

Prioritizing natural and nature-based features (NNBFs) that increase the resilience of coastal communities to flooding

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NNBFs that enhance coastal flooding resilience

Goals

With a NOAA Coastal Resilience Grant, our goals:

1. Support the preservation and creation of natural and nature-based features (NNBFs) as a component of coastal community resilience
2. Incorporate water quality and flood insurance services into the assessment for existing features
3. Support localities' decision-making by:
 - Identifying NNBFs that provide multiple benefits
 - Identifying target areas for new NNBF creation/restoration



NNBFs that enhance coastal flooding resilience

Goals

Three primary steps:

1. Map existing natural and nature-based features (NNBFs) and buildings at less than 10 feet elevation in the coastal zone
2. Identify and rank existing NNBFs that provide multiple benefits for communities
3. Identify target areas for new NNBFs to improve flood resilience



NNBFs that enhance coastal flooding resilience

Map Existing NNBFs and buildings

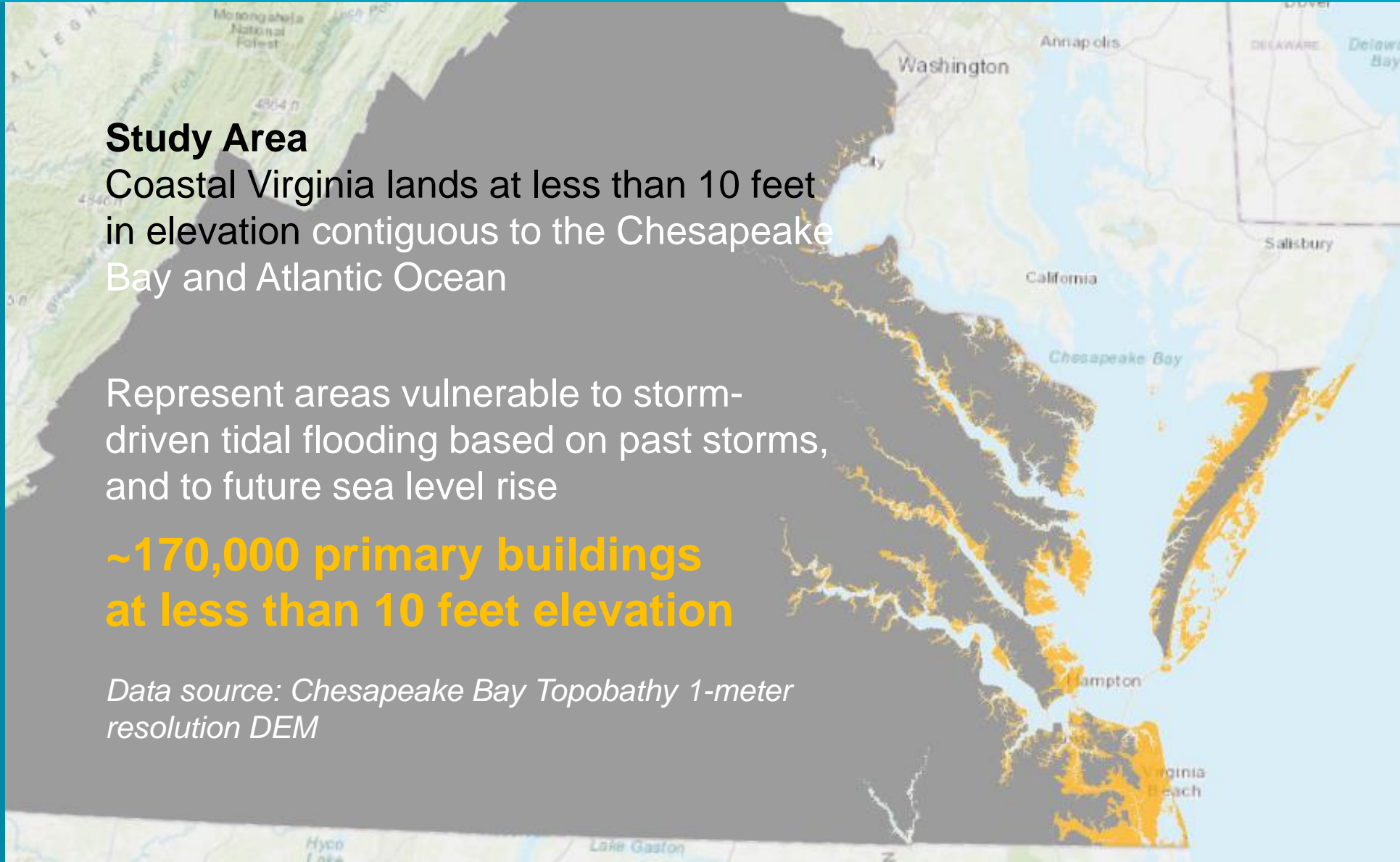
Study Area

Coastal Virginia lands at less than 10 feet in elevation contiguous to the Chesapeake Bay and Atlantic Ocean

Represent areas vulnerable to storm-driven tidal flooding based on past storms, and to future sea level rise

