"Living Shorelines" An Historical Perspective from Chesapeake Bay

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Shoreline Studies Program
VIMS

Shoreline Studies Program VIMS

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"Living Shorelines"

1970s Referred to as marsh fringe creation

1980s &1990s Non-structural approach, MD grant program and VA VEC project

1981 to 1987 VA Shoreline Erosion Advisory Service SEAS

Recent moniker: Living Shorelines (2006 by David Burke former head of MD Non-structural program)

Common goal: to apply marsh fringe and/or beach establishment to shore erosion control vs. hardening the coast.

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Shoreline Erosion

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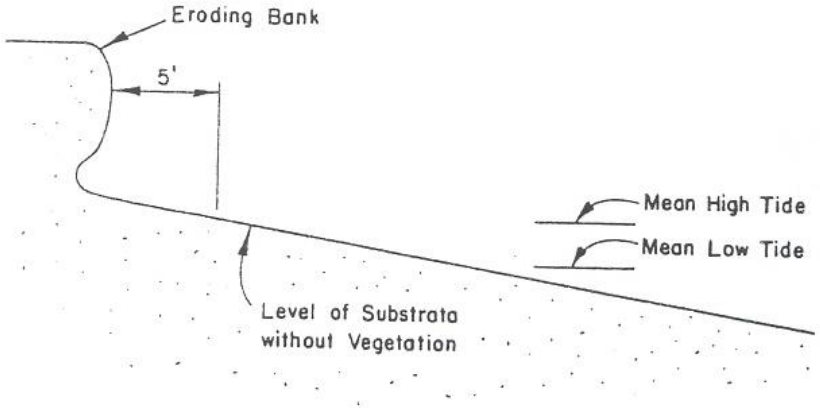
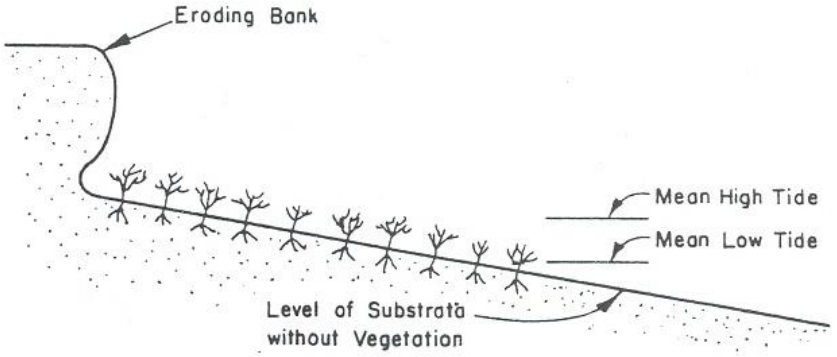
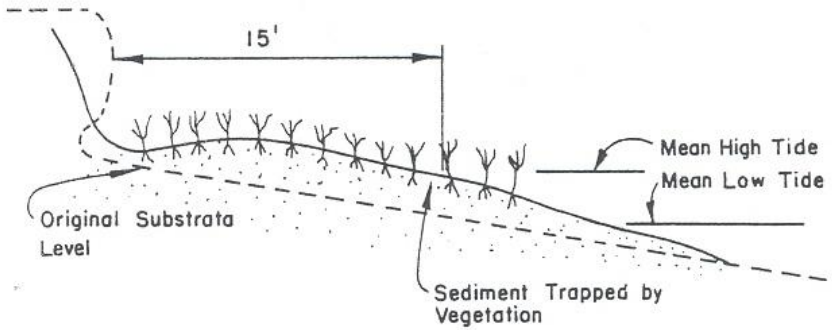
SCS: Vegetation for Tidal Shoreline Stabilization



Before Vegetative Treatment



Immediately After Vegetation Treatment



Anticipated Results From Vegetative Treatment

Early Research on Marsh Fringe Creation

1970s	Knutson and Woodhouse, USCOE reports on marsh creation and wave studies
	Broome and Seneca, NC coastal marshes
	Ed Garbisch, MD
	SCS Cape May Plant Materials Center
1980s	Vegetative Erosion Control Project, VA VIMS and DCR (SEAS)

Same result: a fetch limited application

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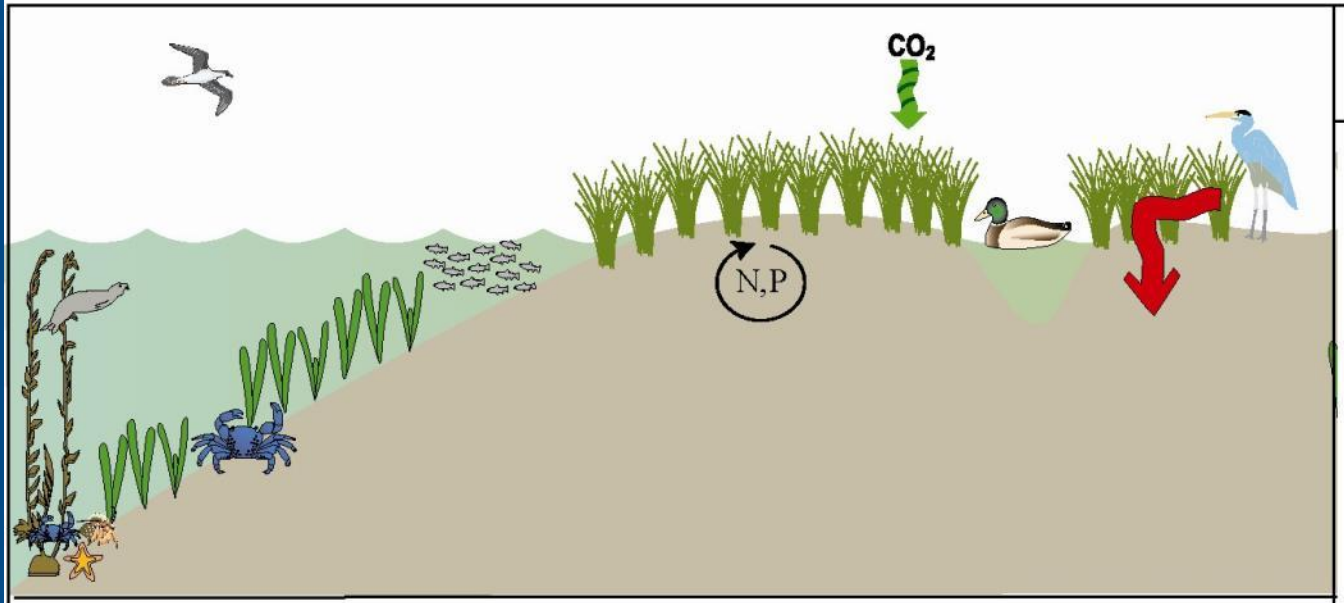
Primary Limiting Parameters

- Fetch
- Shoreline orientation
- Shore geometry
- Nearshore bathymetry
- Boat wakes
- Sunlight (often over looked)

Ecosystem Services: Marshes



Importance and Features

Salt marshes provide important nursery habitat for crabs and fishes.

Salt marshes act as a nutrient filter and is the site of nutrient cycle.

Salt marshes support high primary production.

Seagrasses may or may not occur adjacent to marshes.

Kelp and their associated organisms may occur offshore of salt marshes.

Icon Key

- native marsh grass
- birds and waterfowl
- kelp
- sea otter
- kelp associated fauna

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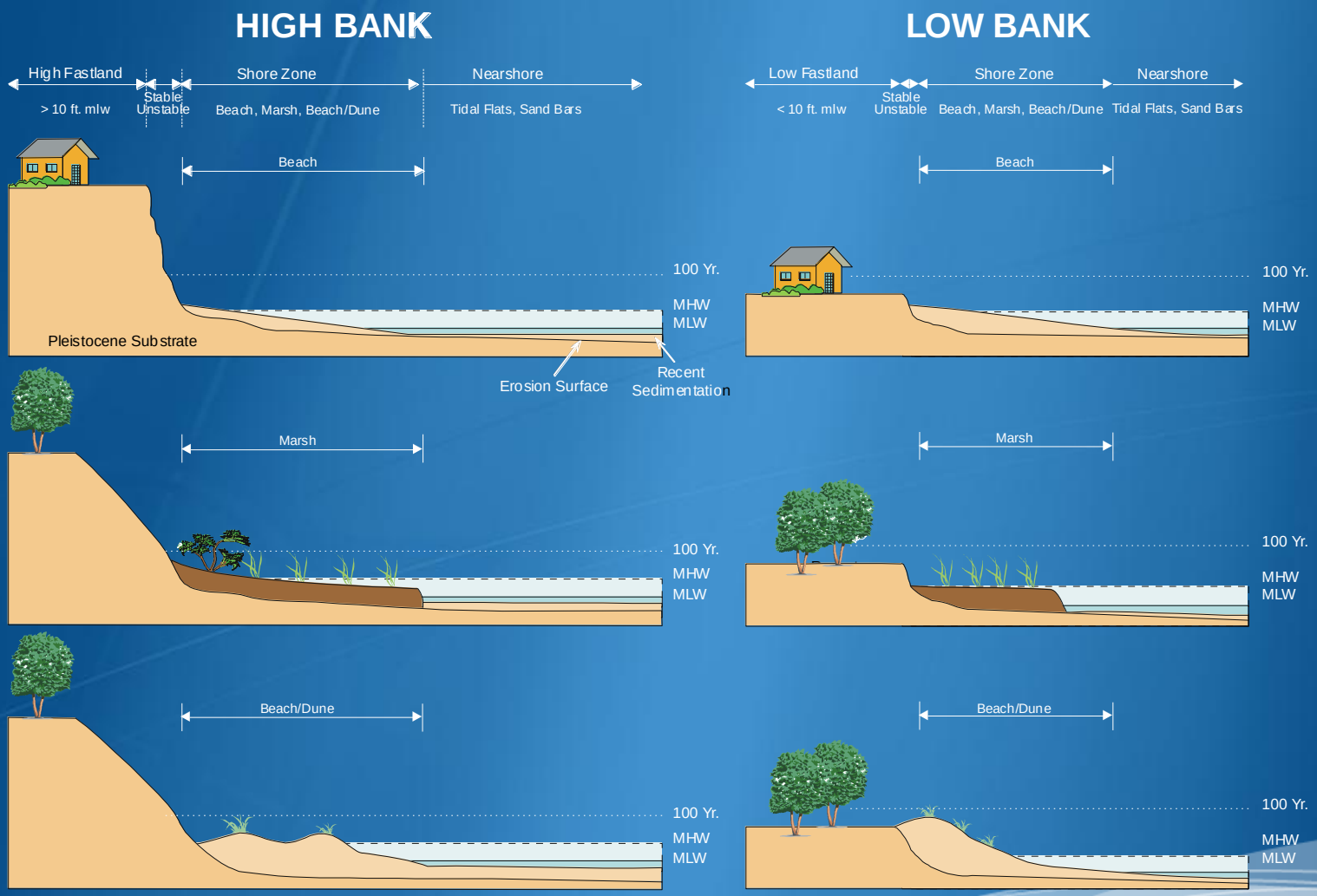
Shoreline Erosion



Six typical shoreline profiles around Chesapeake Bay. The stability of the bank face is dependent upon the width and type of shore zone features. Wide beaches/dunes and marsh zones can offer significant wave protection even during storms.


Stable

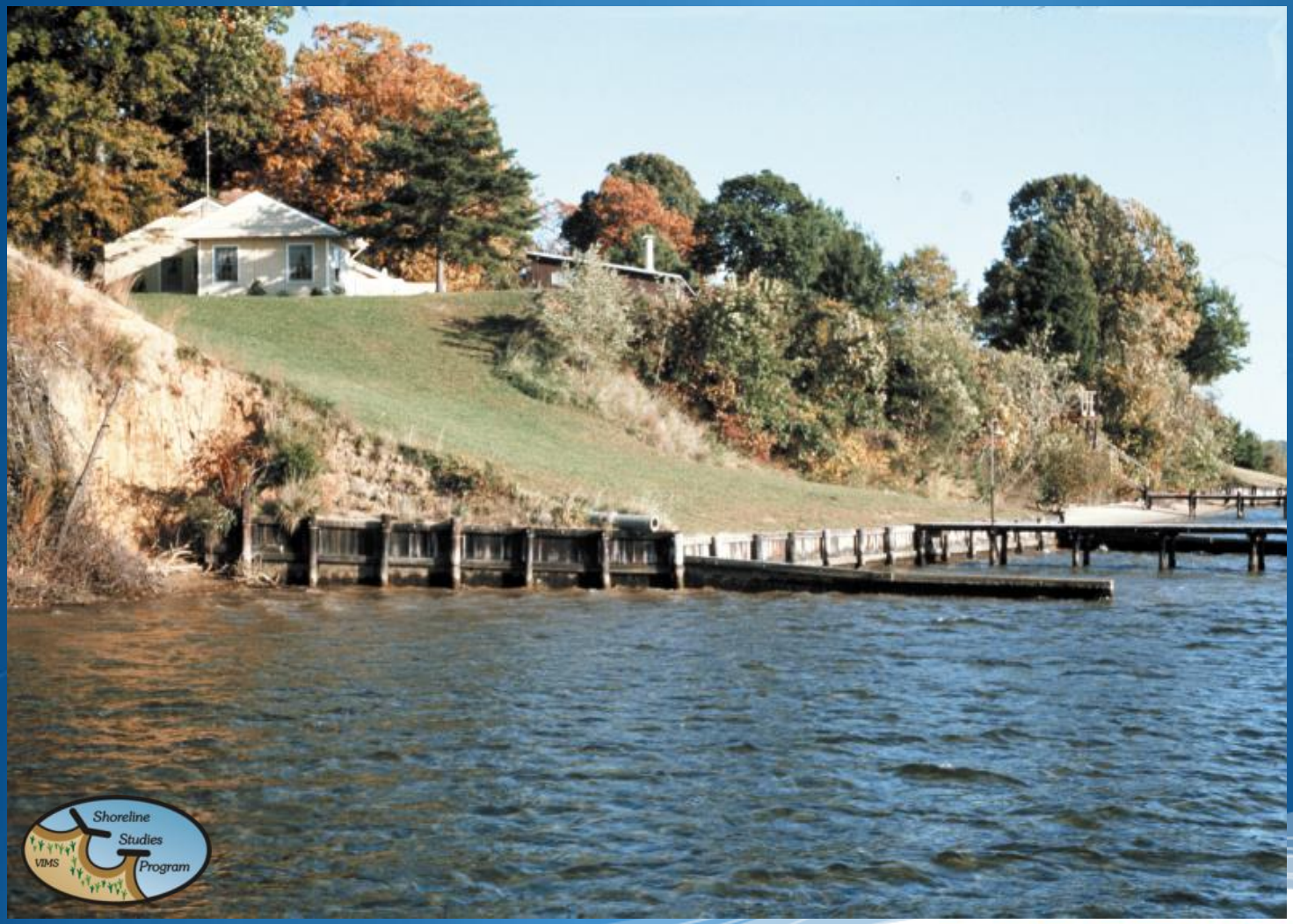

Transitional
Erosional
Transitional

Stable Bank

Transitional Bank

Erosional Bank

Hard Shore Protection Strategies



Bulkheads

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Hard Shore Protection Strategies

