



# Holly Beach Farm: Coastal Protection



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## Overview

The goal of this project is to mitigate erosion of the Holly Beach Farm southern shoreline while supporting education and recreation, providing a green solution, and requiring minimal maintenance. If left unchecked, Holly Beach Farm will inevitably face habitat reduction, freshwater contamination, and reduced opportunity for public access.



Figure 1. Hackett Point

- Red: Full Bulkhead
- Blue: Degrading Bulkhead
- Green: No Bulkhead

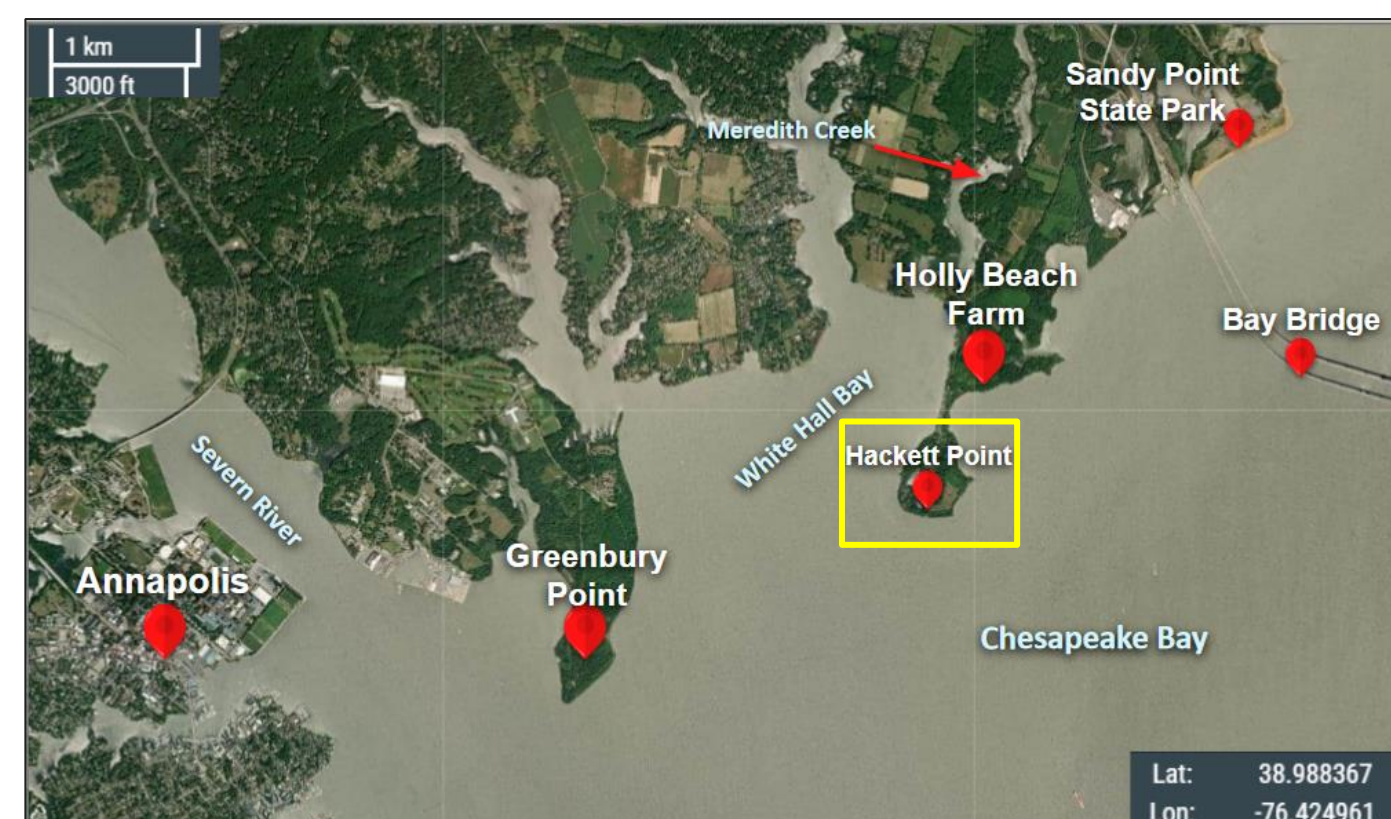


Figure 2. HBF Map Relative Annapolis



Figure 3. No Bulkhead

## Site Evaluation

### I. Metocean Conditions

- a. Fetch Analysis (3.805m)
- b. Water Level Return Periods (1.53m)
- c. Sea level rise (.75m)

### 2. Site Conditions

- a. D50 (.5mm/medium sand)
- b. Beach Profile Measurements (m~1:10)

