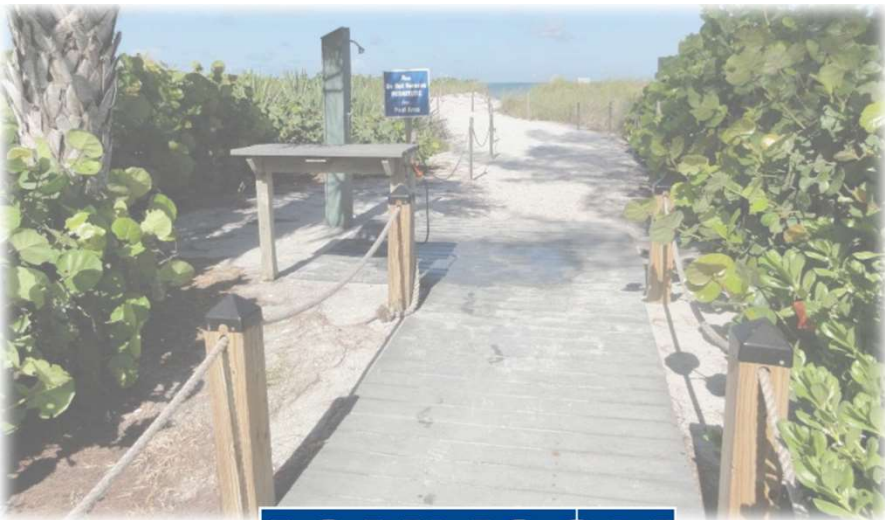




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Surface Water Management Master Plan

Post Hurricane Ian Update

Oisin Dolley, PE – City Engineer
Jordan Varble, PE – Johnson Engineering

July 30, 2025

Agenda

1. Introduction
2. Damage Repairs Post-Hurricane Ian
3. Flooding and Vulnerability
4. Data Collection
5. Resiliency
6. Recommendations

**Surface Water Management
Master Plan Update
Following Hurricane Ian (2022)**

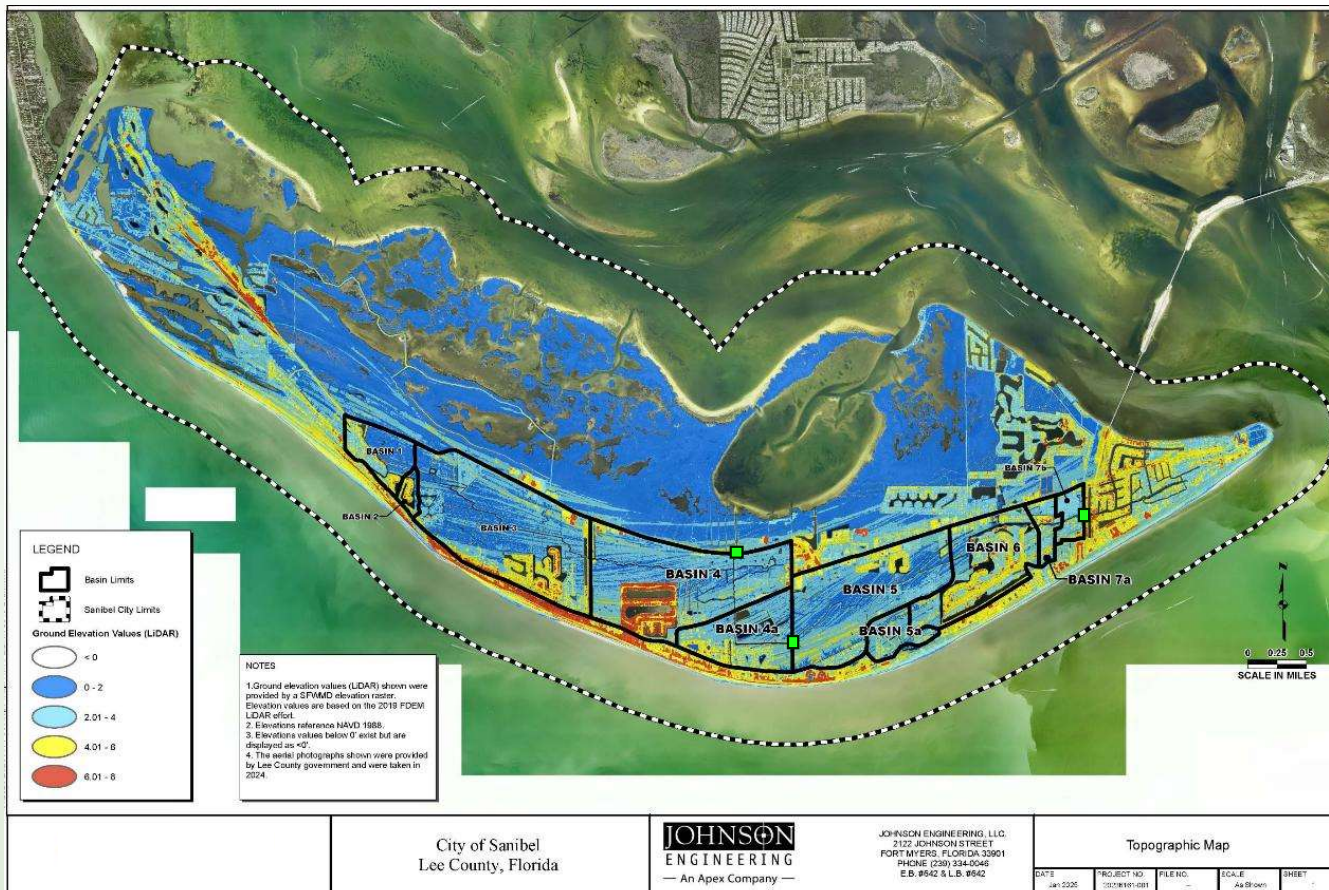
Prepared For:



Prepared By:

