threats to salt marshes?



- Tidal restrictions – culverts, roads, berms
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Threats to salt marshes?

- Armoring and adjacent land uses – restrictions to marsh migration

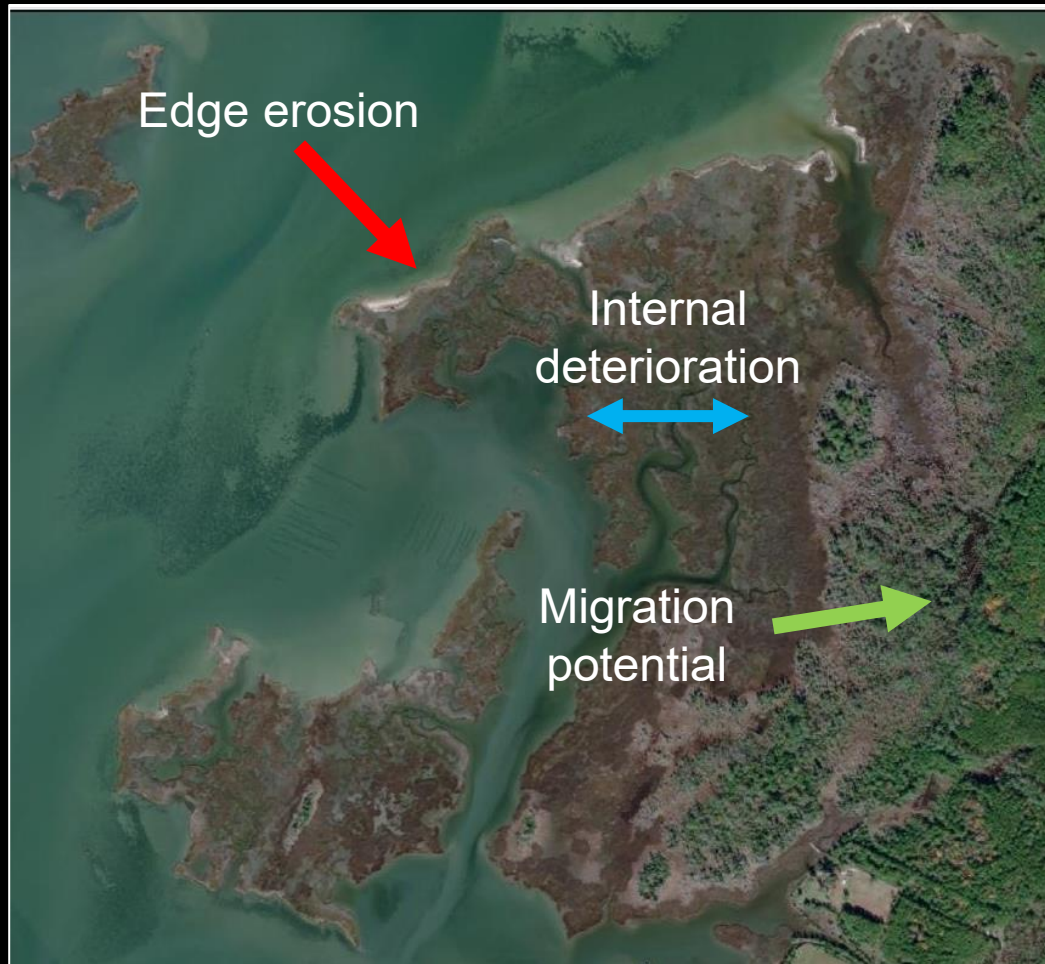


Threats to salt marshes?

- Invasive species – *Phragmites*
- Erosion – wave exposure, excess nutrients, over-grazing



Vulnerability of salt marshes: a combination of processes



Threats responsible for widespread marsh loss

Marsh loss is a three-dimensional process

Edge erosion caused by wave exposure and boat wakes

Internal deterioration caused by multiple factors but diagnosed through open water conversion and elevation loss

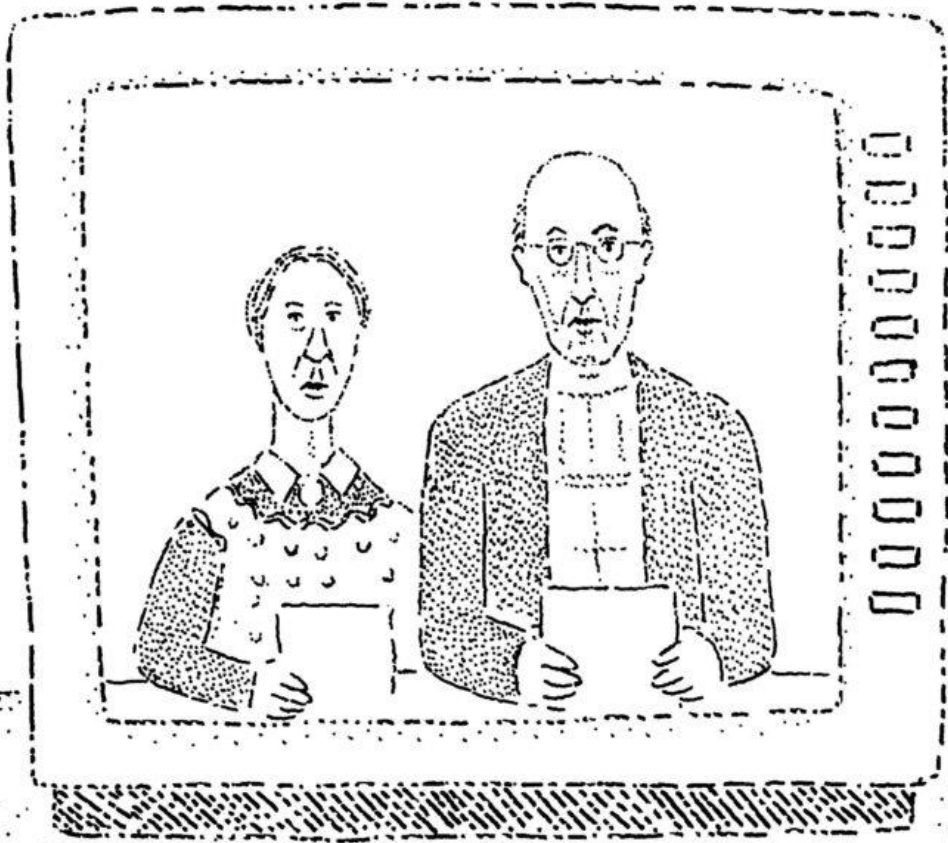
Migration potential depends on slope, tidal inundation frequency, salinity, land use, vegetation cover

Acknowledgments:

Neil Ganju, Kate Ackerman, and Zafer Defne
U.S. Geological Survey, Woods Hole



THE DOOM CHANNEL



MANKOFF

*“Bad things are happening.
Real bad.”*

*“Worse to come.
Much worse.”*



MVP

Municipal Vulnerability
Preparedness

Pleasant Bay Climate Adaptation Action Plan

Salt Marsh Resiliency Assessment



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Salt Marsh Resiliency Assessment Methodology

- Delineate marsh units
 - 180 hydrologically distinct units



Salt Marsh Resiliency Assessment Methodology

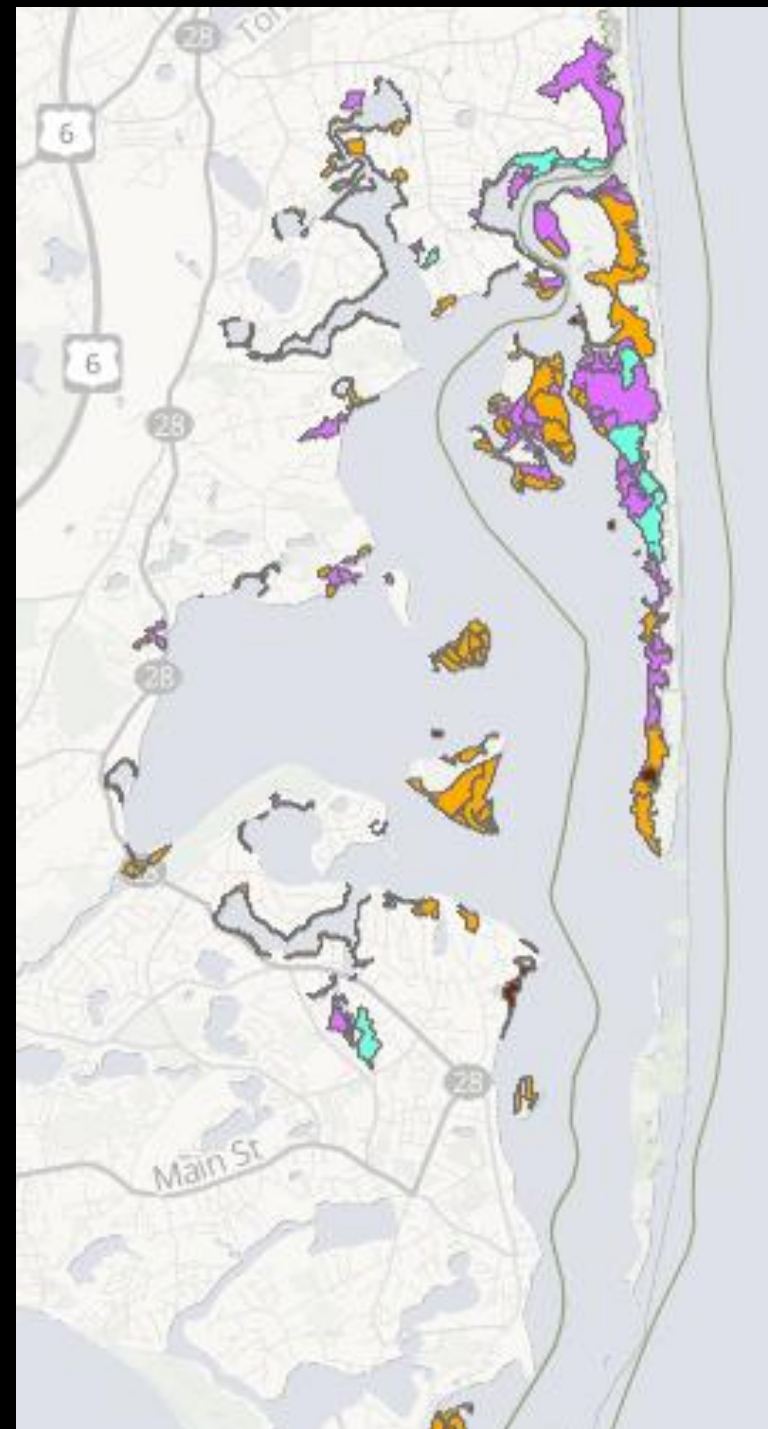
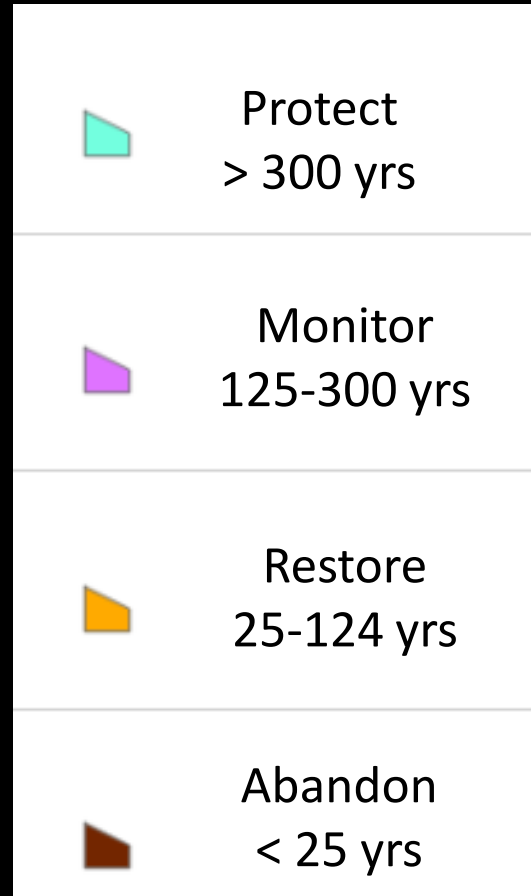
- Predict marsh resiliency using lifespan tool
- Estimate marsh lifespan under a Sea Level Rise (SLR) increase of 1m by 2100
- Estimates incorporate vegetated cover, sediment movement, vegetation biomass, marsh elevation, and sea level (tidal range)

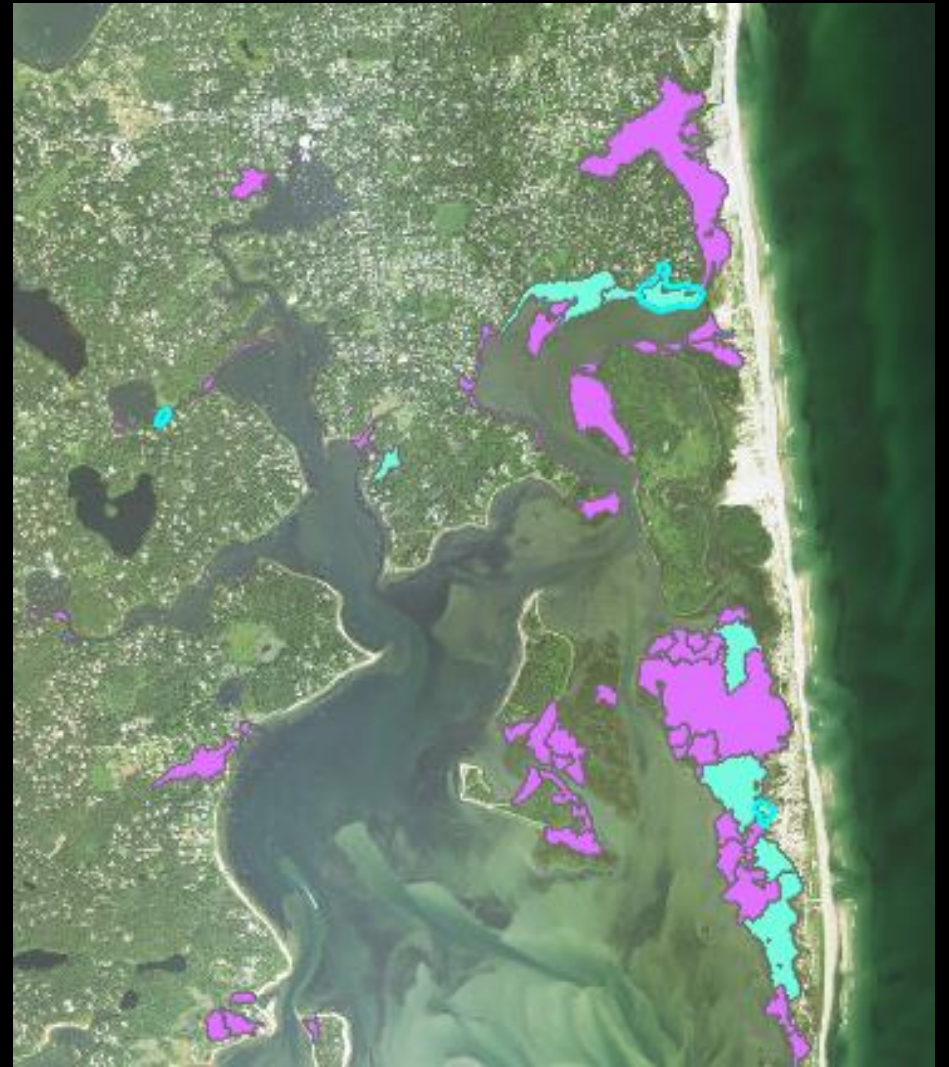


Data from USGS MA Coastal Wetland Synthesis
(Ackerman et al. 2021; Defne et al. 2023)

Salt Marsh Resiliency Assessment

- Lifespan – 1 m sea level rise by 2100
- Blue, purple – more than 125 yrs
- Orange, red – less than 125 years

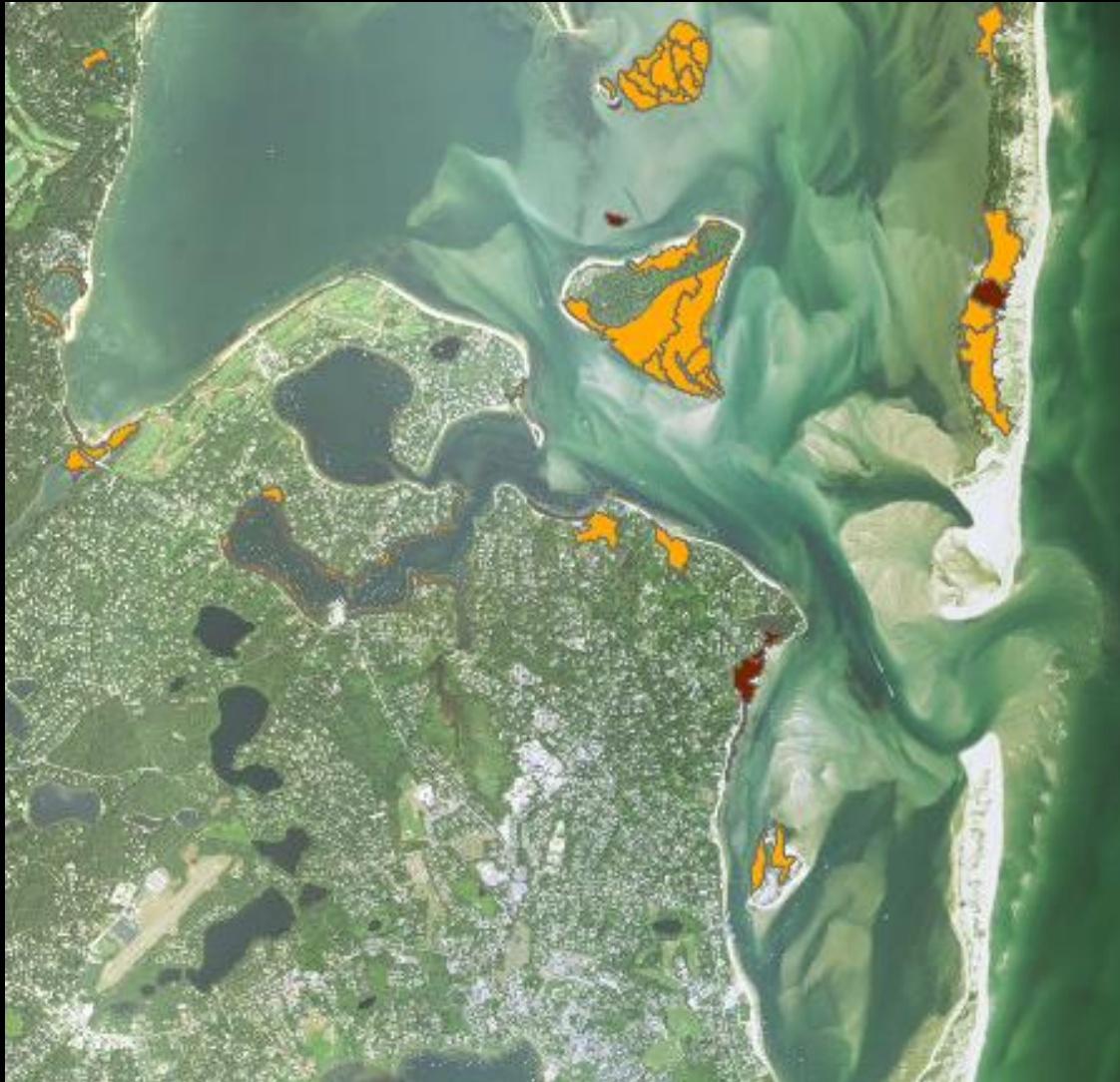




- Most of the sites are in Little Pleasant Bay and within CCNS
- Though a few key sites to examine in the main Bay

Salt Marsh Resiliency Assessment

Restore & Abandon



- Orange sites – focus of restoration actions – need to prioritize based on resource availability
- Red sites are in a state of deterioration – only act if site has meaningful importance

