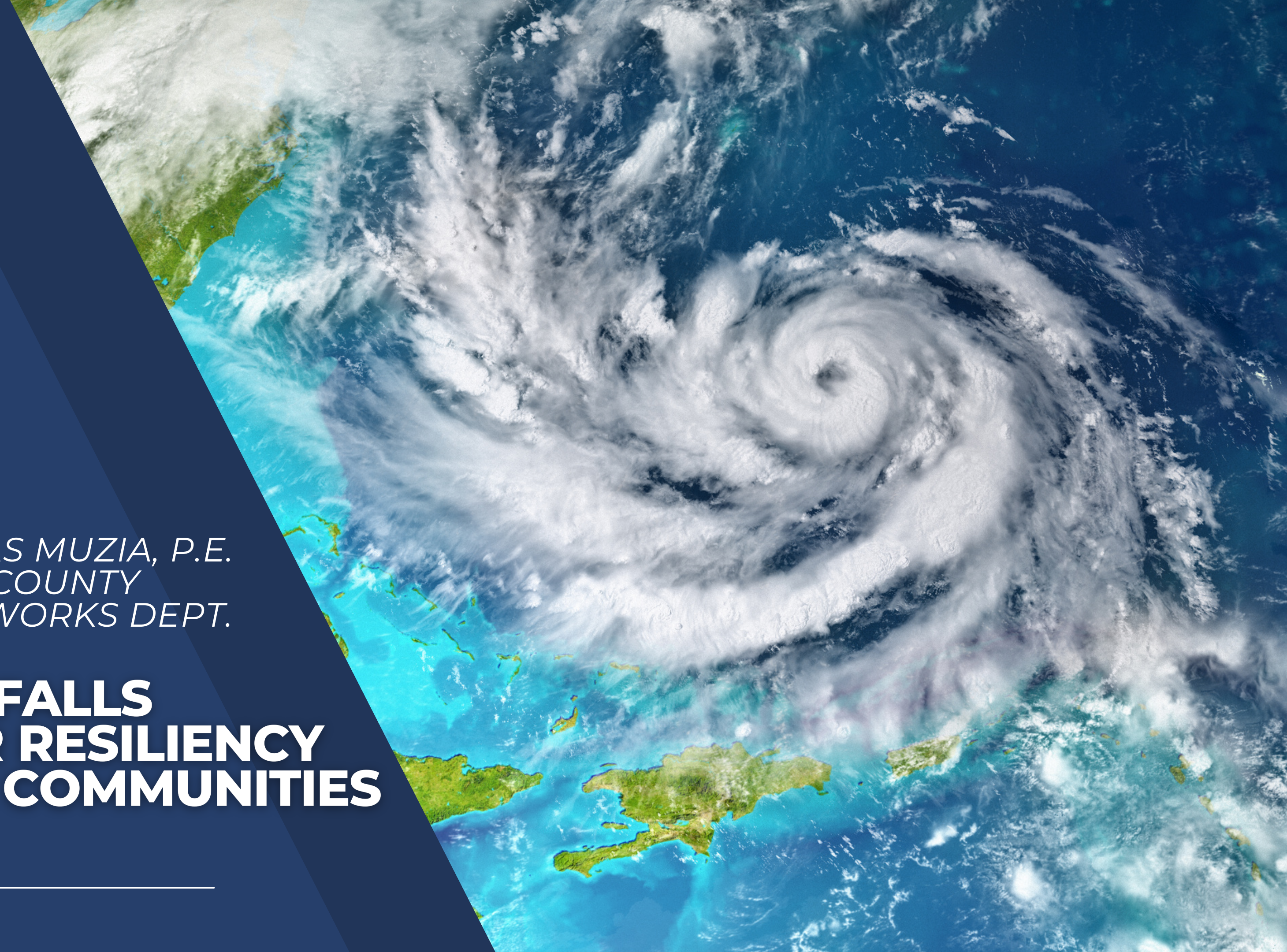




*NICHOLAS MUZIA, P.E.  
MARTIN COUNTY  
PUBLIC WORKS DEPT.*

**COASTAL OUTFALLS  
STORMWATER RESILIENCY  
FOR COASTAL COMMUNITIES**



# WHY IT'S IMPORTANT

- Looks Bad on the News!
- Statewide Flooding and Sea Level Rise Resilience

SB 1954 Effective May 2021

HB 7053 Effective July 2022