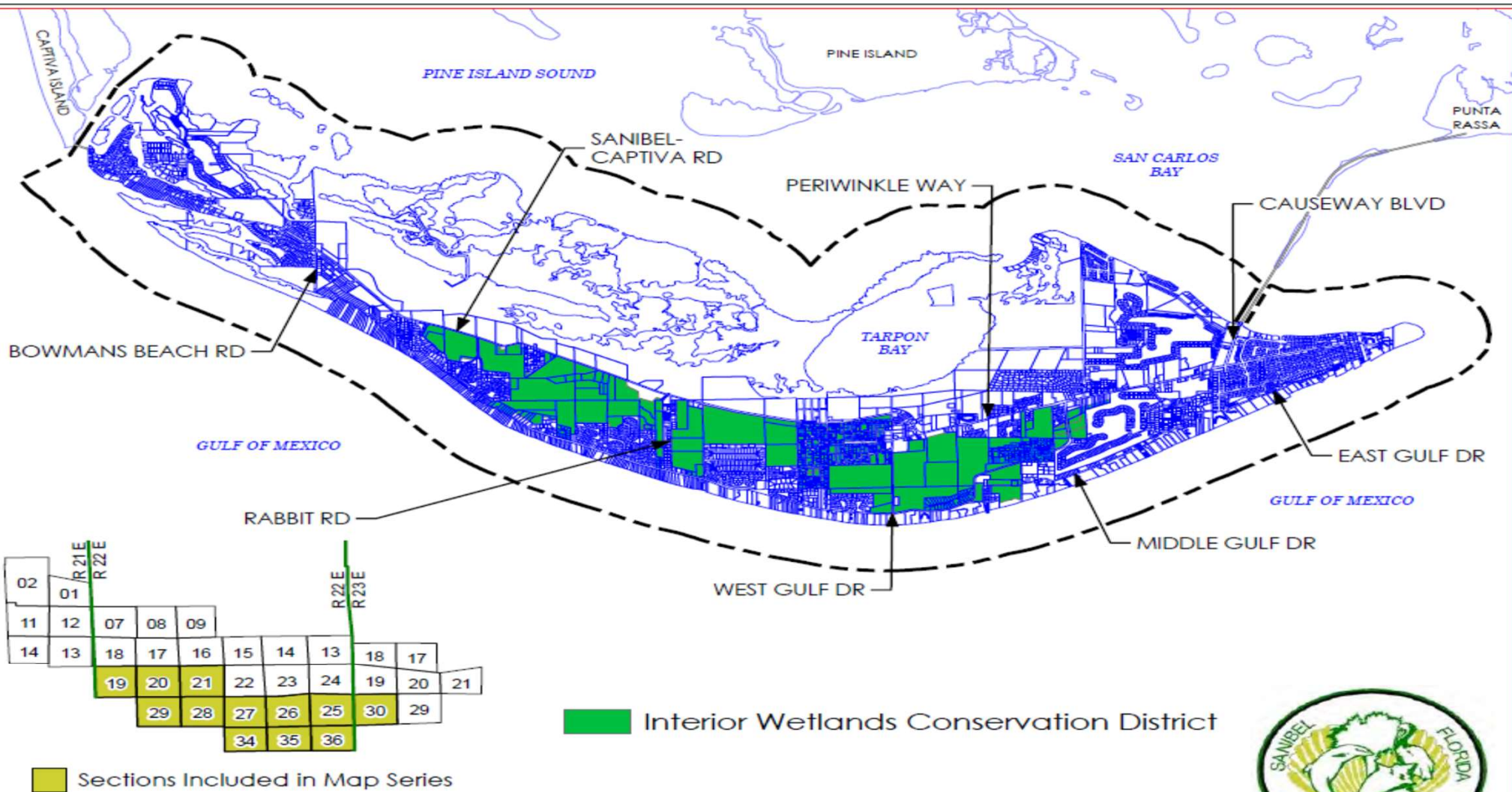
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Johnson Engineering, LLC.
2122 Johnson St.
Fort Myers, Florida 33901
(239) 344-0046

Interior Wetlands and Overland Flow



1. Introduction – Interior Wetlands and Overland Flow

- *The island is essentially a bowl*
- *System fills and overflows, it doesn't drain dry.*
- *Two interior freshwater basins outfall to Pine Island Sound via weirs*
- *Saltwater intrusion occurs when freshwater head decreases*
- *It is necessary to retain as much rainwater as possible to maintain the freshwater wetland ecosystem*



WETLANDS CONSERVATION LANDS MAP



Native Wildlife Species That Rely on Sanibel's Interior Freshwater Wetlands

Mammals

- Sanibel Island rice rat (endemic to the Island)
- Hispid cotton rat
- Marsh rabbit
- River otter



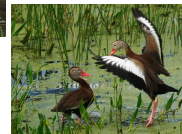
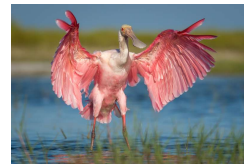
Reptiles & Amphibians (over 19 species)

- Green treefrog
- Pig frog
- Chicken turtle
- Florida mud turtle
- Florida watersnake
- American crocodile



Birds (well over 40 species)

- White ibis
- Roseate spoonbill
- Great egret
- Great blue heron
- Wood stork
- Little blue heron
- Limpkin
- Tri-colored heron
- Green Heron
- Black-bellied whistling duck
- Common moorhen
- Black-necked stilt



Freshwater fish (more than nine species)

- Mosquito fish (very important for mosquito control)
- Sailfin molly
- Flagfish
- Least killifish



Damages from Hurricane Ian

2. Damage Repairs Post-Hurricane Ian – Introduction

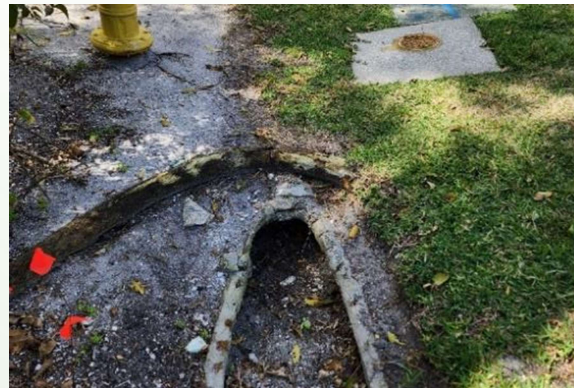
- *Hurricane Ian severely damaged the island's infrastructure.*
- *Culverts, inlets, and swales were buried, leaving the island more vulnerable to riverine flooding.*



PHOTO CREDIT: Steve Helber, the AP, ABC News



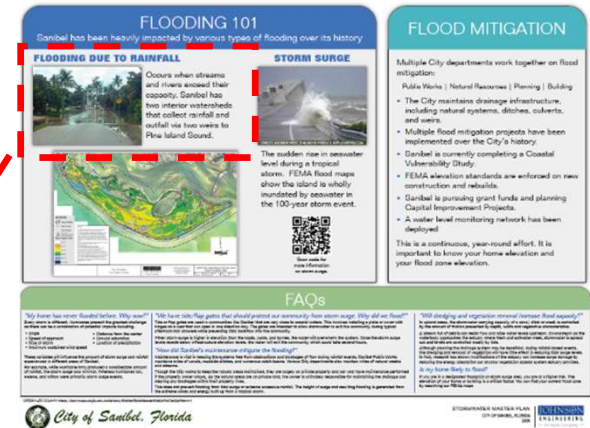
PHOTO CREDIT: Getty Images, ABC News



Flooding 101

3. Flooding and Vulnerability – Riverine

- *Public meeting display boards*
- *Heavy rainfall causes rivers & streams to exceed their capacity.*