Salt Marsh Resiliency Assessment

	Lifespan (yrs)	100 cm SLR	
		N	Area (acres)
Protect	>300	13	131
Monitor	125-300	61	437
Restore	25-124	92	565
Abandon	<25	14	31

Salt Marsh Resiliency Assessment

Next steps –
Prioritizing and
determining
strategies



Restoration strategies

- Range from very simple to the very complex



Restoration strategies

- Restore tidal hydrology – remove restrictions to movement of tide waters



- New tide control structure at Herring River, Wellfleet

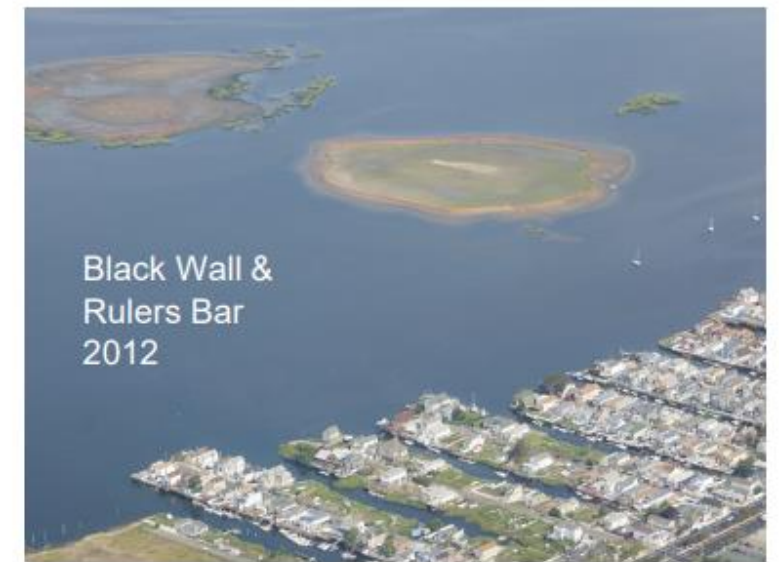
Restoration strategies

- Marsh augmentation and construction
- Marsh planting



Restoration strategies

- Marsh augmentation and construction
- Marsh planting
- Most of these efforts in NY have been largely unsuccessful
- Restoring existing marshes offers more successful outcomes



Restoration strategies

- Mosquito ditch restoration
- Improving marsh drainage



- Use existing ditches to improve marsh drainage



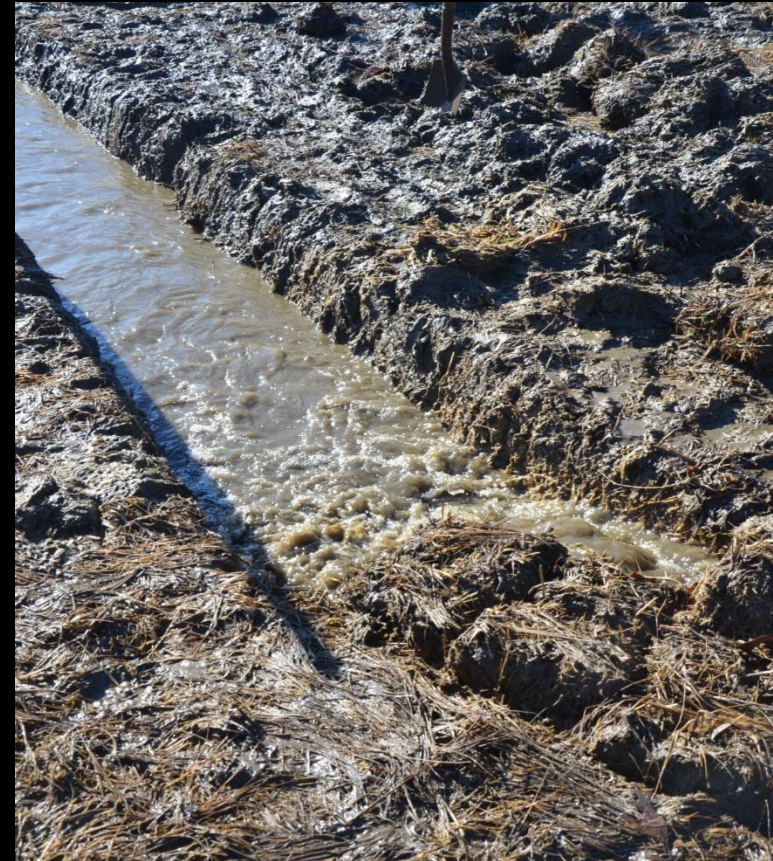
- Significant areas of deterioration
- Substantial vegetation loss due to inundation



- Low-impact, shovels
- Low cost
- Hand dig clogged ditches
- Spread material on adjacent marsh surface



- Immediate effect of improved drainage of inundated areas
- Recovery likely in 1-2 growing seasons



Before

- Surface with no drainage, high water, vegetation loss



After

- Surface drained, lower water, allow for rapid salt marsh vegetation recovery



Conclusions

- Salt marshes are critical natural resources
- Threats are numerous from both global and local threats
- Catastrophic losses of salt marshes are predicted
- Opportunities exist to intervene now and mitigate these losses ranging from small to large
- Learning from experience – improving existing marshes has higher likelihood of success





Thank you!!



Coyote at sunrise in the Narrows



**Chatham Salt Marsh Surveys:
Monitoring Methods, Results, and Next Steps
Pleasant Bay Estuary**

Katie Castagno, PhD – Center for Coastal Studies

Chatham Salt Marsh Surveys: Monitoring Methods, Results, and Next Steps



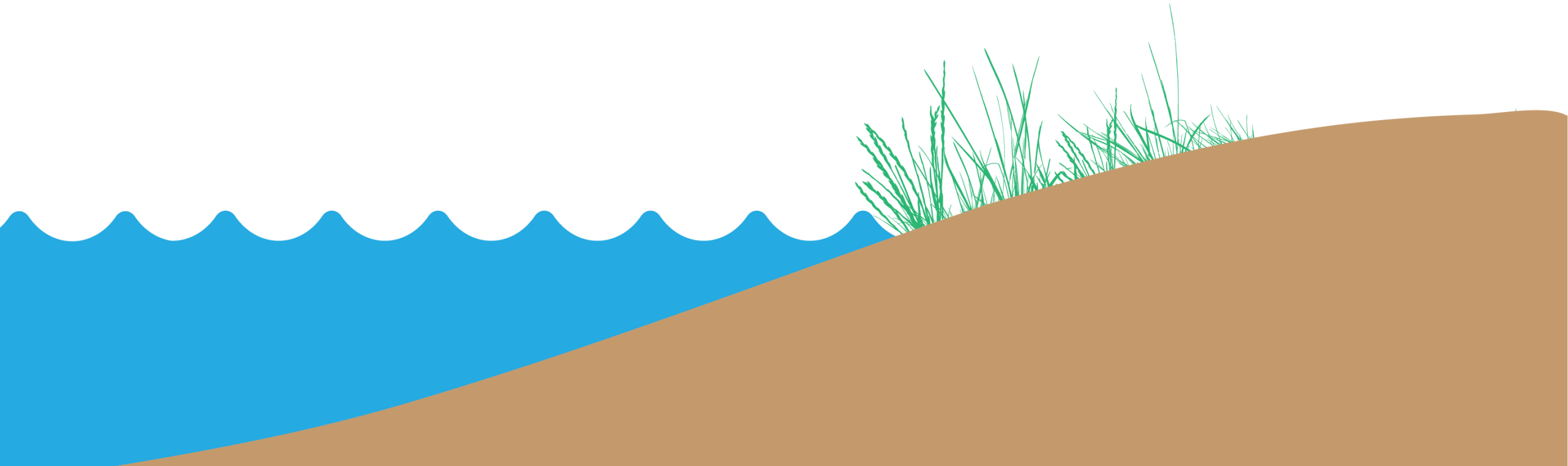
Katie Castagno, Ph.D.

