DEQ: Partners Workshop 12.8.10

- Shore Programs Projects: 2005 to 2010
- Shore Management
  - Dunes: Sands of the Chesapeake
  - Guidance for localities
- Shore Evolution
  - Newport News, York, Gloucester, Mathews
  - Portsmouth, Suffolk, Isle of Wight, James City
  - Surry, King George, Prince William, Richmond
- Living Shorelines
  - Site Survey and Water Quality Assessment of Better Sill Design
  - Sill Performance and Encroachment
  - Living Shoreline Design and Construction Guidance Manual
  - Design and Construction of Living Shorelines: Course Development and Implementation

A Guide to Shoreline Management Planning For Virginia's Coastal Localities

Shoreline Studies Program
Virginia Institute of Marine Science

William & Mary
VIMS
Virginia Institute of Marine Science
School of Marine Science

Shoreline Studies Program
VIMS

NOAA
National Oceanic and Atmospheric Administration
U.S. Department of Commerce
Virginia Coastal Zone Management Program

Why do Localities need a Plan?

- It is a means for regulators and landowners to make informed shoreline management decisions.
- Everyone in the county wins when water quality is enhanced, and the health of coastal waters is improved.
- A Shoreline Management Plan (SMP) is an effective component of a locality's comprehensive plan.
- The plans, based on science and field visits, can serve as an example of best available technical advice when dealing with permitting agencies.

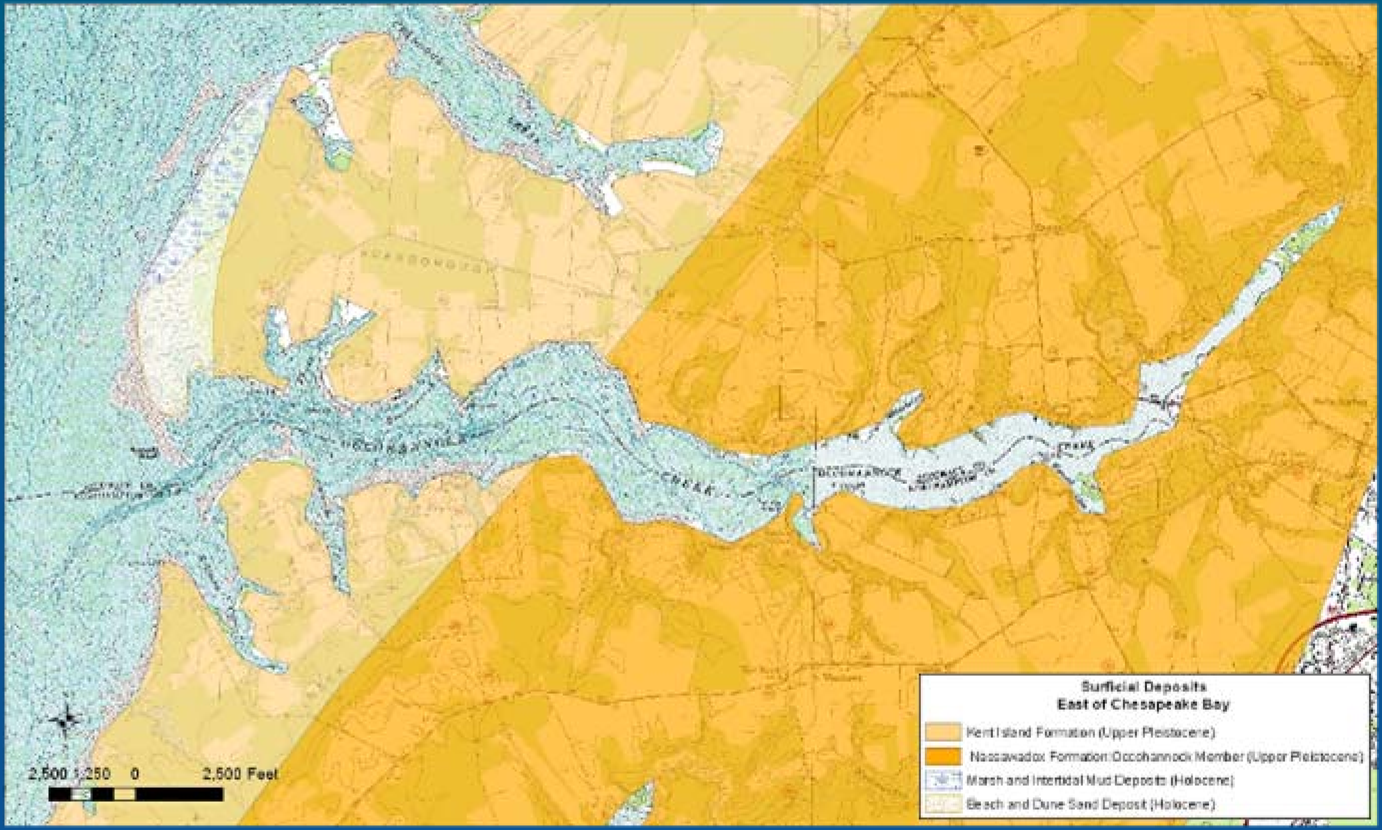
In the absence of guidance, homeowners may use a variety of techniques that are both visually unappealing and often unsuccessful at long-term erosion control.

Elements in the Shoreline Management Plan

- Describe underlying geology and morphology
- Quantify historic and recent shoreline change with maps showing digitized shorelines of the past and present
- Map existing structures and current bank and shore condition
- Assess existing marine resources within the shorezone
- Analyze the general wave climate, storm surge and long-term sea level rise in order to assess the level of protection required and associated costs
- Development of site-specific shore management strategies

Geology and Morphology

Understanding the geology and morphology (shape) of the shore will determine what type of sediment is available and how the shore responds through time to the forces acting on it.



At Occohannock Creek on the Eastern Shore, the geology changes mid way up the creek from a low bank (yellow) to a high bank (orange). Bank height is a parameter in determining what strategies can be used for shore protection.