Flooding Due to Rainfall

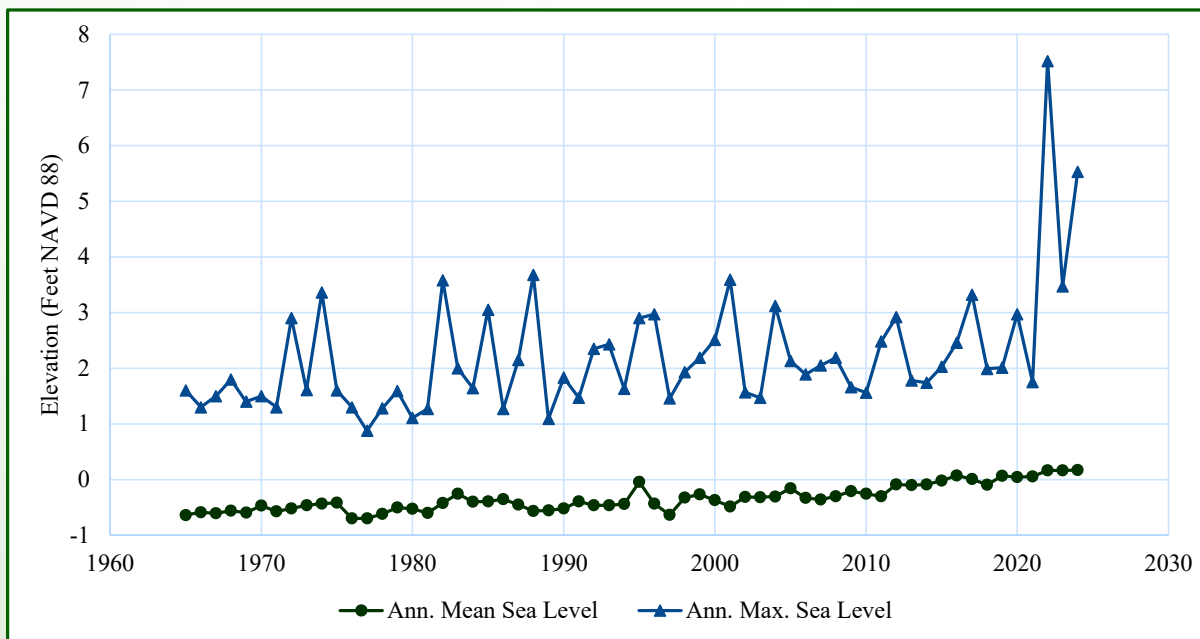


Flooding due to Storm Surge

3. Flooding and Vulnerability – Storm Surge

- *My home has never flooded before. Why now?*
- *5 of top 10 water levels occurred within 3 storm seasons*

NOAA Tide Station – Fort Myers (8725520)



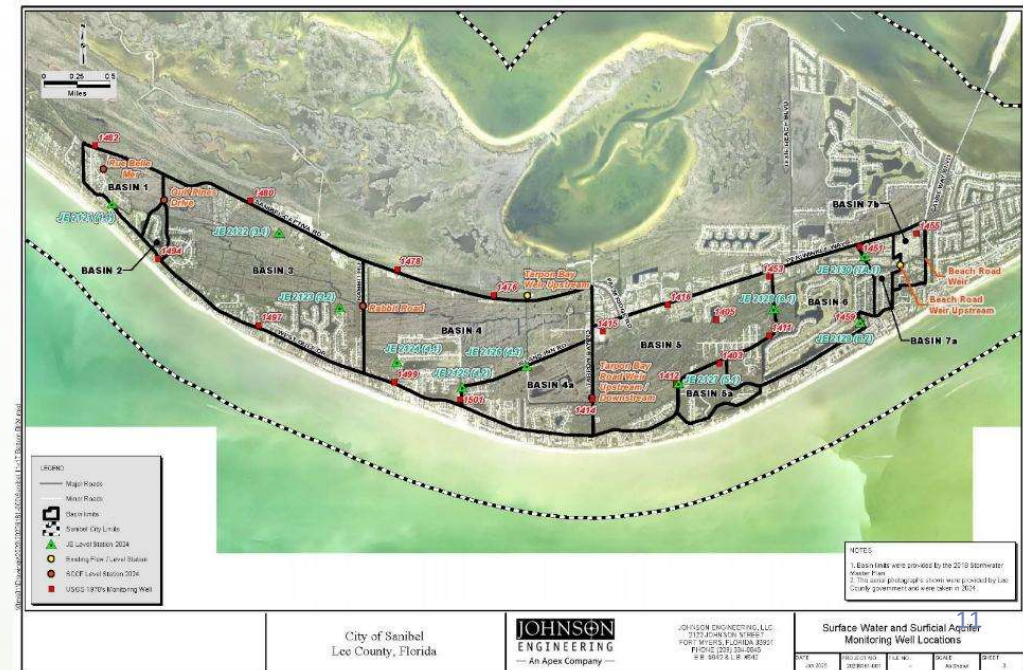
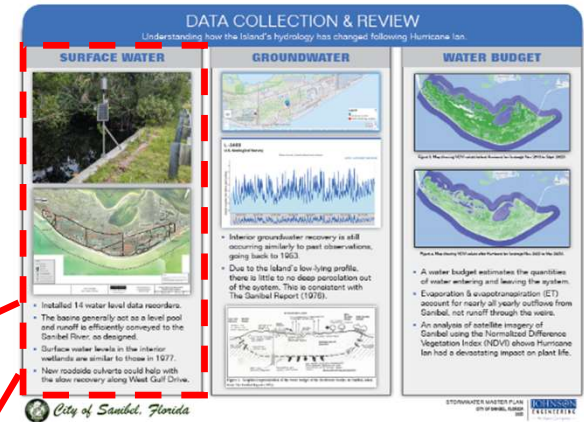
10 Highest Water Levels
1965 to Present

Rank	Peak EL	Date
1	7.52	2022-09-28
2	5.53	2024-10-10
3	5.4	2024-09-27
4	3.68	1988-11-23
5	3.59	2001-09-14
6	3.58	1982-06-18
7	3.53	2024-08-04
8	3.47	2023-08-30
9	3.36	1974-06-25
10	3.32	2017-09-11

