

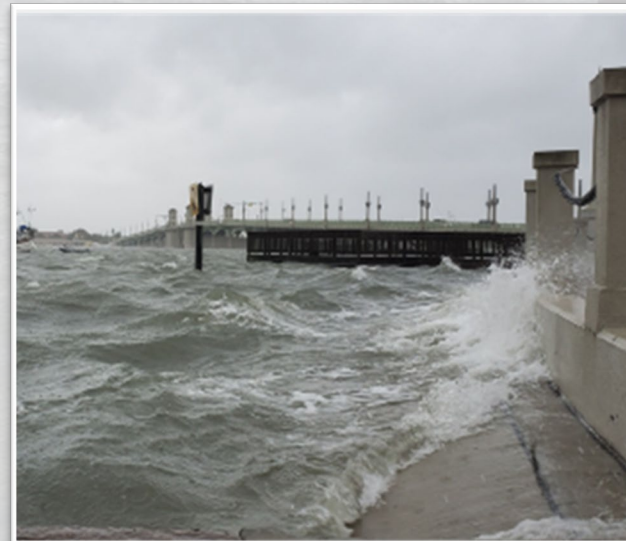
# St. Augustine, Florida Back Bay Coastal Storm Risk Management (CSRM) Feasibility Study

## SEMI-ANNUAL PUBLIC WORKSHOP #3

Presented by:  
U.S. Army Corps of Engineers  
Jacksonville District

October 23, 2024

Non-Federal Sponsor: City of St. Augustine, Florida



The **purpose** of this workshop is to provide residents and key stakeholders with the latest study information and get input on potential alternatives.

- Welcome/Opening Remarks
- Study Overview
- City Projects Overview
- Recap of Study Analysis to Date
- Initial Array of Alternative Features
  - ▶ Walls & Levees
  - ▶ Surge Barrier Systems
  - ▶ Non-Structural
  - ▶ Natural & Nature Based Features
- Closing Remarks
- Adjourn Meeting

## Ways to provide your input...

- Discussion Portions of Tonight's Meeting
- Comment Cards at the Sign In Table
- E-mail to...  
[cesaj-st.augbackbaycsrm@usace.army.mil](mailto:cesaj-st.augbackbaycsrm@usace.army.mil)





U.S. ARMY

# STUDY OVERVIEW



## Study Authority: House Resolution 2646 (June 21, 2000): St. Johns County, Florida

Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the River and Harbor Act of 1962, the Secretary of the Army, acting through the Chief of Engineers, is **requested to survey the shores of St. Johns County, Florida**, with particular reference to the advisability of providing beach erosion control works in the area north of St. Augustine Inlet, the shoreline in the vicinity of Matanzas Inlet, and adjacent shorelines, as may be necessary in the interest of **hurricane protection, storm damage reduction, beach erosion control, and other related purposes.**

## Non-Federal Sponsor: City of St. Augustine (COSA)

POC: Jessica Beach, P.E., Chief Resilience Officer, [jbeach@citystaug.com](mailto:jbeach@citystaug.com)

## Study Area

- Entire COSA Municipal Boundary
- 17 Distinct Neighborhoods
- 3 Separate Land Masses
- Interconnected Water Bodies

**Objectives** to be achieved within the City of St. Augustine over a 50-year period of analysis from 2035-2085 are to...

1. Manage risk of coastal flood damages.
2. Manage risk to health and life-safety.
3. Manage risk to cultural and natural resources.
4. Manage flooding impacts to the local economy.





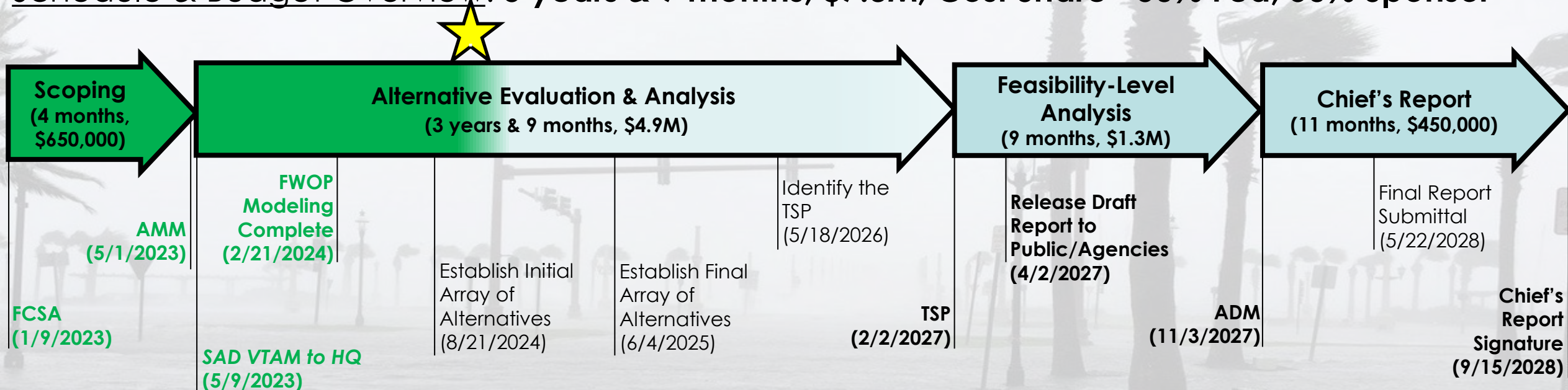
# STUDY OVERVIEW

U.S. ARMY

★ We Are Here



Schedule & Budget Overview: **5 years & 9 months, \$7.3M, Cost Share ~50% Fed, 50% Sponsor**



## Key Components of the Study Scope:

- Entire City of St. Augustine (COSA)
- Compound Flooding
- Full Array of Alternatives & Comprehensive Benefits
- Environmental Impact Statement (EIS) Likely
- Robust Community Outreach

## Acronyms

FCSA = Feasibility Cost Share Agreement  
AMM = Alternatives Milestone Meeting  
FWOP = Future Without Project  
SAD = South Atlantic Division  
VTAM = Vertical Team Alignment Memo  
HQ = Headquarters  
TSP = Tentatively Selected Plan  
ADM = Agency Decision Milestone





U.S. ARMY

# PUBLIC OUTREACH (STUDY WEBSITE)



St. Augustine Back Bay Study - V x +

experience.arcgis.com/experience/06bb9c98d9184bd9a374a244f6d27474/

\_USACE Finance Mapping News USACE Google All Bookmarks

St. Augustine, FL Back Bay Coastal Study





Engineering Economics Environmental Cultural Resources Real Estate About

U.S. Army Corps of Engineers – Jacksonville District Main Website

## Welcome to the St. Augustine, Florida Back Bay Coastal Storm Risk Management (CSRM) Web Experience Homepage

Upcoming Events: Our Next Public Meeting will be held on October 4th, 2023 at 6:30pm. < Prev Next >

This Web Experience Homepage is a visual representation of the ongoing St. Augustine CSRM Study. During the study, this page will be updated with the latest information to include meeting agendas, minutes, graphics, etc. to keep the public and agencies engaged as partners in developing a long term solution to flooding within the City of St. Augustine.

### Page Contents

- Study Overview
- Plan Formulation
- Monthly Planning Meetings
- Interactive Map
- Public Meetings/Workshops
- News, Social Media, Helpful Links
- Scope, Schedule, and Budget
- Contact Information

For better viewing experience, please use Google Chrome or Mozilla Firefox browsers. Also, please use a PC to interact with the web experience homepage.

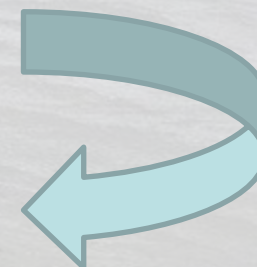
ArcGIS Experience Builder technology animates the complicated concepts considered by the design team by allowing users to:

- See the improvements and reduced flooding impacts from this study in the City of St. Augustine (COSA)
- Experience the various alternatives and recommended plan with detailed artistic graphics and renderings
- Examine Engineering, Economic, Cultural, and Key Environmental Features

## STUDY OVERVIEW

Study Authority

This study is being conducted under the authority from the June 21, 2000, House Resolution 2646 that granted authority for a Coastal Storm Risk Management (CSRM) study in St. Johns County, Florida:  
"Resolved by the Committee on Transportation and Infrastructure of the United States House

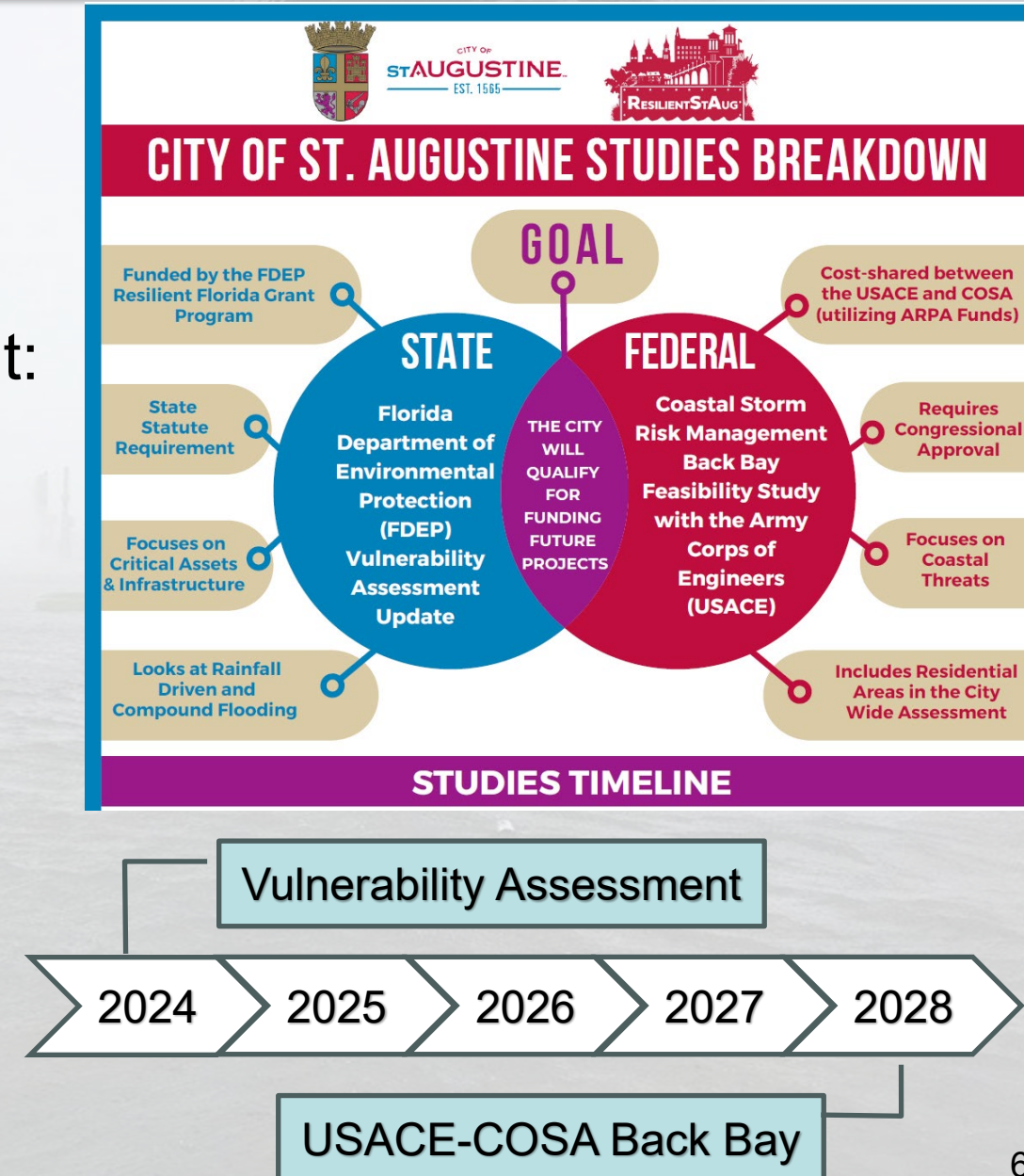


<https://experience.arcgis.com/experience/06bb9c98d9184bd9a374a244f6d27474/>



- **Other On-Going Coordination Efforts**
  - ▶ USACE Back Bay Study
  - ▶ State Funded Vulnerability Assessment:
    - City of St. Augustine
    - St. Johns County
    - City of St. Augustine Beach
  - ▶ FL Dept of Transportation (FDOT) Seawall Rehabilitation
  - ▶ National Park Service (NPS) Seawall Rehabilitation
  - ▶ Northeast Florida Regional Council – Resilient First Coast Collaborative

[www.citystaug.com/Resiliency](http://www.citystaug.com/Resiliency)







U.S. ARMY

# RECAP OF STUDY ANALYSIS TO DATE



## 6-Step Planning Process

Completed

Ongoing

Next Step

1 IDENTIFY PROBLEMS AND OPPORTUNITIES

2 INVENTORY AND FORECAST CONDITIONS

3 FORMULATE ALTERNATIVE PLANS

4 EVALUATE ALTERNATIVE PLANS

5 COMPARE ALTERNATIVE PLANS

6 SELECT RECOMMENDED PLAN

Established Study Objectives & Benefits Metrics  
Compound Flooding Driver Analysis.

Data collection and analysis associated with the key resources throughout the COSA.  
Modeling and analysis to forecast future without project conditions. By 2085 under the USACE intermediate sea level change, on average, the COSA could see...

- ▶ Over \$4 Billion (present value) in Damage to Structures, Content, & Vehicles.
- ▶ Potential Life Loss.
- ▶ Over 1,000 Residential Displacements.
- ▶ 80 Nuisance Flood Days Per Year.
- ▶ Over 100 Instances of Damage to Critical Infrastructure.
- ▶ Over 600 Acres of Saltwater Marsh Lost.
- ▶ Damage to 3,700 Historical Structures.
- ▶ Over \$400 Million in Lost Tourism Expenditures.

Evaluation of initial alternative features is ongoing...