Shoreline Evolution

Existing Conditions

Stable Shore

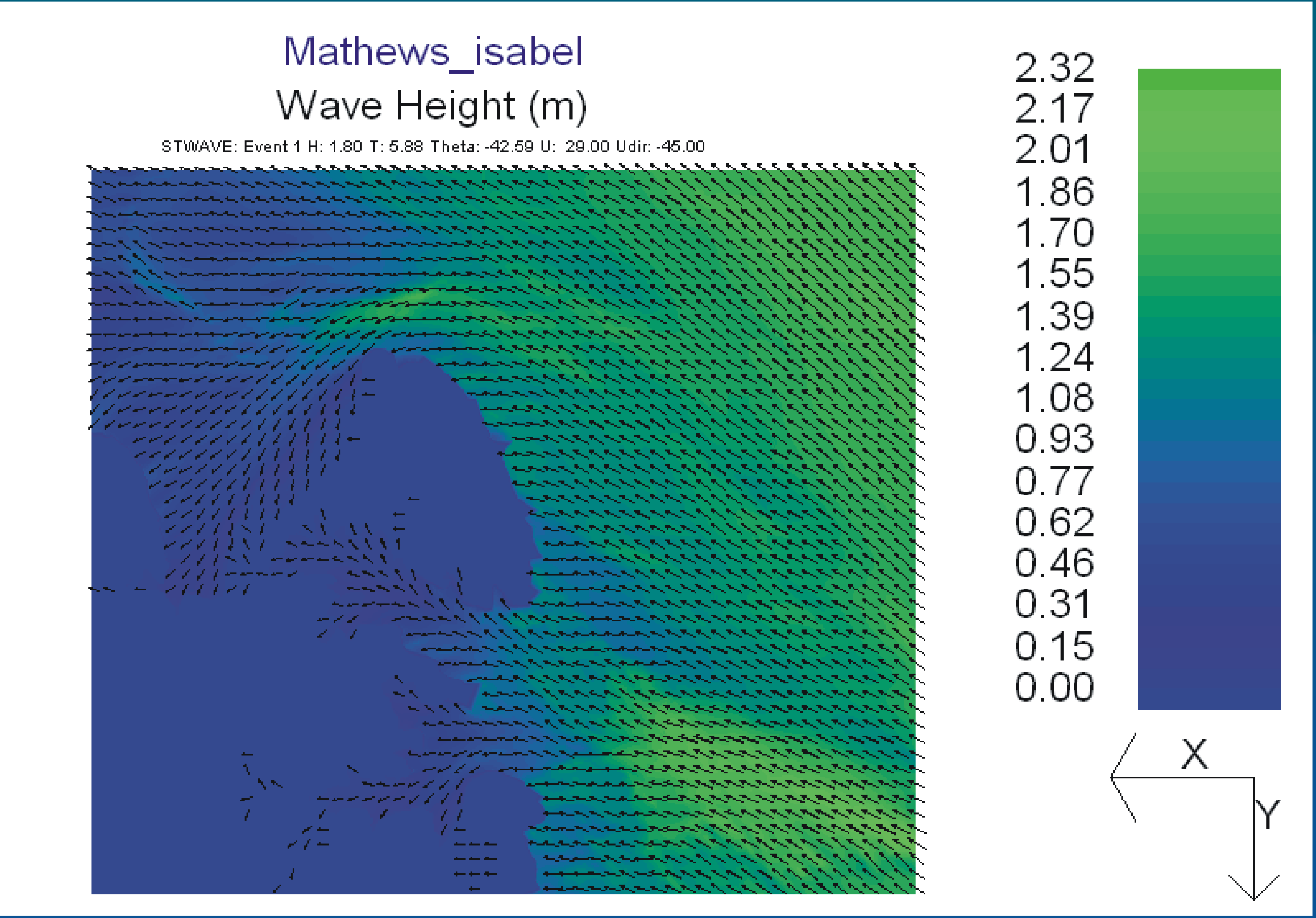
Existing Conditions

Transitional
Shore

Existing Conditions

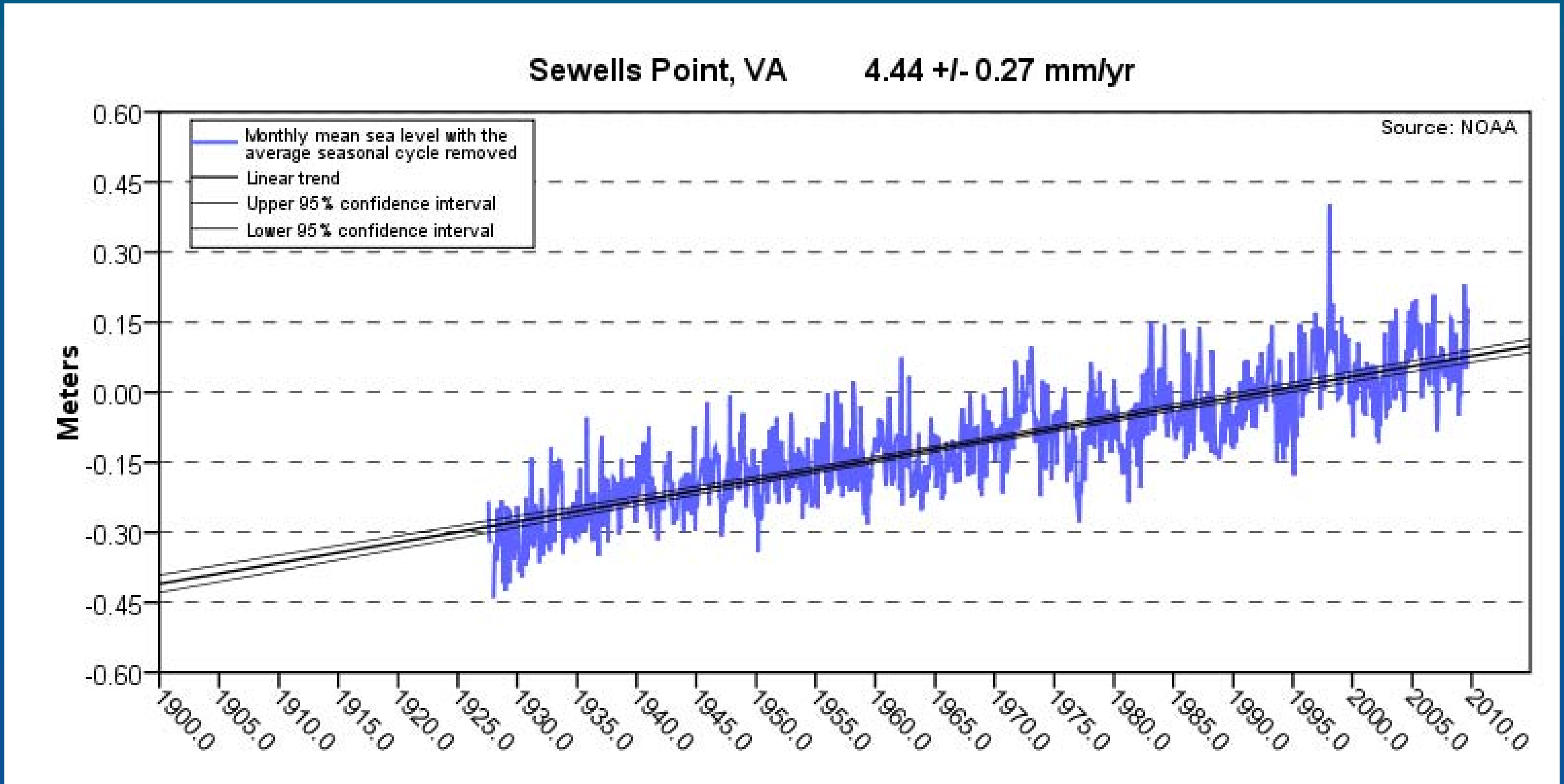
Erosional Shore

Wave Climate



Sea Level Rise

Sea Level is rising in Lower Chesapeake Bay at a rate of 17 inches per century. The change in sea level over the life of proposed structures relates to the level of protection that a property owners wishes to provide for their shore now and in the future.



Site-Specific Recommendations

- Do Nothing
- Marsh Management (Trim trees and/or plant existing bottom with marsh plants)
- Sills
- Breakwaters

