

Valuation of ecological and social benefits provided by marshes and living shorelines for communities and fisheries

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Center for Coastal Resources Management
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William & Mary
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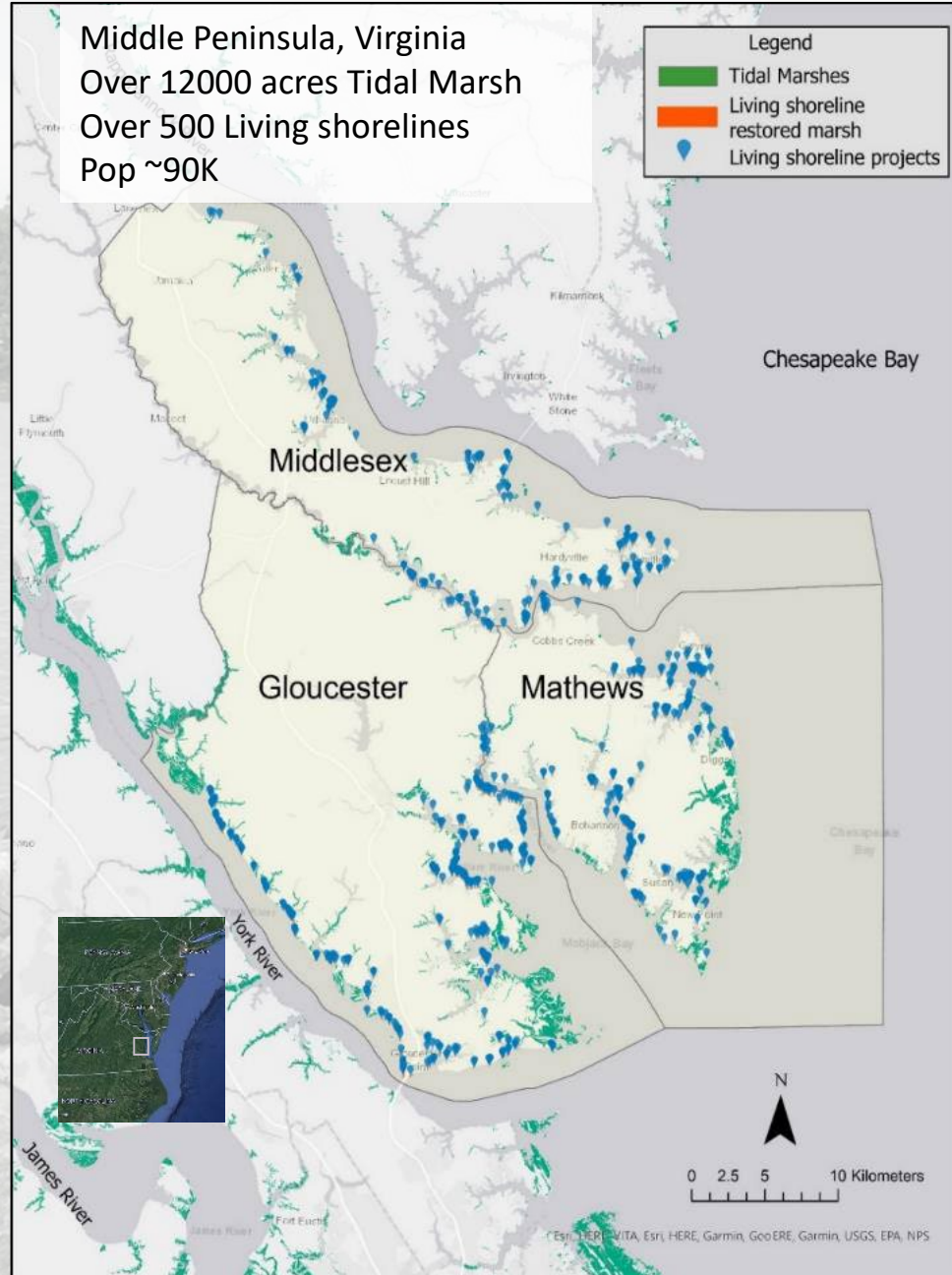
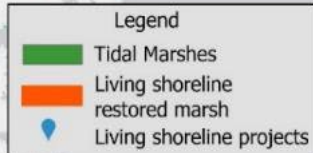
Monetary value of ecosystem services

- **Benefits to people provided by nature** (provisioning, regulating, supporting, cultural)
- **Measuring ecosystem services in monetary terms** facilitates straightforward analysis of tradeoffs for better decision-making and policy formulation
 - e.g., National Strategy to Develop Statistics for Environmental-Economic Decisions (2023)
- **ESV can be highly location specific** - variability in service provision and associated human values



Valuing benefits of marshes and living shorelines

Middle Peninsula, Virginia
Over 12000 acres Tidal Marsh
Over 500 Living shorelines
Pop ~90K

