Review of Suitable NBS Around Crisfield

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Review Coastal NBS & ID Success Criteria

Reviewed ***>1,000 coastal NBS projects*** yielding ***28 unique NBS*** approaches across ***4 categories***

Study yielded ***"key environmental conditions"*** important to NBS feasibility

Delineate Project Area into Unique Regions

Identified ***16 unique geographical regions*** based on similar soil, land cover, and coastal oceanographic conditions

Evaluate NBS Against Local Environmental Conditions

Determined values for each key environmental condition across unique geographies

Developed algorithmic approach to ***identify suitable NBS for each unique geography***

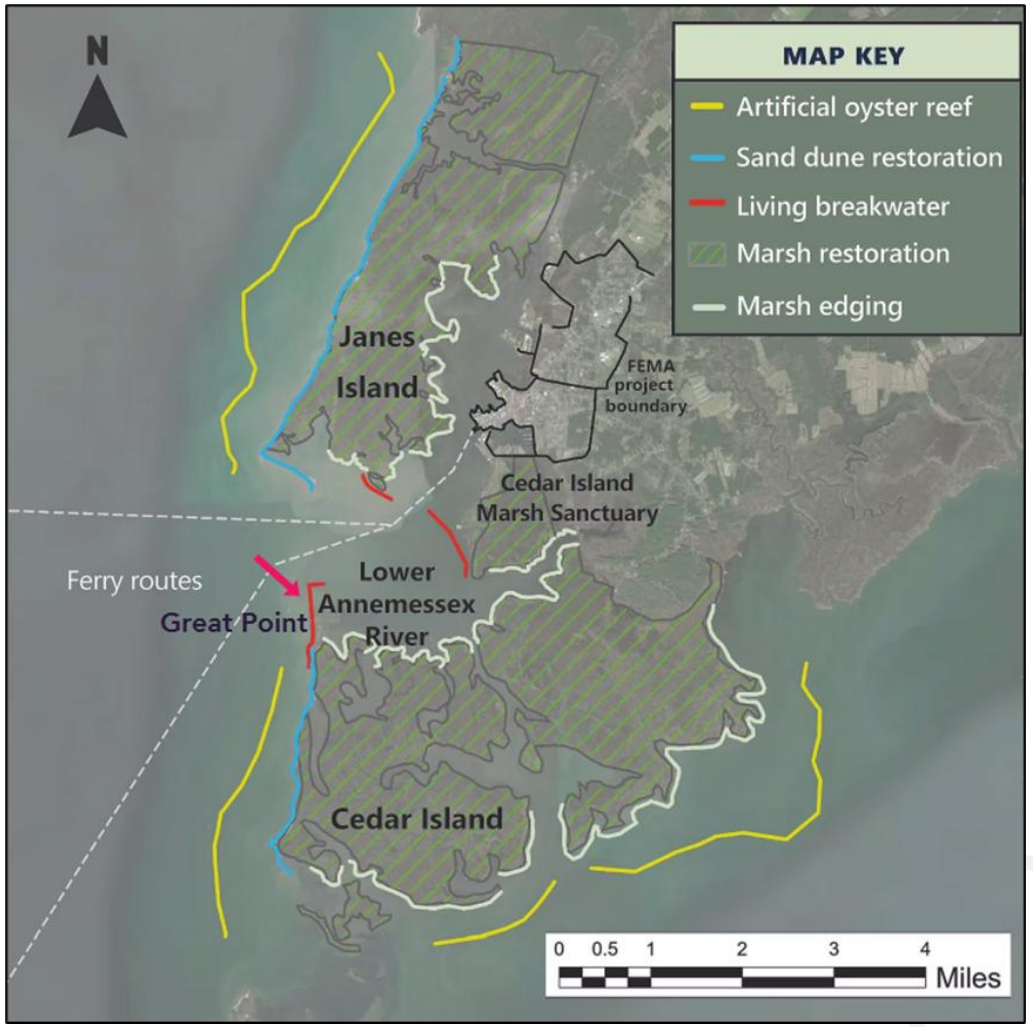
Recommend Region-Specific NBS

Narrowed focus to critical areas for addressing surge, wave, and water level impacts at Crisfield