Pleasant Bay Salt Marsh Symposium

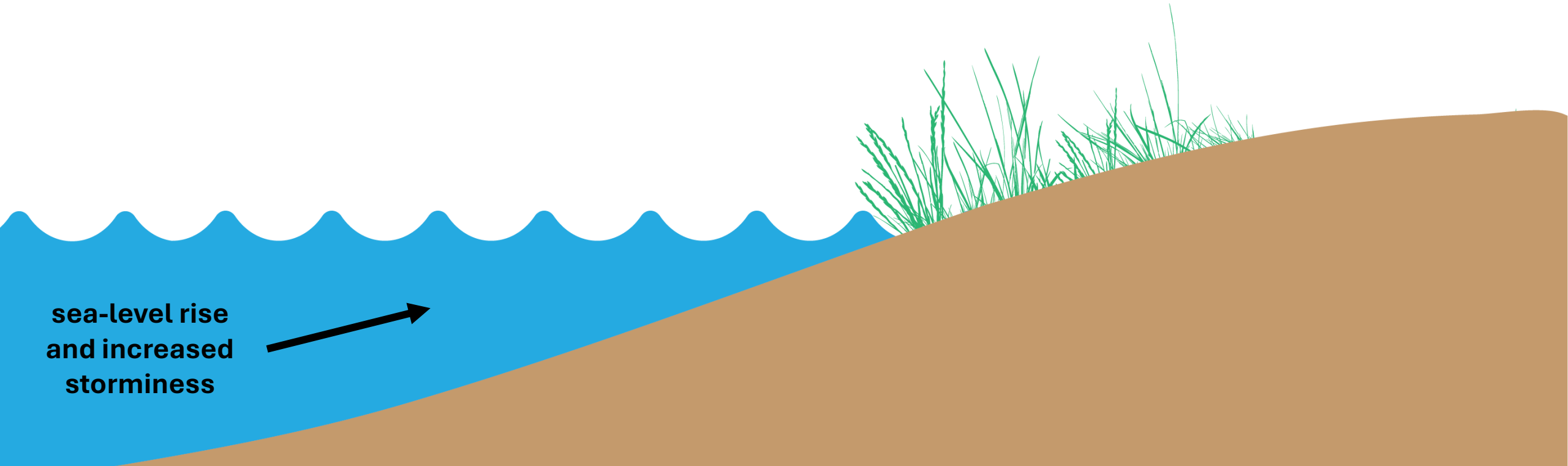
30 March 2026



Marsh Migration

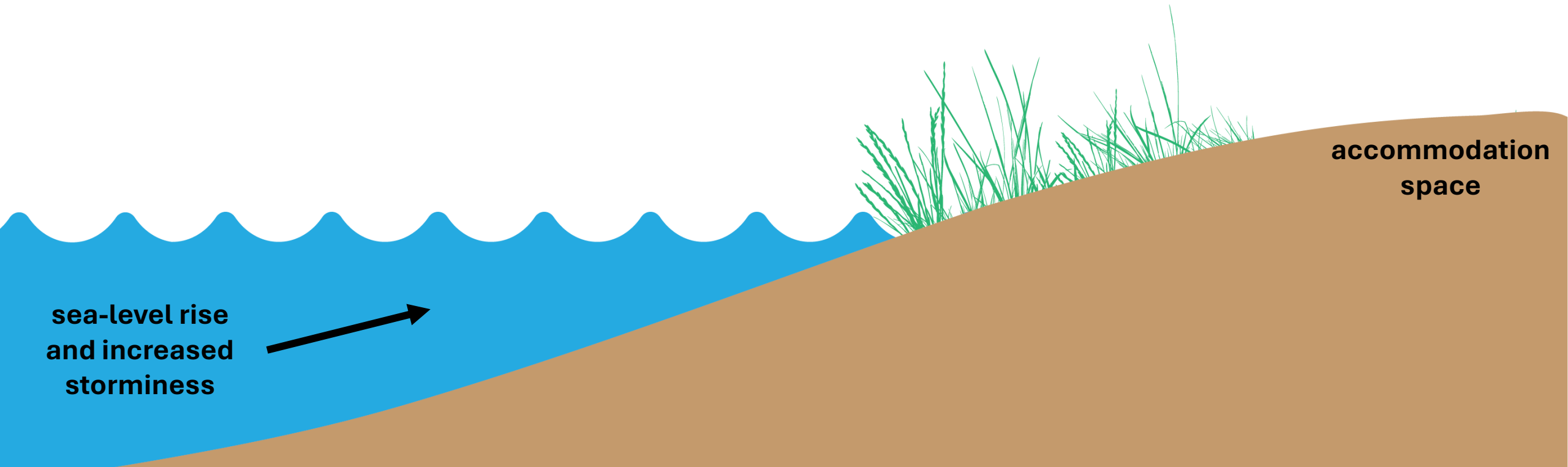


Marsh Migration

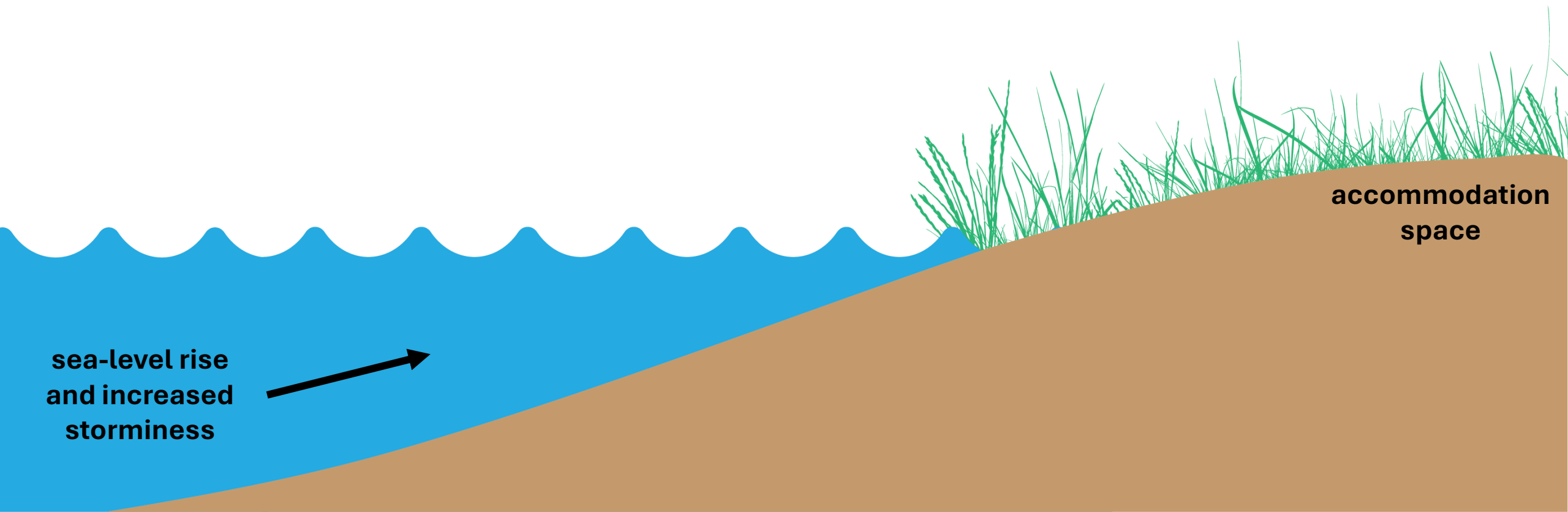


sea-level rise
and increased
storminess

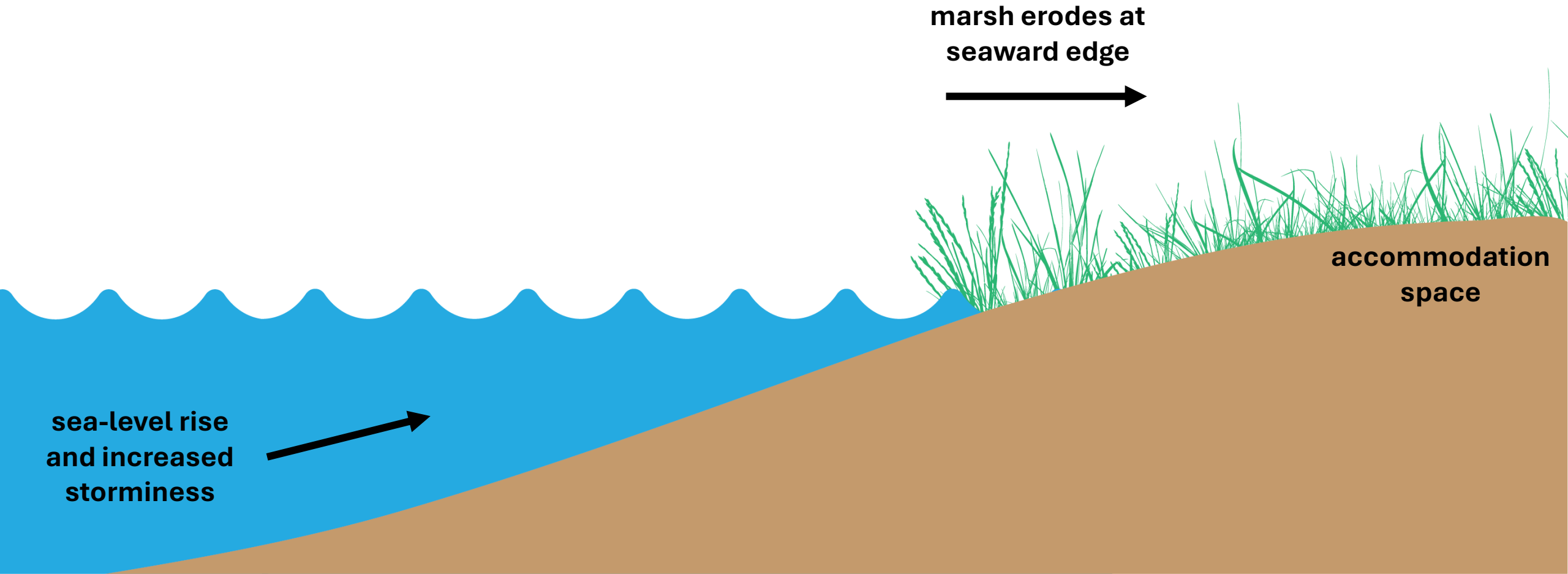
Marsh Migration



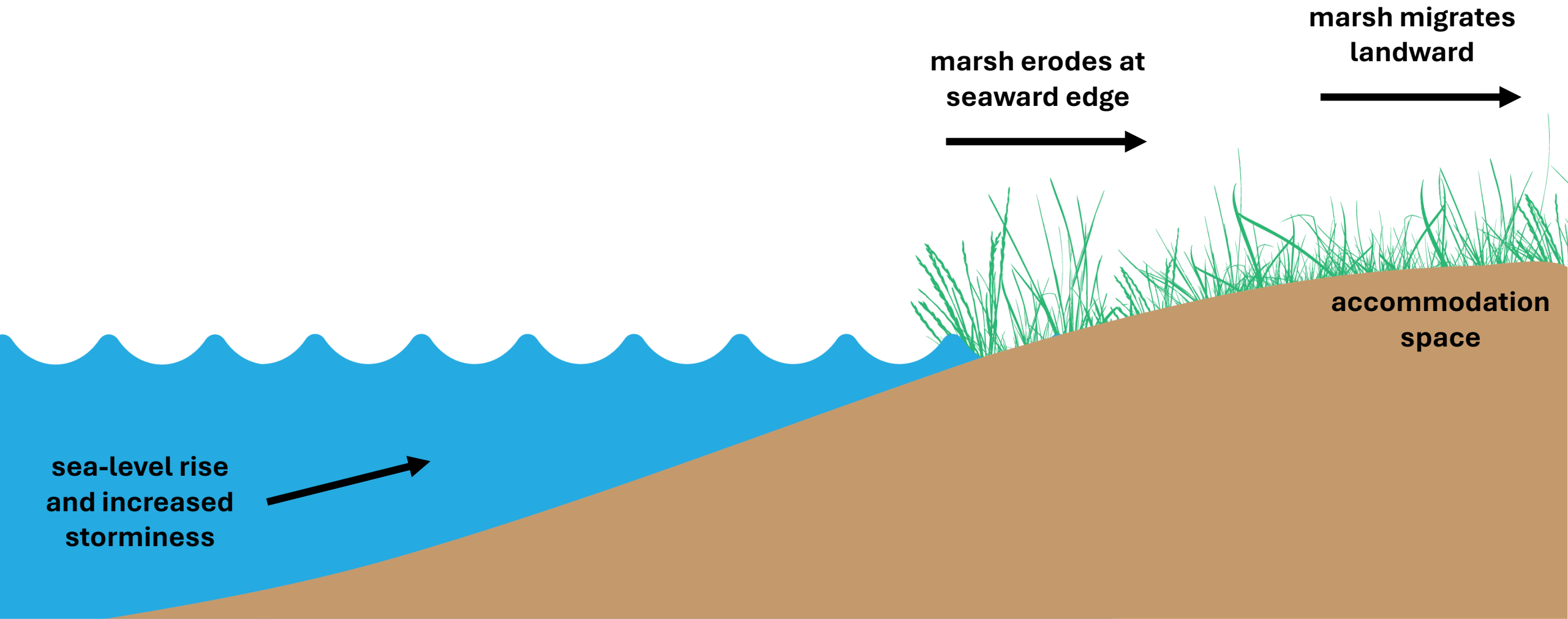
Marsh Migration



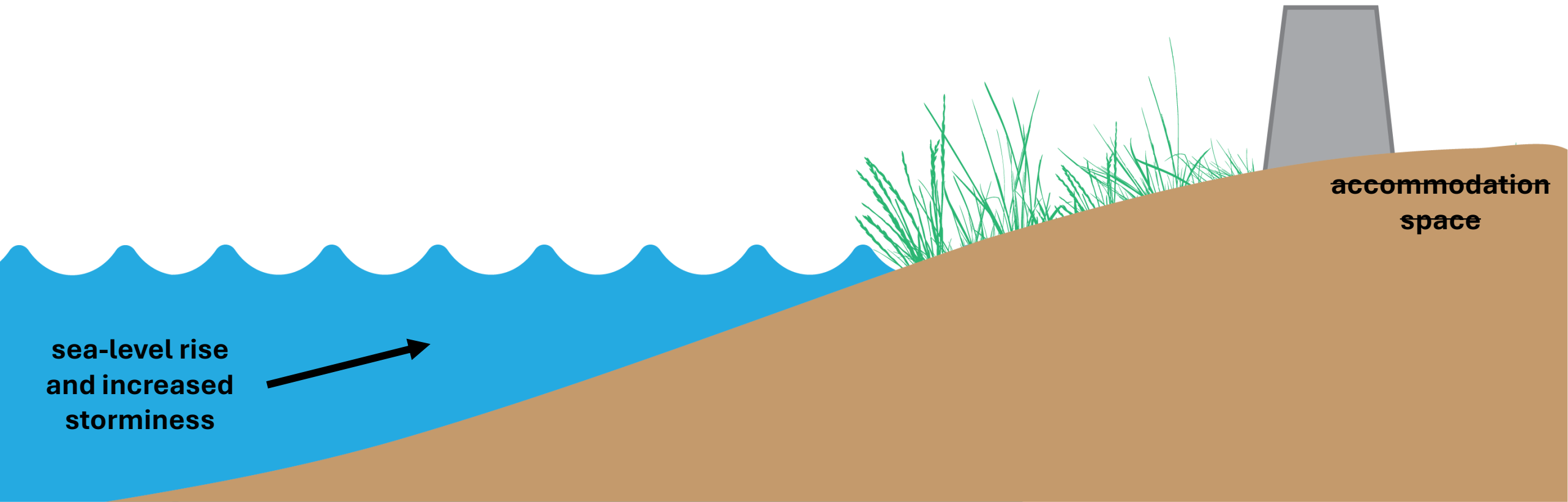
Marsh Migration



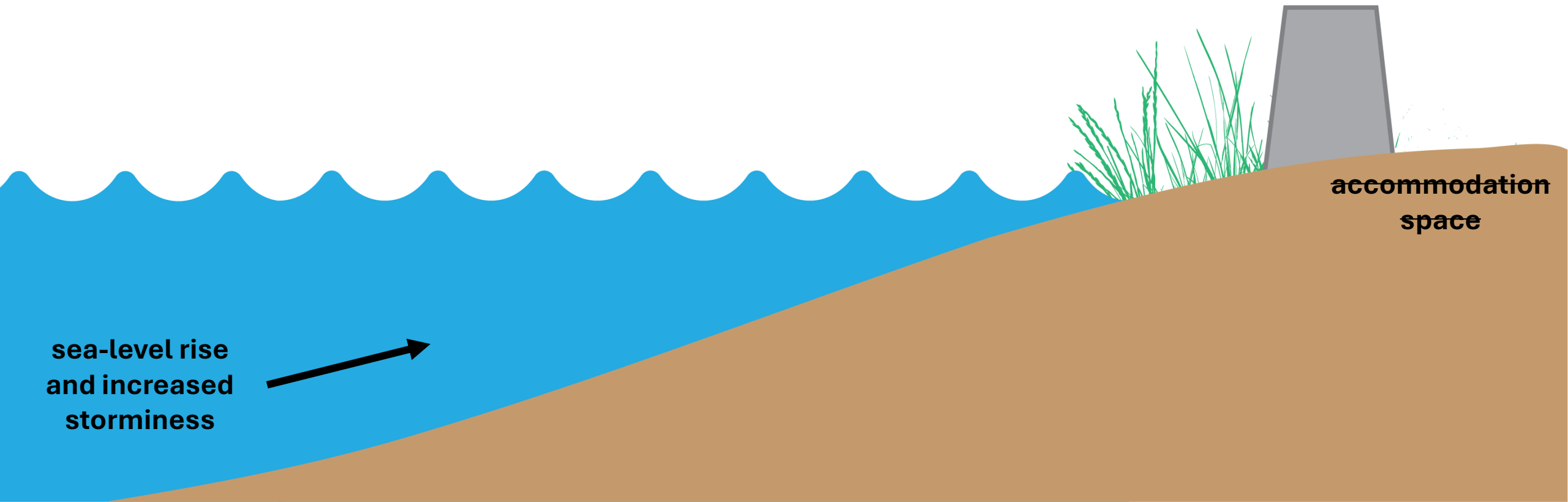
Marsh Migration



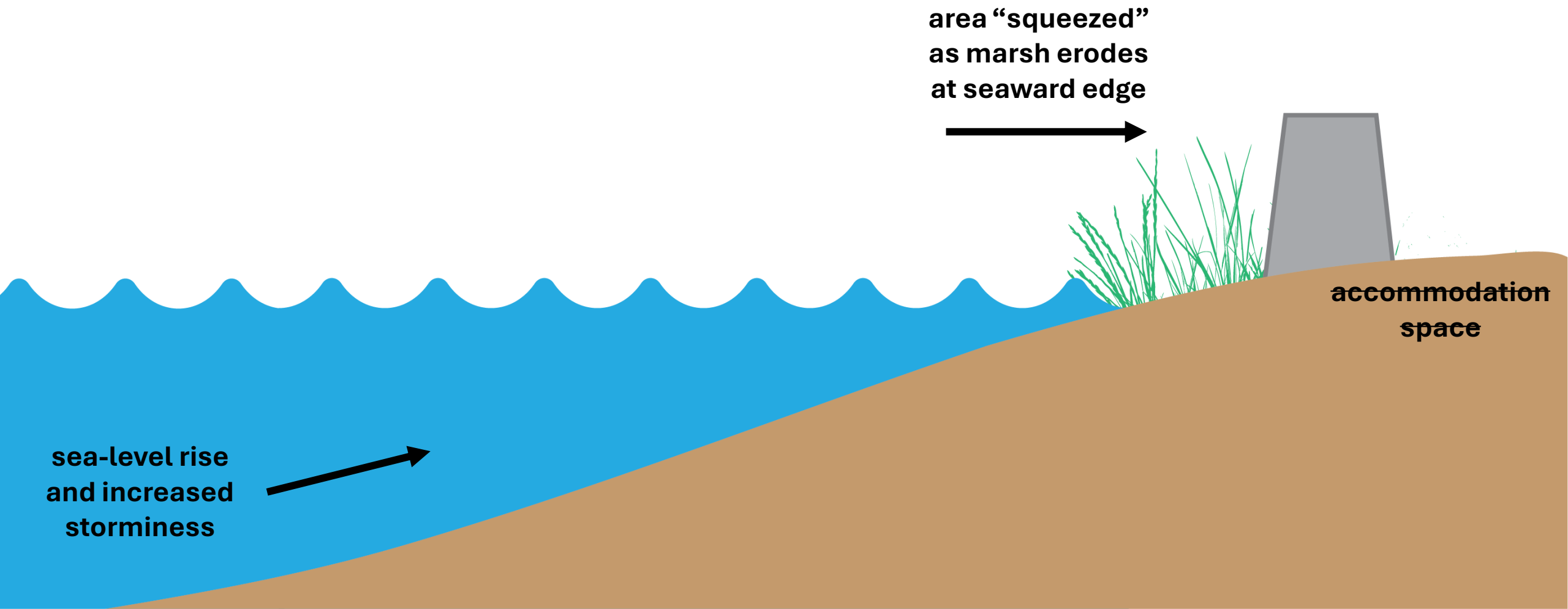
Coastal Squeeze



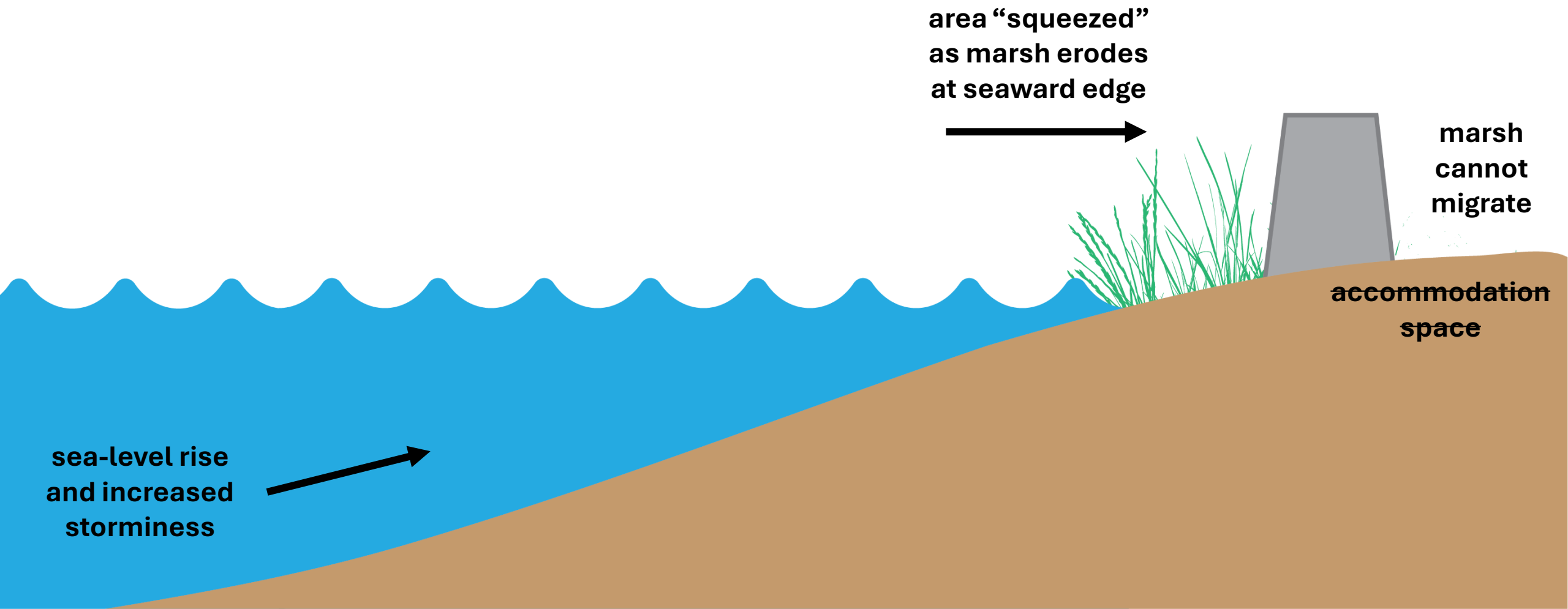
Coastal Squeeze



Coastal Squeeze



Coastal Squeeze



Using geologic inputs for decision making



- UAS surveys: continuous, high-resolution maps
 - Slope
 - Elevation



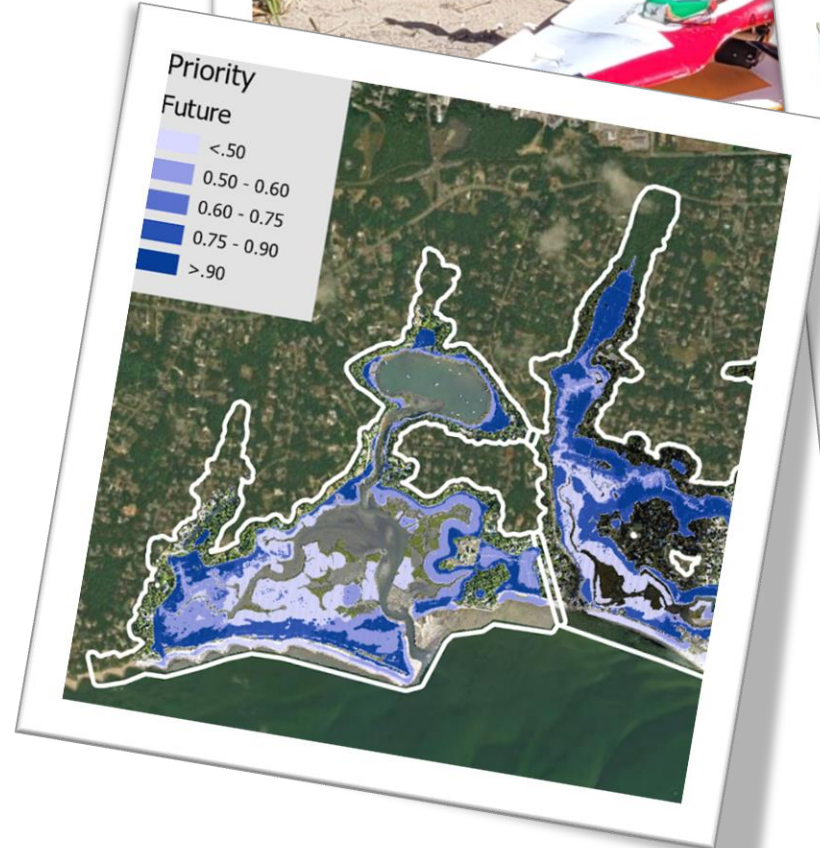
Using geologic inputs for decision making

- UAS surveys: continuous, high-resolution maps
 - Slope
 - Elevation
- Boots-on-the-ground monitoring
 - Sediment availability
 - Flora & fauna surveys



Using geologic inputs for decision making

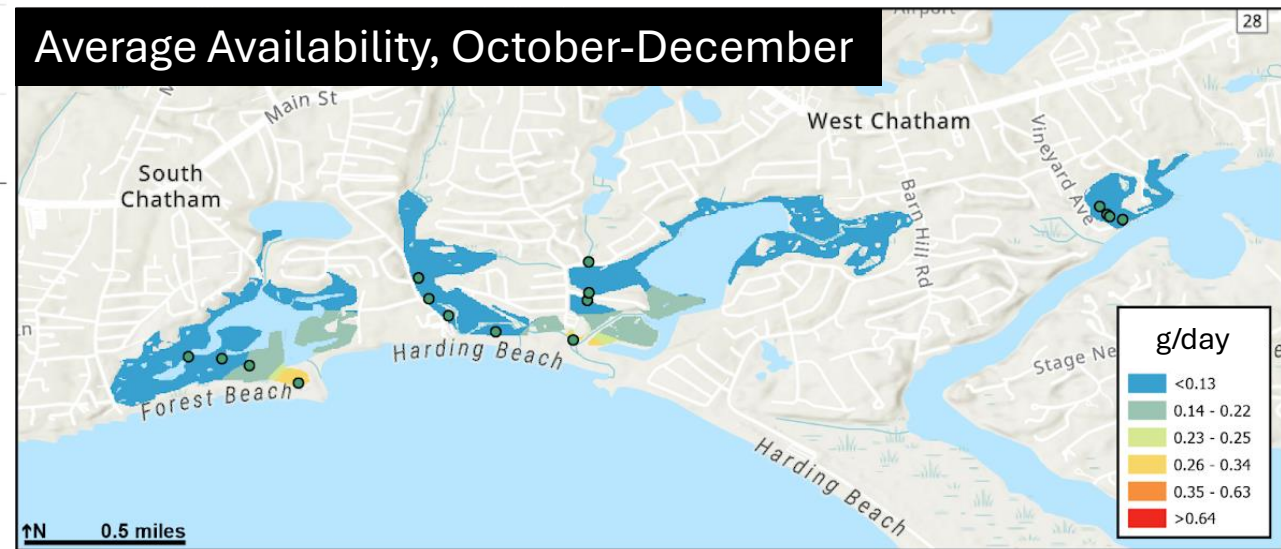
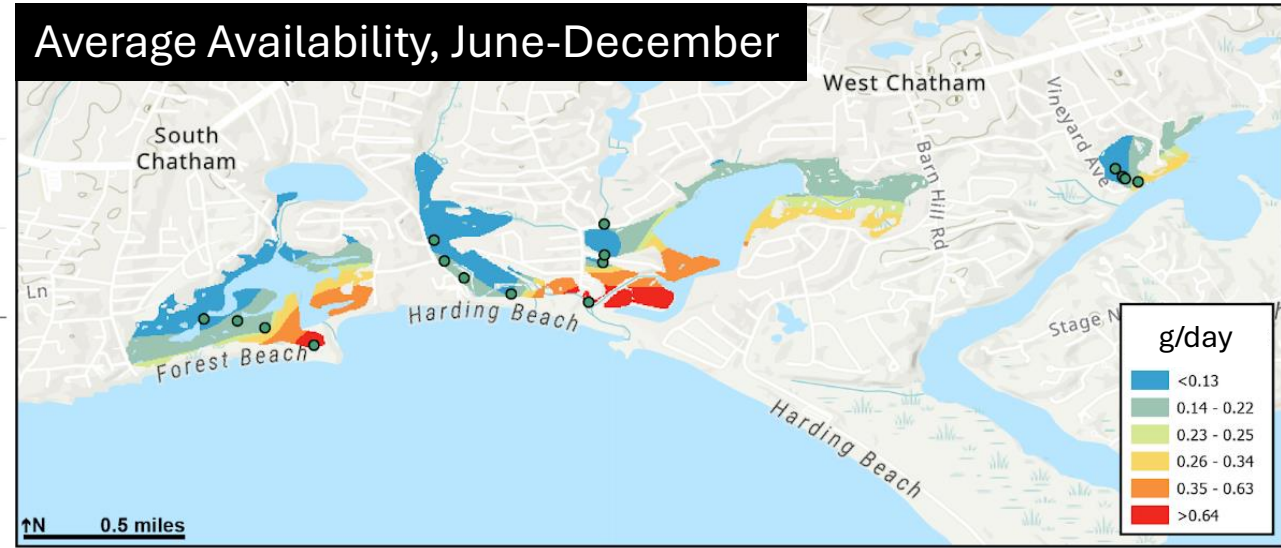
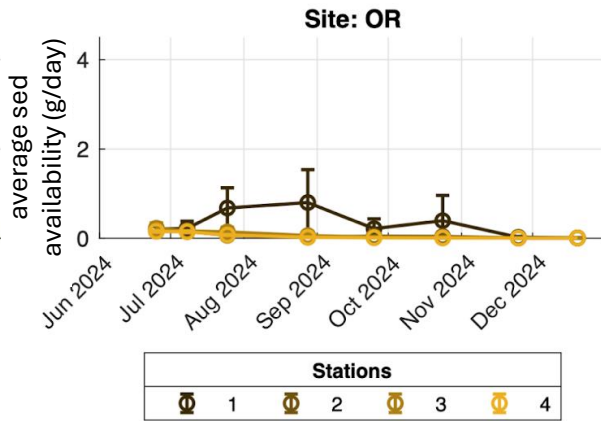
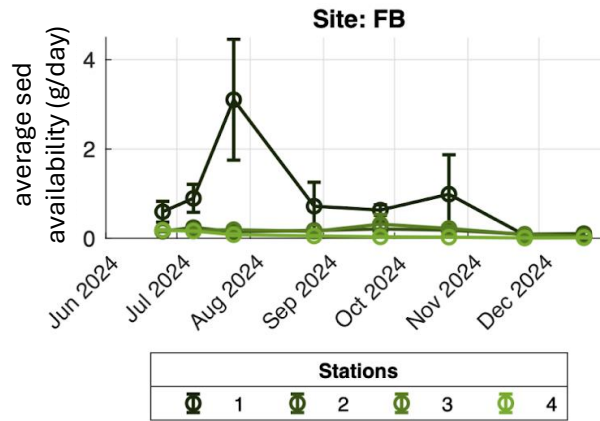
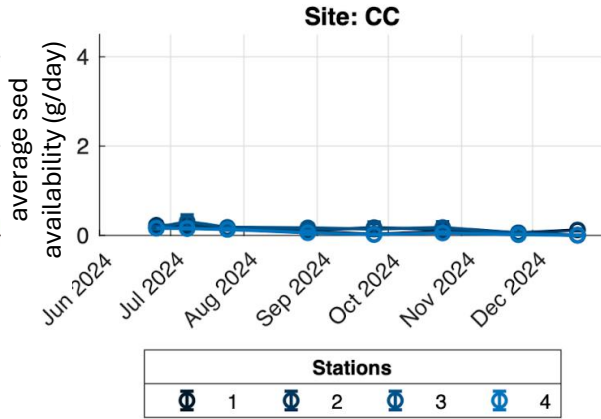
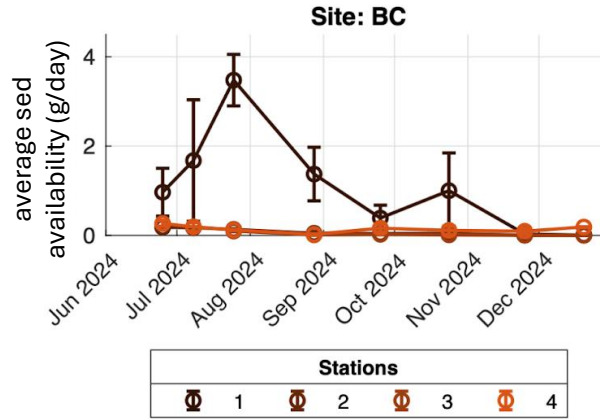
- UAS surveys: continuous, high-resolution maps
 - Slope
 - Elevation
- Boots-on-the-ground monitoring
 - Sediment availability
 - Flora & fauna surveys
- GIS analysis
 - Accommodation space
 - Prioritization