Surface Water Monitoring

4. Data Collection & Review – Surface Water

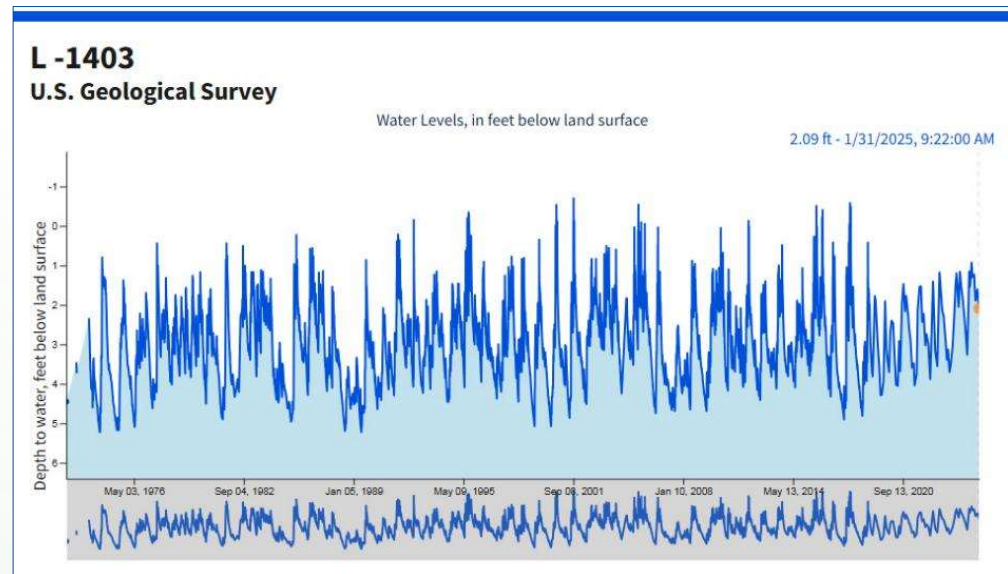
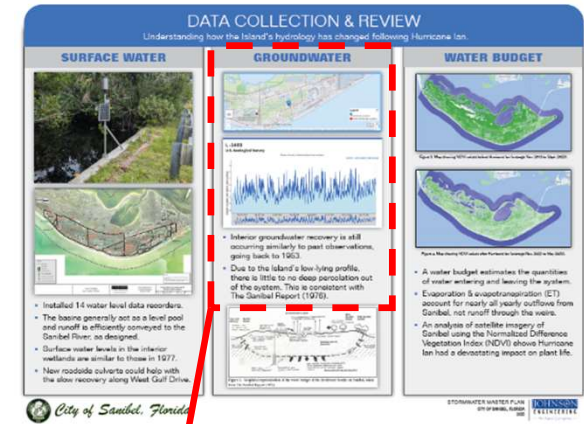
- *Water Level Monitoring Network*
 - › 14 Water Level Datalogger Installations
- *The basins generally act as a level pool*



Groundwater Monitoring

4. Data Collection & Review – Groundwater

- Interior groundwater percolation is still occurring similarly to past observations, going back to 1953.
- Due to the Island's low-lying profile, there is little to no deep percolation out of the system. This is consistent with The Sanibel Report (1976).



Water Budget

4. Data Collection & Review – Water Budget

- Evaporation & evapotranspiration (ET) account for nearly all yearly outflows from Sanibel, not runoff through the weirs.

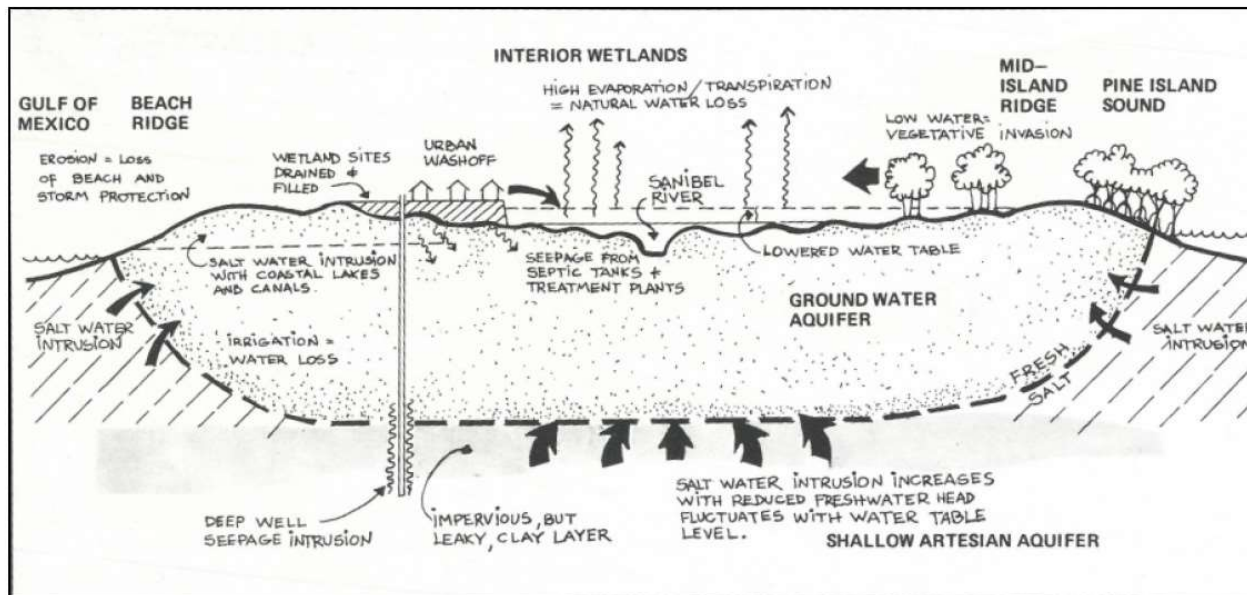
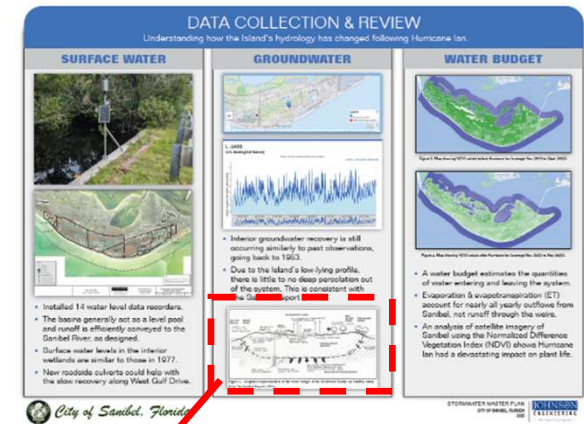
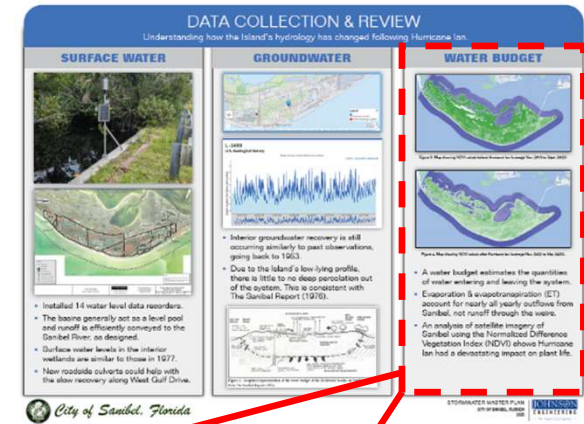


Figure 1. Graphical representation of the water budget of the freshwater basins on Sanibel, taken from The Sanibel Report (1976).