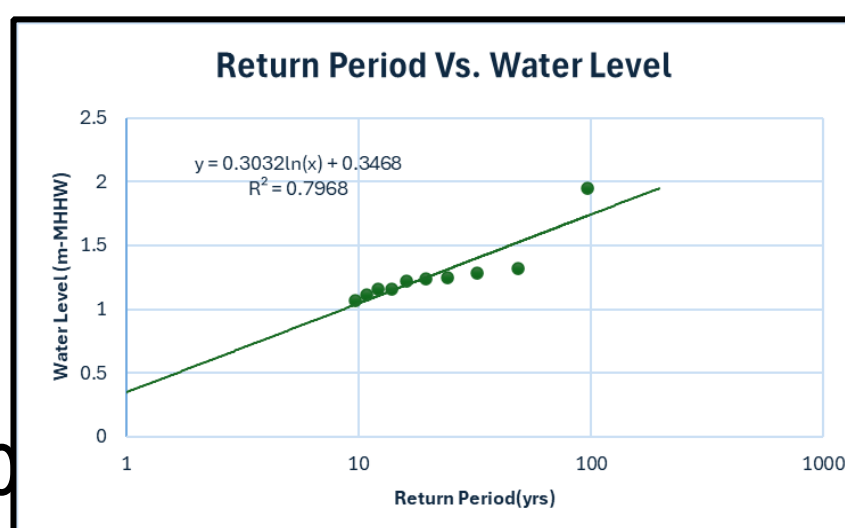


Figure 4. Storm Return Period

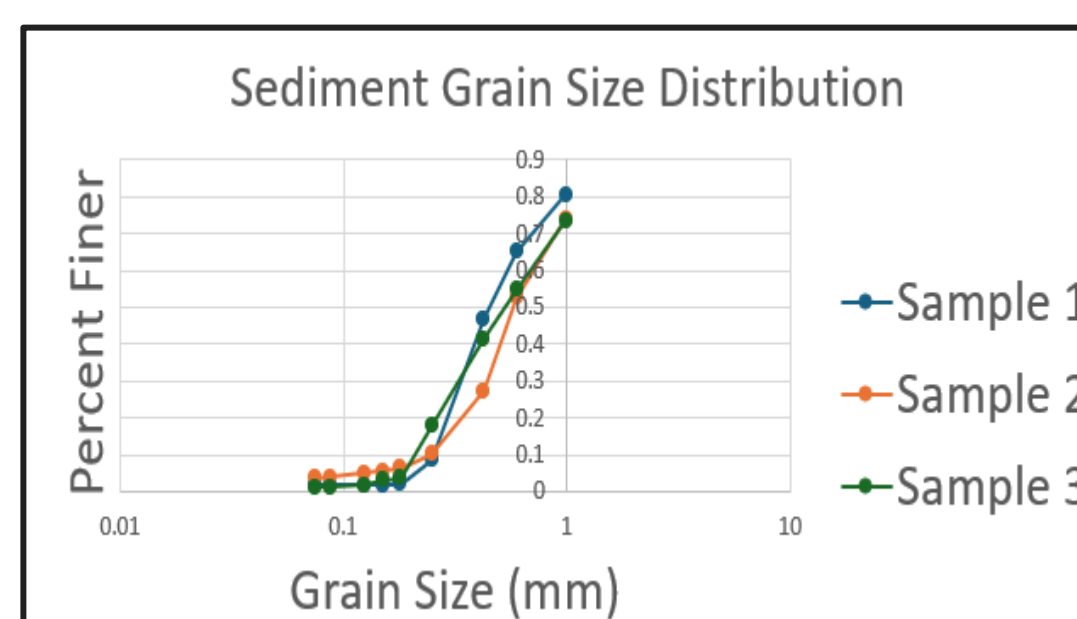


Figure 5. Sediment Grain Size

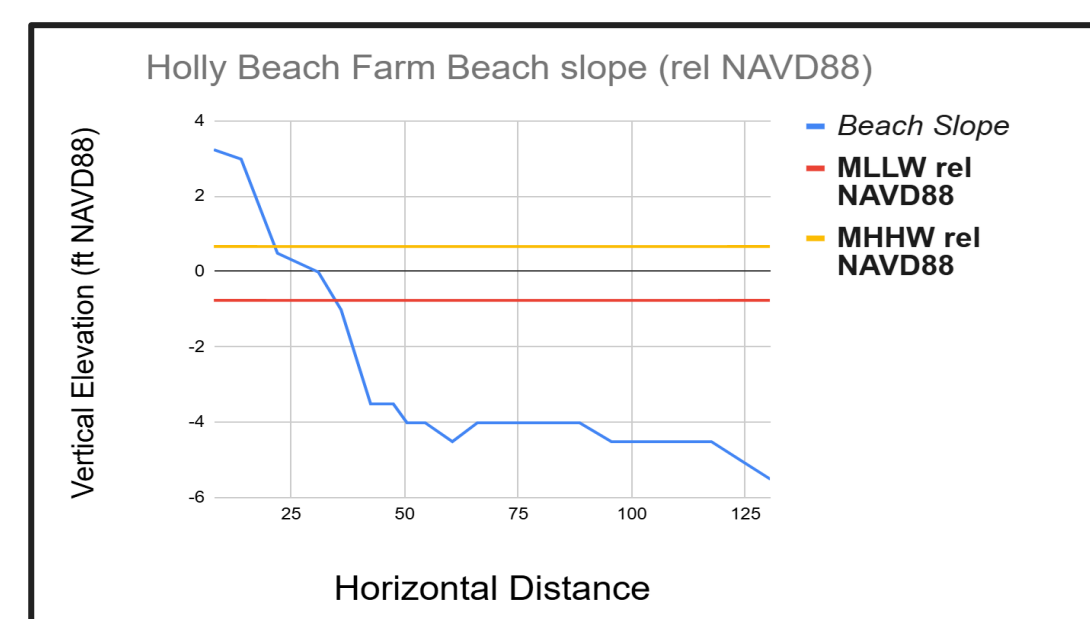


Figure 6. Holly Beach Farm Beach Profile

## Engineering Analysis

### Beach Nourishment

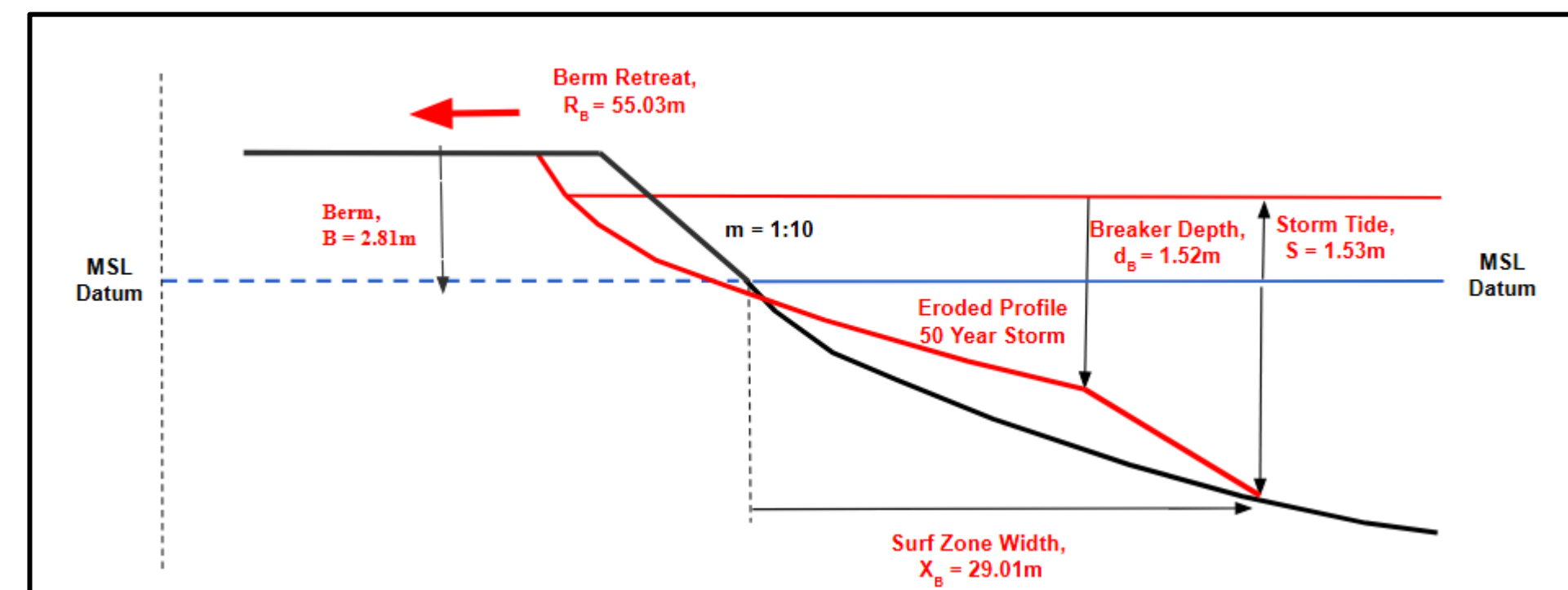


Figure 7. Expected Beach Retreat (Kriebel and Dean, 1993)

Nourishment summary:

- Black lines indicate existing beach
- Red lines indicate updated profile
- Beach Retreat of 5.93m
