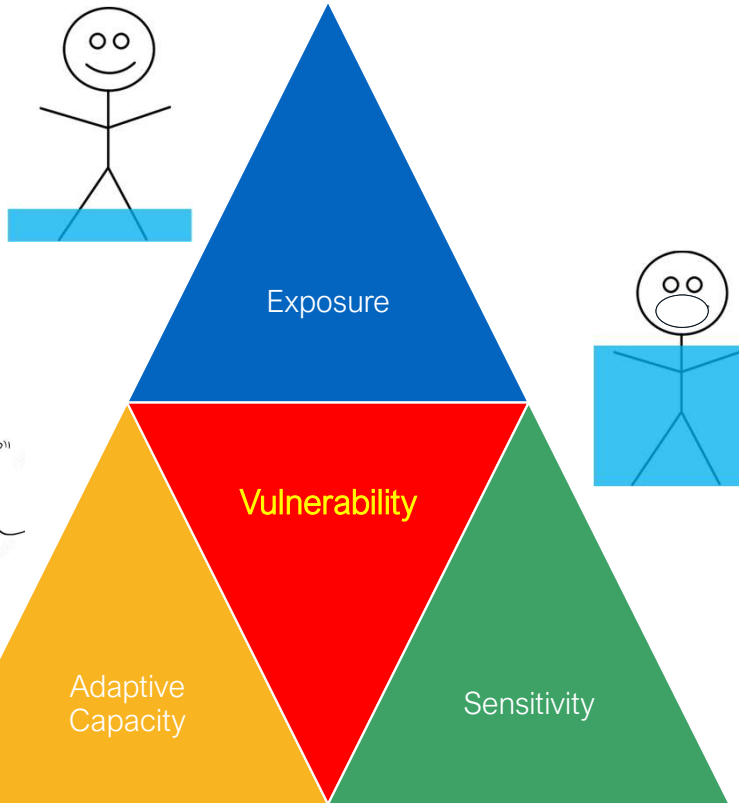
RESILIENT MARTIN

WHAT IS A VULNERABILITY ASSESSMENT?

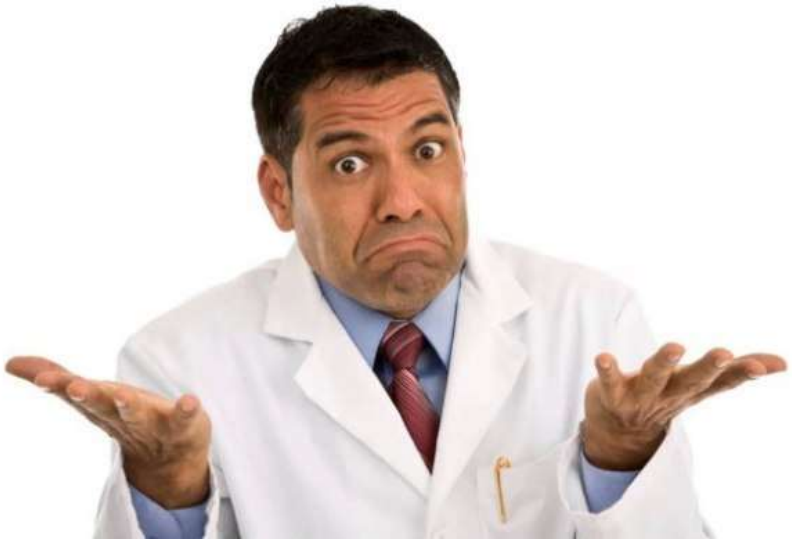
Vulnerability assessments are used to measure the impact of certain acute shocks or chronic stresses to people, infrastructure, and land uses.

It helps a community determine which structural and social assets are likely to be impacted by these stresses.



WHY CARE ABOUT A VULNERABILITY ASSESSMENT?

- Helps determine how resilient a system is
- Helps prepare in emergency situations
- Helps plan for future projects
- Helps prioritize projects
- Helps prioritize land acquisition
- Helps establish policies and code
- Helps get $$$$$$$$$ for projects



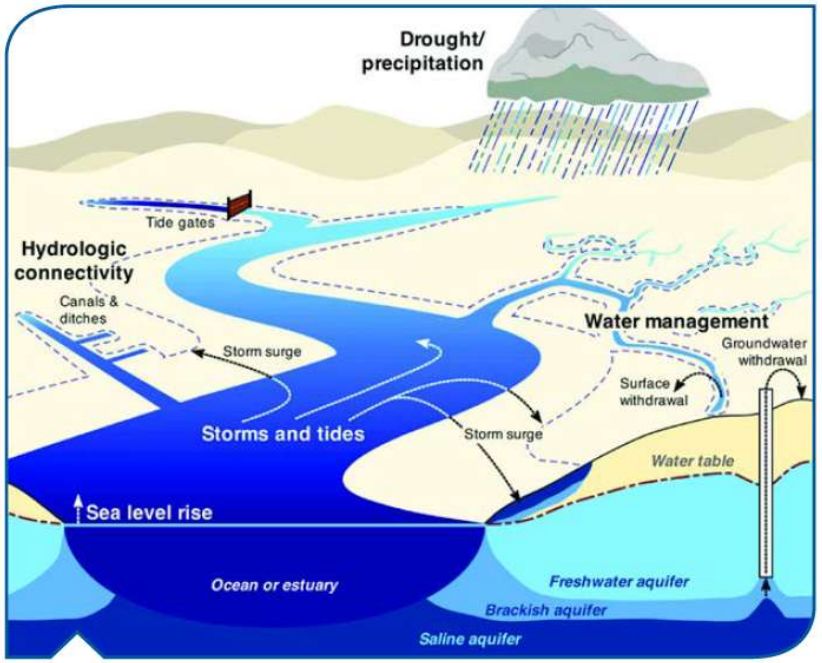
REQUIREMENTS FOR A VULNERABILITY ASSESSMENT?

Critical Assets:

1. Transportation - Roads bridges, rail, and marina
2. Critical Infrastructure - Non-buildings, all utilities
3. Critical Community and Emergency Facilities - Buildings, schools, health care services
4. Natural, Cultural, and Historical Resources - Shorelines, conservation lands, parks

Year	NOAA Intermediate Low	NOAA Intermediate High
Present Day	0.33	0.62
2040	0.69	1.41
2070	1.25	3.28
2100	1.77	6.00

