Living Shorelines
Designs & Techniques

North Carolina
Coastal Federation
Working Together for a Healthy Coast

North Carolina Coastal Federation

Non-profit Organization

- Three offices in each region
- 36 staff and 30 board members
- Protect and restore the coast!

Key Goals

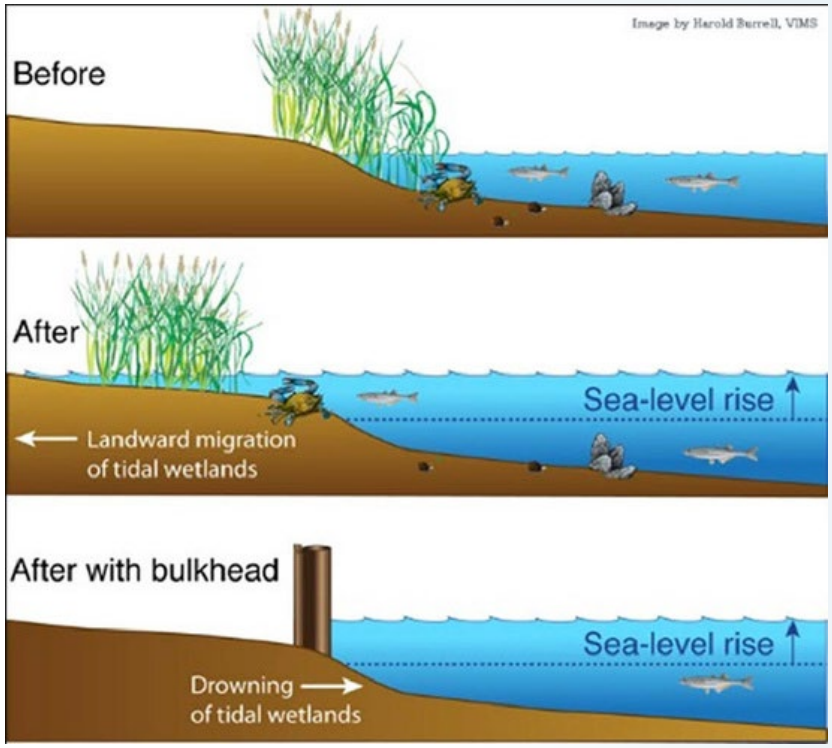
- Healthy **Water Quality**
- Promote **Living Shorelines**
- Restore **Oyster** Habitat
- Advocate for Responsible **Coastal Management**
- Reduce **Marine Debris**

Coastal Environmental Issues

Climate Change, Water Quality, Flooding, Polluted Habitats
Shoreline Erosion | Stormwater Runoff | Marine Debris