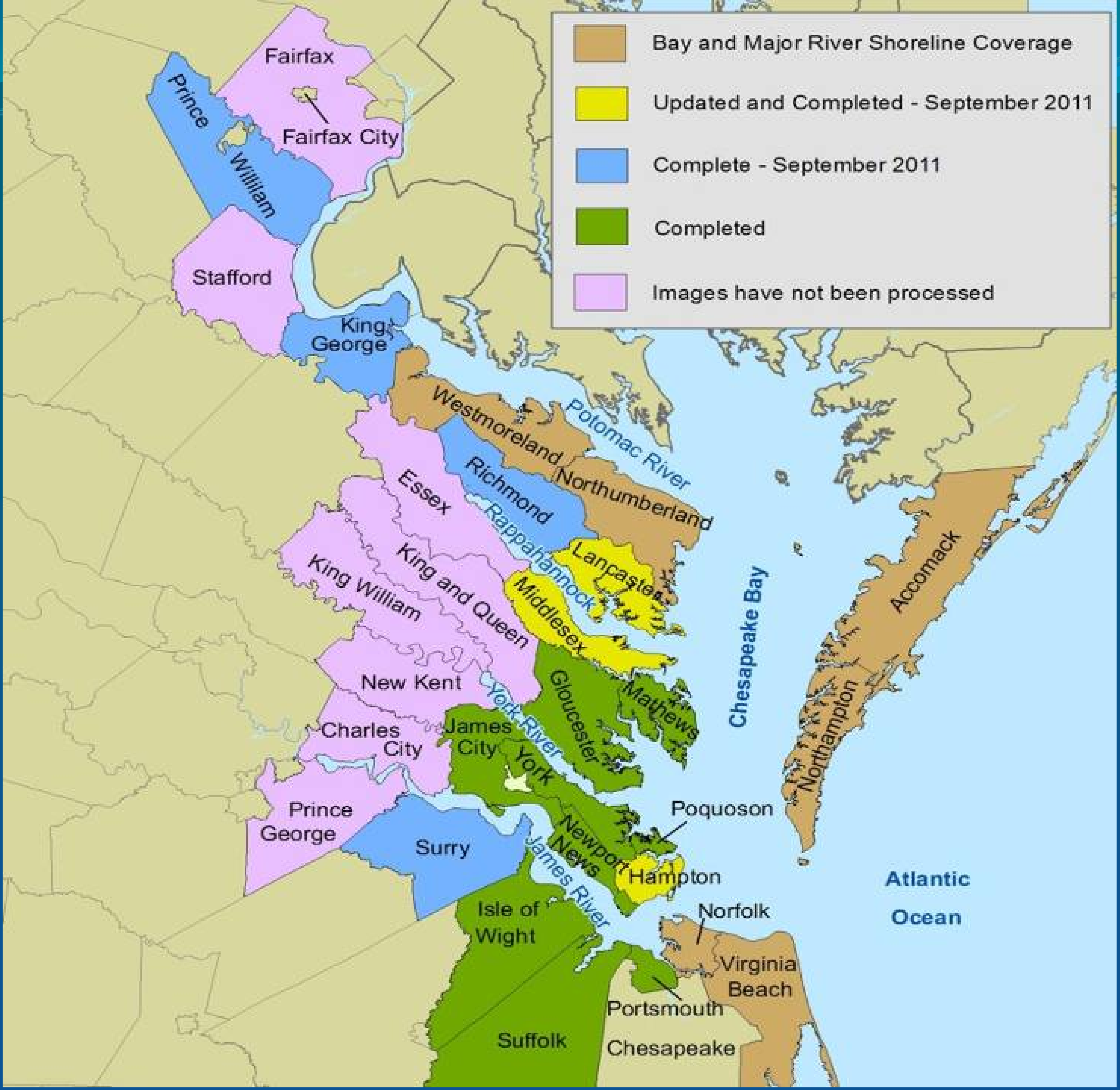
An eroding shoreline was enhanced with a small low sill.

A stone sill provides long-term protection for the marsh fringe, stabilizes the system, and interfaces with the upland riparian wooded buffer.

Breakwaters with beach sand fill are appropriate for longer stretches of shoreline with higher energy impacting them.

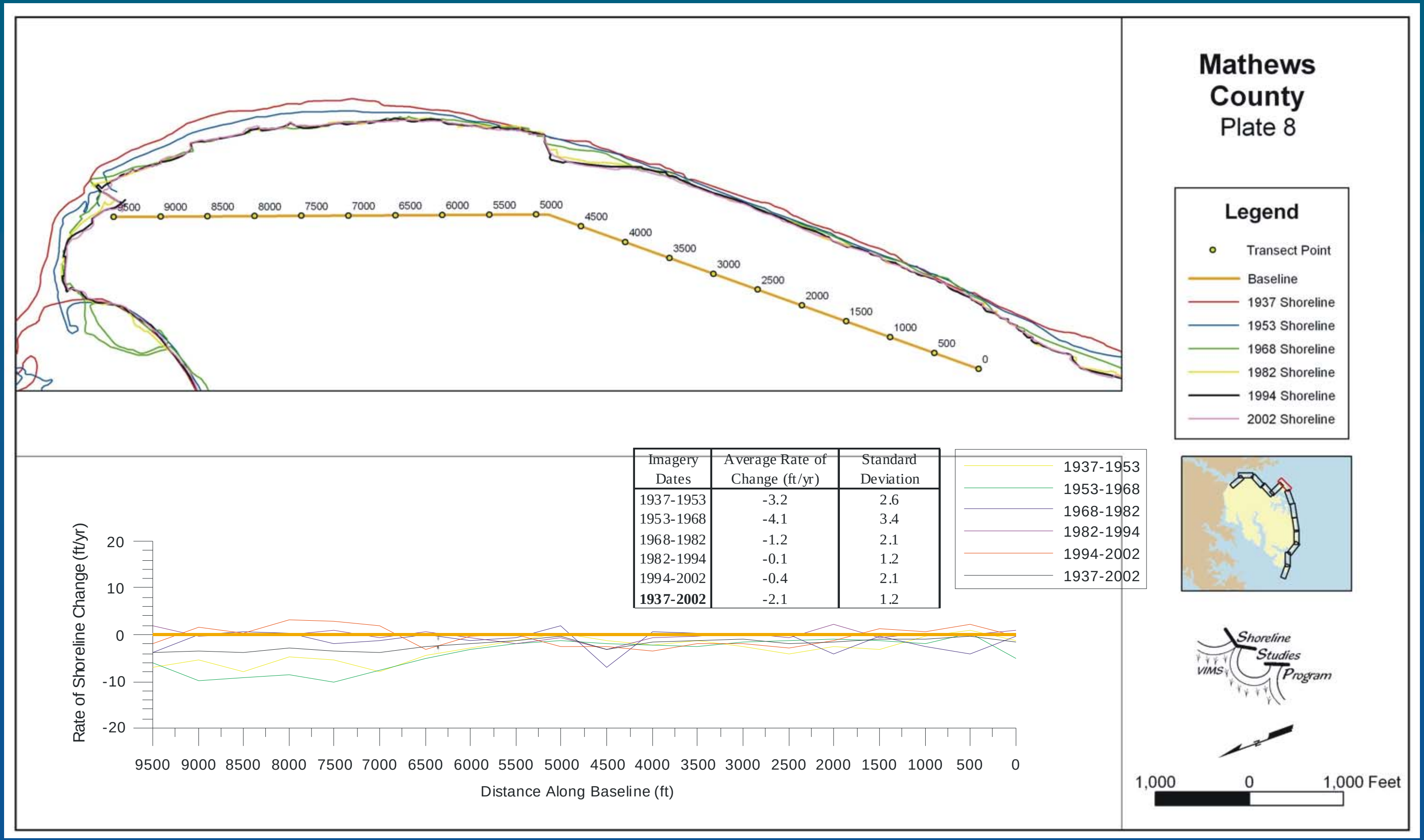
Shore Evolution Localities

- Dune Project Localities (analysis with straight baselines): Accomack, Hampton, Lancaster, Middlesex, Northampton, Northumberland, Norfolk, Westmoreland, Virginia Beach
- Shore Evolution 2008(analysis with DSAS and linear regression): Gloucester, York, Poquoson, Newport News
- Shore Evolution 2009(analysis with DSAS without LR): Portsmouth, Suffolk, Isle of Wight, James City



Bay and Major River Shoreline Coverage
Updated and Completed - September 2011
Complete - September 2011
Completed
Images have not been processed
Fairfax
Fairfax City
Prince William
Stafford
King George
Westmoreland
Potomac River
Richmond
Northumberland
Essex
Rappahannock
Lancaster
King and Queen
King William
Middlesex
Chesapeake Bay
Accomack
Northampton
New Kent
York River
Gloucester
Mathews
Charles City
James City
York
Poquoson
Prince George
Surry
Newport News
Hampton
James River
Atlantic Ocean
Isle of Wight
Norfolk
Virginia Beach
Portsmouth
Suffolk
Chesapeake

Early series with long baselines



Imagery Dates	Average Rate of Change (ft/yr)	Standard Deviation
1937-1953	-3.2	2.6
1953-1968	-4.1	3.4
1968-1982	-1.2	2.1
1982-1994	-0.1	1.2
1994-2002	-0.4	2.1
1937-2002	-2.1	1.2

Digital Shoreline Analysis System (USGS)