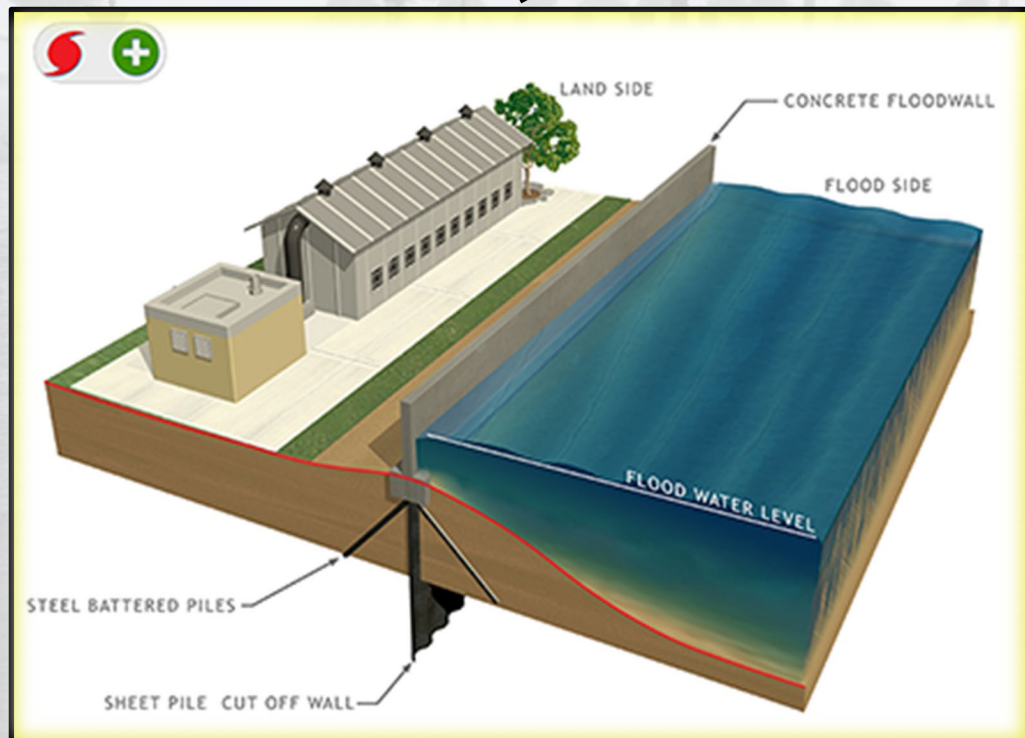
- ▶ Walls & Levees
- ▶ Surge Barrier Systems
- ▶ Nonstructural Measures
- ▶ Nature Based Solutions



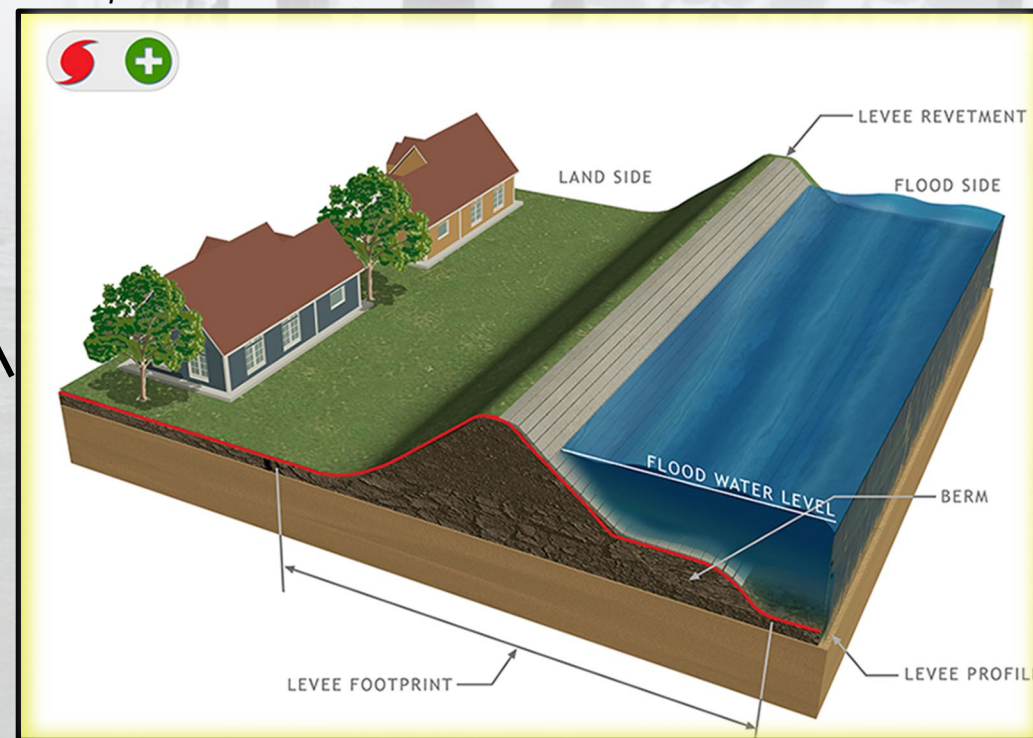
What are Walls and Levees?

*Walls are structures used to prevent flooding and to protect relatively small areas with limited space for construction. Levees are embankments constructed along a waterfront to prevent flooding in relatively large areas. Both wall and levee features function to reduce the risk of coastal flooding at the back bay shoreline.*

Conceptual Wall in Storm Conditions



Conceptual Levee in Storm Conditions





# WALLS & LEVEES

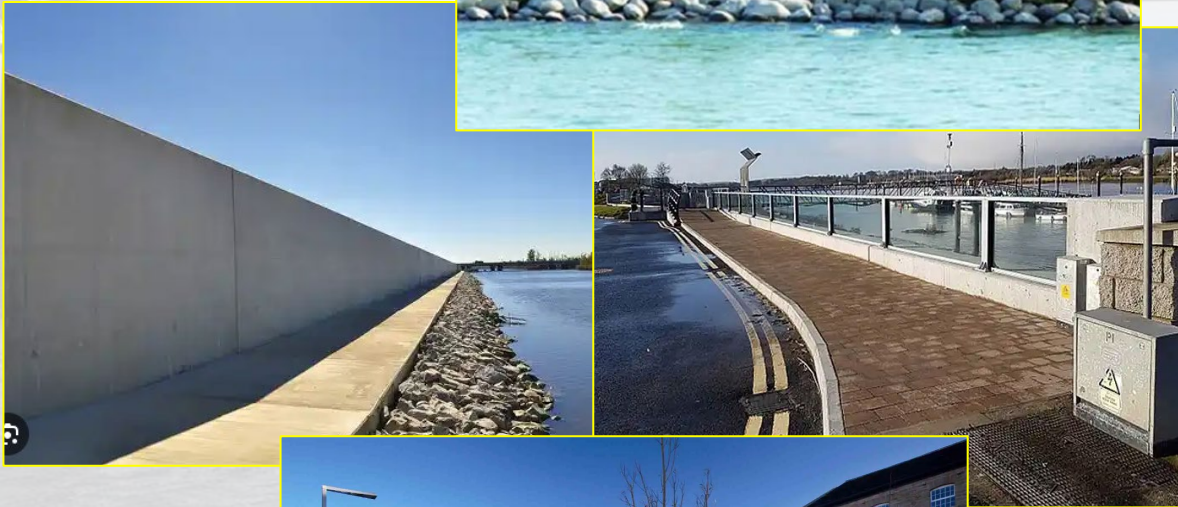


- Existing walls would be elevated.
- Land adjacent to deep water would need to be protected by a wall.
- Levees would be used for areas with more available real estate while walls would be used in land restricted areas.
- Potential Options...
  - ▶ Using roads as levees
  - ▶ Deployable Walls
  - ▶ Integration of Nature Based Features (NBF)
  - ▶ Integration of recreational features

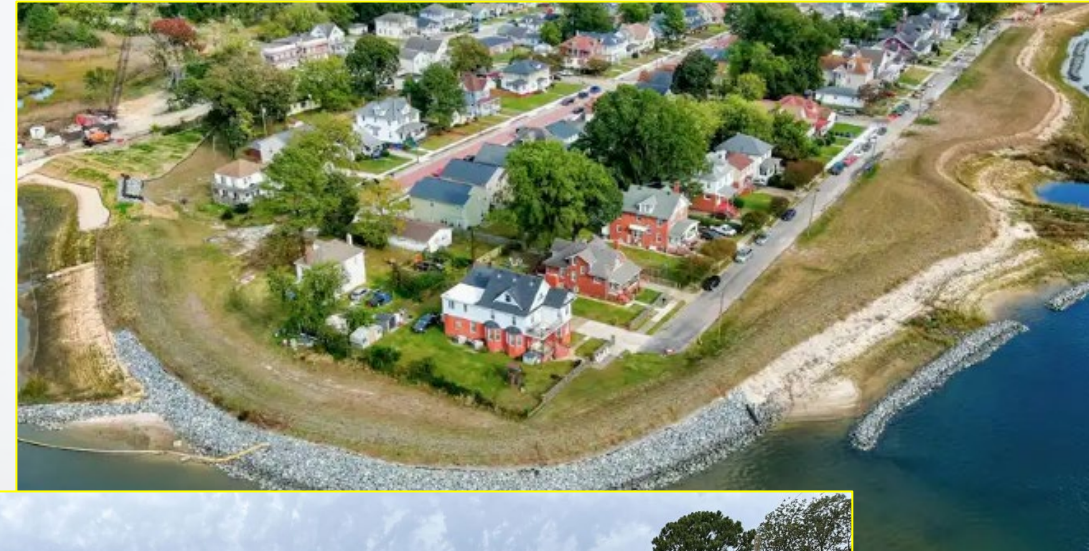


# WALLS & LEVEES

Various Wall Examples



Ohio Creek Levee, Virginia





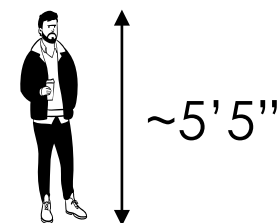


# WALLS & LEVEES Helen Street (Ravenswood)

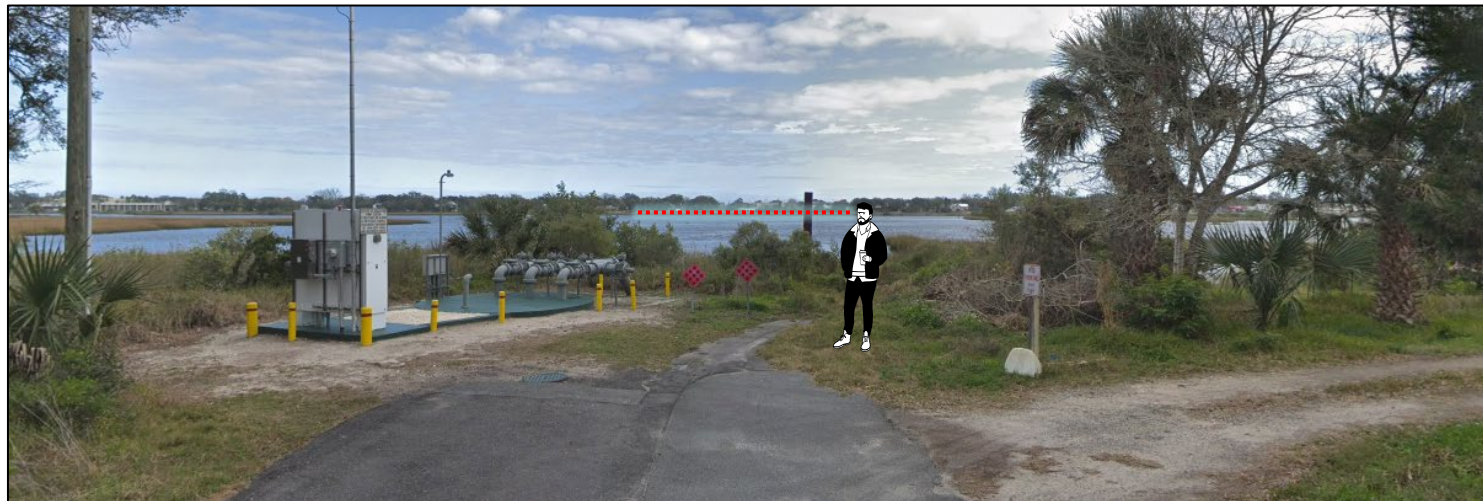
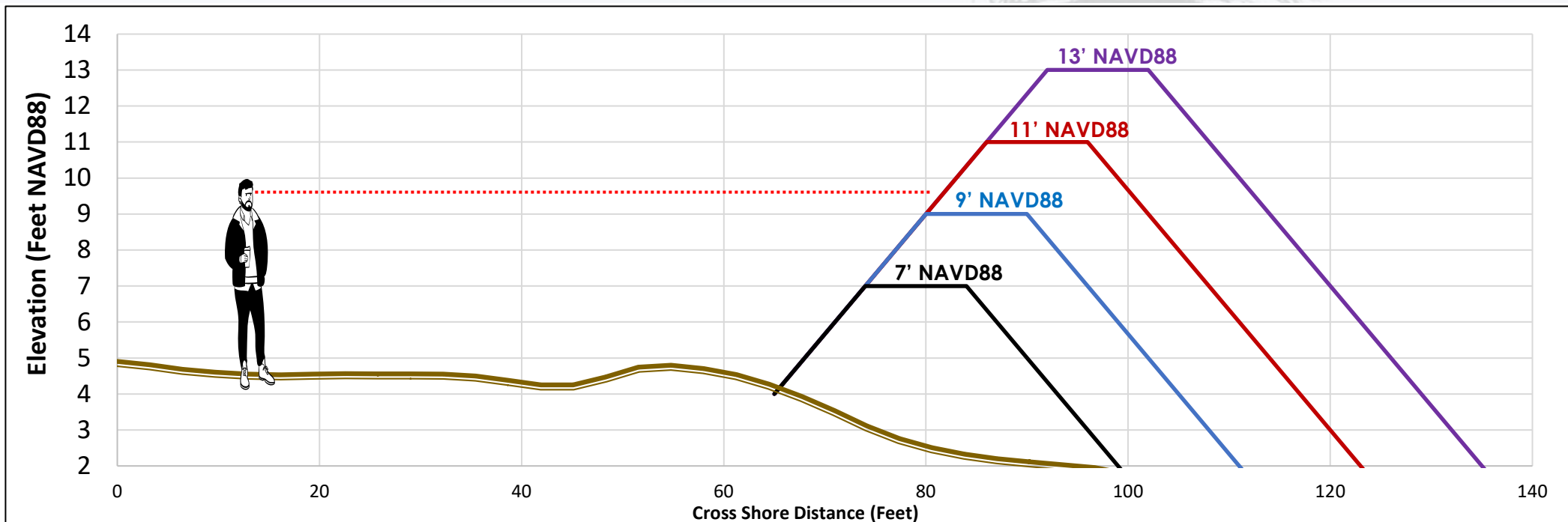