* Elevation NAVD88



- TIDAL FLOODING
- STORM SURGE
- RAINFALL
- COMBINATION

TIDAL FLOODING - EXPOSURE

- VIRGINIA KEY GAGE
- TIDAL FLOODING = MHHW + 2 FEET
- PROJECTIONS – PRESENT DAY, 2040, 2070, 2100

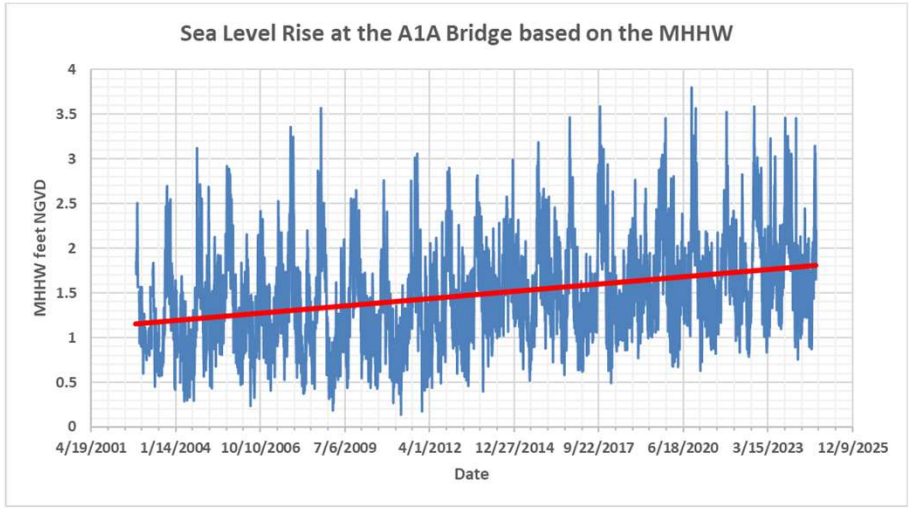
TIDAL FLOODING

PRESENT DAY – TIDAL FLOOD DAYS (VIRGINIA KEY)

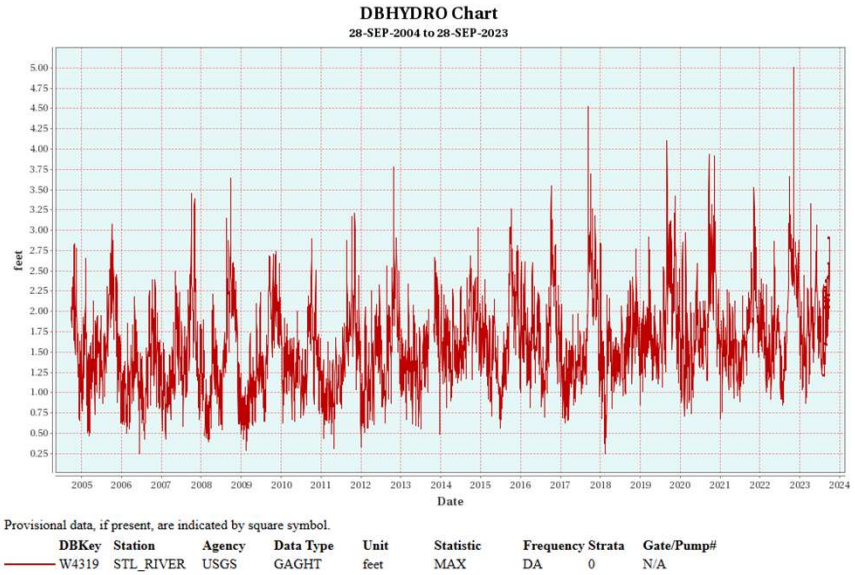
Approximate Days of Tidal Flooding Observed	2004-2022 (NAVD88 Feet)
1	2.02
5	1.80
10	1.60
15	1.45
20	1.35
30	1.23
40	1.14
50	0.98
100	0.79
≥150	0.47

FUTURE – TIDAL FLOOD DAYS (VIRGINIA KEY)

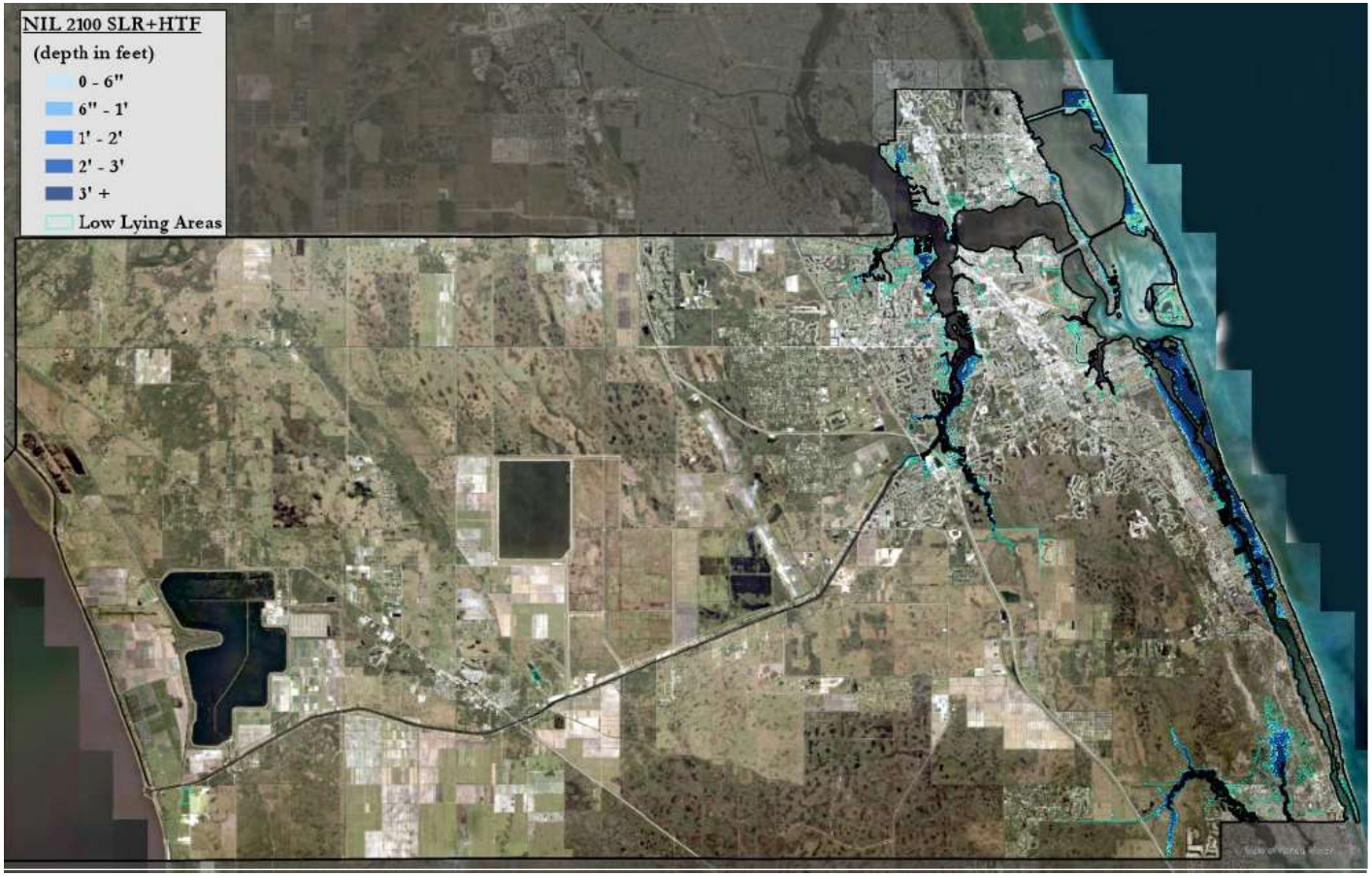
Approx. Days	2040-NIL	2070-NIL	2100-NIL	2040-NIH	2070-NIH	2100-NIH
1	2.10	2.76	3.28	2.92	5.06	7.82
5	1.90	2.54	3.06	2.64	4.79	7.52
10	1.74	2.32	2.93	2.50	4.58	7.31
15	1.60	2.15	2.80	2.37	4.38	7.17
20	1.49	2.05	2.70	2.26	4.26	7.07
30	1.37	1.94	2.57	2.12	4.13	6.94
40	1.27	1.85	2.48	2.02	4.02	6.84
50	1.12	1.70	2.34	1.86	3.88	6.65
100	0.93	1.51	2.14	1.65	3.66	6.38
≥150	0.61	1.17	1.81	1.30	3.24	5.85