Suggested 3 suites of NBS across Janes Island, Cedar Island Marsh complex, and Little Annemessex

Broad NBS Categorization

- Marsh Restoration
- Living Shorelines
- Artificial Reefs
- Dune Restoration



Top 6 Proposed Implementable NBS Projects for Crisfield

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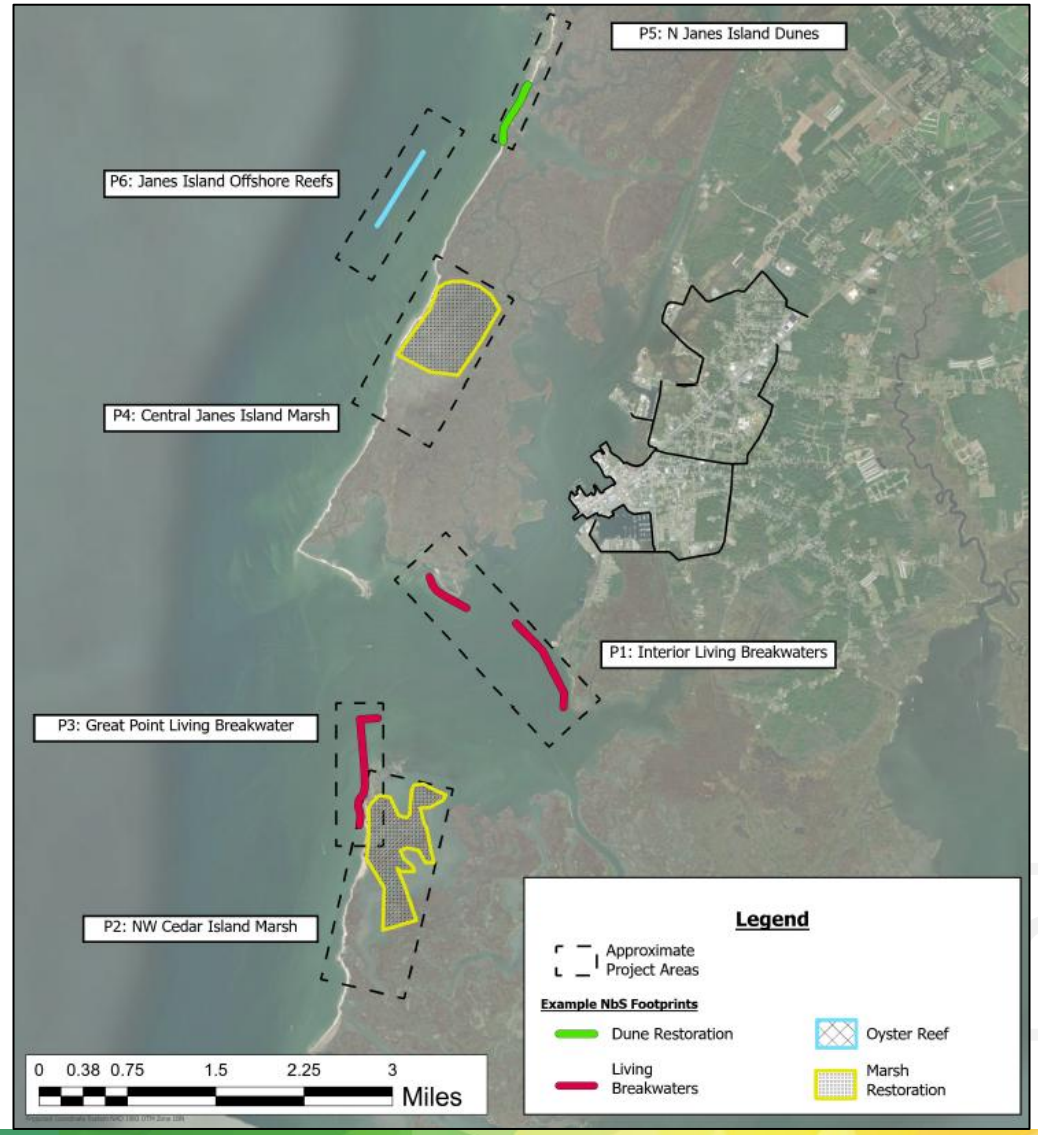
1. Long Point and Cedar Island Marsh Sanctuary ***living breakwaters***
2. Northwest Cedar Island ***marsh restoration*** and edging
3. Great Point ***living breakwater***
4. Central Janes Island ***marsh restoration*** and edging
5. North Janes Island ***dune restoration***
6. Central Janes Island ***offshore oyster reefs***