U.S. ARMY

- Existing Ground
- 7' Levee
- 9' Levee
- 11' Levee
- 13' Levee



Not 1V:1H Scale







U.S. ARMY

# WALLS & LEVEES River Road (Oyster Creek)

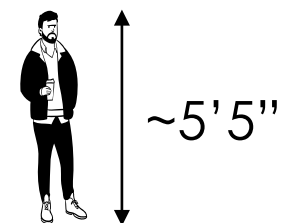


Existing Ground

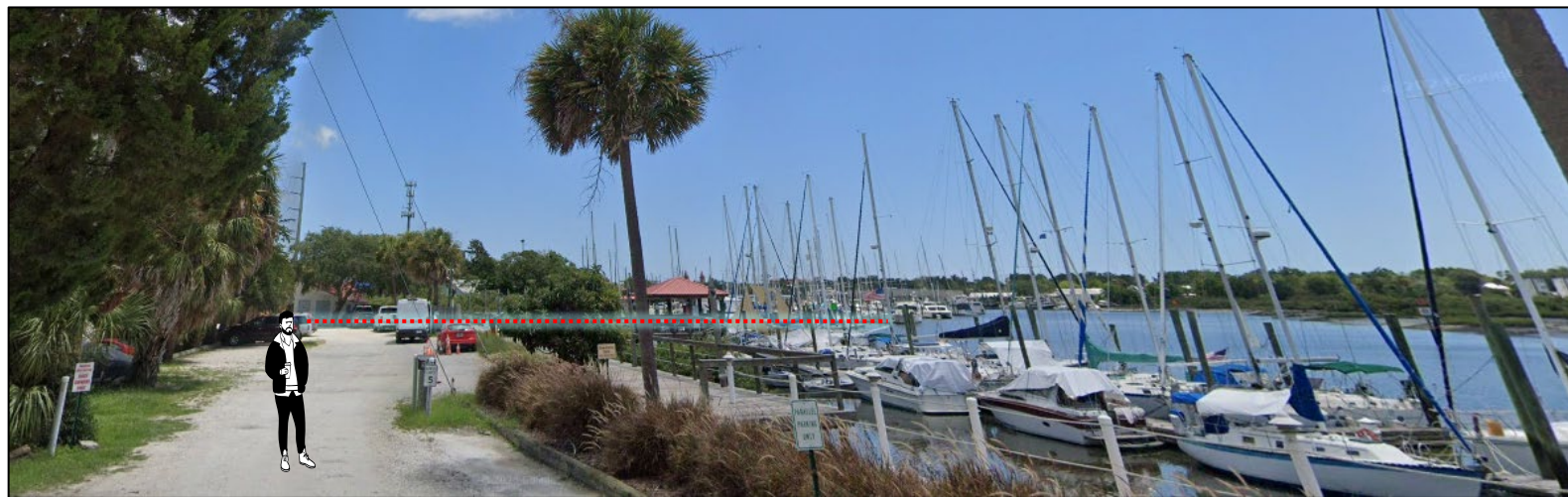
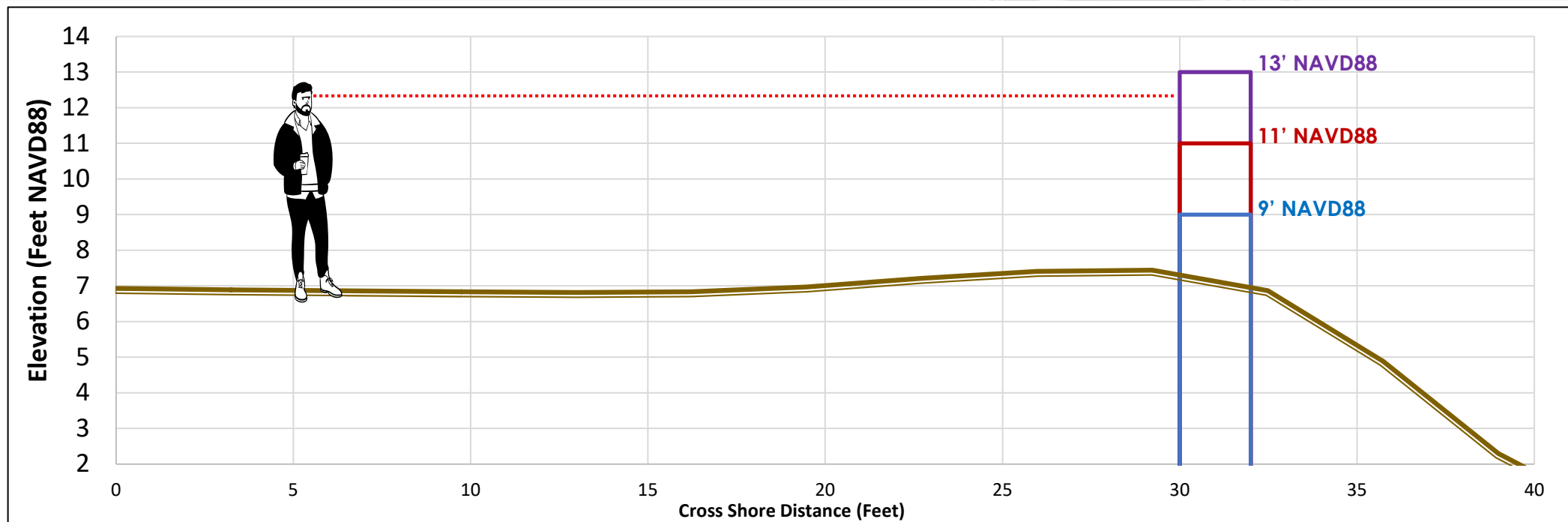
9' Wall

11' Wall

13' Wall



Not 1V:1H Scale





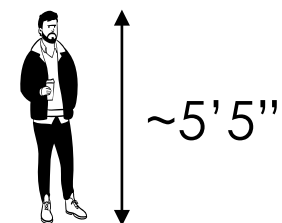


U.S. ARMY

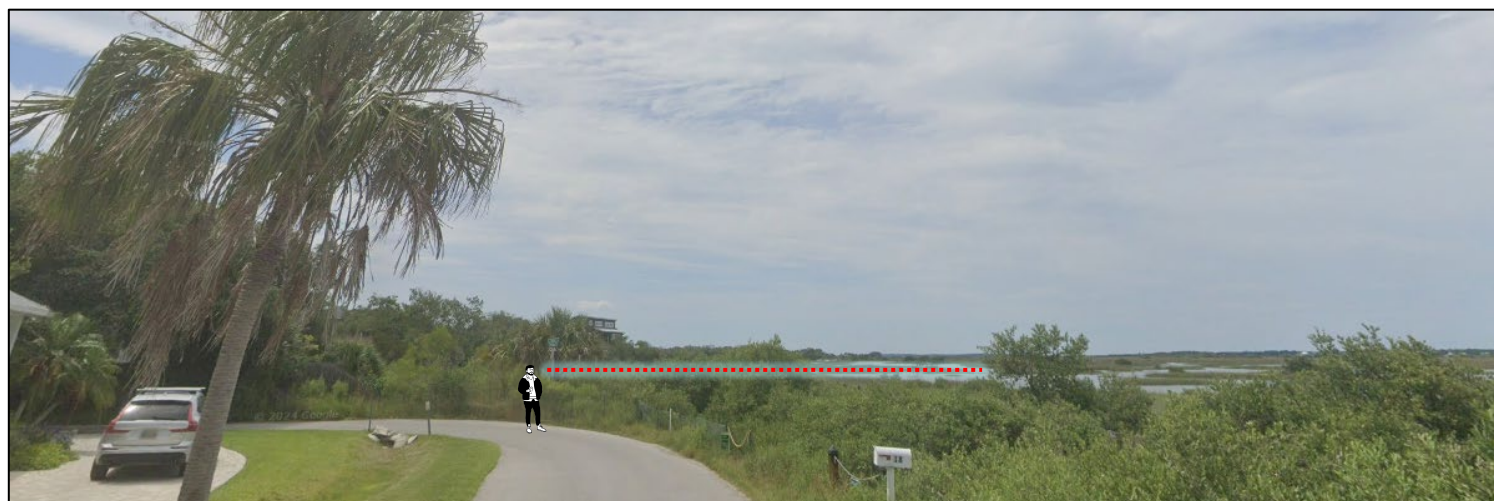
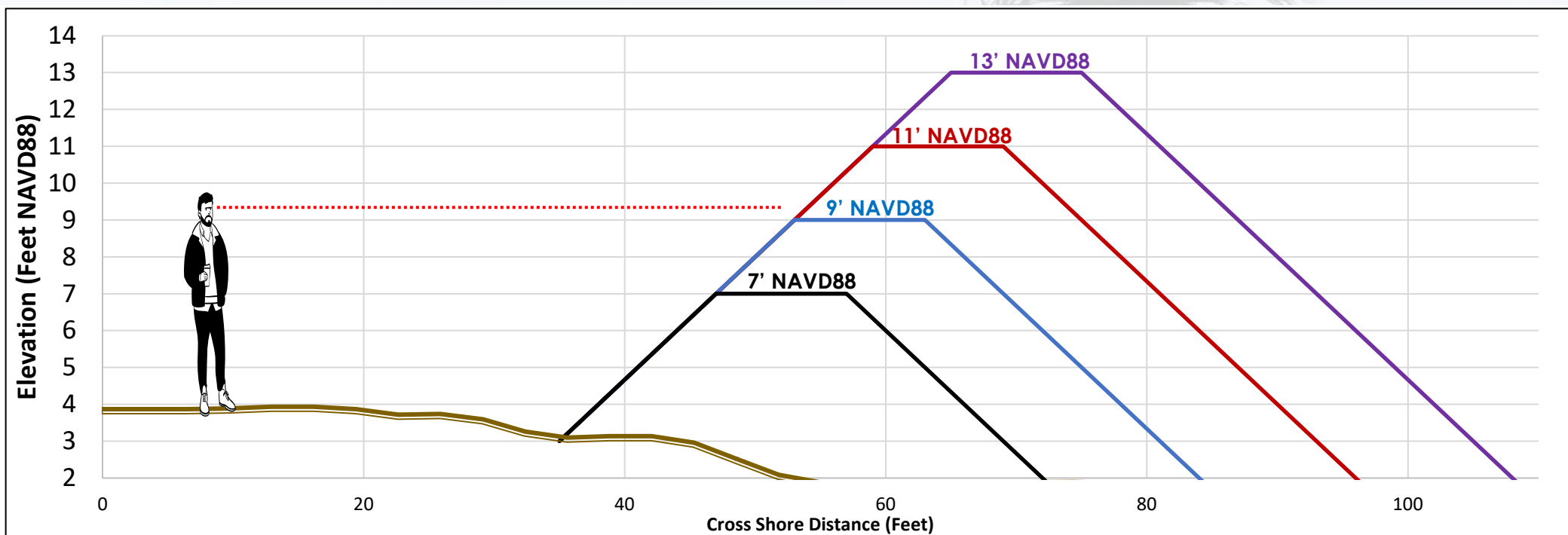
# WALLS & LEVEES Fern Street (Greater Fullerwood)



- Existing Ground
- 7' Levee
- 9' Levee
- 11' Levee
- 13' Levee



Not 1V:1H Scale







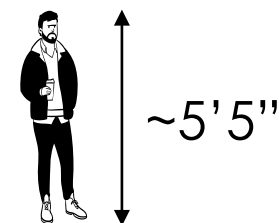
# WALLS & LEVEES

## Avenida Menendez (Spanish Quarter)

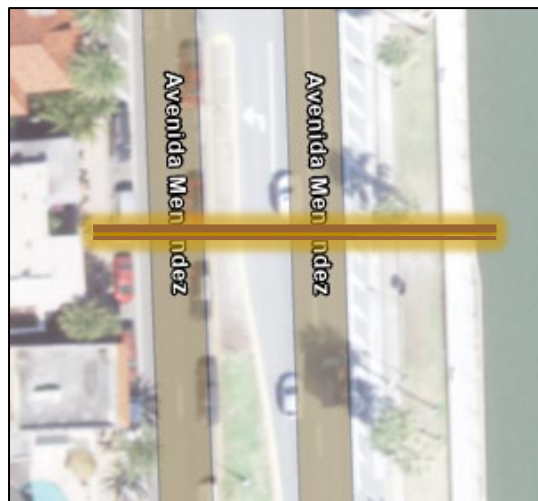
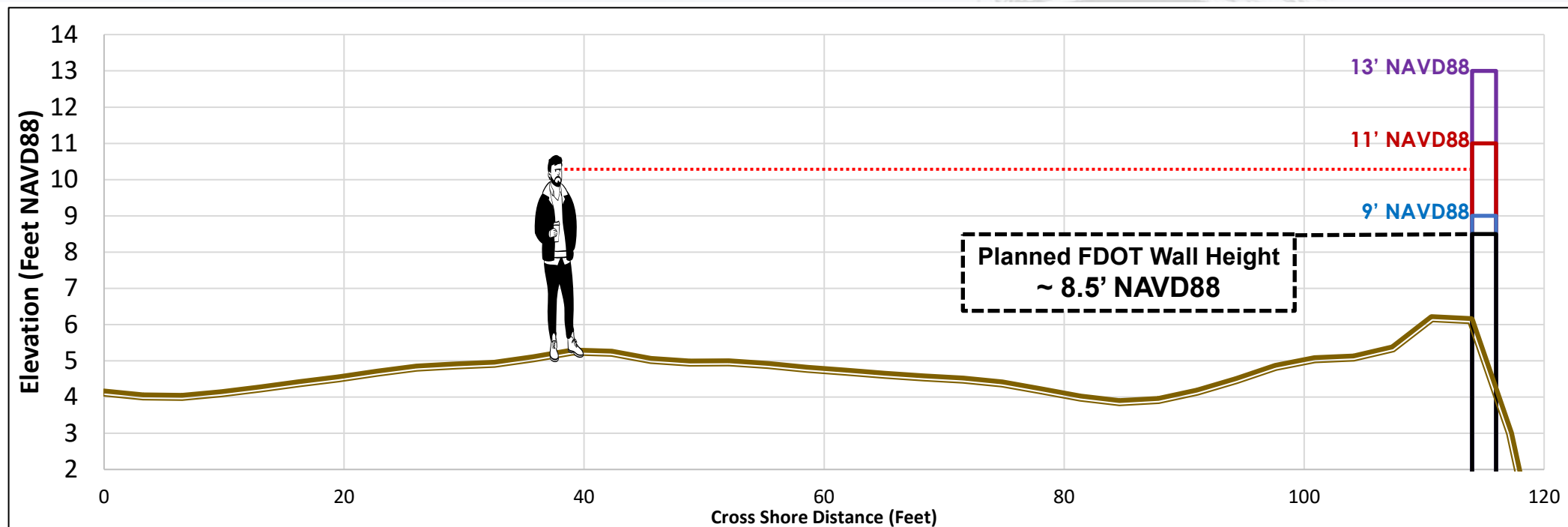