Revetments

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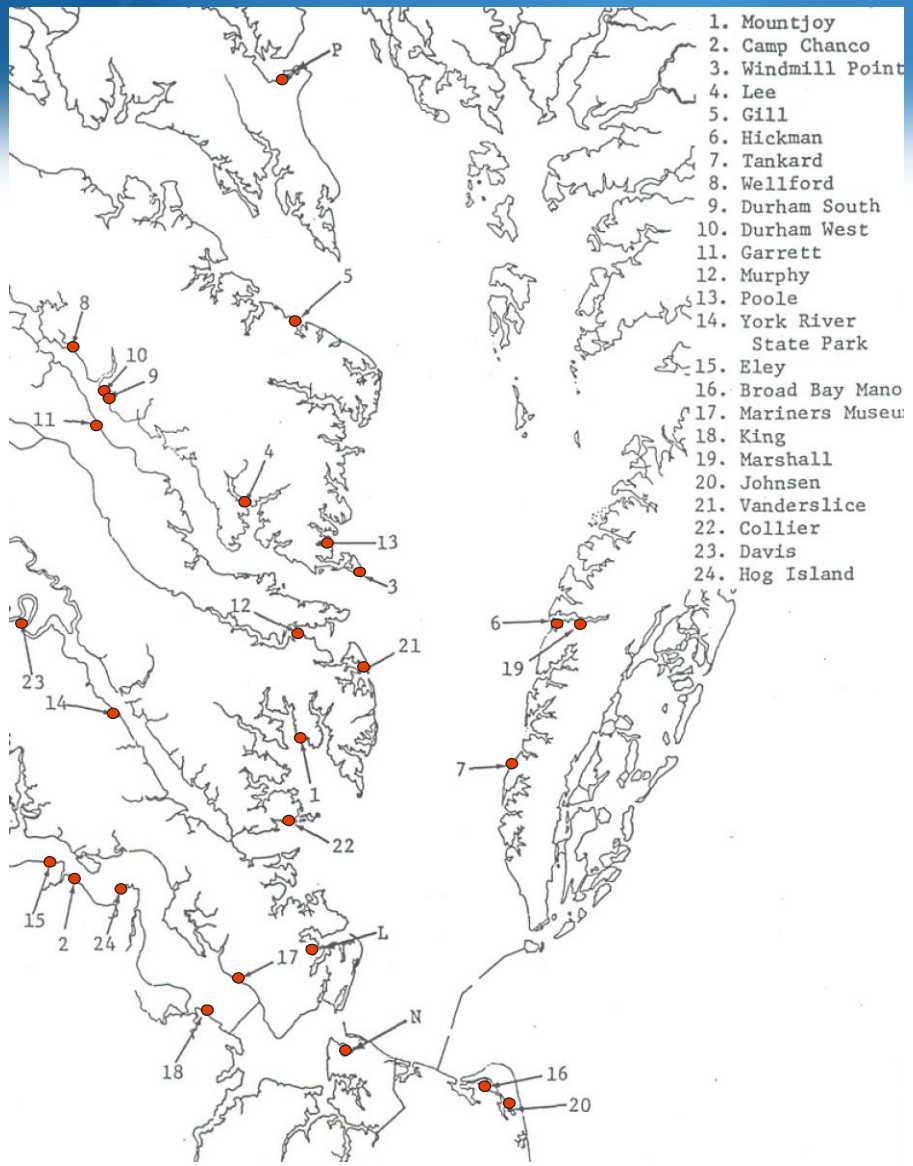
Vegetative Erosion Control Project VIMS and SEAS (DCR) 1981-1987



Occahannock Creek VEC Site

Marsh planting along Occahannock Creek, Northampton County, Virginia.

Occahannock Creek marsh plantings after 1 year.

Occahannock Creek marsh planting after 10 years of growth.

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Poole VEC Site

Minor bank grading and temporary toe protection utilizing straw bales was used to protect the planted marsh fringe.

Since high water impinged upon the base of the bank, only the intertidal species (*Spartina alterniflora*) was utilized.

After one year.

After six years.

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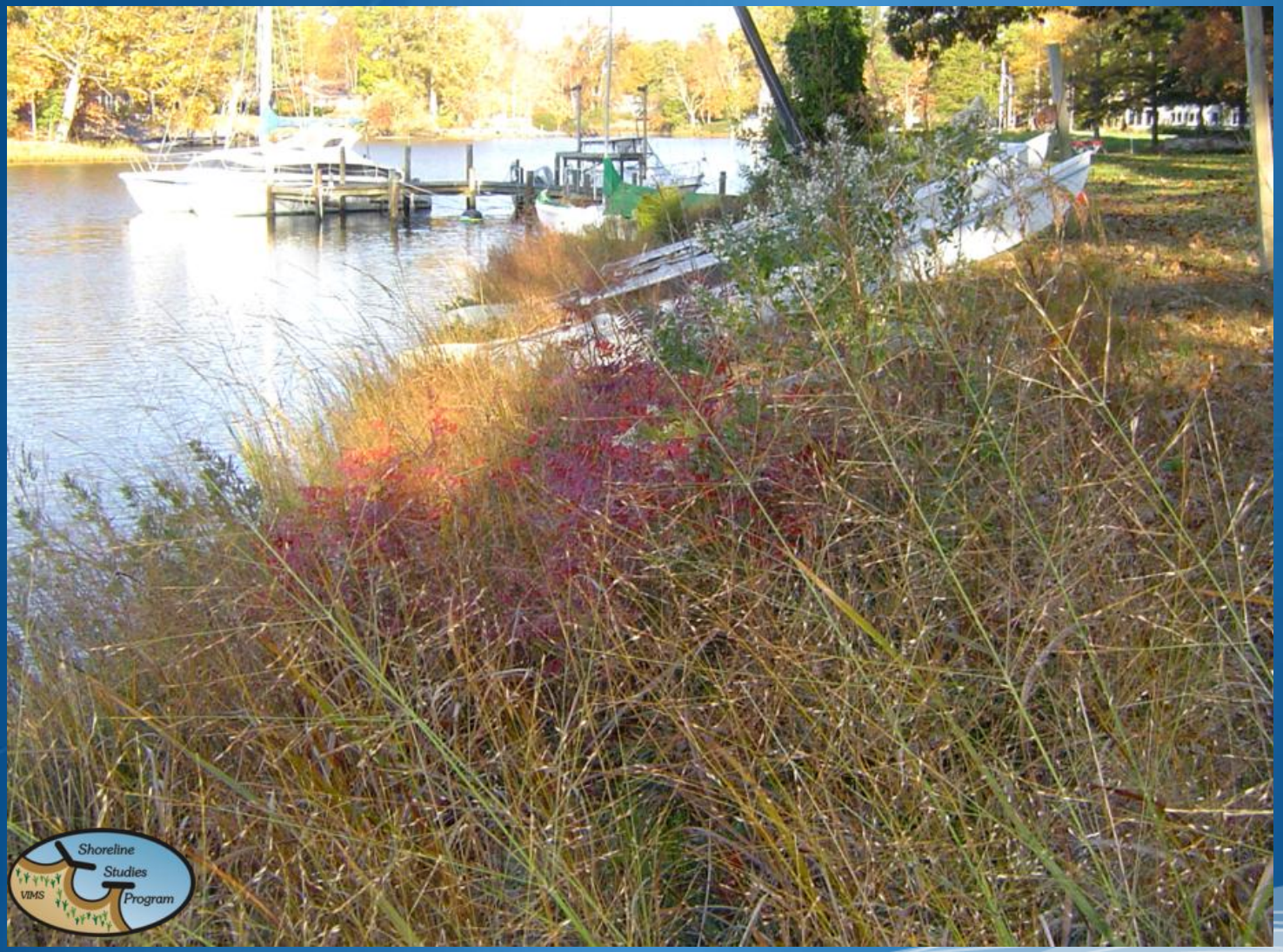
Poole VEC Site



24 years after construction

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Lee VEC Site

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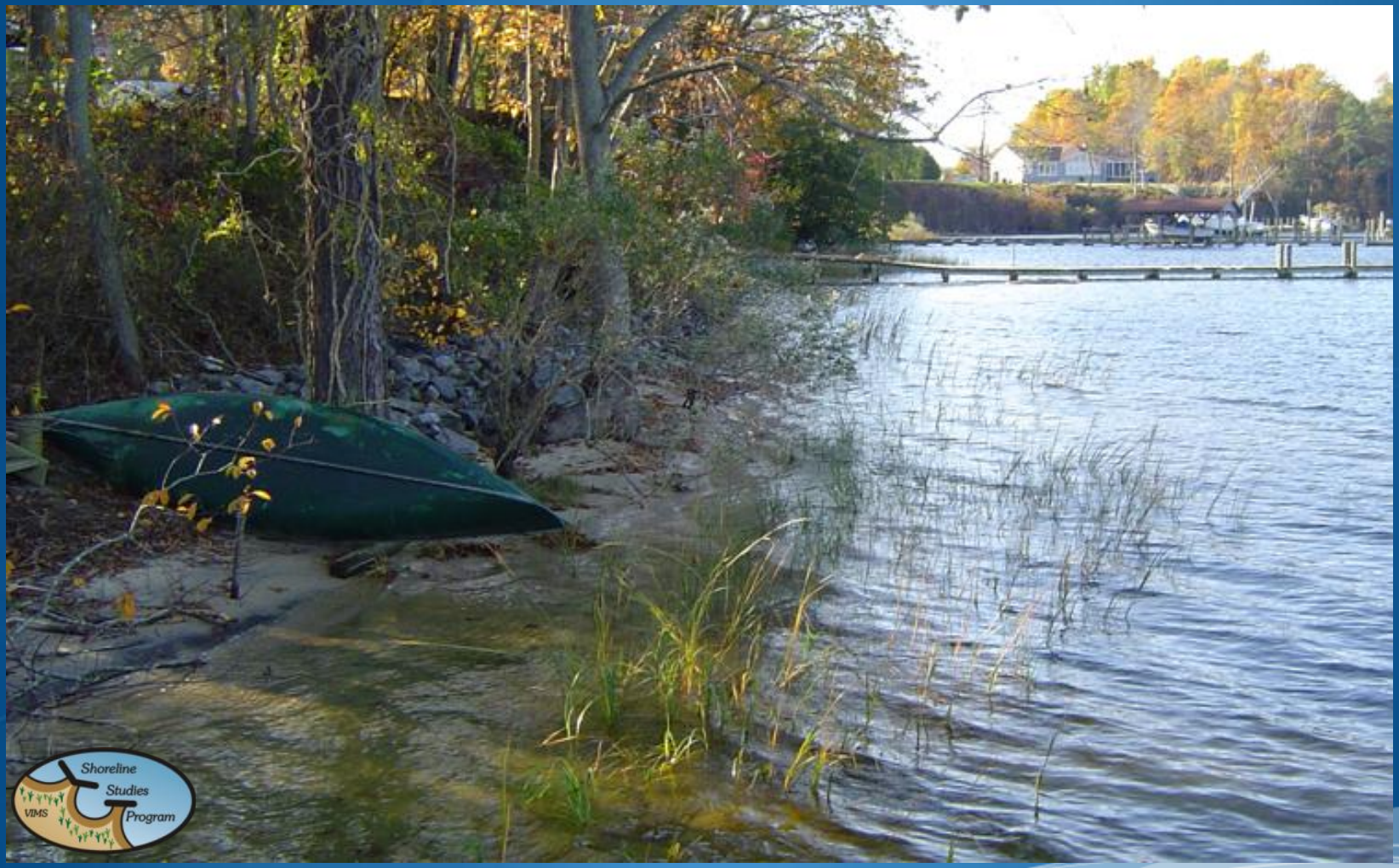
Lee VEC Site



25 years after construction

VEC Project

- 24 sites planted in a variety of shore settings on existing substrate

- Success dependent of 1) fetch 2) shore geomorphology and 3) shore orientation

- Fetch:
  - <1.0 nm, high probability of success;
  - 1-5 nm, low probability, even with maintenance,
  - >5 nm, no probability of success.

- South facing shoreline have better chance.

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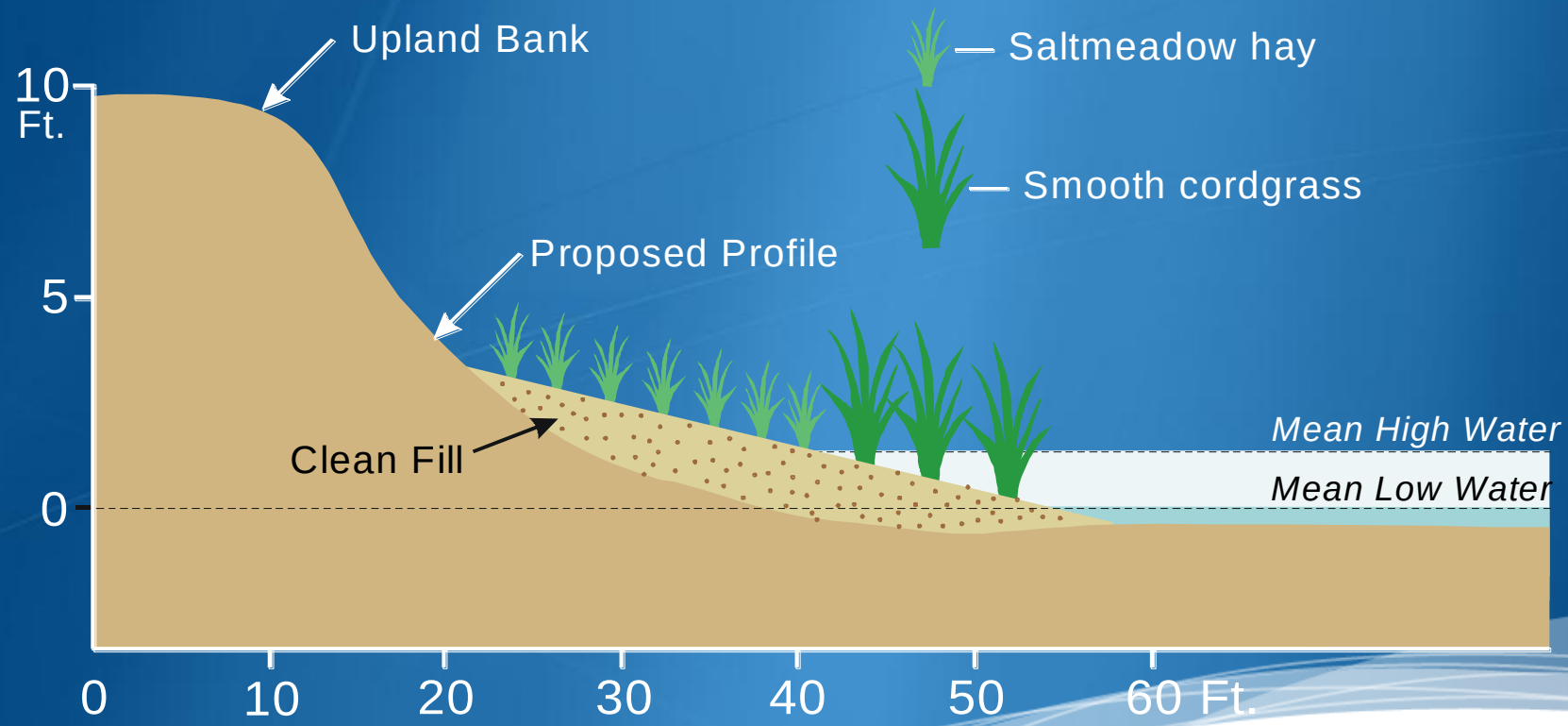
Management Strategies

This cross-section shows a proposed plan to stabilize a typical eroding shoreline using clean sand to create the appropriate planting area.