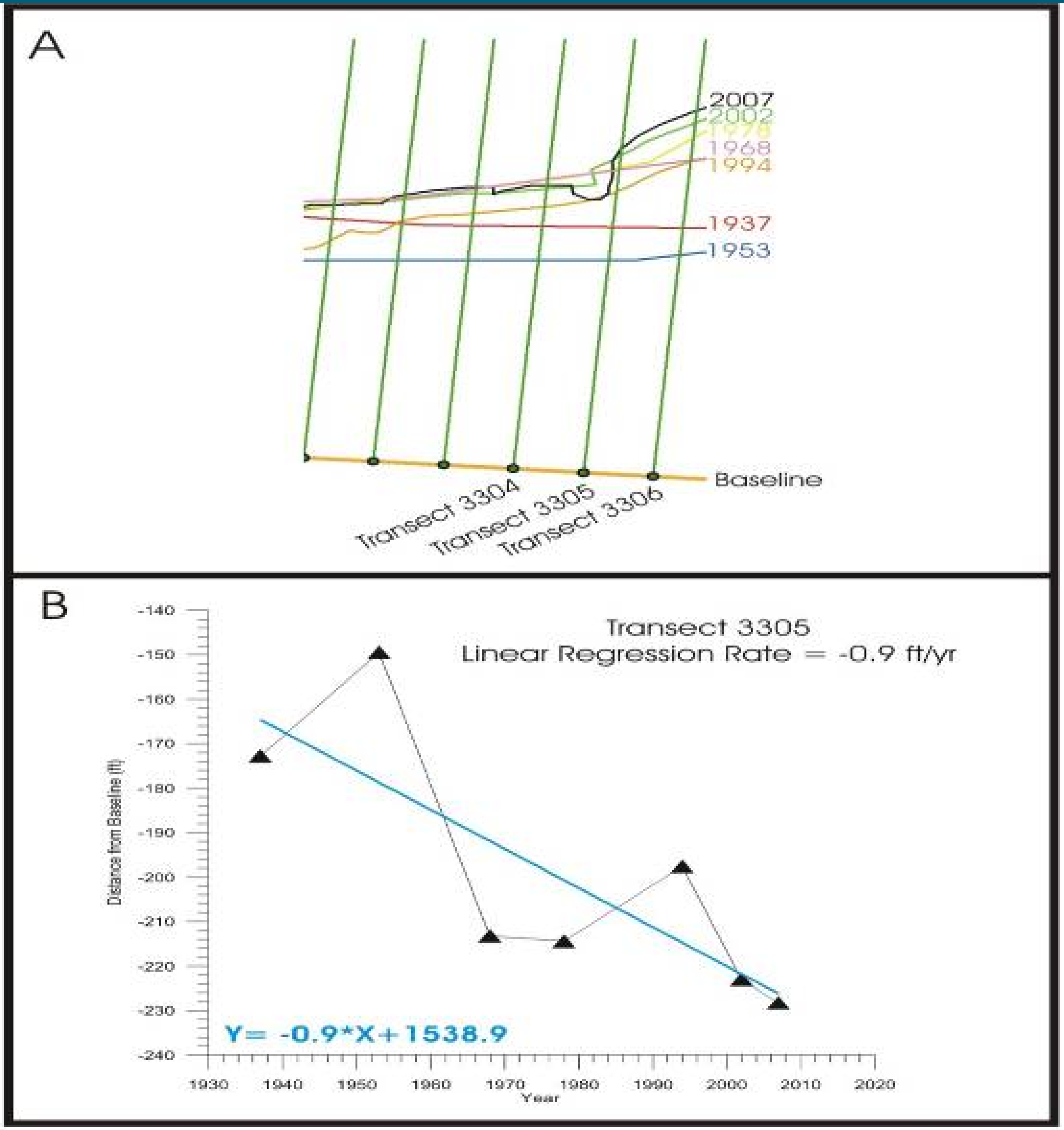
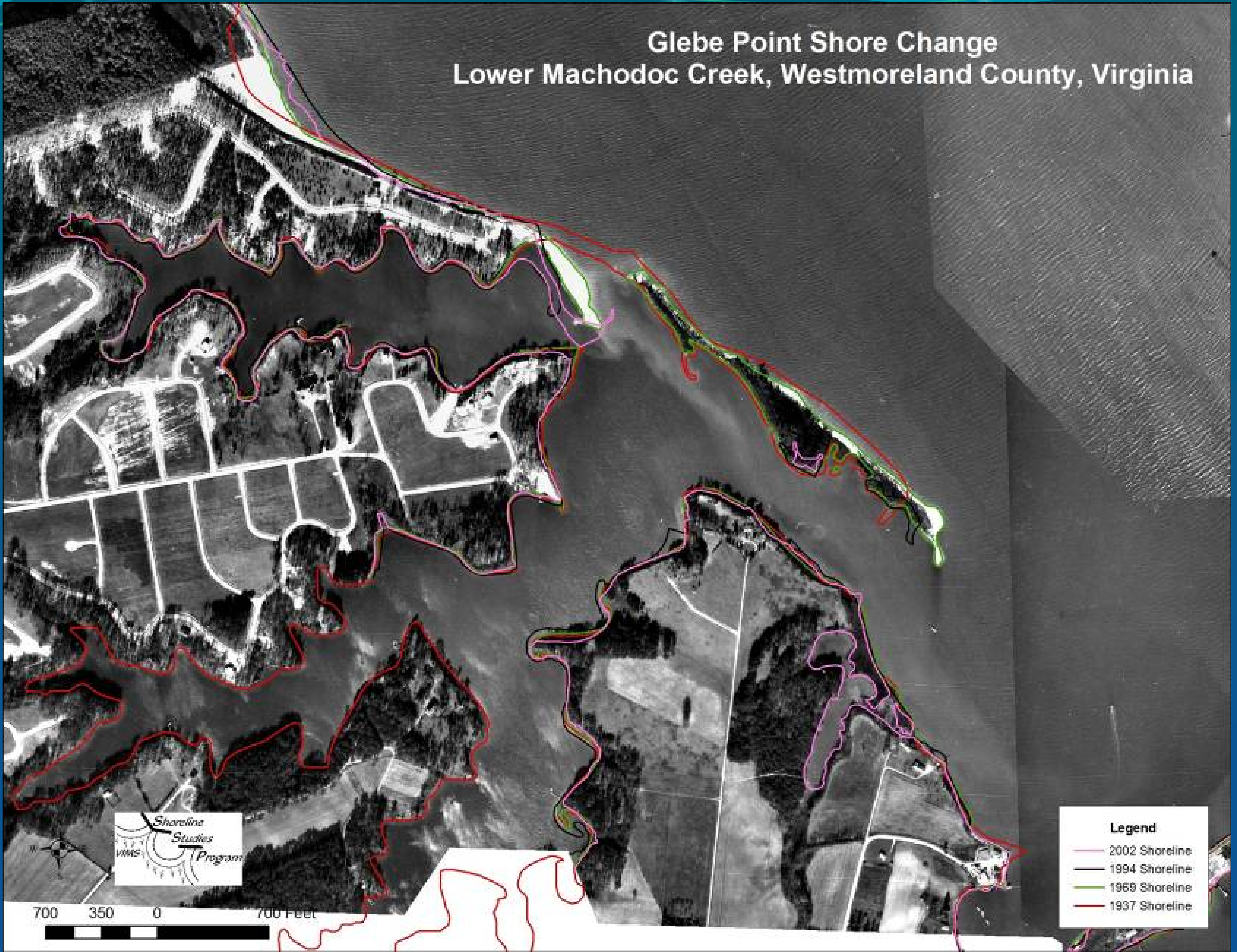


Figure 4. Graphics depicting A) sample DSAS baseline, transects and measured shorelinelines, and B) how the measured shoreline data is analyzed in a linear regression.