Estuarine (Soundside)Shoreline Erosion

Trying to Hold Back the Water



Hard Structures

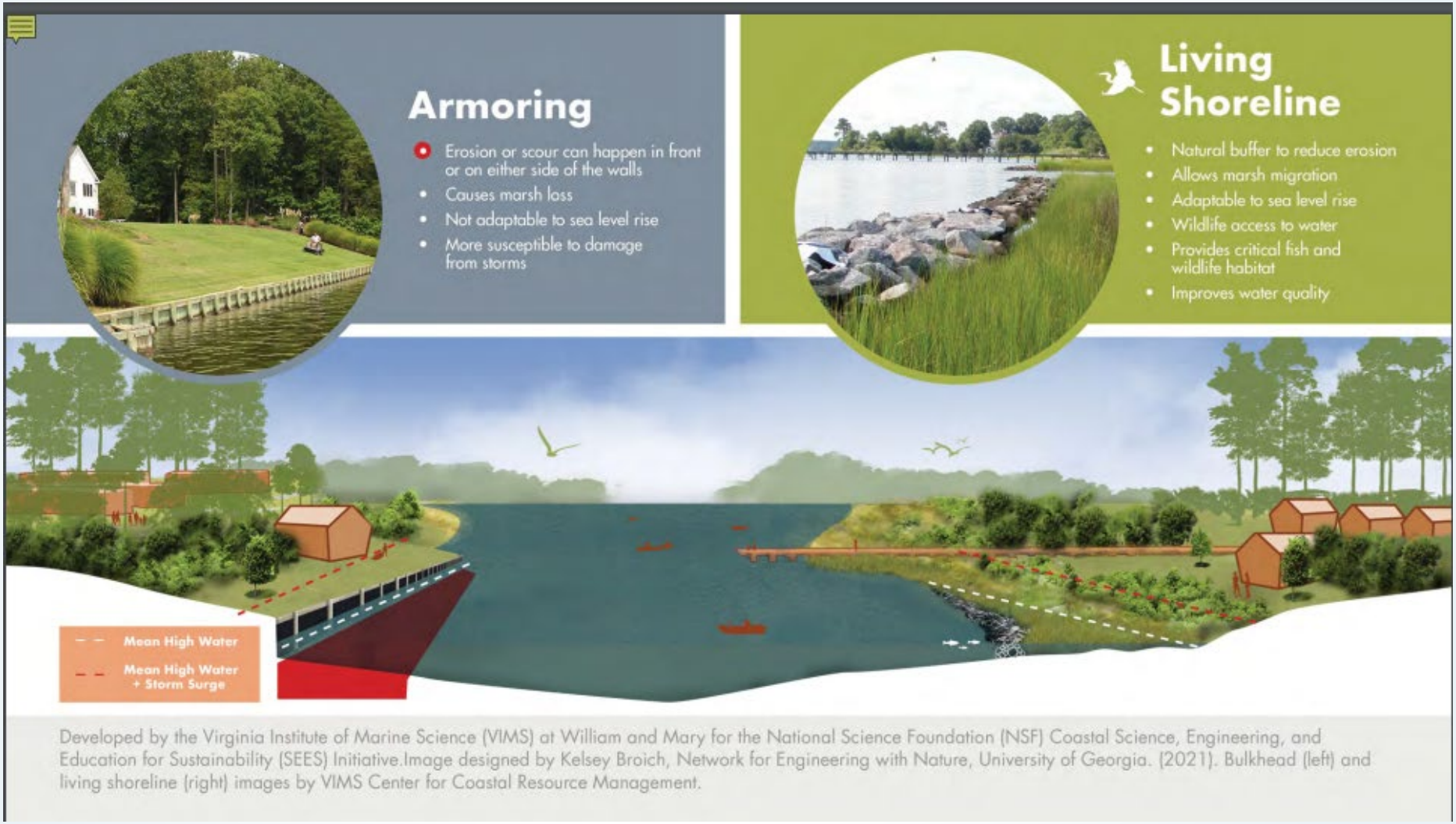
Bulkheads

Seawalls

Rip Rap

Bulkhead Failures

Hold Fast or Bend?



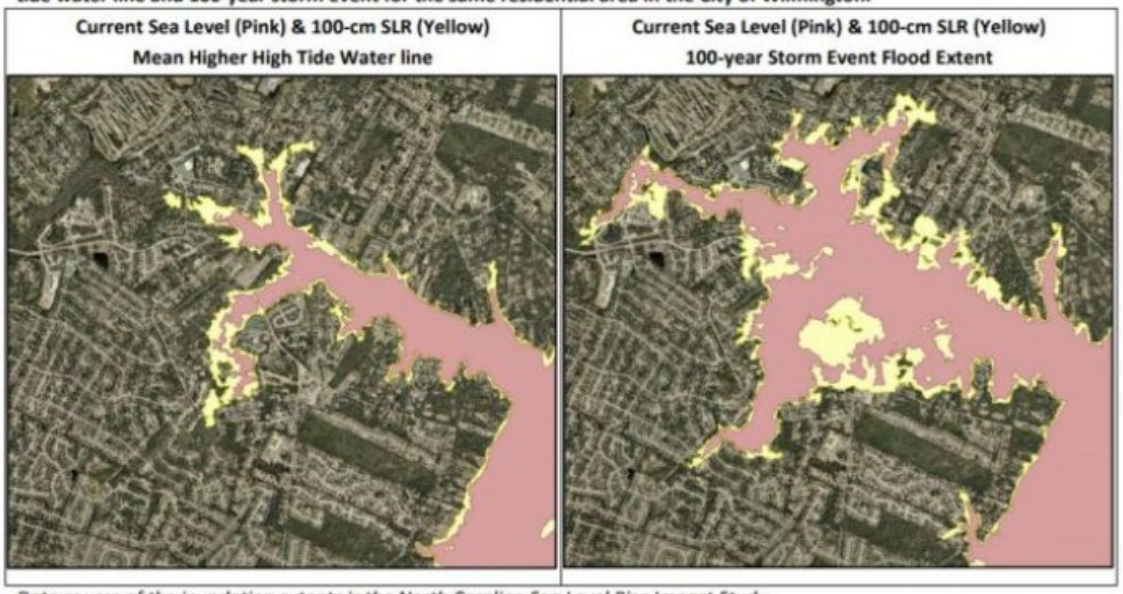
Developed by the Virginia Institute of Marine Science (VIMS) at William and Mary for the National Science Foundation (NSF) Coastal Science, Engineering, and Education for Sustainability (SEES) Initiative.Image designed by Kelsey Broich, Network for Engineering with Nature, University of Georgia. (2021). Bulkhead (left) and living shoreline (right) images by VIMS Center for Coastal Resource Management.

Sea Level Rise, Intensity of Storms

New studies show 'unprecedented' sea-level rise along the North Carolina coast

Gareth McGrathUSA TODAY NETWORK

Comparison of the current sea level and a 100-cm SLR scenario (by 2100) extent of inundation for the mean higher high tide water line and 100-year storm event for the same residential area in the City of Wilmington.



Data source of the inundation extents is the North Carolina Sea Level Rise Impact Study.

