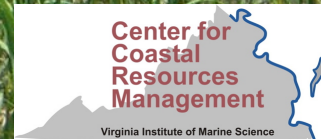


# VIMS Shoreline Management Model

**Karen Duhring & Karinna Nunez**  
**VIMS Center for Coastal Resources Management**

**December 14, 2021**

**CBP Joint Wetland Workgroup & Climate Resiliency Workgroup Meeting**



**Contact: [karend@vims.edu](mailto:karend@vims.edu)**



# Shoreline Management Model

Model Background

Inputs & Outputs

Advantages & Limitations

Products & Applications





# Shoreline Management Model Purpose & Intent

1. Provide living shoreline site suitability assessment
2. Generate shoreline management best practice recommendations

For natural & currently defended shorelines with determined problems



*Upland Bank Erosion*



*Marsh Edge Erosion*



*Failing Defense Structures*

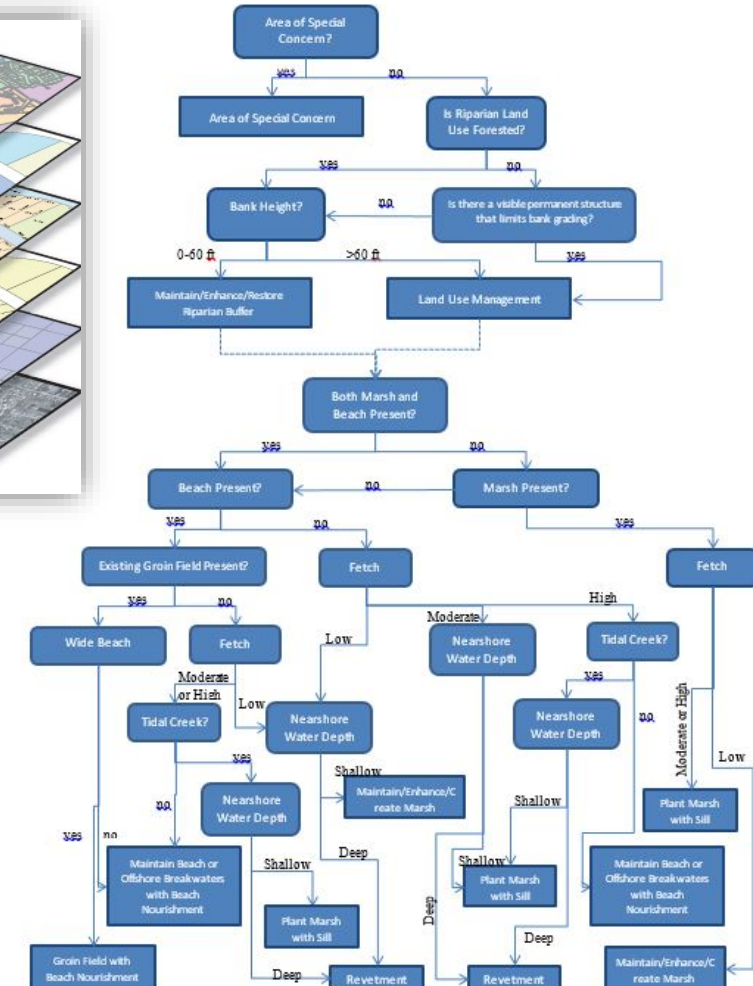


# Shoreline Management Model Purpose & Intent

## Shoreline Expert Best Professional Judgment



## Automated ArcGIS Model

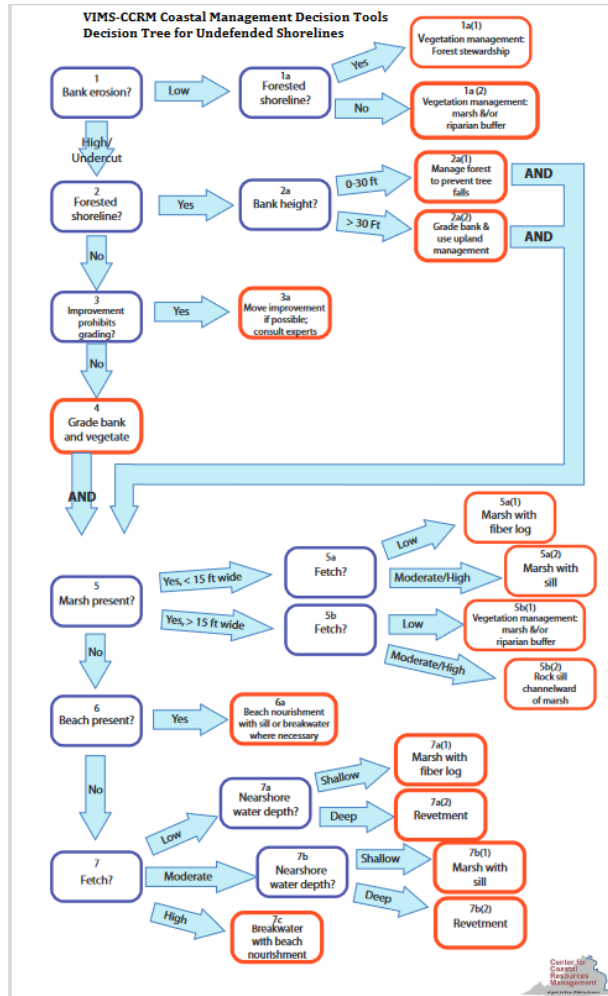


Collective scientific knowledge

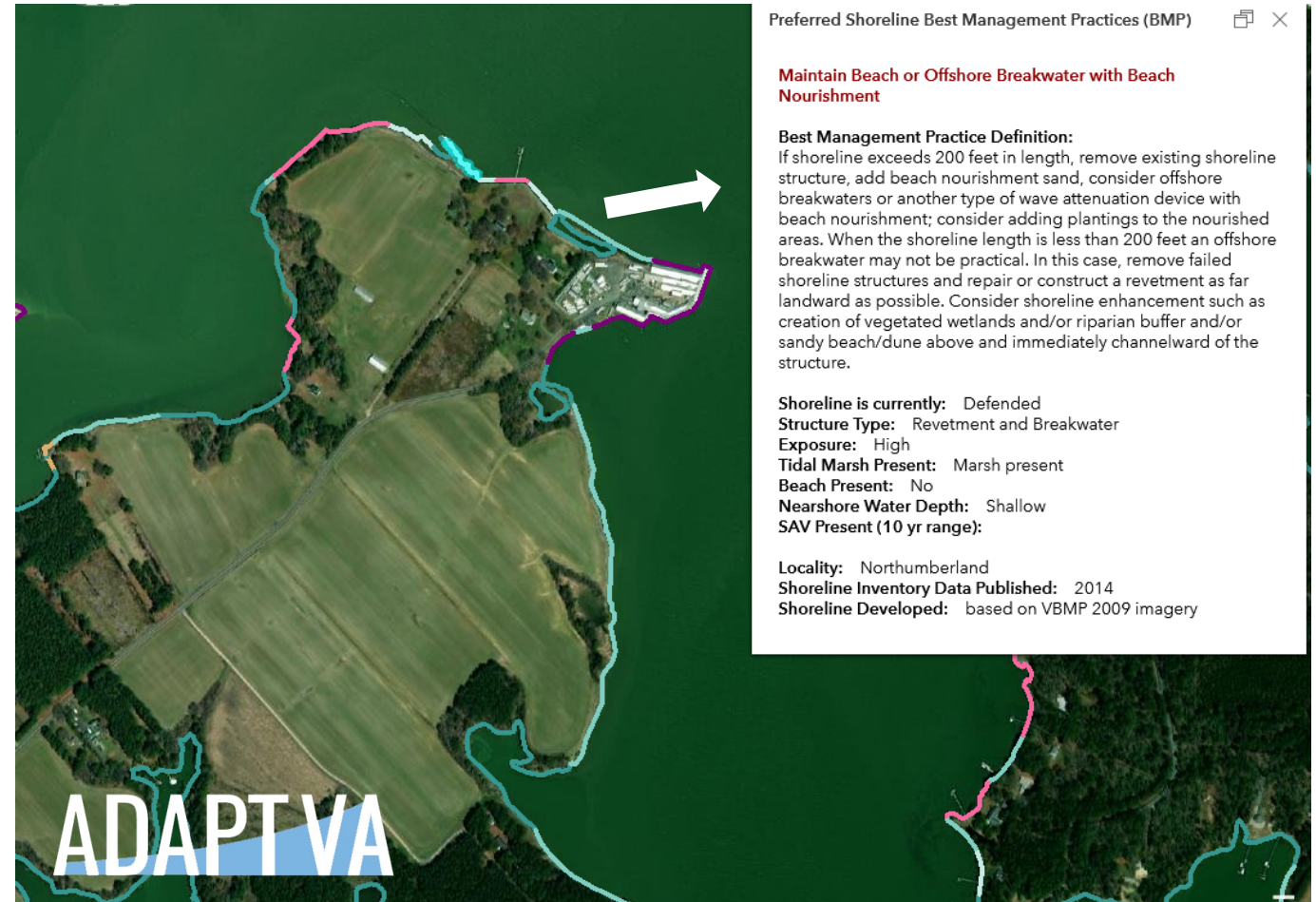