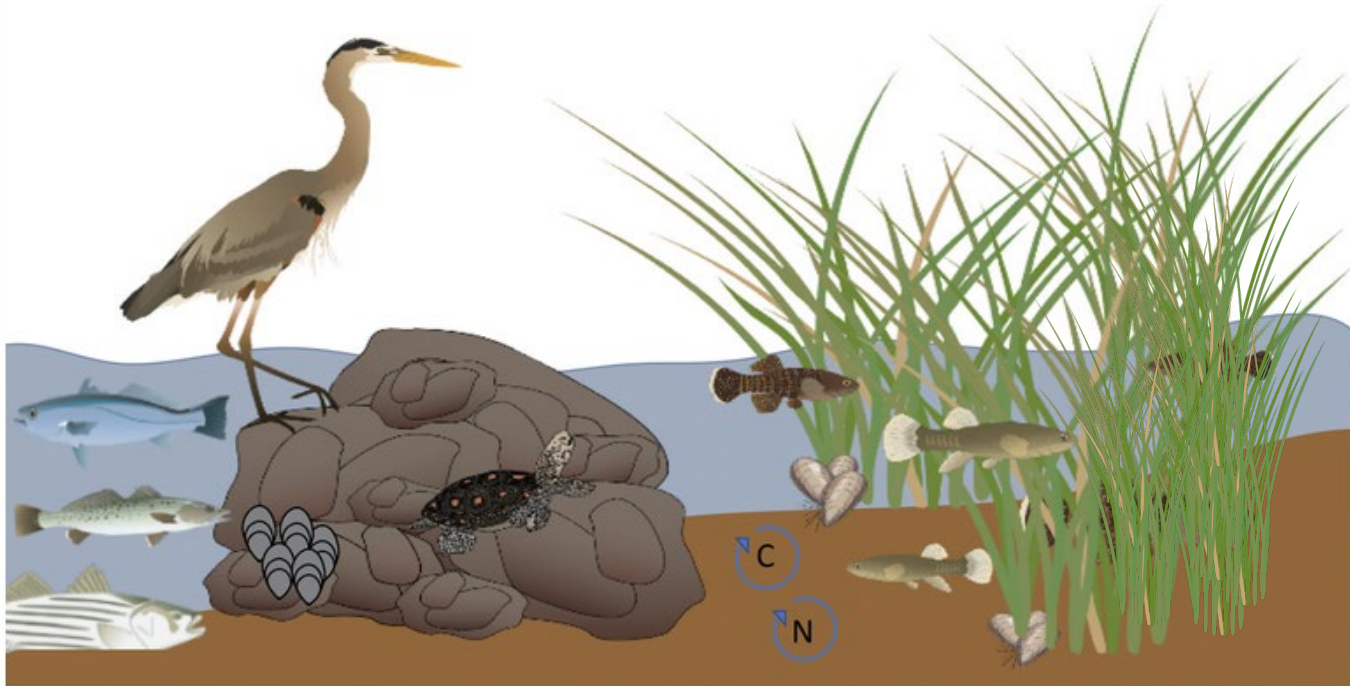


OBJECTIVES

1. Estimate the monetary value of ecosystem service benefits provided by marshes & living shorelines for local communities in the Middle Peninsula
2. Develop a **Shoreline Restoration Benefit Calculator** - input project specific information and output community benefits



Ecosystem benefits of living shorelines



ECOSYSTEM SERVICES OF SUSTAINABLE SHORELINES



Credit: Center for Coastal Resources Management; Kelsey Broich, Network for Engineering with Nature, University of Georgia; Integration and Application Network (ian.umces.edu/media-library)