U.S. ARMY

- Existing Ground
- 8.5' Wall
- 9' Wall
- 11' Wall
- 13' Wall



Not 1V:1H Scale





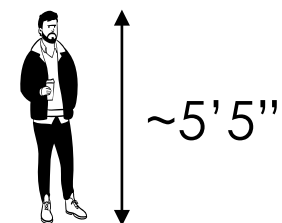


U.S. ARMY

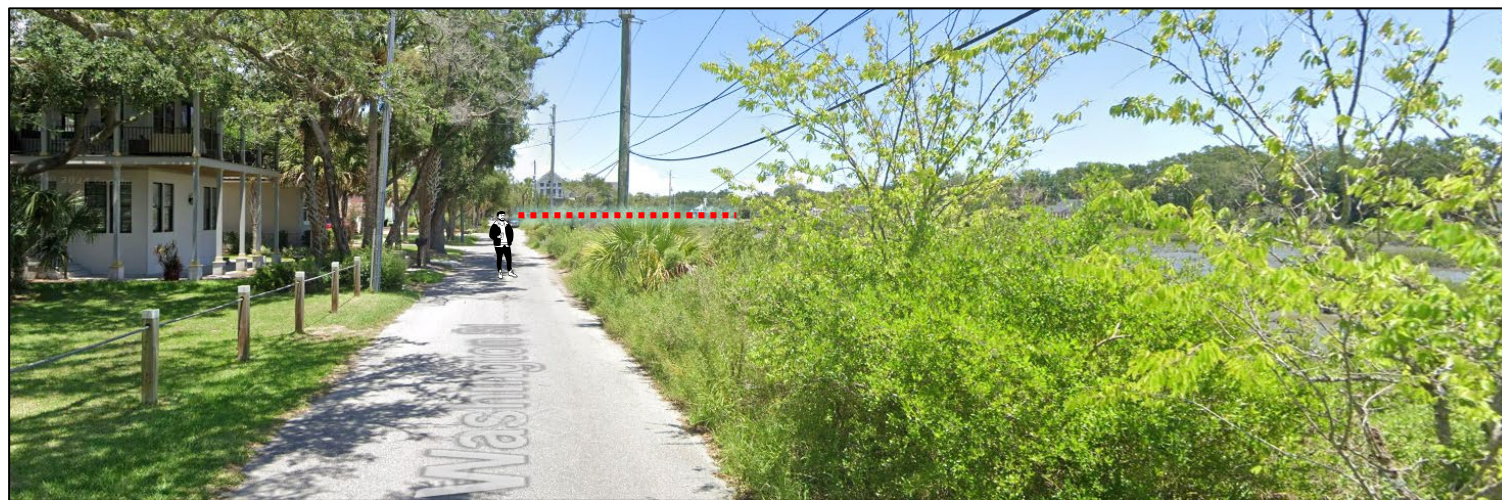
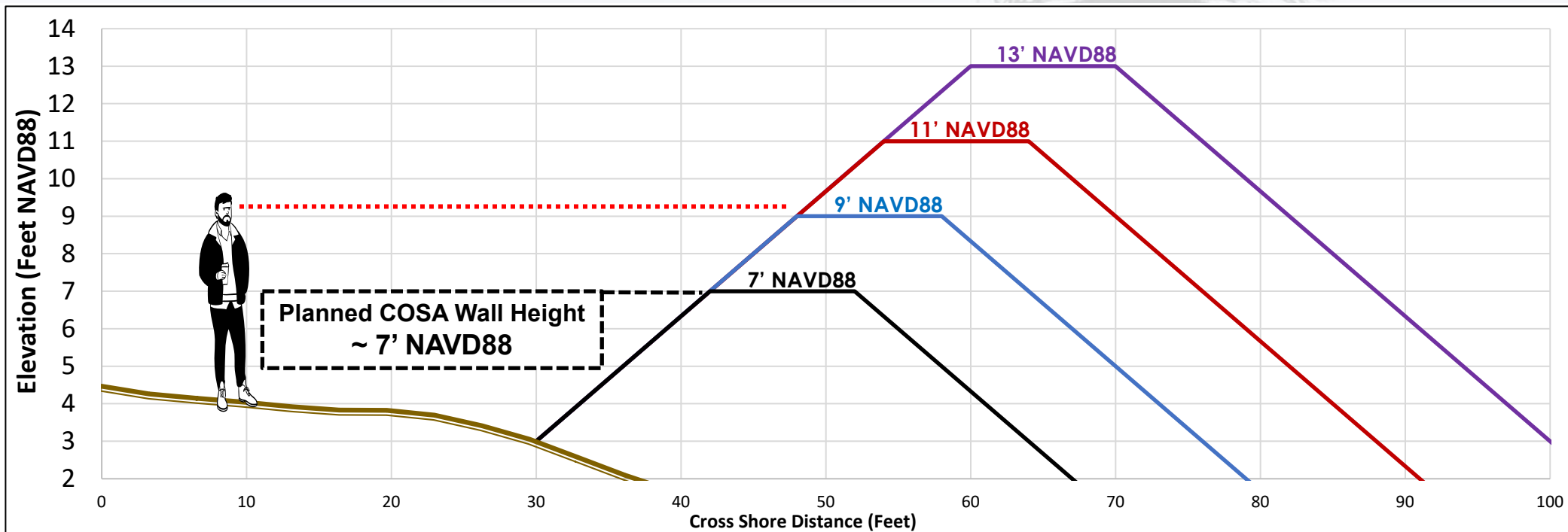
# WALLS & LEVEES Washington Street (Lincolnville)



- Existing Ground
- 7' Levee
- 9' Levee
- 11' Levee
- 13' Levee



Not 1V:1H Scale







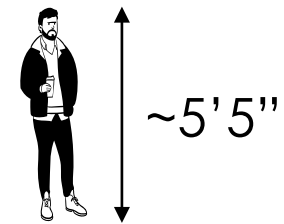
# WALLS & LEVEES

## Inlet Drive (North Davis Shores)

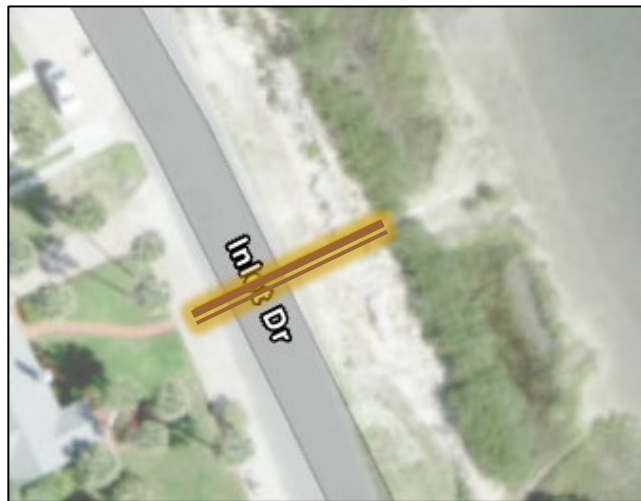
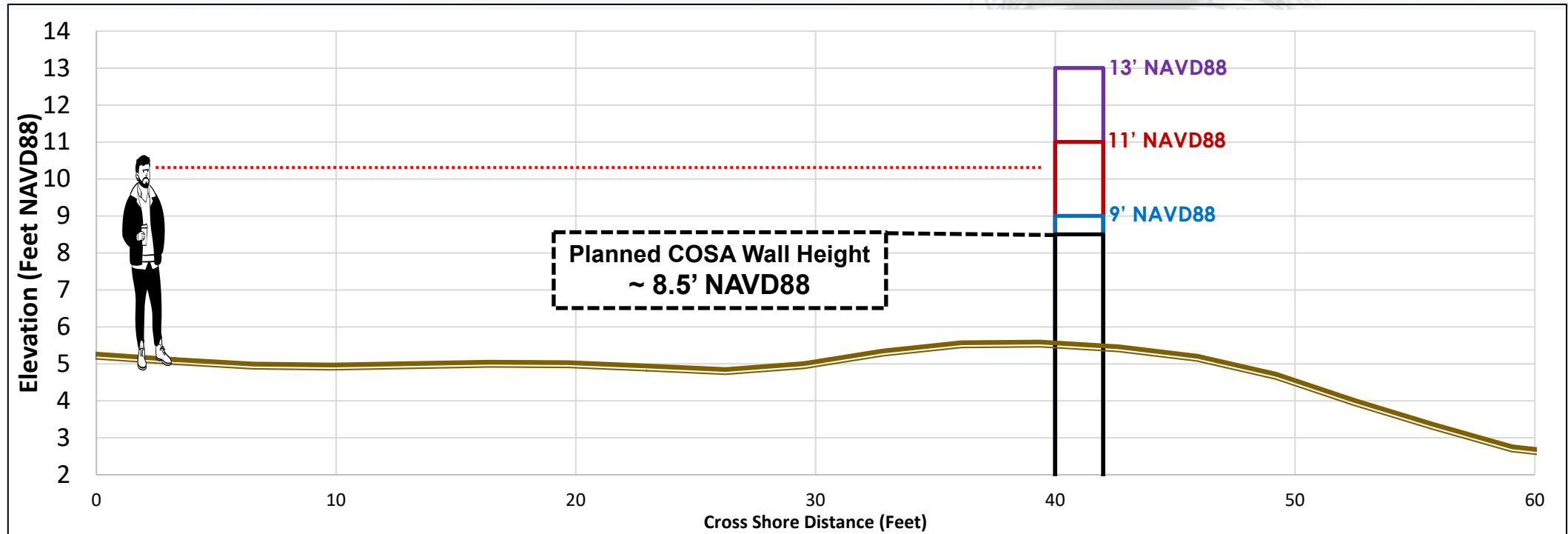


U.S. ARMY

- Existing Ground
- 7' Wall
- 9' Wall
- 11' Wall
- 13' Wall



Not 1V:1H Scale







# WALLS & LEVEES



What benefits do walls and levees provide?

- ❖ Reduced coastal storm damages from both small and large storm events.
- ❖ Reduced nuisance flooding days and impacts.
- ❖ Potential for incorporating nature-based features.
- ❖ Potential for recreation enhancement.

What resources could walls and levees impact?

- ❖ Saltwater marsh habitat
- ❖ Visual aesthetics
- ❖ Existing interior drainage infrastructure

Implementation considerations and potential options to avoid/minimize/mitigate impacts of walls and levees?

- ❖ Minimize direct overlap with existing habitat.
- ❖ Avoid/Minimize alignments across creeks.
- ❖ Maintain public and private water access.
- ❖ Minimize footprint on private property.
- ❖ Minimize closure gates.





U.S. ARMY

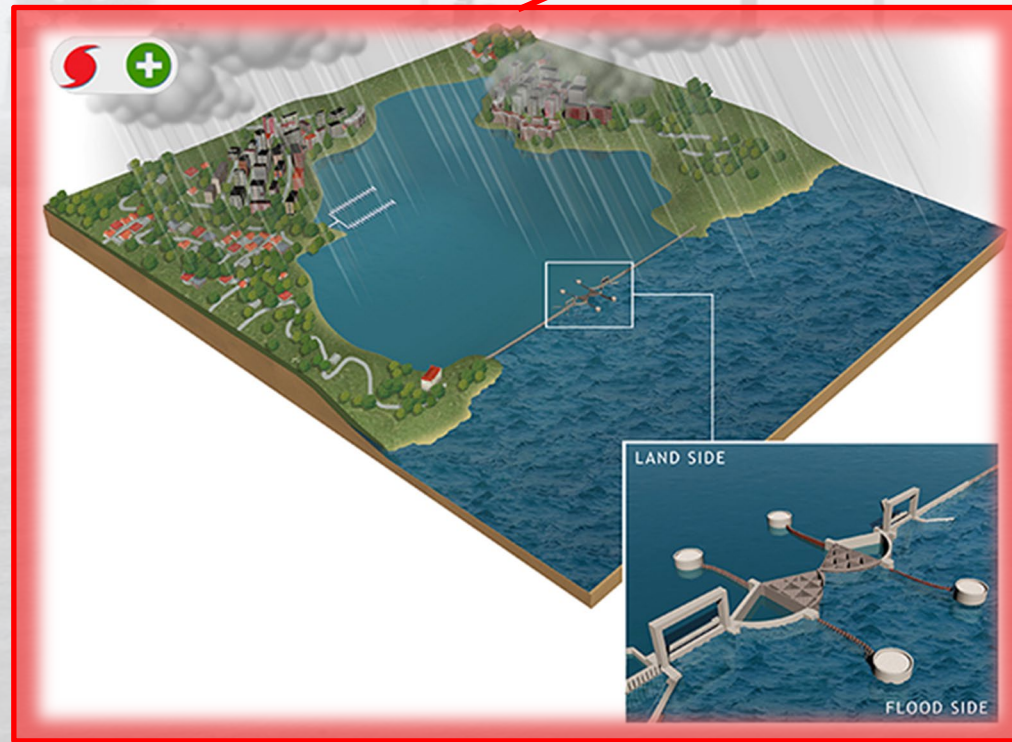
# SURGE BARRIER SYSTEMS



What are Surge Barrier Systems?

*Surge Barrier Systems would combine gates across inlets and/or rivers that would close during large storms along with walls, levees, and/or dunes to tie the system into high ground. Surge Barriers reduce the risk of coastal flooding before it gets into the back bay waters*

Conceptual Surge Barrier System



Surge Barrier Design Rendering in Galveston, TX.