# Shoreline Management Model Purpose & Intent

**Original Decision Tree PDF**  
*requires subjective interpretation*



**Easy to use map viewer**  
*with site-specific attribute display*





# Shoreline Conditions Factored into Model

## **BASELINE SHORELINE**

Land – water, tidal marsh, or beach interface

## **SHORELINE INVENTORY**

Natural Features *presence or absence tidal marshes, beaches, SAV*

Upland bank height *imagery, field inspection, videography &/or LIDAR*

Existing shoreline defense structures

Riparian land use *within 100 feet of shoreline*

Special shoreline conditions *Canals, boat ramps, marinas & sand spits*

## **POST-INVENTORY**

Nearshore bathymetry *distance to 1m contour NOAA topobathy*

Wave exposure *fetch model captures maximum and average fetch*

Permanent structure proximity *buildings & roads*

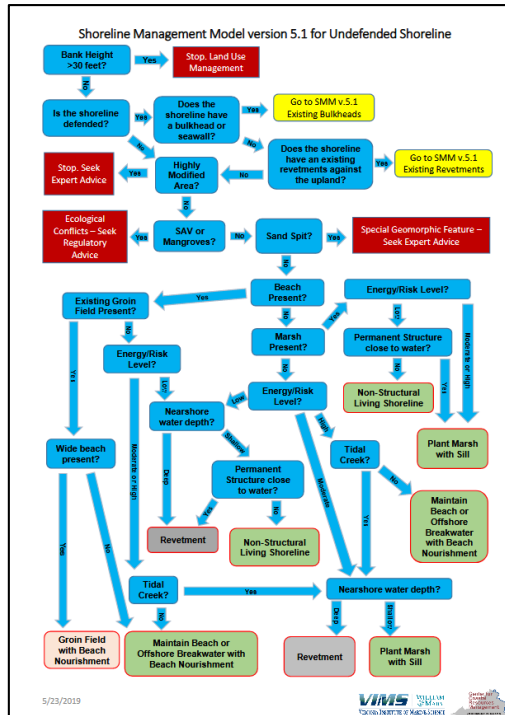




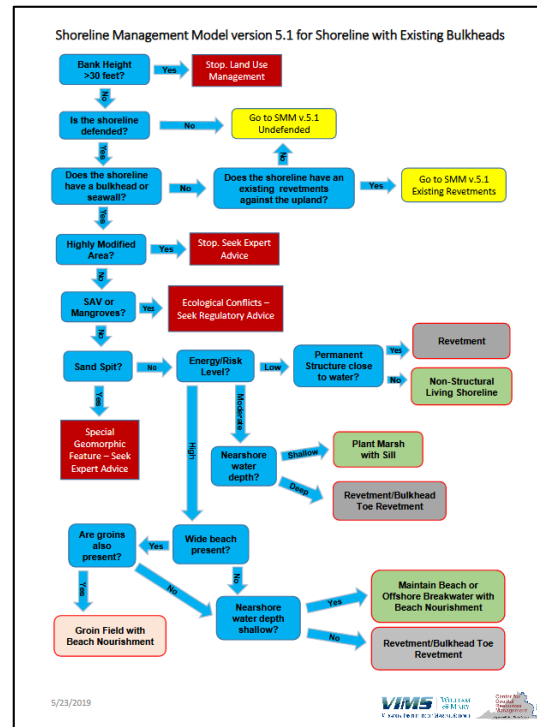
# Shoreline Management Model v. 5.1 (Virginia)

## Combines 3 submodels

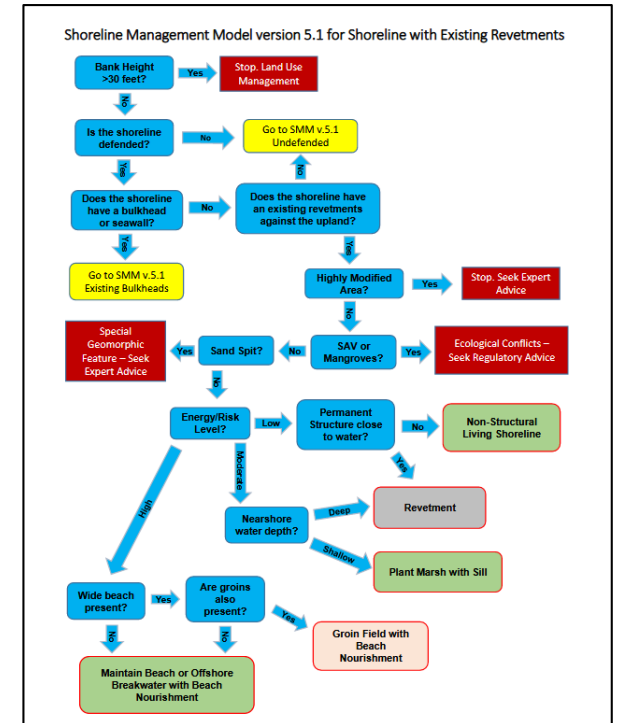
### Undefended Shorelines



### Existing Bulkheads



### Existing Revetments



[View Online](#)