Later series with DSAS

Glebe Point Shore Change
Lower Machodoc Creek, Westmoreland County, Virginia
Legend
2002 Shoreline
1994 Shoreline
1969 Shoreline
1937 Shoreline
Shoreline Studies Program
VIMS
700 350 0
W E S


Glebe Point Shore Change
Lower Machodoc Creek, Westmoreland County, Virginia
Shoreline Studies Program
VIMS
700 350 0 700 Feet
Legend
2002 Shoreline
1994 Shoreline
1969 Shoreline
1937 Shoreline


Glebe Point Shore Change
Lower Machodoc Creek, Westmoreland County, Virginia
Shoreline
Studies
Program
VIMS
700
350
0
Legend
2002 Shoreline
1994 Shoreline
1969 Shoreline
1937 Shoreline


Glebe Point Shore Change
Lower Machodoc Creek, Westmoreland County, Virginia
Legend
2002 Shoreline
1994 Shoreline
1969 Shoreline
1937 Shoreline
Shoreline Studies Program
VIMS
700 350 0 700 Feet

Design and Construction of Living Shorelines

A course for living shorelines professionals

September 29, 2010

This course made possible by a grant from the
Virginia Coastal Zone Management Program
NOAA

Living Shorelines Principles

- Shore protection
  - Solving erosion problems
  - Least impacting, necessary method
- Sustaining ecosystem services
  - Water quality
  - Storm protection
  - Habitat

Integrated Shoreline Management

Riparian Buffer

+

Tidal Wetlands

+

Shallow Water Habitat

= Combined Protection Benefits

Desktop or Map Parameters

Shoreline orientation

Fetch

Shore Morphology

Depth Offshore

Nearshore Morphology

Submerged Aquatic Vegetation (SAV)

Tide Range

Storm Surge

Erosion Rate

Design Wave

Site Visit Parameters

- Site boundaries
- Site characteristics
- RPA Buffer

- Bank condition
- Bank height
- Bank composition

- Shore zone
  - width and elevation
- Backshore zone
  - width and elevation
- Existing shoreline defense structures