APPROXIMATELY 0.35 INCHES PER YEAR



TIDAL FLOODING MAPS



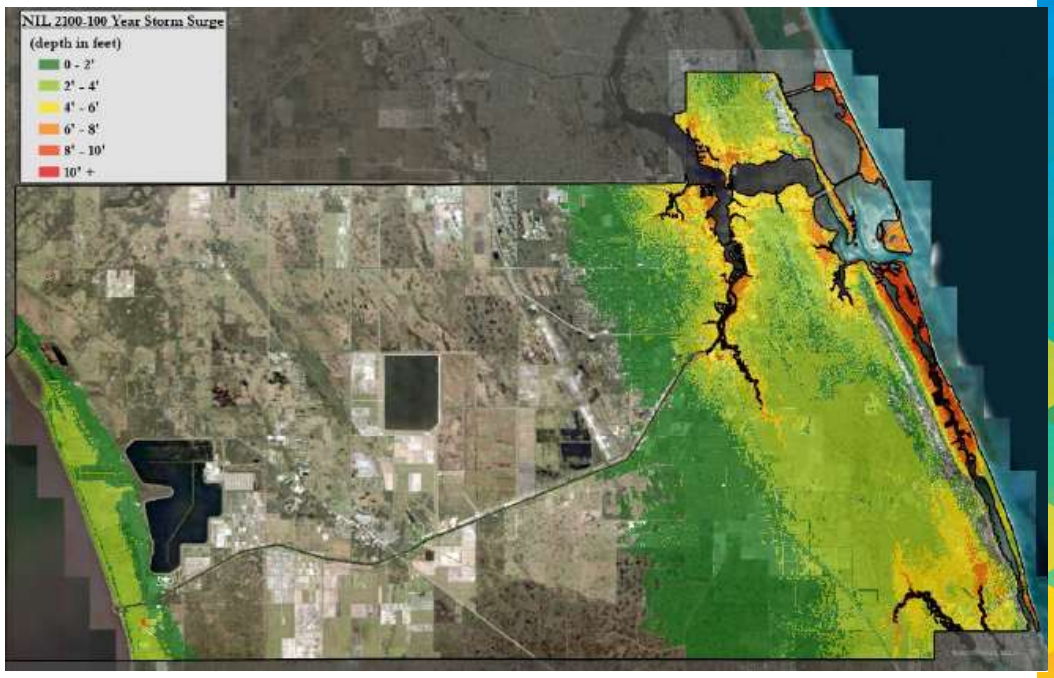
EXPOSURE ANALYSIS: SEA LEVEL RISE

- NOAA Intermediate High, Present day + 2040/2070/2100 SLR + High Tide = 2.85’ above NAVD88

STORM SURGE

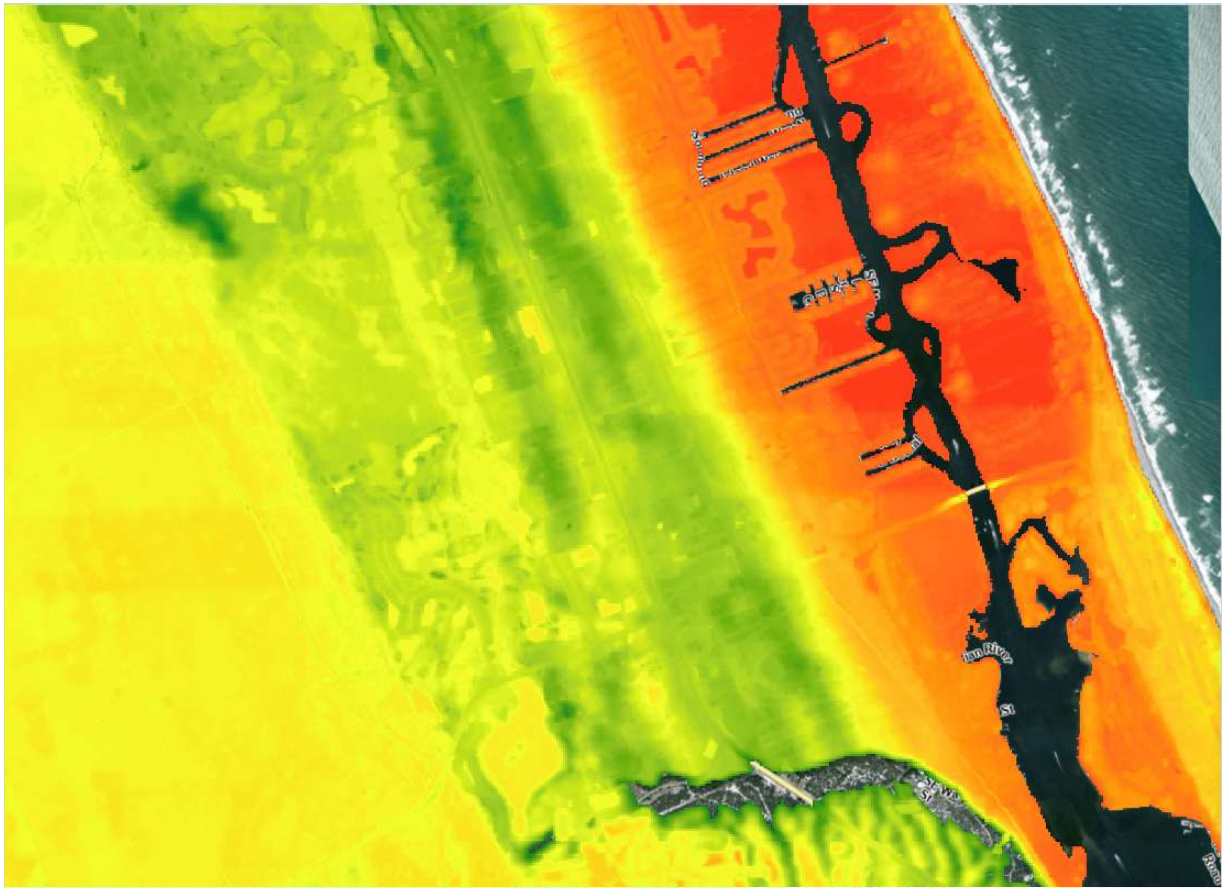
- Utilized HAZUS-MH program
- Evaluated 100 year and 500 year Stillwater Elevations
- Projections – Present Day, 2040, 2070, 2100

Planning Horizon	100-Year	500-Year
Present Day Average Stillwater	4.96	6.59
NIL 2040 Adjusted Average Stillwater	5.65	7.28
NIL 2070 Adjusted Average Stillwater	6.21	7.84
NIL 2100 Adjusted Average Stillwater	6.73	8.36
NIH 2040 Adjusted Average Stillwater	6.37	8.00
NIH 2070 Adjusted Average Stillwater	8.24	9.87
NIH 2100 Adjusted Average Stillwater	10.96	12.59