# Model Output

## Shoreline Best Management Practice Recommendations

Non- Structural Living Shoreline

Plant Marsh with Sill

Maintain Beach or Offshore Breakwater  
with Beach Nourishment

Revetment

Bulkhead Toe Revetment

Groin Field with Beach Nourishment





# Model Output Special Considerations

Ecological Conflicts – SAV Presence



Land Use Management  
Bank height > 30 ft



Special Geomorphic Feature



No Action Needed

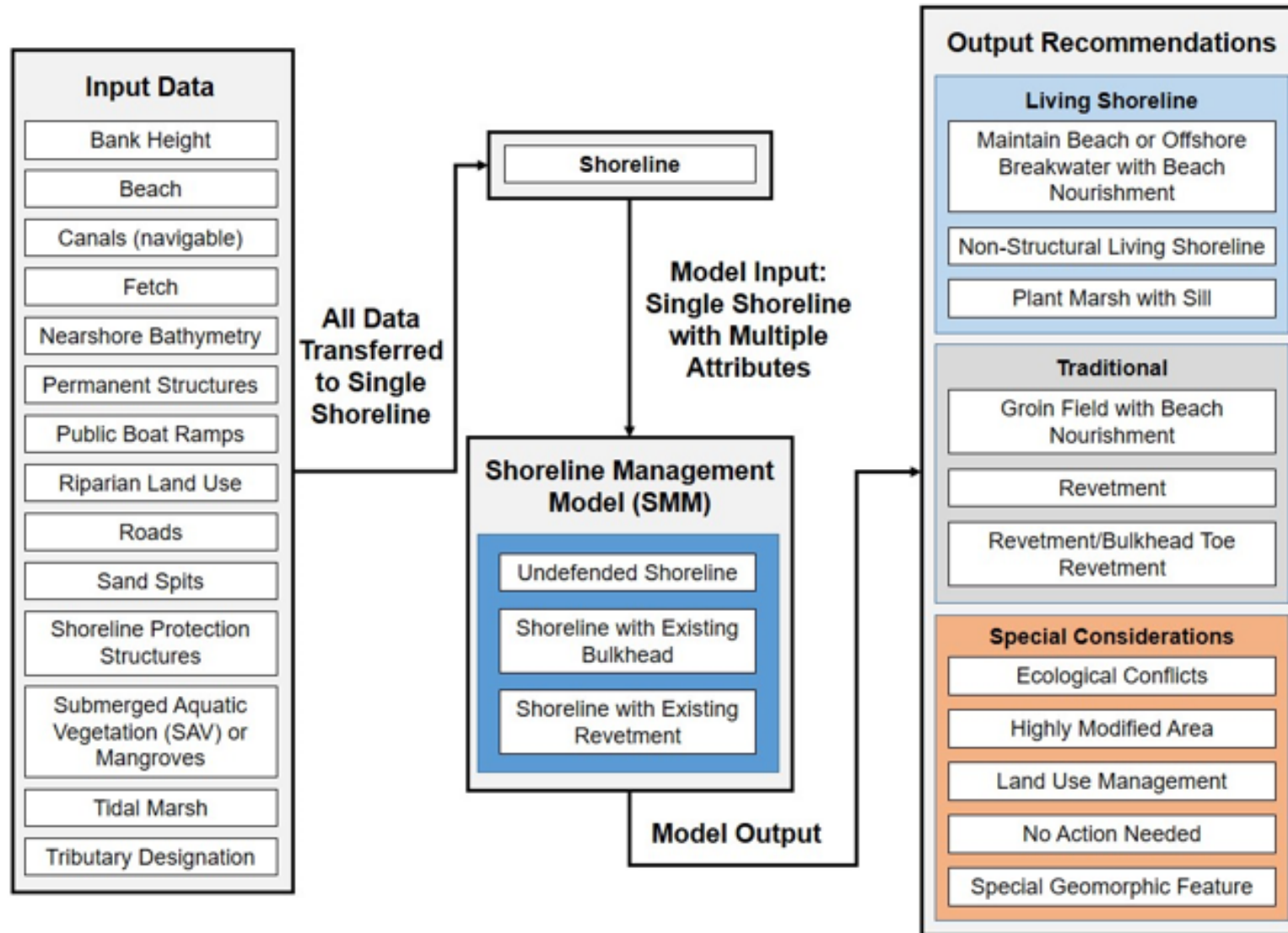


Highly Modified Areas



# Shoreline Management Model v. 5.1

## Input & Output



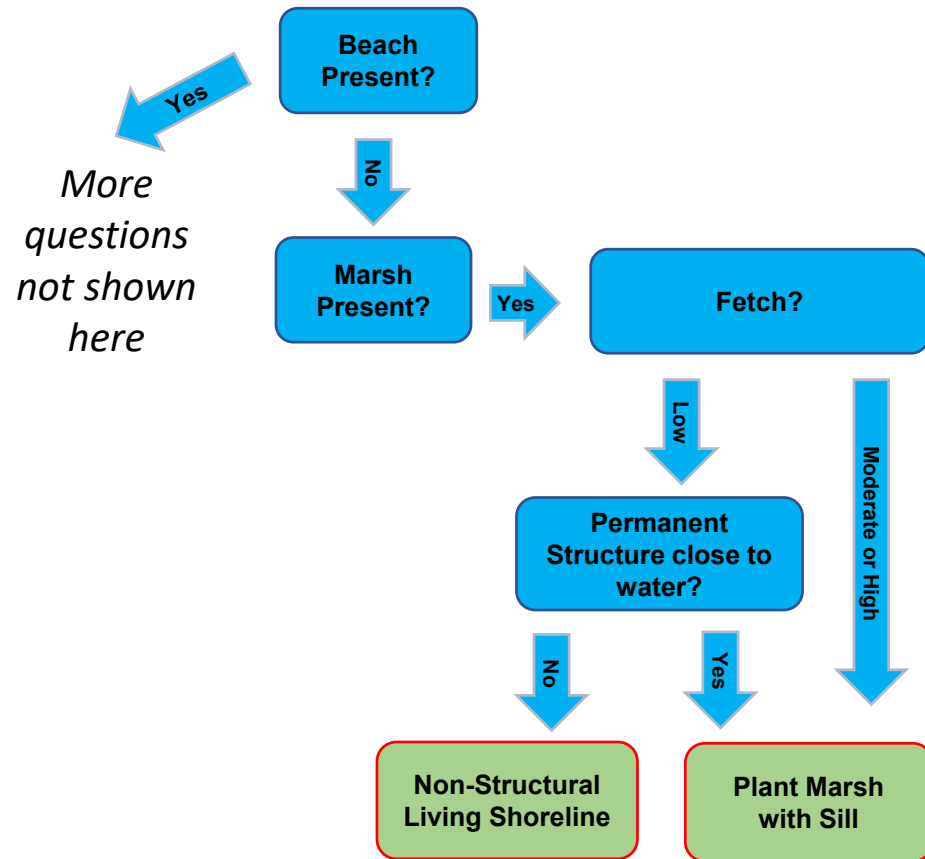