- 50 meters of width added
- 38212 m<sup>3</sup> of sediment needed

### Living Shoreline

Table I. The Vegetation Treatment Potential (VTP)

FETCH	VTP Analysis					0
	< 0.5 mi	0.5 - 1.4	1.5 - 3.4	3.5 - 4.9	>= 5.0	
8	8	7	4	2	0	0
SHAPE	Coves	Irregular Shoreline	Headland or straight			0
ORIENT	0.5 mi fetch	W to N	S to W	S to E	N to E	2
BOAT TRAFFIC	None	1 - 10 per week	10 - 50 mi	1 - 10 100 yds	> 10 100 yds	3
	5	3	2	1	0	5



Figure 8. Phragmites



Figure 9. Switchgrass

The VTP is an environmental engineering analysis technique that determines if a living shoreline is viable for a coastline.

- Score of 0-13 considered "Poor" conditions for living shoreline
- This results emphasizes the importance of additional wave attenuation measures
- Phragmites/Switchgrass used at a density of 300 stems/m<sup>2</sup>

### Minibay Oyster Balls

$$K_t = 1.616 - 31.322\left(\frac{H_t}{gT^2}\right) - 1.099\left(\frac{h}{d_{rb}}\right) + 0.265\left(\frac{h}{t}\right) = \frac{H_t}{H_i} \quad (1)$$