Water Budget and NDVI

4. Data Collection & Review – Water Budget

- *An analysis of satellite imagery of Sanibel using the Normalized Difference Vegetation Index (NDVI) shows Hurricane Ian had a devastating impact on plant life.*
- *As less water is lost to ET, management strategies may change.*



NDVI BEFORE HURRICANE IAN (2013-22)



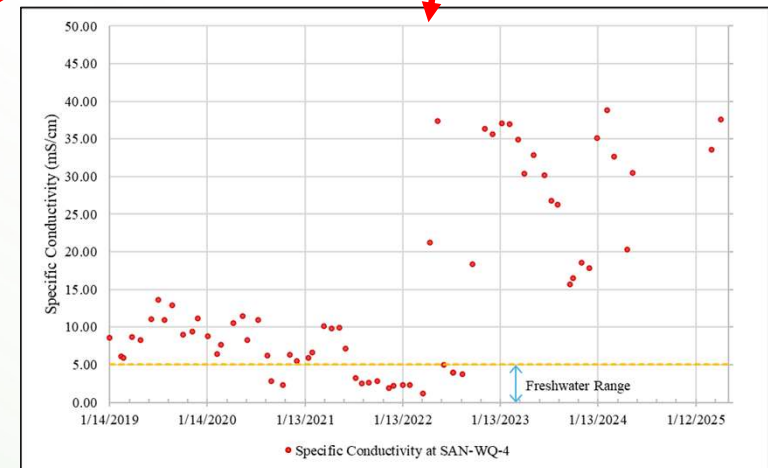
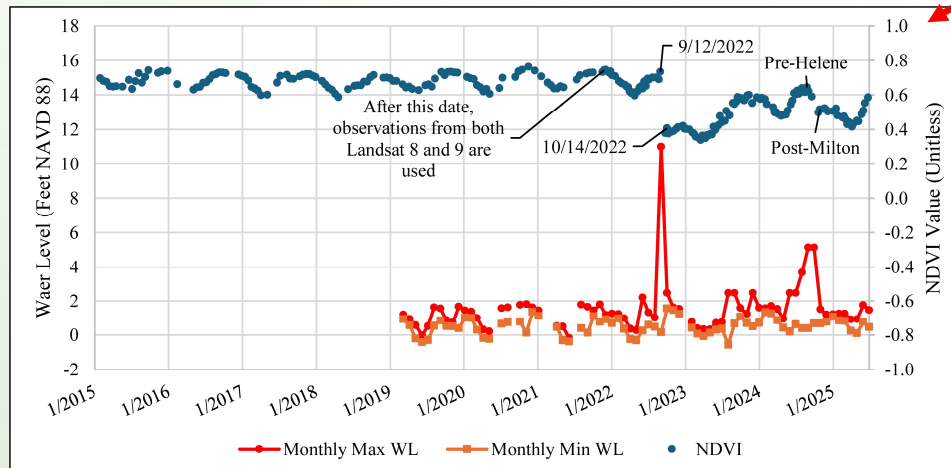
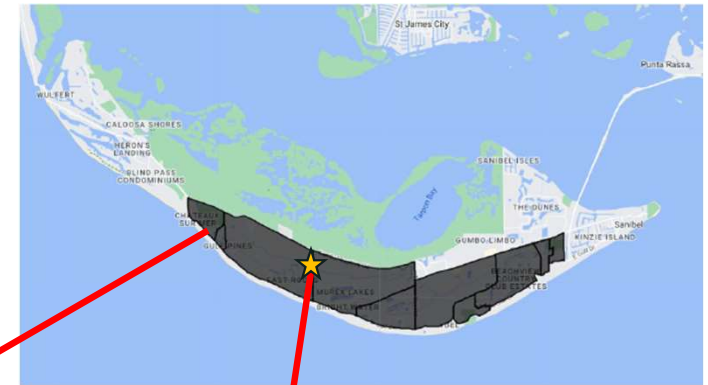
NDVI AFTER HURRICANE IAN (2022-23)



NDVI Method and Findings

4. Data Collection & Review – Method and Findings

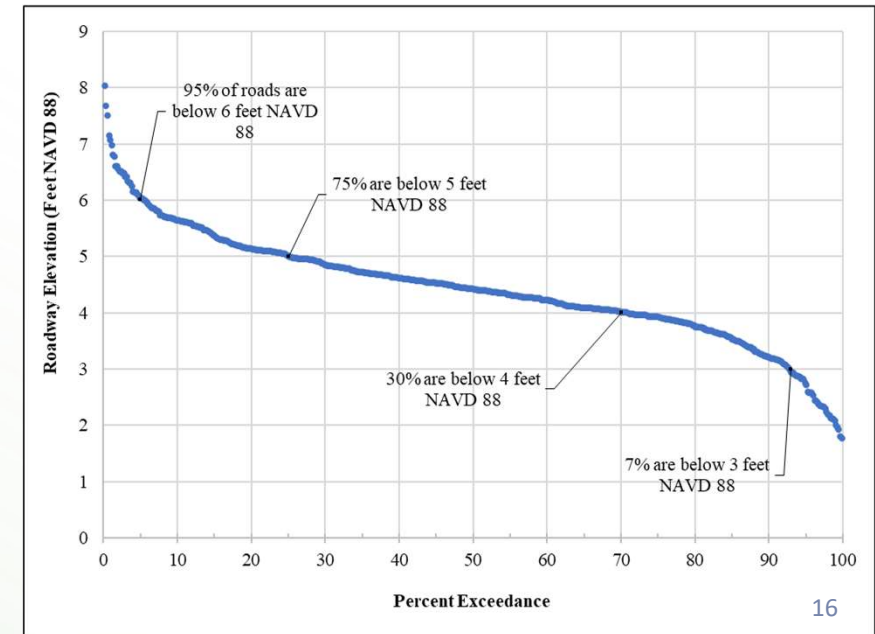
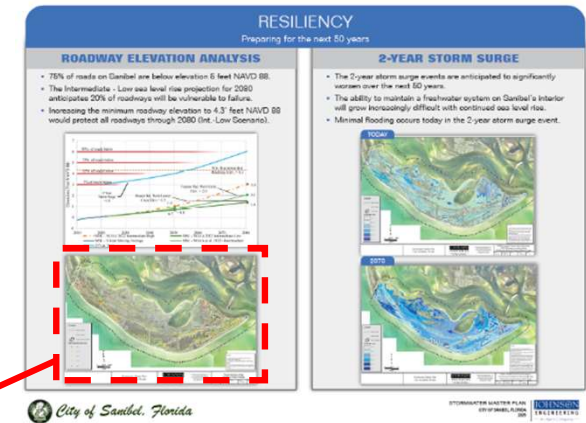
- Used Landsat 8 and Landsat 9 surface reflectance products to calculate average NDVI for the interior basins over time.
- Results:
 - › Significant drop in NDVI post-Ian (2022)
 - › Progress towards vegetative recovery until 2024 hurricanes
- This drop was likely caused by stress due to extreme wind, wave action, and increased salinity.