Source: Nunez et al in progress

# Model Output *Virginia v. 5.1*

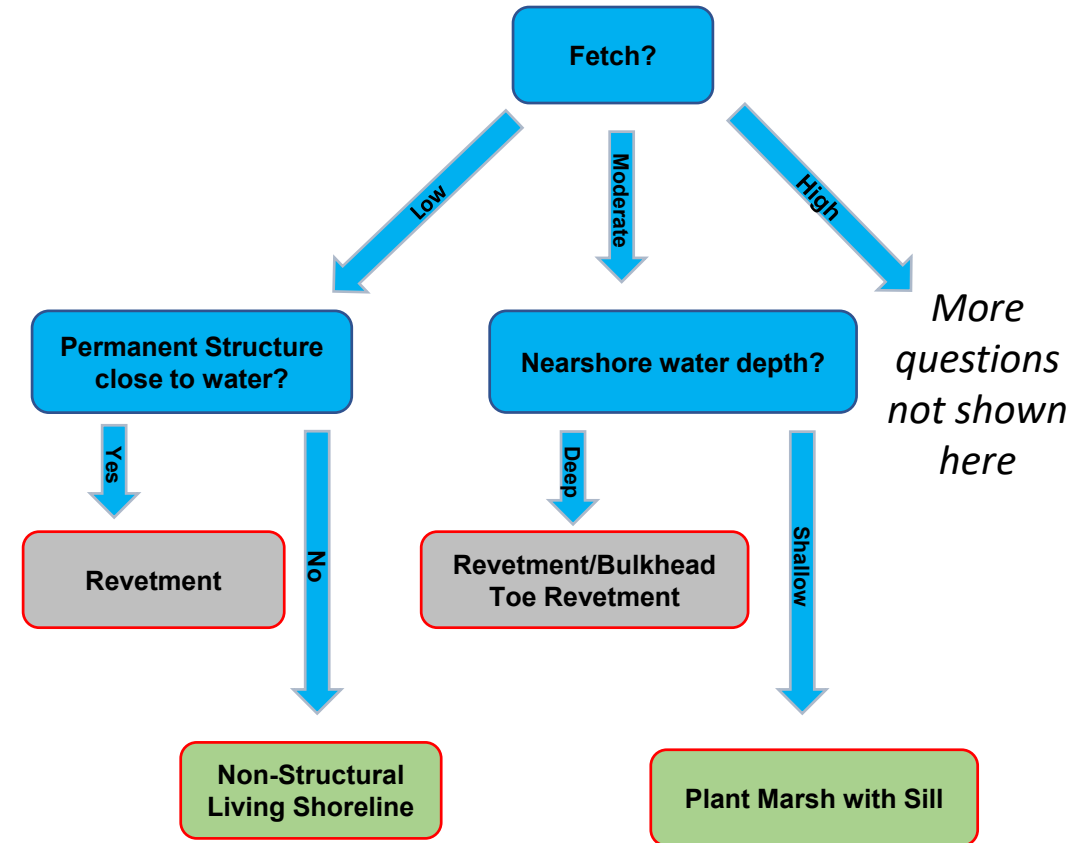
## Scenario Examples

No Special  
Considerations

### Undefended with Existing Tidal Marsh



### Existing Bulkhead

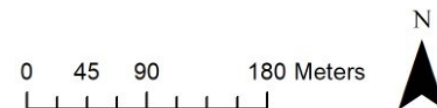






## SMM Output

- Non-Structural Living Shoreline
  - Plant Marsh with Sill
  - Maintain Beach or Offshore Breakwater with Beach Nourishment
  - Groin Field with Beach Nourishment
  - Revetment
  - Revetment / Bulkhead Toe Revetment
  - Highly Modified Area
  - Land Use Management
  - Ecological Conflicts
  - Special Geomorphic Feature
  - No Action Needed