Sediment monitoring results



Sediment monitoring results

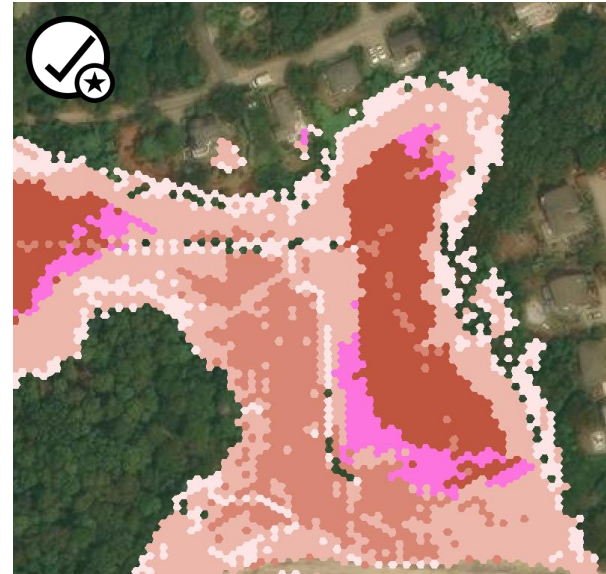


Geospatial Marsh Assessment and Ranking: Sediment Health

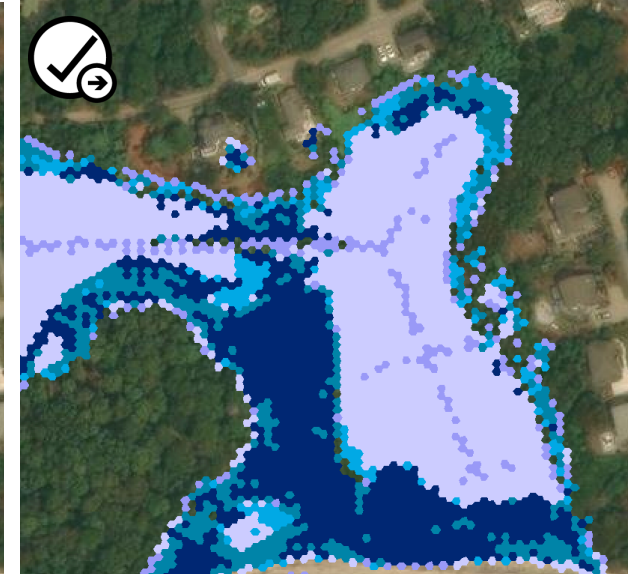
<https://tinyurl.com/CCSgeomarshChatham>



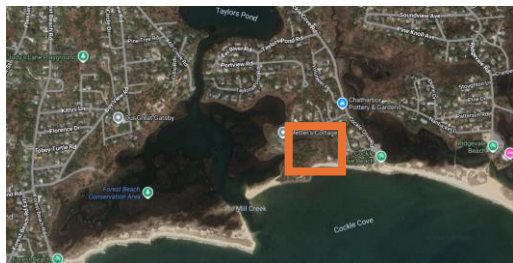
Suitability Score:
slope, elevation, proximity to &
area of accommodation space



Current Prioritization Score:
suitability score + sediment
availability + marsh presence

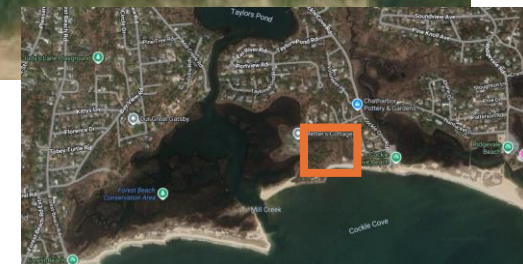


Future Prioritization Score:
suitability score + sediment
availability + 2050
accommodation space



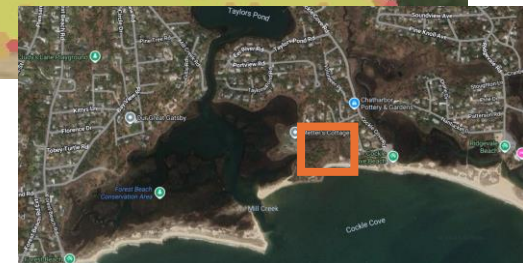
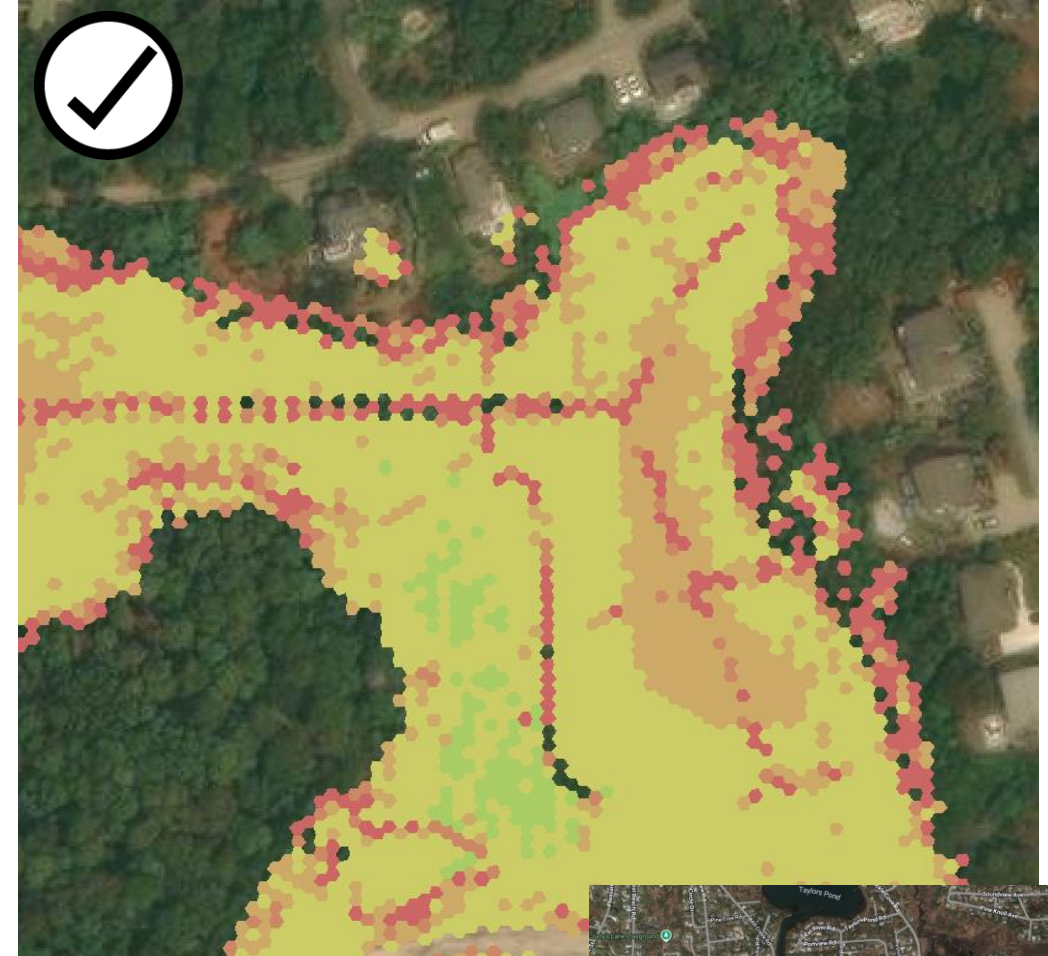
Ranking: Suitability Score

- **Is the area within current or future marsh-suitable elevations?**
- **Is the area's slope $<20\%$?**
- **Inputs**
 - Slope (ranked on curve)
 - Proximity to accommodation space (ranked on curve)
 - Accommodation thickness



Ranking: Suitability Score

- **Is the area within current or future marsh-suitable elevations?**
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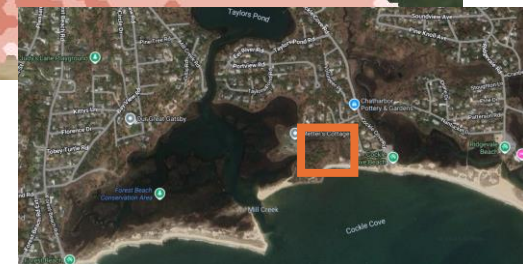
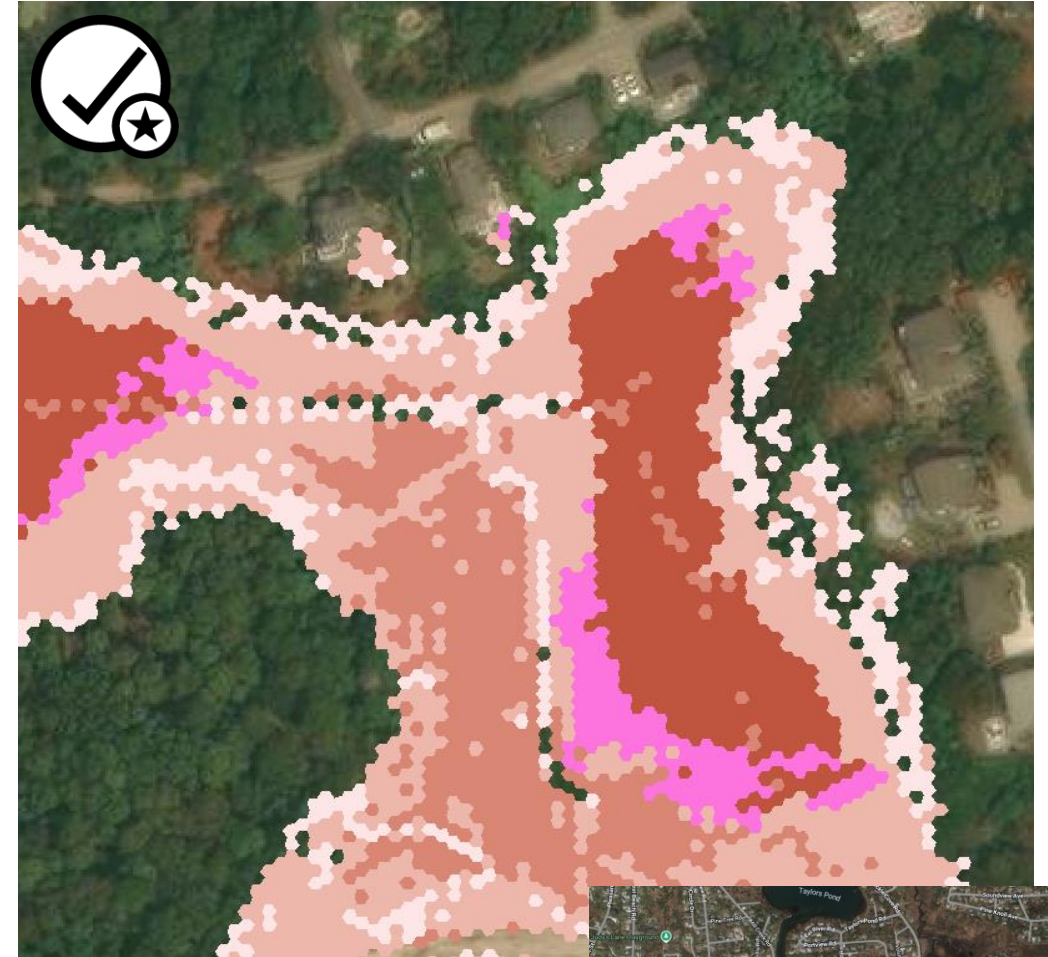
Ranking: Current Prioritization Score

- **Is the area suitable for marsh?**
 - **Is the area currently marsh?**
 - **Is the area near accommodation space? If so, how much?**
-
- **Inputs**
 - Suitability score
 - Sediment availability (ranked on curve using site-specific maximums)
 - Marsh presence (0 or 1)



Ranking: Current Prioritization Score

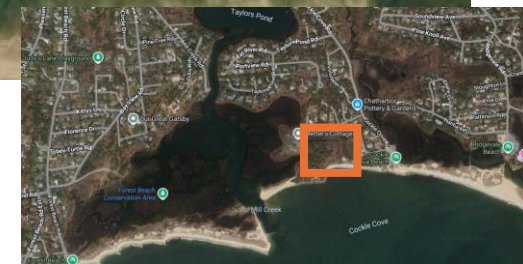
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-
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 - Suitability score
 - Sediment availability (ranked on curve using site-specific maximums)
 - Marsh presence (0 or 1)



Ranking: Future Prioritization Score

- **Is the area suitable for marsh?**
- **Is the area near accommodation space? If so, how much?**
- **Is the area accommodation space?**

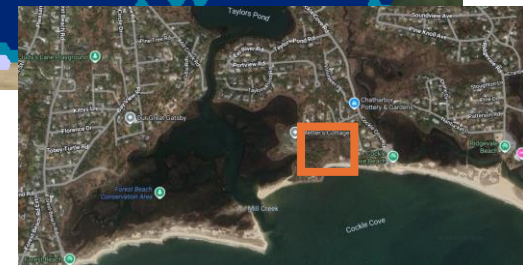
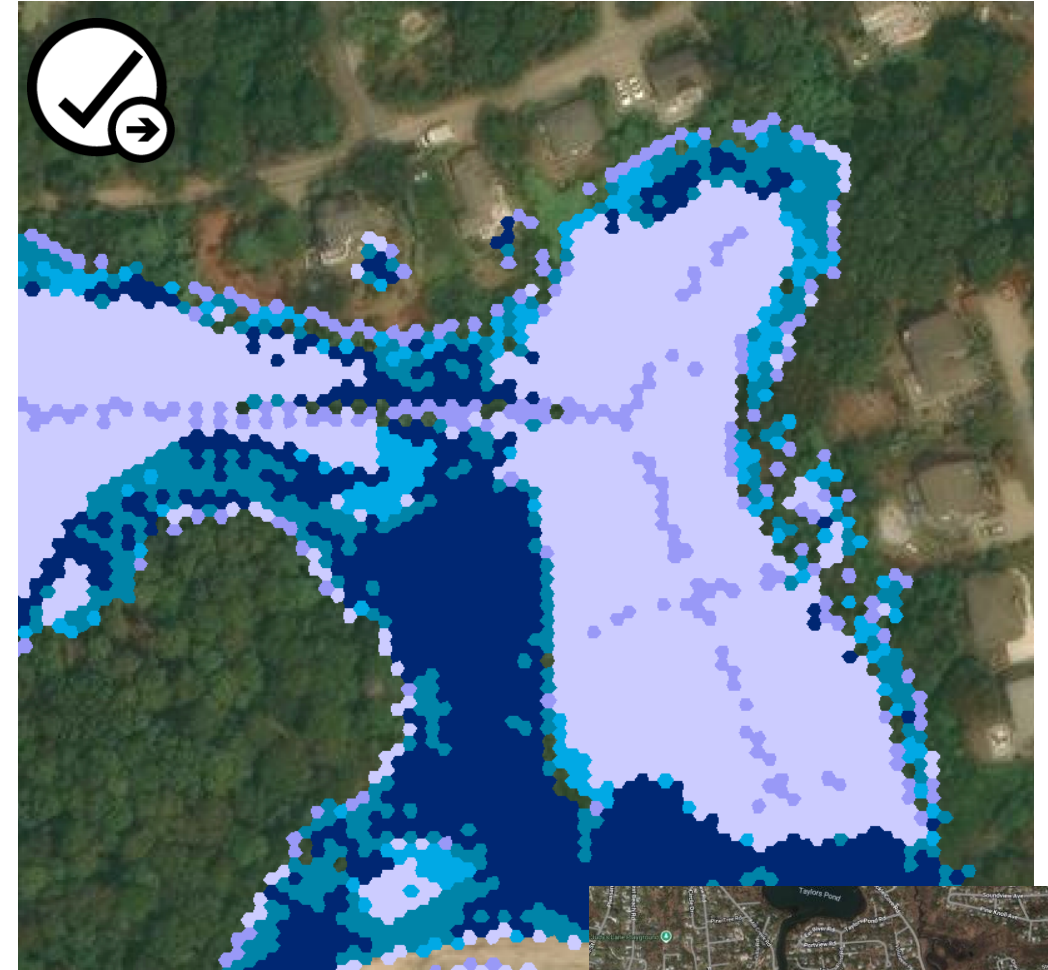
- **Inputs**
 - Suitability score
 - Sediment availability (ranked on curve using site-specific maximums)
 - 2050 accommodation space (0 or 1)