Crisfield nature-based solutions prioritization

Project Rank & Name	Project Description	Protection for Crisfield prioritization	"Adaptive, Independent, and Additive" prioritization	Benefit-cost prioritization	Total Score
P1: Interior Living Breakwaters	Long Point and Cedar Island Marsh Sanctuary living breakwaters	5	5	3	13
P2: NW Cedar Island Marsh	Marsh creation, restoration, runneling, and edging along the Tangier Sound shoreline of Cedar Island	4	3	4	11
P3: Great Point Living Breakwater	Living breakwater at Great Point with marsh edging along northern shore of Cedar Island	3	5	3	11
P4: Central Janes Island Marsh	Marsh creation, restoration, runneling, and edging along Tangier Sound shoreline of central Janes Island	3	3	4	10
P5: N Janes Island Dunes	Dune restoration along Tangier Sound shoreline of north Janes Island near green kayak trail tidal inlet	2	4	3	9
P6: Janes Island Offshore Reefs	Subtidal oyster reefs along Janes Island bayward of green kayak trail tidal inlet	1	2	5	8

Approximate unit cost for nature-based solution features

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Nature-based solution feature	Unit dimension at median cost	Unit cost (low end)[1]	Unit cost (high end)[1]	Estimated Cost Low	Estimate Median Cost	Estimated Cost High	Notes on cost coverage
Oyster reef	***~33,950 square feet (ft²) [implemented as a series of ten parallel staggered broken lines spaced 3 ft apart]***	$203/lf	$386/lf	$4,208,000.00	**$9,994,000.00**	$15,780,000.00	Ecological baseline assessment, design, permitting, restoration materials (oyster substrate), labor, monitoring, and maintenance
Dune restoration	***~2,855 linear feet (ft)***	$2,000/lf	$5,000/lf	$5,710,000.00	**$9,992,500.00**	$14,275,000.00	Ecological baseline assessment, design, engineering, permitting, materials (e.g. plants), equipment for purchase or lease, and monitoring
Marsh restoration	***~263 acres (ac)***	$16,000/ac	$60,000/ac	$6,891,850.00	**$9,998,275.00**	$13,104,700.00	Ecological baseline assessment, design, engineering, permitting, materials, equipment for purchase or lease, monitoring, labor and maintenance
Living breakwater	Preliminary dimensions and costs of these breakwaters are evaluated in a United States Army Corps of Engineers feasibility study (USACE 2012). The following are the breakwater lengths as modeled: Great Point (~5,700 lf), Interior Breakwaters (~6,700 lf). Costs for breakwaters can greatly **exceed $1,000/lf**.			**Alternative 1, Option B** of the USACE study includes breakwaters at Great Point and Long Point/Cedar Island Marsh Sanctuary for a total cost of **$9.2M.** Due to its age, this estimate is included only for demonstration purposes only. Based on a $2,000/lf cost: Great Point (**~$11.4M**) and Interior Breakwaters (**~$13.4M**)			USACE Cost for Great Point, Long Point, and Cedar Island Marsh Sanctuary Breakwaters[2].

