A Co-Benefit Approach to Prioritizing Lands for Coastal Resilience

Center for Coastal Resources Management
Virginia Institute of Marine Science

VIMS | William & Mary
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Increasing use of natural and nature-based features to build resilience to storm-driven flooding

Natural and Nature Based Features (NNBF)

Natural and Nature-Based Features (NNBFs)

- Beach
- Dune
- Forest
- Tree
- Scrub-Shrub
- Non-Tidal Forested Wetland
- Non-Tidal Scrub-Shrub Wetland
- Non-Tidal Emergent Wetland
- Tidal Marsh
- Living Shoreline: Oyster Sill
- Living Shoreline: Marsh Sill
- Living Shoreline: Breakwater

Identify NNBFs that enhance flood resilience-

Capacity of NNBFs to mitigate coastal flooding:

What are the characteristics of each NNBF that slow water movement, allow flood waters to infiltrate, and dampen wave energy?

Newsworks.org

Coastal wetlands can act like 'shag carpet' during a hurricane — NewsWorks

Living shoreline project in Gloucester. Photo: Karen Duhring

"…Because of their vegetation, the marshes act like shag carpeting, dampening the energy of a wave before it reaches land."
- Lenore Tedesco, PhD, executive director of The Wetlands Institute in Stone Harbor.

Diane Stopyra, April 30, 2016WHYY in Philadelphia
https://whyy.org/articles/coastal-wetlands-can-act-like-shag-carpet-during-a-hurricane/

Approach to increase NNBF Use

Step 1. Model flood benefits:

NNBF Capacity ⟶ Flooding Resilience

Step 2. Add water quality and socio-economic benefits

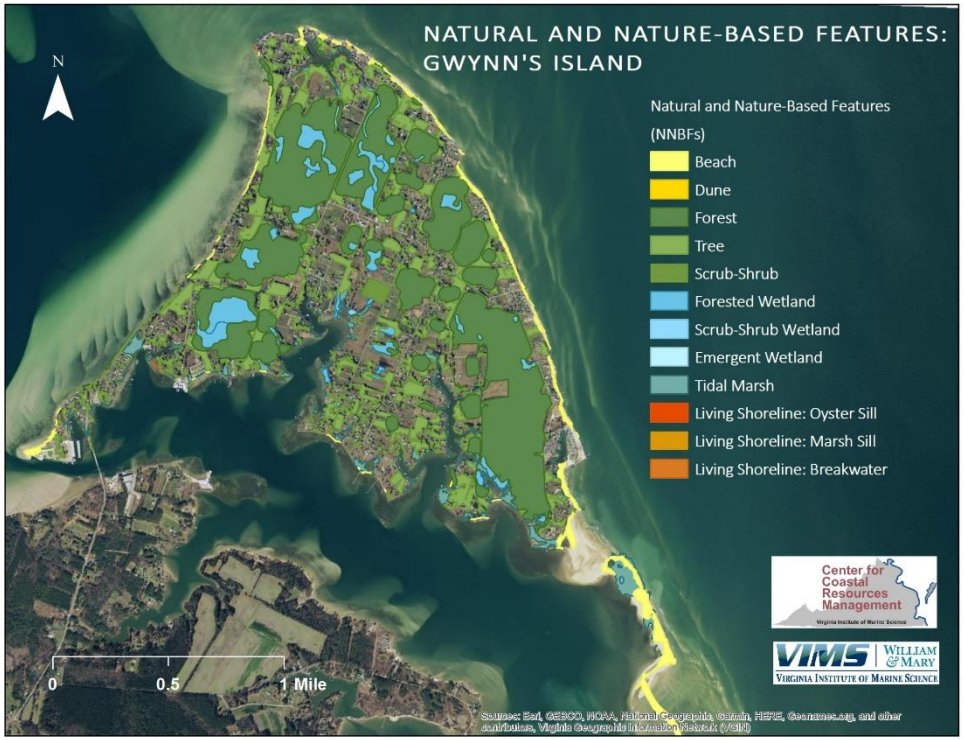
NNBF + TMDL/ Stormwater & Community Rating System/ FEMA Credits ⟶ Co-benefits