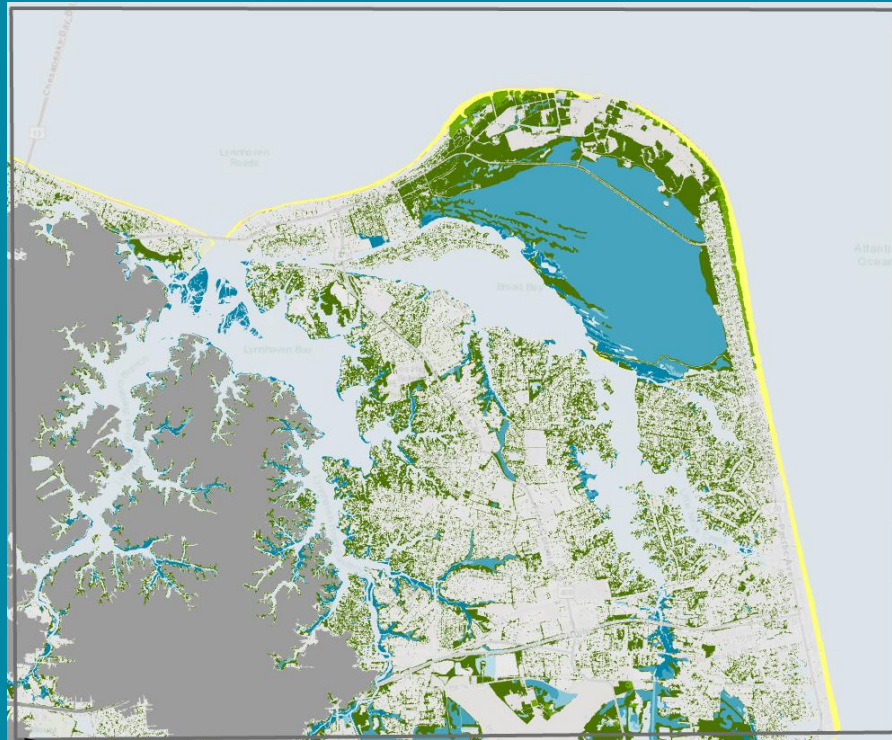
~170,000 primary buildings at less than 10 feet elevation

Data source: Chesapeake Bay Topobathy 1-meter resolution DEM

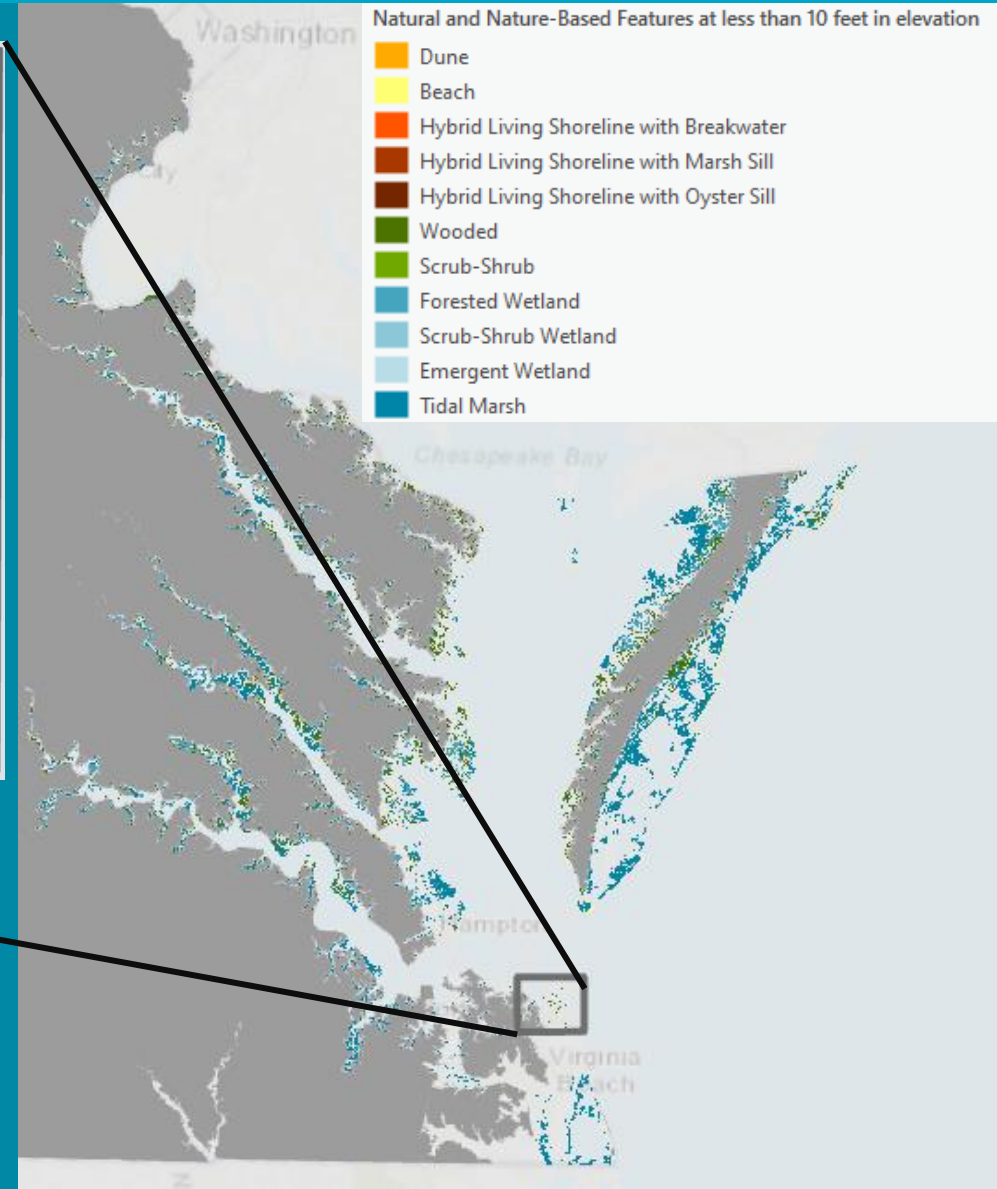


NNBFs that enhance coastal flooding resilience

Map Existing NNBFs and buildings



**~ 350,000 NNBFs within
study area**



NNBFs that enhance coastal flooding resilience

Identify NNBFs that provide multiple benefits



How do we link NNBFs with buildings that they benefit?