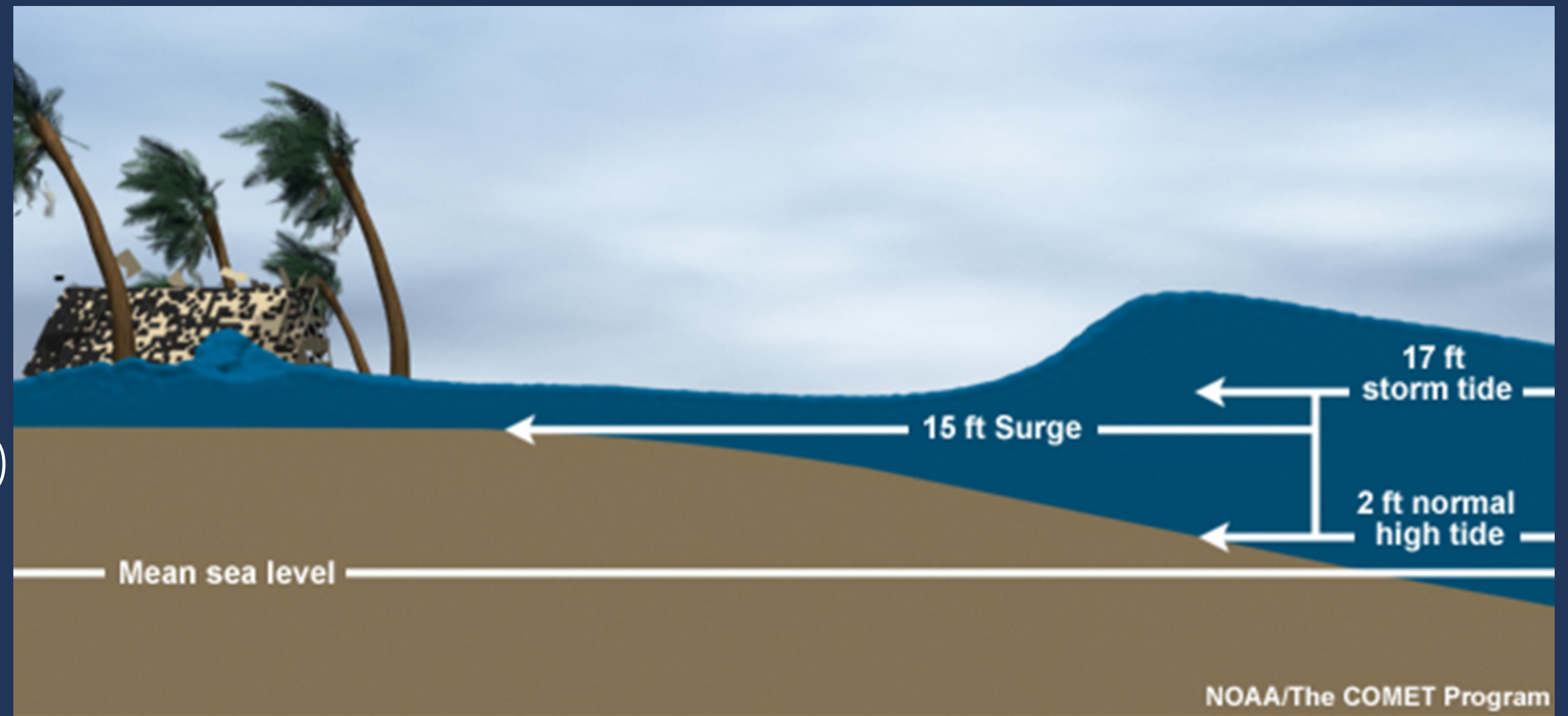
- Resilient Florida Grant Program

Section 380.093 F.S.



# WHAT DO WE KNOW...

- Spring/King Tides
- Storm Surge
- Storm Tides (Combined)



# WHAT TOOLS ARE AVAILABLE?

- NOAA Sea Level Rise Viewer
- USGS Water Data Dashboard
- Resilient Florida Webpage
- Sea Level Impact Projection Tool