- Nearshore stability
- Boat wake potential

Mean Tide Ranges in feet

Polygons interpolated from NOAA data points

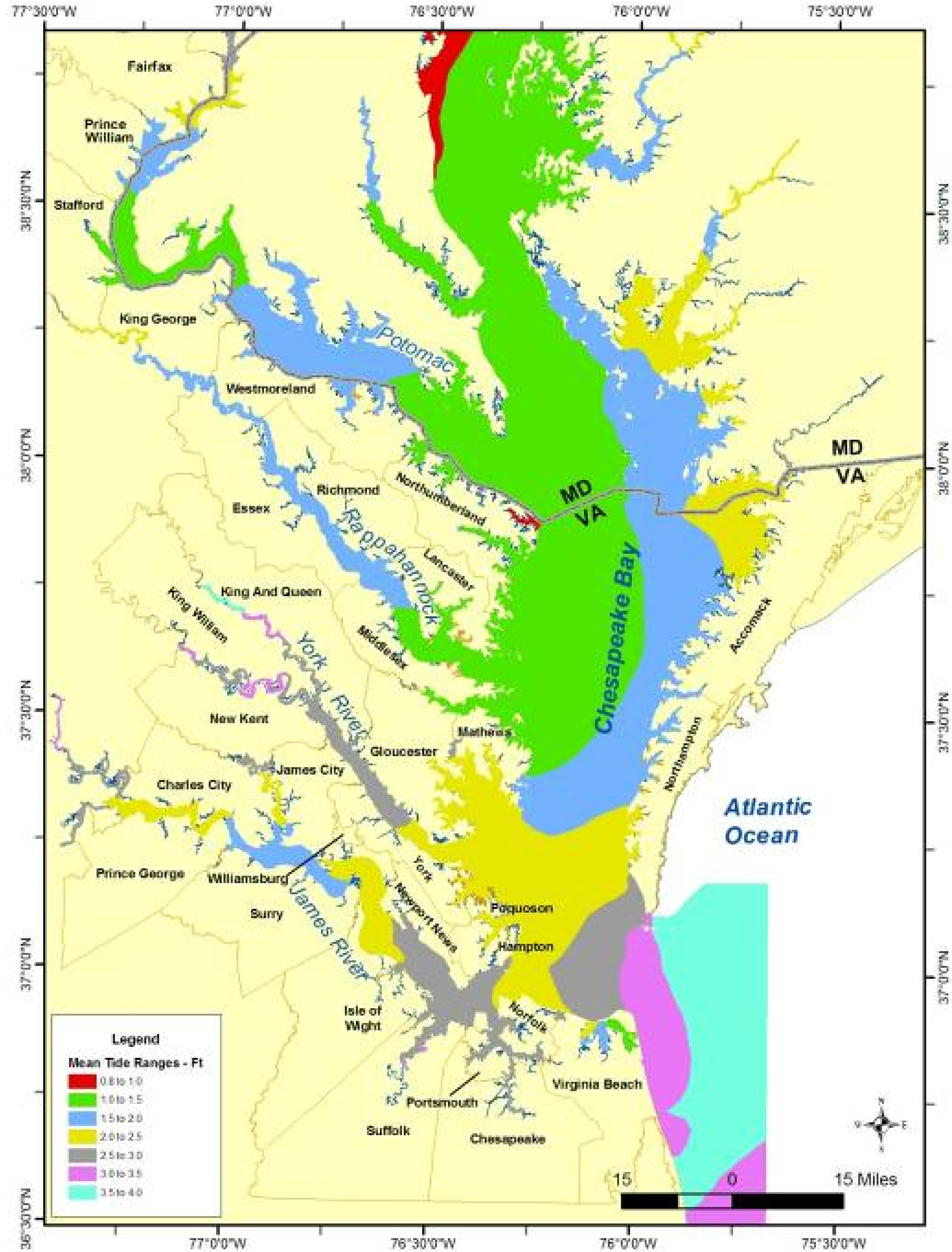


Figure 1-3, pp. 46

Spring Tide or Great Diurnal Tide Ranges in feet

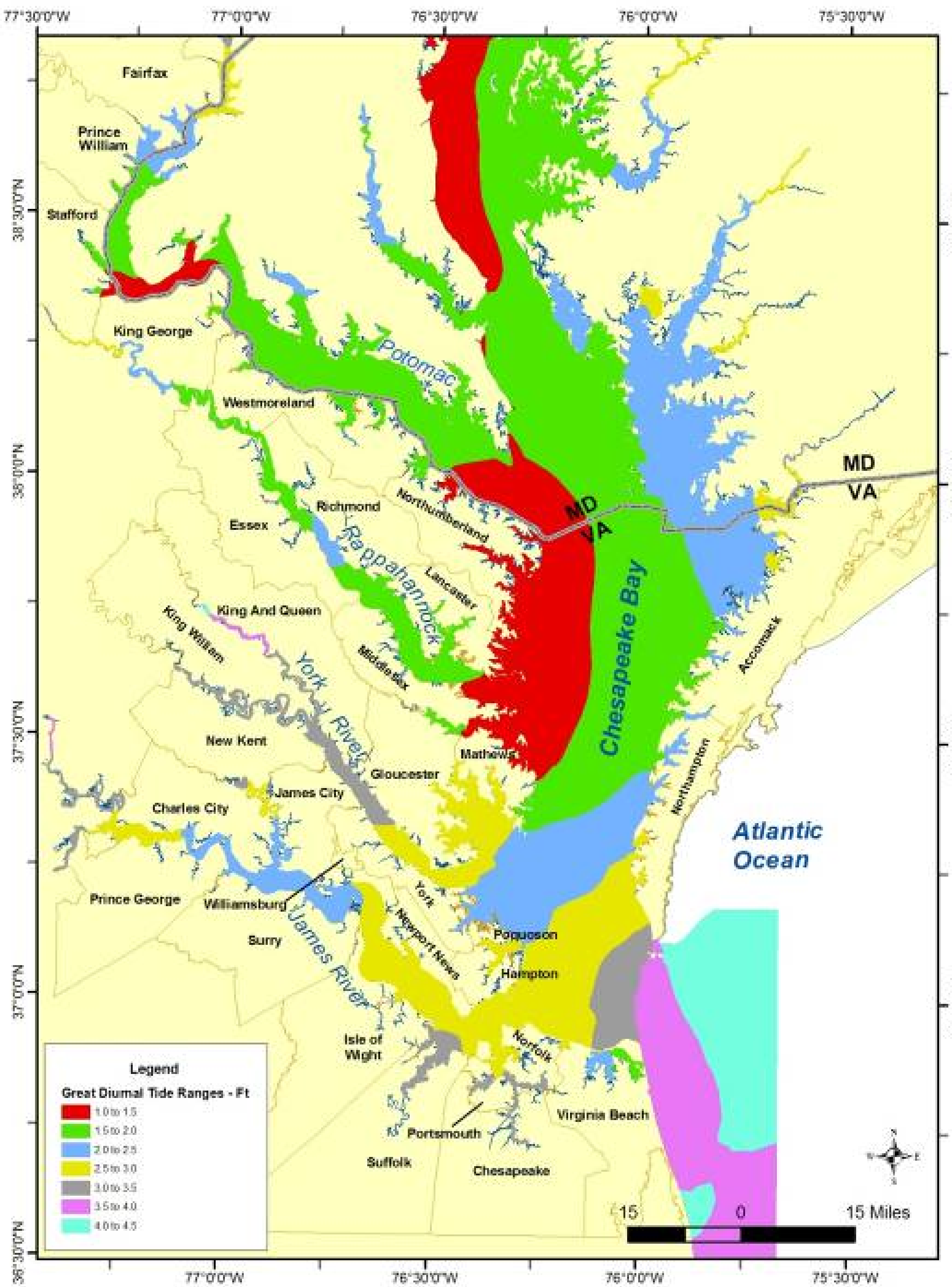


Figure 1-4, pp. 47

Marsh Planting and Management

- Non-structural approach
- Very low fetch <0.5 mile
- Planting at grade or into sand fill
- Fiber logs
- Tree pruning

If marsh will not persist without fiber logs, then consider marsh sill

Marsh Sill

- Stone revetment placed near MLW
- Backfilled with sand
- Planted with tidal wetland vegetation

Stone

Sand

Plants

All 3 elements usually required for sustainable design

Marsh Toe Revetment

- Sill placed next to an existing wide marsh
- Maintain desirable marsh ecosystem services
- Natural accretion depends on local sediment supply
- Can also spot fill and plant to fill in non-vegetated areas

Tidal Openings
When should they be included?

- Site-specific
  - Tidal ponds
  - Natural or created channels
  - Open ends
  - Recreation access
- Sill crest height > MHW
- Sill length > 100 Ft
  - No definitive standard
  - May need more or less

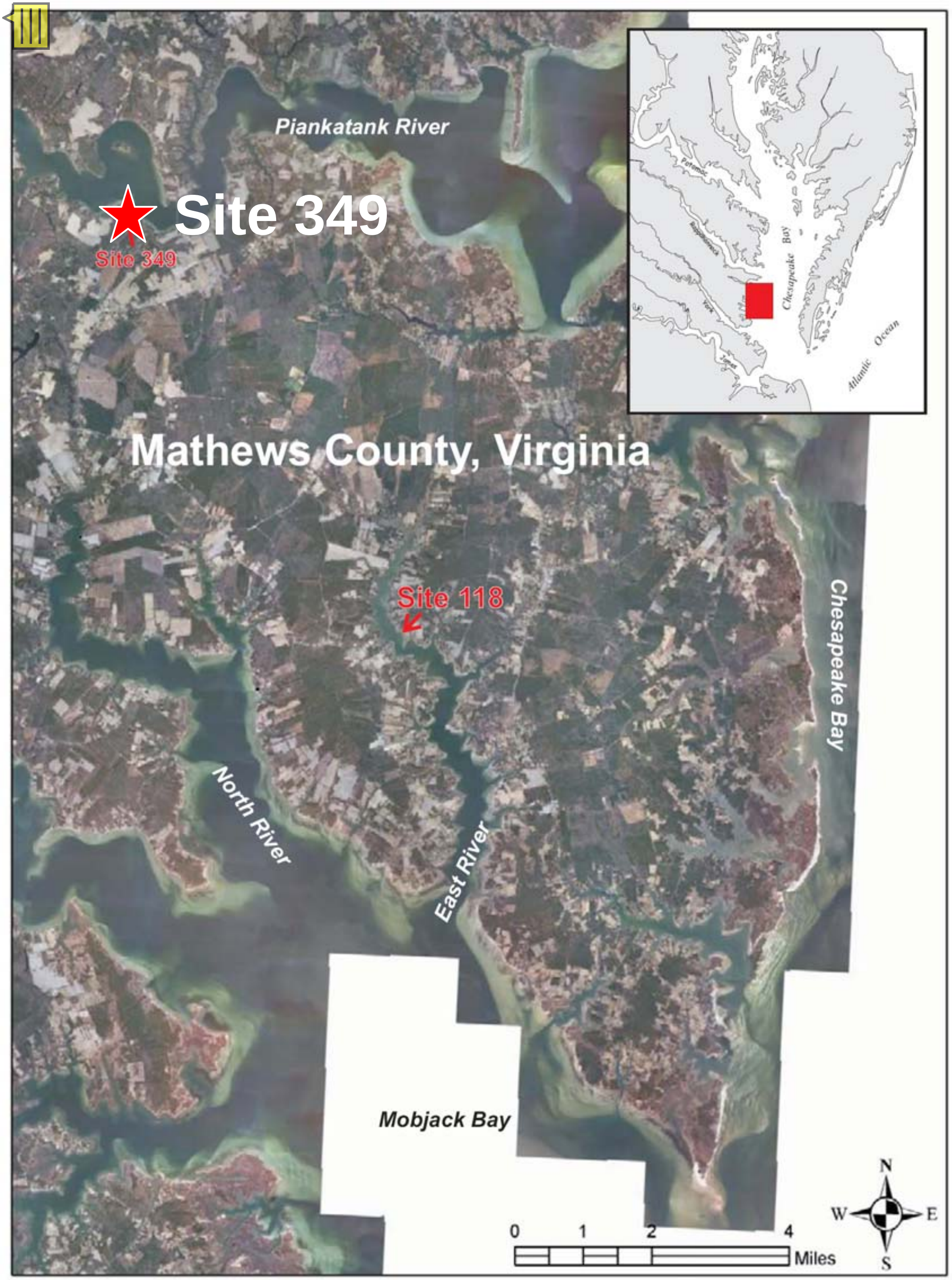
Tidal openings allow access for marine wildlife, but they also introduce wave energy into the planted marsh.