- VBMP 2017 WGS



## EXAMPLE OF SPATIAL OUTPUT

LINE FEATURES  
DISPLAY  
SHORELINE  
MANAGEMENT  
RECOMMENDATIONS

# Model Limitations

## SHORELINE MANAGEMENT SUITABILITY FACTORS NOT INCLUDED

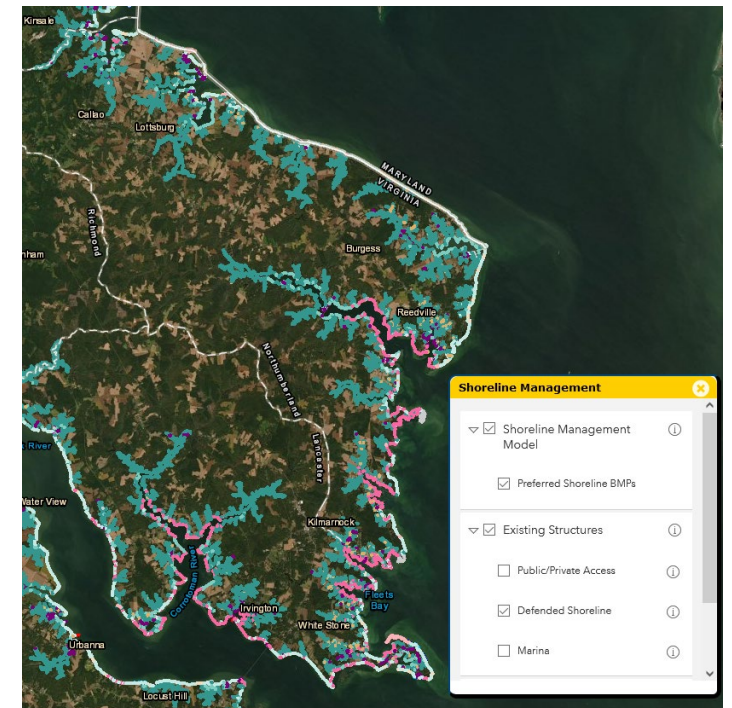
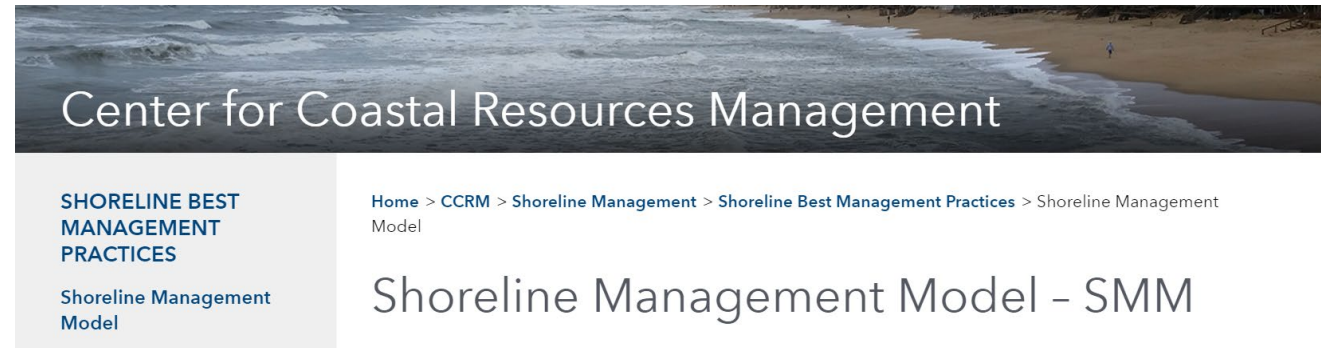
Erosion potential	Parcel dimensions - length
Stabilization need	Invisible infrastructure
Flooding potential	Land use changes since 2017
Sediment type & hardness	Shoreline ownership
Boat wakes	Potentially conflicting land uses
Upland topography & slope	Potentially conflicting water uses
Upland vegetation conditions	Costs
Local biota	