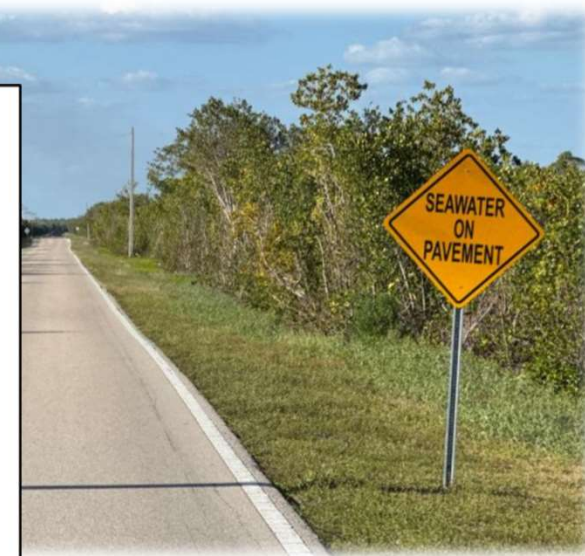
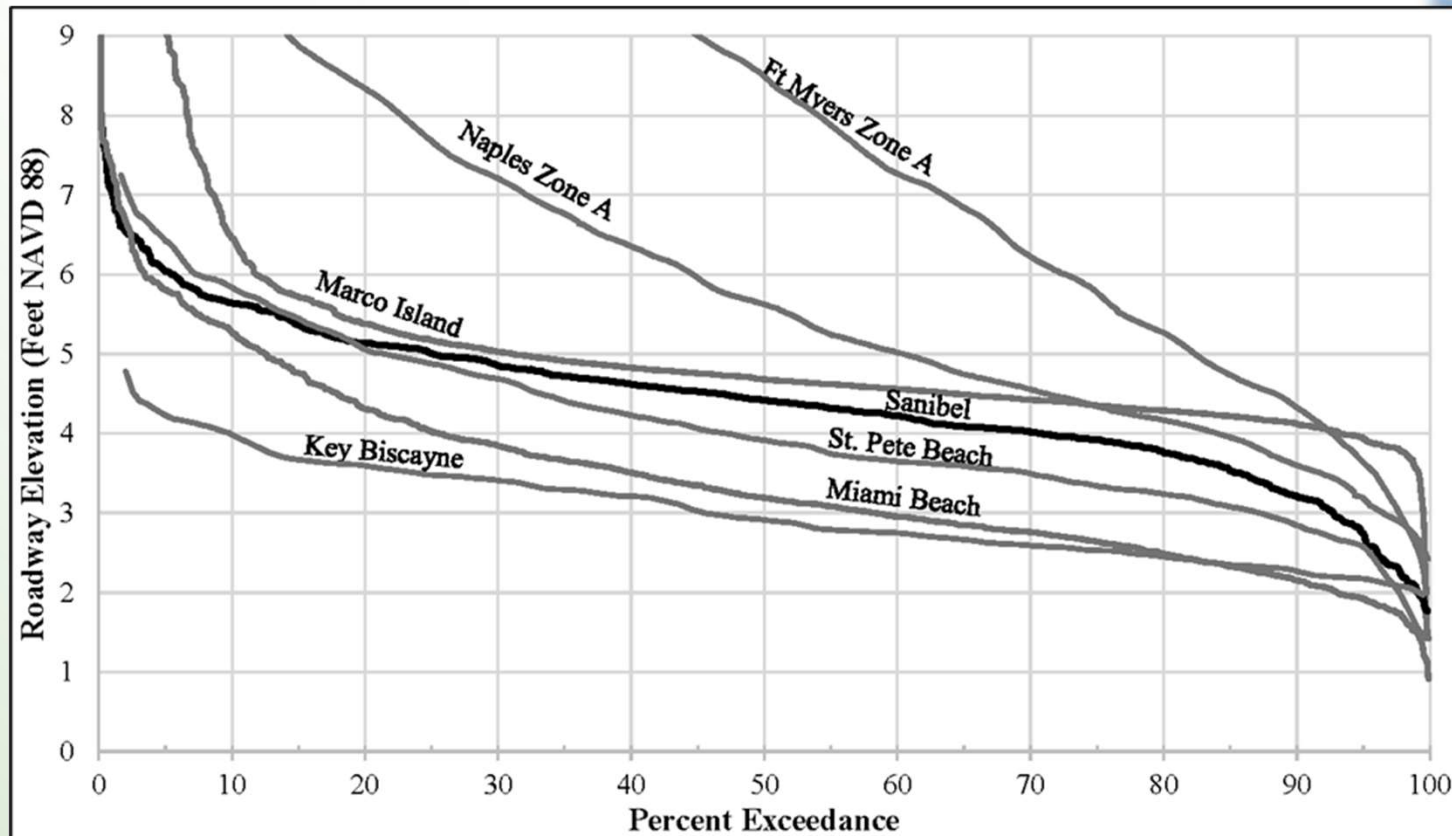
Roadway Elevation Analysis

5. Resiliency – Roadway Elevation Analysis

- 75% of roads on Sanibel are below elevation 5 feet NAVD 88.