Step 3. NNBF Flood Mitigation + Co-Benefits = Priority land for protection

Step 4. Unprotected flood areas + Co-benefits = Priority areas for Restoration & Creation

Step 1: Model NNBFs flood mitigation benefits

Use of Natural and Nature-Based Features (NNBFs) to Build Resilience to Coastal Flooding



Goals of the project:

- Map/Inventory 350,000 NNBFs across the coastal region
- Identify those NNBFs that enhance flood resilience to about 190,000 buildings in coastal areas
- Identify the co-benefits generated by NNBFs
  - Ecologic – water quality
  - Socio-economic – CRS FEMA
- Identify those NNBFs that provide multiple benefits for communities

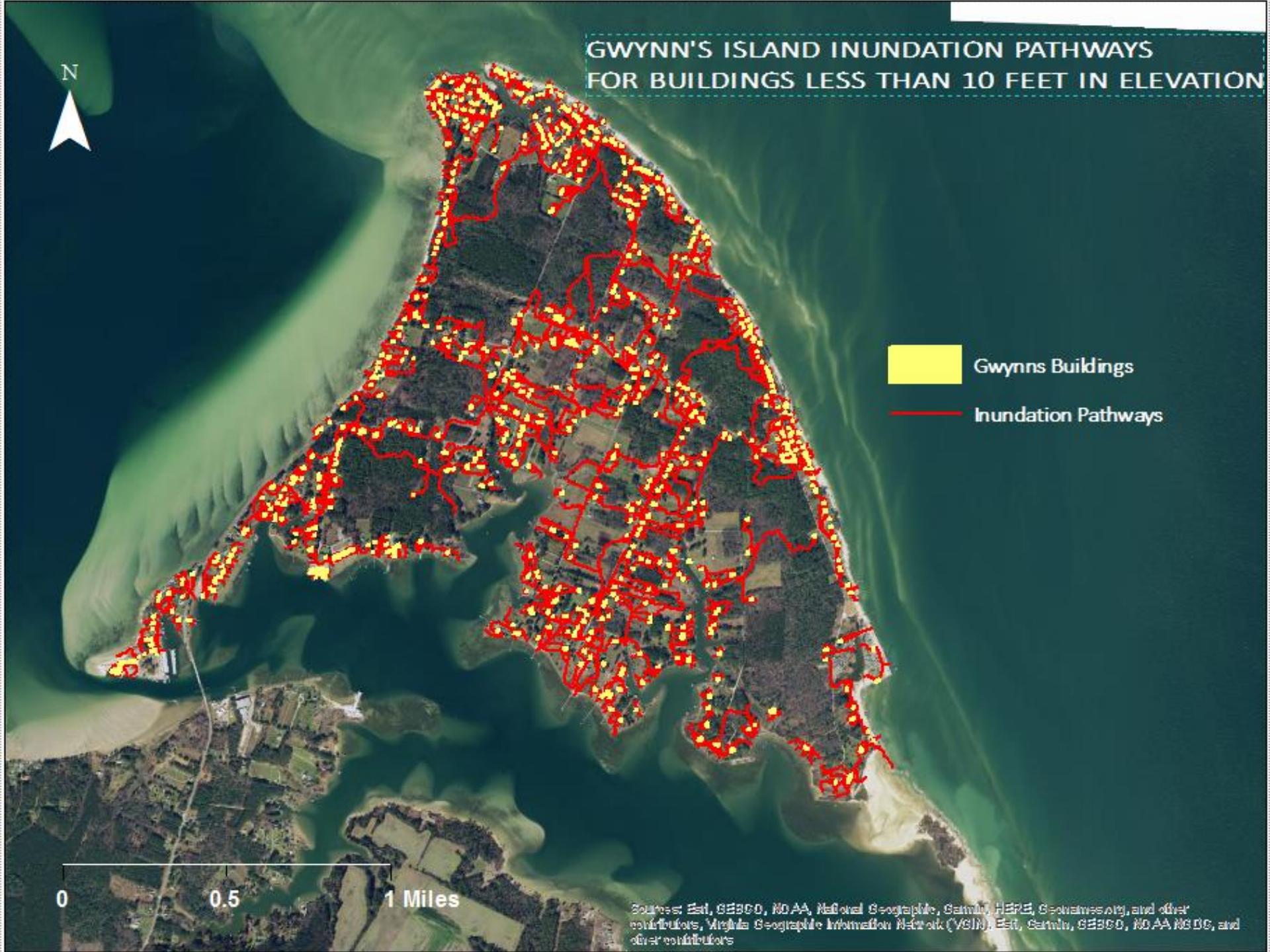
How do we link NNBFs with the buildings they benefit?