Inundation Pathways (IPs)

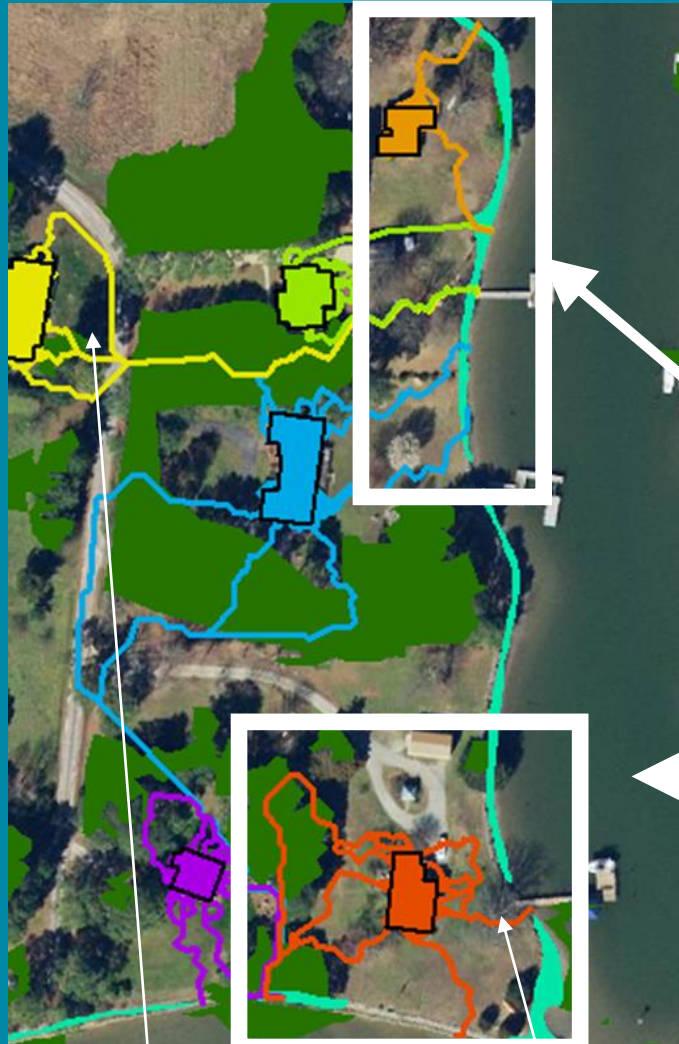
...depict lowest elevation areas connecting the shoreline to buildings.

IPs represent where rising waters begin to flood onto the land, but *do not represent flooding extent*.

IPs depicted as multicolored lines. Building footprints are outlined in black.

NNBFs that enhance coastal flooding resilience

Identify NNBFs that provide multiple benefits



Building footprint

Inundation Pathway (IP)

Using these IPs, we can find NNBFs that lie between the shoreline and building and in the path of rising water

For each NNBF, count the number of building IPs that intersect

→ This NNBF (tidal marsh) benefits 4 buildings

For each building, count how many NNBFs intersect its' IP

→ This building receives benefits from 2 NNBFs (a tidal marsh and a wooded area)

NNBF Types (on this map):

 Tidal Marsh

 Wooded

NNBFs that enhance coastal flooding resilience

Identify NNBFs that provide multiple benefits

NNBF Ranking

Four components or measures:

1. NNBF flooding mitigation services
2. How many buildings does the NNBF benefit?
3. Are there any critical community facilities the NNBF benefits?
4. **Can the NNBF be used to take advantage of existing programmatic incentives?**

Each NNBF is assigned a normalized score of low, medium, or high for each of these four components.

Overall NNBF Score for Priority Ranking: Add score for each category			
	low	medium	high
1. NNBF Total Capacity <i>Flooding mitigation potential based on elevation and feature type.</i>	0-0.0008 (1-33 percentile)	0.008-0.4 (33-66 percentile)	>0.4 (66-100 percentile)
2. Number of buildings impacted <i>Number of buildings that the NNBF benefits.</i>	0	1 building	>= 2 buildings
3. Critical Facility Benefit <i>Does the NNBF benefit a community critical facility?</i>	no		yes
4. Co-Benefits Potential <i>Potential for NNBF to be used in incentive programs.</i>	0	1 cobenefit	>=2 cobenefits
Score	1	2	3

NNBFs that enhance coastal flooding resilience

Identify NNBFs that provide multiple benefits

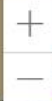
Identify NNBFs that may be used to take advantage of incentives


1. FEMA Community Rating System (CRS) credits. Potentially qualifying NNBFs are in 100-year flood zone Special Flood Hazard Area and overlay the Resource Protection Area (RPA) or RPA 100-ft buffer

- Undeveloped set-aside lands in the Special Flood Hazard Area (SFHA).
- Land must have some level of protection: Regulatory or Property ownership
- Resource Protection Area Buffer considered Regulatory Protection
- CRS Potential = all open space in SFHA and the Resource Protection Area 100 foot buffer

2. Water quality/TMDL credit potential – N, P, TSS reductions. All NNBFs except for beaches and dunes

- NNBFs provide water quality services to varying degree dependent on intrinsic factors and location
- Within the study area and proximal to the shore
- Assumed all NNBF features other than beach and dune provide service
- Existing Chesapeake Bay Program approved BMPs for tidal and nontidal wetlands and riparian buffers

**Infrastructure**

- ☐ General Infrastructure 
- ☒ Infrastructure at less than 10 feet land elevation
 - ☒ Critical Facilities 
 - ☒ Coastal Buildings 

Layer Information**Coastal Buildings**

This layer depicts primary building footprints (buildings greater than 870 square feet footprint size) located on lands that are generally less than 10 feet in elevation (NAVD88) in the coastal zone.