Roadway Elevation Comparison

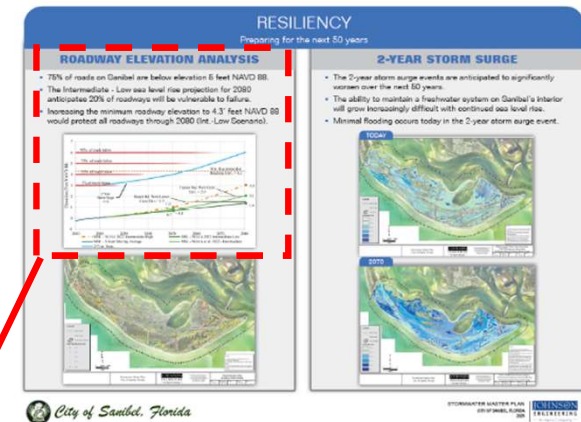
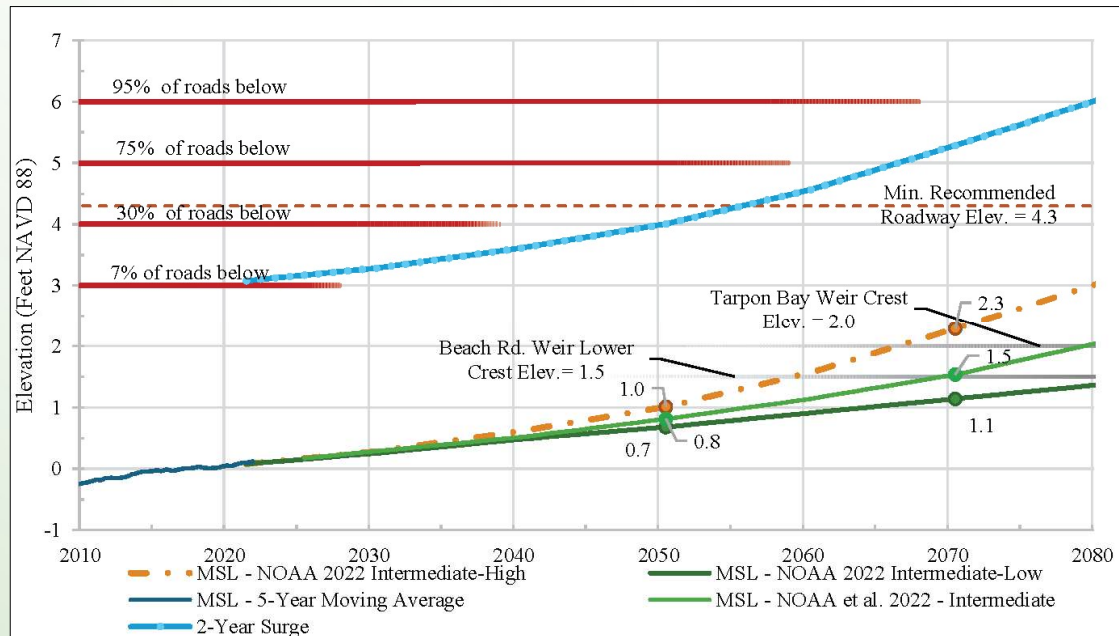


Collier County Road 92
to Marco Island

Roadway Elevation and Sea Level Rise

5. Resiliency – Roadway Elevation and SLR

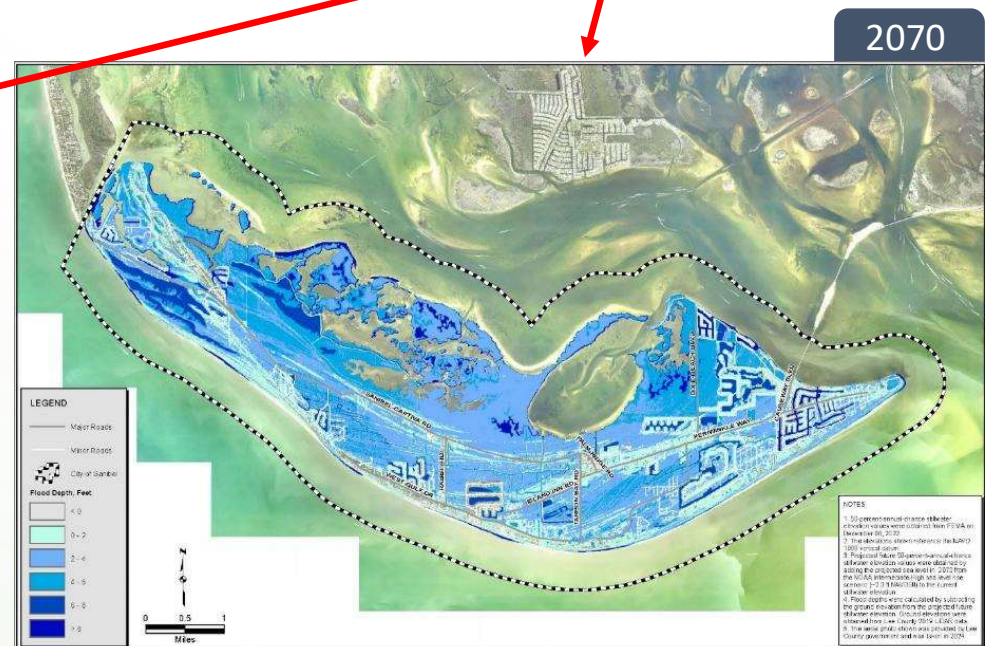
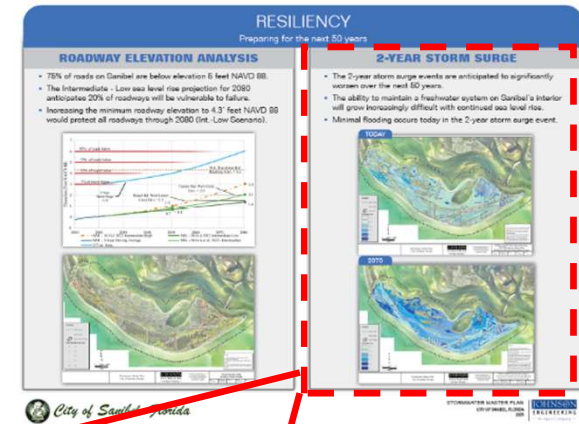
- The Intermediate - Low sea level rise projection for 2080 anticipates 20% of roadways will be vulnerable.
- Increasing the minimum roadway elevation to 4.3' feet NAVD 88 would protect all roadways through 2080 (Int.-Low Scenario).



2-Year Storm Surge Event

5. Resiliency – 2-Year Storm Surge

- Minimal flooding today in the 2-year surge event.
- Impacts of storm surge are anticipated to worsen.
- Maintaining freshwater wetlands becomes increasingly difficult.



Stormwater Master Plan
City of Sanibel, Florida

JOHNSON
ENGINEERING
— An Apex Company —

JOHNSON ENGINEERING, LLC
2022 JOHNSON STREET
FORT MYERS, FL 33901-1000
PHONE (239) 334-2045
FAX (239) 334-2046

FEMA Coastal Flood Hazard Analysis
2022 Stillwater Inundation Map
50-Percent-Annual-Chance Storm Surge

Stormwater Master Plan
City of Sanibel, Florida

JOHNSON
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FEMA Coastal Flood Hazard Analysis
2070 Projected Stillwater Flood Depth Map
50-Percent-Annual-Chance Storm Surge

19

6. Recommendations

- Specific Area Projects
 - Road Elevation
 - Weir Policy
 - Weir System Improvements
-
- Annual Maintenance is key to preventing issues as hurricane related stormwater work has restored many areas currently.
 - Education of public through GIS system and informational materials

6. Recommendations: Specific Areas and Road Elevating

- Tradewinds Subdivision Drainage
- Bailey Road Drainage
- Areas of West Gulf Drive
- Road Elevation goal of 4.3 feet NAVD 88
 - Would provide protection through 2080 Int.-Low Scenario

6. Recommendations: Weir Policy Evaluation

The primary objective of the City's Weir Control Policy should be to continue retaining as much freshwater on the island as practical.