Reduced Storm Impacts



Improved Fish Habitat



Nutrients Removed/Stored



Carbon Removed/Stored



Improved Recreation

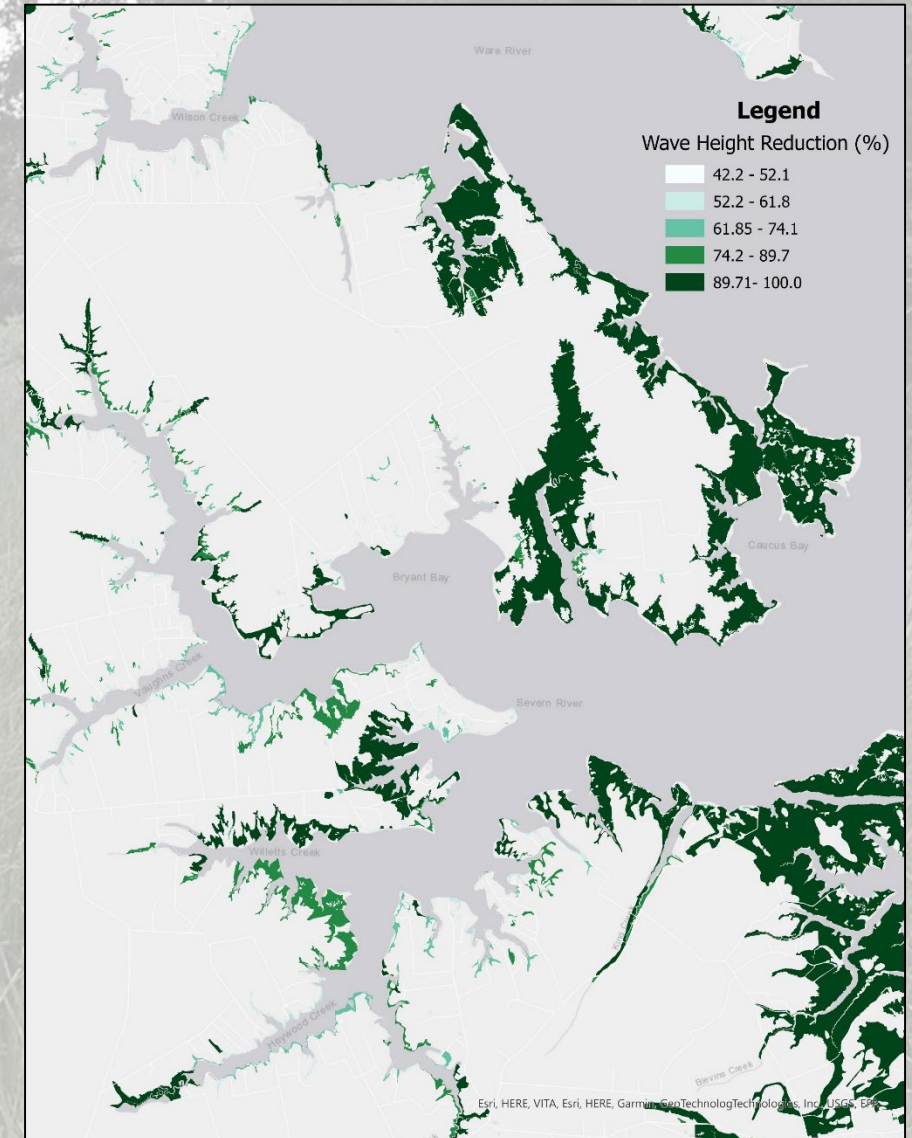
Supporting studies within the region of marshes/living shorelines ES: Chambers et al. 2021, Isdell et al. 2021, Bilkovic et al. 2021, Guthrie et al, 2022; Levene et al. 2022, Leu et al. 2024

Valuation methods

Hybrid Benefit Transfer Approach— we applied mean estimates of the economic value for marsh ecosystem services from existing studies to Middle Peninsula

Literature-derived service values were adjusted to the region with human use and preference surveys and geospatial, statistical and physical modeling

- **Storm risk reduction** values adjusted based on marsh size and shape (wave attenuation capacity) and relative storm exposure, determined by wave heights that occurred during 2 historic storms
- **Fish habitat provision** values adjusted based on low marsh area, width and length relationships with fish abundance from local studies
- **Recreational fishing** values adjusted based on the stated preferences of recreational fishers in the region and distance to public access
- **Nutrient and carbon storage** adjusted based on restored marsh area



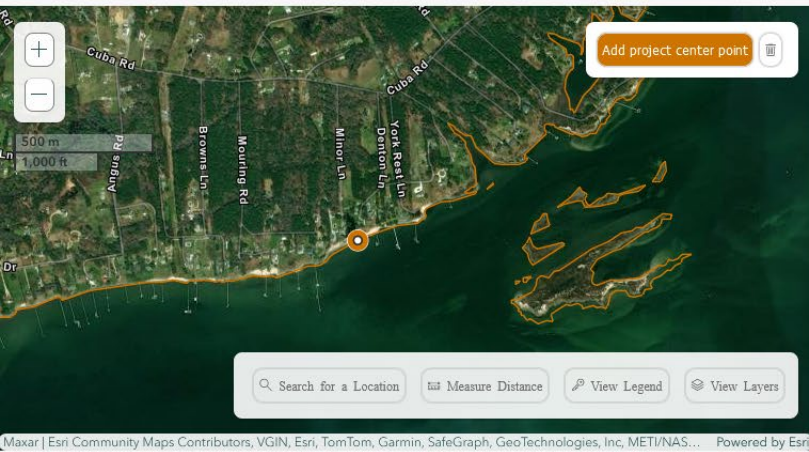
SHORE-BET – Benefit Evaluation Tool

SHORE-BET Marsh Restoration Community Benefit Calculator



STEP 1: LOCATE PROJECT ON THE MAP

Map Help



COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$11,798.93	\$264,254.37	
Improved Fish Habitat	\$1,966.36	\$44,039.50	
Nutrients Removed/Stored	\$3,172.52	\$71,053.29	
Carbon Removed/Stored	\$1,489.37	\$33,356.51	
Improved Recreational Fishing	\$423.64	\$9,488.12	

TOTAL 30-YEAR COMMUNITY BENEFIT VALUE

This Project	\$422,191.80	
Existing Middle Peninsula Living Shoreline Projects	\$4-6 Million	



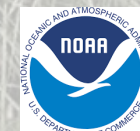
ABOUT CALCULATION INFO PRINT REPORT RESOURCES

Outputs for each project

- Annual and projected 30-year benefits for each service
- Total projected 30-year value for the bundle of services
- Total shoreline length protected
- Marsh area restored
- Amount of pollution reduction per year
- Relative rankings for public access, storm exposure, fish habitat quality, social vulnerability
- Population per square mile for the project location