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Maryland Non-Structural Program

- Over 300 sites installed through grant program
- Program is still active.

RC&D: Dave Wilson and Jerry Walls

Maryland DNR: Lin Casanova, Dave Burke, Jordan Loran, Chris Zabawa, Kevin Smith

Current personnel: Kevin Smith, Tom Brower, Bhaskar Subramanian

Wye Island

Pre-project shoreline on Wye Island, Kent County, Maryland.

Marsh grass plantings with sand fill and short, stone groins

3 months after installation

4 years after construction.

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Wye Island

21 years after construction

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Wye Island South-Facing Shore

Loss of fill and shading by previously cut trees caused reduction in marsh fringe.

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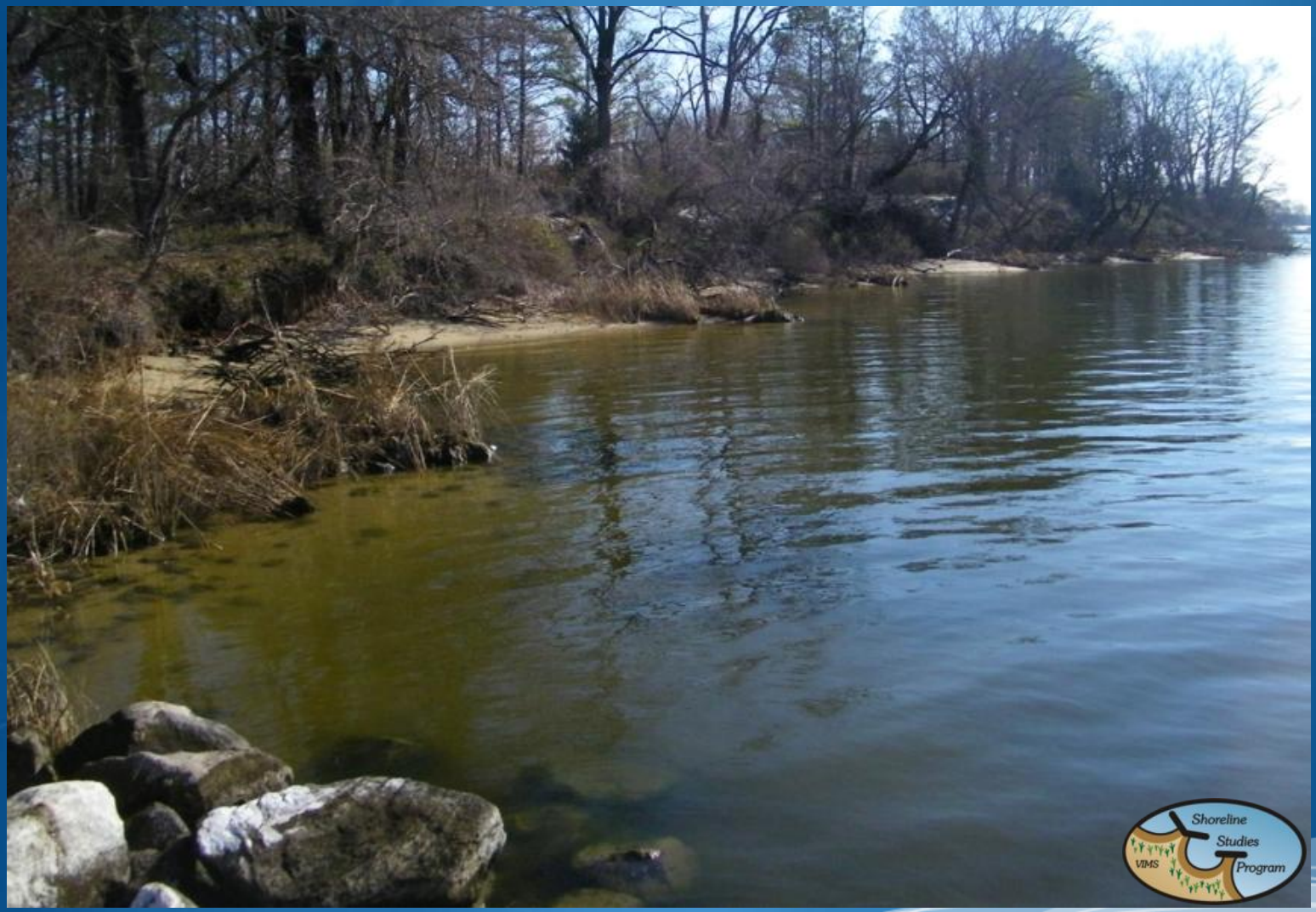
Wye Island



28 years after construction

Wye Island North-facing Shore

21 years after construction

No marsh; too much shade?

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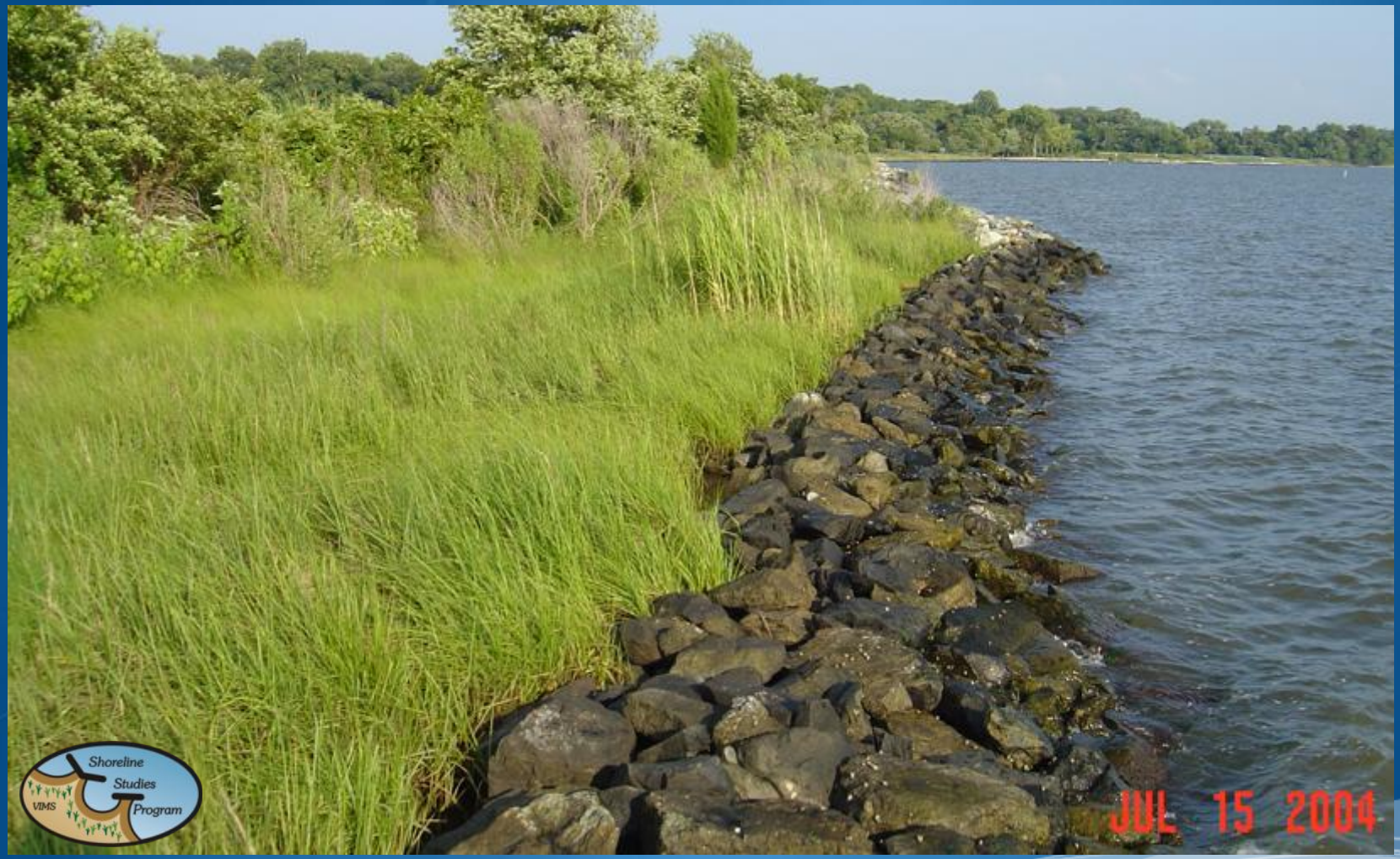
Who's been gnawing here?

Jefferson Patterson Park & Museum

October 1986
Pre-project

December 1988

Jefferson Patterson Sill



16 years after construction

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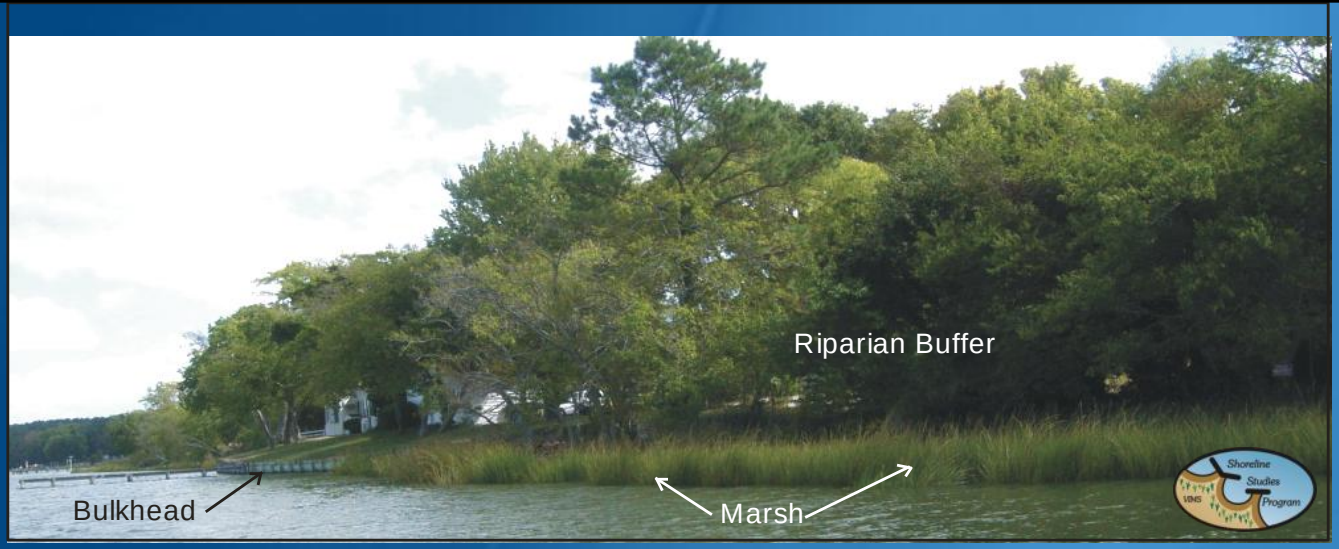
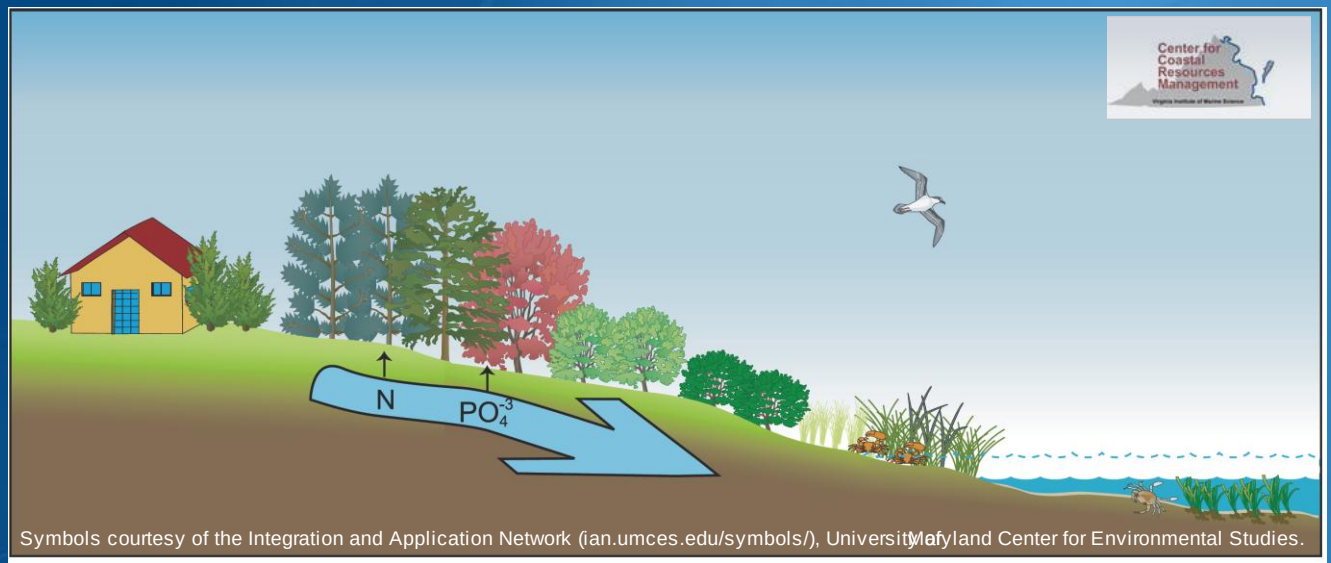


Difference between hardening and aspects of a typical coastal profile.