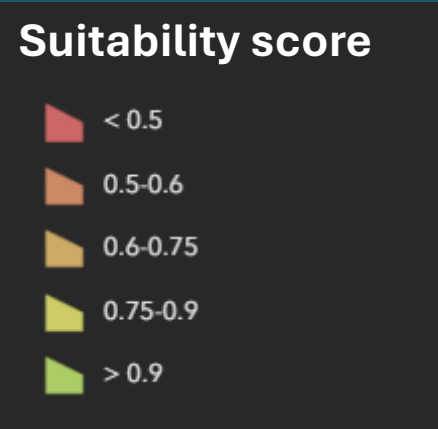
Ranking: Future Prioritization Score

- **Is the area suitable for marsh?**
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- **Is the area accommodation space?**

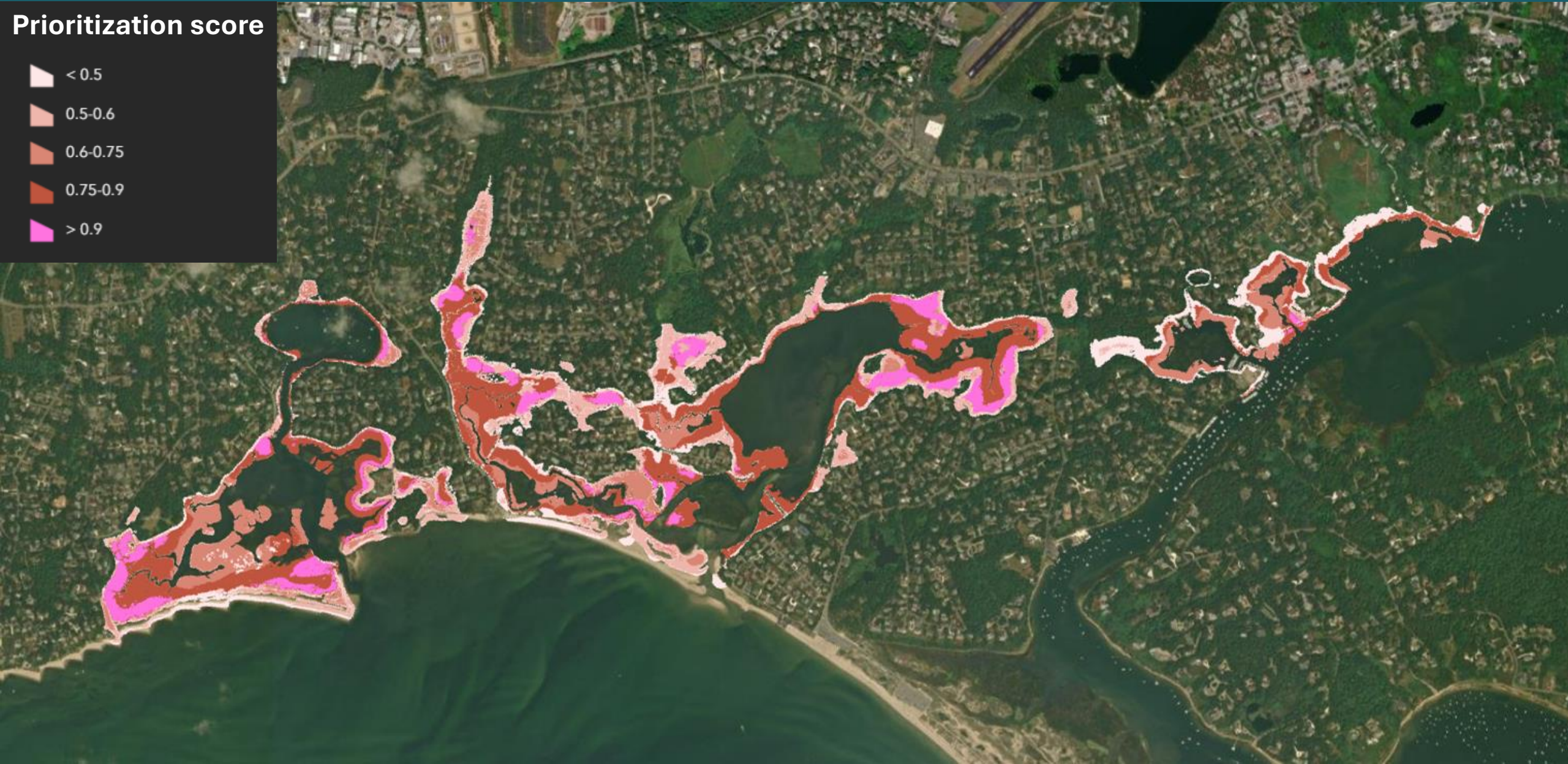
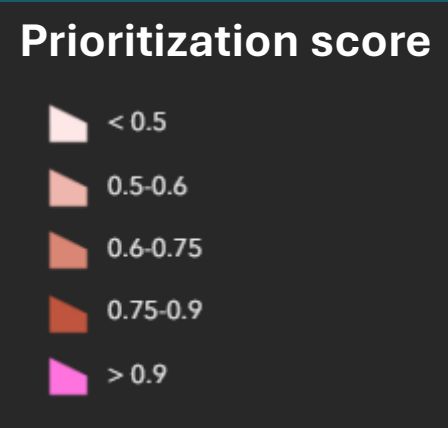
- **Inputs**
 - Suitability score
 - Sediment availability (ranked on curve using site-specific maximums)
 - 2050 accommodation space (0 or 1)



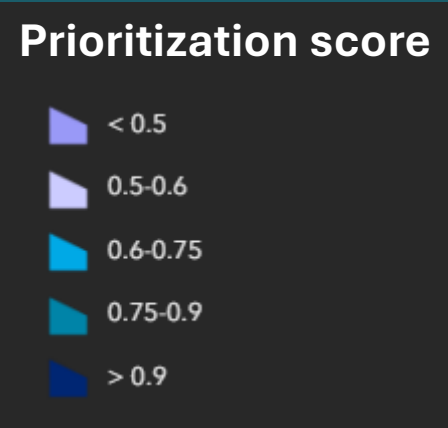
Chatham Results: Suitability



Chatham Results: Current Prioritization



Chatham Results: Future Prioritization



GeoMARSH walkthrough



GeoMARSH^{beta}: Chatham Geospatial Marsh Assessment and Ranking: Sediment Health

Layers

Layer Legend

Suitability Score

Suitability_Score

- < 0.5
- 0.5-0.6
- 0.6-0.75
- 0.75-0.9
- > 0.9

Leading layers

- Future Prioritization Score
- Current Prioritization Score
- Suitability Score

Trailing layers

- Future Prioritization Score
- Current Prioritization Score
- Suitability Score

Future Prioritization Score ...

Current Prioritization Score ...

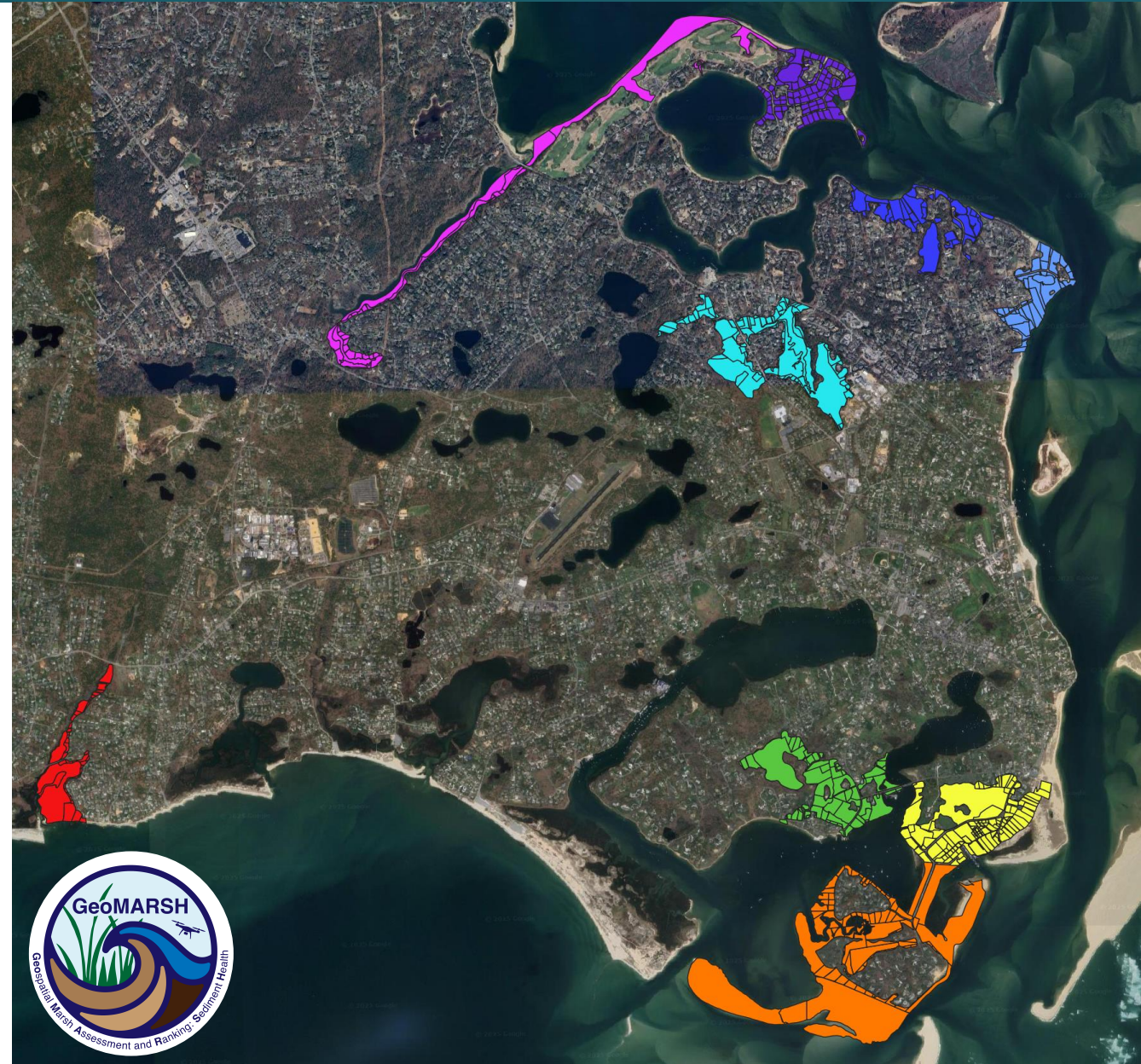
Suitability Score ...

Powered by Esri

Conclusions & Next Steps

Geospatial Marsh Assessment and Ranking: Sediment Health

- An easy-to-use, geologically-backed method for decisionmakers to identify marsh migration priority areas
- Model and viewer refinement ongoing
- **Up next:** expansion to nine marshes in Chatham







A Tale of Two Creeks...
Muddy and Frost Fish Creeks

Greg Berman, Director of Natural Resources
Town of Chatham, MA

**Coastal Salt Marsh Symposium
Science. Solutions. Stewardship**

**Protecting, Restoring & Monitoring Salt Marsh
Change in Pleasant Bay & Beyond**

Greg Berman, Director of Natural Resources



**Muddy
Creek**

**Frost
Fish
Creek**



Muddy
Creek



TOWN OF CHATHAM | MA

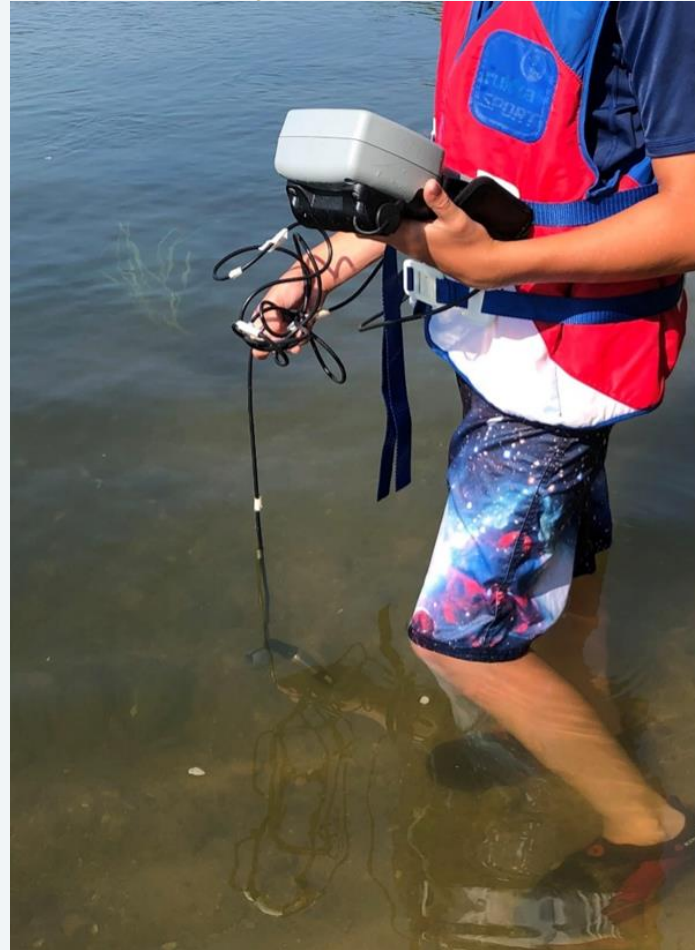


Long-term, volunteer-based program **Water Watchers** collect water samples and measure key water quality indicators to track the health of Chatham and Pleasant Bay estuaries.

Water Transparency



Salinity, Temp, & DO



Phytoplankton, Nitrogen, etc.



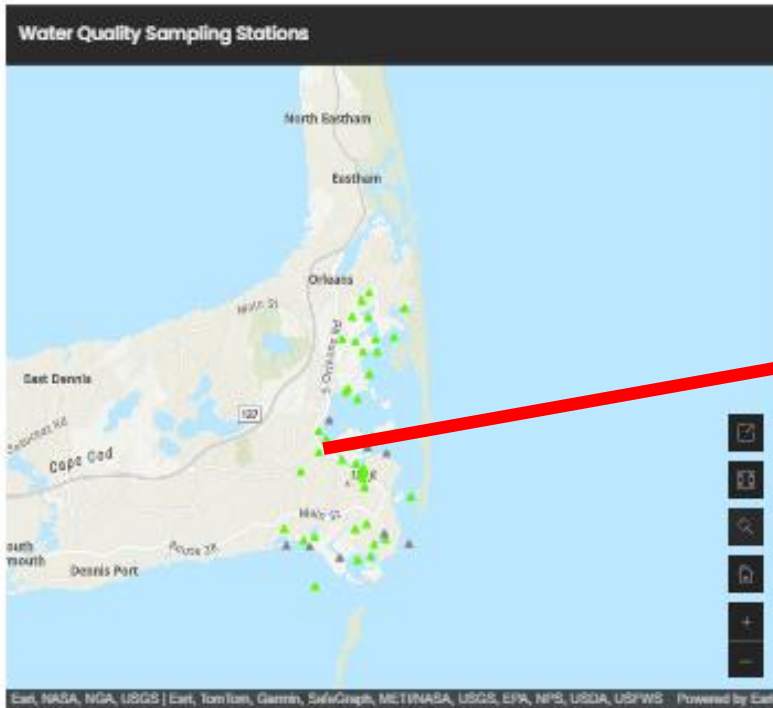
TOWN OF CHATHAM | MA



Program Introduction

home - Departments - Water Quality Laboratory - Coastal Water Nutrient Monitoring Program

Click sites below to view Data Graphs on the Map



All graphs are available at this [link in pdf format](#). Raw data is available upon request to the Town.

Water Quality Sampling Stations

Legend

Water Quality Sampling Stations

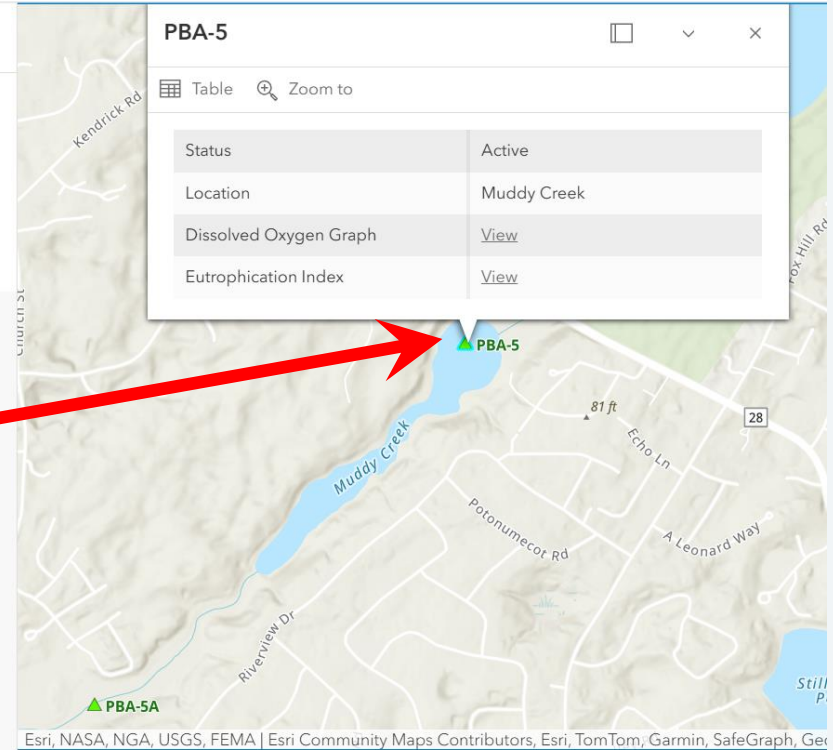
Station Status

- ▲ Active
- ▲ Inactive

PBA-5

Table Zoom to

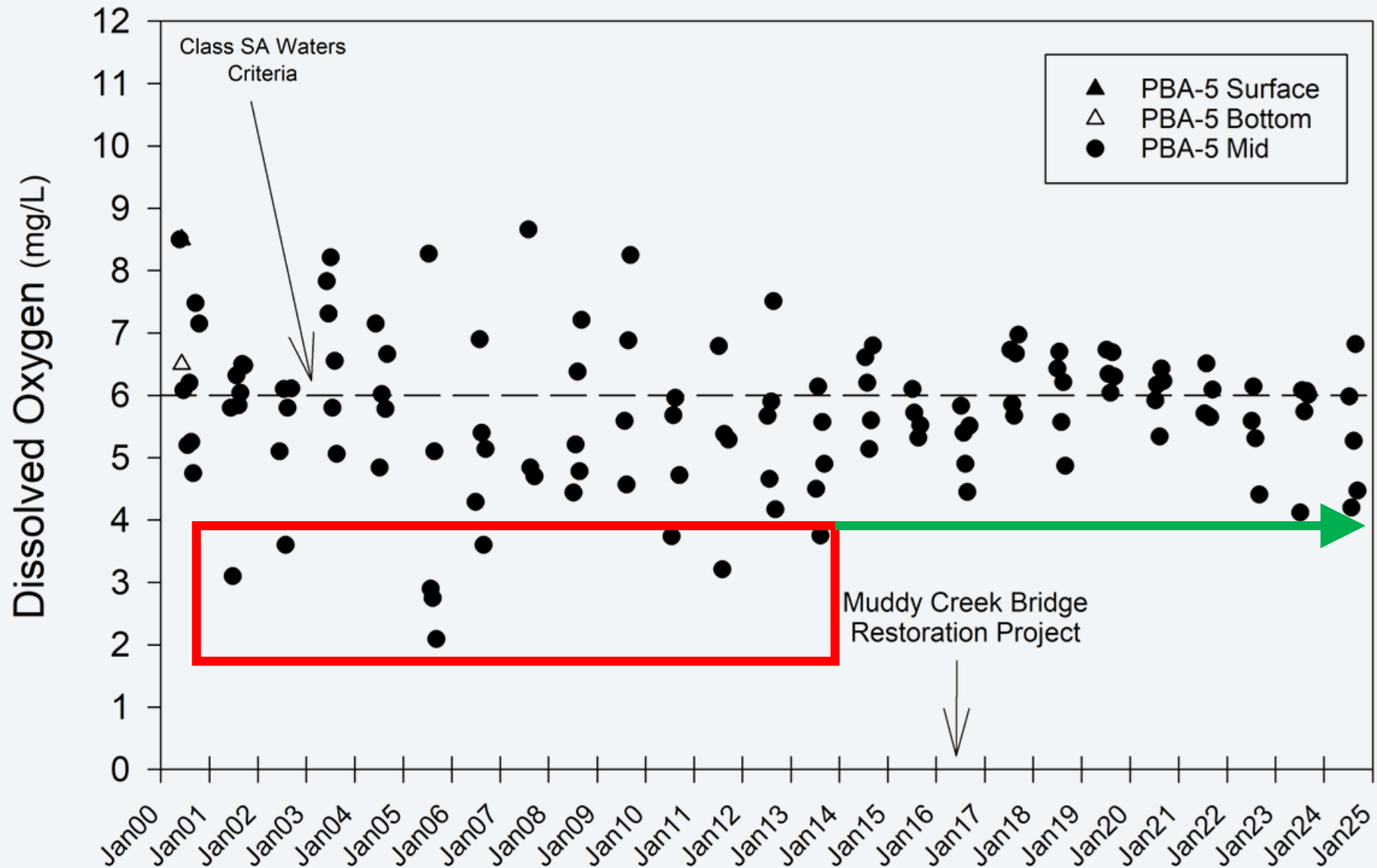
Status	Active
Location	Muddy Creek
Dissolved Oxygen Graph	View
Eutrophication Index	View