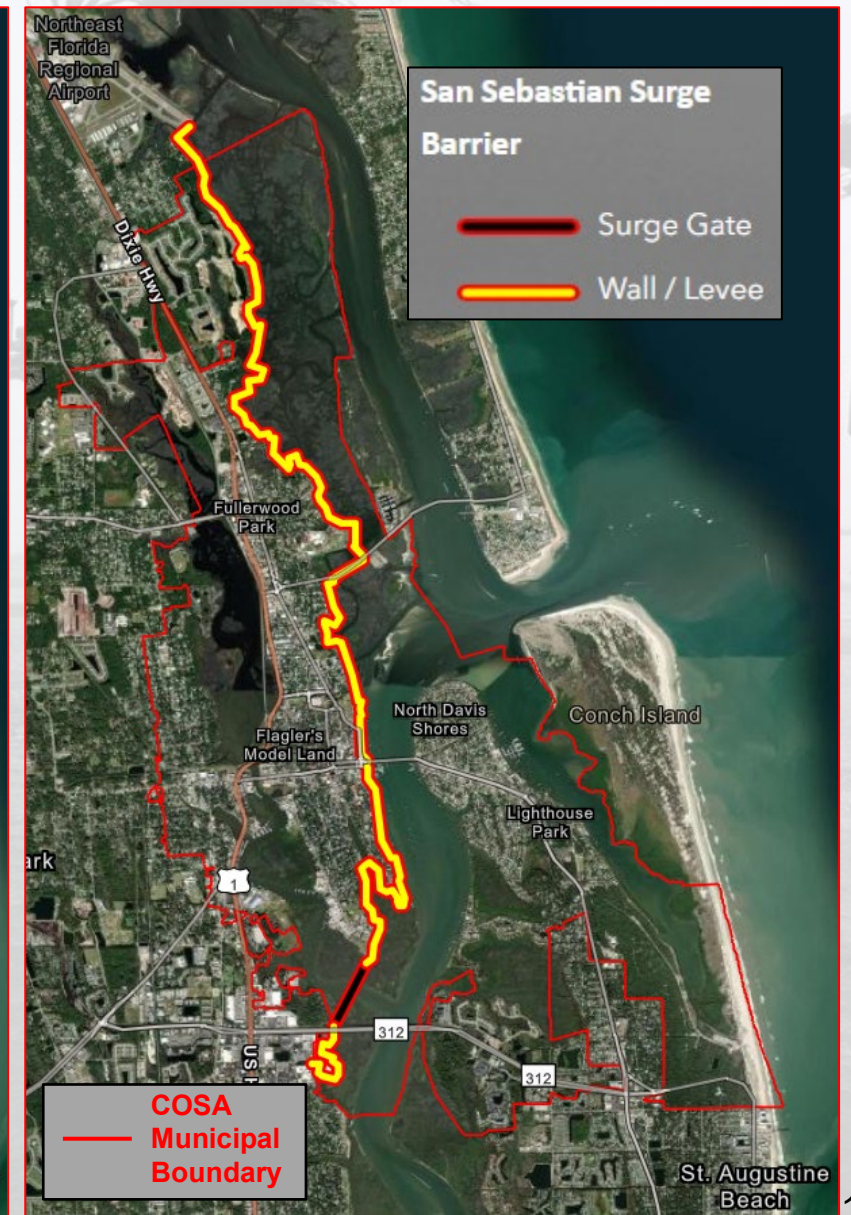
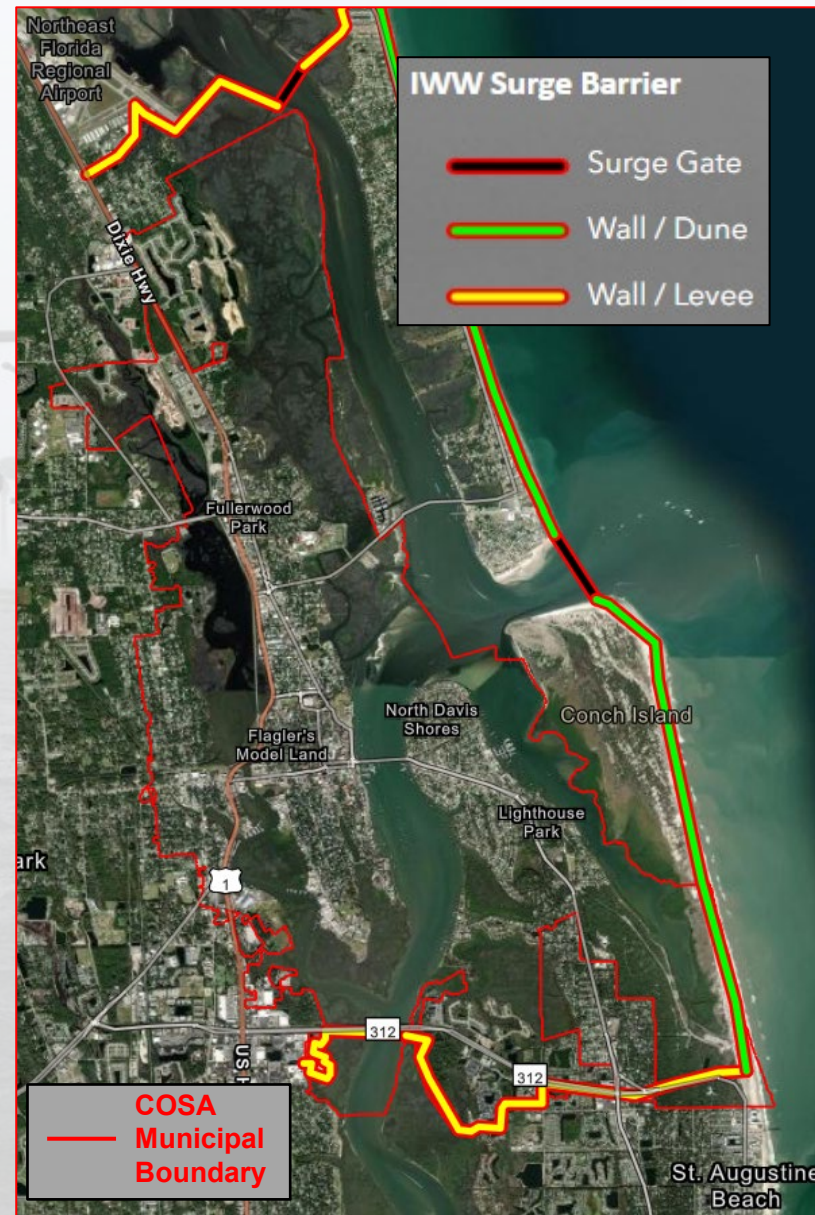
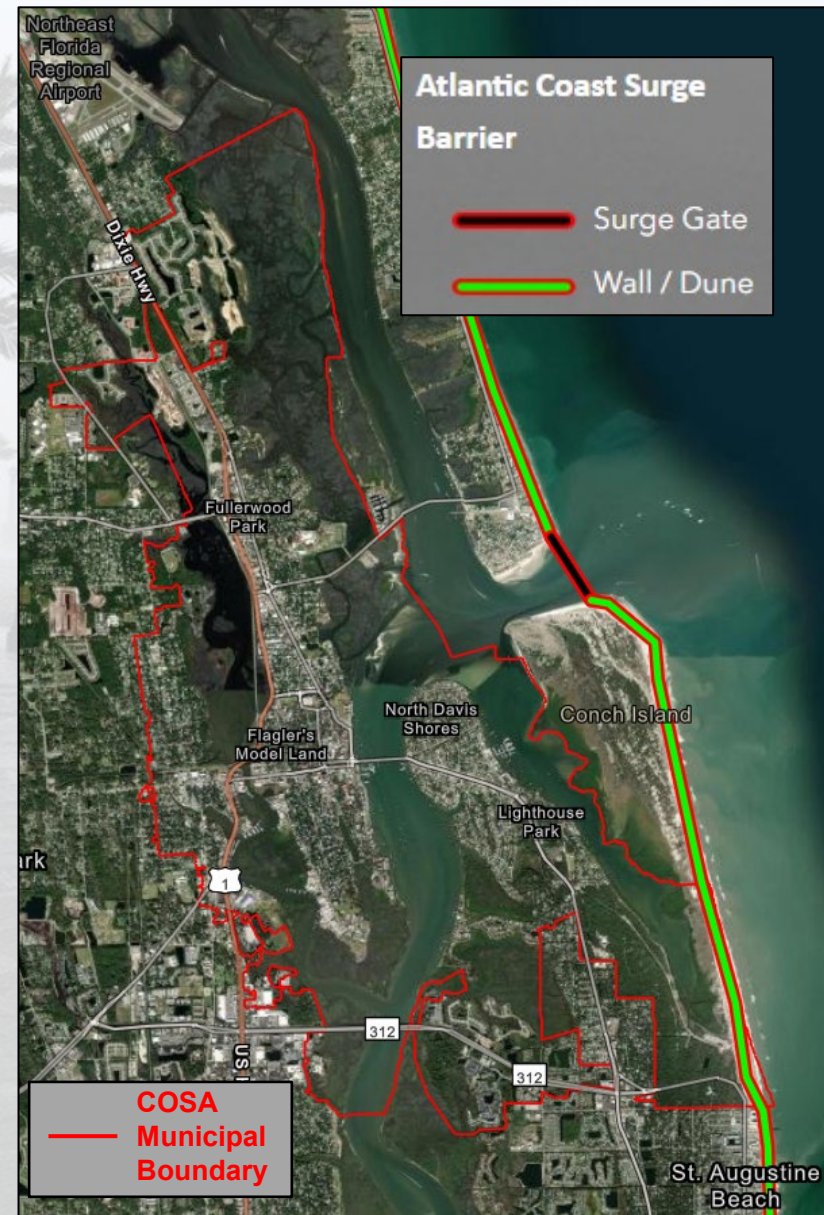




# SURGE BARRIER SYSTEMS



U.S. ARMY







U.S. ARMY

# SURGE BARRIER SYSTEMS



New Orleans Sector Gate







# SURGE BARRIER SYSTEMS



Rotterdam Surge Barrier, Netherlands







# SURGE BARRIER SYSTEMS



What benefits do surge barrier systems provide?

- ❖ Reduced coastal storm damages from large storm events.
- ❖ Maintain inlet access
- ❖ Minimize in-city footprint

What resources could surge barrier systems impact?

- ❖ Water quality (Matanzas and San Sebastian Rivers, Salt Run)
- ❖ Saltwater marsh habitat
- ❖ Marine/estuarine animal transit and habitat
- ❖ Essential Fish Habitat
- ❖ Visual aesthetics
- ❖ Beach access (St. Augustine, Porpoise Point)
- ❖ Sediment transport (Porpoise Point)

Implementation considerations and potential options to avoid/minimize/mitigate impacts of walls and levees?

- ❖ Time to implement
- ❖ Operations & Maintenance
- ❖ Footprint / Real Estate
- ❖ High ground tie in
- ❖ Likely not closed for “sunny day” flooding
- ❖ Rainfall drainage



## Coastal Barrier Resources Act (CBRA)

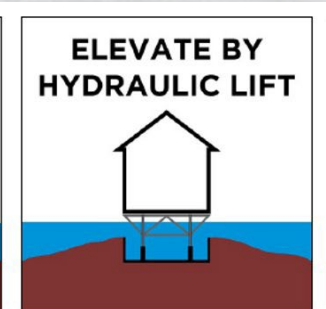
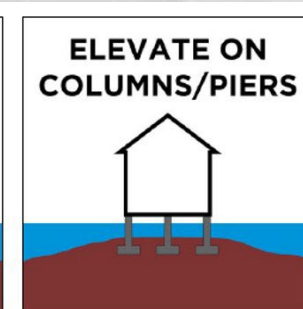
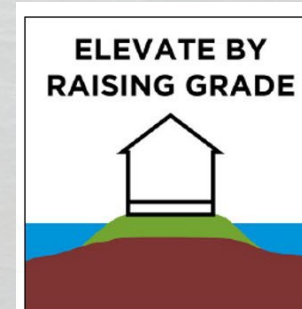
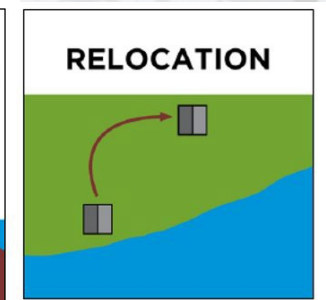
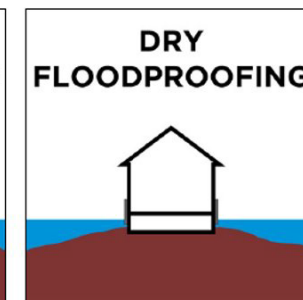
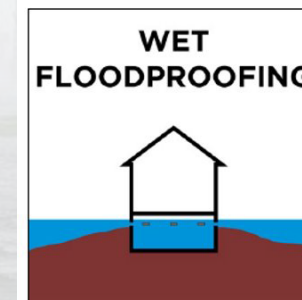
- 3 purposes of CBRA:
  - Minimize loss of human life
  - Minimize wasteful expenditure of federal revenues
  - Minimize damage to fish, wildlife, and other natural resources associated with coastal barriers
- System Units
  - Most new federal expenditures and financial assistance, including federal flood insurance, are prohibited
  - Consultation with USFWS required
- Otherwise Protected Areas
  - Only prohibition is on federal flood insurance, and there is an exception for park-related structures
  - Consultation with USFWS not required
- Federal VS Private Funding





## WHAT ARE NONSTRUCTURAL MEASURES?

- An array of options used to **adapt to** existing and future coastal flood risks and damage without major modification to floodplain characteristics
- Often, physical and permanent measures retrofitted into existing structures and incorporated into new designs
- Examples:
  - Elevation of Structures
  - Buyout/Relocation of Structures
  - Dry Floodproofing
  - Wet Floodproofing

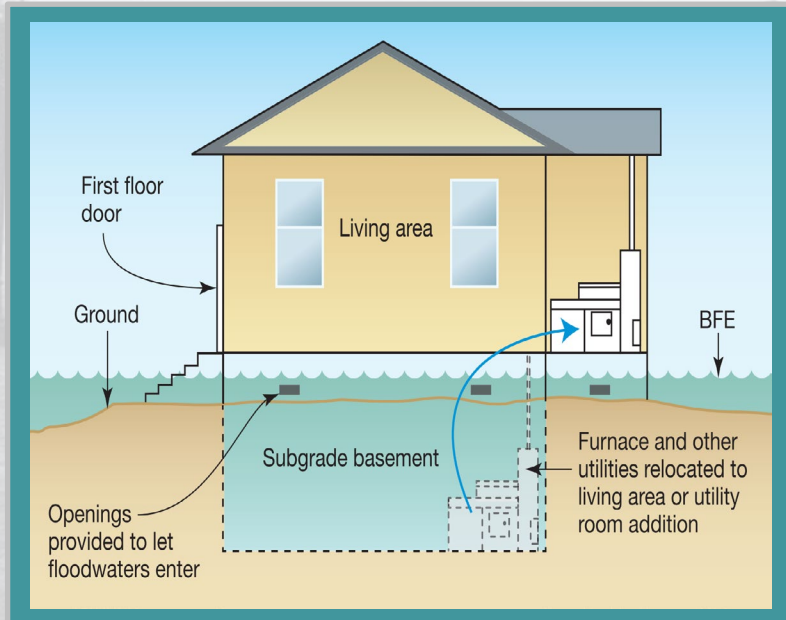




# NONSTRUCTURAL MEASURE EXAMPLES



Wet Floodproofing:  
allowing floodwaters to  
enter/exit with minimal damage



Dry Floodproofing:  
sealing portion of building,  
making it impermeable to  
floodwater



Buyout/Relocation:  
moving structures from  
location with flood risk



Examples of Nonstructural Measures, including structure relocation, dry and wet floodproofing



# NONSTRUCTURAL MEASURE EXAMPLES



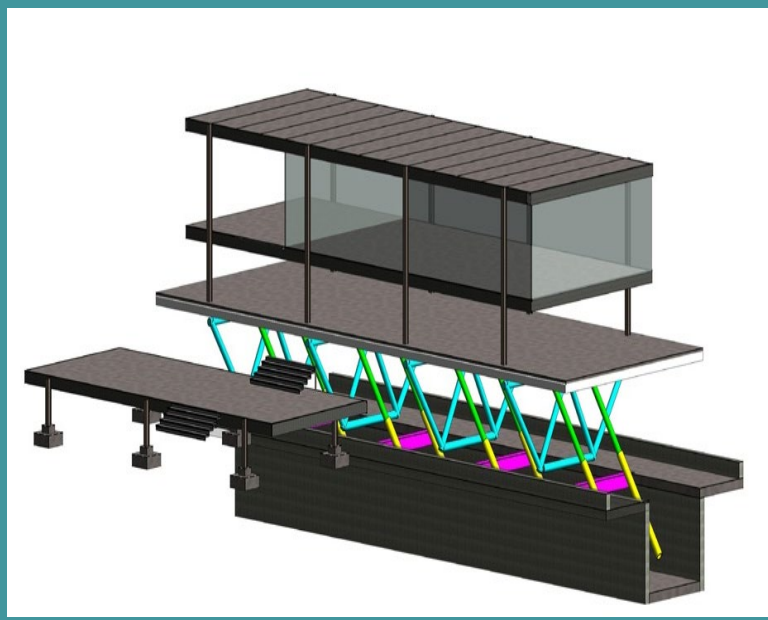
Elevation  
By Raising Grade



Elevation By  
Columns/Piers/Slab



Elevation  
By Hydraulics



Different Approaches to Elevating Structures



## Elevation for Residential Structures

- Lift an existing structure to an elevation greater than a perceived flooding elevation.
- For example, a **residential** structure with a first-floor elevation below the flooding elevation.



*Flooding Elev.*

*First Floor Elev.*

*Lowest Adjacent  
Ground Elev.*

Residential structure **pre-elevation**



*First Floor Elev.*  
*Flooding Elev.*

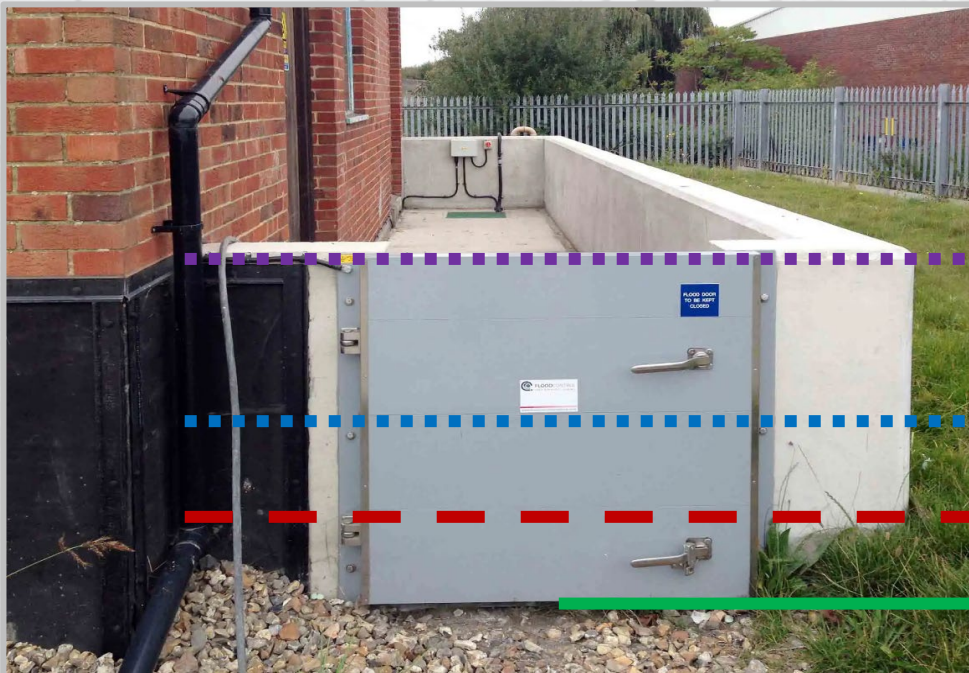
*Lowest Adjacent  
Ground Elev.*

Residential structure **post-elevation**



## Dry Floodproofing for Commercial/Public Structures

- Waterproofing the structure to prevent floodwater from damaging contents.
- For example, **commercial/public** structure that experiences shallow flooding.