Data Sources: VGIN Virginia Footprint Dataset (2017) and Virginia Land Cover Dataset (2016)

Sea Level Rise / Flooding
/ Storm Surge

Vulnerability / Risk

Infrastructure

Shoreline Management

Natural Resources

Protection / Restoration
Opportunities

Legend

Tools

How To

Int-High
SLR
scenario

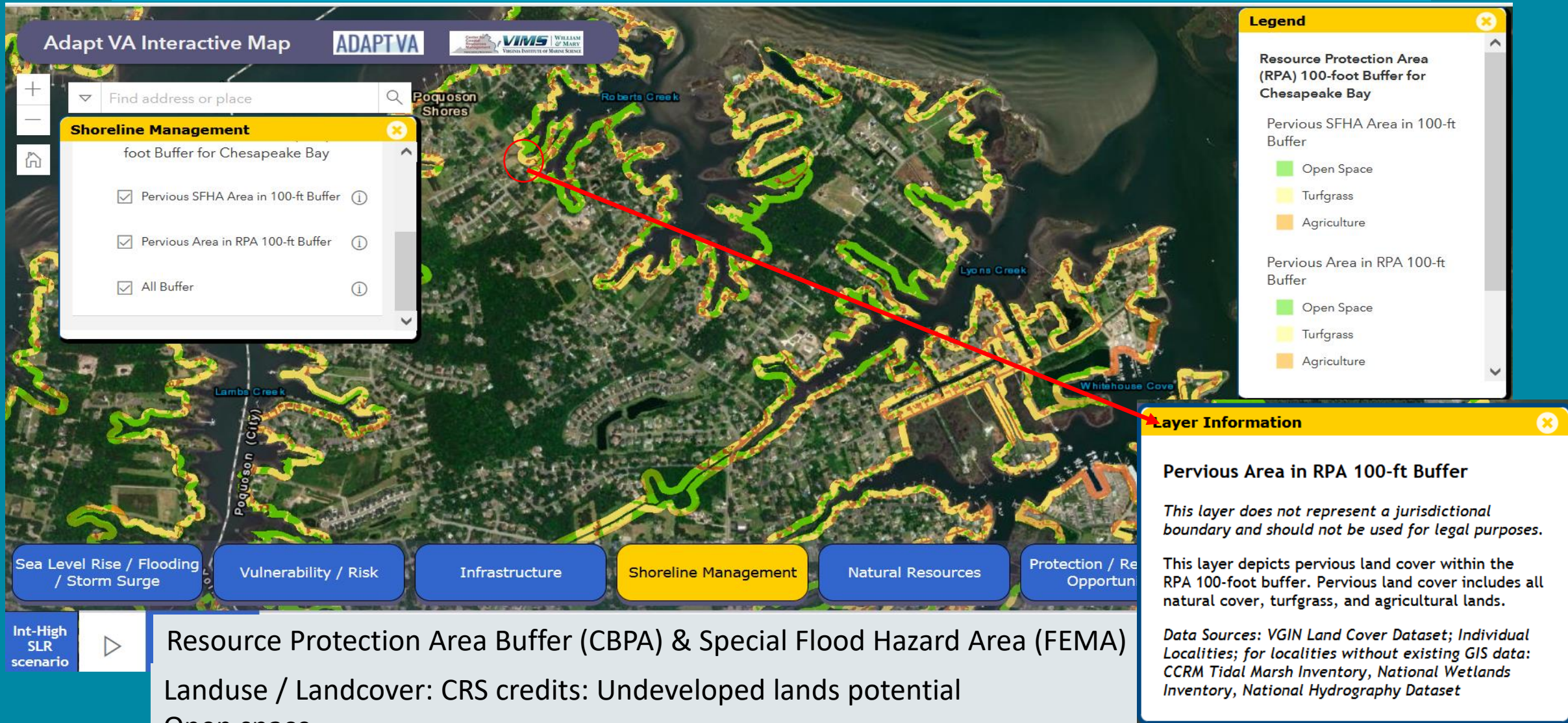
NNBF Study Area: Buildings on land elevation less than 10 feet
Critical Facilities

Beige mask is lands with elevation greater than 10 feet



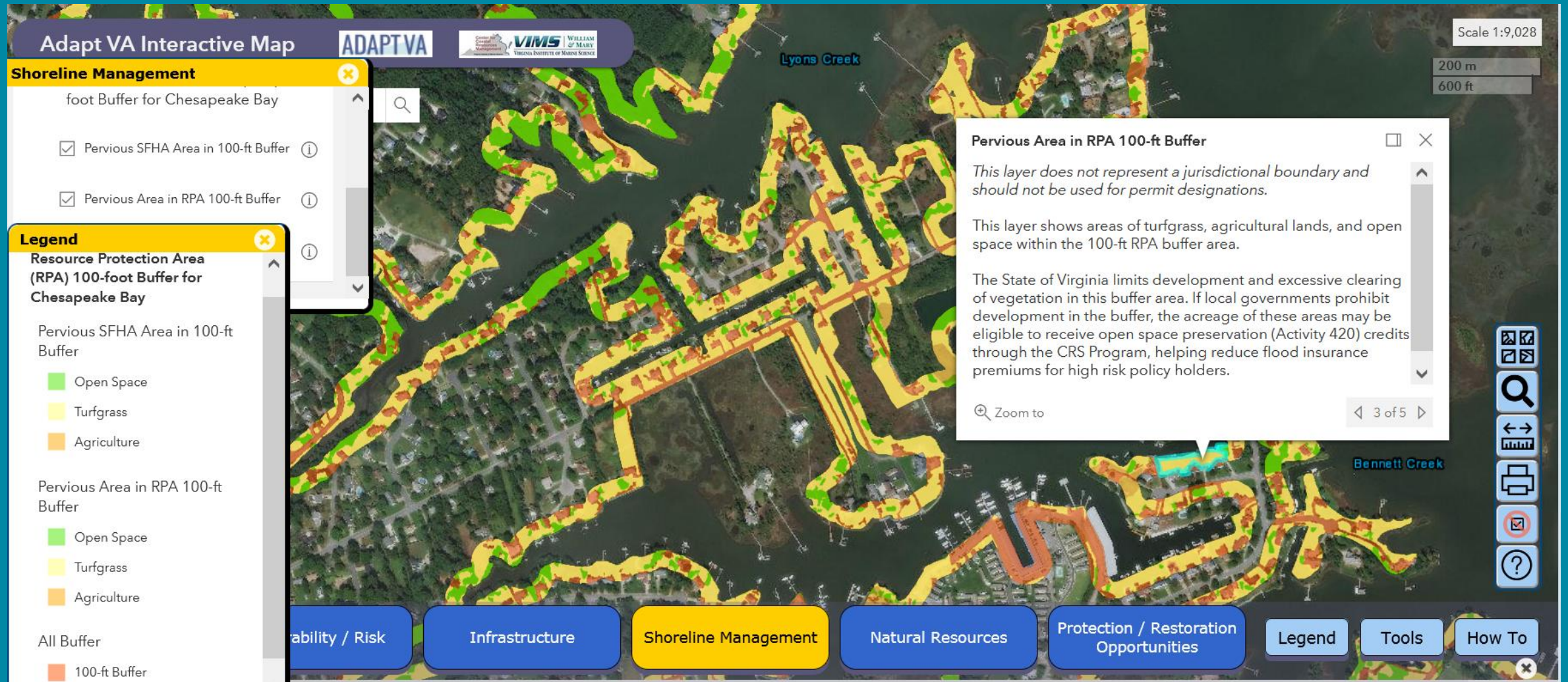
Opportunities to improve coastal resilience