- [1] Spread in completed project costs reported in the NOAA green infrastructure effectiveness database (NOAA 2025b).
- [2] Note that the cost is outdated by around 12 years.

Long Point and Cedar Island Marsh Sanctuary (interior) living breakwaters

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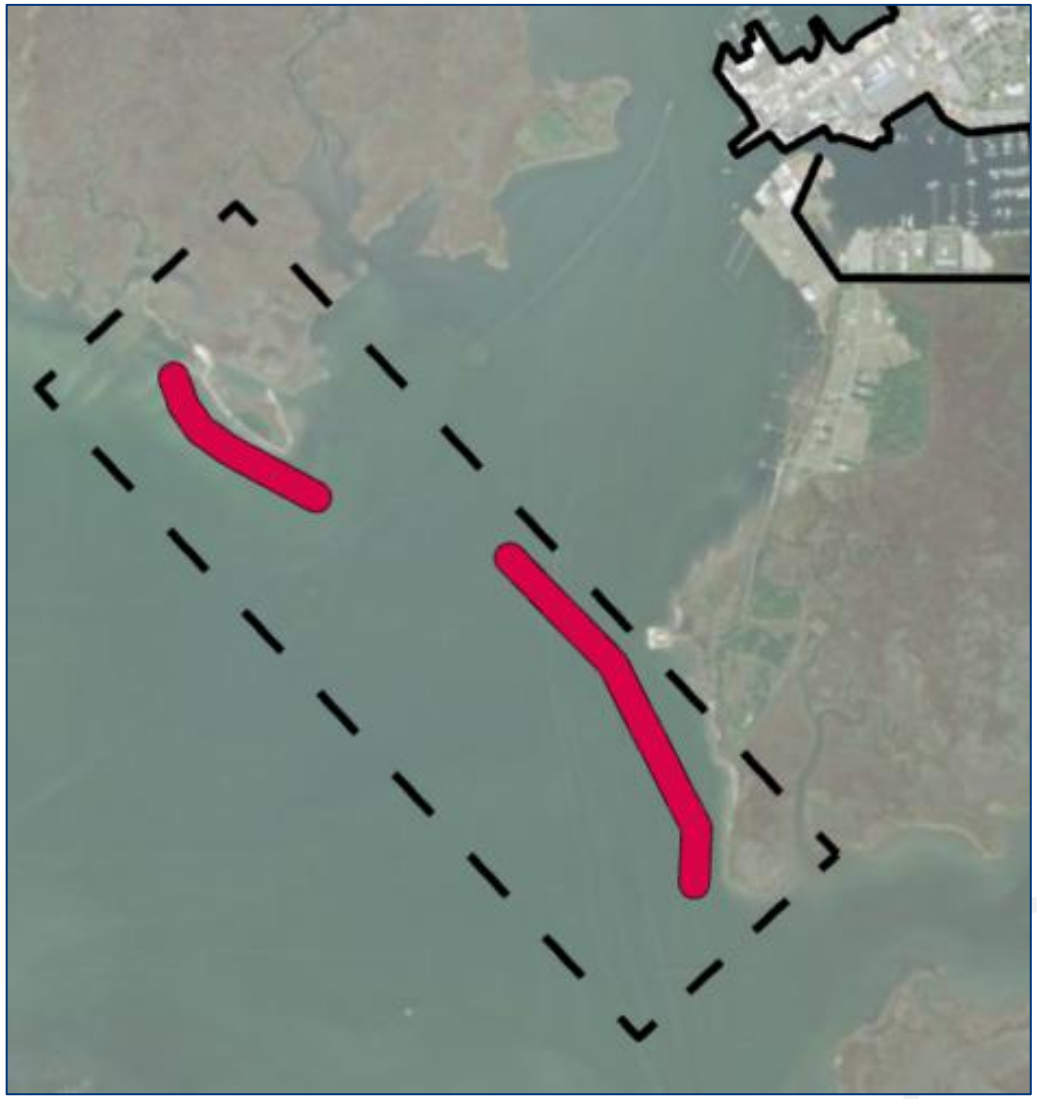