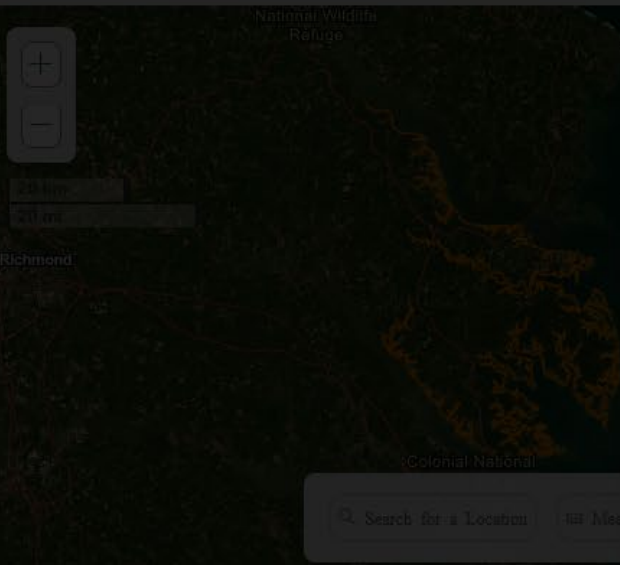
<https://cmap22.vims.edu/ShoreBet/>



SHORE-BET Marsh Restoration Community Benefit Calculator



STEP 1: LOCATE PROJECT ON THE MAP



COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$0	\$0	0
	\$0	\$0	0
	\$0	\$0	0
	\$0	\$0	0
	\$0	\$0	0

SHORE-BET: Marsh Restoration Community Benefit Calculator



The SHORE-BET: Marsh Restoration Community Benefit Calculator calculates the economic value of select key coastal community benefits to be gained by using living shoreline techniques that restore marshes. This tool helps to account for these ecosystem services so that coastal communities can be better informed when making decisions impacting their environment, economy, and overall quality of life. The geographic focus of the tool is the counties along the Chesapeake Bay within the Middle Peninsula, Virginia (Gloucester, Mathews, Middlesex); however, the approaches behind the tool can be transferred to other regions.

DISCLAIMER
The use of SHORE-BET is intended to support preliminary planning, reporting, and restoration prioritization; however, its use does not guarantee the approval of any authorization or shoreline project. We acknowledge that the calculations represented herein do not reflect the full suite of services and benefits provided by a marsh or living shoreline. This project has been funded wholly by the National Oceanic and Atmospheric Administration (NOAA), NOAA Chesapeake Bay Office & the Chesapeake Bay Fisheries Research Program.

OK

STEP 2: PROVIDE PROJECT DETAILS

1200 LENGTH ALONG SHORELINE
40 HIGH MARSH WIDTH (FEET)
30 LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

COMMUNITY BENEFIT VALUE

\$1.6 Million



SHORE-BET – Step 1: locate project

<https://cmap22.vims.edu/ShoreBet/>

SHORE-BET Marsh Restoration Community Benefit Calculator



STEP 1: LOCATE PROJECT ON THE MAP

Map Help

Search for a Location | Measure Distance | View Legend | View Layers

Earthstar Geographics | VGIN, Esri, TomTom, Garmin, SafeGraph, FAO, METI/NASA, USGS, EPA, NPS, USFWS | Powered by Esri

COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$0	\$0	
Improved Fish Habitat	\$0	\$0	
Nutrients Removed/Stored	\$0	\$0	
Carbon Removed/Stored	\$0	\$0	
Improved Recreational Fishing	\$0	\$0	

TOTAL 30-YEAR COMMUNITY BENEFIT VALUE

This Project \$0

Existing Middle Peninsula Living Shoreline Projects \$4-6 Million

STEP 2: PROVIDE PROJECT DETAILS

LENGTH ALONG SHORELINE

HIGH MARSH WIDTH (FEET) ⓘ

LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

PROJECT DETAILS

Length of Shoreline Protected	Marsh Area Protected/Restored	Pollution Reduction
Recreational Access	Storm Exposure	LOCATION DETAILS
		Fish Habitat Provided
		Social Vulnerability
		Area Population Density

SHORE-BET – Step 1: locate project



SHORE-BET Marsh Restoration Community Benefit Calculator



STEP 1: LOCATE PROJECT ON THE MAP

Map Help

COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$0	\$0	
Improved Fish Habitat	\$0	\$0	
Nutrients Removed/Stored	\$0	\$0	
Carbon Removed/Stored	\$0	\$0	
Improved Recreational Fishing	\$0	\$0	

TOTAL 30-YEAR COMMUNITY BENEFIT VALUE

This Project	\$0	
<i>Existing Middle Peninsula Living Shoreline Projects</i>	\$4-6 Million	

STEP 2: PROVIDE PROJECT DETAILS

LENGTH ALONG SHORELINE
 HIGH MARSH WIDTH (FEET) ⓘ
 LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS



PROJECT DETAILS

Length of Shoreline Protected Marsh Area Protected/Restored Pollution Reduction

LOCATION DETAILS

Recreational Access Storm Exposure Fish Habitat Provided Social Vulnerability Area Population Density

SHORE-BET – Step 1: locate project



SHORE-BET: Coastal Community Benefit Tool



STEP 1: LOCATE PROJECT ON THE MAP

Map Help

Map interface showing a satellite view of a coastal area with a yellow outline indicating a project area. A yellow arrow points to the 'View Layers' button in the bottom right of the map area.