Identify Co-Benefits for NNBFs



Opportunities to improve coastal resilience

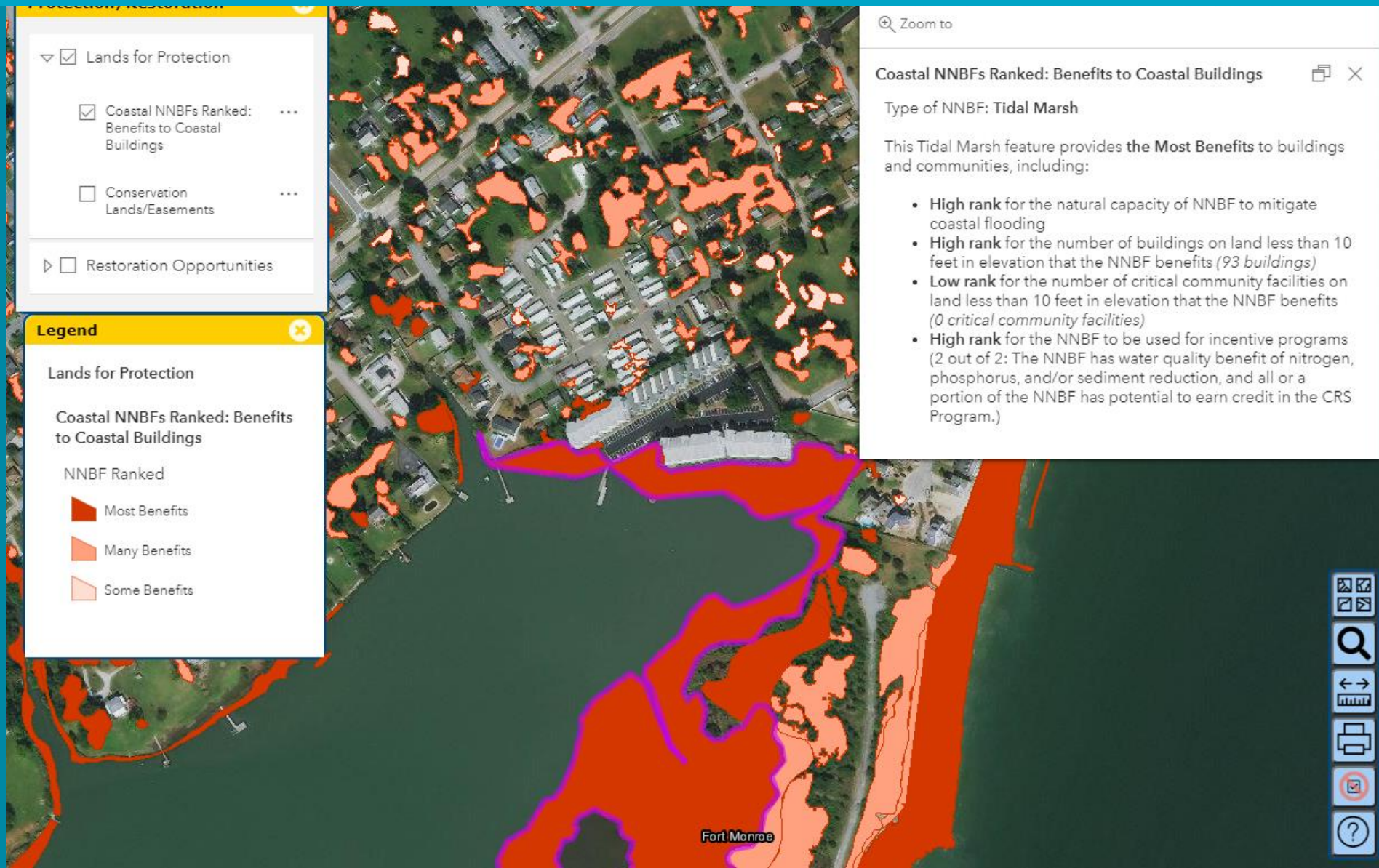
Identify Co-Benefits for NNBFs



Possible open space credits for
FEMA National Flood Insurance Program Community Rating System