EXPOSURE ANALYSIS: STORM SURGE

- NOAA Intermediate Low, Present day + 2040/2070/2100 SLR + Storm Surge

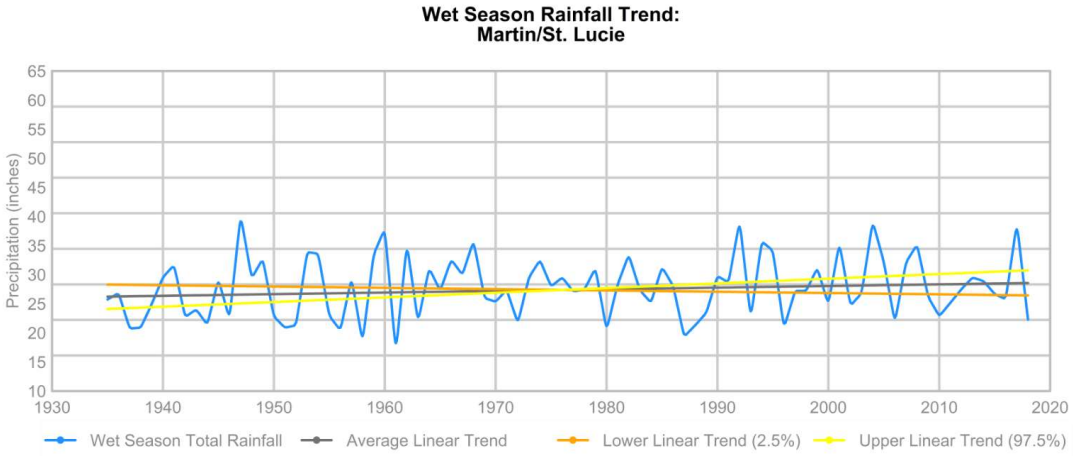


RAINFALL

- HEC-RAS
- Storm Events – 10YR-1D, 25YR-1D, 50YR-1D, and 100YR-1D
- Utilized SFWMD Rainfall Change Factors
- Projections – Present Day, 2040, 2070, 2100

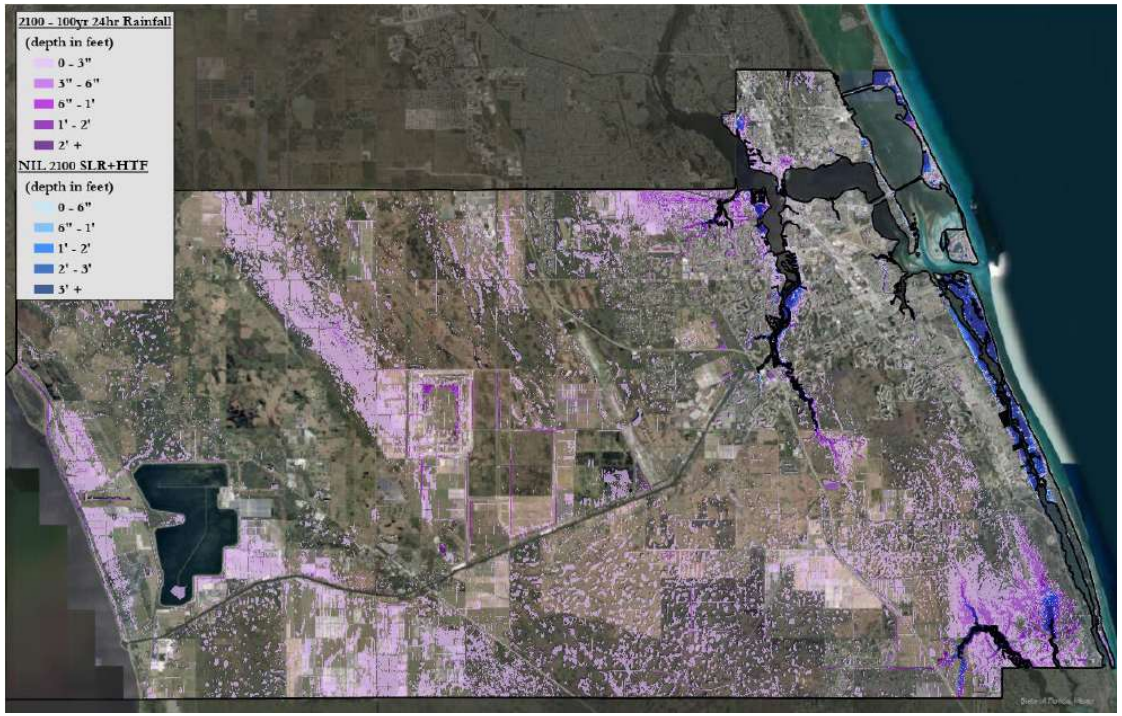
Return Period	2040	2070	2100
10	1.09	1.12	1.25
25	1.11	1.15	1.31
50	1.11	1.17	1.36
100	1.12	1.19	1.43

Year	Scenario	Precipitation (inches)
Present Day	10-Year	7.50
Present Day	25-Year	9.34
Present Day	50-Year	10.90
Present Day	100-Year	12.50