STEP 2: PROVIDE PROJECT DETAILS

Enter linear feet LENGTH ALONG SHORELINE

Enter feet HIGH MARSH WIDTH (FEET)

Enter feet LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

CALCULATED COMMUNITY BENEFITS

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$0	\$0	0
Improved Fish Habitat	\$0	\$0	0
Nutrients Removed/Stored	\$0	\$0	0
Carbon Removed/Stored	\$0	\$0	0
Improved Recreation	\$0	\$0	0

TOTAL 30-YEAR COMMUNITY BENEFIT VALUE

This Project

Existing Middle Peninsula Living Shoreline Projects

\$0

\$4.6 Million

PROJECT DETAILS

Length of Shoreline Protected

Marsh Area Protected/Restored

Pollution Reduction

LOCATION DETAILS

Recreational Access

Storm Exposure

Fish Habitat Provided

Social Vulnerability

Area Population Density

HELP

CALCULATION INFO

PRINT SUMMARY

ABOUT

SHORE-BET – Step 2: enter project info



SHORE-BET Marsh Restoration Community Benefit Calculator



STEP 1: LOCATE PROJECT ON THE MAP

Map Help

100 m
200 ft

Add project center point

Search for a Location Measure Distance View Legend View Layers

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COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$0	\$0	i
Improved Fish Habitat	\$0	\$0	i
Nutrients Removed/Stored	\$0	\$0	i
Carbon Removed/Stored	\$0	\$0	i
Improved Recreational Fishing	\$0	\$0	i

TOTAL 30-YEAR COMMUNITY BENEFIT VALUE

This Project	\$0	i
<i>Existing Middle Peninsula Living Shoreline Projects</i>	\$4-6 Million	i

PROJECT DETAILS

Length of Shoreline Protected	Marsh Area Protected/Restored	Pollution Reduction
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LOCATION DETAILS

Recreational Access	Storm Exposure	Fish Habitat Provided	Social Vulnerability	Area Population Density
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STEP 2: PROVIDE PROJECT DETAILS

1200	LENGTH ALONG SHORELINE
40	HIGH MARSH WIDTH (FEET) ⓘ
30	LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

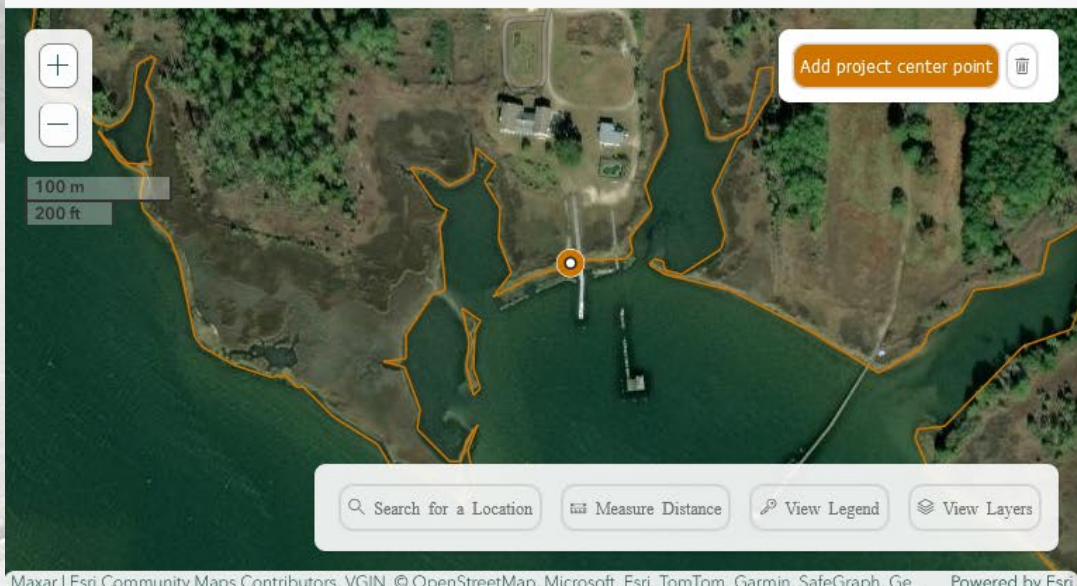


SHORE-BET – Step 3: calculate benefits

SHORE-BET Marsh Restoration Community Benefit Calculator

STEP 1: LOCATE PROJECT ON THE MAP

Map Help



STEP 2: PROVIDE PROJECT DETAILS

1200 LENGTH ALONG SHORELINE
40 HIGH MARSH WIDTH (FEET) ⓘ
30 LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$7,865.96	\$176,169.58	ⓘ
Improved Fish Habitat	\$1,966.36	\$44,039.50	ⓘ
Nutrients Removed/Stored	\$3,172.52	\$71,053.29	ⓘ
Carbon Removed/Stored	\$1,489.37	\$33,356.51	ⓘ
Improved Recreational Fishing	\$1,270.93	\$28,464.37	ⓘ