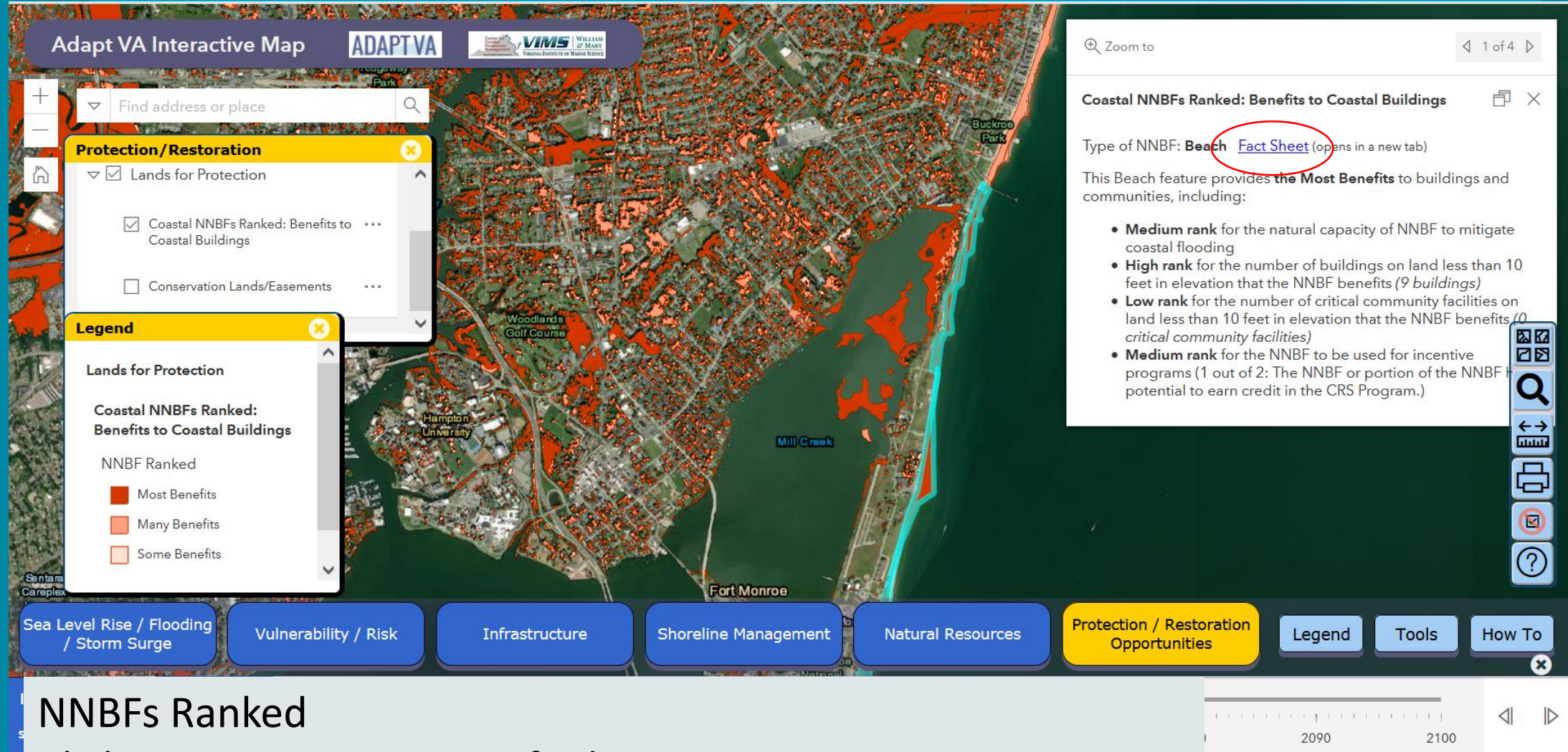
NNBFs that enhance coastal flooding resilience

Identify NNBFs that provide multiple benefits



NNBFs that enhance coastal flooding resilience

Identify NNBFs that provide multiple benefits



Mill Creek, Hampton

NNBFs Ranked

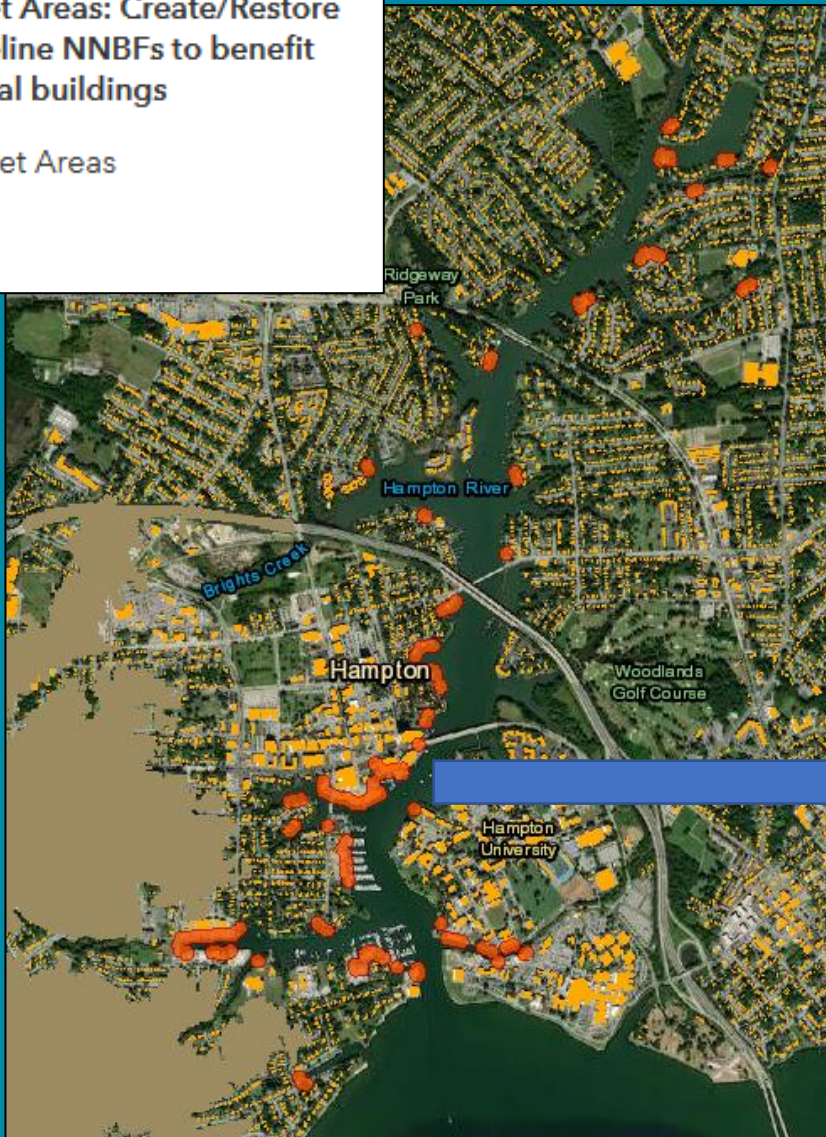
Click on any NNBF area to find:

- Ranking information specifics
- Fact Sheet

Identify Target Areas for NNBF Improvements

Target Areas: Create/Restore shoreline NNBFs to benefit coastal buildings

Target Areas



Shoreline areas where NNBF benefits are absent for vulnerable buildings

Target Areas: Create/Restore shoreline NNBFs to benefit coastal buildings



Total 208 building(s) will benefit
Including 78 building(s) with no other benefit from NNBFs

Potential NNBF Restoration Options

Convert Existing Land Cover:
Impervious
Turf Grass

Expand Adjacent Existing NNBFs:
[Tidal Marsh](#), [Wooded](#)
(pdf links open in a new tab)

NNBF Erosion Control Recommendation (SMM v. 5.1)
Highly Modified Area. Seek expert advice.
[Click here for more information](#)

Shoreline Structure Enhancements
Add natural features to existing structures: Bulkhead, Marina, Unconventional, Wharf.

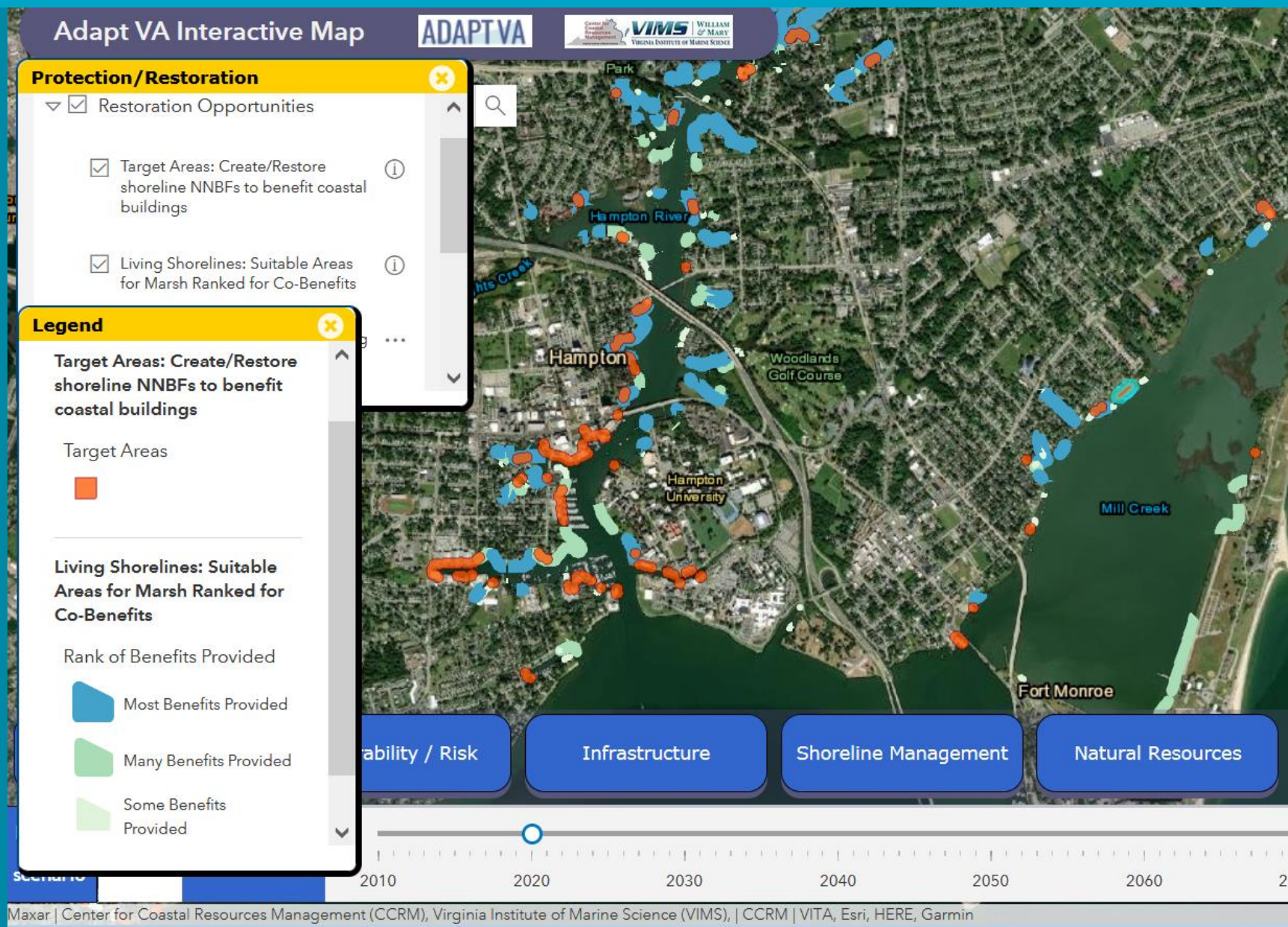
Opportunities to improve coastal resilience

Identify target areas for new NNBFs

Why target the shoreline?

- First line of defense
- Programmatic incentives – in RPA
- Other tools available to help inform NNBf creation (e.g., CCRM Shoreline Management Model)

Hampton River, Hampton




NNBF Project

Products (Fact Sheets & More) + Info on Adapt VA Map

New Web Site

www.vims.edu/ccrm/nmbf



Center for Coastal Resources Management

ADAPTATION & MANAGEMENT

- Adapt Virginia
- Sea-Level Report Cards
- Nature-Based Solutions (2021)
- Sustainability in Chesapeake Bay (2013-2015)
- Commonwealth Center for Recurrent Flooding Resiliency
- Virginia Flood Risk Information System





Home > CCRM > Research > Climate Change & Coastal Resilience > Adaptation & Management > Nature-Based Solutions (2021)

Nature-Based Solutions


Natural & Nature-Based Features (NNBFs)
Coastal forests, wetlands, beaches, and living shorelines provide multiple benefits for coastal communities, including storm protection, soaking up floodwaters, improving water quality, providing recreation areas and maintaining important habitats. Protected and restored natural features can also reduce the cost of flood insurance.