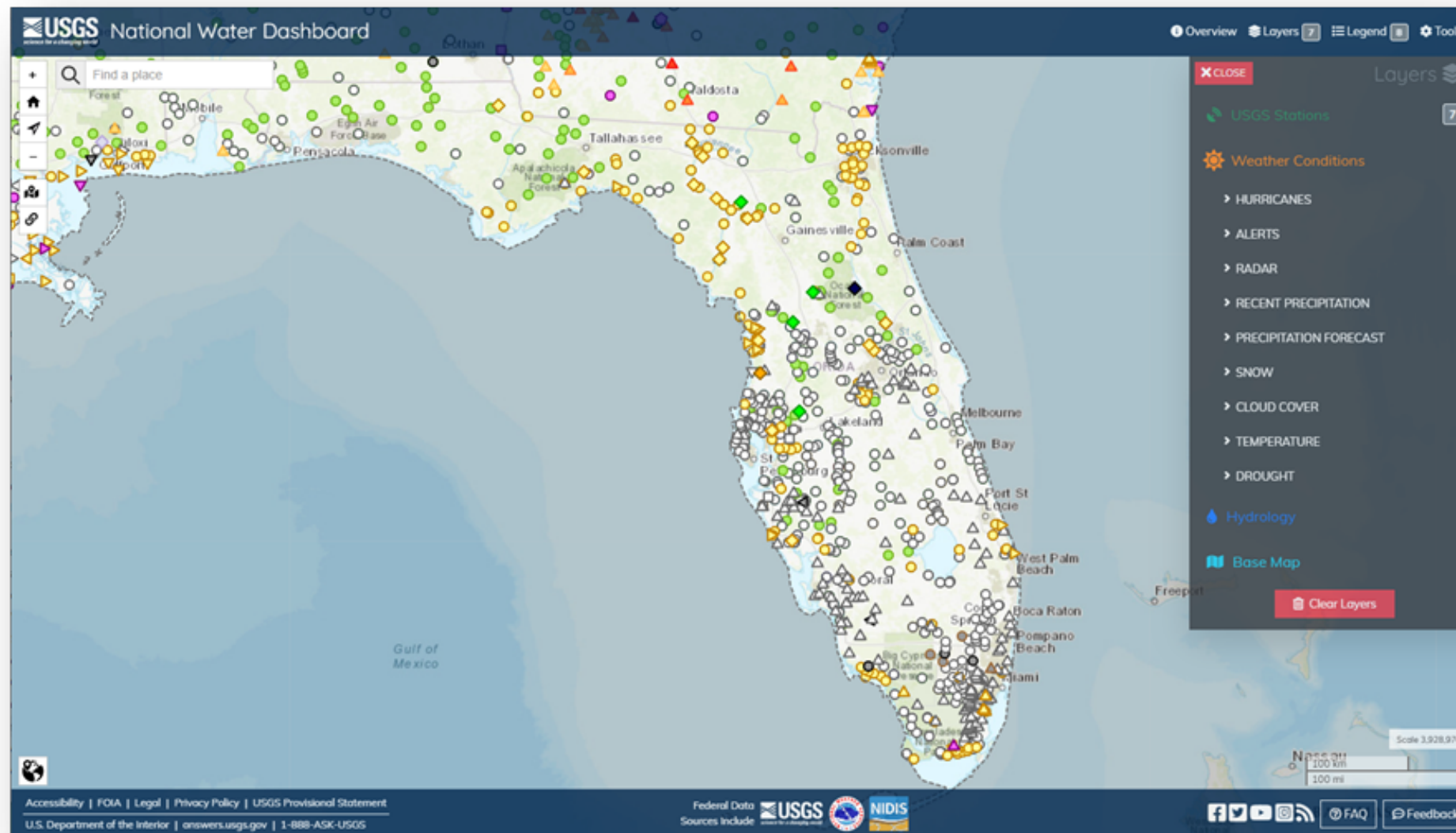
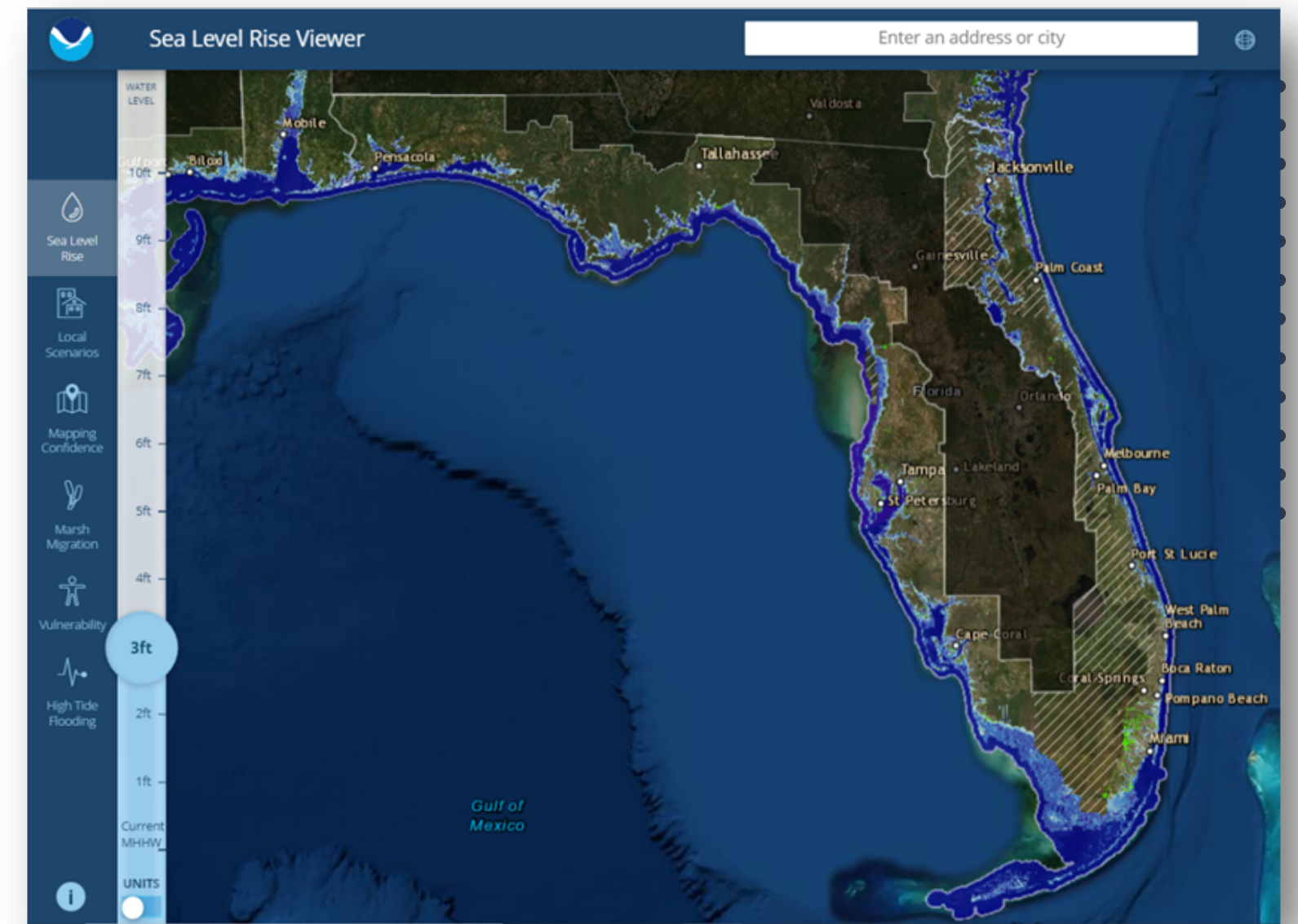