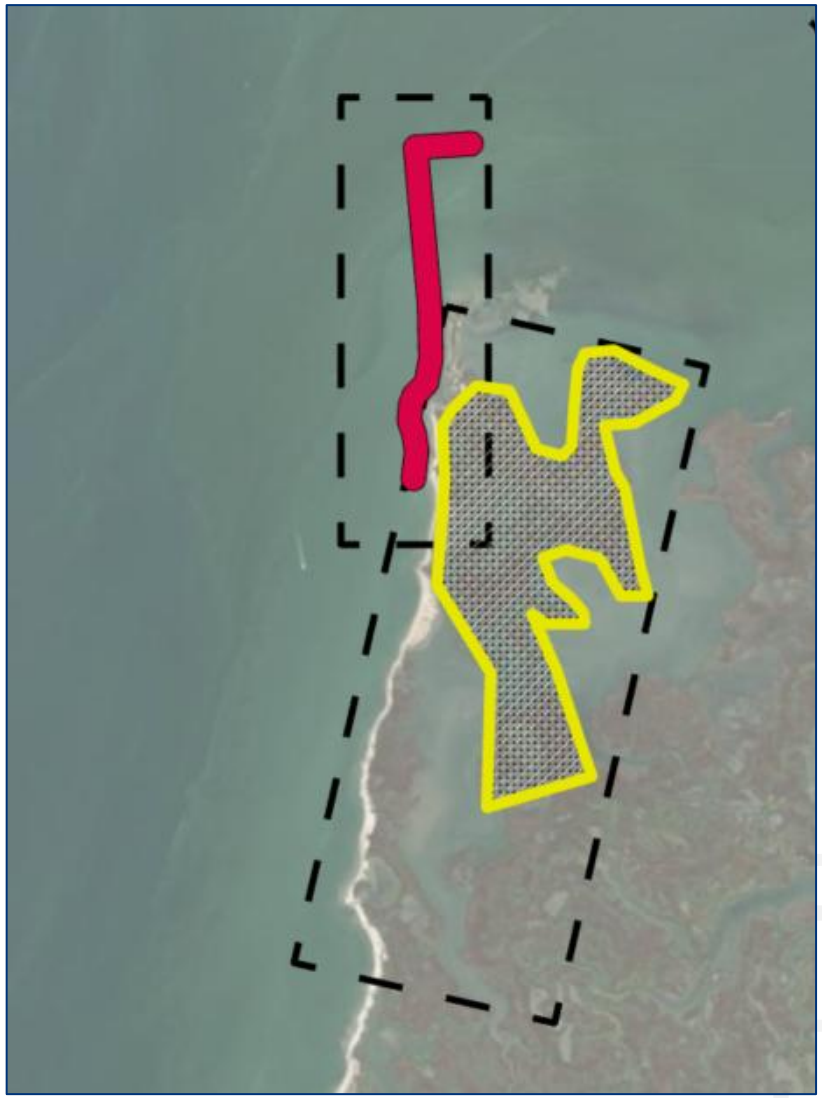
- Wave height reductions to Crisfield's shorefront are most substantial compared to all other solutions.
- Can be implemented as standalone projects within an adaptive management framework.
- Capital expense can be high, but can support local oyster and seagrass recruitment.