- Water inside the basin be held at least one foot above mean sea level (0.17 feet NAVD 88 last year)
- To account for dry season evapotranspiration losses, need 1 foot above MSL on May 1.
- Weirs limit levels to 1.6 feet and 2.0 feet NAVD 88 so there's not capacity to lower levels under current sea level conditions now.
- Under high salinity conditions a lowering levels at the beginning of the wet season may be beneficial to flush salt water from the system.

6. Recommendations: Weir System

- **Flap Gate Addition/Modification**
 - Necessary to prevent backflow of high tides and prevent minor surge events
 - Limited to what height as island itself has limited perimeter elevation
- **Automation of Weir Gates**
 - Provides ability to maximize tides in overnight periods and dangerous conditions.
- **Pump stations**
 - Need is related to future sea level rise more than current conditions
 - Won't provide surge protection or increase flow compared to current flows with gates open

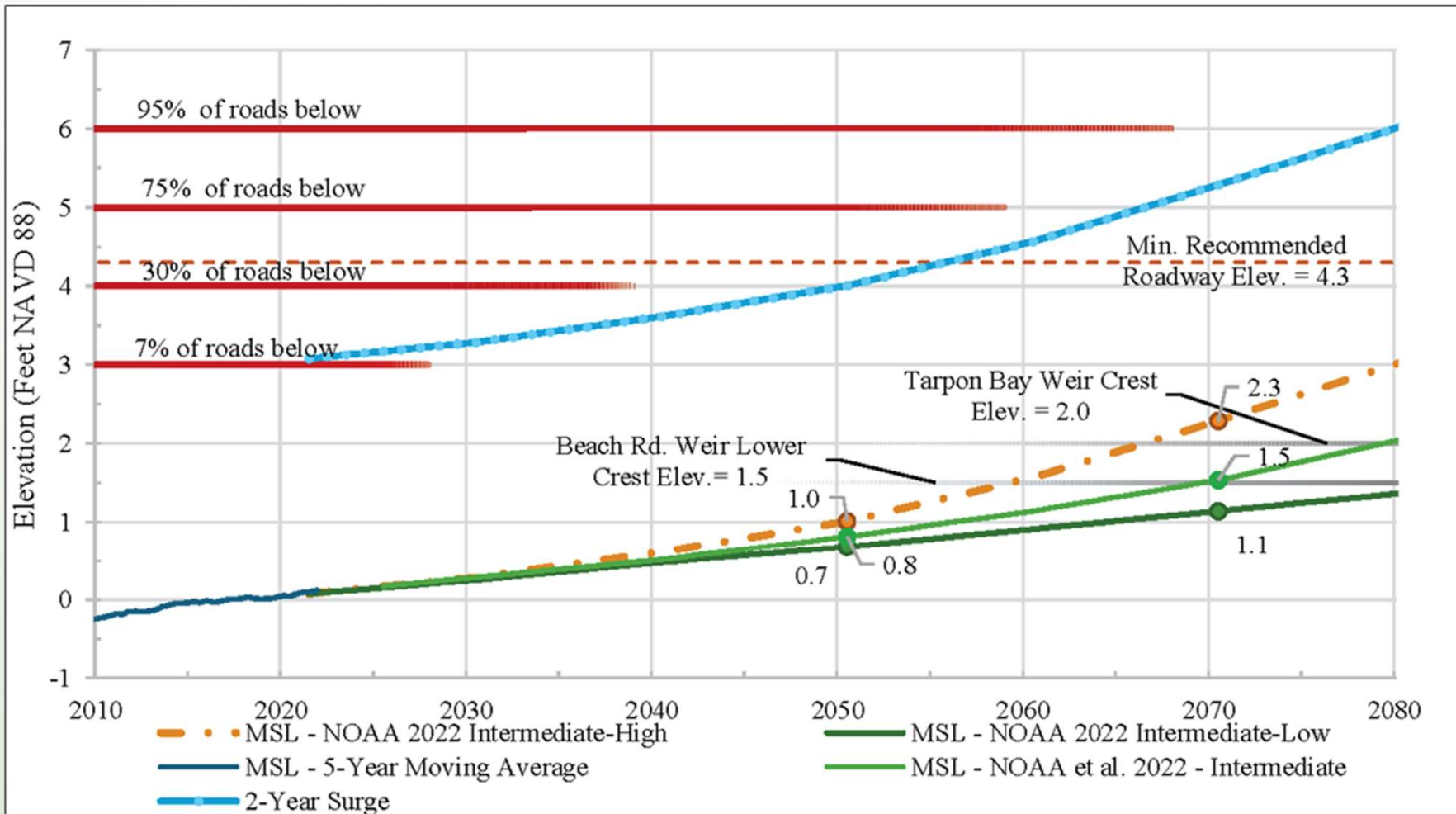


6. Recommendations: Pumps compared to Current Gate Operations

TARPON BAY WEIR	FLOW RATE (cfs)	6" DRAWDOWN TIME (hrs)
EXISTING GATES (6" head difference)	408	12-24
150 CFS DESIGN	150	32
1989 PLAN <i>All Pump Scenario</i>	350	14
FOUR TRAILER PUMPS	120	40

BEACH ROAD	FLOW RATE (cfs)	6" DRAWDOWN TIME (hrs)
EXISTING GATES (6" head difference)	204	16-32
3-YEAR, 1-HOUR STORM	150	22
1989 PLAN <i>All Pump Scenario</i>	50	64
TWO TRAILER PUMPS	60	54

THE FUTURE



THE FUTURE

Mean Sea Level Projections, NOAA Intermediate Scenarios

YEAR	2020	2050	2070
LOW	0	0.7	1.1
AVERAGE	0	0.8	1.5
HIGH	0	1	2.3
2 Year Storm Surge	3	4	5.2

CURRENT BENCHMARKS		ELEVATION (feet NAVD 88)	
TB WEIR		2.0	
BEACH WEIR (FLAPGATE)		1.6 (2.5)	
DEVELOPED AREAS		4-8	
ROAD ELEVATIONS (RECOMMEND)		3-6 (4.3)	
Debbie Milton	Helene Ian	3.5 6	5.4 8-13

Questions and Comments

Thank you!