# PUBLIC TOOLS

NOAA Sea Level Rise Viewer

<https://coast.noaa.gov/slr>

Qualitative Analysis & Visual Tool



USGS Water Data Dashboard

<https://dashboard.waterdata.usgs.gov>

Public Database

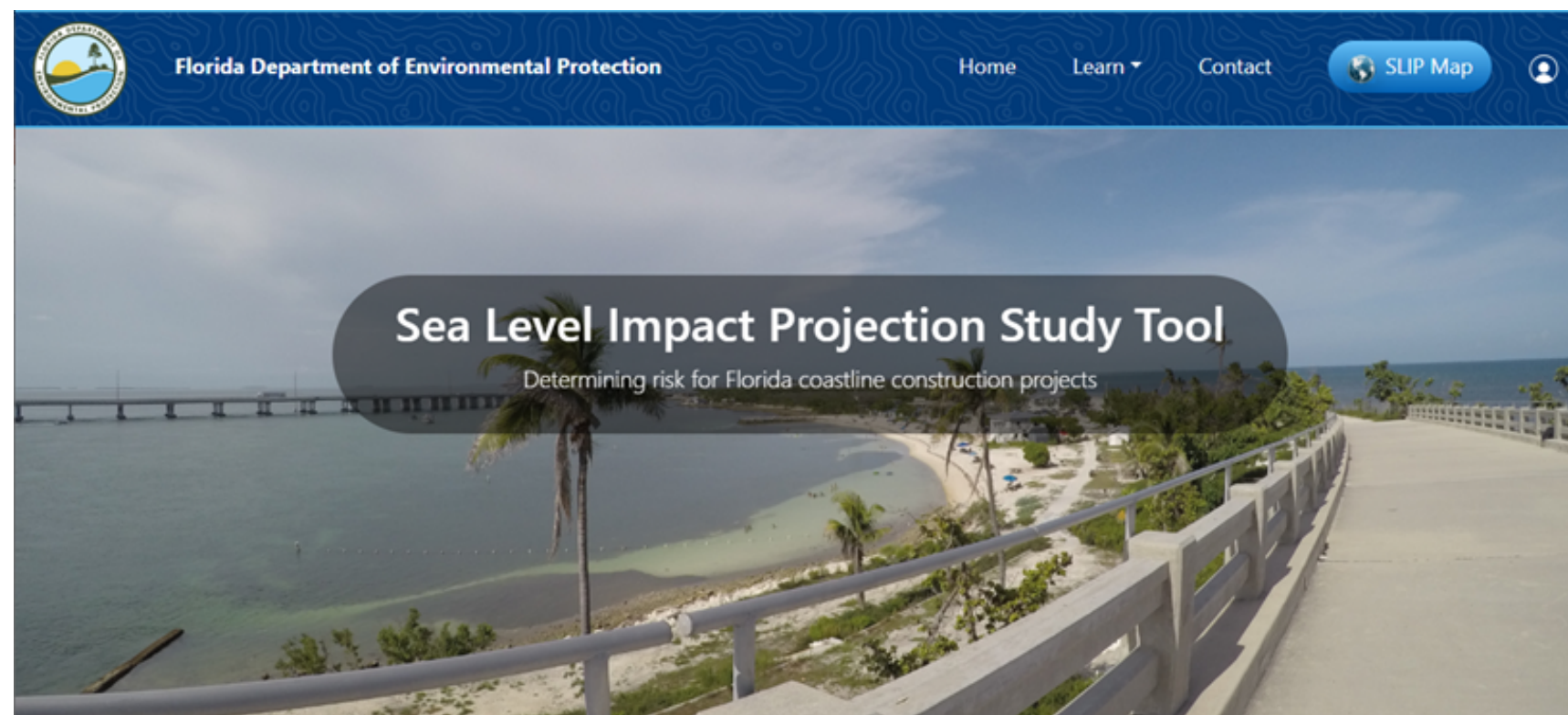
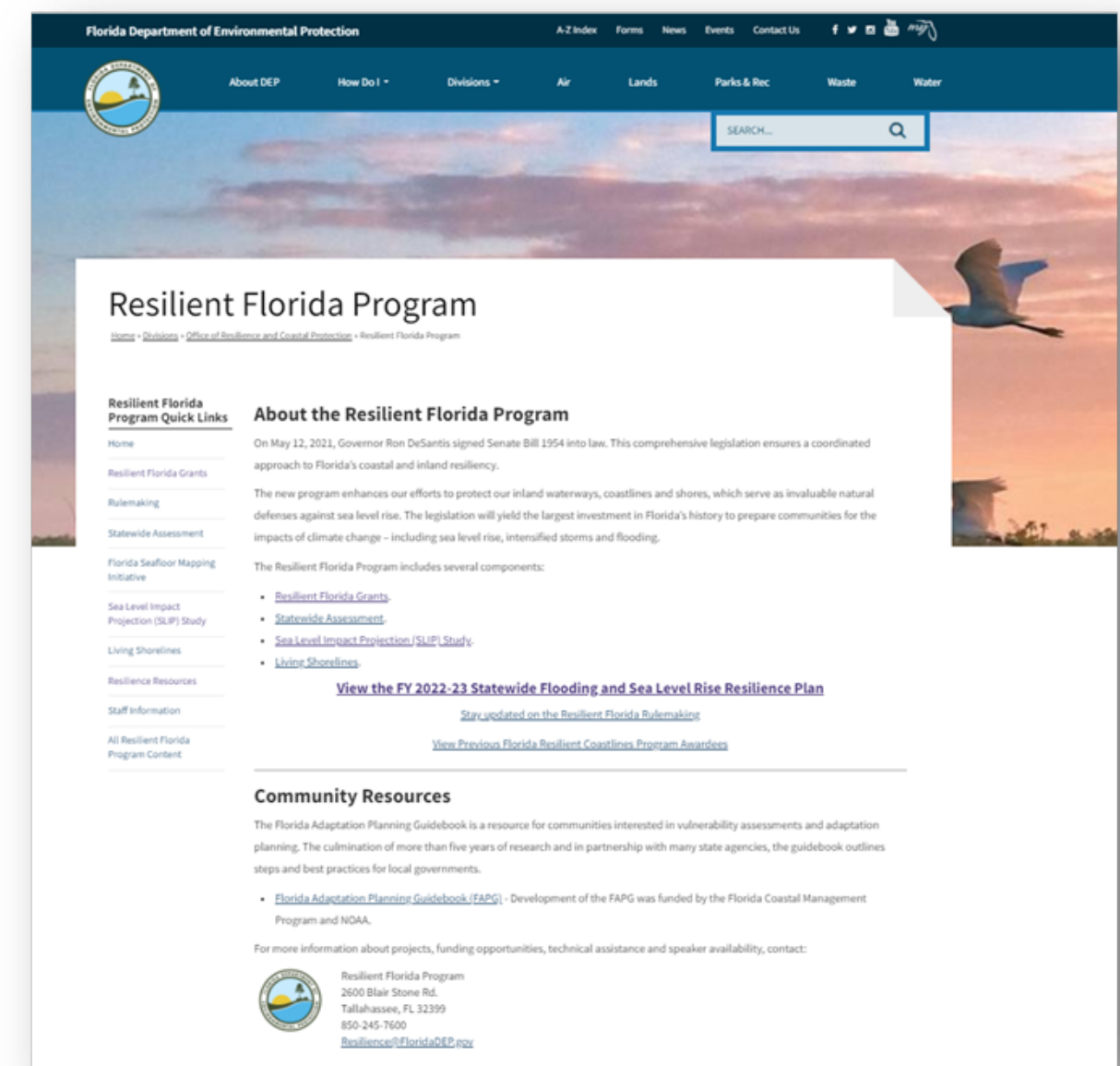
Wide Variety of Data

# PUBLIC TOOLS

Resilient Florida website

<https://floridadep.gov/ResilientFlorida>

Information on resiliency and state programs



The purpose of the Sea Level Impact Projection (SLIP) Study Tool is to facilitate the conduction of SLIP studies for state-funded construction within the coastal building zone in accordance with Section 161.551, F.S.