From the 2012-2013 pilot program study of sea level rise in Wilmington: potential flooding exacerbated by rising sea levels. (Port City Daily photo / COURTESY CITY OF WILMINGTON)

(Port City Daily file photo / HANNAH LEYVA)

40 YEARS North Carolina Coastal Federation
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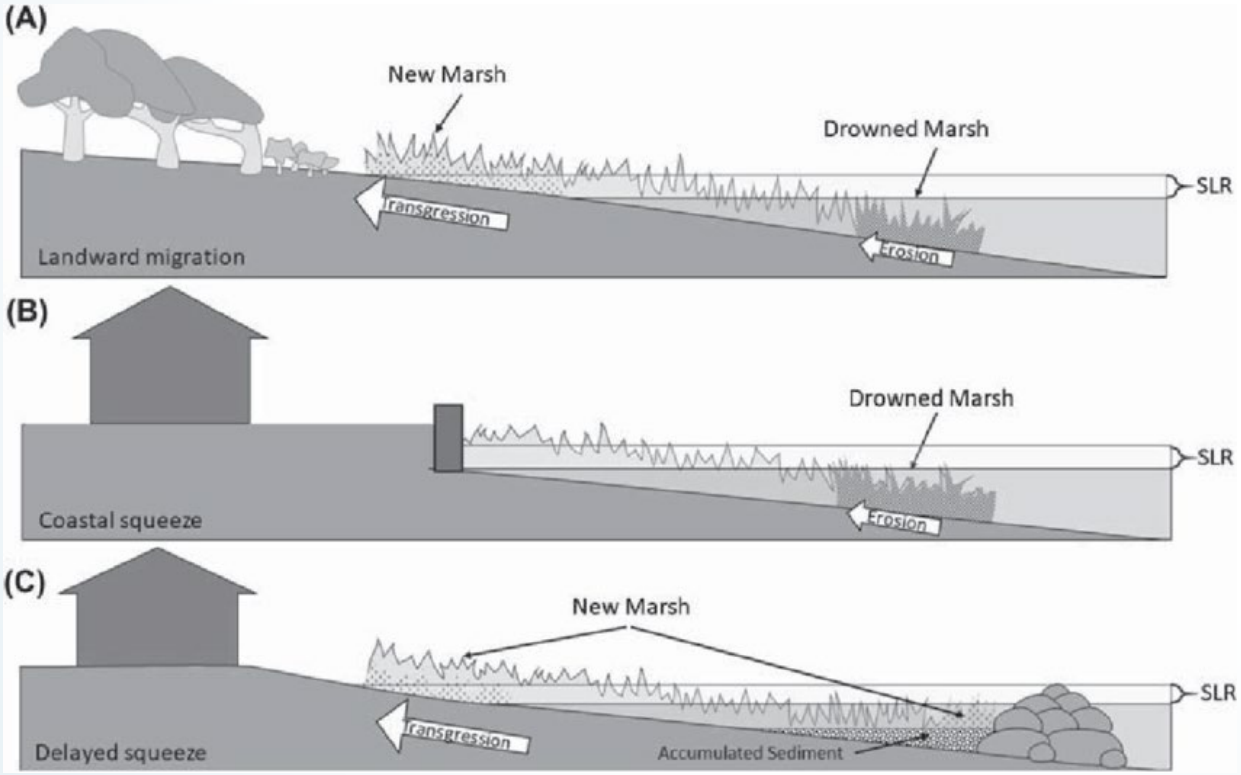

Carolyn A. Currin

NOAA · National

Ocean Service

Coastal Resiliency & Solutions

Living Shorelines| Nature Based Solutions | Education

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Living Shorelines

Living Shorelines

Terminology:

Living Shoreline: stable, coastal edge constructed of natural materials like plants, shell, rock, sand