	Upland Landuse	Riparian Landuse	Banks	Intertidal Zone	Subaqueous Lands
(+)	Trees, shrubs, tall grass	Trees, shrubs, tall grass	Vegetated, Stable	Marshes, Phragmites	Seagrass (SAV)
			Partial vegetation	Coastal Sand Dunes	Oyster Reefs
	Agriculture	Residential, Agriculture	Undercut	Riprap, Bulkheads	Aquaculture
(-)	Residential, Commerial	Industrial	Bare, Unstable	Boat ramps	Marinas

An integrated water quality model

Positive = diverse habitat opportunities and improved water quality

Negative = few habitat opportunities and reduced water quality

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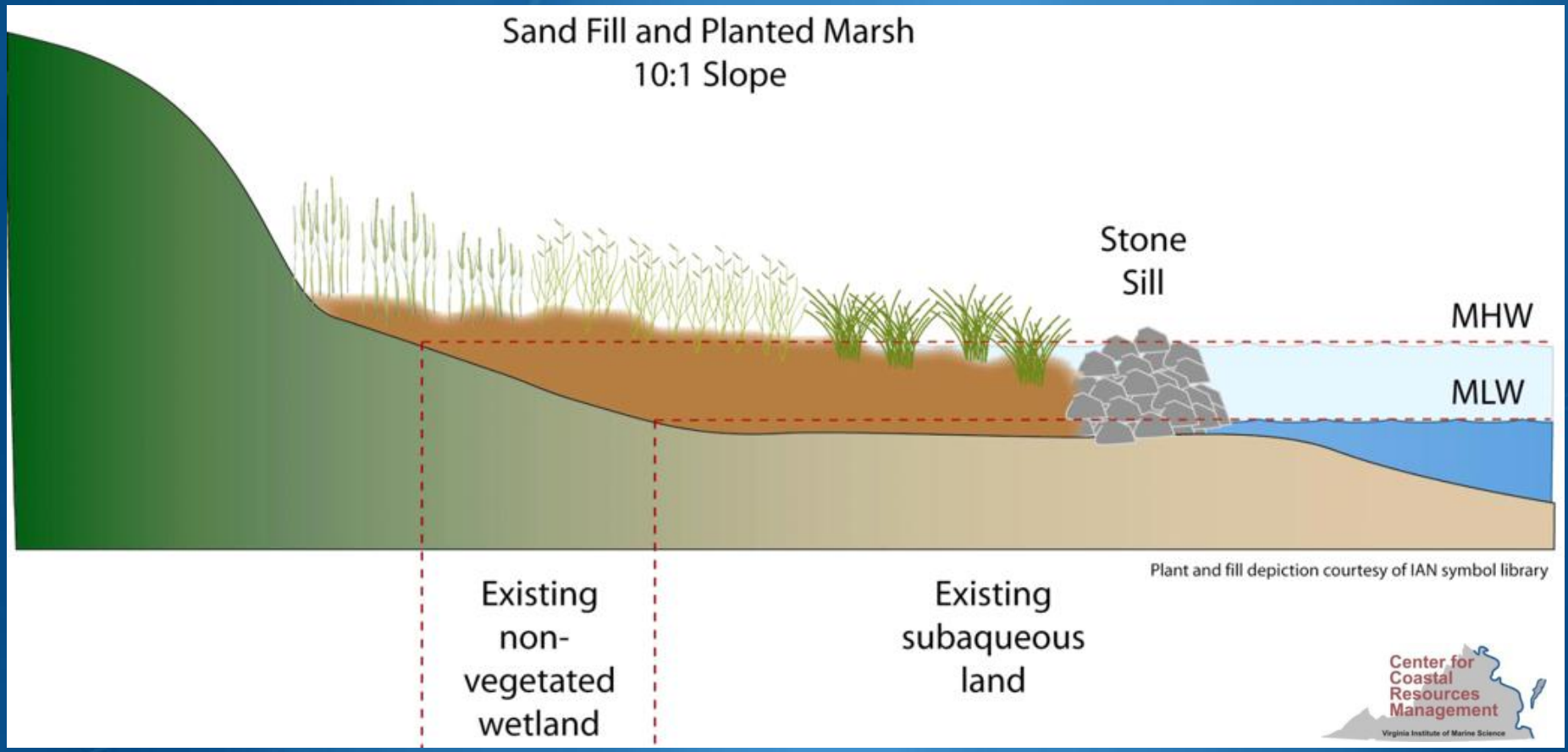
Typical Living Shoreline Treatment



Elevations & planting widths will vary depending on site conditions.
Extent of channelward encroachment depends on extent of landward design.

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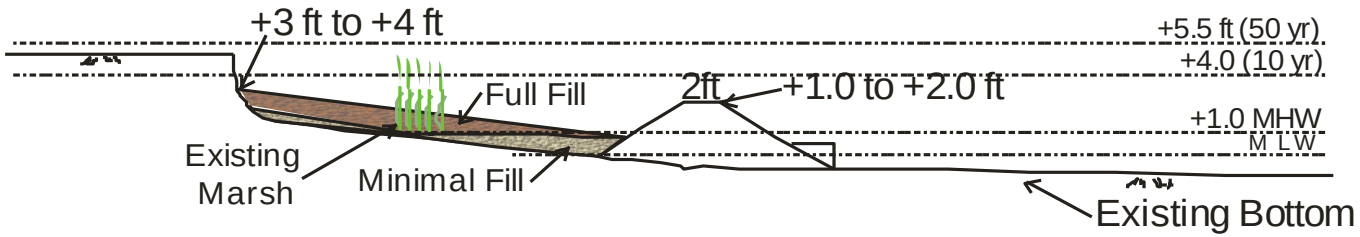
Typical Cross-sections for Living Shorelines

Low Sill/Low Bank

Existing Conditions

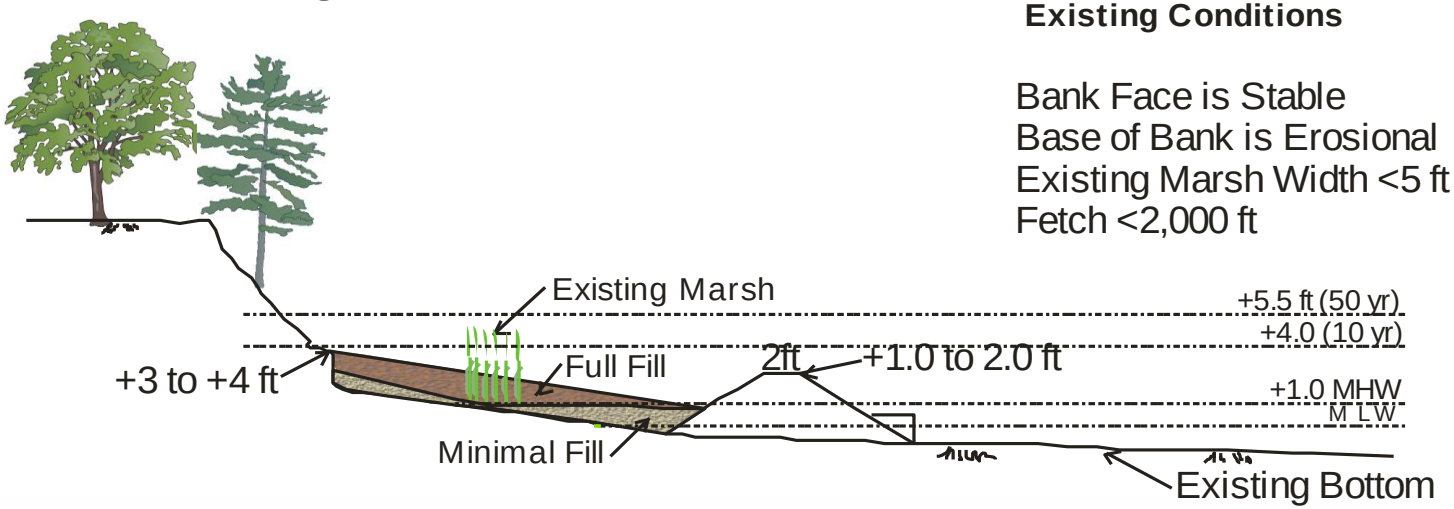
Bank Face is Erosional
Base of Bank is Erosional
Existing marsh <5ft



Low Sill/High Bank

Existing Conditions

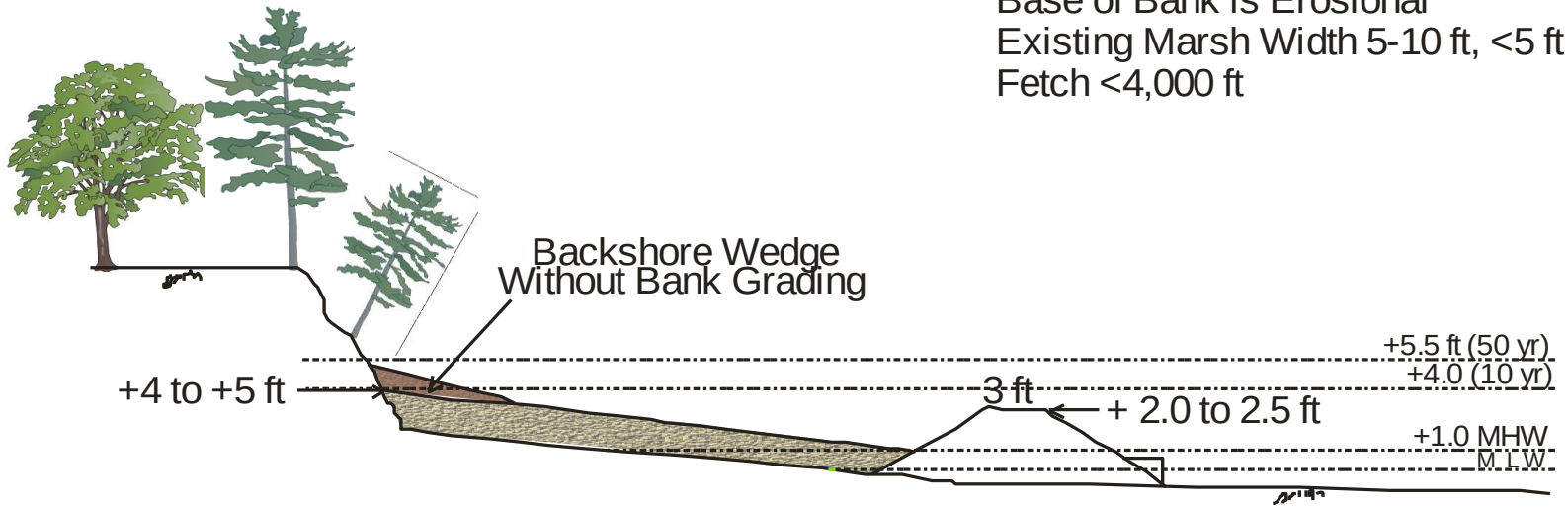
Bank Face is Stable
Base of Bank is Erosional
Existing Marsh Width <5 ft
Fetch <2,000 ft



Typical Cross-sections for Living Shorelines

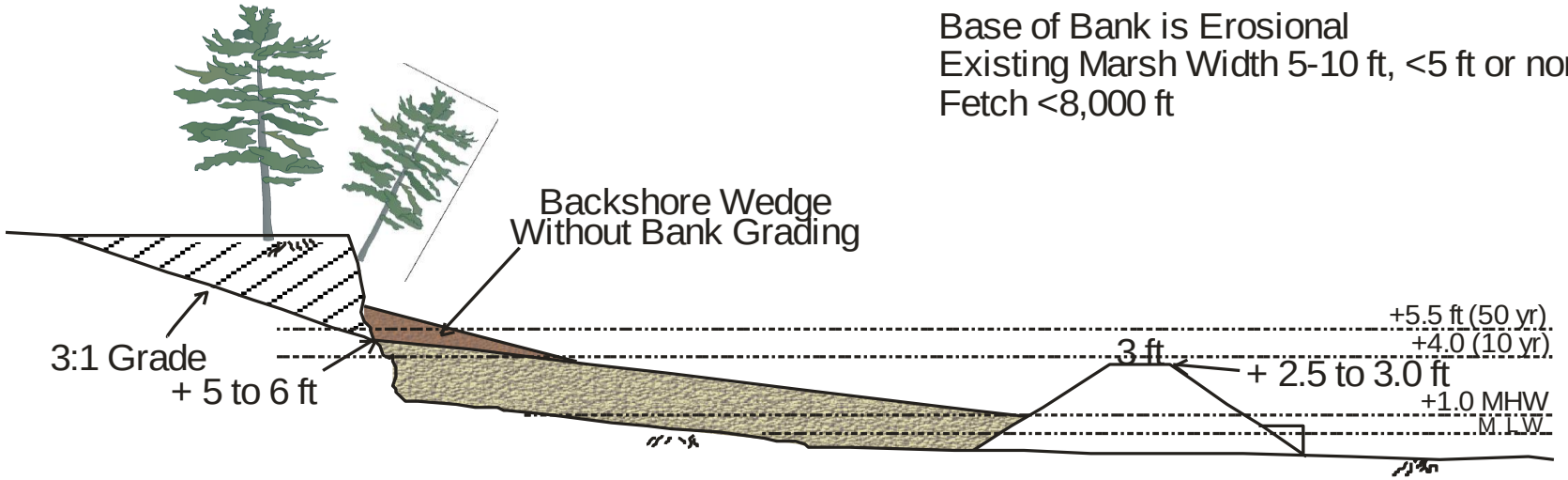
Medium Sill/High Bank

Bank Face is Transitional
Base of Bank is Erosional
Existing Marsh Width 5-10 ft, <5 ft or none
Fetch <4,000 ft



High Sill/High Bank

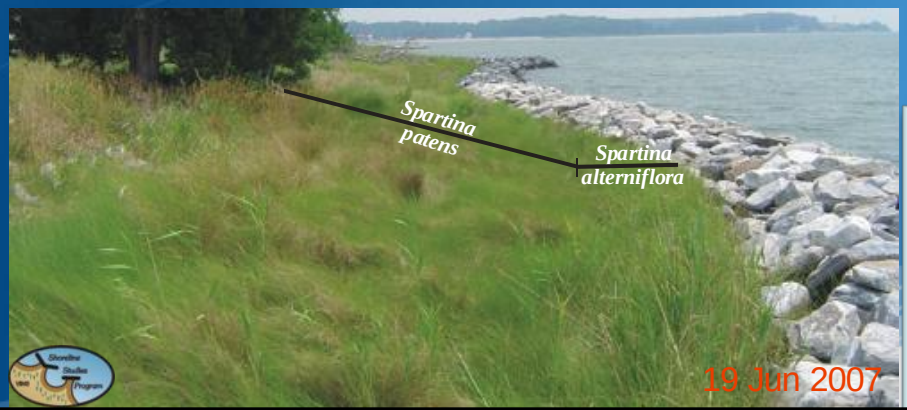
Bank Face is Erosional
Base of Bank is Erosional
Existing Marsh Width 5-10 ft, <5 ft or none
Fetch <8,000 ft



Webster Field Annex, Maryland
Sand fill with stone sills and marsh

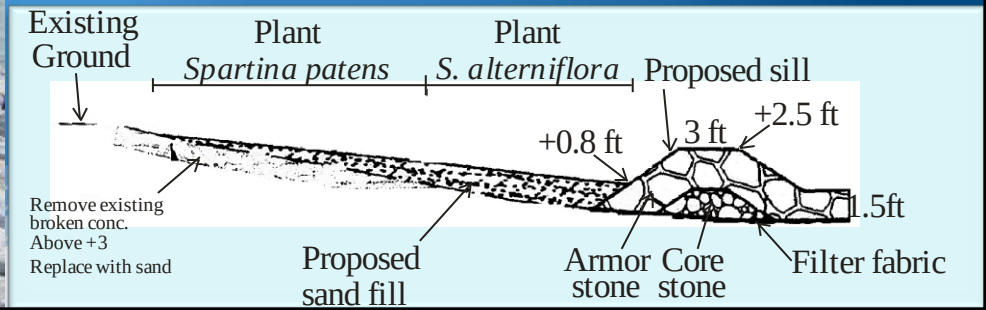
before installation

after installation but before planting



after four years

the cross-section used for construction.