- **Natural Features** evolve over time through processes operating in nature
- **Nature-Based Features** are created by human design, engineering and construction for specific services such as coastal hazard risk reduction

Multiple Benefits

-  **Flood risk reduction for coastal buildings** – Natural features intercept and reduce the energy of rainfall, storm surge and tidal flooding. Floodwaters are stored and slowly released by trees and wetlands.
-  **Flood insurance** – Protecting and restoring natural features can earn credits for reduced insurance premiums through the National Flood Insurance Program's Community Rating System.
-  **Water quality improvement** – Forests, trees, and wetlands effectively filter air pollution and remove excess nitrogen and phosphorus, and also capture sediment in stormwater runoff and tidal floodwaters.
-  **Floodplain restoration** – Natural floodplains store floodwaters, filter pollution, and provide habitat. Floodplain restoration reestablishes a more natural hydrologic regime that connects wetlands, waterways and adjacent land.

- Description of natural feature
- Benefits provided by it
- Restoration tips
- Links to additional resources
- Potential CRS & water quality credit info



Natural & Nature-Based Features

Living Shorelines: Oyster Sills

Description

Hybrid living shorelines combine organic features with structures to support wide tidal marshes and beaches. Oyster sills combine natural and planted tidal marshes with low-elevation reef structures that support the growth of shellfish and filter-feeders. Oyster sills are suitable where natural oyster productivity is high, existing marshes have eroding edges, and where minor upland bank erosion is present despite marsh vegetation. Research has shown that hybrid living shorelines and the habitats they support provide cleaner water, economic gains, and cultural traditions as ecosystem service benefits.

Multiple Benefits

- Increase tidal habitat diversity
- Dissipate energy of incoming waves
- Flood storage
- Nitrogen, phosphorus & sediment capture
- Seafood production

Oyster Sill Restoration Tips

- Average salinity should always be above 10 ppt
- Locate normal & extreme tide elevations on land, present & future scenarios
- Make sure construction & future maintenance access is feasible
- Choose wetland plants based on local salinity average
- Plant low & high marsh, expect plant changes over time
- Reserve adjacent land upslope for future tidal marsh location
- Perform periodic inspections & maintenance, like remove trash
- Add thin-layer fill over time to maintain marsh elevations

Resources

- [Living Shoreline Shellfish Reefs](#)
- [Living Shorelines: Marshes and Oysters Story Map](#)

Water Quality BMPs

- Urban or Ag Shoreline Management
- Urban or Ag Shoreline Erosion Control: Vegetated
- Urban or Ag Shoreline Erosion Control: Non-Vegetated

Community Rating System


Credit Potential

Oyster Sills in Special Flood Hazard Areas

Oyster sills will not receive credit in the CRS Program.

Vegetated tidal marsh areas landward of the sills can potentially earn **Open Space Preservation** related credit.

Learn More www.vims.edu/ccrm/nmbf



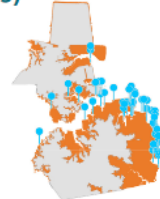
NNBF Locality Summary Reports

COASTAL RESILIENCE SUMMARY

CITY OF PORTSMOUTH, VIRGINIA

Natural and Nature-Based Features (NNBFs)






Forests, trees, wetlands, beaches, and living shorelines benefit communities by reducing storm wave energy, soaking up floodwaters, improving water quality, providing areas for recreation, creating habitats for important plants and animals, and even lowering flood insurance costs. These Natural and Nature-Based Features (NNBFs) have been mapped for areas that are less than 10-feet in elevation, experience tidal and storm flooding, and include buildings at risk. (All numbers are approximate.)



MAP: City of Portsmouth coastal areas less than 10-ft elevation, with targets for new NNBFs

NNBFs in City of Portsmouth Coastal Areas

1,664 acres All Coastal NNBFs, including:

	1,054 acres	Wooded
	464 acres	Tidal Marsh
	52 acres	Forested Wetland
	42 acres	Emergent Wetland
	>1 miles	Hybrid Living Shorelines

Visit www.AdaptVA.org to view all coastal NNBFs

Coastal Area Facts

for areas less than 10-ft elevation

37% of locality area (8,005 acres)




10,651 coastal buildings

10 critical facilities

431 coastal buildings without NNBF benefits

49 targets for new NNBFs

Benefits of NNBFs in City of Portsmouth

	1,055 acres	of NNBFs that decrease flooding risks for buildings
	1,596 acres	of NNBFs that improve water quality by reducing sediment, nitrogen, and phosphorus
	294 acres	of NNBFs potentially eligible for FEMA Community Rating System credits (100-ft RPA buffers and wetlands located within 100-year flood zones)

Chesapeake Bay RPA 100-ft Buffer Overview

across all of City of Portsmouth

878 acres of RPA buffer

209 acres of RPA buffer currently turfgrass that is potentially eligible for water quality credits if converted into NNBF



To learn more: www.vims.edu/ccrm/nnbf

- NNBFs identified below 10-foot land elevation
- Benefits of protecting and increasing NNBFs
- Information about what's at risk

NNBFs that enhance coastal flooding resilience

Next steps...

- Work with localities to refine and communicate

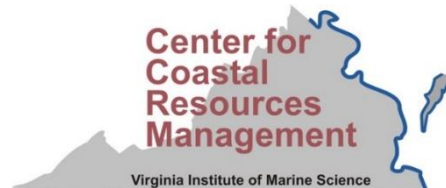
Build on the Current Project:

- Add sea level rise projections
- Add co-benefits, e.g. RTE species habitats, habitat corridors...
- Incorporate offshore NNBFs: spits, SAV...
- Broaden target areas for NNBF creation to the upland



Thank you!

Questions?
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