Escarpment: area of erosion with drastic elevation change, cliff-like

Sill: the elevated structure of the living shoreline

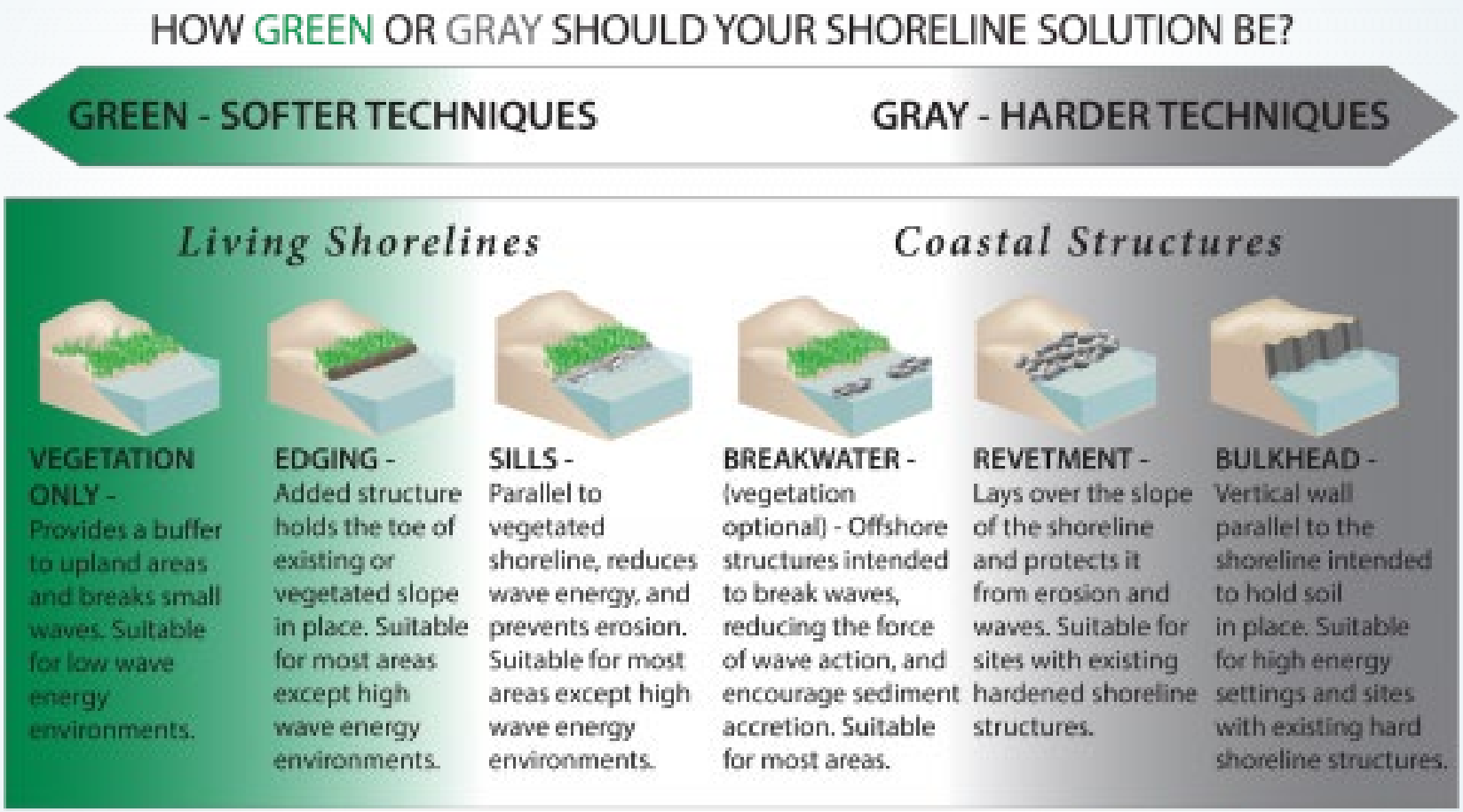
Revetment: barrier applied to the bank

Normal High Water: elevation on shore established by tidal fluctuations

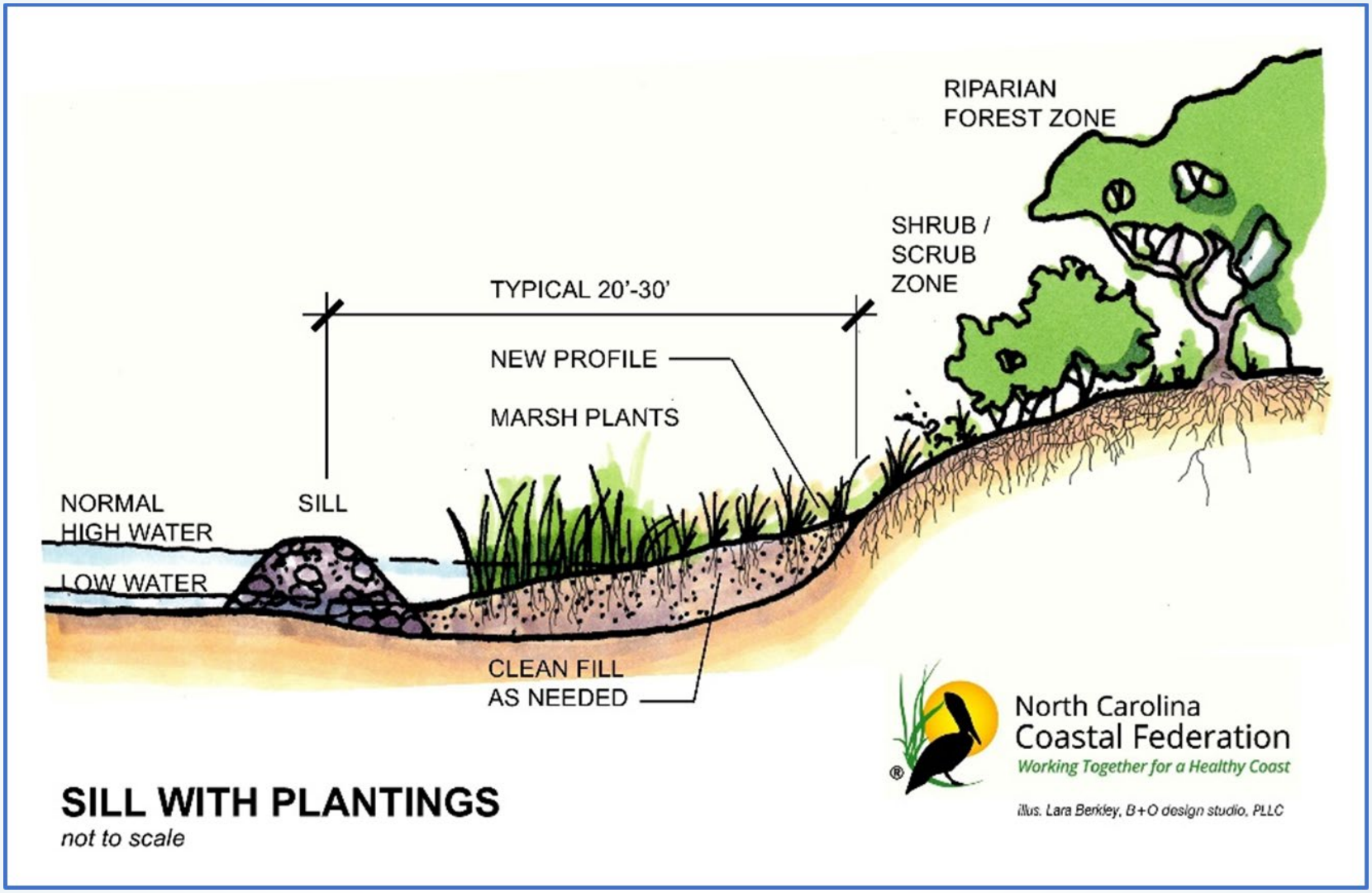
Riparian Zone: banks situated near the river/waterway