St. Mary's City Sill

August 2001

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St. Mary's City: Sill with Window

November 2006

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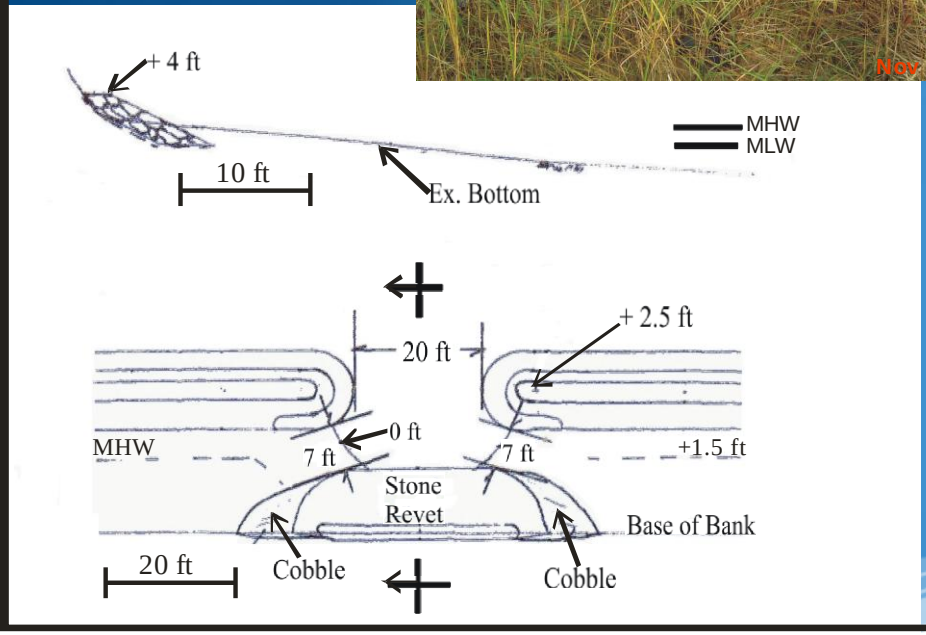
The sill at St. Mary's City at low tide depicting two of the access pathways including the sill windows and macro-pores in the sill.

(from Hardaway et al., 2008)



Photos showing a window in the Historic St. Mary's City sill post construction in 2002 and in 2006. The window 9 has a stone revetment along the backshore shown in the planform and cross-sectional design.

(From Hardaway et al., 2008)

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Marsh Fringe Applications

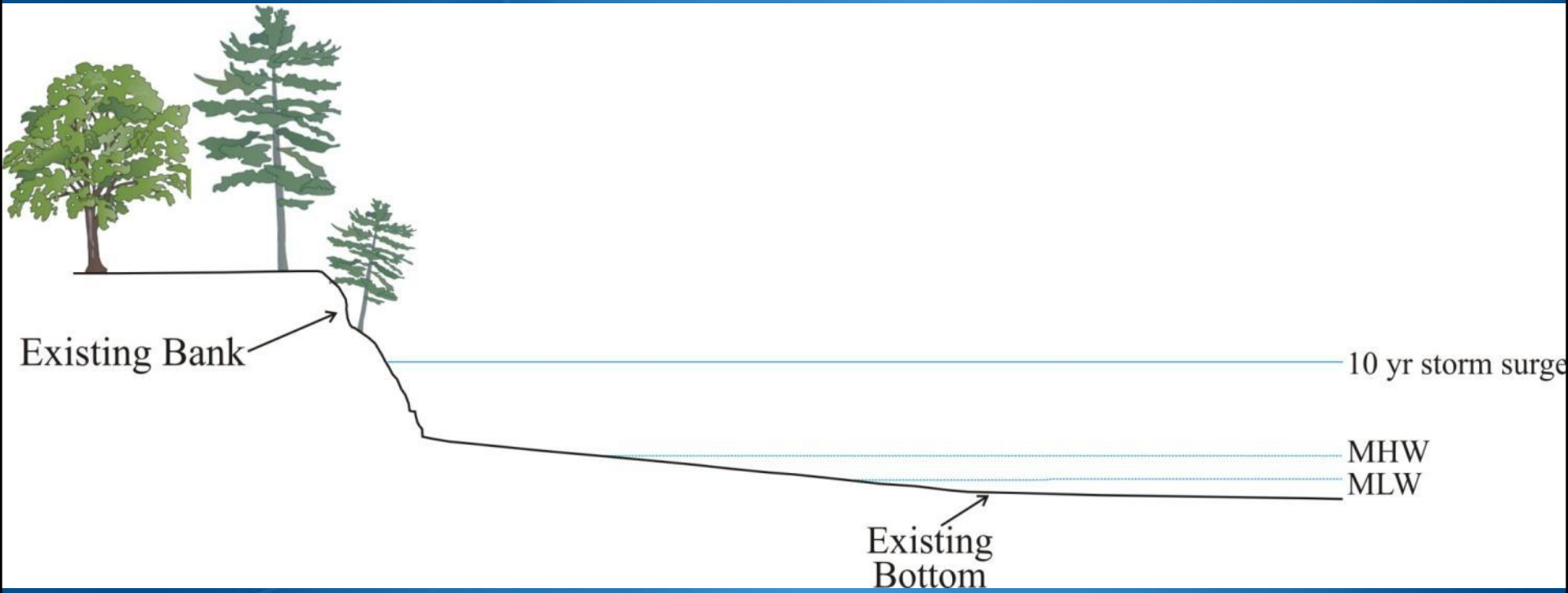
1) Plant existing substrate, provide sun.

2) Add sand fill with minimal containment structures such as stone groins, coir logs, etc.)

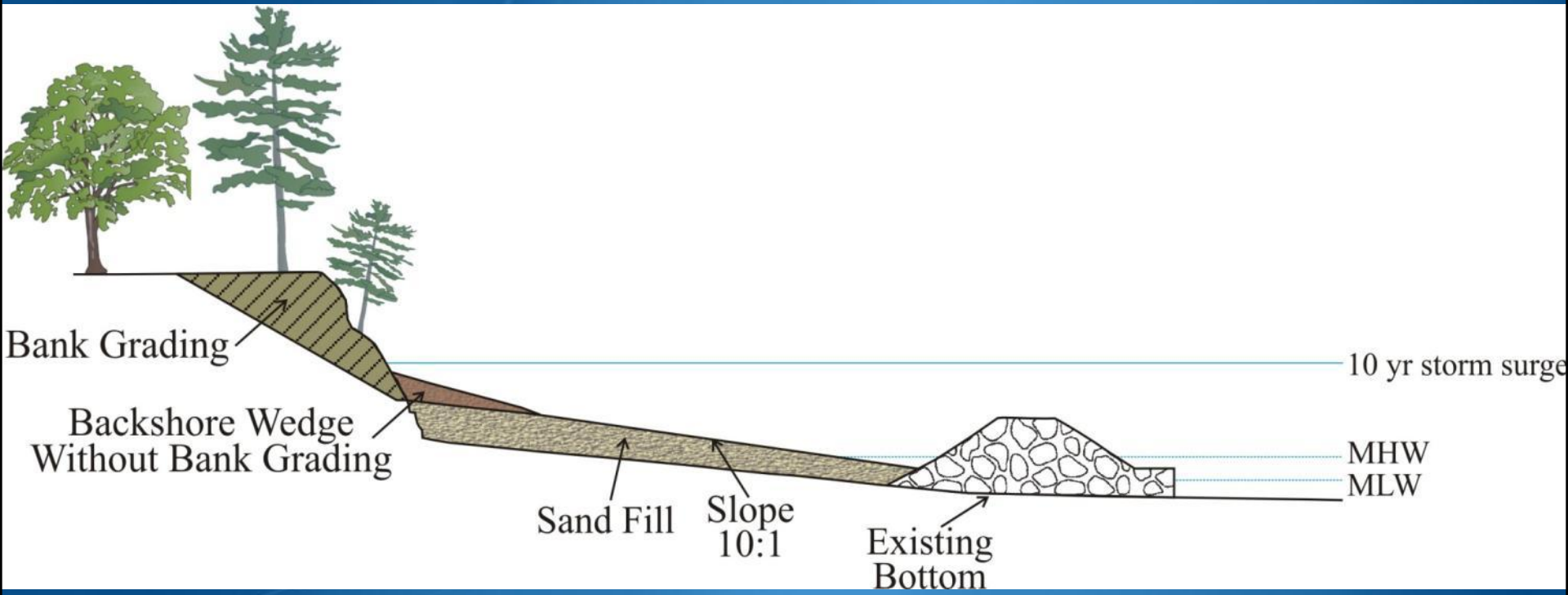
3) Use stone sills, add sand and plant new marsh.

Define “Level of Protection”
10 year, 25 year???

Marsh Fringe Applications



Marsh Fringe Applications



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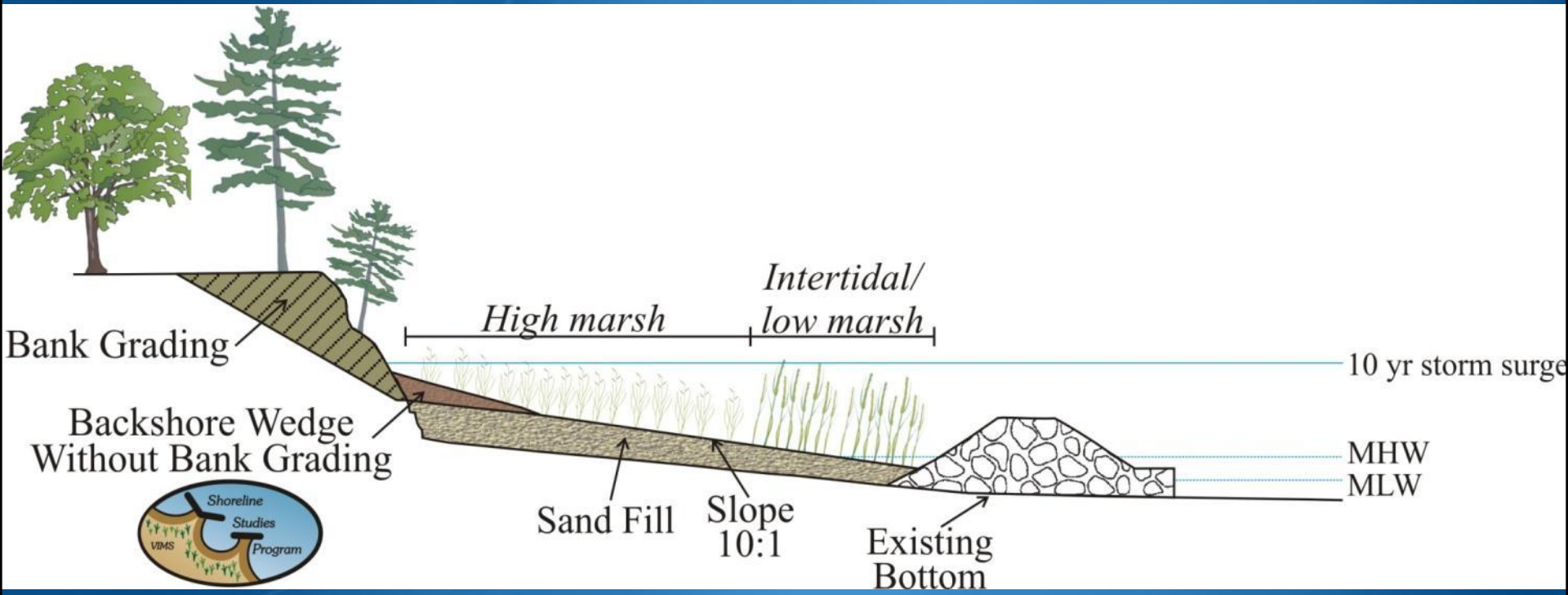
Marsh Fringe Applications



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Mathews County, Virginia

Sill with marsh and pocket beach.

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Mathews County, Virginia

Aerial view of entire project which included sills, pocket beach, and revetment to stabilize spit with historic mill.