Table 2. Oyster Ball Equation Variables

H <sub>i</sub>	Incident Wave Height	2m
H <sub>t</sub>	Transmitted Wave Height	0.8m
K <sub>t</sub>	Transmission Coefficient	0.4
d <sub>rb</sub>	Placement Depth of Reef Ball	0.63
h/t	Porosity Coefficient	0.35
h/d <sub>rb</sub>	Submerged depth coefficient	0.8
H/gT <sup>2</sup>	Wave Steepness Coefficient	0.01

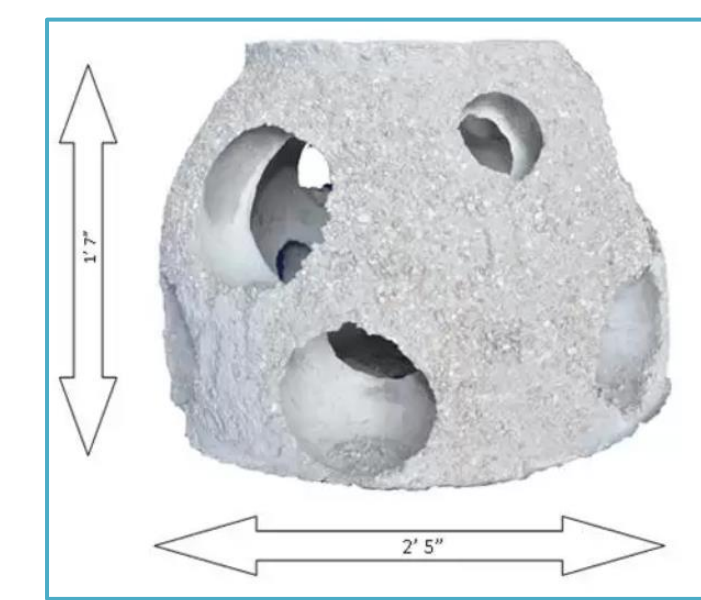


Figure 10. Minibay reef balls

Reefball summary:

- Ideal transmitted wave height of 0.8m
- Necessary model for waves is Minibay Ball dimensions
- Two row model to prioritize wave attenuation and increase total crest width
- Minibay ball ideal for oyster growth and pH range (7.4)