Making Informed Decisions

https://www.deq.nc.gov/about/divisions/coastal-management/estuarine-shorelines/estuarine-shoreline-stabilization



A continuum of green to gray shoreline stabilization techniques, including soft (green), hybrid, and hard (gray) armoring techniques. Source: NOAA 2015; modified from SAGE 2015.



SILL WITH PLANTINGS

not to scale

Storm Damage to Bulkheads

Ocean & Coastal Management 102 (2014) 94–102

Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a Category 1 hurricane

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ARTICLE INFO

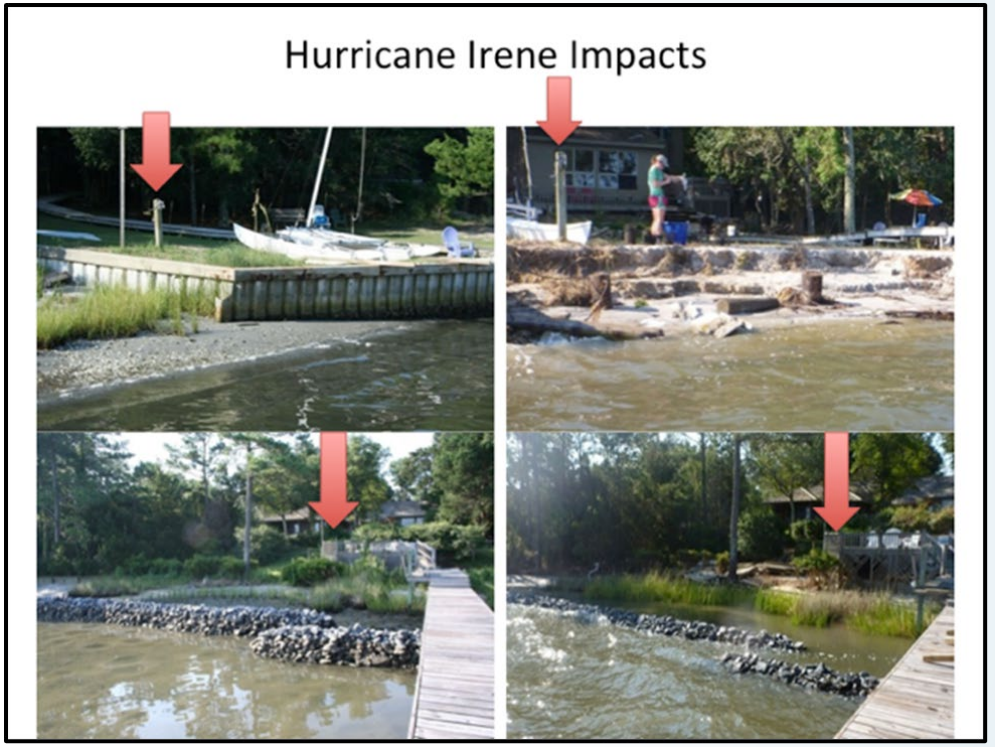
Article history:
Received 23 September 2013
Received in revised form
7 September 2014
Accepted 10 September 2014
Available online

Keywords:
Coastal management
Marsh
Erosion
Estuarine shoreline protection
Storm

ABSTRACT

Acting on the perception that they perform better for longer, most property owners in the United States choose hard engineered structures, such as bulkheads or riprap revetments, to protect estuarine shorelines from erosion. Less intrusive alternatives, specifically marsh plantings with and without sills, have the potential to better sustain marsh habitat and support its ecosystem services, yet their shoreline protection capabilities during storms have not been evaluated. In this study, the performances of alternative shoreline protection approaches during Hurricane Irene (Category 1 storm) were compared by 1) classifying resultant damage to shorelines with different types of shoreline protection in three NC coastal regions after Irene; and 2) quantifying shoreline erosion at marshes with and without sills in one NC region by using repeated measurements of marsh surface elevation and marsh vegetation stem density before and after Irene. In the central Outer Banks, NC, where the strongest sustained winds blew across the longest fetch; Irene damaged 76% of bulkheads surveyed, while no damage to other shoreline protection options was detected. Across marsh sites within 25 km of its landfall, Hurricane Irene had no effect on marsh surface elevations behind sills or along marsh shorelines without sills. Although Irene temporarily reduced marsh vegetation density at sites with and without sills, vegetation recovered to pre-hurricane levels within a year. Storm responses suggest that marshes with and without sills are more durable and may protect shorelines from erosion better than the bulkheads in a Category 1 storm. This study is the first to provide data on the shoreline protection capabilities of marshes with and without sills relative to bulkheads during a substantial storm event, and to articulate a research framework to assist in the development of comprehensive policies for climate change adaptation and sustainable management of estuarine shorelines and resources in U.S. and globally.