EXPOSURE ANALYSIS: RAINFALL

- NOAA Intermediate Low – 2040, 2070, 2100 for the 100YR-1D



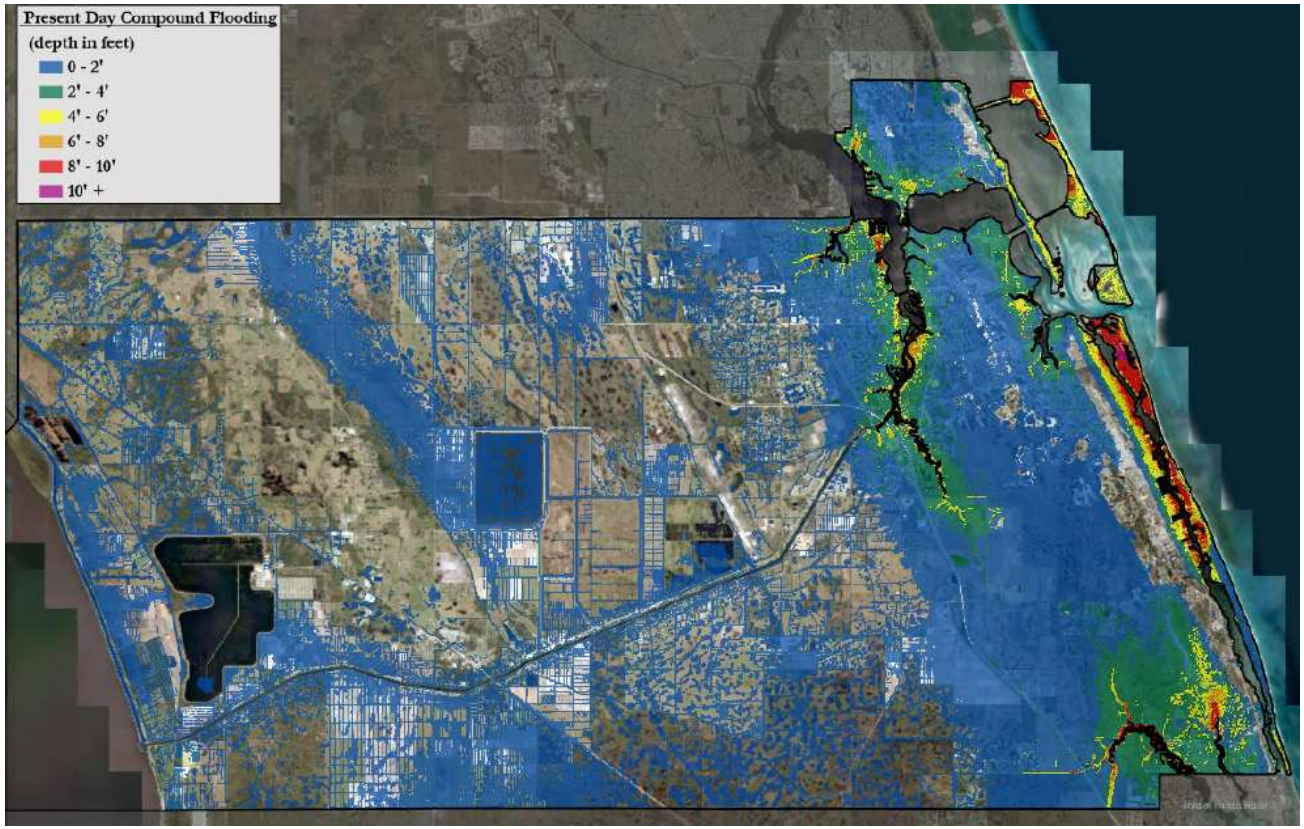
COMBINATION FLOODING

- High Tide Flooding: Projected sea level rise and high tide flooding scenarios based on NOAA Intermediate Low (NIL) and Intermediate High (NIH) projections
- Storm Surge Events: 100-year and 500-year storm surge projections
- Rainfall Events: 25-year and 100-year rainfall event

NOAA Intermediate Low and High Combined Flood Scenario Water Rise Impacts

Sea Level Rise Scenario	Surge Scenario	Rainfall Scenario	Combined Water Rise (ft)
NIH Present Day	100-Year	25 Year 24 Hour	7.55
NIH Present Day	100-Year	100 Year 24 Hour	8.00
NIH Present Day	500-Year	25 Year 24 Hour	9.18
NIH Present Day	500-Year	100 Year 24 Hour	9.63
NIL 2040	100-Year	25 Year 24 Hour	8.63
NIL 2040	100-Year	100 Year 24 Hour	9.27
NIL 2040	500 Year	25 Year 24 Hour	10.26
NIL 2040	500 Year	100 Year 24 Hour	10.90
NIH 2040	100-Year	25 Year 24 Hour	9.35
NIH 2040	100-Year	100 Year 24 Hour	9.99
NIH 2040	500-Year	25 Year 24 Hour	10.96
NIH 2040	500-Year	100 Year 24 Hour	11.62
NIL 2070	100-Year	25 Year 24 Hour	9.19
NIL 2070	100-Year	100 Year 24 Hour	9.83
NIL 2070	500-Year	25 Year 24 Hour	10.82
NIL 2070	500-Year	100 Year 24 Hour	11.46
NIH 2070	100-Year	25 Year 24 Hour	11.22
NIH 2070	100-Year	100 Year 24 Hour	11.86
NIH 2070	500-Year	25 Year 24 Hour	12.85
NIH 2070	500-Year	100 Year 24 Hour	13.49
NIL 2100	100-Year	25 Year 24 Hour	9.71
NIL 2100	100-Year	100 Year 24 Hour	10.35
NIL 2100	500-Year	25 Year 24 Hour	11.34
NIL 2100	500-Year	100 Year 24 Hour	11.98
NIH 2100	100-Year	25 Year 24 Hour	13.94
NIH 2100	100-Year	100 Year 24 Hour	14.58
NIH 2100	500-Year	25 Year 24 Hour	15.57
NIH 2100	500-Year	100 Year 24 Hour	16.21

EXPOSURE ANALYSIS: PRESENT DAY SLR + 100 YEAR STORM SURGE + 25 YEAR RAINFALL

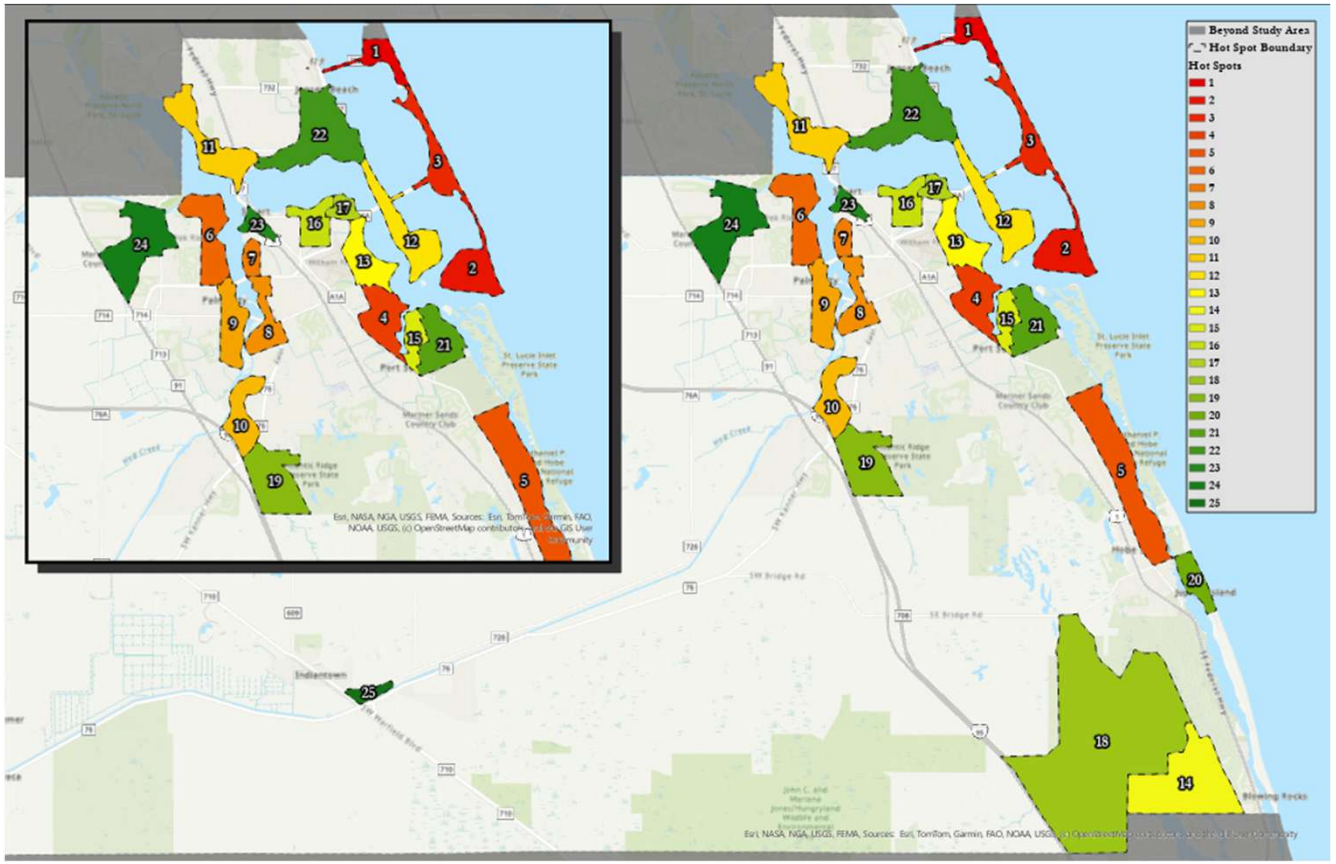


FLOODING “HOT SPOTS”