# Shoreline Management Model Products

*Click banners for links*

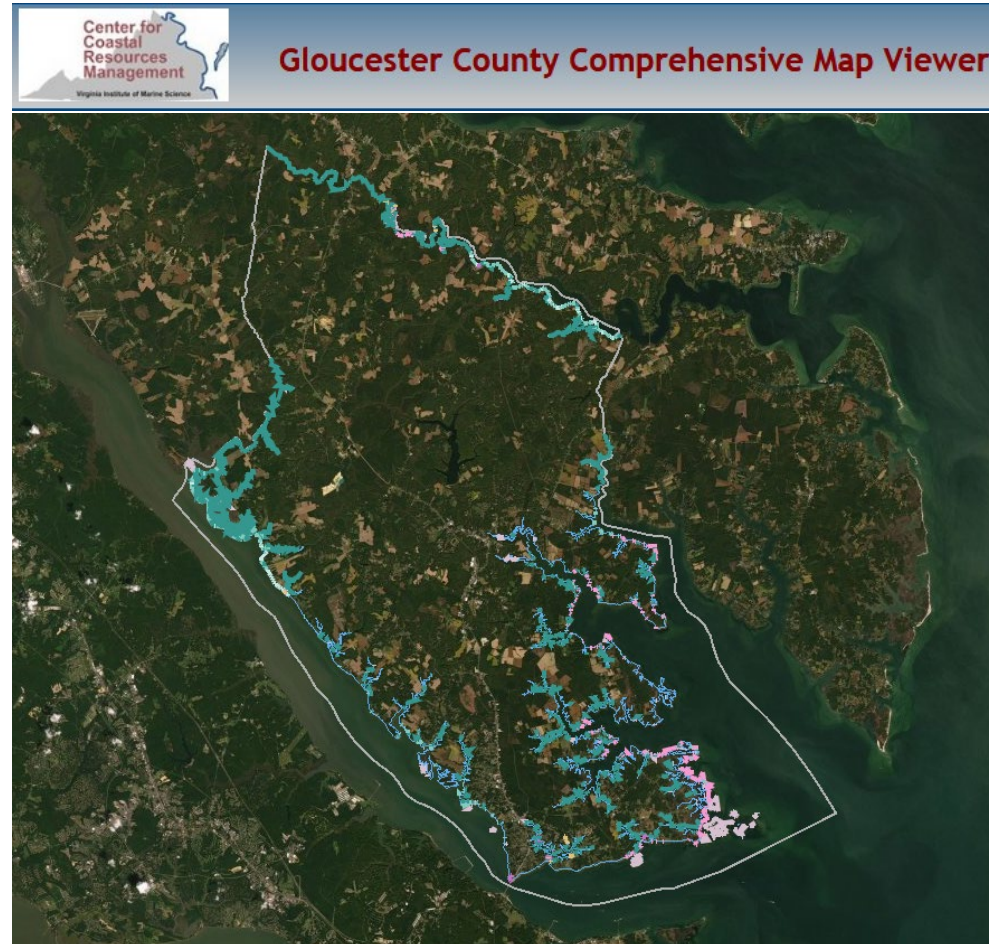
Dedicated Web Site



# Shoreline Management Model Products

Virginia Locality Portals

[Link](#)