Inundation Pathways (IPs)

Gwynn's Island, Mathews

Inundation Pathways represent lowest areas where flooding waters would begin to flood onto the land and approach buildings

- for more than 190,000 primary buildings in the coastal area @ less than 10 feet in elevation
- pathways based on land elevation derived from LIDAR data


GWYNN'S ISLAND INUNDATION PATHWAYS
FOR BUILDINGS LESS THAN 10 FEET IN ELEVATION
N
Gwynns Buildings
Inundation Pathways
0
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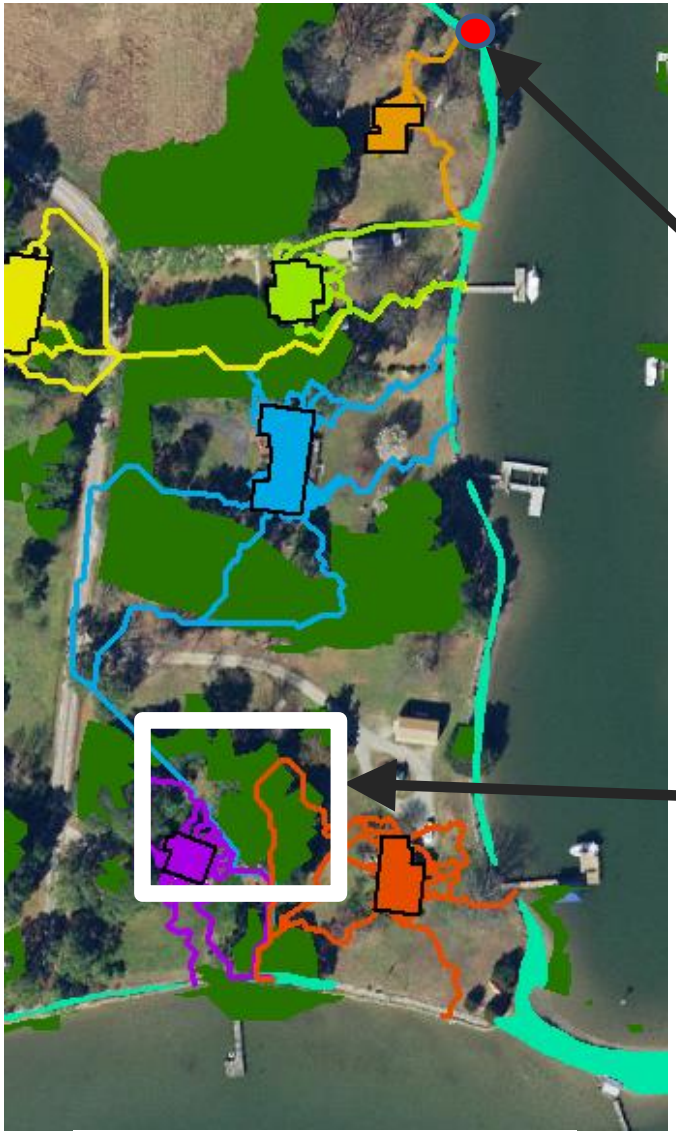
1 Miles
Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors, Virginia Geographic Information Network (VGIN), Esri, Garmin, GEBCO, NOAA NGDC, and other contributors

How to we link NNBFs with the buildings they benefit?