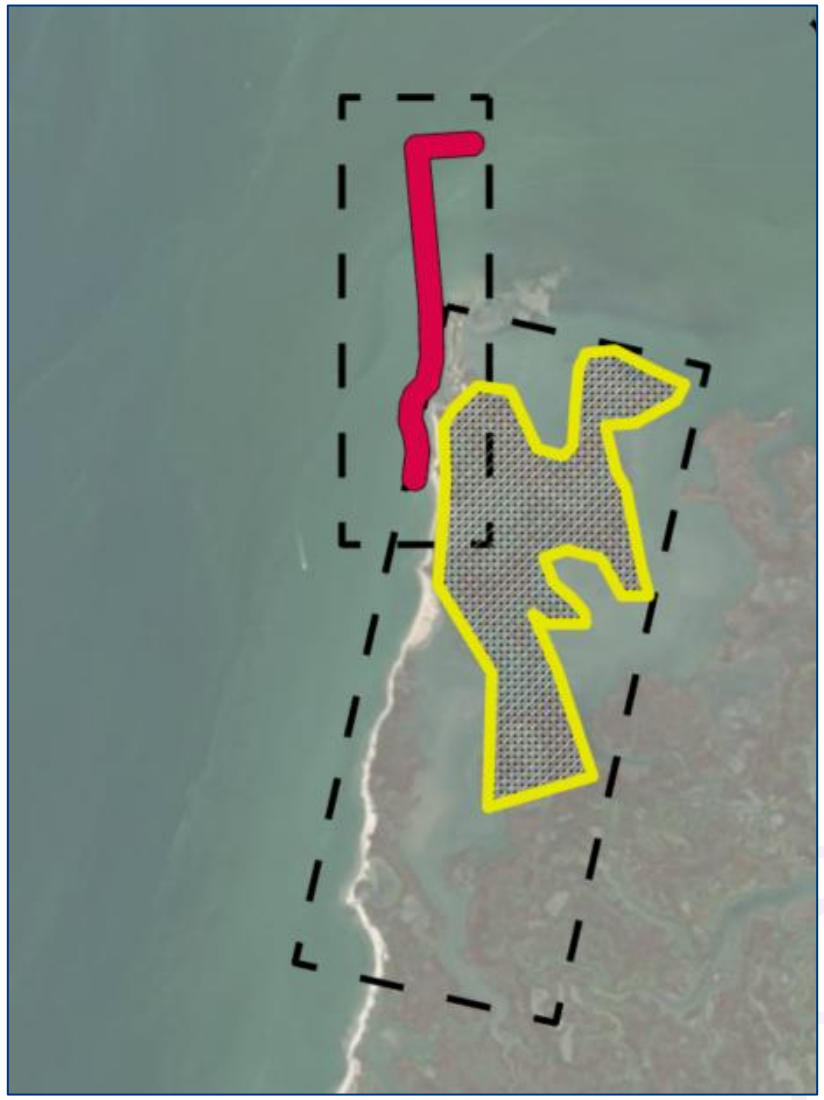
Northwest Cedar Island marsh restoration and edging

- High wave reduction benefits. Geographically important to shielding Crisfield from coastal hazards.
- Would benefit from the presence of barriers such as dunes or breakwaters to mitigate edge erosion.
- Can be expensive to implement and maintain over time, but can support local biodiversity.



Great Point living breakwater

- Moderate wave reduction benefits. Protects, restores, and enhances important geographic feature. May reduce erosion within Little Annemessex.
- Can be implemented as standalone projects within an adaptive management framework.
- Capital expense can be high, but can support local oyster and seagrass recruitment.