**Map Contents**

- Shoreline Condition Layers:**
  - ☐ Shoreline Access Structures
  - ☐ Shoreline Protection Structures
  - ☐ Marina
  - ☐ Bank Height
  - ☐ Bank Cover
  - ☐ Beach
  - ☐ Riparian Land Use/Land Cover
  - ☐ Tree Fringe
  - ☒ Shoreline
  - ☐ Phragmites australis
  - ☐ Tidal Marsh
  - ☐ River Systems
- Preferred Shoreline BMPs:**  
(Layers display at a scale of 1:300,000 and below)  
[Turn all BMPs Off](#)
  - ☒ Living Shoreline BMPs
  - ☒ Non-Living Shoreline BMPs
  - ☒ Special Considerations
- Sea Level Rise:**
  - ☐ Sea Level Rise High Scenario
- Other Layers:**
  - ☒ Jurisdictional Boundary
  - ☐ Parcels (displays at 1:48000 and below)
  - ☐ Photographs
  - ☐ Hydrology
  - ☐ Aquaculture Sites
  - ☐ Intertidal Flats



# Shoreline Management Model Applications

## Parcel – Scale Shoreline Management

- Regulatory agencies and Wetland Boards (VA)

- Shoreline professionals & contractors

- Private citizens

## Pollutant Load Reduction Potential

- Tidal marsh creation & shoreline management BMPs

- Defended shoreline retrofits

## Community Resiliency

- Targeting protection & restoration natural and nature-based features

- Living shoreline ranking & co-benefits

## Regional Customization

- Exportable code + regional terminology and regulations

# Regional Applications

Virginia

Maryland (in progress)

Texas

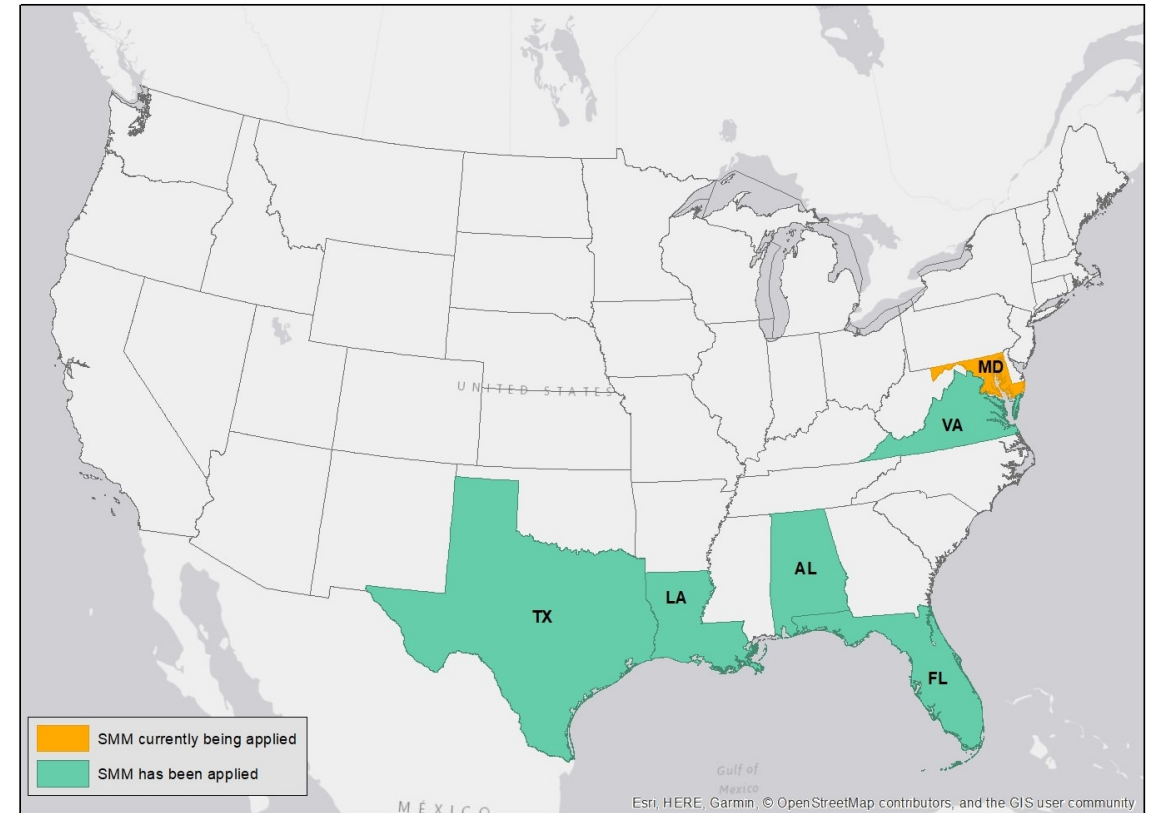
Florida – Tampa Bay

Louisiana – Lake Pontchartrain

Alabama – Mobile Bay

Alabama & Florida – Pensacola Bay

States Where the Shoreline Management Model (SMM) Has or Is Being Applied



[More Information](#)



# Regional Applications

## Maryland Shoreline Inventory Update *in progress*

2005-2006 MD shoreline inventory completed

Updates in progress

### 2019

Anne Arundel

Calvert

Dorchester

Talbot

### 2020-2021

Charles

Somerset

St. Marys

Worcester

### 2021-2022

Baltimore

Kent

Queen Anne

Wicomico



GIS Data available in VIMS ScholarWorks digital archive

Customized version of Shoreline Management Model run

# Regional Applications

## Maryland Shoreline Stabilization Mapper *in progress*

Regulatory program application

4 submodels

Special Considerations + Undefended + Existing Bulkhead + Existing Revetment

Customized Special Considerations

Ecological Considerations

Seek Expert or Regulatory Advice

Flow Diagram continues after Seek Expert Advice

Additional Shoreline Management Recommendation

Undetermined: Complete a Waiver Request Form

Customized map viewer *coming soon*



# Shoreline Management Model Manual for GIS professionals

2020

Handbook

Definitions

GIS Toolbox

[Zip file link](#)

Rudnick, Tamia and Berman, Marcia. 2020. Shoreline Management Model version 5.1 Handbook, Center for Coastal Resources Management, Virginia Institute of Marine Science, William & Mary, Gloucester Point, VA, pp54.