Inundation Pathways (IPs)



Gwynn's Island, Mathews

Inundation Pathways

For each building, we can count the number and types NNBFs that affect it

- *This building is benefitted by 1 NNBF (a tidal marsh)*

For each NNBF, we can count the number of buildings it affects

- *This tree area benefits 3 buildings*

NNBF Feature Types (in this map):
- Tidal Marsh
- Tree

Step 3: Prioritize NNBFs for protection

Score and rank NNBFs based on:

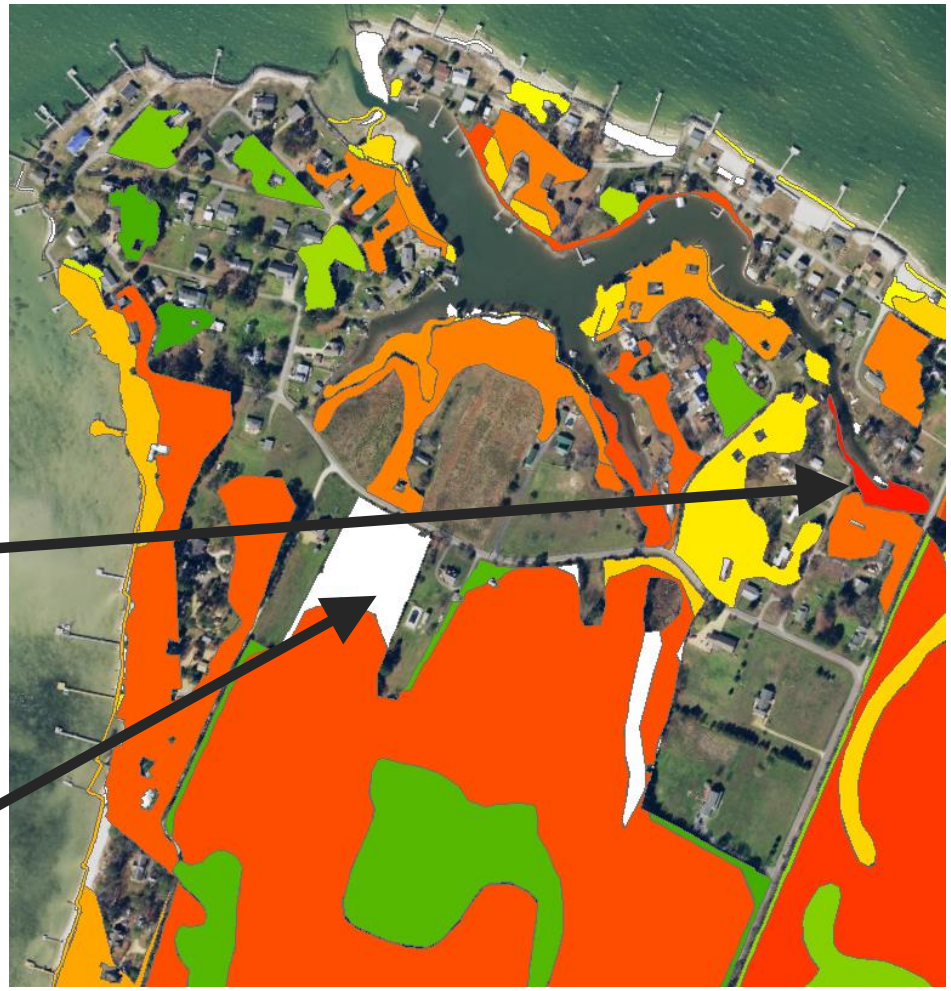
1. Ability to mitigate flooding
   - Elevation = frequency of encountering flooding events
   - Capacity of NNBF type to mitigate flooding (e.g., ability to dampen waves)
2. Number of buildings the NNBF affects
3. Socio-economic co-benefits provided or potential

Tidal Marsh NNBF = High Benefit
Low elevation = high frequency to intercept flood water
Good capacity to mitigate flooding
Benefits 32 buildings
Offers water quality benefits and CRS credits

Wooded NNBF = Low Benefit
High elevation = low frequency of flood
Good capacity to mitigate flooding
Affects 0 buildings
Out of RPA, no WQ or CRS credit avail.