*Dry Floodproof Elev.*

*Flooding Elev.*

*First Floor Elev.*

*Lowest Adjacent  
Ground Elev.*



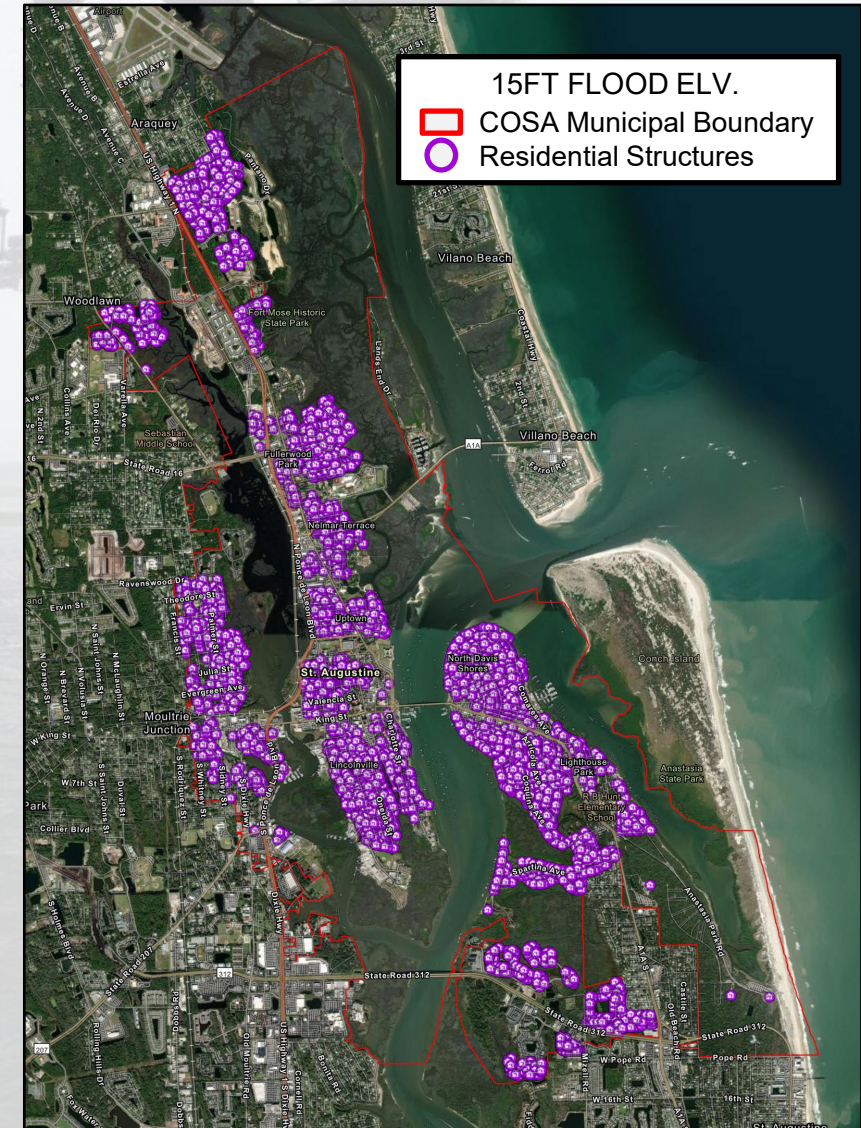
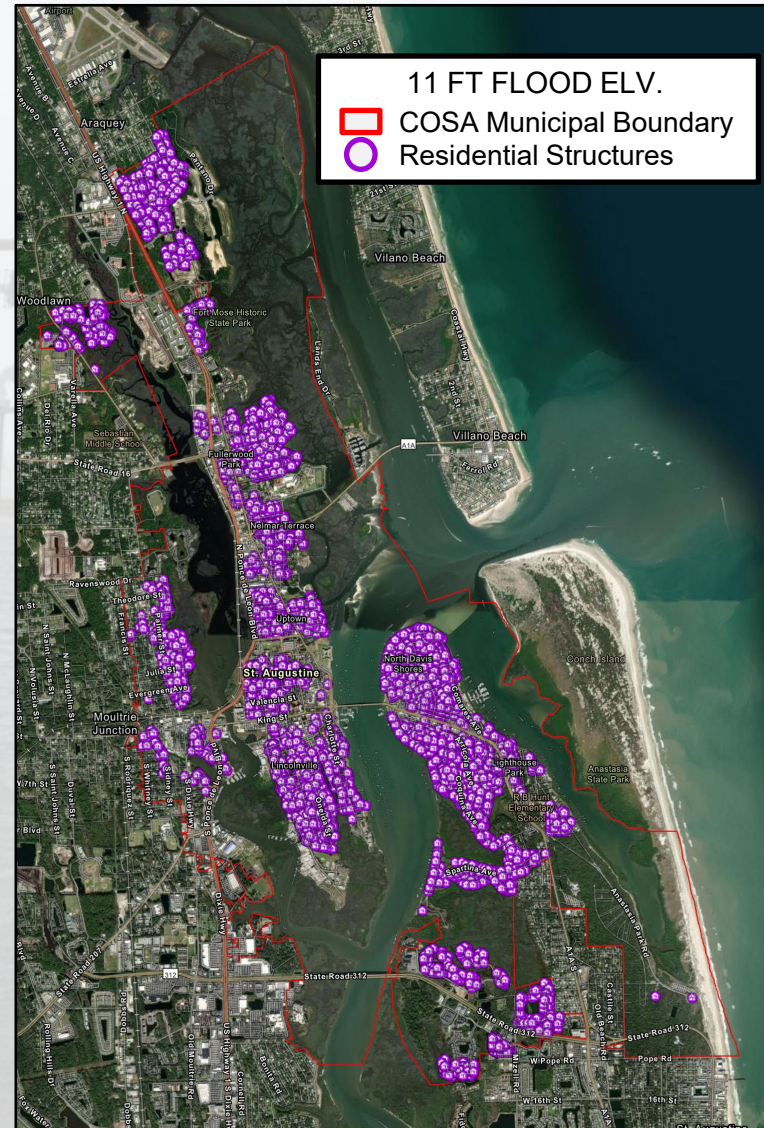
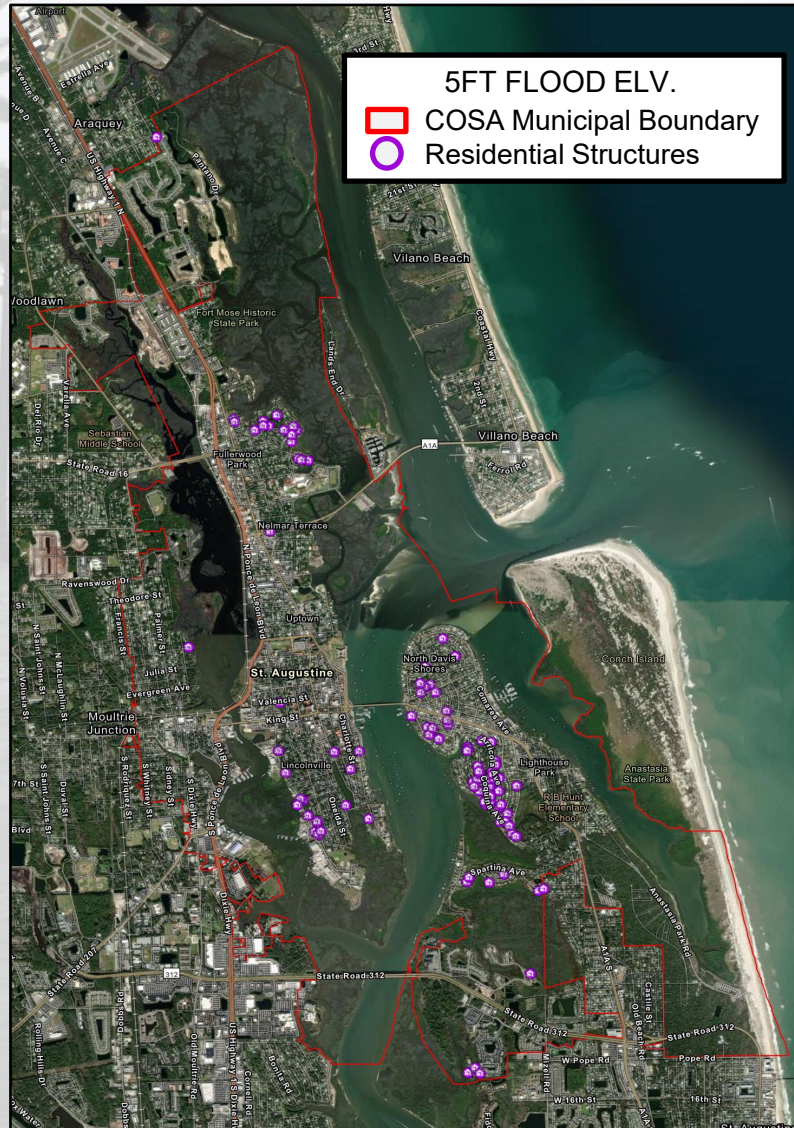


# NONSTRUCTURAL MEASURES



U.S. ARMY

Examples of locations of residential structure elevation potential at 5 ft, 11 ft, and 15 ft design (no other protective measures considered).



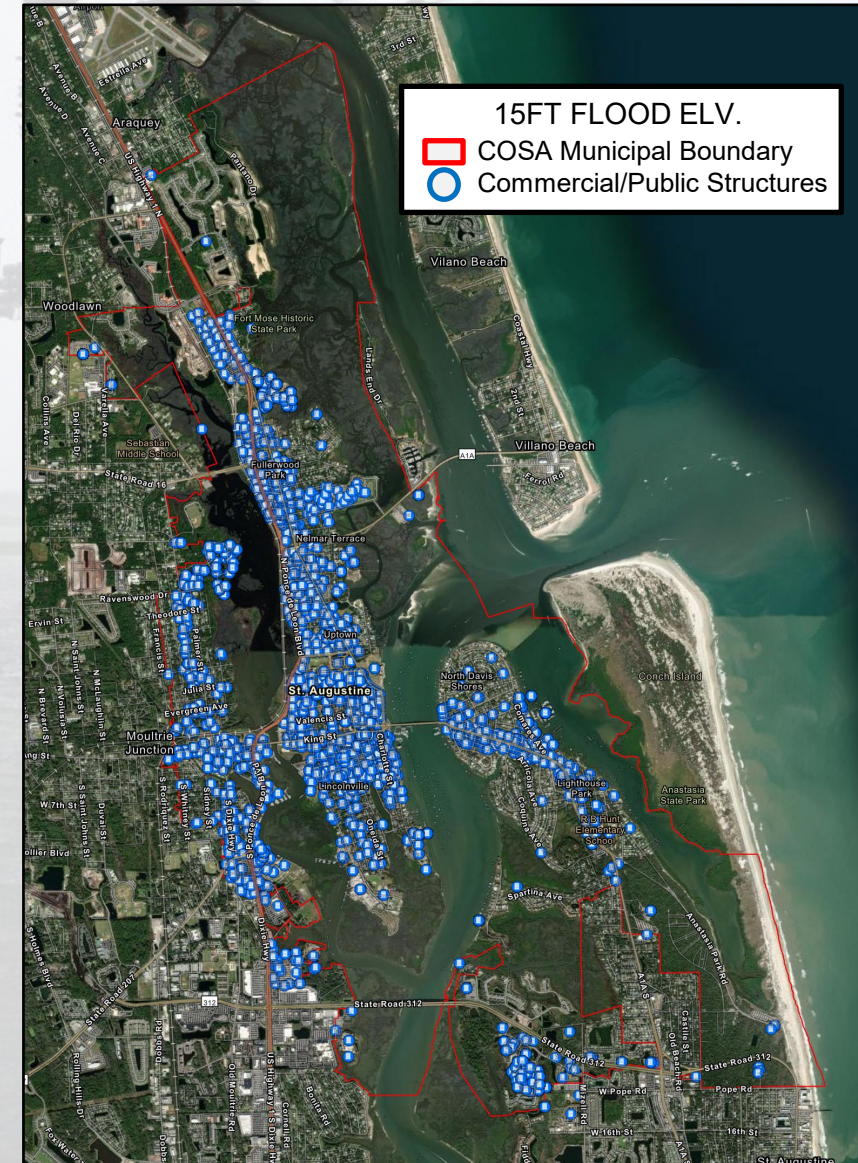
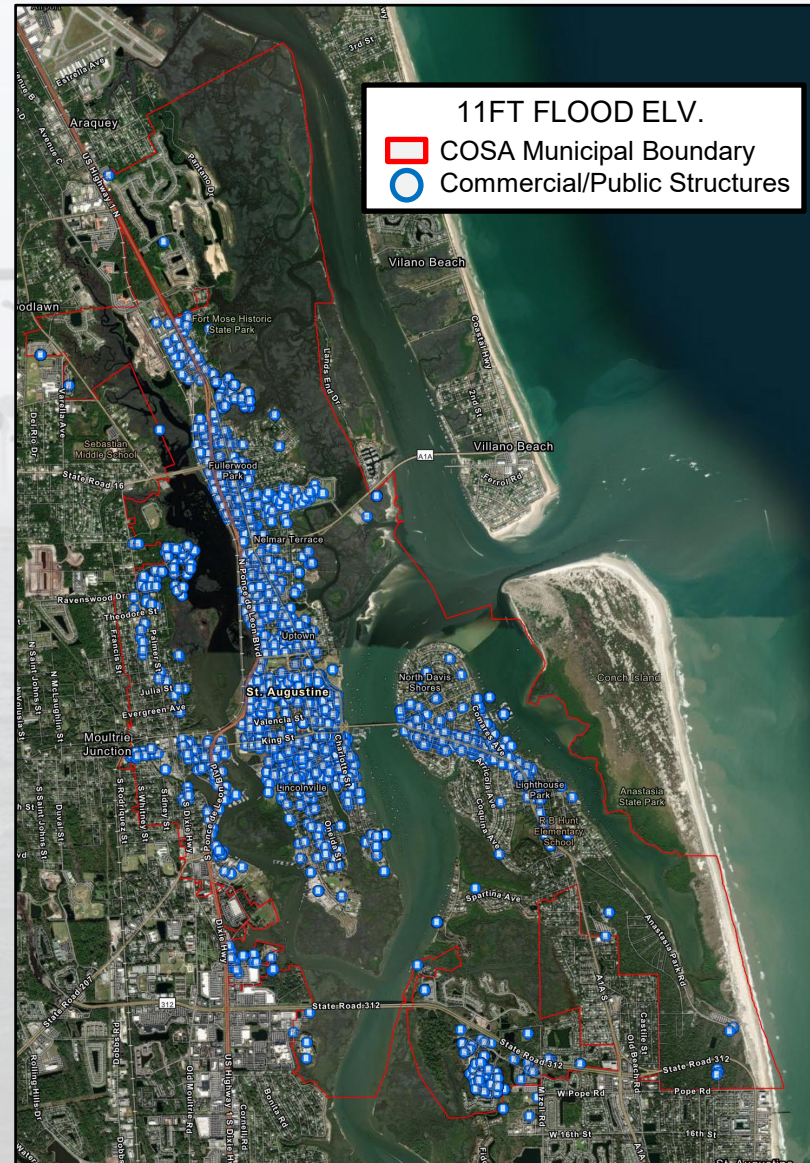
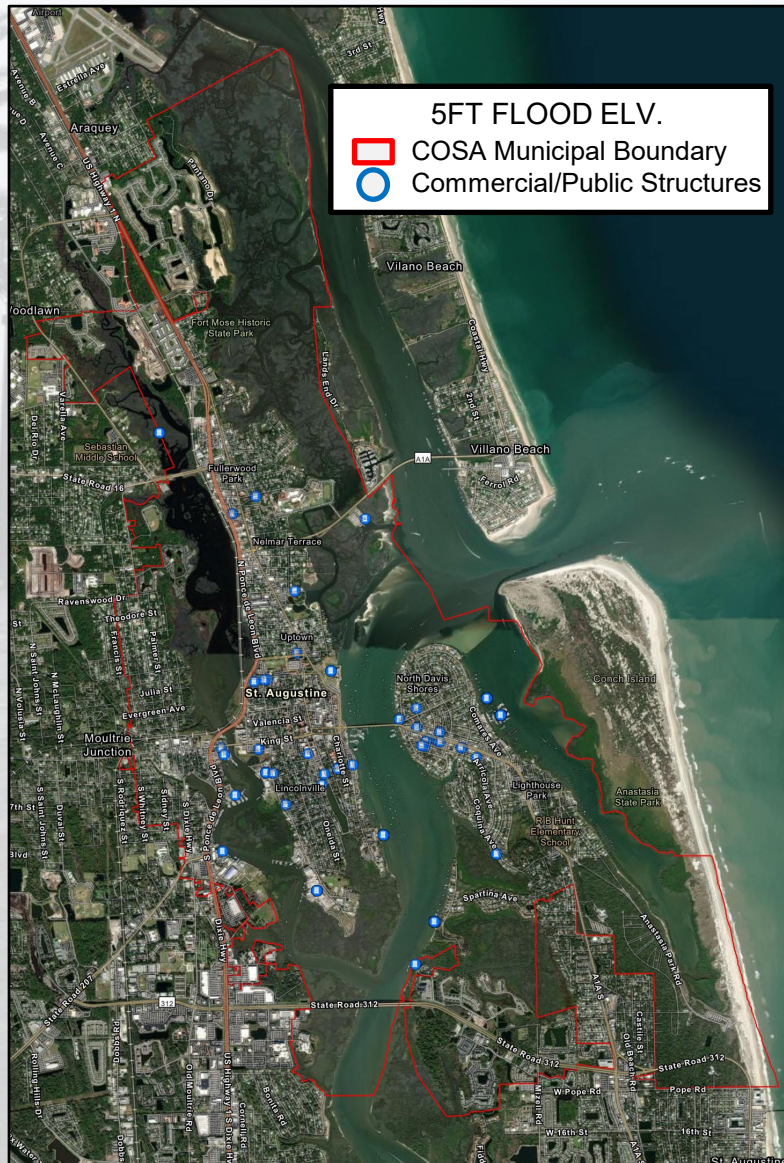


