



A Hybrid Living Shoreline Approach to Protect Carrot Island, a NC Estuarine Research Reserve



Introduction





moffatt & nichol

Margaret R Boshek PE Senior Coastal Engineer Moffatt & Nichol Mboshek@moffattnichol.com





Beaufort & the Town Marsh

- > Town of Beaufort
 - Est 1709 3rd oldest town in the state
 - Fishing Village & Port of Safety
- > Town Marsh
 - Included on the
 National Register of
 Historic Place
 - "Needed to Protect the Waterfront and Harbor View of the Town"





Rachel Carson Reserve

- > As an Estuary, it is an Important Natural Habitat.
- > Dedicated Nature Reserve





Photos Ref Rachel Carson Reserve & William Martin

Carrot Island





Carrot Island





Carrot Island – Changing Neighbors





Carrot Island – Current Condition





Funding Overview

- > National Fish and Wildlife Foundation
 - > Emergency Coastal Resilience Funds
 - > Congressionally authorized due to impacts from Hurricane Florence
 - > Funds to be spent by November 2024
 - > Total award = \$1,513,500
 - > NC Land and Water Fund
 - > Restoration implementation (construction)
 - > Funds to be spent by June 30, 2024
 - > Total award = \$400,000







Radio Island Shoreline Restoration Project provided match for the NFWF grant funds and leveraged restoration in the region.



Goals of the Project

- Construct living shoreline features to provide shoreline protection from documented long-term erosion while also helping to restore upland habitat
- The shoreline structure will help <u>stabilize the upland and</u> <u>estuarine marsh habitat</u> by minimizing wave impacts, enhancing sedimentation, and buffering tidal velocities
- Construct a <u>resilient shoreline structure</u> capable of sustaining the flood and wave events
- The proposed project will include a <u>hybrid design to</u> incorporate both natural and structural elements





Living Shoreline Viability



Shoreline Management Model: Preferred Shoreline Best Management Practices

> The Shoreline Management Model assumes that the shoreline is unstable.

12/11/2015

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Living Shorelines





Environmental Conditions

› Water Levels

- > Winds
- > Water Temperatures
- > Waves
- > Currents





Water Levels

ltem	Elevation (ft, NAVD88) NOAA 1983-2001 epoch	Elevation (ft, NAVD88) M&N 2004-2022 epoch			
Highest recorded Water Elevation (09/14/2018)	+5.09	-			
Mean Higher-High Water	+1.46	+1.80			
Mean High Water	+1.17	+1.48			
Mean Sea Level	-0.37	-			
Mean Tide Level	-0.38	-0.09			
Mean Low Water	-1.93	-1.67			
Mean Lower-Low Water	-2.08	-1.88			
Highest Astronomical Tide	+2.61	-			
Lowest Astronomical Tide	-3.12	-			
Lowest Recorded Water Elevation (03/08/2004)	-4.54	-			
Great Diurnal Range	3.54	-			
Mean Range of Tide	3.10	3.15			





Design Water Levels – Normal Conditions

Percent Exceedance	Water Level (ft, NAVD88) M&N 2004-2022 epoch				
99%	-2.51				
95%	-2.00				
MLLW	-1.88				
90%	-1.70				
MLW	-1.67				
75%	-1.09				
50%	-0.10				
25%	0.90				
MHW	1.48				
10%	1.56				
мннw	1.80				
5%	1.90				
1%	2.48				

Design Water Levels for Wetland Platform Creation

- Between -1.7 & 1.56
- Based on survival of estuarine intertidal vegetation.





Design Water Levels – Storm Conditions



Return Period [year]	Elevation (ft, NAVD88)			
1-year	2.5			
2-year	2.9			
5-year	3.4			
10-year	3.9			
25-vear	4.4			

PLUS SEA LEVEL CHANGE!



Return Period [year]	Elevation (ft, NAVD88)			
1-year	2.8			
2-year	3.2			
5-year	3.7			
10-year	4.2			
25-year	4.7			



Wave Modeling





Туре	Annual Probability of Exceedance [%]	Water Level [ft,NAVD88]	Significant Wave Height [ft]	Peak Wave Period [sec]		
Normal	25%	1.2	0.3	1.7		
Normal	10%	1.9	0.4	1.7		
Normal	5%	2.2	0.5	1.8		
Normal	1%	2.8	0.6	2.0		

Туре	Return Period [yr]	Water Level [ft,NAVD88]	Significant Wave Height [ft]	Peak Wave Period [sec]	
Extreme	1	2.8	2.0	2.9	
Extreme	2	3.2	2.2	3.0	
Extreme	5	3.7	2.5	3.1	
Extreme	10	4.2	2.7	3.2	
Extreme	25	4.7	3.0	3.4	



Modeled Wave Transmission Results

 Where transmitted wave heights are greater than 0.5 ft, it is expected that the protected marsh restoration feature could experience erosion



	Annual Prob. of Exceedance [%]	Water	Significant	Peak	Design Crest Elevation [ft,NAVD88]				
Туре		Period I [yr] I	Level [ft, NAVD88]	Wave Height [ft, NAVD88]	wave Period [sec]	1.0 Trans	2.0 smit ed [f	3.0 Wave H t]	4.0 leight
Normal	25%		1.2	0.3	1.7	0.2	0.0	0.0	0.0
Normal	10%		1.9	0.4	1.7	0.5	0.1	0.0	0.0
Normal	5%		2.2	0.5	1.8	0.6	0.2	0.0	0.0
Normal	1%		2.8	0.6	2.0	0.9	0.5	0.1	0.0
Extreme		1	2.8	2.0	2.9	1.2	0.8	0.4	0.0
Extreme		2	3.2	2.2	3.0	1.5	1.1	0.7	0.2
Extreme		5	3.7	2.5	3.1	1.7	1.3	0.9	0.5
Extreme		10	4.2	2.7	3.2	1.9	1.5	1.1	0.7
Extreme		25	4.7	3.0	3.4	2.2	1.8	1.4	1.0



Currents





Currents & Morphology

















Construction & Monitoring

- > Construction: Winter/Spring 2024
- > Monitoring: Spring-Fall Seasons '24-'26
 - > Metrics:
 - Establishment and Expansion of Planted Grasses
 - > Passive Build-up of Sedimentation
 - Establishment of Oysters & Other Aquatic Species
 - > No to Minimal Additional Bluff Erosion
 - Wave Attenuation and Oyster Habitat
 Units Remain Resilient Through
 Storm Events







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- > Rachel Carson Reserve & NC DEQ
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Thank you



Margaret R Boshek PE 984.239.2765 Mboshek@moffattnichol.com

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