NNBF Flooding Mitigation Value

White = Zero score, Green = low score, Red = high score



Gwynn's Island, Mathews

Step 4: Target areas for NNBFs creation or restoration

Identify areas with buildings that receive no or low benefit from NNBFs, and have potential for co-benefits

Town of Cape Charles

500+ buildings.

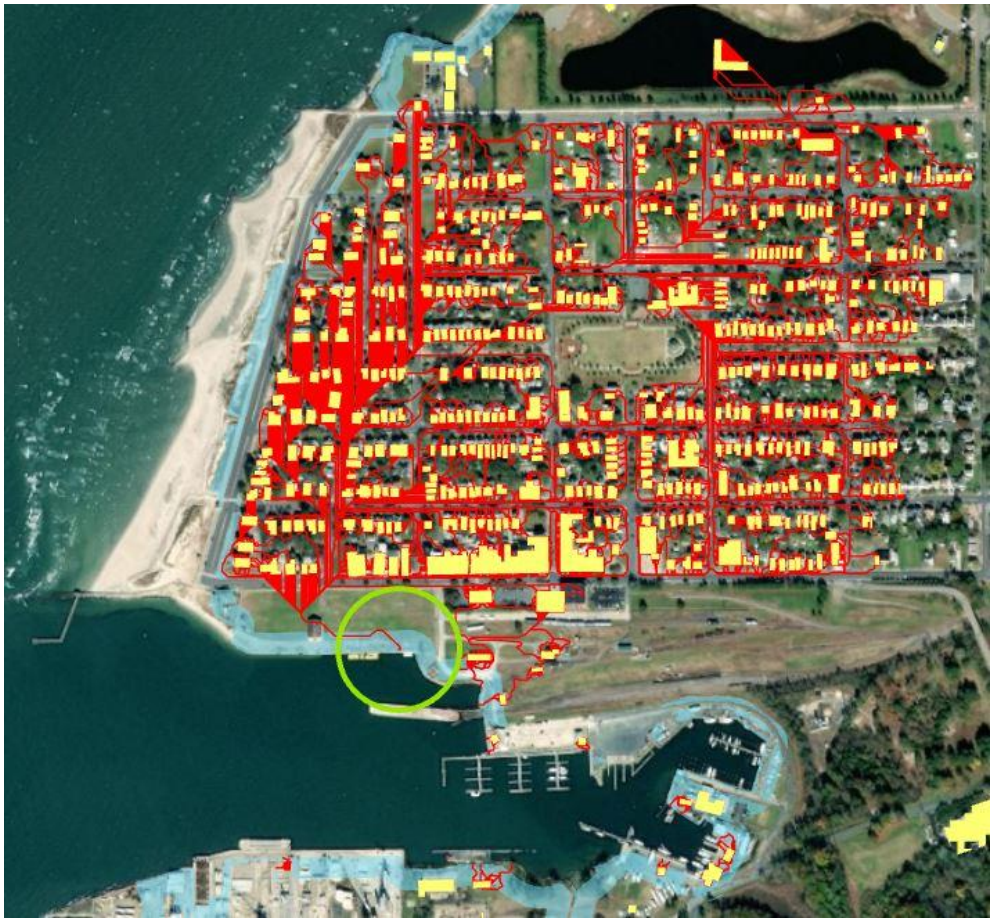
Many shared Inundation Pathways

Lowest elevation could be priority for new NNBFs

Additional NNBFs priorities can be along IPs that protect:

- Important infrastructure: Schools, Hospitals, Shelters, etc
- Clusters of buildings

Step 4: Target areas for NNBFs creation or restoration



Town of Cape Charles

Lowest elevation could be priority for new NNBFs

Areas along the shore and within the FEMA floodplain may also qualify for:

- Flood Insurance Premium reductions via the Community Rating System

AND/ OR

- TMDL/ Stormwater credits

Take Home Points

- Identifies Natural and Nature Based Features that provide flood mitigation benefits
- Identifies areas lacking NNBF flood mitigation benefits
- Incorporate water quality and flood insurance services into the assessment for existing features
- Can target locations for NNBF creation/ restoration to maximize multiple benefits
- Supports the preservation and implementation of NNBF features as a component of coastal community resilience