Published by Elsevier Ltd.



Provided by Dr. Rachel Gittman

One year before

One day after

Living Shoreline Types

Marsh-toe Revetment

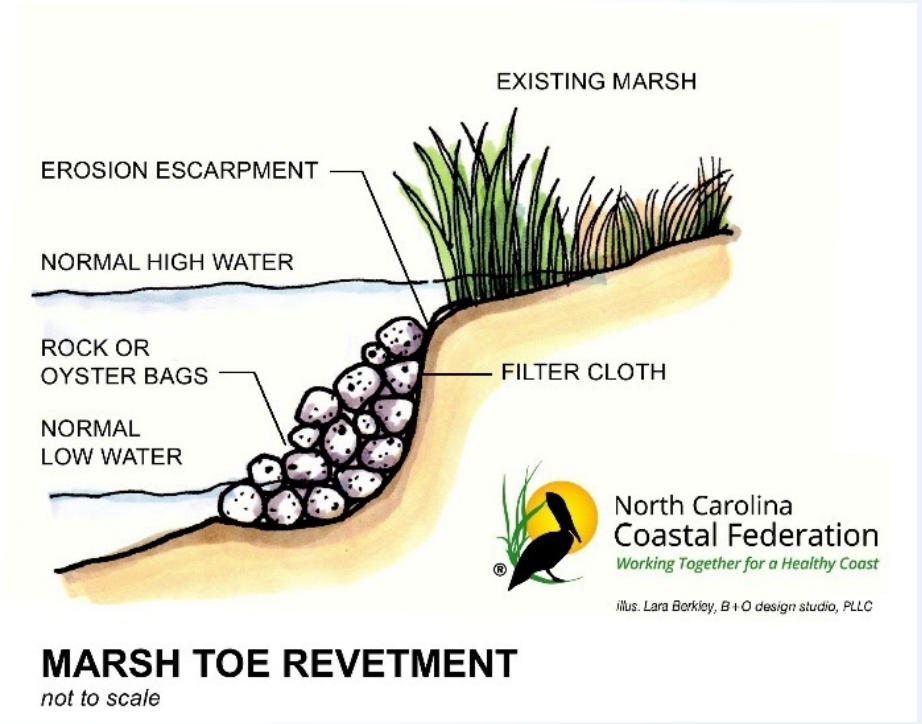
Offshore Sill

Vertical Wall

Marsh Grass Planting

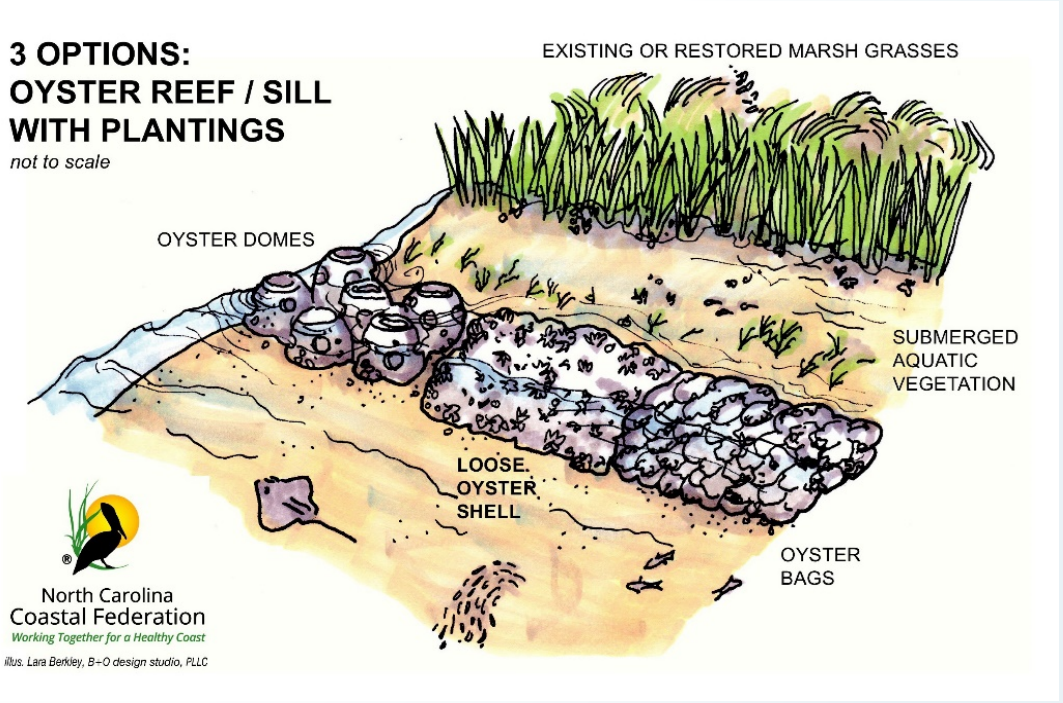
Marsh-toe Revetment

- Extreme escarpments
- Heavy loss of sediment
- Protects existing marsh from further erosion