*This project was funded in part by the NOAA RESTORE Science Program through Grant # NA17NOS4510100 of the U.S. Department of Commerce, Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program.*

## Shoreline Management Model version 5.1 Handbook



*This project was funded in part by the NOAA RESTORE Science Program through Grant # NA17NOS4510100 of the U.S. Department of Commerce, Gulf Coast Ecosystem Restoration Science, Observation, Monitoring, and Technology Program.*



# Shoreline Decision Support Tool


Trusted scientific foundation

On-site observations + model logic

Higher accuracy than model alone

Re-sizes for different screens

[Tool Link](#)



## Shoreline Decision Support Tool

Answer a series of questions and follow the prompts below to arrive at a recommended shoreline erosion control strategy.

[< Back to Introduction and How To](#)

Is the shoreline currently defended with an erosion control structure?	<input checked="" type="radio"/> yes, with bulkhead or seawall <input type="radio"/> yes, with revetment (riprap) against the upland <input type="radio"/> no
Is the shoreline part of a residential canal?	<input type="radio"/> yes <input checked="" type="radio"/> no
Is the shoreline part of any of the following?	<input type="radio"/> marina <input type="radio"/> defended shoreline along commercial or industrial area <input type="radio"/> next to road, parking area, or railroad bed <input checked="" type="radio"/> no
Is there submerged aquatic vegetation (SAV) or mangroves within 30 feet of the shoreline, or is the shoreline part of a sand spit?	<input type="radio"/> sav present <input type="radio"/> mangroves present <input type="radio"/> sand spit present <input checked="" type="radio"/> no
The height of the bank at the interface between the shoreline and the upland can limit the type of management solutions that would be effective at countering erosion. Erosion on very high banks (those greater than 30 feet) may not be driven by wave energy, and therefore shoreline management strategies would not be appropriate.  Is your bank height greater than 30 feet?	<input type="radio"/> yes <input checked="" type="radio"/> no



# Shoreline Decision Support Tool



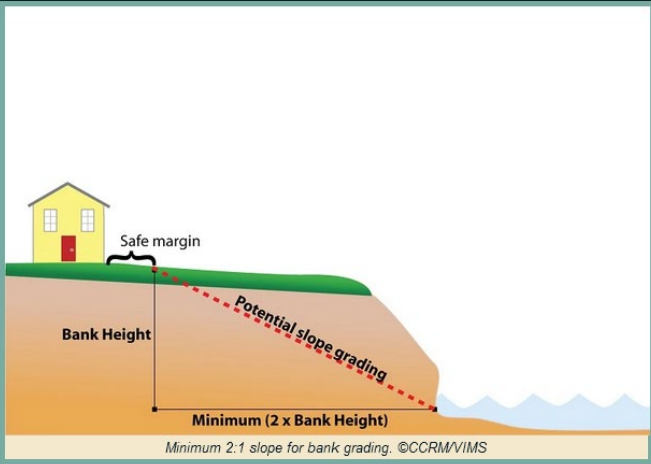
## Interactive Help Information

## Shoreline Management Recommendations

Can the shoreline bank be graded, if necessary? ☒ yes ☐ no

**Shoreline Bank** **Before-After**

The intent of bank grading is to reduce the steepness of the bank slope thereby minimizing erosion caused by wave activity at the base of the bank. In Virginia a 2:1 or 3:1 slope is appropriate. For example: for a 2:1 slope, a 10 foot tall bank would need to be graded back a minimum of 20 feet (i.e.  $2 \times 10 = 20$ ). Different slope ratios may be appropriate for other regions.



Minimum 2:1 slope for bank grading. ©CCRM/VIMS

**Recommendation for Defended (Bulkhead) shoreline with Moderate Exposure, and Bank can be Graded**

**Plant Marsh with Sill**

Remove existing failing or failed structure, plant tidal marsh (or maintain/widen existing marsh) and construct a rock sill placed offshore from the marsh. The target area for planting tidal marsh should extend from mid-tide to an elevation 1.5 times the tide range above mean low water where the presence of upland vegetation begins, with wetland vegetation planted at appropriate elevations to establish both low and high marsh zones where possible. Consider widening an existing marsh by grading bank landward and/or adding sand fill channelward to increase marsh width and/or elevation and placing a sill just offshore from the new marsh edge

In nontidal, fresh water systems, plant wetland vegetation in elevation zones to mimic local, natural wetlands and to accommodate various water levels including extreme high and low water levels during floods and droughts.

The site-specific suitability for a sill must be determined, including bottom hardness, navigation conflicts, construction access limitations, orientation and available sunlight for marsh plants.

For a list of wetland plants, consult the [Lady Bird Johnson Wildflower Center](#) or the NRCS [Plant Materials Program](#) websites.

*This recommendation is derived from basic shoreline conditions. Additional factors to consider include land and water uses, adjacent shoreline conditions, construction access, and sensitive cultural and natural resources.*

Show/hide pictures ...

Embedded resource links



# Questions & Comments about Shoreline Management Model

## Contact Information

Karen Duhring

[karend@vims.edu](mailto:karend@vims.edu)

[www.vims.edu/ccrm](http://www.vims.edu/ccrm)