Central Janes Island marsh restoration and edging

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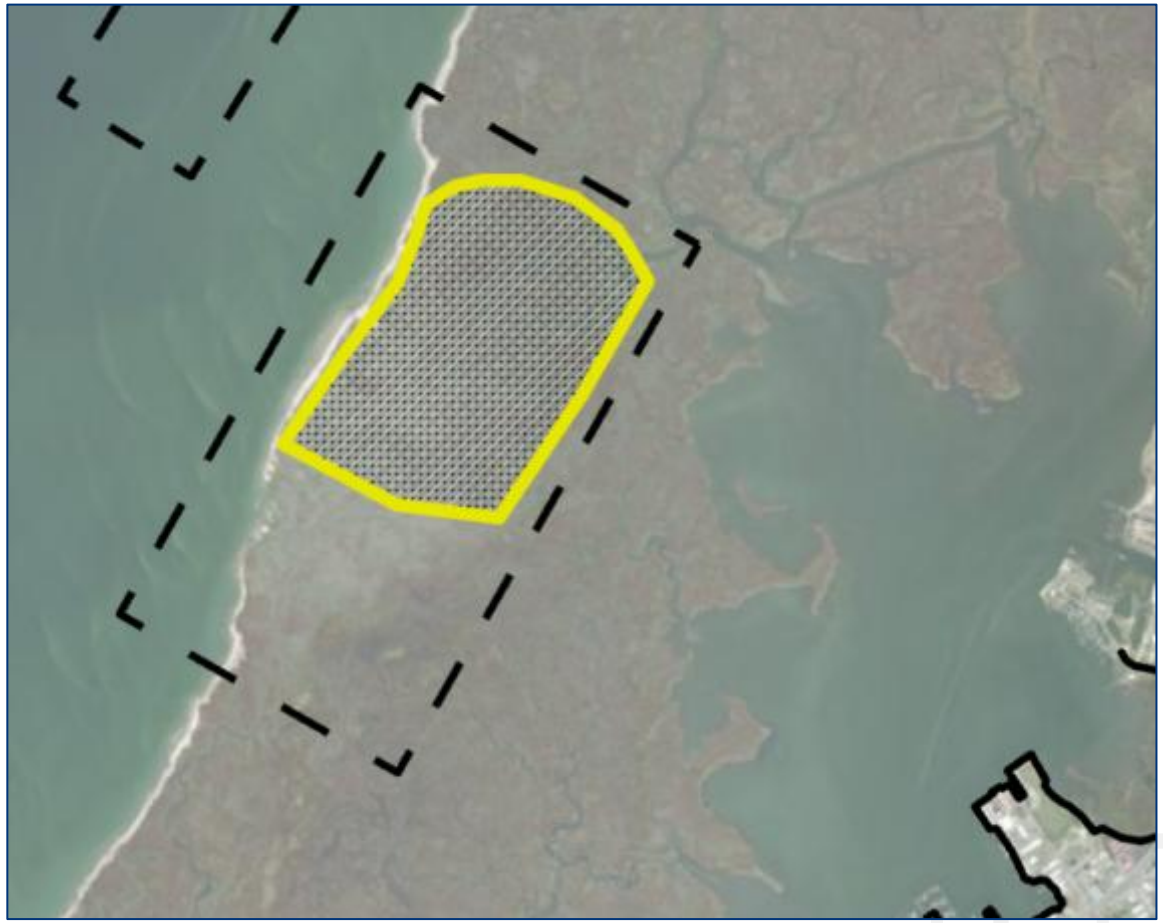
- Moderate wave reduction benefits. Marsh highly degraded and in geographically “thin” point along Janes Island.
- Would benefit from the presence of barriers such as dunes or breakwaters to mitigate edge erosion.
- Can be expensive to implement and maintain over time, but can support local biodiversity.



North Janes Island dune restoration

- Local erosion reduction. In area of high erosion potential and possible breaching.
- Can be standalone project combining beach nourishment with dune restoration. Can be supported by marsh fringe vegetation and offshore reefs.
- Can be very expensive to implement and maintain over time, but can support local biodiversity and recreation.

Central Janes Island offshore oyster reefs

- Local wave height and erosion reduction due to oyster reefs is most substantial here, but relatively low compared to other NbS.
- Success depends on local habitat suitability. Will function independently but serve as an additive feature within an adaptive management framework.
- Moderately expensive to implement and maintain, and can improve local water quality and support biodiversity