## Final Design

### 1. Full Bulkhead - Repair existing potholes



Figure 11. HBF Full Bulkhead damage

### 2. Degrading Bulkhead - Repair bulkhead and add minibay oyster balls

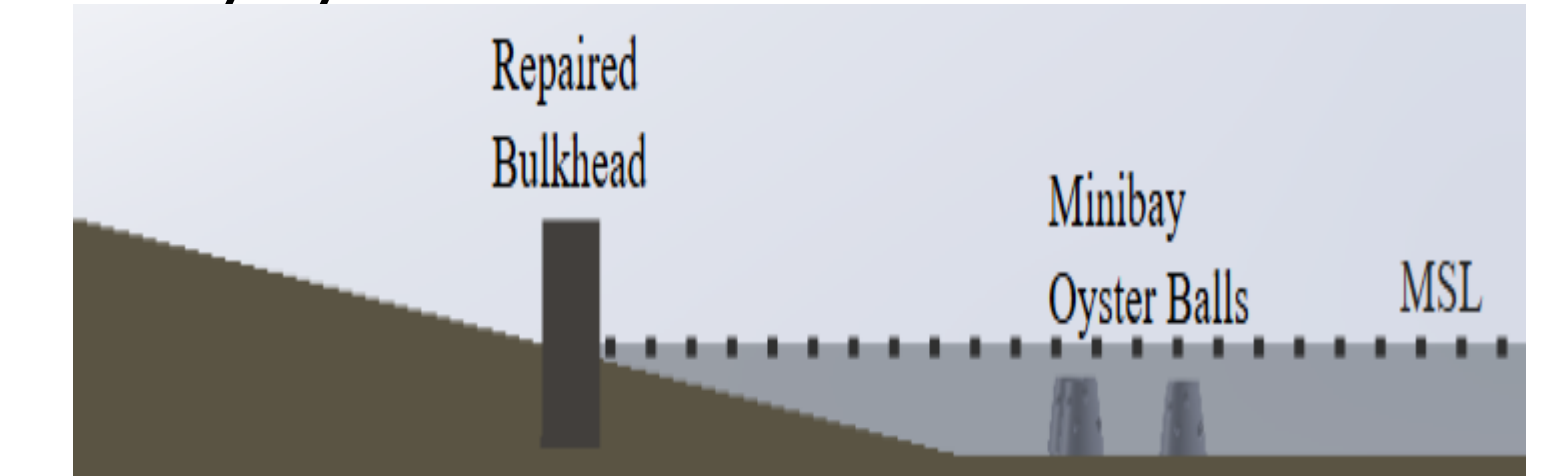


Figure 12. Degraded Bulkhead SolidWorks Drawing

### 3. No Bulkhead - Install Living shoreline, undergo beach nourishment and add minibay oyster balls

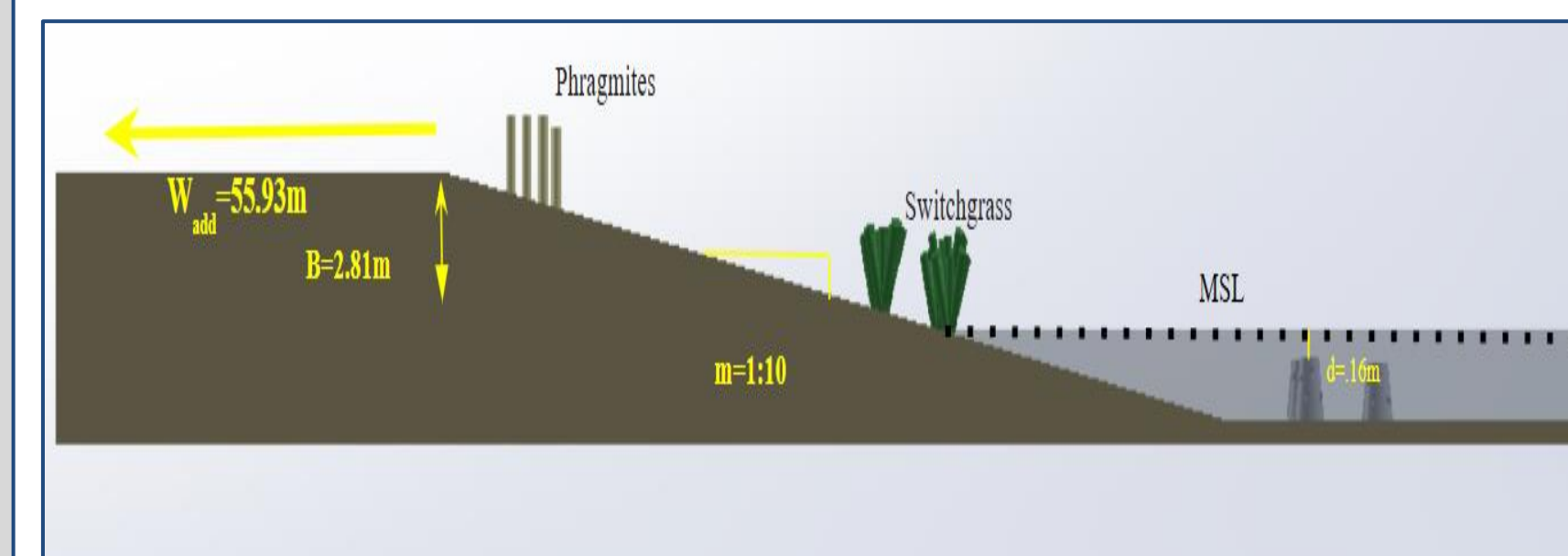


Figure 13. Beach Nourishment SolidWorks Drawing

## Acknowledgements



Client: Maryland Department of Natural Resources

Report and Citations



Technical Advisor: Professor Anna Zaslov