### SLIP Studies

Learn how to create a SLIP study report using this website and see published reports.

[Continue](#)



### Section 161.551, F.S.

Learn more about the Florida statute that mandates SLIP studies.

[Continue](#)



### Adaptation

Learn about adaptation strategies for your construction projects.

[Continue](#)

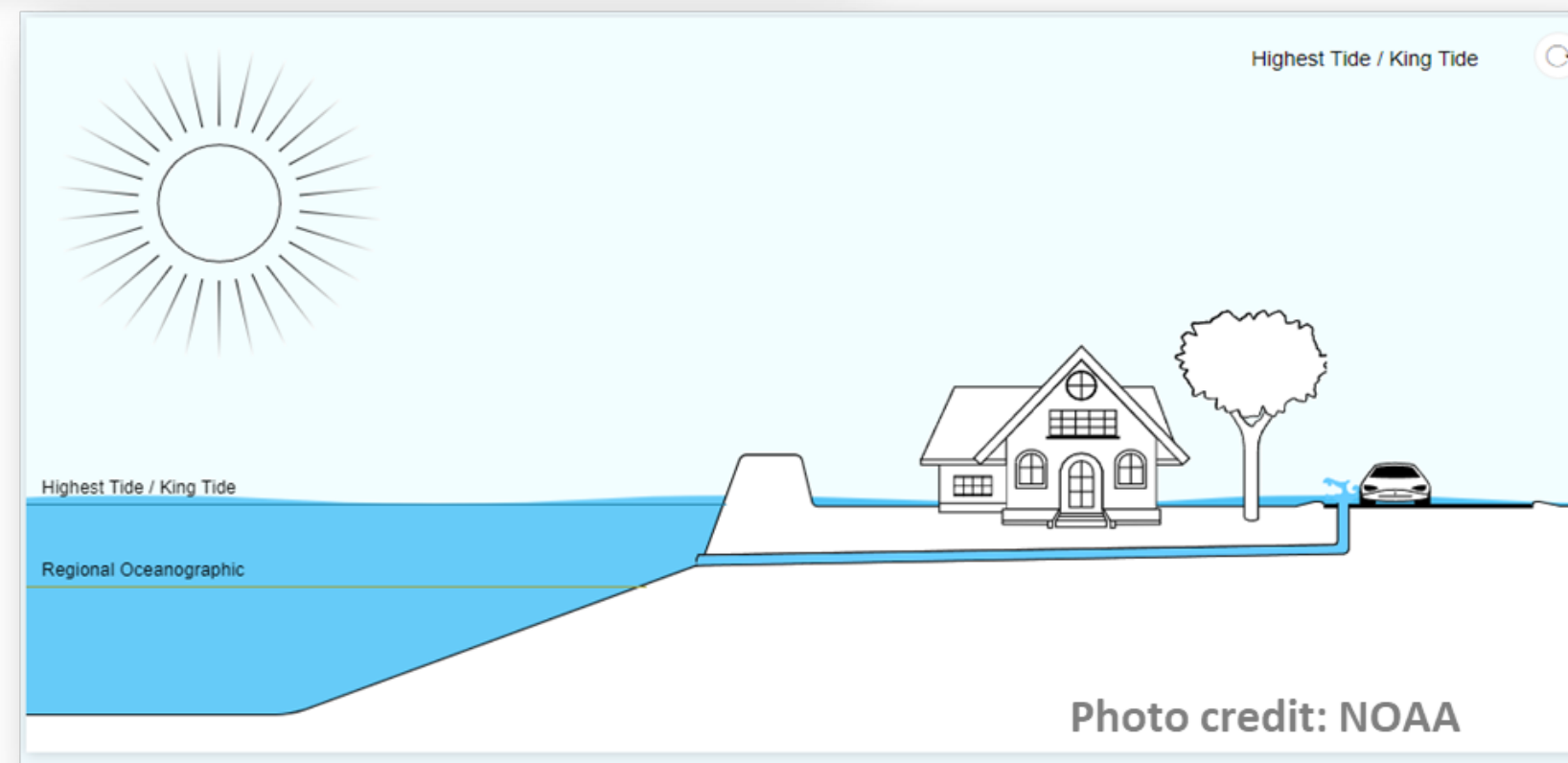
Sea Level Impact Projection Study Tool

<https://www.floridadep-slip.org/>

Identify potential impact to sea level rise and coastal hazards.