# NONSTRUCTURAL MEASURES



U.S. ARMY

Examples of locations of commercial/public structure floodproofing potential at 5 ft, 11 ft, and 15 ft design (no other protective measures considered).





What benefits do nonstructural measures provide?



What resources may nonstructural measures impact?



Potential options to avoid/minimize/mitigate impacts of implementing nonstructural measures?



- ❖ Reduces risk of coastal flood damage to structure and its contents
- ❖ Reduces risk of community displacement due to coastal flooding

- ❖ Cultural resources eligible for listing in the NRHP
- ❖ Visual or aesthetic resources

- ❖ Evaluate impacts to eligible cultural resources
- ❖ Adhere to NPS guidelines for flood adaptation for historic properties
- ❖ Maintain visual aesthetics
- ❖ Use of temporary/deployable structures





U.S. ARMY

# ENGINEERING WITH NATURE: NATURE BASED FEATURES



**EWN**...the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental and social benefits through collaboration.

**What are Nature Based Features?**  
*Landscape features used to provide engineering function relevant to coastal flood risk management, while producing additional economic, environmental, and/or social benefits.*

Long Beach Island  
Coastal Storm  
Damage Reduction



Galveston Beach  
Nourishment at  
61<sup>st</sup> Street



MacDill Oyster  
Reef Shoreline  
Stabilization



Bayou La Batre  
(Lightning Point)



Evia Island  
Bird Habitat



West Bay River  
Diversion Project

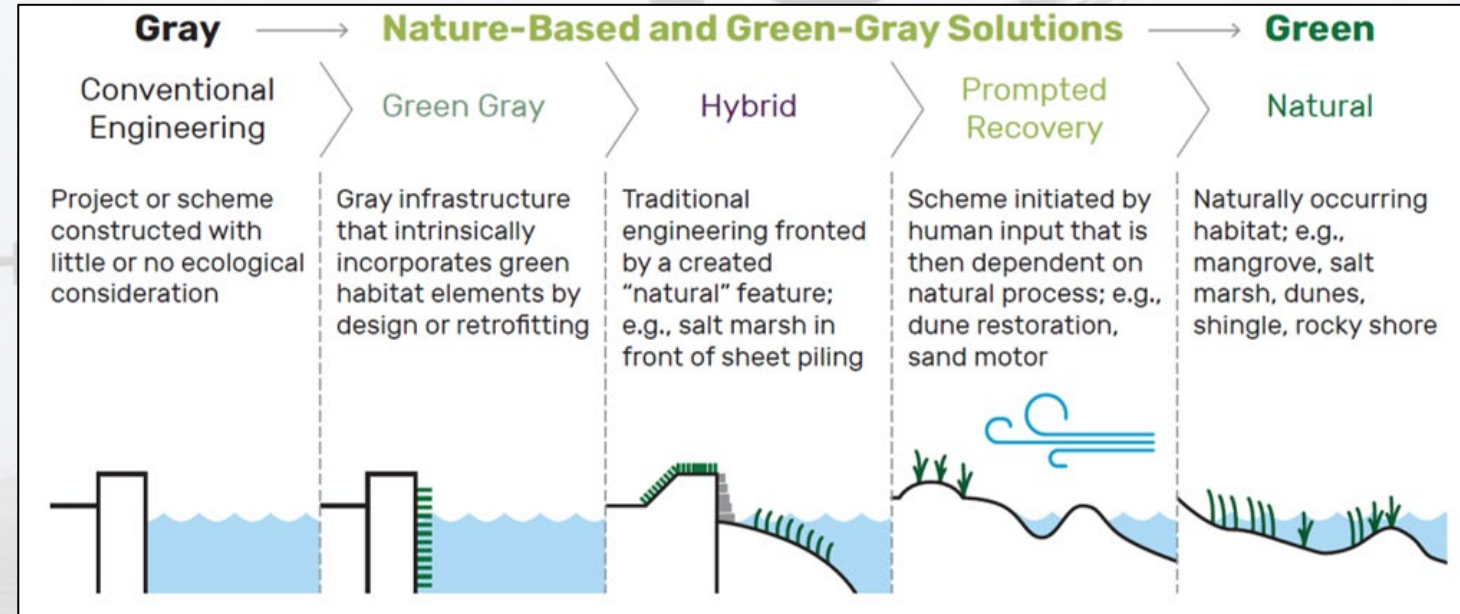




## How do Nature Based Features deliver Coastal Storm Risk Management benefits?

### Coastal Flood Risk Management through:

- Attenuate the energy and height of waves
- Attenuate storm surge water levels along the shoreline
- Provide storage of floodwater in the upper tidal reaches of estuaries
- Reduce erosion of sediments and soils
- Attract and stabilize sediments
- Attract and sustain flora and fauna, which can stabilize structures such as coastal levees



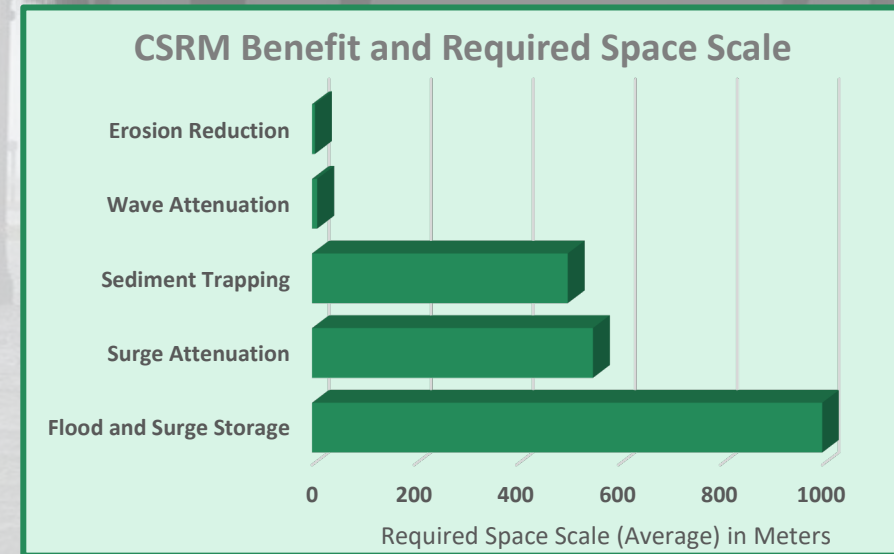
### Nature Based Features Considerations:

- Wetland or shoreline location and geometry
- Space constraints (reducing water levels requires more extensive widths than reduction of waves)
- Vegetation constraints (native types and performance)
- Expected storm characteristic



## Nature Based Features Potential Benefits and Required Space Scale for Implementation?

CSRM Benefit	Benefit Description
<b>Erosion Reduction</b> Required Space Scale: 1 to 10 meters	Potential to lower shoreline recession rate
	Potential to prevent erosion at toe of landward structural features
	Potential to reduce maintenance costs of protected structures
	Potential to increases life span of protected structures
<b>Sediment Trapping</b> Required Space Scale: 1 to 1,000s of meters	Potential to maintaining or increasing wetland elevation and extent
	Potential to prevent erosion at toe of landward structural features
	Potential to reduce maintenance costs of protected structures
<b>Wave Attenuation</b> Required Space Scale: > 10s of meters	Potential to reduce flooding by wave overtopping and run-up
	Potential to reduces required height of structural measures
	Potential to reduce maintenance costs of protected structures
<b>Surge Attenuation</b> Required Space Scale: > 100s to 1,000s of meters	Potential to reduce flooding from storm surge (wetland must occupy large proportion of total flow area to provide measurable benefit)
	Potential to reduce required height of structural measures
<b>Flood and Surge Storage</b> Required Space Scale: > 1,000s of cubic meters	Potential to reduces water level
	Potential to provides flood and surge storage
	Potential to store runoff during coastal storms



Adapted from USACEs  
International Guidelines  
on Natural and Nature-  
Based Features for Flood  
Risk Management







## HORIZONTAL LEVEE

A Nature Based Feature composed of a traditional flood-control levee core with a seaward ecotone slope, grading smoothly to a low marsh elevation. The slope is planted with native wetland and transitional species, restoring habitats, as well as providing adaptive capacity allowing wetlands to adjust landward as sea levels rise.



### CSRM Benefits:

- Storm surge attenuation and protection
- Wave attenuation, reduction of wave energy impacts seaward of the shoreline
- Reduce shoreline erosion
- Adaptable to sea level rise
- Possible flood storage

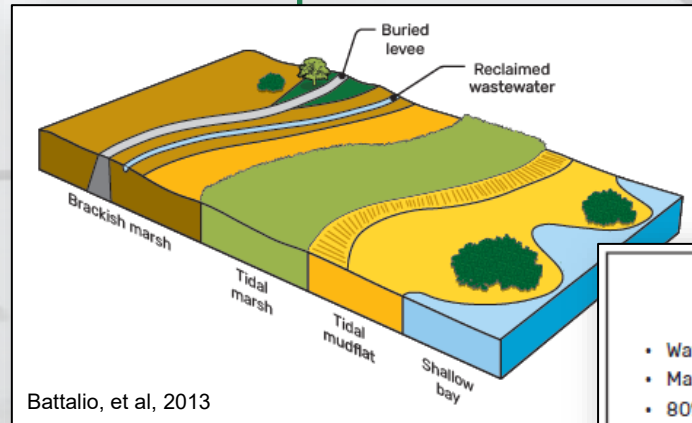
### Challenges:

- Greater cost than traditional grey infrastructure
- Larger footprint required
- Easement challenges



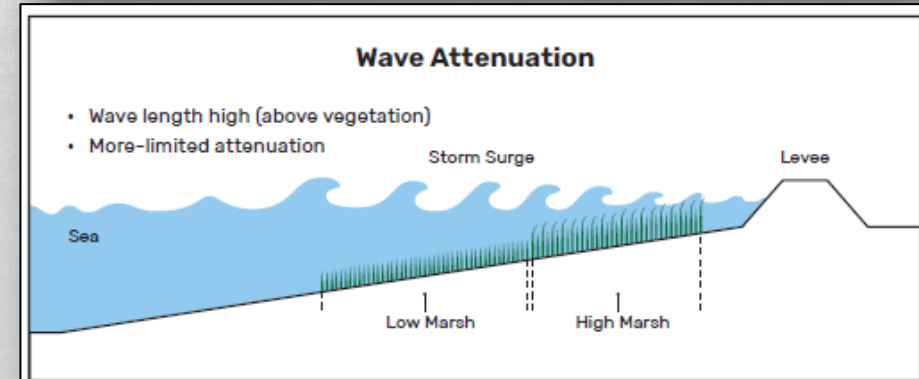
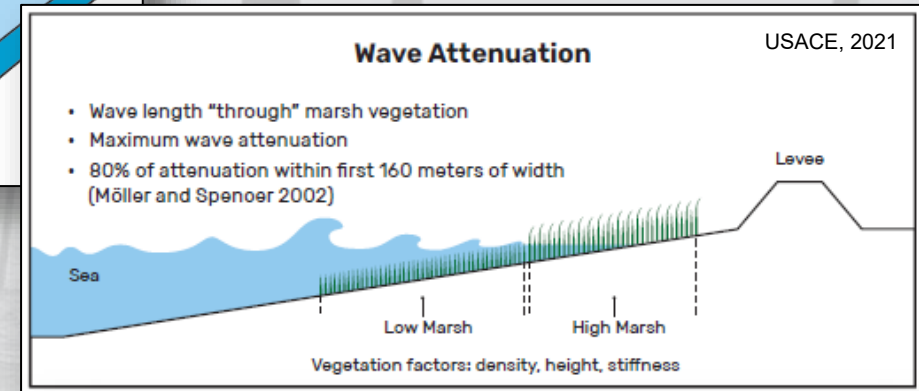


## Horizontal Levee – Implementation in the City of St. Augustine Back Bay Coastal Storm Risk Management



Example of Horizontal Levee in San Francisco Bay paired with freshwater discharged

Works in conjunction with structural levee to reduce coastal storm risk. Reduces wave action intercepted by structure. May require thin layer placement to retain or restore salt marsh.