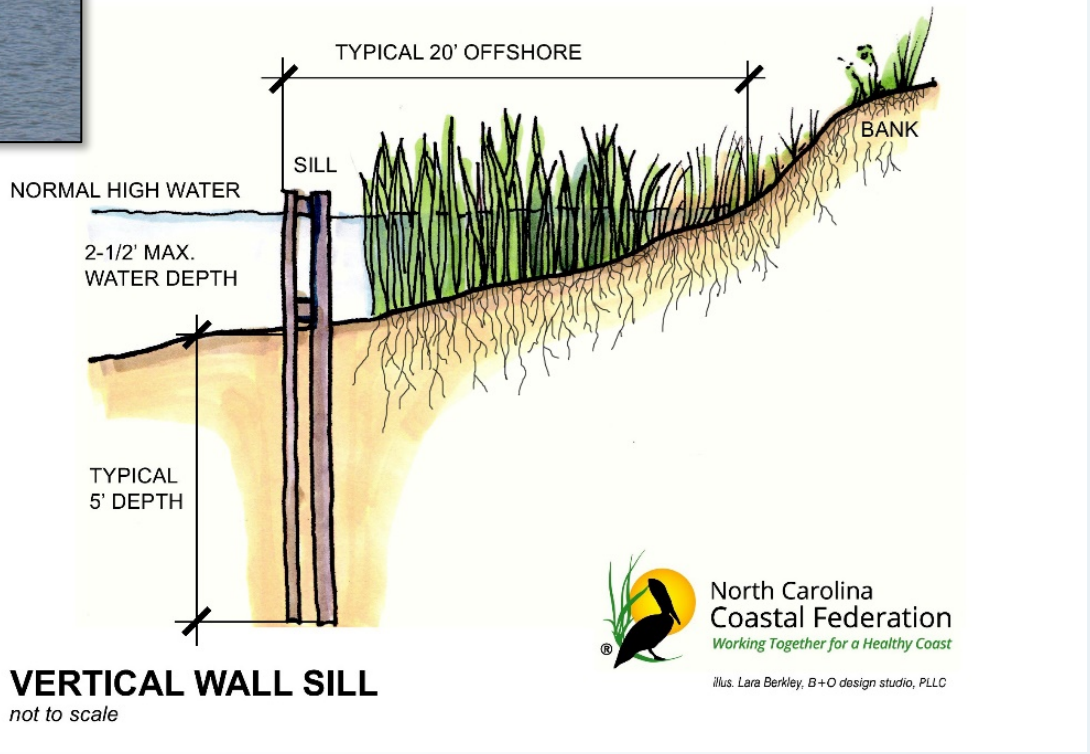
Offshore Sill

- Bottom support for heavy materials
- Lots of material options
- Paired with marsh grass plantings



Vertical Wall (Sill)

- Narrow canals
- Bottoms that don't support weight of heavy stone/bags
- Areas subject to low/moderate energy conditions



VERTICAL WALL SILL
not to scale

Living Shoreline Materials

Bagged Oyster Shell

Loose Oyster Shell

Granite

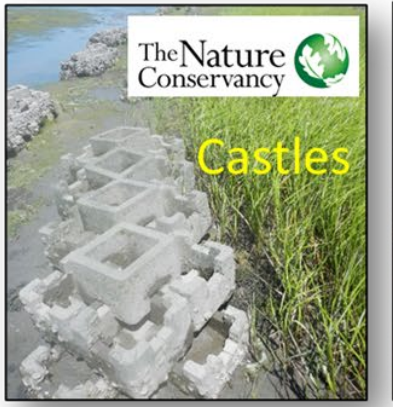
Concrete Structures

Marine Limestone ("Marl")

Bagged Oyster Shell

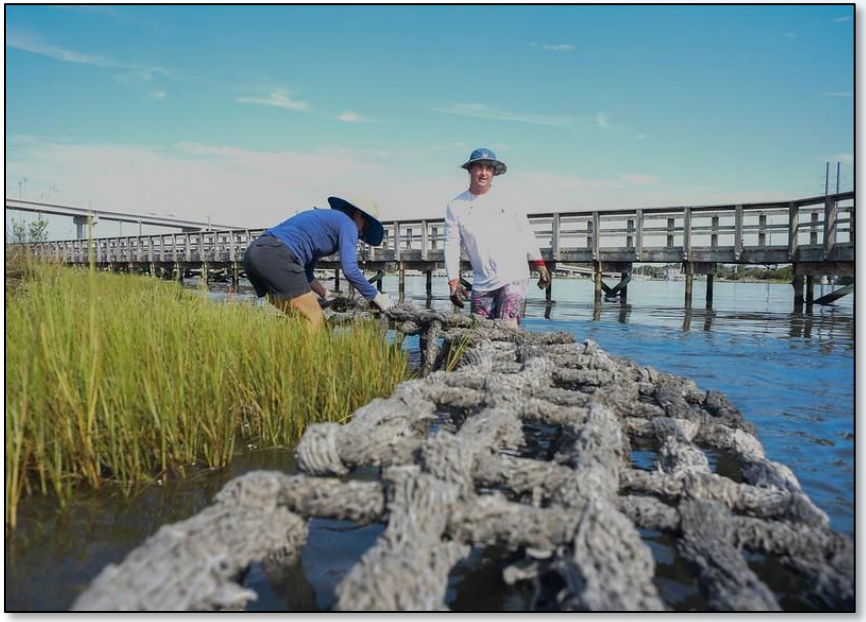
Granite & Marl

Innovative Living Shoreline Designs



Innovative Living Shoreline Designs

Oyster Catcher™ by Sandbar Oyster Co.