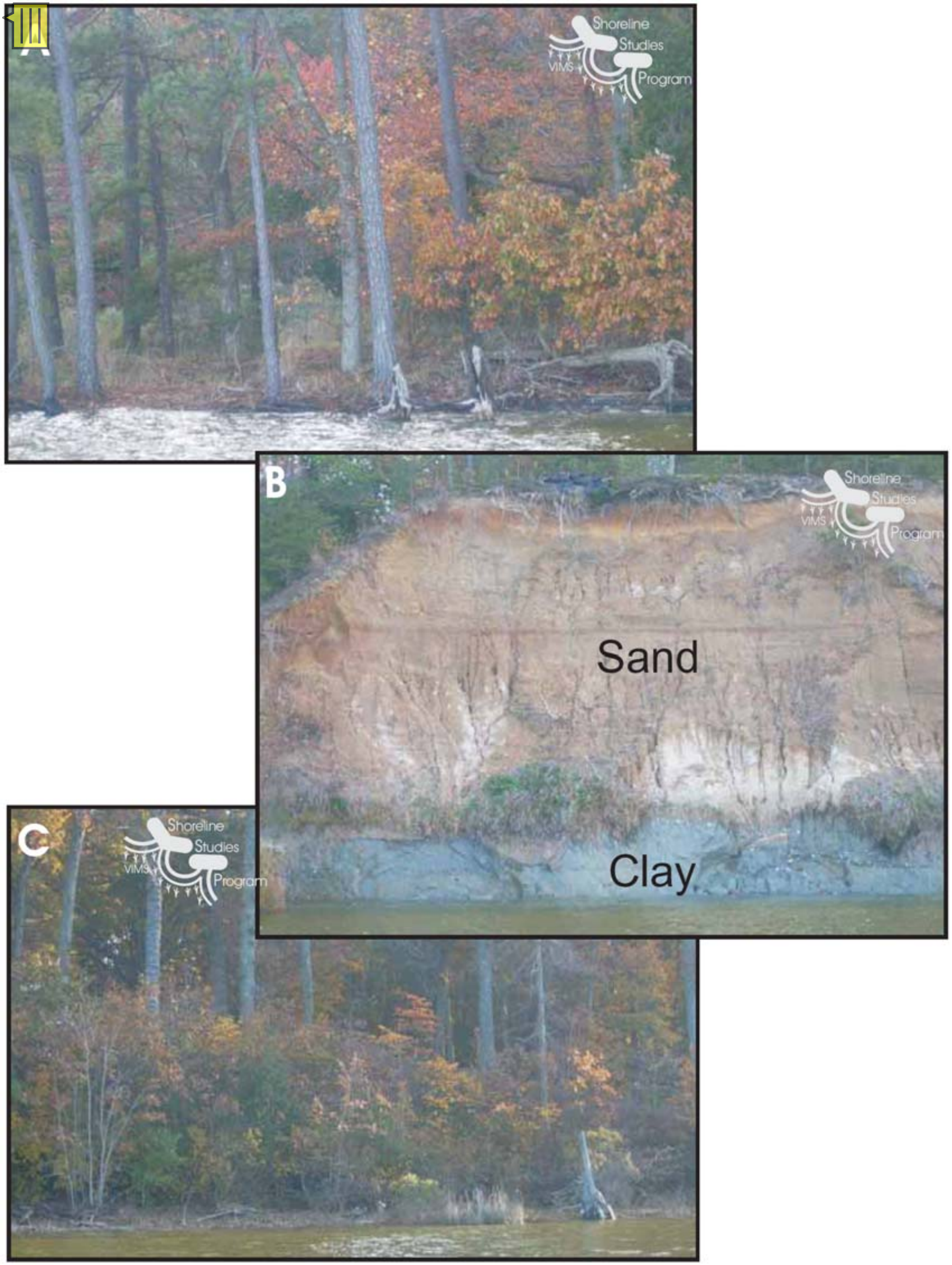
Stable embayments eventually form

Offshore Breakwaters

- Most appropriate for high energy sand beach sites
- Create stable pocket beaches between fixed headlands
  - At least 2 units
- Proper design requires advanced knowledge of coastal processes at site

Location of example





Site 349 existing conditions

Example Site Evaluation worksheet for Site 349

Site Evaluation

Site Name #349
Site Locality Mathews

Date July 2010
Body of Water Piankatank R.

Pre-Visit Parameters

Shore Orientation(s): N NE E SE S SW W (NW)

Site Length: 900 (ft)

Average Fetch(es):
Very High (> 15 miles) High (5-15 miles) Medium (1-5 miles)
(Low (0.5-1 miles)) Very Low (< 0.5 miles)

Longest Fetch: 3.5 miles to the WNW

Shore Morphology: Pocket (Straight) Headland Irregular

Depth Offshore: 250 ft min, 750 ft max

Nearshore Morphology: Bars no Tidal Flats no

Nearshore Aquatic Vegetation: none

Tide Range: 1.2 ft

Storm Surge: 10 yr 4.4 50 yr 5.9 100 yr 6.7 ft MLW

Erosion Rate: Very High Accretion (> +10 ft/yr) High Accretion (+10 to +5 ft/yr)
Medium Accretion (+5 to +2 ft/yr) Low Accretion (+2 to +1 ft/yr)
Very Low Accretion (+ 1 to 0 ft/yr) (Very Low Erosion (0 to -1 ft/yr)) — West End
East End — (Low Erosion (-1 to -2 ft/yr)) Medium Erosion (-2 to -5 ft/yr)
High Erosion (-5 to -10 ft/yr) Very High Erosion (<-10 ft/yr)

Design Wave: Height_____ Period_____

Notes:
* no actual field work took place.
This is an example.

Site Visit Parameters

Site Boundaries:
Creek boundary on right

Site Characteristics:
Upland Land Use
wood residential
Proximity to Infrastructure
160 ft to house
Cover
wooded

Bank Condition:

Bank Face- (Erosional) Stable Transitional Undercut
Bank of Bank (Erosional) Stable Transitional

Bank Height: 4 ft to 20 ft

Bank Composition: upper sand, lower clay

RPA Buffer:

Shore Zone: Sand ✓ Marsh_____

Width 15 ft

Elevation at bank ~2 ft MLW

Backshore Zone: Sand_____ Marsh_____

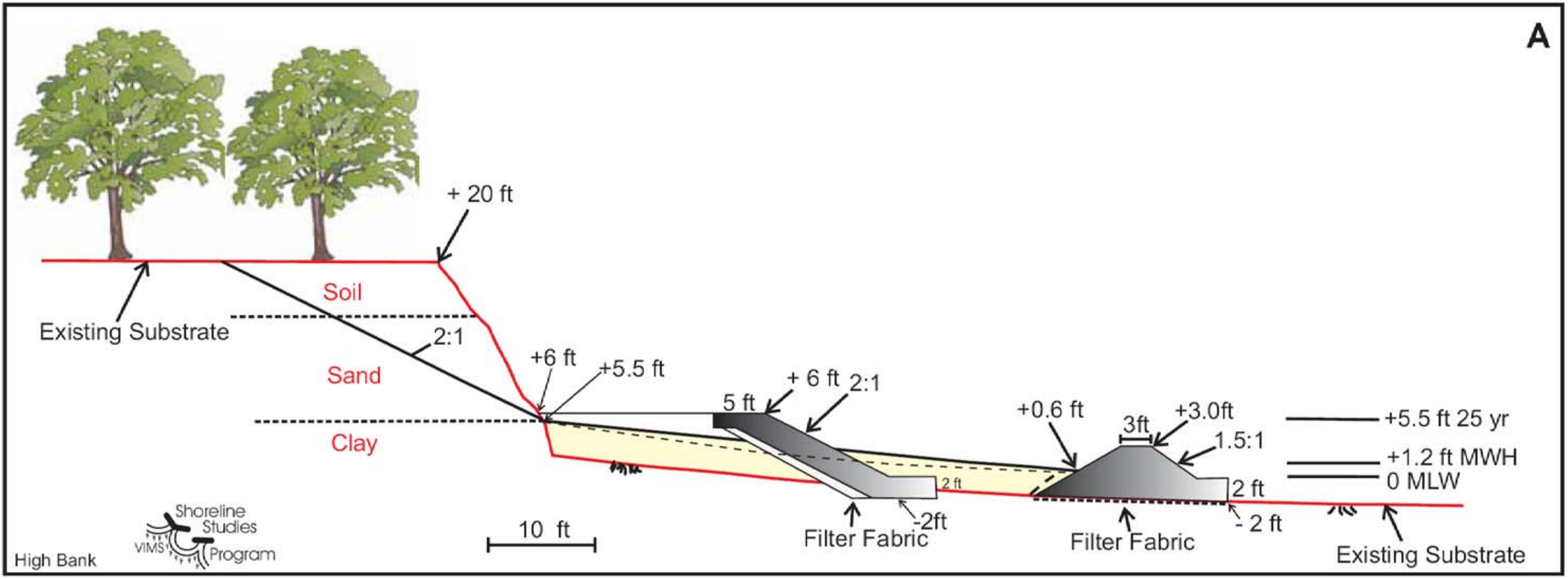
Width none

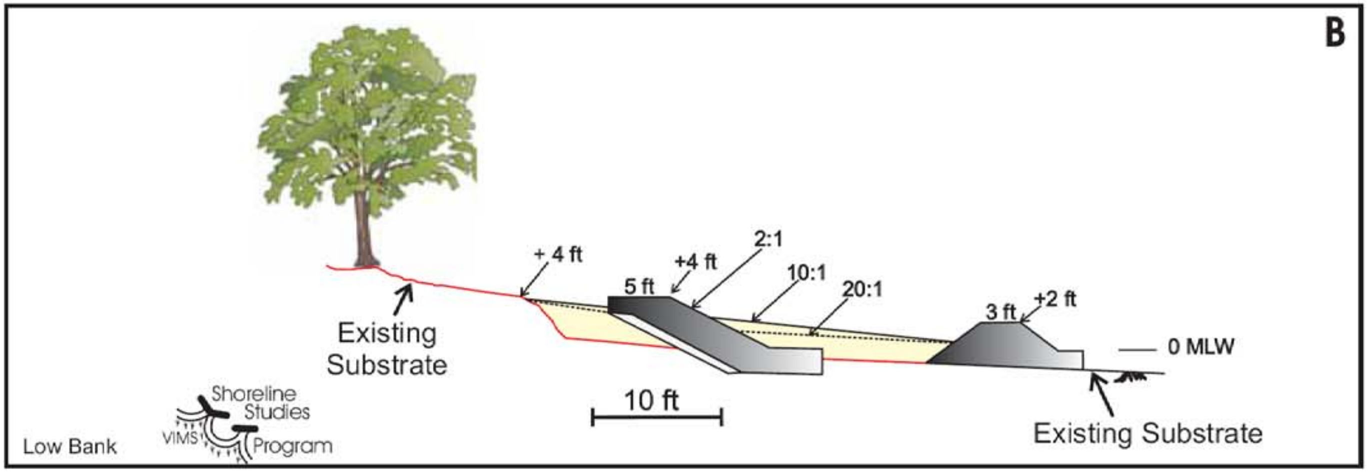
Elevation

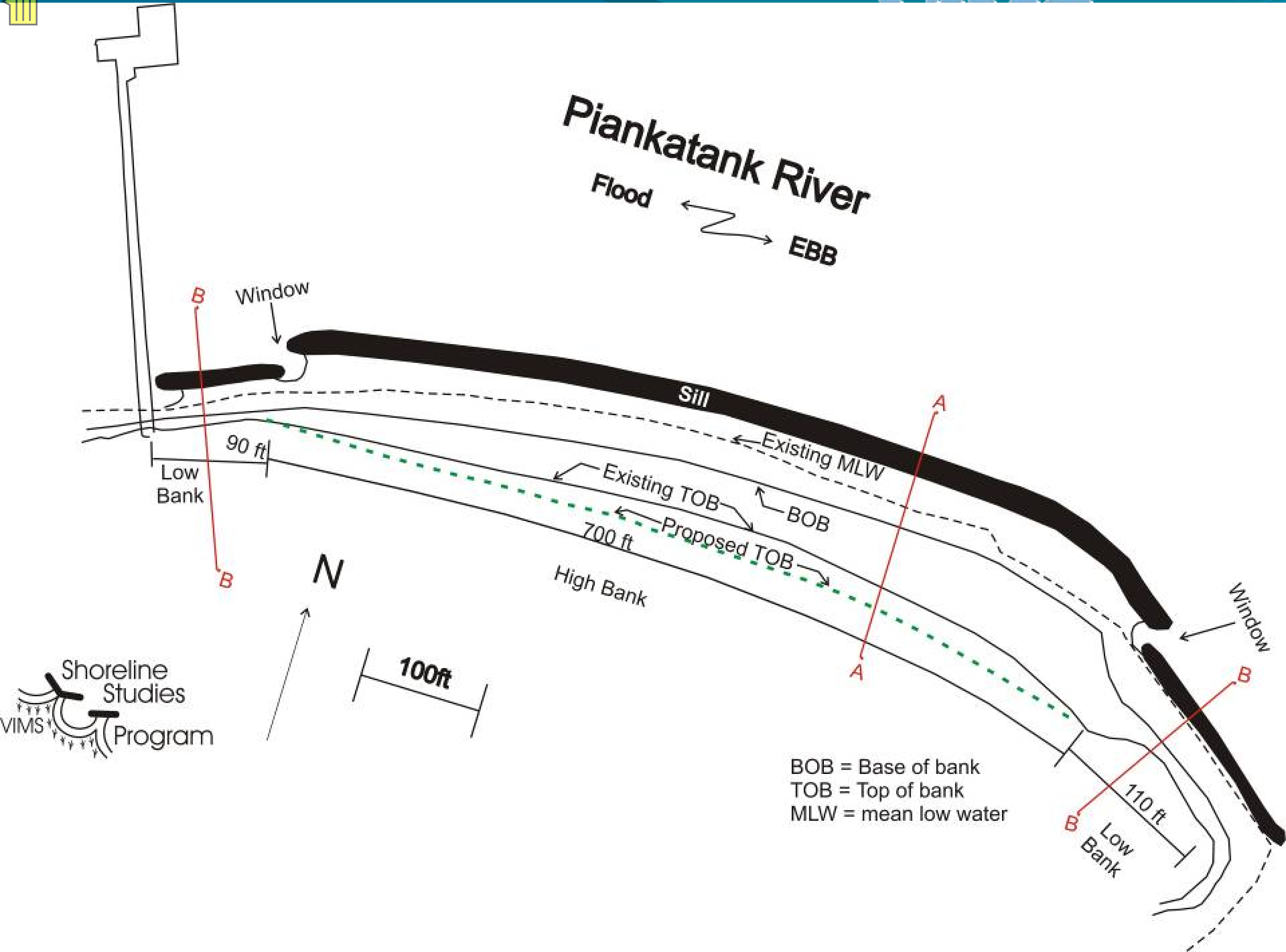
Boat Wakes:

Existing Shoreline Defensive Structures: no

Typical cross-sections for proposed structures






Piankatank River
Flood
EBB
Window
B
Sill
A
Existing MLW
Existing TOB
BOB
Proposed TOB
90 ft
Low
Bank
700 ft
High Bank
N
100ft
Window
110 ft
Low
Bank
BOB = Base of bank
TOB = Top of bank
MLW = mean low water
Shoreline
Studies
VIMS
Program

Estimated cost comparison

	Amount of Material (tons or cubic yards)	Cost per Ton	Cost per cubic yard	Cost per foot	Total Cost per foot*
High Bank					
Revetment					
Rock	3.7	$70		$259	**$309**
Sand	5		$10	$50	
Sill					
Rock	3.7	$70		$259	**$309**
Sand from Bank	5		$10	$50	
Low Bank					
Revetment					
Rock	2.8	$70		$196	**$236**
Subgrade with Sand from Bank	4		$10	$40	
Sill - Option 1					
Rock	2	$70		$140	**$169**
Sand from Bank	2.9		$10	$29	
Sill - Option 2					
Rock	2	$70		$140	**$242**
Sand from Offsite	2.9		$35	$102	

*Total cost only includes materials installed and does not include other costs such as plants, permitting, site work, access, or mitigation.

Reference Reports in Adobe PDF format:

Shoreline Evolution Reports: Locality based reports documenting how the shore zones evolved in the Chesapeake since 1937.

Mathews County Shoreline Management Plan: Examples of Management Strategies

Shoreline Mangement in the Chesapeake Bay: Management Strategies to significantly reduce shoreline erosion with cost-effective and environmentally acceptable methods.

Other Links :

CCRM Living Shoreline Information Web Page

Submerged Aquatic Vegetation (SAV): Interactive mapper monitoring data for SAV which serves as habitat, protection, and food for many aquatic animals.

FEMA Map Service Center: FEMA flood information, studies and maps

CCRM Permit Database: Example of Permits

Shoreline Assessment Mapper (SAM): A compilation of data useful for reviewing shoreline conditions.