# SLR - EFFECTS ON STORMWATER

- Flooding
- Increased Salinity
- Decreased WQ Storage Volume
- Increased tail water condition





## KNOW THE INDICATORS

- Measure the salinity in your stormwater system after an event. The effects may linger for days.
- Conductivity in water can determine salinity.
- Refractometer may also be used

Typical Freshwater Wetland  
0-1 PPT or < 1000 microhos/cm

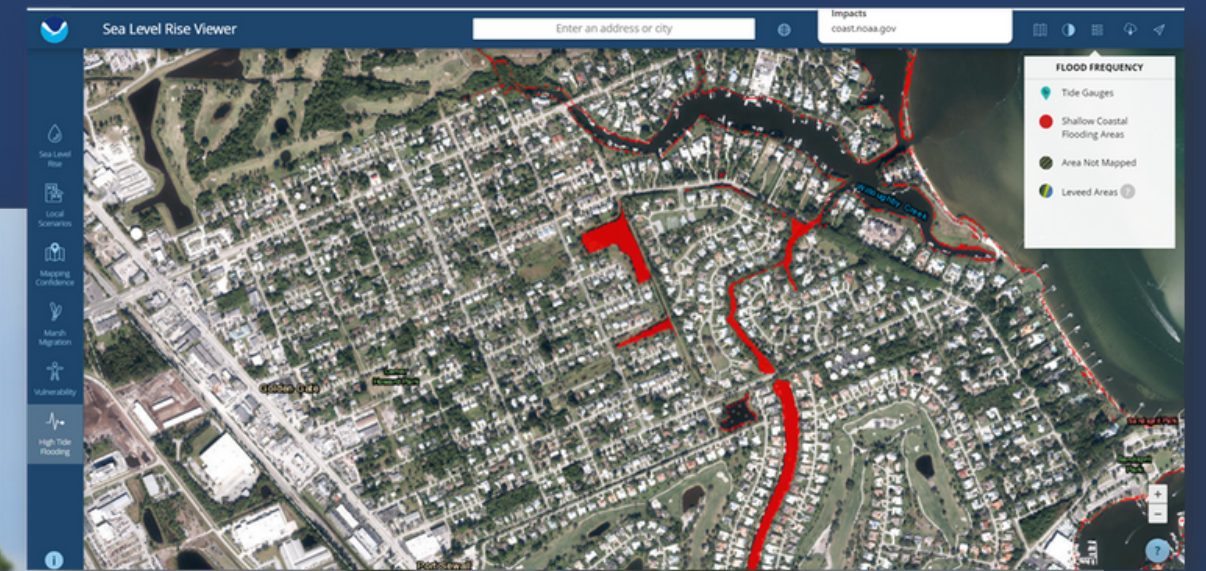






# KNOW THE INDICATORS

- Is the water flowing backward?... It's not always obvious
- NOAA Sea Level Rise Viewer and help guide.
- Most Important is to know your control elevations.





# PROBLEMS

- Increased Salinity
- Decreases storage volume



# SOLUTIONS



## Natural Solutions

Utilize Nature to solve engineering problems



## Modelling & Retrofits

Analyze and solve through iterative solutions



## Check Valves

Control the direction of flow



## Control Structures & Weirs

New or Elevate Existing Structures

# NATURAL SOLUTIONS



## **Coral Restoration & Artificial Reefs**

Continue to grow overtime and create material



## **Vegetated Buffer**

Plants and roots grow to provide stabilization & protection



## **Beneficial Vegetation in Stormwater**

Selected to sequester sediment, clean water, improve habitat

# GREY INFRASTRUCTURE & OTHER SOLUTIONS



## Concrete Structures

Solve the most  
challenging  
problems



## Check Valves

Provide ability to  
maintain control  
elevations



## Water Pumps

Pushes water, but less  
volume than gravity.  
Last resort.

# Keys to Success

- Solutions tend to be multi-disciplinary - Assemble the A-Team
- Communicate the "not so obvious" causes
- Cost-benefit for lost flood control and water quality storage
- Environmental improvements can be significant within a resiliency retrofit project.

# GOLDEN GATE RESILIENT OUTFALL PROJECT







6.8 Acres of Wet Ponds @ 0.5 Control EL.

3 areas are all Hydraulically Connected.

Plant Die offs and Poor Water Quality.

Started Resiliency Retrofit Planning in 2018



-  Drainage Flow
-  Dry Detention Areas
-  Wet Detention Areas
-  Tidal Water Bodies



# GOLDEN GATE RESILIENT OUTFALL PROJECT







Monitored Salinity up to 8 ppt.

2018 Modelling study confirmed we could temporarily elevate the lake control by 3 ft and bleed down to existing control without impacting flood control

Estimated 11.5 Acre-feet of storage was lost to storm tides from Hurricane Dorian in 2019.



-  *Drainage Flow*
-  *Dry Detention Areas*
-  *Wet Detention Areas*
-  *Tidal Water Bodies*





# GOLDEN GATE RESILIENT OUTFALL PROJECT



South Outfall Improvement Project;

Installed a 48" diameter check valve  
in 2020

Headwall installation was needed to  
accept the valve.

Channel enhancements for energy  
dissipation.