SANDBAR
OYSTER COMPANY
Shellfishly Motivated

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Innovative Living Shoreline Designs

Pre-cast Concrete Structures: Oyster Domes/Reef Balls

Graphic Credit: Mobile Press Register

Innovative Living Shoreline Designs

QuickReef™ by Native Shorelines, LLC

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Innovative Living Shoreline Designs

Oyster Castles

Innovative Living Shoreline Designs

Atlantic ReefMaker EcoSystems

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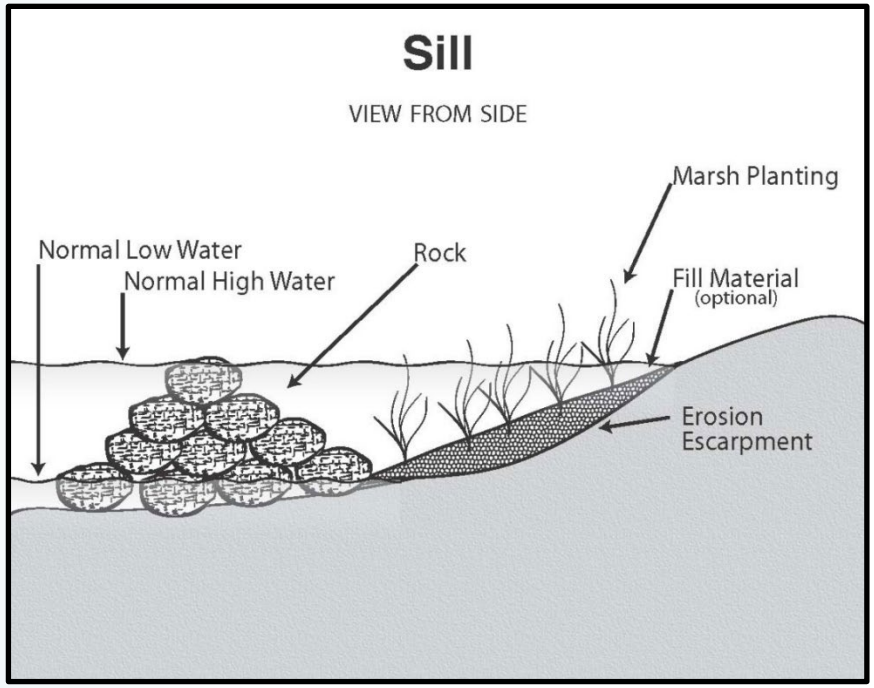
Living Shoreline Design Considerations



- Wave energy
- Fetch
- Predominant wind direction
- Water depths
- Proximity to navigation channels
- Shoreline orientation
- Extent of erosion
- Slope
- Natural abundance of oysters
- Cost
- Property owner preference

Typical Costs for Living Shorelines by Material

~50 Linear Feet

<u>Bagged Oyster Shell: need 14 bags/lf</u>

- $4/bushel x 175 bushels = $700 in shell
- Mesh bags = $375
- Labor $5/bag = $3,500

<u>Stone:</u>

- $250 - $400/lf for labor and materials
- Estimated costs = $10,000 - $20,000

<u>Plants:</u>

- $2 - $3 installed
- 1,500 plants = $3,000 - $4,500

Bulkhead & Rip-Rap Revetment Enhancement Projects

- Bulkhead or revetment enhancement projects can be utilized when existing structures are already in place or if there are infrastructure conflicts
- Elements such as rip-rap, marsh plantings, or other shoreline plants can provide wave dissipation and habitat
- These features can mitigate the effects of erosion on the existing structures and extend the life of the structure

Living Shorelines: Takeaways

- Human disturbances can influence shoreline erosion
  - Development
  - Boat Wakes
- Traditional approaches often damage valuable marsh and oyster habitat
- We can work with nature and use solutions that stabilize the shoreline and provide habitat (*nature-based solutions*)

Current Living Shoreline Financial Assistance for Soundfront Property Owners

- Grants awarded to the Federation
  - NC Land and Water Fund
  - NC General Assembly
- Federation applies for N.C. Division of Soil and Water Conservation's Community Assistance Program (CCAP) funds on behalf of landowner
  - Typically, the Federation is the Applicant on the CCAP contract to match the CCAP funds with other grants, making the installation of living shorelines very easy and affordable to the landowner
  - The Federation pays the contractor and then requests payment from CCAP and the landowner
  - **100% of the CCAP funds are used for construction**
  - Federation time and travel is covered by other grants awarded to the Federation

Questions about **Living Shorelines** or the **North Carolina Coastal Federation?**

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