Esri, NASA, NGA, USGS, FEMA | Esri Community Maps Contributors, Esri, TomTom, Garmin, SafeGraph, Ger

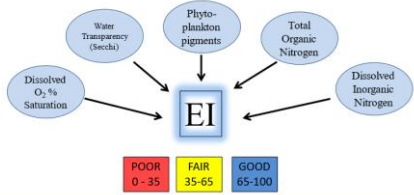


Muddy Creek (PBA-5)

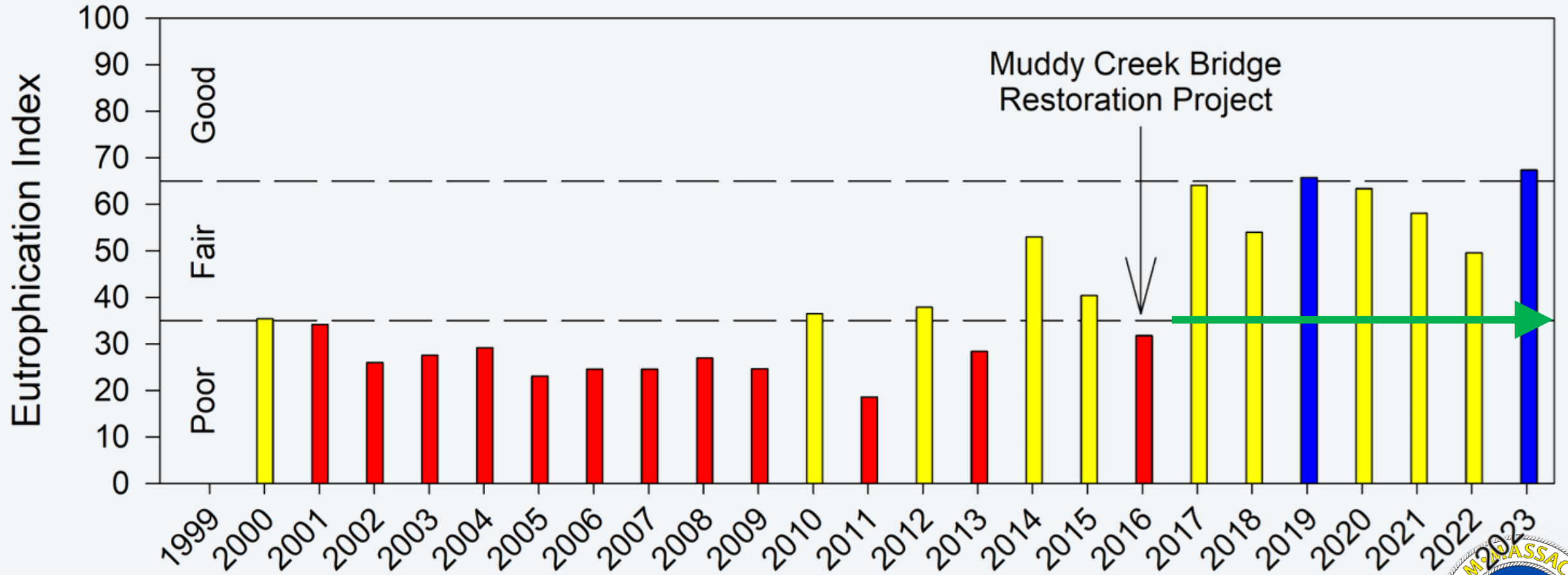


Eutrophication Index - EI

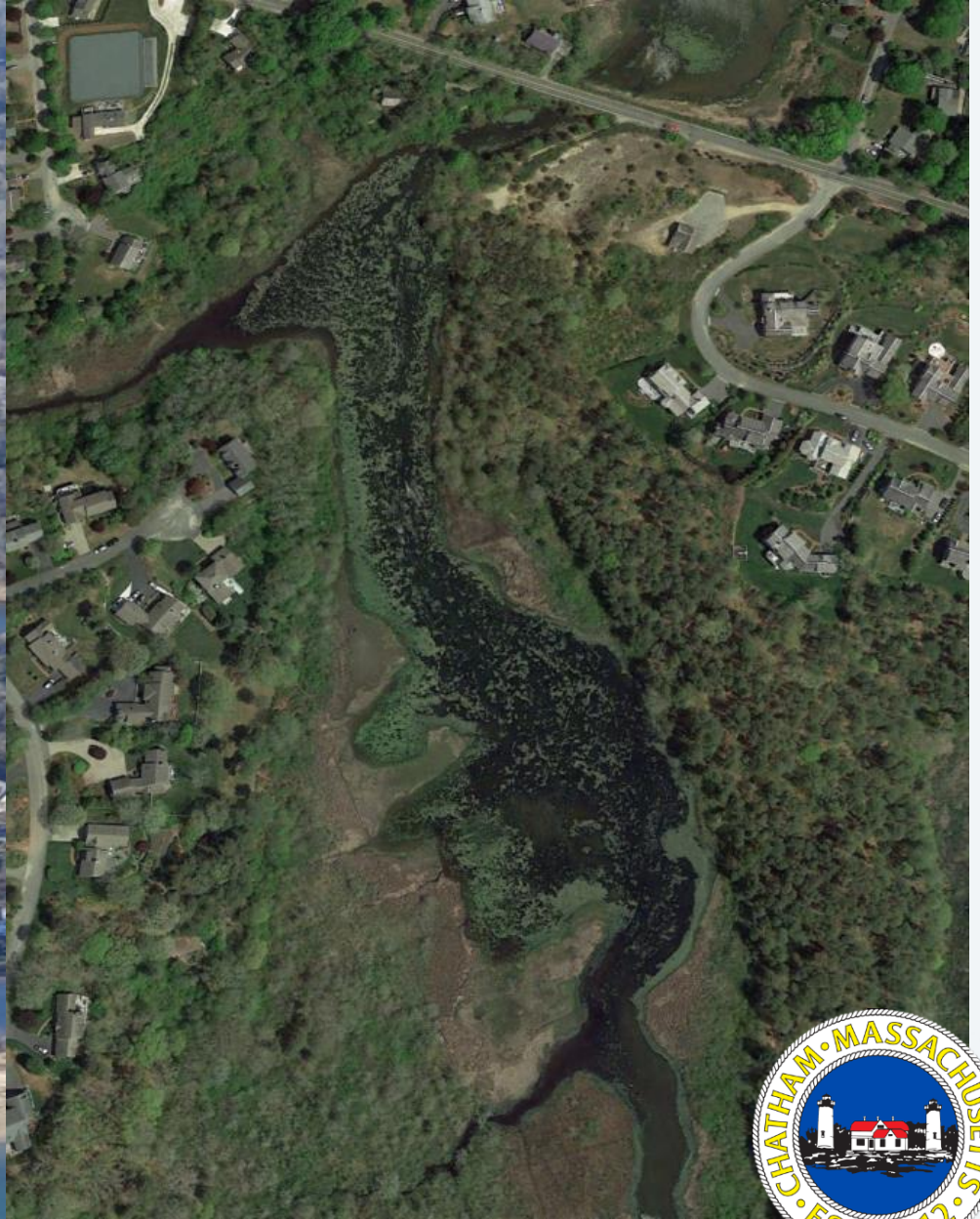
- Used to compare WQ of different embayments
- Establish baseline for long term changes in WQ
- Five measurements used to calculate EI are:



Muddy Creek (PBA-5)



Frost
Fish
Creek





Legend

 Parcel

Contour

-  Existing Spring Tide Elevation (1.52 ft)
-  Post-Restoration Spring Tide Elevation (2.98 ft)
-  Existing 100-Year Storm Tide Elevation (7.1 ft)
-  Post-Restoration 100-Year Storm Tide Elevation (9.6 ft)
-  Septic Infrastructure

Note: all elevations are taken at the ground surface of the labeled structure unless otherwise noted.

Furthermore, certain contour elevations may not be visible on all properties, particularly the mapped spring tides. These data were mapped for completeness but are unlikely to affect your property.

0 12.5 25
Ft

**FUSS &
O'NEILL**





Questions?





Jackknife Beach Living Shoreline: Restoration Update

Catherine Ricks, Coastal Resilience Director
Town of Chatham, MA

SALT MARSH SYMPOSIUM

March 30, 2026

**JACKKNIFE BEACH HARBOR LIVING
SHORELINE**

ADVANCES IN SALT MARSH REBUILDING AND GROWTH



Catherine Ricks, Director of Coastal Resilience



Salt Marsh Vegetation Protects the Coast and Provides Habitat



What Can We Do To Help Vegetation establish a thick healthy marsh system?





LIVING SHORELINES SUPPORT RESILIENT COMMUNITIES

Living shorelines use plants or other natural elements—sometimes in combination with harder shoreline structures—to stabilize estuarine coasts, bays, and tributaries.



One square mile of salt marsh stores the carbon equivalent of **76,000 gal of gas** annually.



Marshes trap sediments from tidal waters, allowing them to **grow in elevation** as sea level rises.



Living shorelines improve **water quality**, provide fisheries **habitat**, increase **biodiversity**, and promote **recreation**.



Marshes and oyster reefs act as natural **barriers** to waves. **15 ft** of marsh can **absorb 50%** of incoming wave energy.



Living shorelines are **more resilient** against storms than bulkheads.



33% of shorelines in the U.S. will be **hardened** by **2100**, decreasing fisheries habitat and biodiversity.



Hard shoreline structures like **bulkheads** prevent natural marsh migration and may create seaward **erosion**.



The National Centers for Coastal Ocean Science | coastalscience.noaa.gov

Some graphics courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/)



Salt Marsh Loss



2014



2024

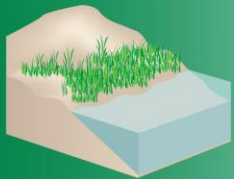


HOW GREEN OR GRAY SHOULD YOUR SHORELINE SOLUTION BE?

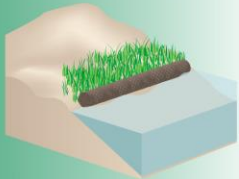
GREEN - SOFTER TECHNIQUES

GRAY - HARDER TECHNIQUES

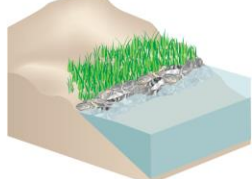
Living Shorelines



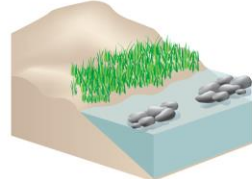
VEGETATION ONLY -
Provides a buffer to upland areas and breaks small waves. Suitable for low wave energy environments.



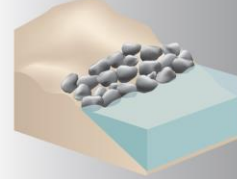
EDGING -
Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.



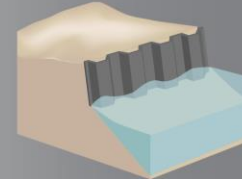
SILLS -
Parallel to vegetated shoreline, reduces wave energy, and prevents erosion. Suitable for most areas except high wave energy environments.



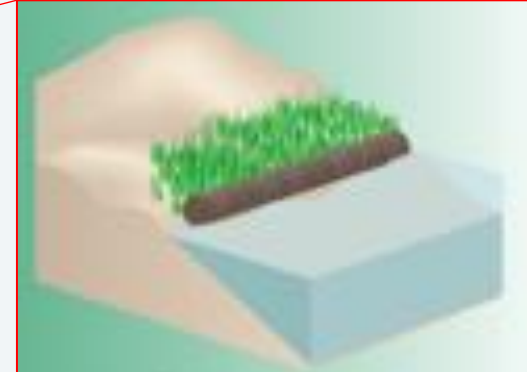
BREAKWATER -
(vegetation optional) - Offshore structures intended to break waves, reducing the force of wave action, and encourage sediment accretion. Suitable for most areas.



REVETMENT -
Lays over the slope of the shoreline and protects it from erosion and waves. Suitable for sites with existing hardened shoreline structures.



BULKHEAD -
Vertical wall parallel to the shoreline intended to hold soil in place. Suitable for high energy settings and sites with existing hard shoreline structures.



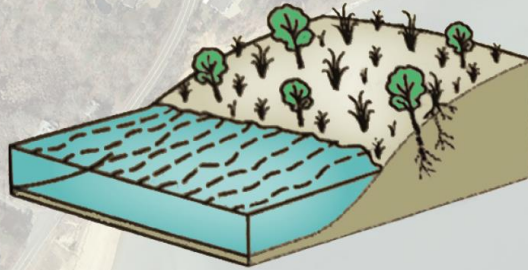
EDGING -
Added structure holds the toe of existing or vegetated slope in place. Suitable for most areas except high wave energy environments.



STABILIZATION OPTIONS

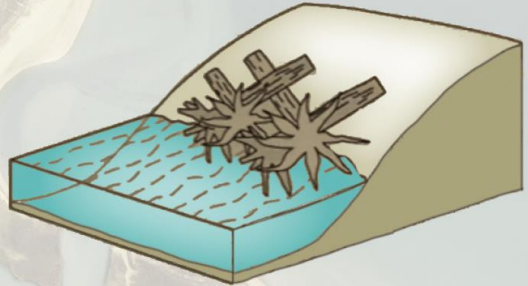
These solutions are only a few of the soft strategies that can be considered for this site. Combining a number of these strategies can provide the stability required to maintain public access and being more acceptable during permitting.

VEGETATION ALONE



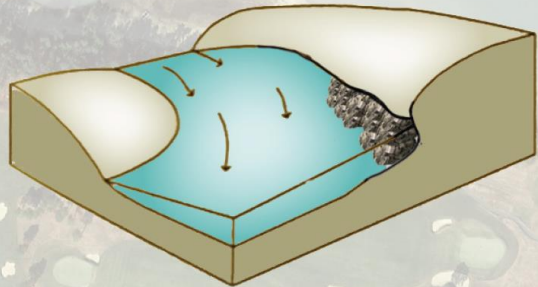
Vegetation can be viewed as a living, organic ground cover consisting of grasses/legumes, forbs and/or woody plants. Vegetation is established on bare soils in order help prevent erosion, minimize shallow seated mass movement, provide habitat, and enhance aesthetics or visual appearance. Vegetation can be used alone under special circumstances, but it also lends itself well to conjunctive use with other erosion control techniques in a mutually beneficial manner. Vegetation needs to be supplemented with other stabilization measures to protect the toe of a bank from under cutting.

LARGE WOODY DEBRIS (LWD) STRUCTURES



LWD structures are made from felled trees and used to deflect erosive flows and promote sediment deposit at the base of eroding banks. Root wads consisting of a short section of trunk and attached root ball can be incorporated into the structures. Using the classical spur design criteria and methods, the placement of LWD can be designed to achieve optimum benefit for both aquatic and bank protection.

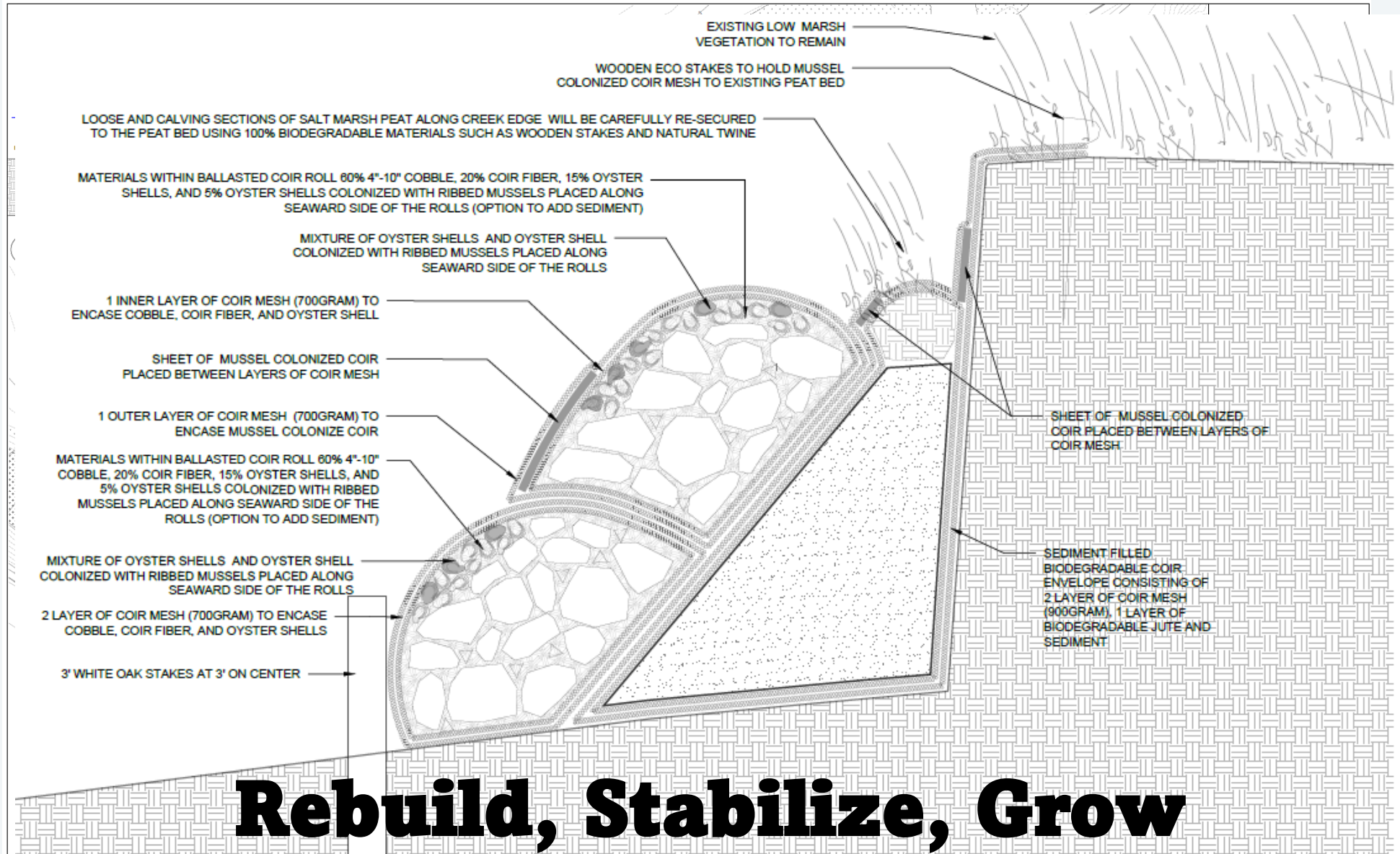
SHELL BAGS



Shells have been used in living shoreline projects as a substitute for stone sills or in addition to hybrid structures to increase habitat diversity. Bagged shell, rather than loose shells, is more sustainable for reducing wave energy to protect the toe of an eroding bank. Shell bags may need to be anchored into place if they are stacked or, if there is any threat of waves over topping. Routine monitoring of the oyster shell arrangement and adjacent upland bank erosion will track the effectiveness of this approach. Like all shore protection methods the effectiveness of the strategy is tied to site conditions and constraints.