# GOLDEN GATE RESILIENT OUTFALL PROJECT







North Outfall Improvement Project;

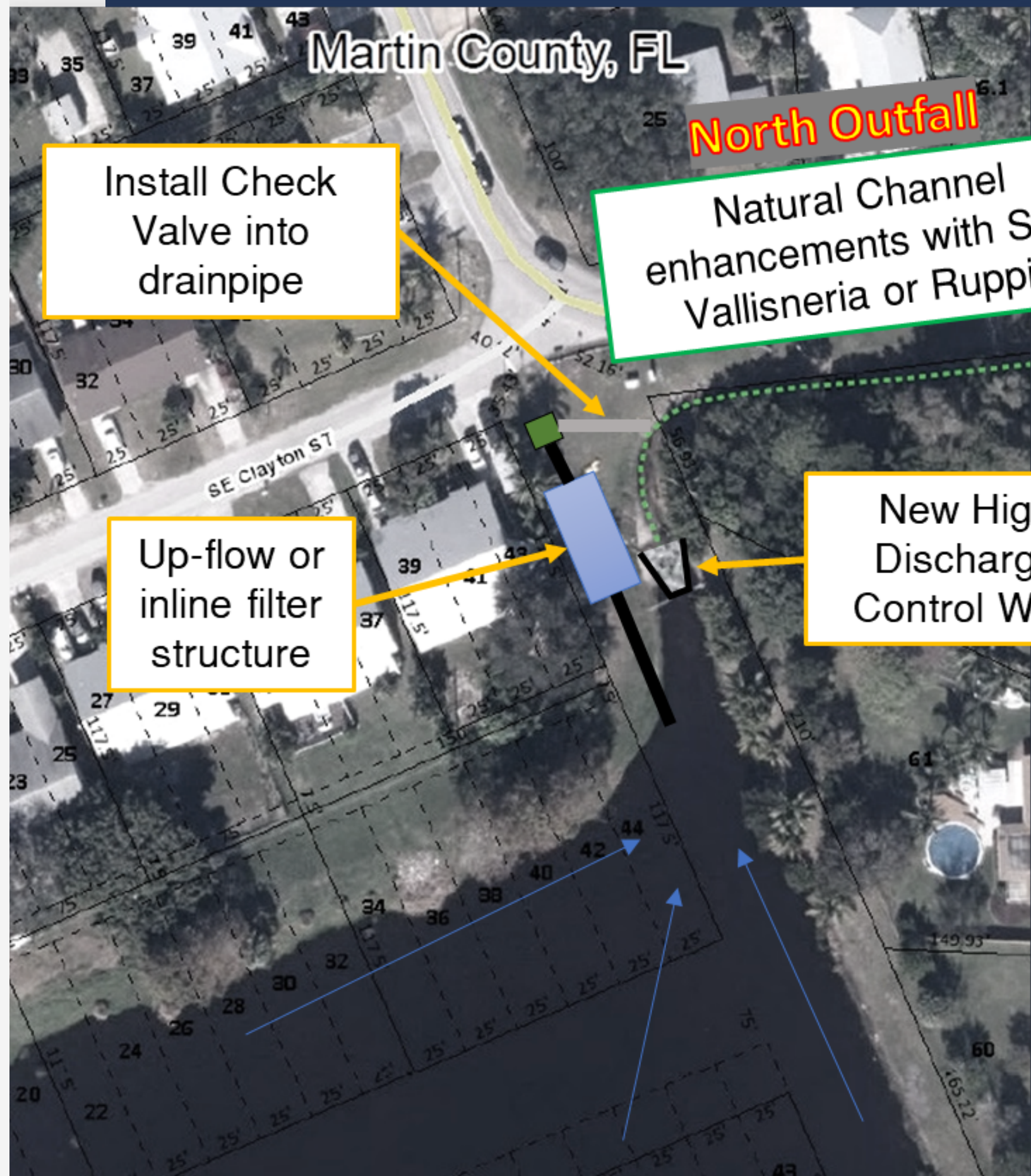
Listed on the Florida Statewide Flooding  
and SLR Resilience Plan

Project Goals

- Flood Prevention
- Water Quality
- Habitat Restoration
- Include Nature Based Solutions



-  *Drainage Flow*
-  *Dry Detention Areas*
-  *Wet Detention Areas*
-  *Tidal Water Bodies*



# GOLDEN GATE RESILIENT OUTFALL PROJECT



North Outfall Improvement Project;

Listed on the Florida Statewide Flooding and SLR Resilience Plan

Components:

- High Discharge Weir design
- Check valve to maintain lake EL 0.5
- Increased Storage and filtration
- Nature based Eelgrass and Seagrass planting in outfall ditch to support IRL Restoration

# WHAT WE LEARNED

How Coastal Stormwater Facilities are impacted by SLR.

Where to look for the less obvious impacts of SLR on stormwater.

What tools are available to guide and communicate impacts.

What an actual solution looks like.