- Areas prioritized with:

1) the highest amount of critical assets

2) where those aggregations of assets are also impacted by flooding



SENSITIVITY ANALYSIS

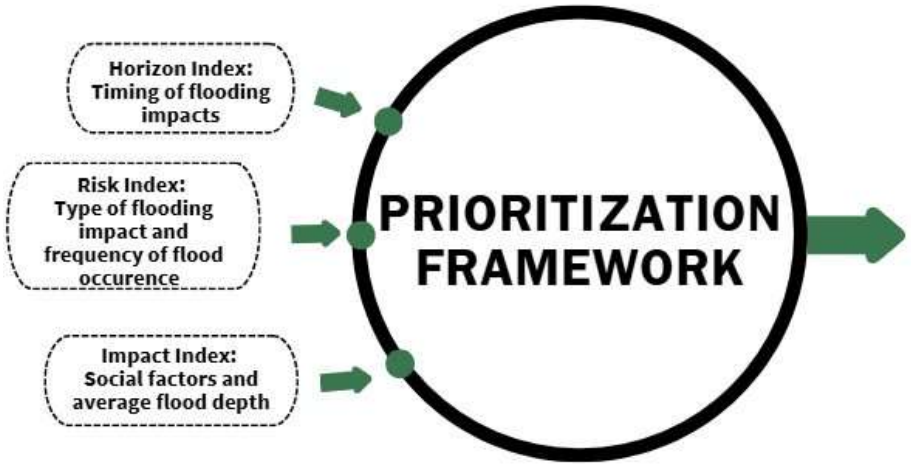
- Reflects what assets will be impacted and when
- Prioritizes Assets (both within and outside of the Flooding Hot Spots
- Provides results in both lists of assets and maps

Flood Depth	Exposure Ranking	Description
0 feet	No Exposure	No flooding detected. Areas with no impact from sea level rise or flooding.
0 to 0.5 feet	Low Exposure	Minor flooding. Shallow inundation typically causing minimal impact.
0.5 feet to 1.0 foot	Medium Exposure	Moderate flooding. Likely to impact structures and disrupt daily life. One foot or more of flooding also generally compromises emergency management operations.
1.0 foot to 3.0 feet	High Exposure	Significant flooding. Serious degree of inundation causing damage and major disruptions.
More than 3.0 feet	Very High Exposure	Severe flooding. Extensive inundation posing critical threats and causing extensive damage.

Asset Name	Asset ID	NIL Present Day SLR+HTF	NIH Present Day SLR+HTF	NIL 2040 SLR+HTF	NIH 2040 SLR+HTF	NIL 2070 SLR+HTF	NIH 2070 SLR+HTF	NIL 2100 SLR+HTF	NIH 2100 SLR+HTF
Roads	SE BETHAL WAY	0	0	0	0	0	0.26250267	0	1.588425267
Roads	SE GOVERNORS WAY	0	0	0	0	0	0.404586905	0.159519911	3.056811465
Roads	SE MAST TER	0	0	0	0	0	1.21332749	0	3.933327271
Roads	SE SOUNDING DR	0	0	0	0	0	0.404642749	0	3.058888535
Roads	SE YARDARM PL	0	0	0	0	0	0.751119226	0	3.384322537
Roads	SE YARDARM TER	0	0	0	0	0	1.022937192	0	3.742936982
Roads	SE BAYBERRY TER	0	0	0	0	0	0.351002162	0	2.993245687
Roads	SE ELIM LN	0	0	0	0	0	0.300953233	0	3.020953023
Roads	SE GOMEZ AVE	0	0	0	0	0	0	0	1.270426483
Roads	SE PALM ST	0.442135304	0.635196567	0.675846843	1.089953384	0.98564093	2.257116087	1.314117242	4.001636701
Roads	SE WILKES PL	0	0	0	0	0	0.504128724	0	2.498623081
Roads	SE BURGEE CT	0	0	0	0	0	1.302917627	0	4.022917454
Roads	SE GOMEZ AVE	0	0	0	0	0	0	0	1.21749457
Roads	SE HAWSER CT	0	0	0	0	0	1.423259765	0	4.143259615
Roads	SE DECK CT	0	0	0	0	0	1.459142853	0	4.179142643
Roads	SE YARDARM TER	0	0	0	0	0	1.091240063	0	3.811239834
Roads	SE ELIM LN	0	0	0	0	0	0.694736401	0	3.414736191
Roads	SE GOMEZ AVE	0	0	0	0	0	0	0	1.446310014
Roads	SE FLOTILLA CT	0	0	0	0	0	1.446735229	0	4.16673507
Roads	SE GETTYSBURG CT	0	0	0	0	0	0	0	2.753897383
Roads	SE PROPHET LN	0	0	0	0.146417239	0.076141085	1.961509829	0.4515096	4.681509598
Roads	SE CRAPE MYRT CT	0	0	0	0	0	0.416505768	0	3.105604094

ASSET PRIORITIZATION FOR MAPPING

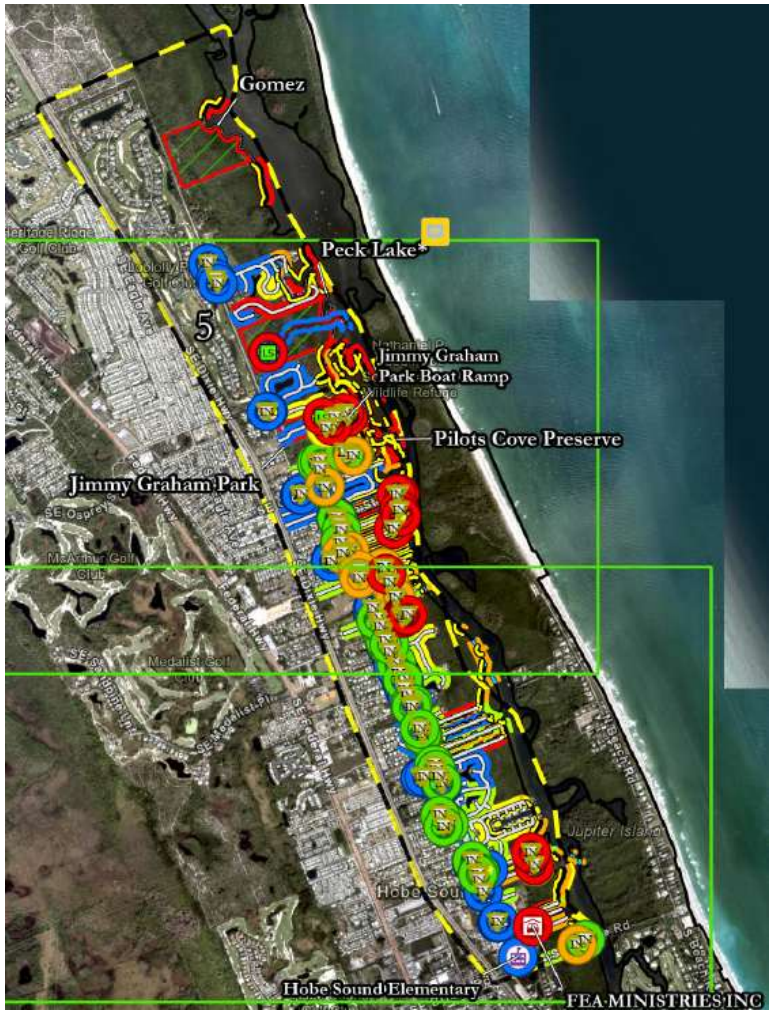
- Reflects: timing of impacts, type of flooding impact, severity/frequency of impact and social vulnerability of those people affected