TOTAL 30-YEAR COMMUNITY BENEFIT VALUE

This Project **\$353,083.25** ⓘ
Existing Middle Peninsula Living Shoreline Projects **\$4-6 Million** ⓘ

PROJECT DETAILS

1,200 FEET Shoreline Length Protected
84,000 SQ. FT Marsh Area Protected/Restored
177.08 lbs Nitrogen
10.78 lbs Phosphorus
13419.53 lbs Sediment
Pollution Reduction per Year

LOCATION DETAILS

High Public Access
Less than 1.5 miles to an access point

Medium Storm Exposure

Exceptional Quality Fish Habitat Created

Moderate Social Vulnerability

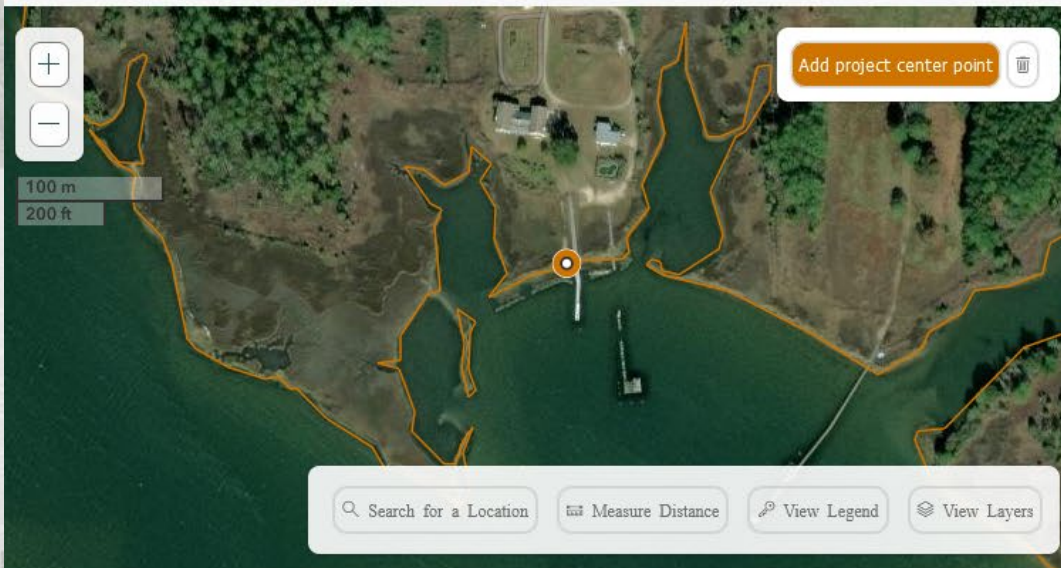
49 Population Per Square Mile

SHORE-BET – Step 3: calculate benefits

SHORE-BET Marsh Restoration Community Benefit Calculator

STEP 1: LOCATE PROJECT ON THE MAP

Map Help



Add project center point

Search for a Location Measure Distance View Legend View Layers

STEP 2: PROVIDE PROJECT DETAILS

1200 LENGTH ALONG SHORELINE
 40 HIGH MARSH WIDTH (FEET)
 30 LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

COMMUNITY BENEFITS OF MARSH RESTORATION

	PER YEAR	30-YEAR	
Reduced Storm Impacts	\$7,865.96	\$176,169.58	i
Reduced Storm Impacts	\$36	\$44,039.50	i
Marsh vegetation and wetland areas absorb flood water and dampen wave energy, reducing nearby flooding and damage caused by waves to areas behind the marsh.	\$52	\$71,053.29	i
Marshes also trap sediment which helps slow shoreline erosion.	\$37	\$33,356.51	i
This Existing Value	\$93	\$28,464.37	i
		VALUE	i
		\$353,083.25	i
		\$4-6 Million	i