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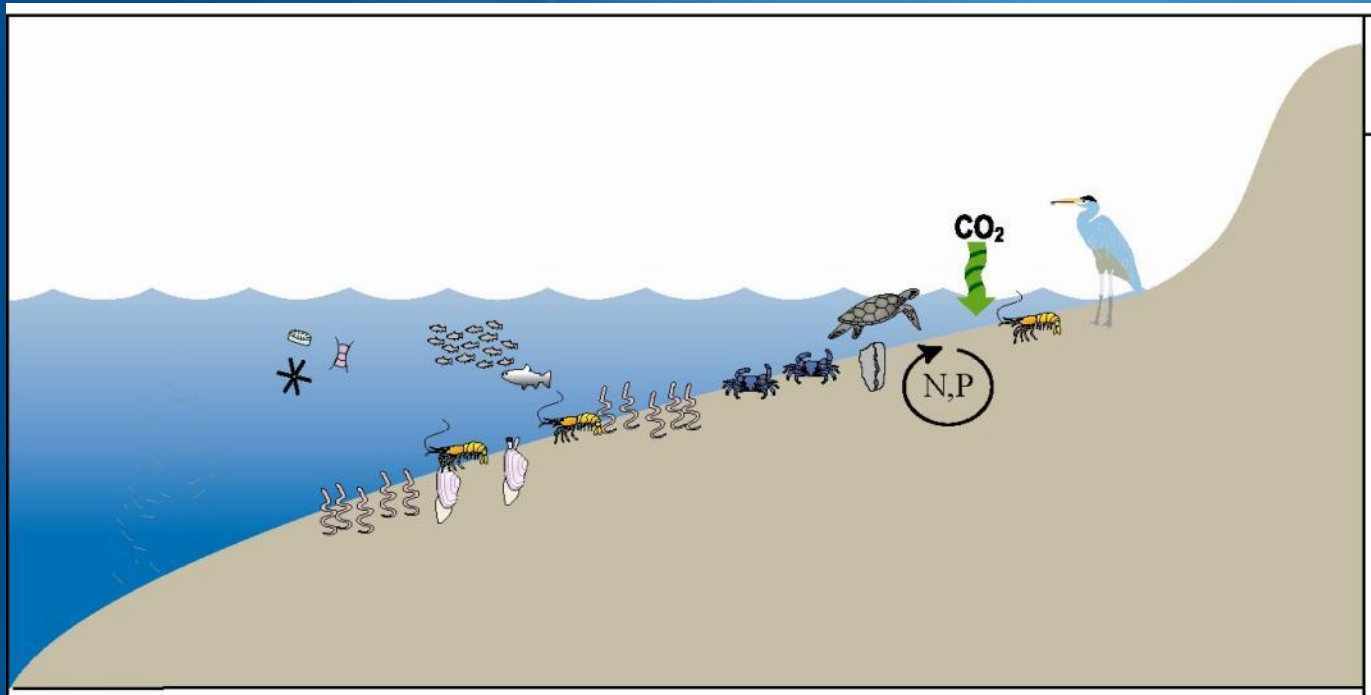
Ecosystem Services: Beaches



Importance and Features

Beaches provide habitat for invertebrates, crustaceans and birds.

Microalgae on the sand are important primary producers.

Turtles lay their eggs on sandy beaches.

Extensive nutrient cycling takes place on sandy beaches.

Icon Key

molluscs

worms

phytoplankton

turtle

shrimp

wading birds

crabs

sand

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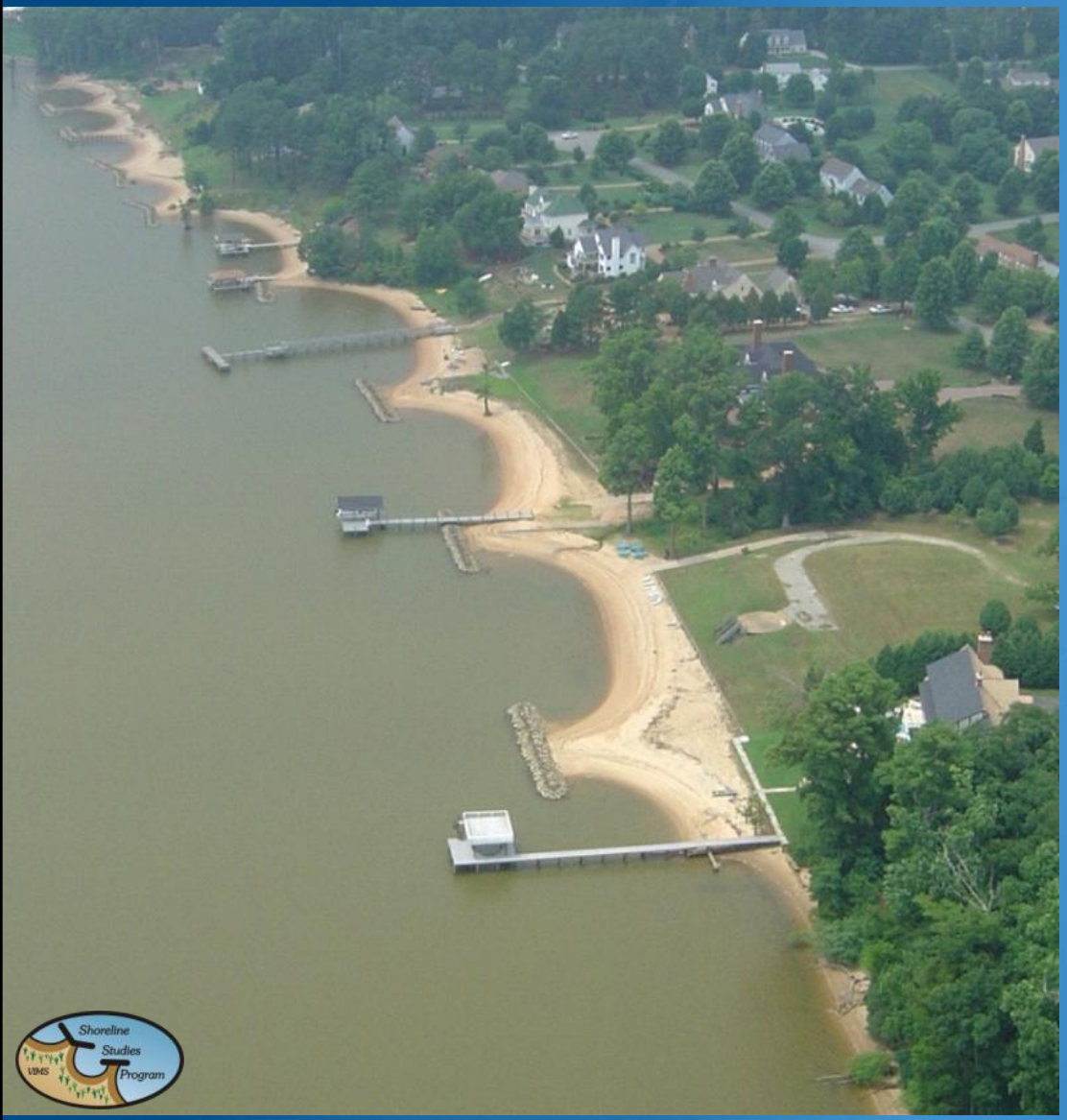
Beaches

- Naturally occurring beaches can provide shore protection if wide and high enough.
- Beach nourishment is a method used to maintain a protective beach.
- In Chesapeake Bay, ongoing beach nourishment projects are usually done in conjunction with some type of securing structure such as groins or breakwaters.
- The use of breakwaters on private property began in 1985.



First Chesapeake Bay Breakwater Project

Installed 1985

Drummond Field; James River
June 2005

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Drummond Field performance

Luter 2002
James River

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Headland Breakwater Systems Assisted Living Shorelines

Luter, Isle of Wright; James River
May 2004

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Luter, Isle of Wright; James River
January 2010

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Chesapeake Bay Headland Breakwater Sites

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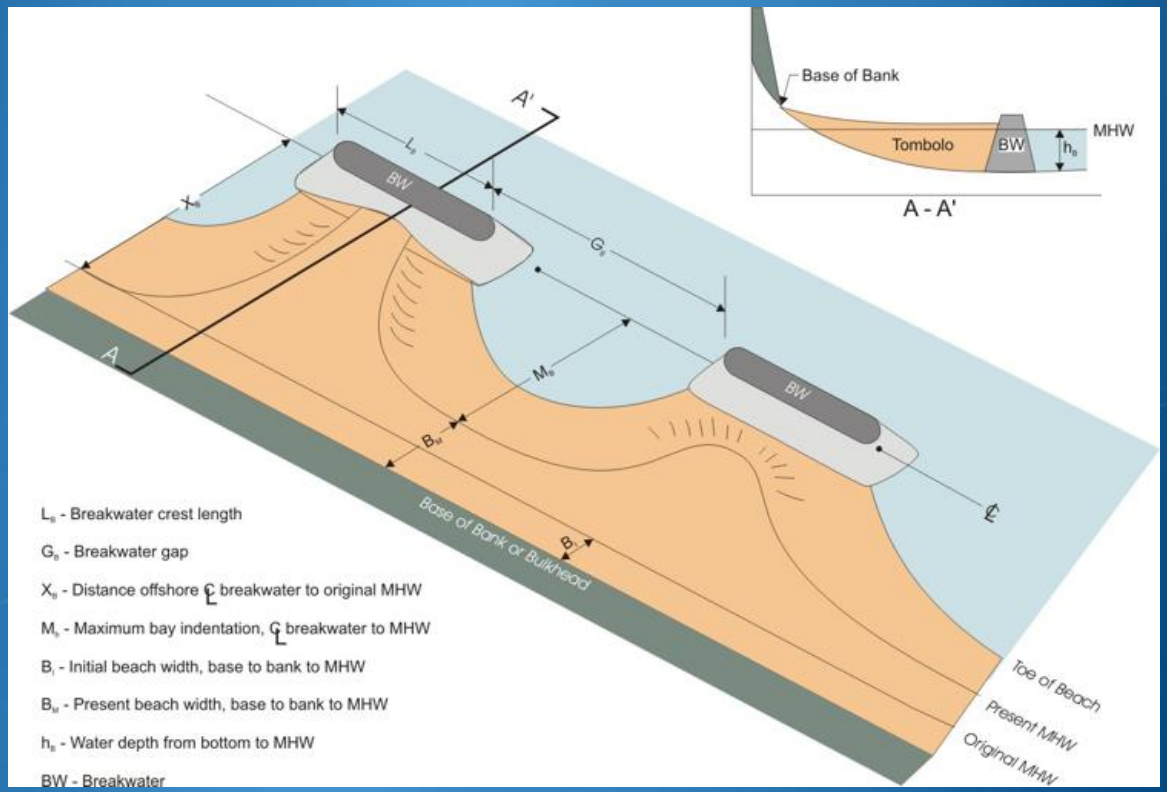
Breakwater Design Guidelines