Illustrations and text from: *Bioengineering Case Studies Sustainable Stream Bank and Slope Stabilization*, Goldsmith, Gray, & McCullah - Springer New York - 2014

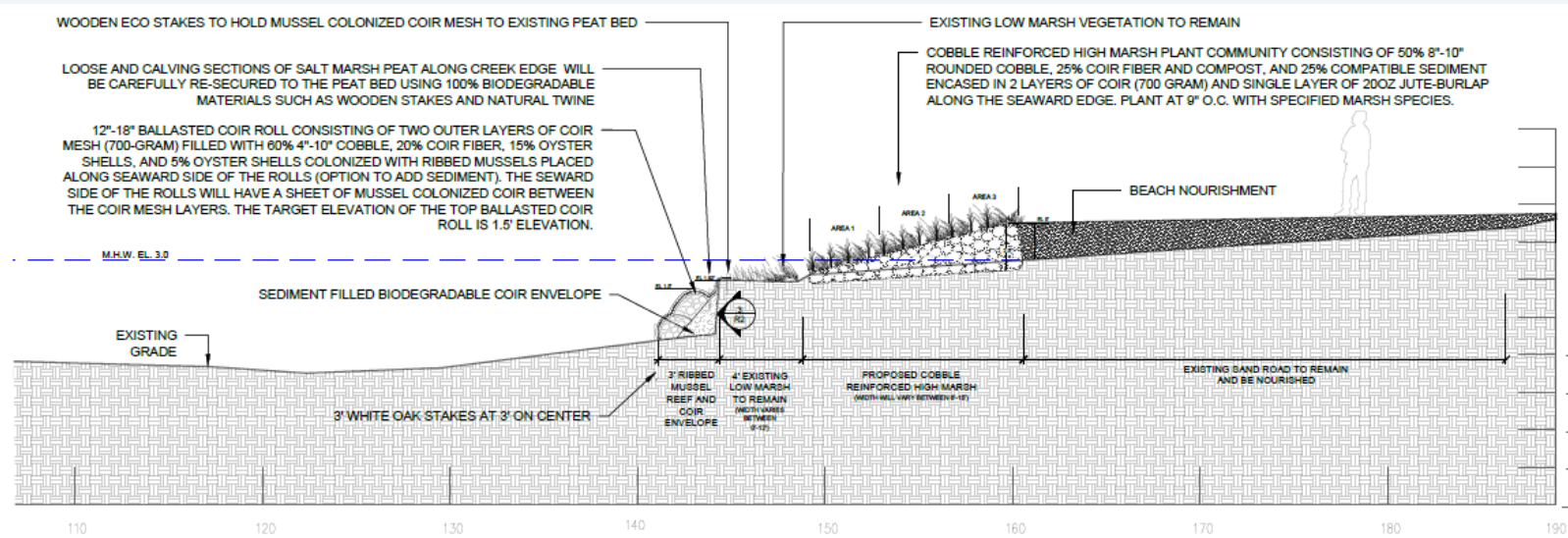




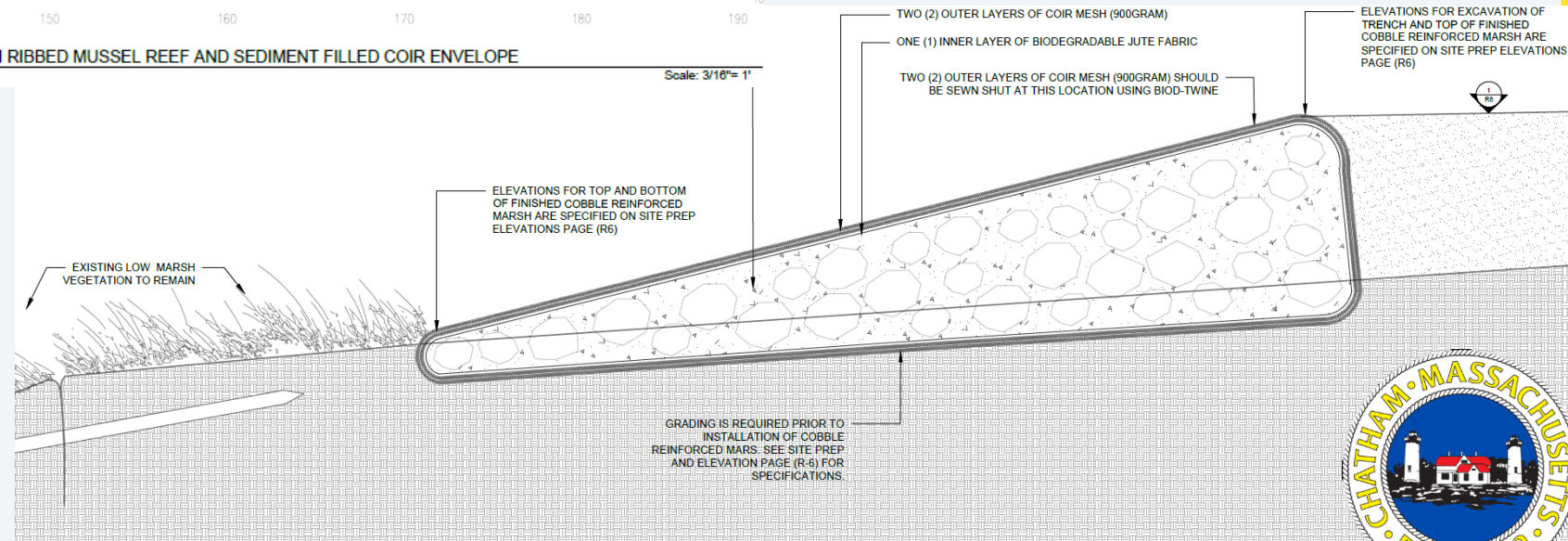
Rebuild, Stabilize, Grow



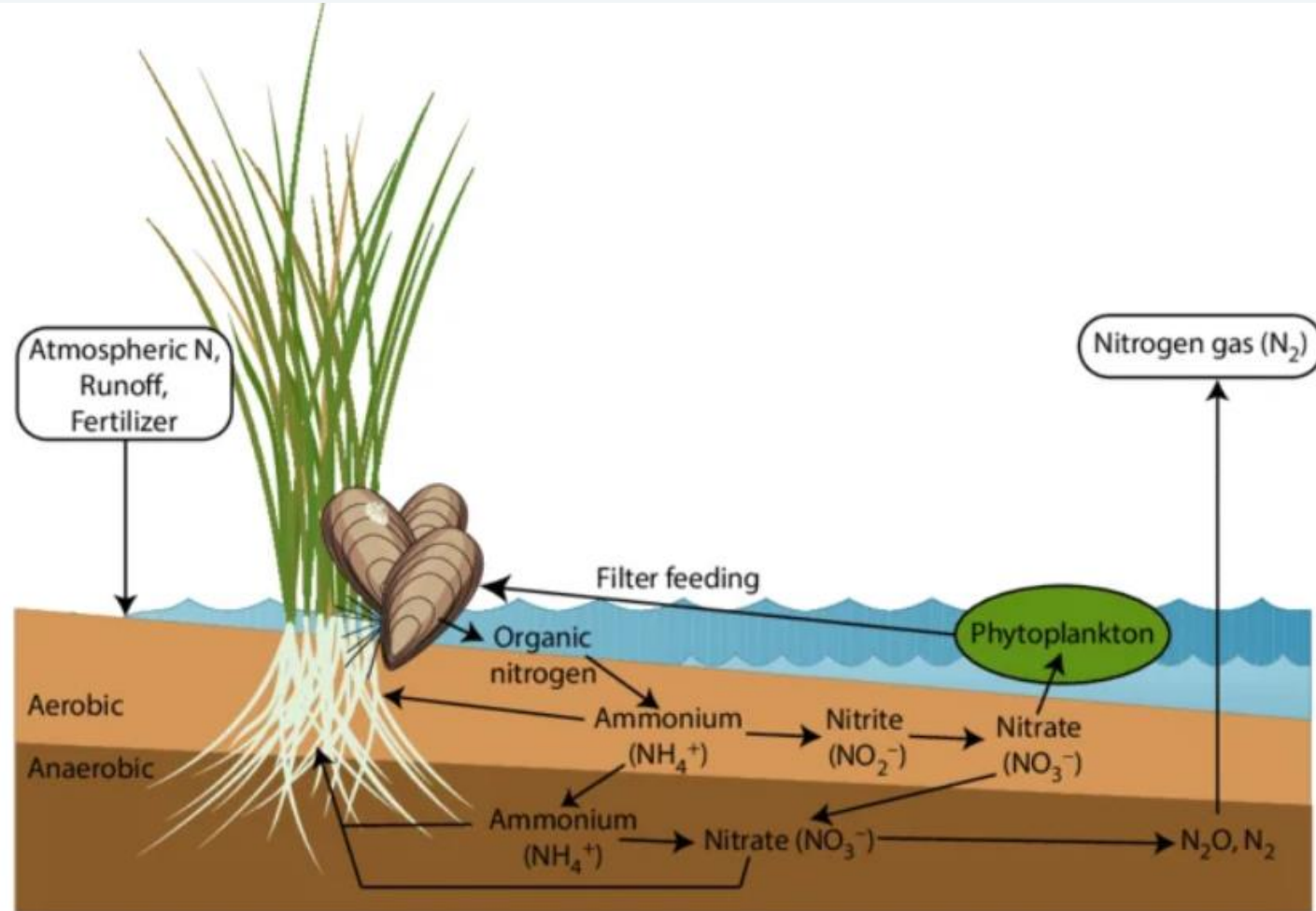
Rebuild, Stabilize, Grow



1 2 HIGH BALLASTED COIR ROLL OPTION - COBBLE REINFORCED HIGH MARSH WITH RIBBED MUSSEL REEF AND SEDIMENT FILLED COIR ENVELOPE



Ribbed Mussels and Water Quality



Thin Layer Placement



Evaluation of Ecosystem Response to Thin Layer Placement on a Jekyll Island, Georgia Salt Marsh

Christine M. Hladik,
Risa A. Cohen
James Morris

Funding

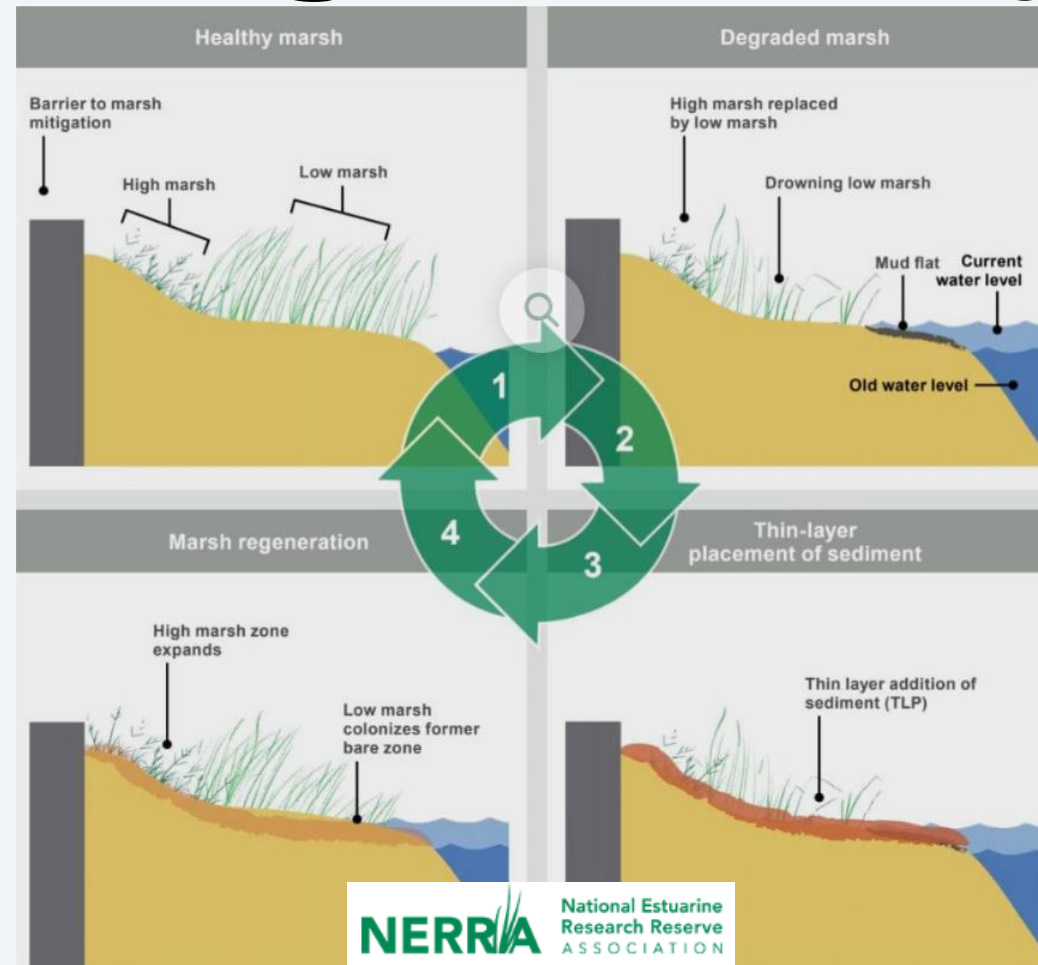
Cooperative Ecosystem Studies Units (CESU) – Piedmont-South Atlantic Coast Award W912HZ-18-2-0014 and W81EWF-23-SOI-0012

Collaborators

Karen Sundberg, Karim Alizad
Clay McCoy and Laurel Reichold, USACE, GA DNR, NWFS, USFWS, Nature Conservancy, Jekyll Island Authority
Francis Lapolla



Thin Layer Placement Creating Marsh Layers



FUNDING

Massachusetts Office of Coastal
Zone Management (CZM)

Coastal Resilience Grant Program

Find information on these Massachusetts Office of Coastal Zone Management (CZM) grants to advance local and regional efforts to address coastal flooding, erosion, and sea level rise.



Environment & Climate One Stop





Questions?





Namequoit Bog: Restoration Update

Tom Keras - Orleans Conservation Trust



Namequoit Bog, Orleans, MA



Contents



Site Introduction



Project Selection



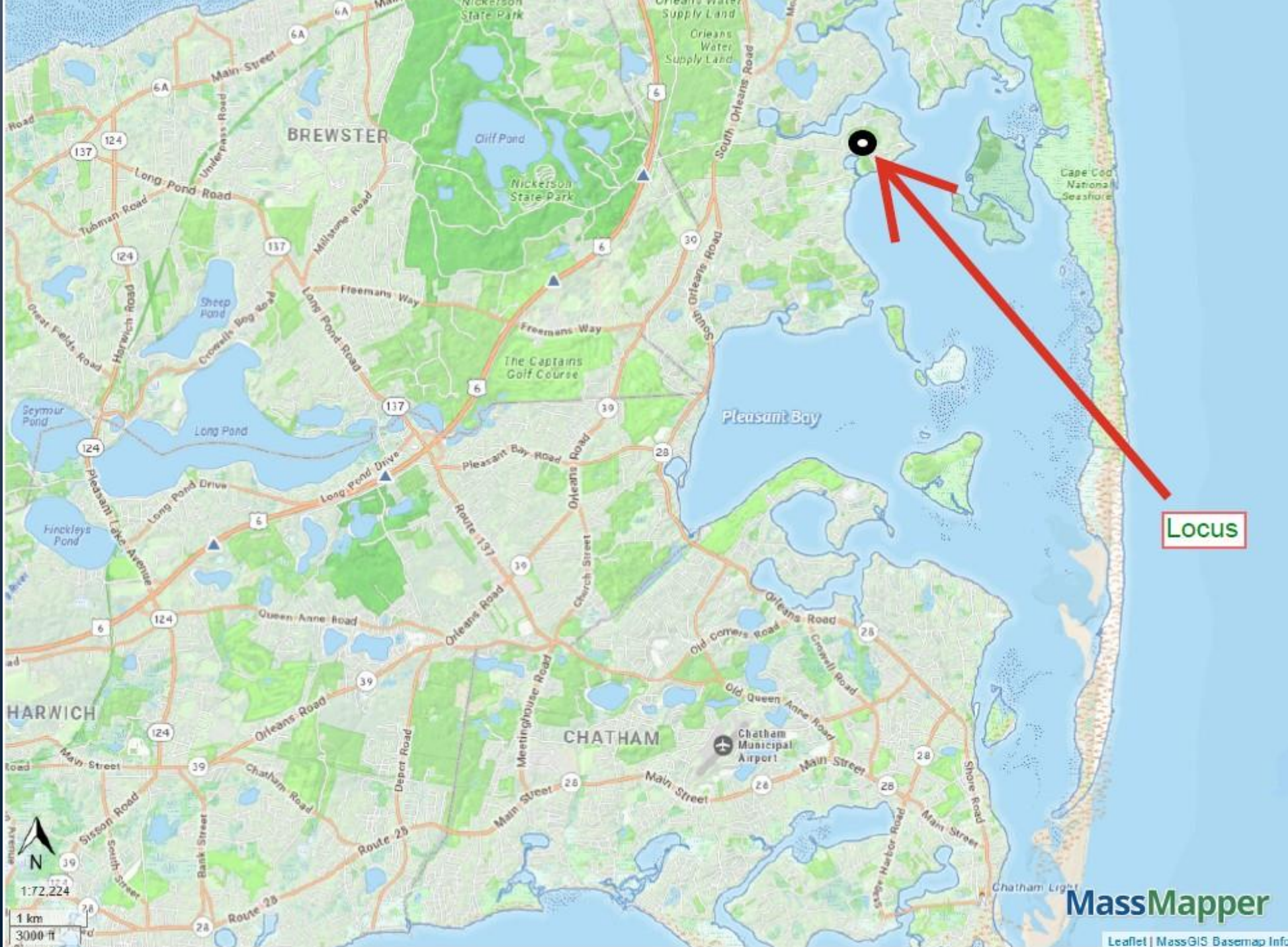
Project Goals



Project Outlook



Reflections



Locus

MassMapper

Leaflet | MassGIS Basemap Info

Namequoit Bog Baseline Photo Map



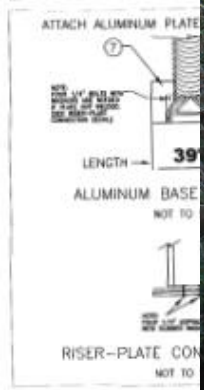
Site Introduction

- 22.5-acre former cranberry bog (1920-50s)
- Fallow from 1950s-2000s
- OCT purchase in 1998
- Land management work commences in 2005: managing for freshwater wetland vegetation.
- 2012 AWC die off.
- 2023 recalibration.





TOP OF RISER ELEV. =
POND/BOG ELEV. = **4'**
DITCH BOTTOM ELEV. =
INVERT IN ELEV. =



Why Namequoit Bog?

- Tier 1 property
- Site & management history
- Intact ecosystem
- Proximity to Pleasant Bay (potential salt marsh migration)
- Program & funding availability
- Organizational direction



Benefits of Restoration

Short-term

- For the land:
 - Self-sustaining ecosystem.
 - Patchwork restoration.
- For OCT:
 - Management upside.
 - Relational upside: DER, DPW, Inter-Fluve, etc.
 - Restoration messaging.