1,200 ft Shoreline Length Protected

Marsh Area Protected/Restored

17,700 lbs Nitrogen

10,778 lbs Phosphorus

13419.53 lbs Sediment

Pollution Reduction per Year

High Public Access
Less than 1.5 miles to an access point

Medium Storm Exposure

Exceptional Quality Fish Habitat Created

Moderate Social Vulnerability

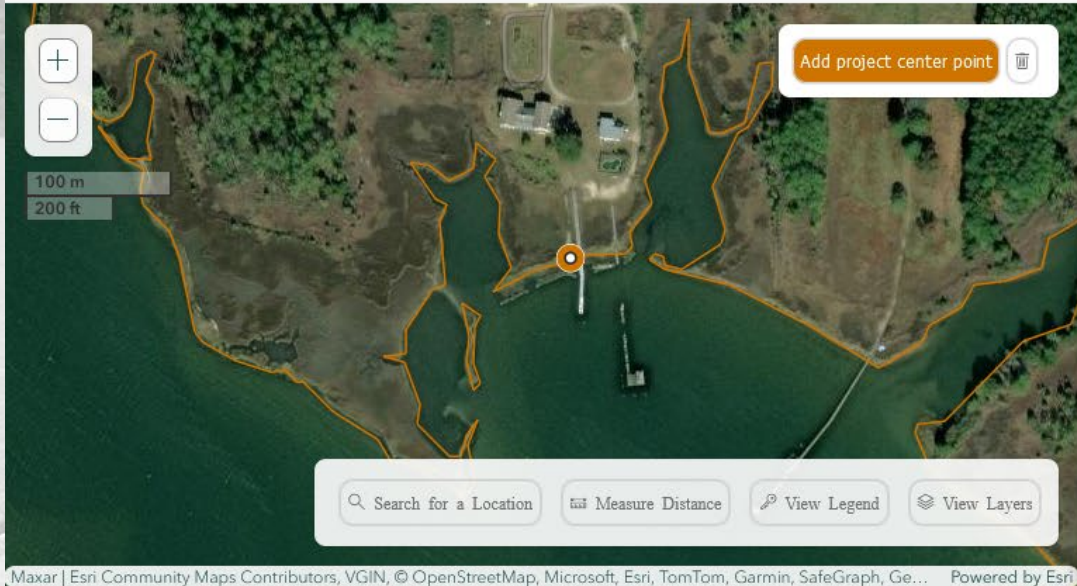
Population Per Square Mile: 49

SHORE-BET – Step 3: calculate benefits

SHORE-BET Marsh Restoration Community Benefit Calculator

STEP 1: LOCATE PROJECT ON THE MAP

Map Help



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STEP 2: PROVIDE PROJECT DETAILS

LENGTH ALONG SHORELINE
 HIGH MARSH WIDTH (FEET) ⓘ
 LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

COMMUNITY BENEFITS OF MARSH RESTORATION

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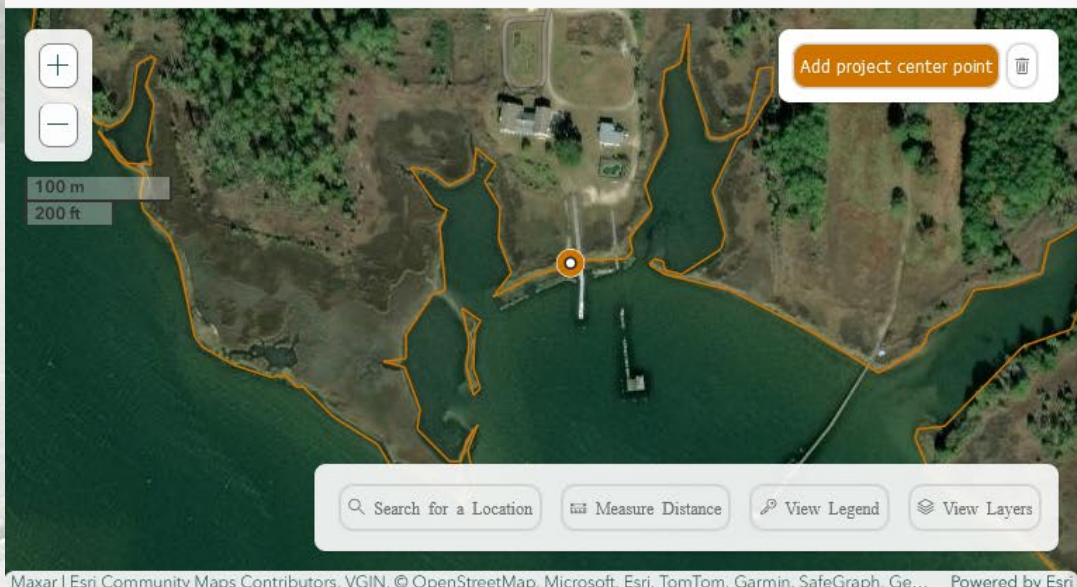
High Public Access **Less than 1.5 miles to an access point**
 Medium Storm Exposure
 Exceptional Quality Fish Habitat Created
 Moderate Social Vulnerability
49 Population Per Square Mile

SHORE-BET – Step 3: calculate benefits

SHORE-BET Marsh Restoration Community Benefit Calculator

STEP 1: LOCATE PROJECT ON THE MAP

Map Help



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STEP 2: PROVIDE PROJECT DETAILS

LENGTH ALONG SHORELINE
 HIGH MARSH WIDTH (FEET) ⓘ
 LOW MARSH WIDTH (FEET)