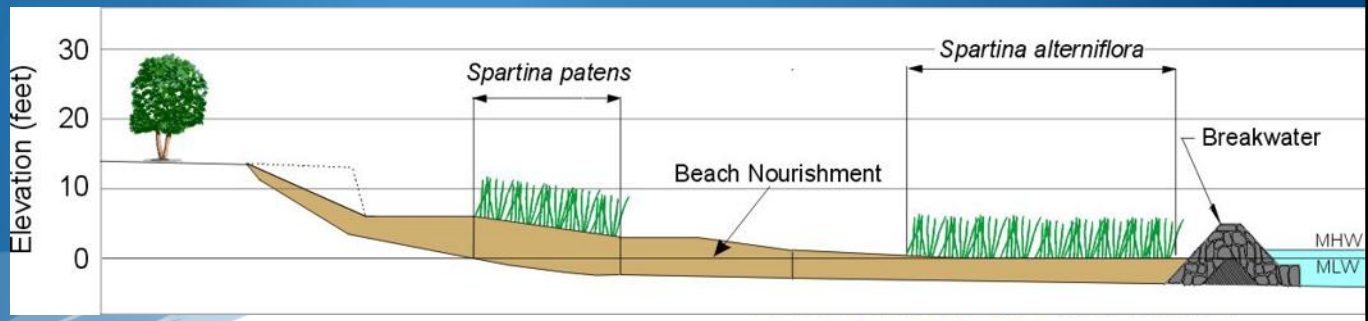
Maximum Bay Indentation : Gap Width

Mb:Gb
1:1.65

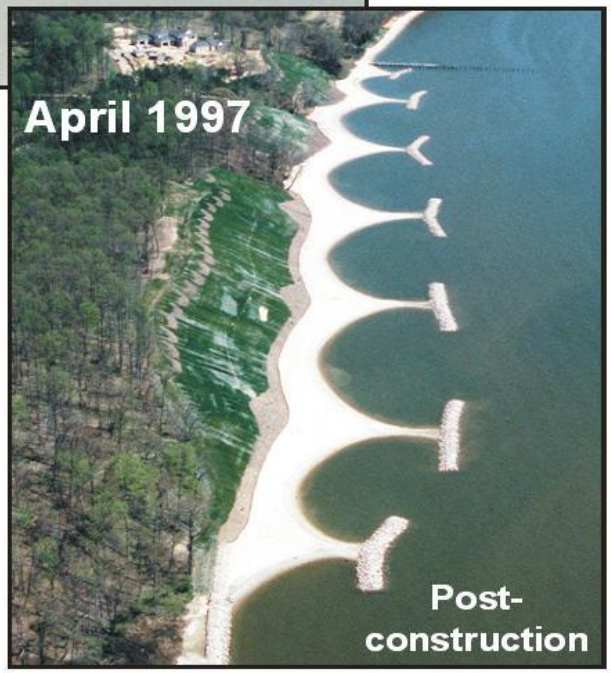
Crest Length : Gap Width

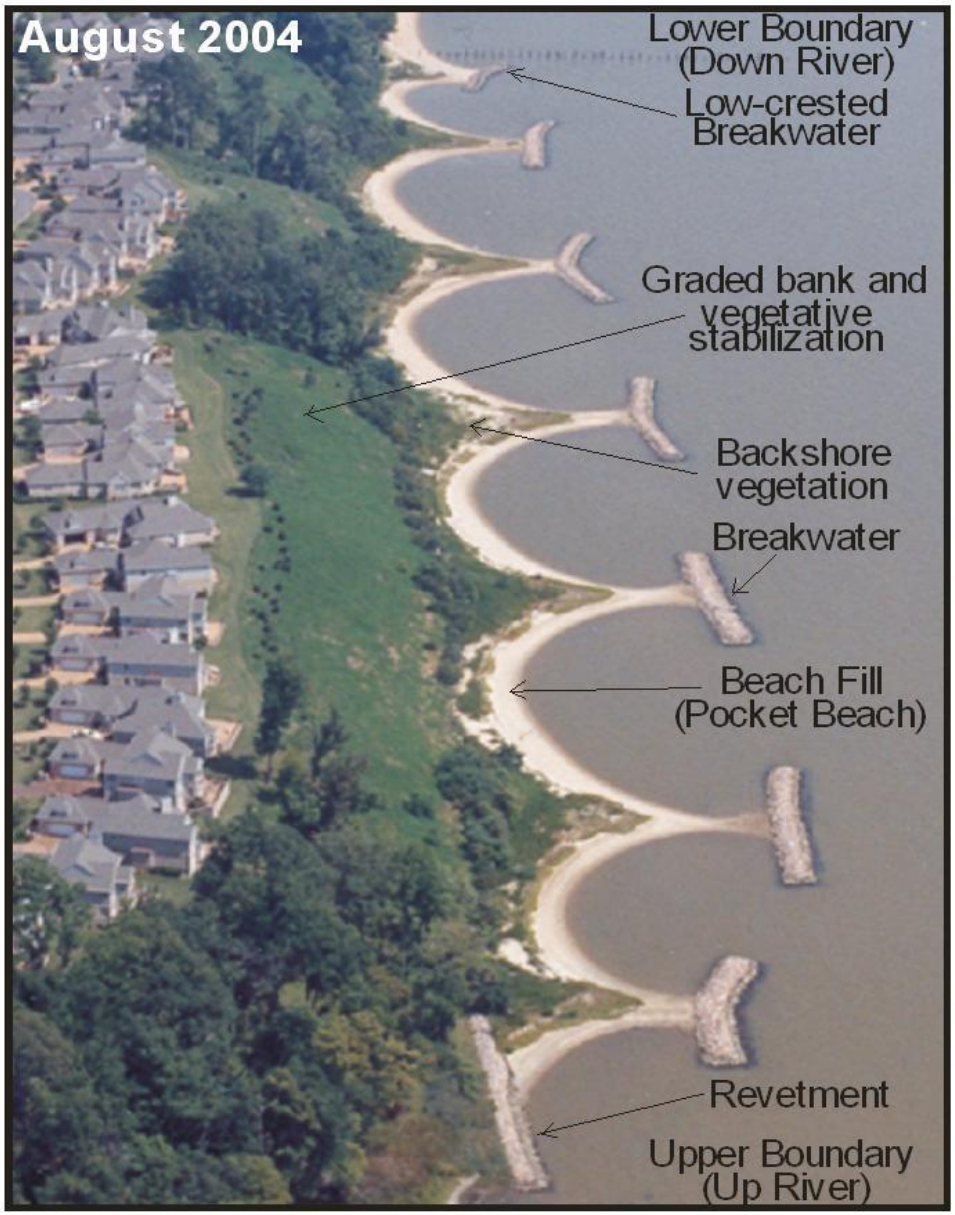
Lb:Gb
1:1.4





Kingsmill on the James





Kingsmill, James River, Virginia

Pre Isabel
21 Aug 2003

Post Isabel
16 Oct 2003

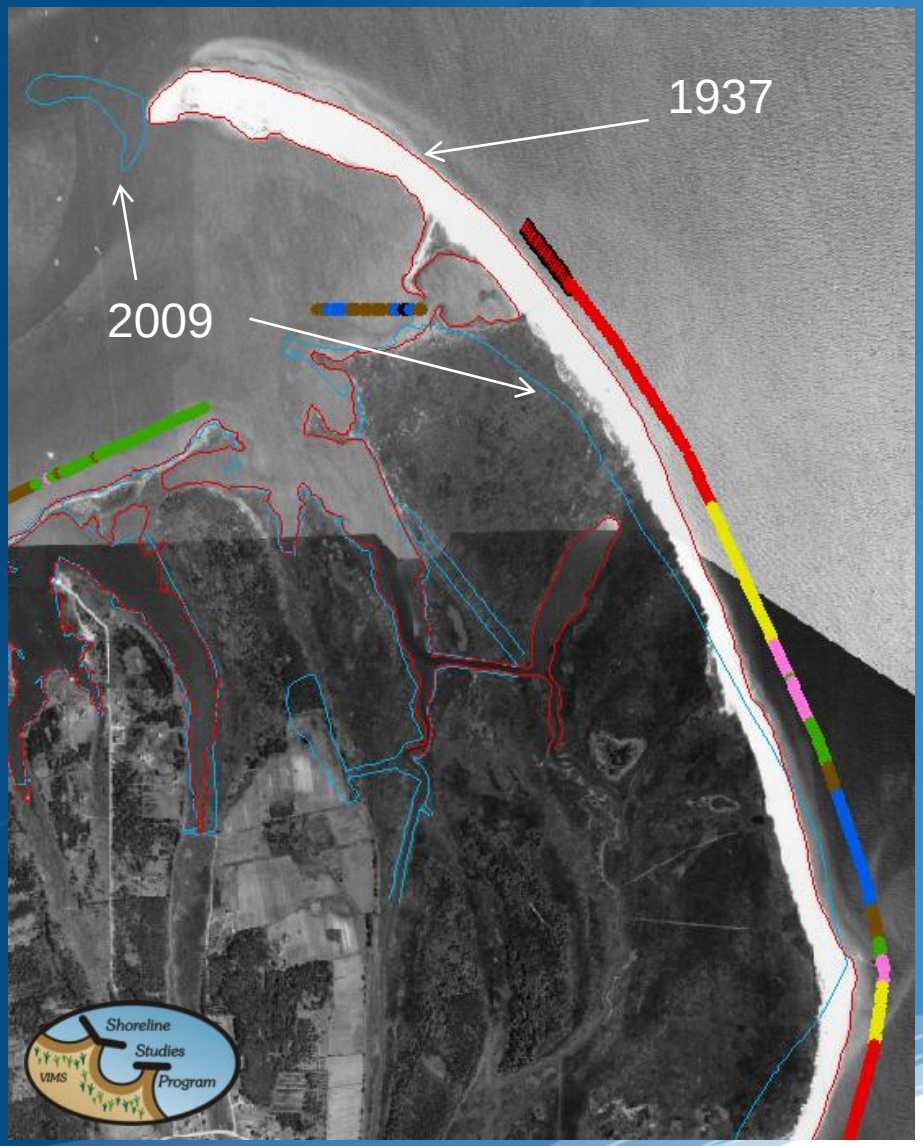
Minor scarping of the bank and a loss of vegetation were the major impacts to this site.


2002
2007
2009

Factory Point and Grandview Nature Preserve

1937

2011



City of Hampton
Factory Point

May 2012

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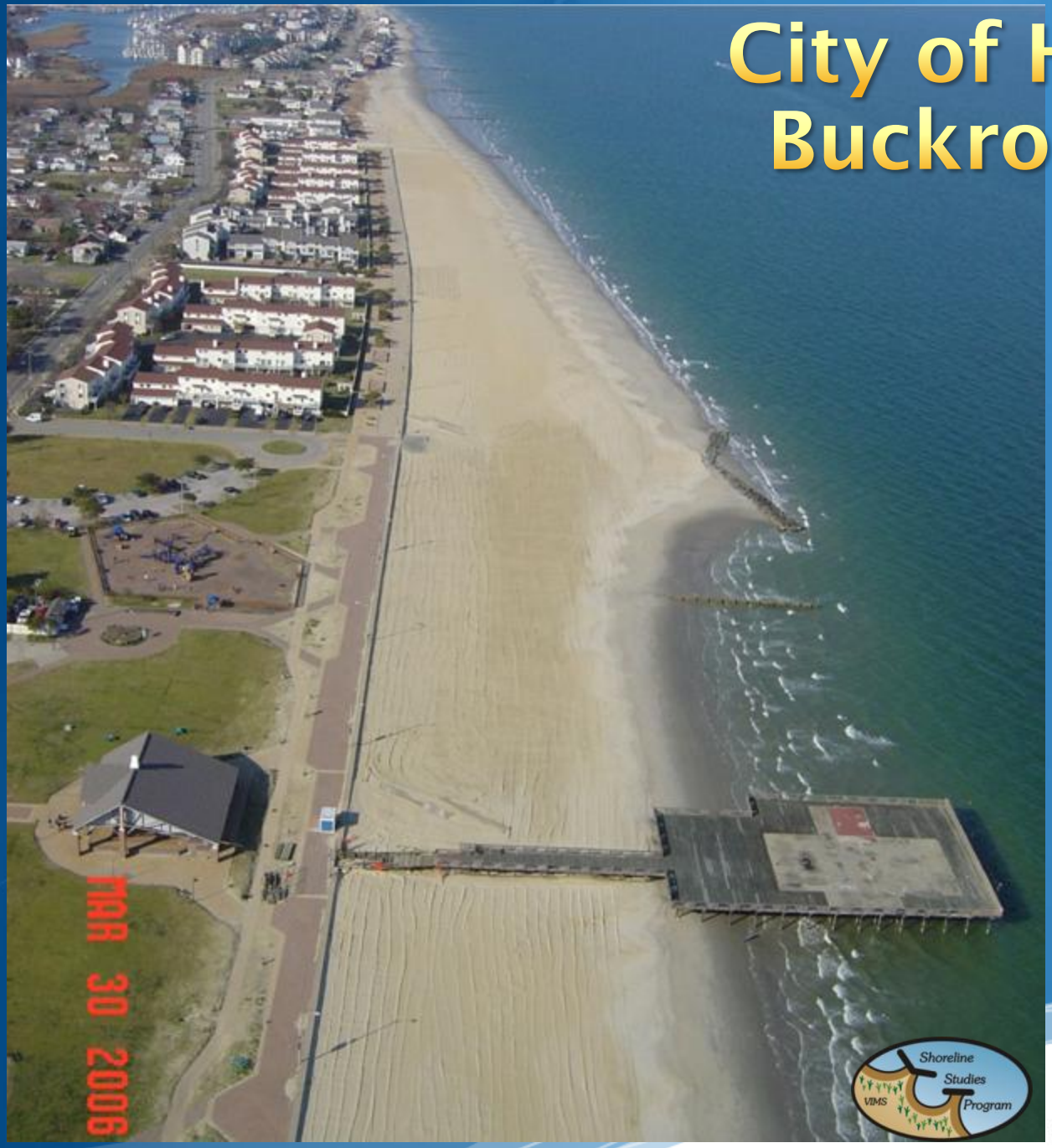
City of Hampton
Buckroe Beach



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VIMS, Gloucester Point, Virginia

VIMS

Tropical Storm Ernesto,
September 1, 2006

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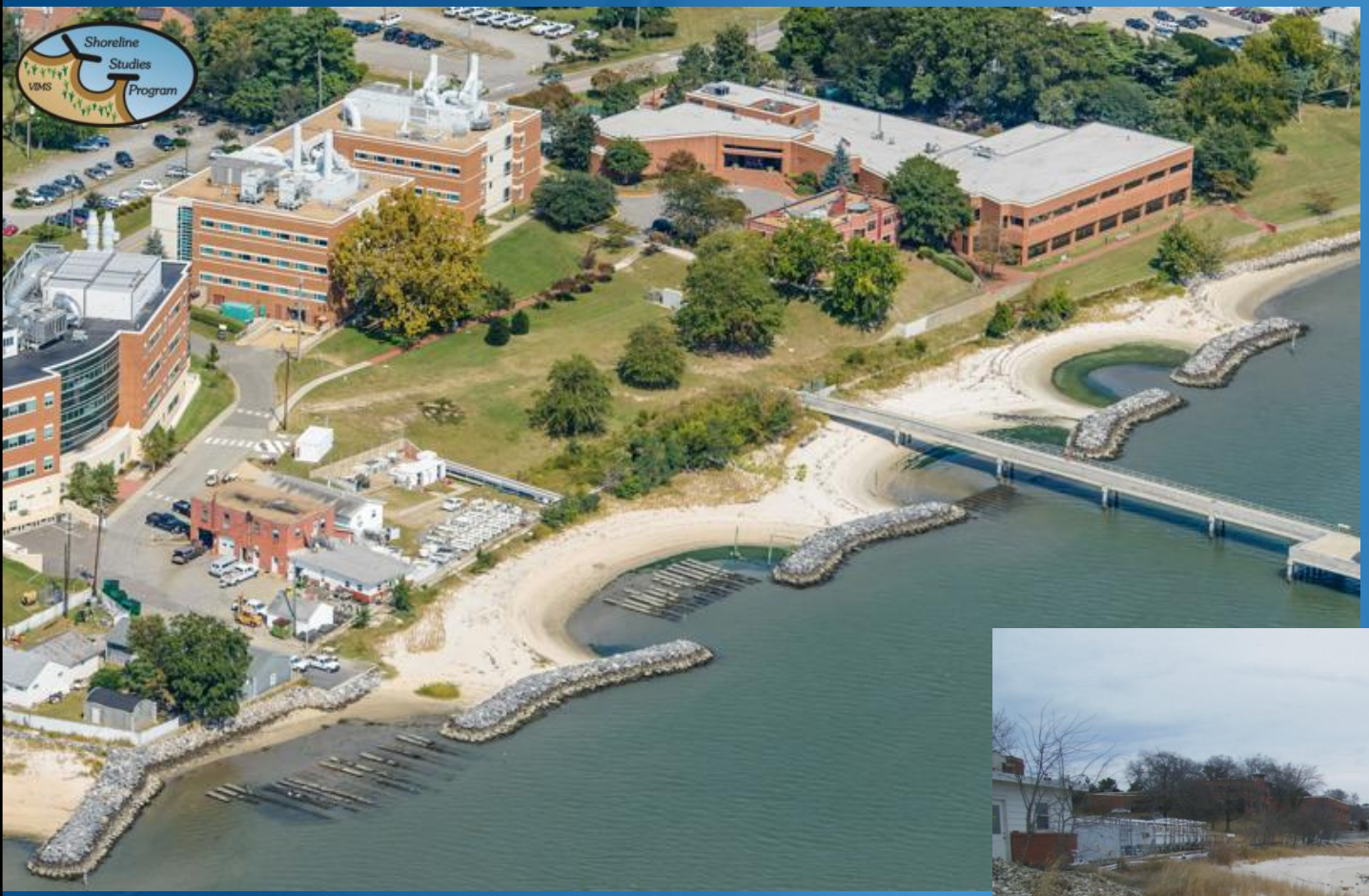
VIMS Design


Shoreline Studies Program
VIMS
West Shore
W5
W4
W3
W1
Watermans Hall
Greate Road
E1
E2
E3
E4
E5
East Shore
Shoreline Studies Program
VIMS