## LIVING SHORELINE

A Nature Based Feature that involves the use of native vegetation to protect against shoreline erosion. Living shorelines have a footprint that is dominated by native elements such as tidal flats, intertidal marshes, or mangroves (or a combination of these). In exposed locations, living shorelines often include a structure parallel to and along the waterward edge of the shore to buffer it against incoming wave energy.



vhb, 2024

### CSRM Benefits:

- Wave attenuation, reduction of wave energy impacts seaward of the shoreline
- Reduce shoreline erosion
- Possible cost reduction for traditional grey shore protection structural measures
- Adaptable to sea level rise

### Challenges:

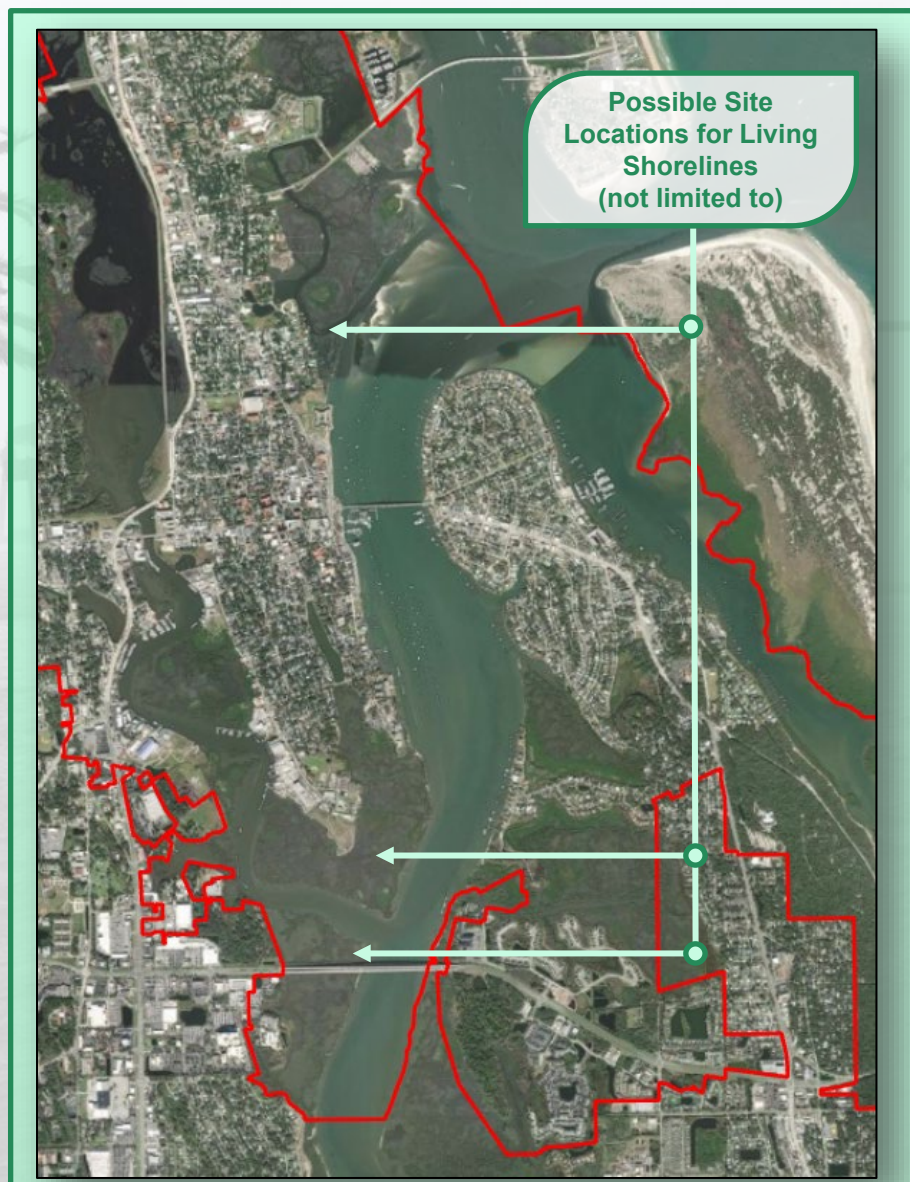
- Not applicable to high energy environments (large waves, high water velocity, high surge)
- Not a standalone CSRM alternative
- Alteration of water and sediment exchange



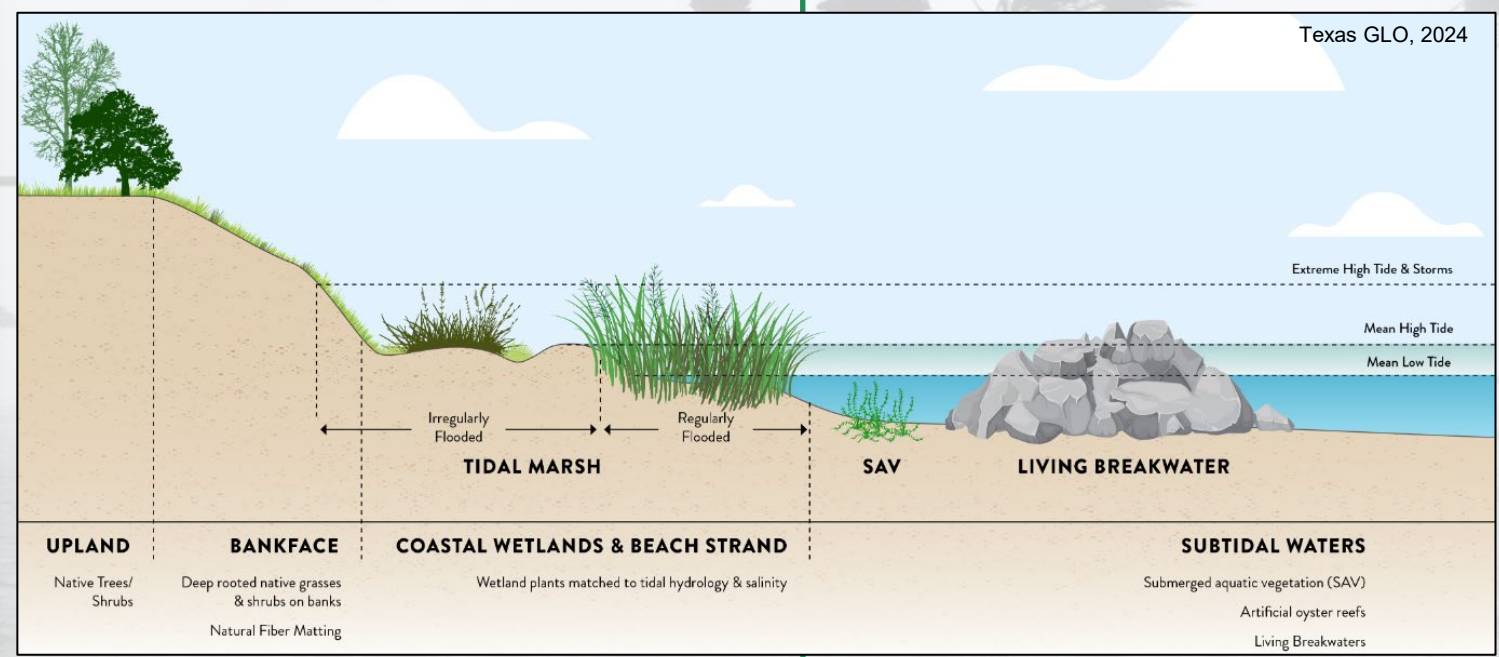


U.S. ARMY

# ENGINEERING WITH NATURE: NATURE BASED FEATURES



## Living Shoreline – Implementation in the City of St. Augustine Back Bay Coastal Storm Risk Management



Shoreline stabilization technique that provides erosion protection and reduction of wave energy fronting existing marsh habitat or marsh habitat with traditional coastal storm risk management structural measures.





## HYBRID SEAWALL WITH COASTAL VEGETATION

Combines green and grey infrastructure to achieve both a robust coastal storm protection measure with a seawall while maintaining or restoring ecosystems with implementation of appropriate vegetation. This vegetation buffer offers aesthetic benefits while also fortifying the traditional structural measures.



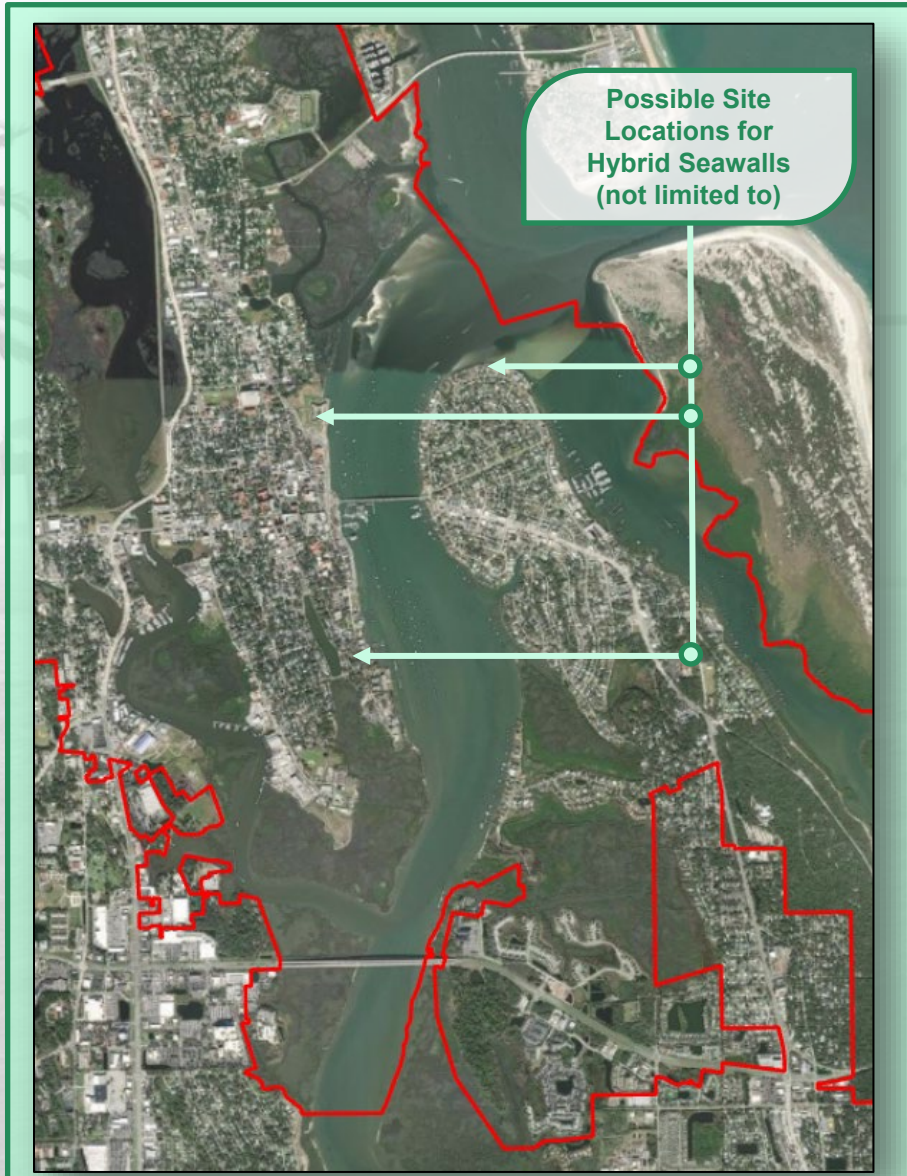
### CSRM Benefits:

- Wave attenuation, reduction of wave energy impacts seaward of the shoreline
- Reduce shoreline erosion
- Possible cost reduction for traditional grey shore protection structural measures.

### Challenges:

- Not applicable to high energy environments (large waves, high water velocity, high surge)
- Higher cost than traditional seawalls
- Requires more space than traditional seawalls





## HYBRID SEAWALL WITH COASTAL VEGETATION – Implementation in the City of St. Augustine Back Bay Coastal Storm Risk Management



Hybrid seawalls may offer wave attenuation and scour prevention for a traditional structure to improve performance and lifespan.





U.S. ARMY

# ENGINEERING WITH NATURE: NATURE BASED FEATURES

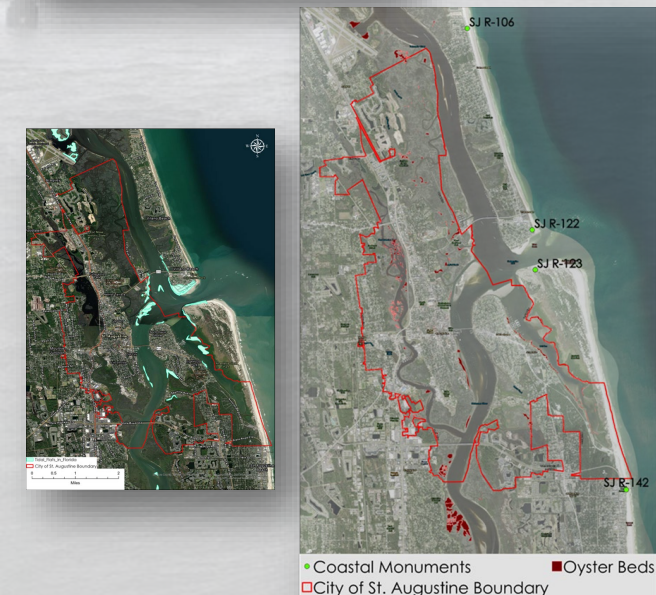
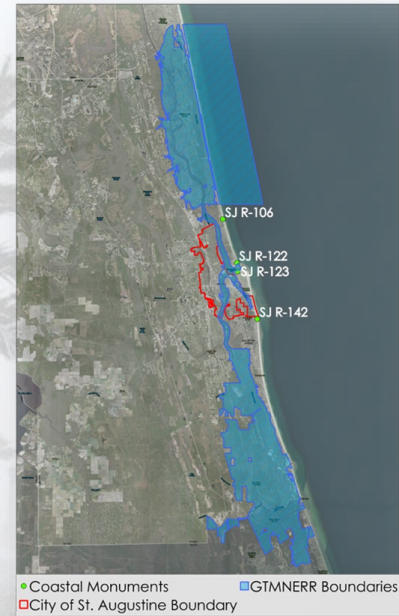


What important resources could these features impact?

Implementation considerations for potential alternatives

- ❖ GTMNERR extends through the project area and includes many habitat types, including mangroves, oyster reefs, and salt marsh
- ❖ Oyster beds throughout the project area, notably within Salt Run
- ❖ Wetlands of various types
  - ❖ Tidal flats, a specific type of coastal wetland, are also present in the study area.
- ❖ Marine/estuarine animals (e.g., manatees, gopher tortoises, shorebirds, etc.) and habitat

- ❖ Coastal Barrier Resources Act (CBRA)
- ❖ Endangered Species Act
- ❖ Essential Fish Habitat
- ❖ Cultural Resources
- ❖ Aesthetics
- ❖ Recreation
- ❖ Environmental Justice
- ❖ Climate Change/Sea Level Rise
- ❖ Space
- ❖ Cost





Please check out the study website...



<https://experience.arcgis.com/experience/06bb9c98d9184bd9a374a244f6d27474/>

E-mail questions or comments at anytime to...

[cesaj-st.augbackbaycsrm@usace.army.mil](mailto:cesaj-st.augbackbaycsrm@usace.army.mil)

Turn in your comment cards tonight

# Thank You!!!