STEP 3: CALCULATE BENEFITS

COMMUNITY BENEFITS OF MARSH RESTORATION

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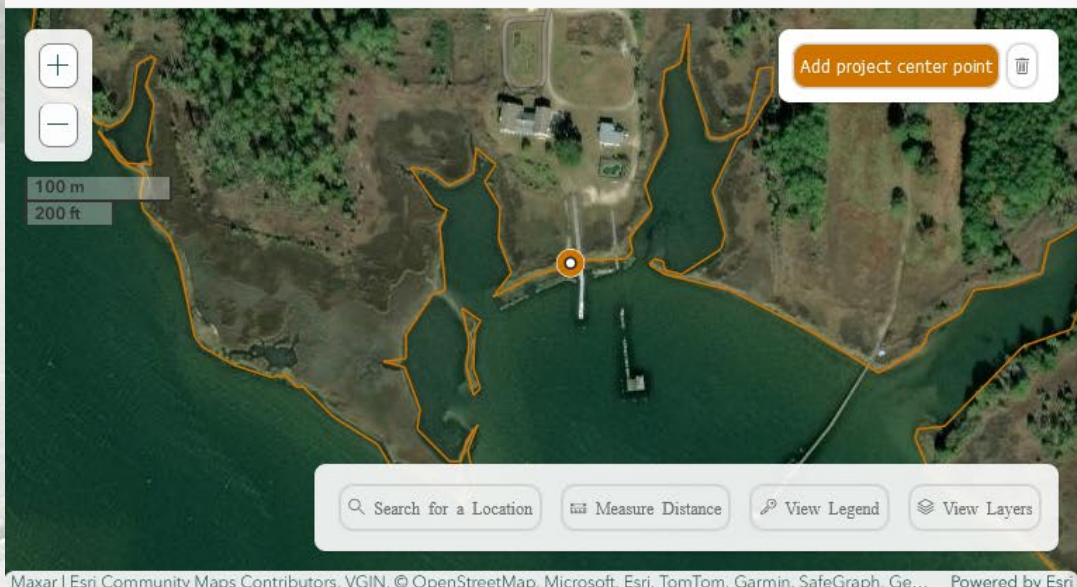
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SHORE-BET – Step 3: calculate benefits

SHORE-BET Marsh Restoration Community Benefit Calculator

STEP 1: LOCATE PROJECT ON THE MAP

Map Help



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STEP 2: PROVIDE PROJECT DETAILS

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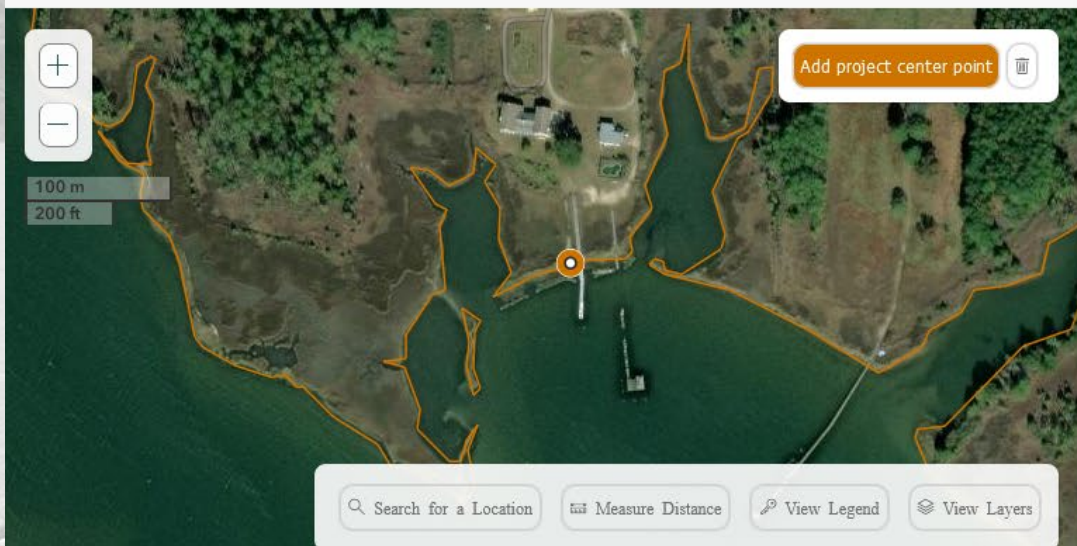
SHORE-BET – Step 3: calculate benefits

SHORE-BET Marsh Restoration Community Benefit Calculator



STEP 1: LOCATE PROJECT ON THE MAP

Map Help



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STEP 2: PROVIDE PROJECT DETAILS

LENGTH ALONG SHORELINE
 HIGH MARSH WIDTH (FEET) ⓘ
 LOW MARSH WIDTH (FEET)

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LOCATION DETAILS

High Public Access
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Medium Storm Exposure

Exceptional Quality Fish Habitat Created

Moderate Storm Vulnerability

Population 40 Square Miles

- **Restoration decisions** – a method for stakeholders to plan and prioritize restoration projects
- **Funding** - an aid for grant proposal development and reporting
- **Communication** - Establishing a monetary value connected to the services provided by the ecosystem will help in “translating” the importance of these services to coastal communities and decision makers

Valuing the Societal Benefits of Marshes and Living Shorelines - Summary



Total Benefits
\$19,746 USD/ha/yr

Living shorelines generate
more than 3X the value for
anglers than armored
shores



Questions or Comments?

SHORE-BET

THANK YOU!
donnab@vims.edu

For more info

- www.vims.edu/ccrm/



<https://cmap22.vims.edu/ShoreBet/>