VIMS Post-Construction

2010

VIMS East Shore



Sep 2012

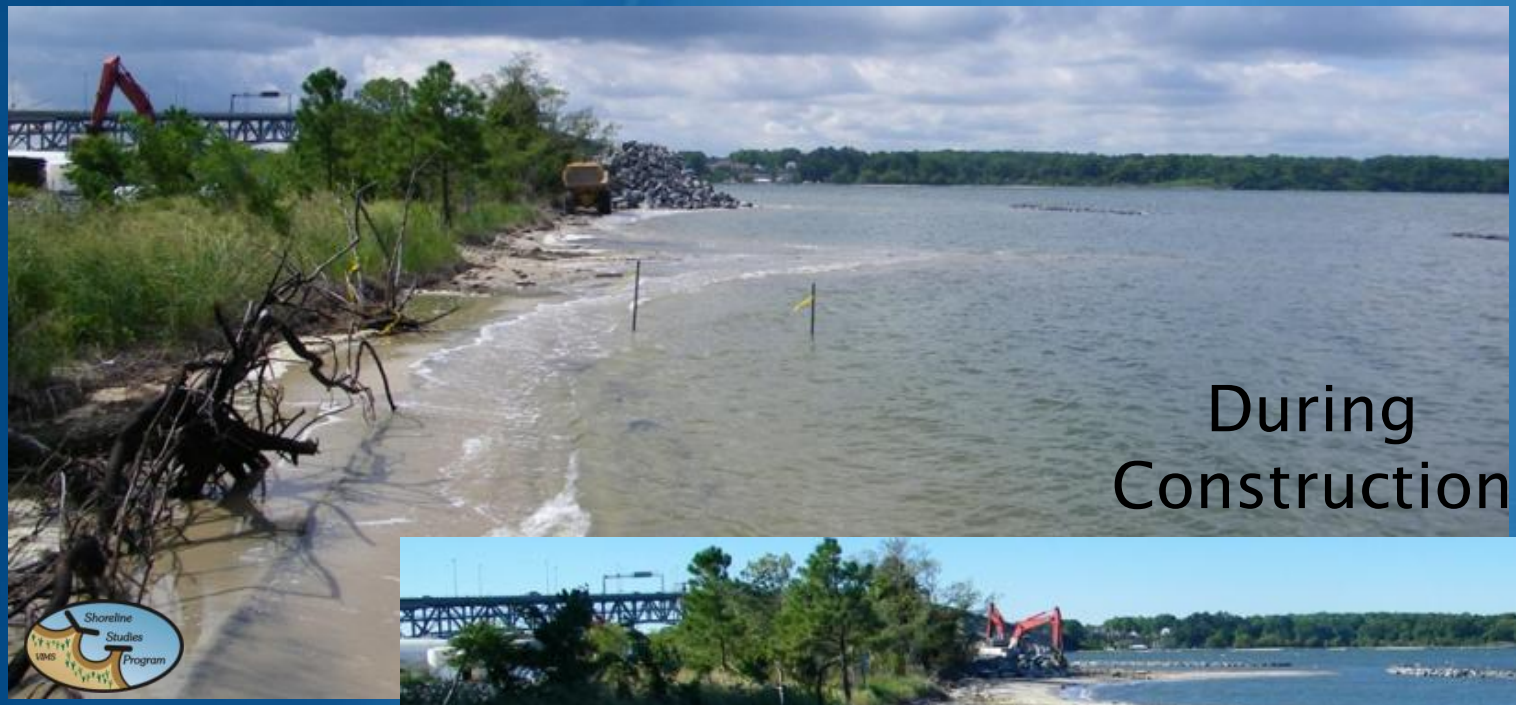
Feb 2013

VIMS West Shore

Pre-Construction

After Construction

VIMS West Shore



VIMS West Shore

After Construction

Jan 2012

Summary: Marshes

- As fetch exposure increases so does the marsh width and elevation needed to attenuate wave action.

- At some point (> 0.5 nm fetch) a sill may be needed for long term marsh fringe stabilization.

- Marshes can provide long term protection if properly maintained.

- A large data base of marsh sites exists around the Bay along with various brochures and reports to support the Living Shoreline concept.

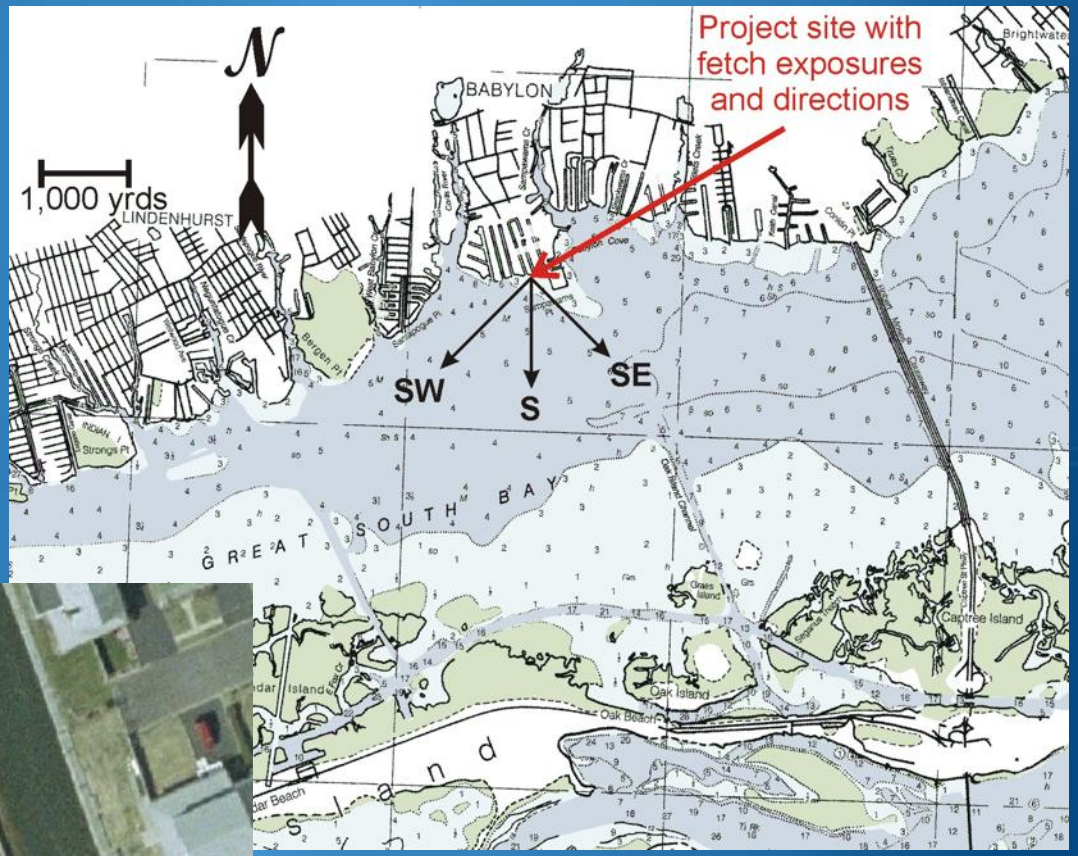
- This historical site data allows us to proclaim that shore erosion control can be achieved by creating ***Living Shorelines (i.e. marsh fringes).***

Summary: Beaches

- Beaches are generally more suitable for greater fetch exposures > 1 nm.

- In Chesapeake Bay, maintaining a stable, wide protective beach requires:
  - some type of breakwater (s),
  - ongoing beach nourishment
  - or some combination.

Dalton Point, New York



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Dalton Point, New York

Dalton Point, New York

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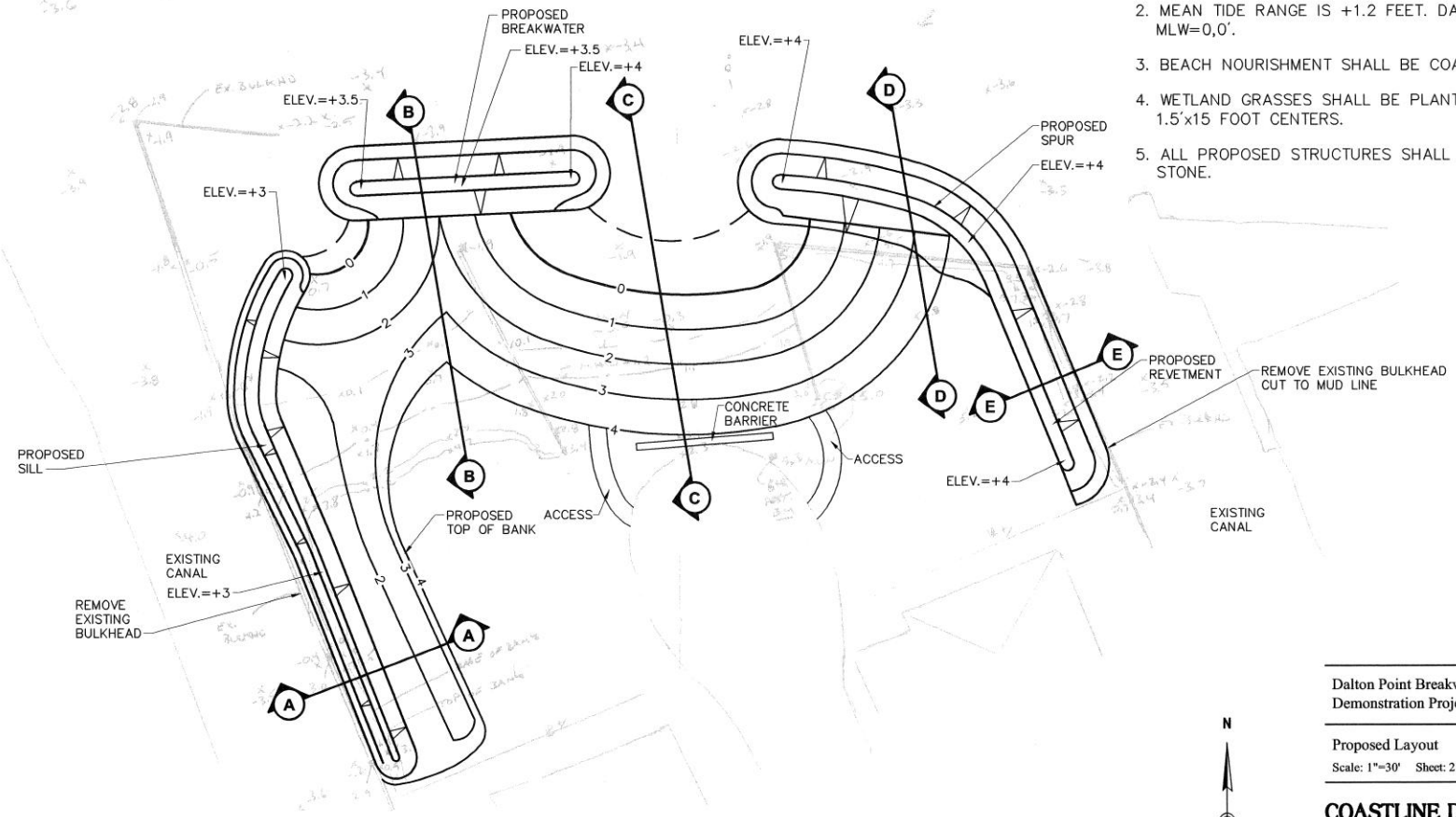


1. SURVEY PERFORMED ON 11/29.05 USING CLOSED LOOP. LOCAL HORIZONTAL CONTROL. VERTICAL CONTROL BASED ON WATER LEVEL AND TIME OF TIDE AT LINDENHERST TIDE GAUGE APPROX. 2 MILES WEST OF SITE.
2. MEAN TIDE RANGE IS +1.2 FEET. DATUM IS MLW=0,0'.
3. BEACH NOURISHMENT SHALL BE COARSE SAND.
4. WETLAND GRASSES SHALL BE PLANTED ON 1.5'x15 FOOT CENTERS.
5. ALL PROPOSED STRUCTURES SHALL BE GRANITE STONE.

Dalton Point Breakwater / Marsh Demonstration Project

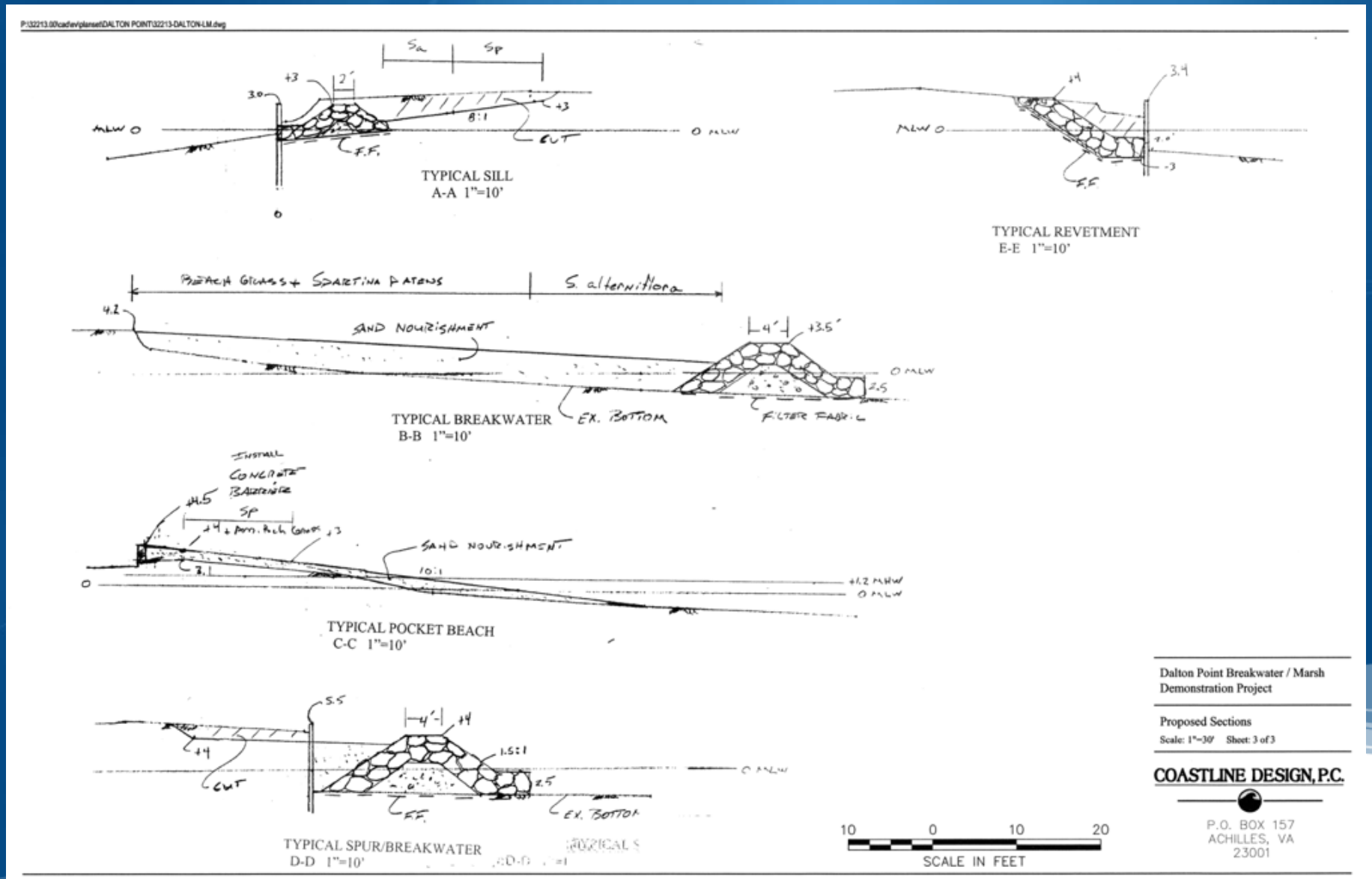
Proposed Layout

Scale: 1"=30' Sheet: 2 of 3

COASTLINE DESIGN, P.C.

P.O. BOX 157
ACHILLES, VA
23001

Dalton Point, New York




THE END

St. Mary's City
Cobble in window to reduce scour

November 2006

VIMS | William & Mary
Virginia Institute of Marine Science

St. Mary's Sill
Small granite revetment in window

November 2006

VIMS | William & Mary
Virginia Institute of Marine Science