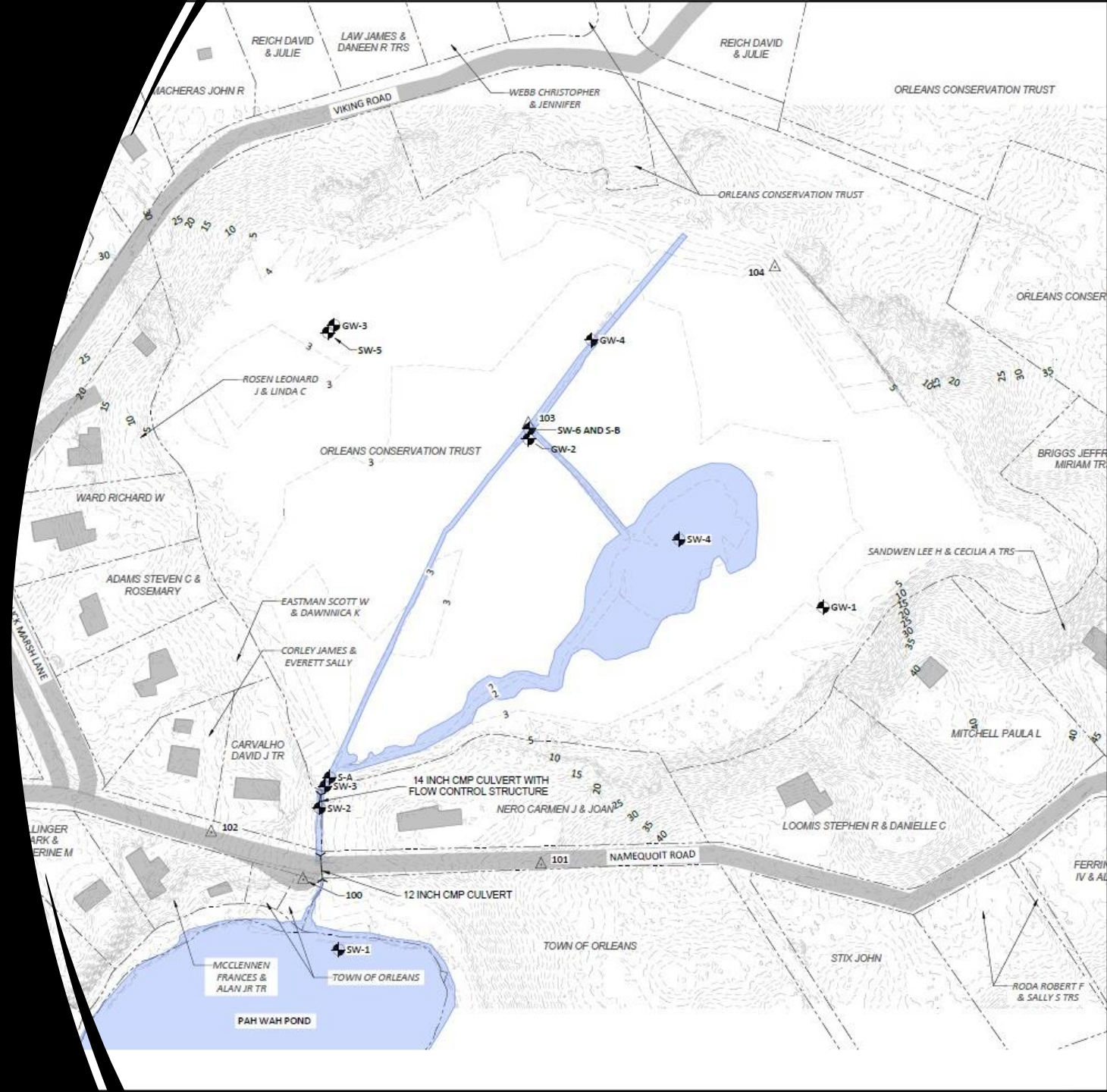
Long-term

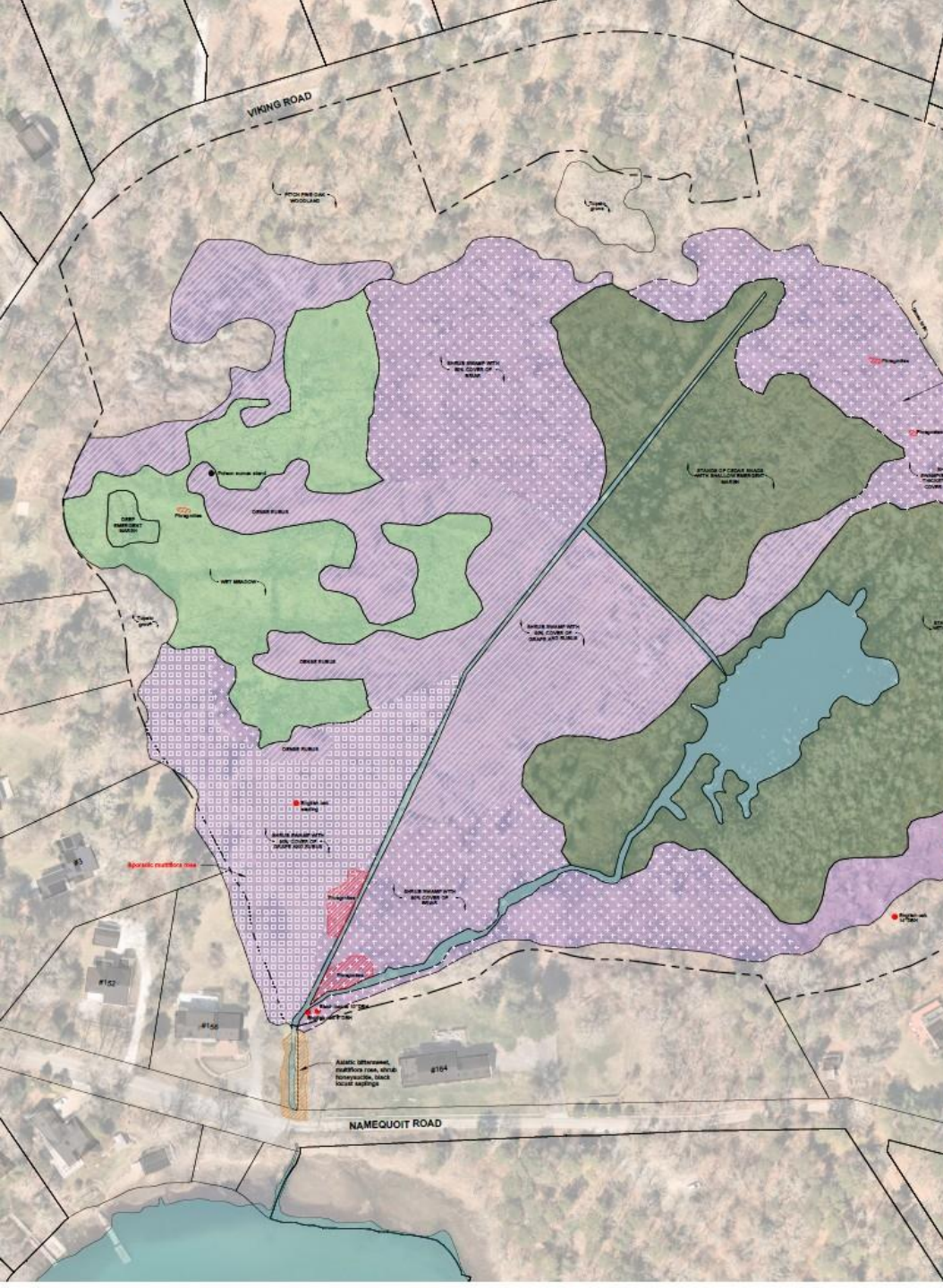
- Flexibility/Non-prescriptive approach
 - Salt marsh migration potential
- Habitat coexistence



Tools

- For concept design:
 - LiDAR vs. ground survey
 - Water loggers: ground, surface, salinity
 - Expertise: Inter-Fluve, Inc., Wilkinson ED, DER
 - Modeling and mapping
- For (eventual) restoration work:
 - Sand removal
 - Infrastructure removal: sluice, culvert, ditching
 - Potential: berming, re-channeling





Measuring Project Success

Current phase:

- Funding for Phase II.
- Establish baseline data to inform design phase.
- Establish a plan that addresses historic disturbances (e.g. cranberry).
- Establish framework for a community-involved restoration project.



Future phase(s):

- Create a research framework to measure changes in plant community/hydrology/additional ecosystem indicators (e.g. aerial surveys, plot surveys, etc.).
- Pre-restoration outreach efforts minimize lift during construction phase.
- Stakeholder involvement and successful implementation (e.g. mosquitos, roadwork, flooding, etc.).

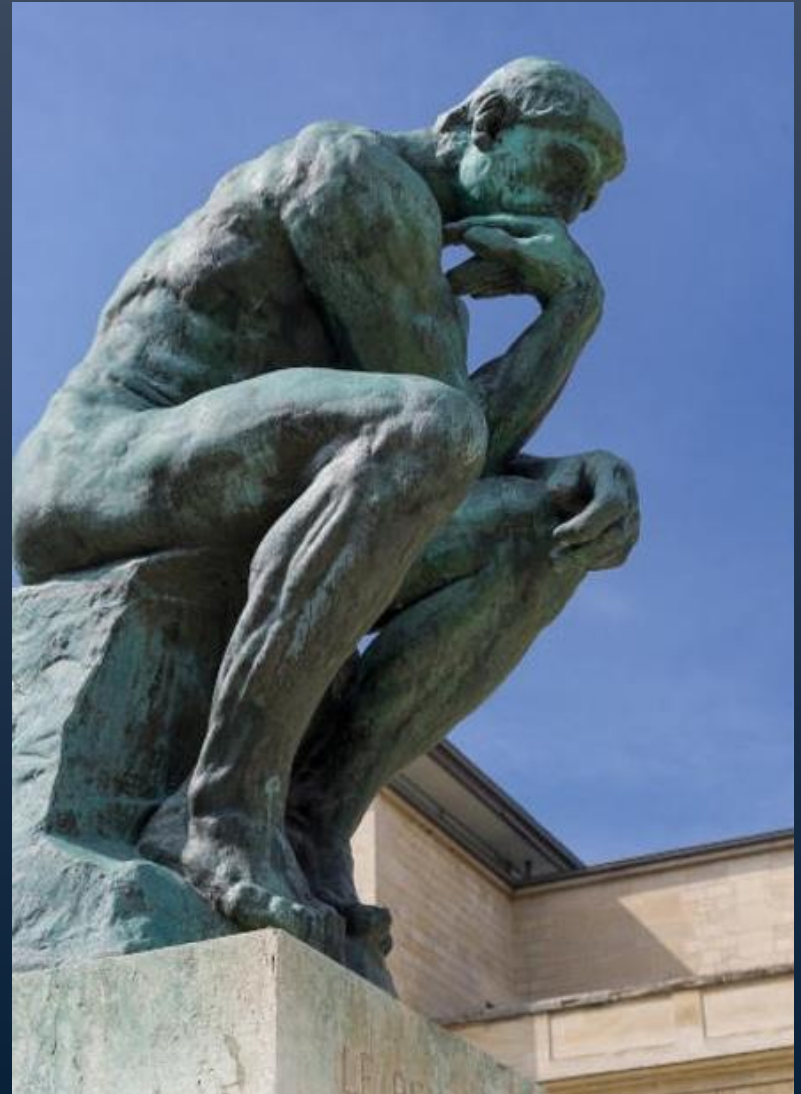
Project Reflections (thus far...)

Obstacles:

- Incomplete land-use history
- Contradictory historical records
- Expertise
- Organizational shift

Easier than expected:

- Funding
- DER guidance
- Staff time





Salt Marsh Restoration Tools & Resources

Carole Ridley – Pleasant Bay Alliance

Salt Marsh Restoration Tools & Resources



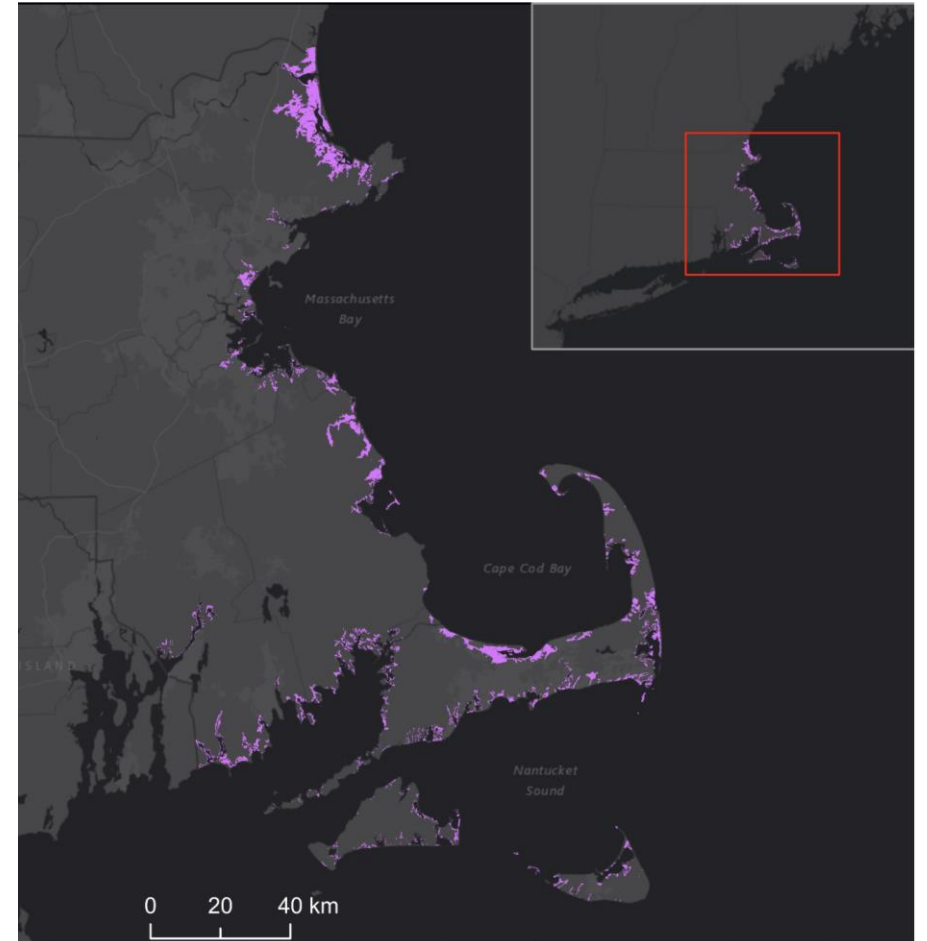
**PLEASANT BAY
ALLIANCE**



Carole Ridley
508 221 8941
cr@ridleyandassociates.com

MA is at Leading Edge in Salt Marsh Restoration

- Science
- Funding
- Regulatory streamlining & guidance
- Active Restoration Practice
 - Marsh Platform
 - Tidal Restoration
 - Sediment supplementation
- Technical support: Federal, State, private non-profits



Science & Assessment Tools (partial list)

Assessing need and suitability for restoration

- Lifespan of Massachusetts Salt Marsh Units (USGS)
- Unvegetated to Vegetated Ratio (USGS)

Assessing persistence under Sea Level Rise

- Sea Level Affecting Marshes Model (SLAMM) Viewer (MA CZM)
- Marsh Equilibrium Model (MEM)

Assessing post restoration conditions

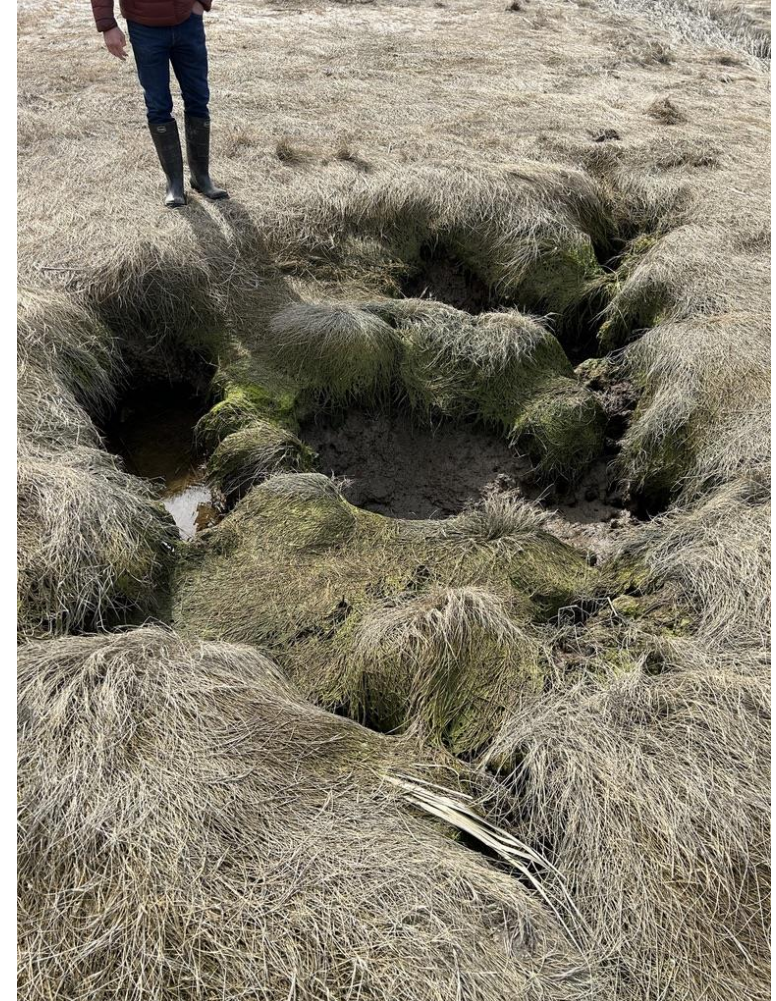
- Multiple models (EFDC, Delft 3D, MEM, other)

Monitoring effectiveness of restoration

- MassMarsh (UMASS-Amherst & MA DEP)

Many other sources for data and tools:

- Cape Cod National Seashore, Center for Coastal Studies, APCC, MA Audubon, etc.



Funding

- Restoration cost range: ~ \$8,500/ac for marsh platform restoration to multiples of that for tidal restoration
- State and federal grants
 - USDA Natural Resources Conservation Service/Cape Cod Conservation District
 - NOAA Restoration Center
 - US Fish & Wildlife Service
 - MA Division of Ecological Restoration
 - MA Dept of Environmental Protection
 - MA Coastal Zone Management
 - National Fisheries and Wildlife Foundation
- Private non-profit
- New potential financing techniques
 - Voluntary Carbon Market



Streamlining Regulations

- Streamlined MEPA review for Ecological Restoration Limited Projects
- MA Permit Streamlining Project - MA Ready Act
 - Streamline reviews for some restoration projects
 - Some salt marsh restoration projects (e.g. ditch remediation) exempt from Ch 91 review
- MA DEP permitting guidance for marsh restoration techniques
 - Ditching, runneling and habitat islands
 - Thin layer placement



Restoration Practice on Cape Cod

Multiple projects in planning/design/permitting/construction across Cape Cod

Tidal restoration, examples

- Muddy Creek, Frost Fish Creek
- Herring River Wellfleet
- Weir Creek

Ditch remediation, runneling and/or habitat islands, examples

- Barnstable Great Marsh
- Waquoit Bay-Dog Head Marsh

Thin-layer sediment placement, examples

- Herring River Wellfleet pilot
- MA Audubon Wellfleet Sanctuary pilot

Salt marsh migration

Living shoreline



Salt Marsh Restoration Tools & Resources



**PLEASANT BAY
ALLIANCE**



Carole Ridley
508 221 8941
cr@ridleyandassociates.com

Benefitting Salt Marsh in Pleasant Bay

Prioritize Pilot Projects in Pleasant Bay

- 137 ac suitable for protection
- 565 ac suitable for restoration

Next Steps

- Select at least 2 pilot project sites
- Land owner agreements
- Evaluate and select restoration/protection techniques for each site
- Design, permitting, implementation, monitoring



QUESTION & ANSWERS - ALL SPEAKERS