Composite Index Score Threshold	Assigned Priority
Top 5% Highest Values	1
5-10%	2
10-15%	3
15-25%	4
25-50%	5
Below 50%/Median Value - Not Prioritized	0

SENSITIVITY ANALYSIS

- Reflects what assets will be impacted and when
- Prioritizes Assets
- Provides results in both lists of assets and maps



URBAN HEAT ANALYSIS

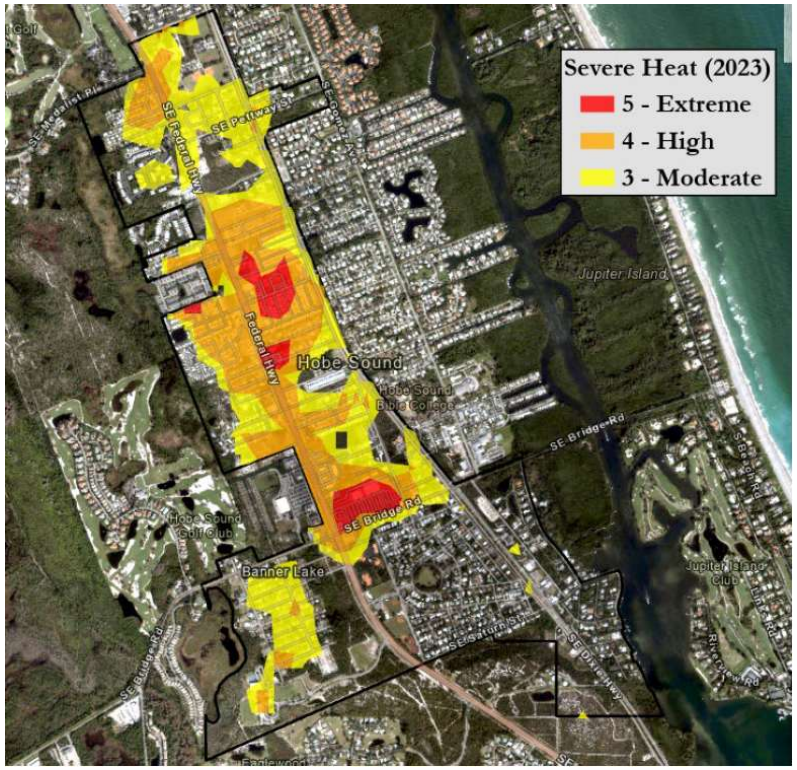
➢ DATA FROM THE 2020-2023 TRUST FOR PUBLIC LAND SEVERE HEAT ANALYSIS

➢ KEY FACTORS
- IMPERVIOUS SURFACES
- LIMITED VEGETATION
- HIGH BUILDING DENSITY

➢ URBAN AREAS
- JENSEN BEACH
- OCEAN BREEZE
- RIO
- STUART
- SEWALL'S POINT
- OLD PALM CITY
- PORT SALERNO
- HOBE SOUND
- JUPITER ISLAND
- INDIANTOWN

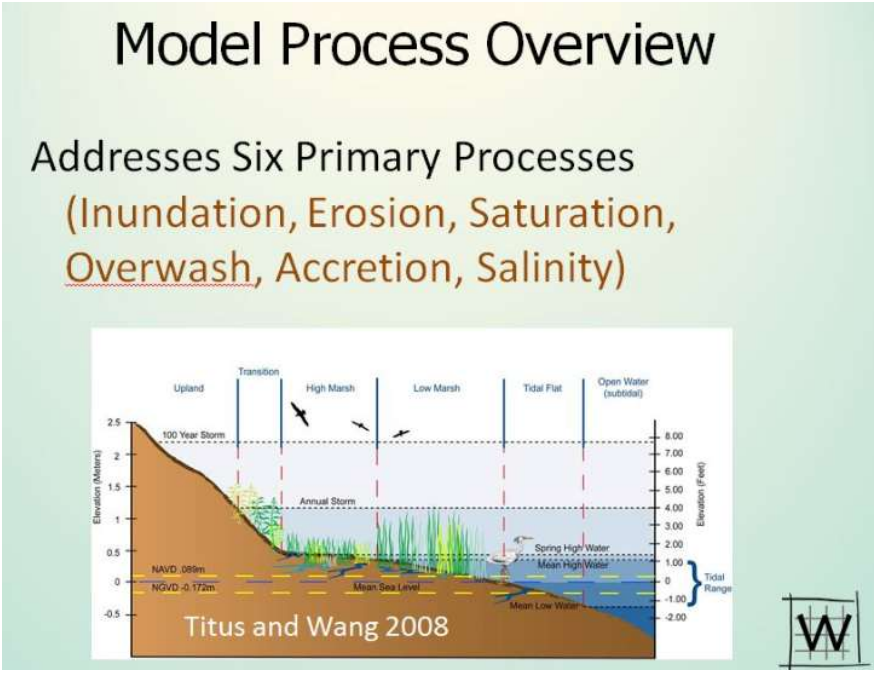
Table H - Hobe Sound Heat Severity Statistics 2020-2023

Year	Land Area Exposed to Level 3 Heat Severity	Land Area Exposed to Level 4 Heat Severity	Land Area Exposed to Level 5 Heat Severity
2020	132.5 acres (13.90%)	26.0 acres (2.50%)	2.60 acres (0.25%)
2021	184.0 acres (18.00%)	52.0 acres (5.10%)	9.20 acres (0.90%)
2022	242.4 acres (23.60%)	34.4 acres (3.40%)	1.10 acres (0.11%)
2023	210.3 acres (20.50%)	190.0 acres (18.60%)	35.40 acres (3.50%)

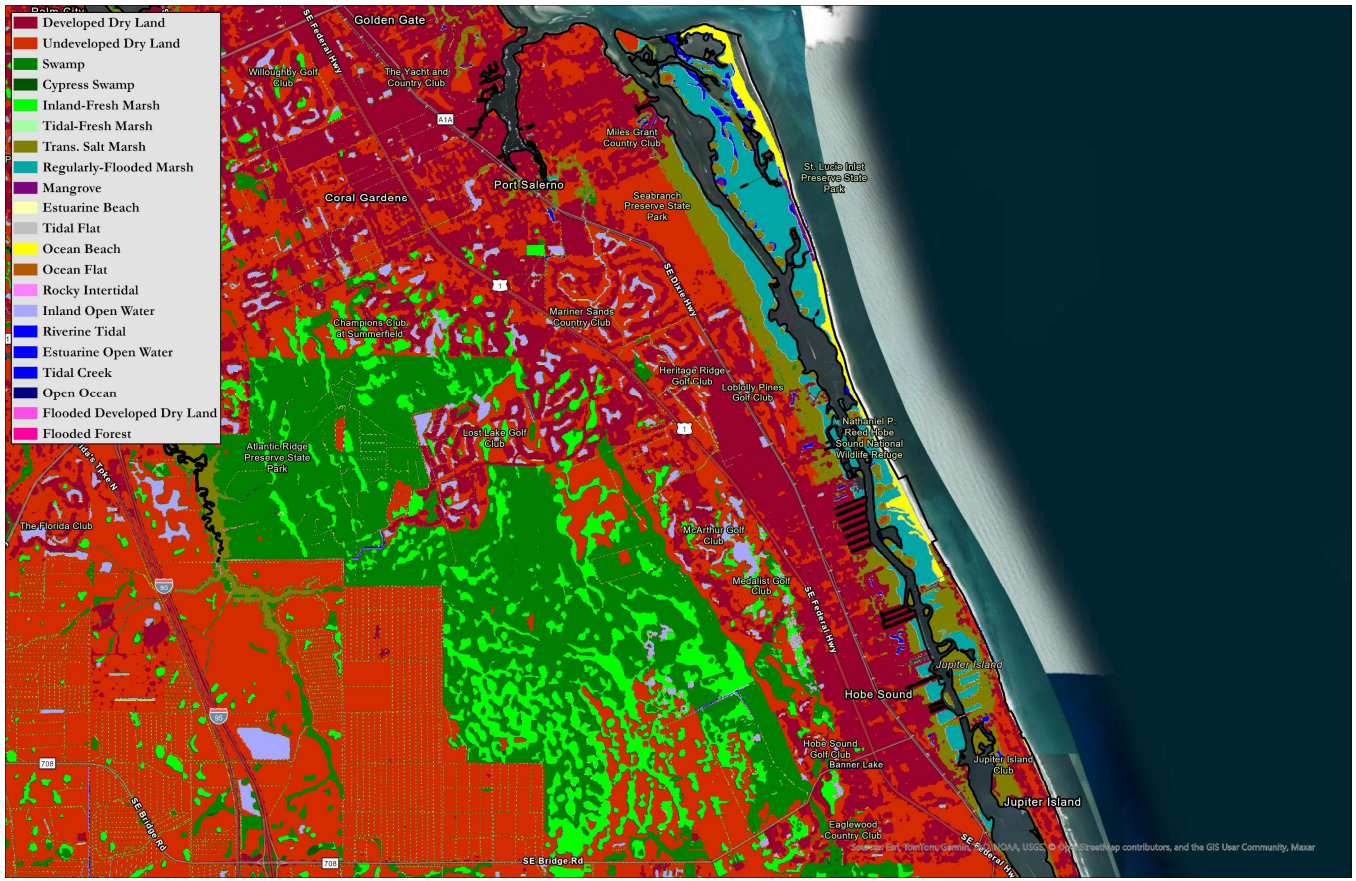


SEA LEVEL AFFECTING MARSHES MODEL (SLAMM)

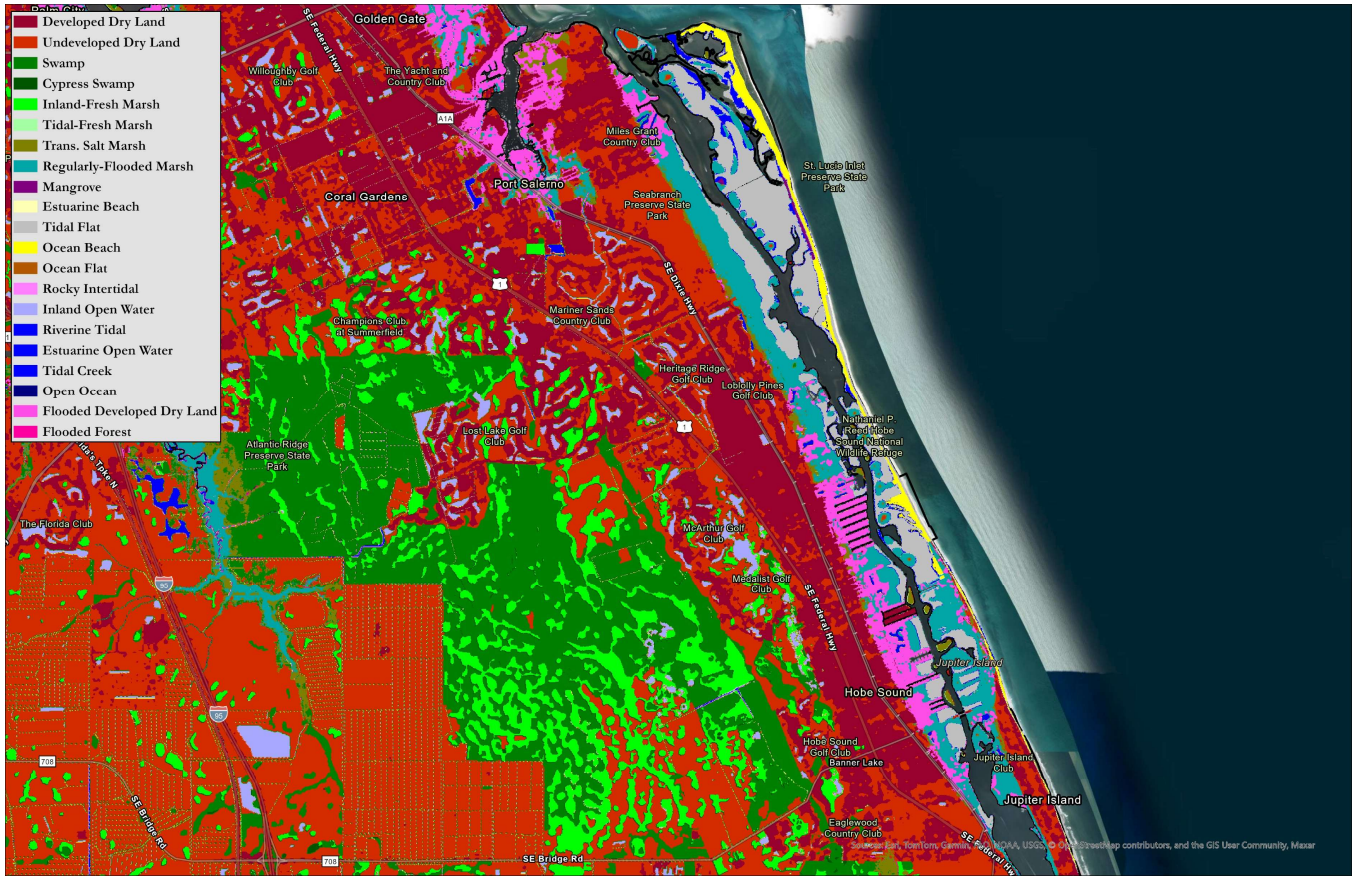
- Available on NOAA website: https://coast.noaa.gov/digitalcoast/tools/slamm.html
- Originally founded by the Nature Conservancy
- Produced by Warren Pinnacle Consulting, Inc. in partnership with ESA Associates
- Mathematical Model that uses digital elevation data and other information to simulate potential impacts of long-term sea level rise on wetlands and shorelines



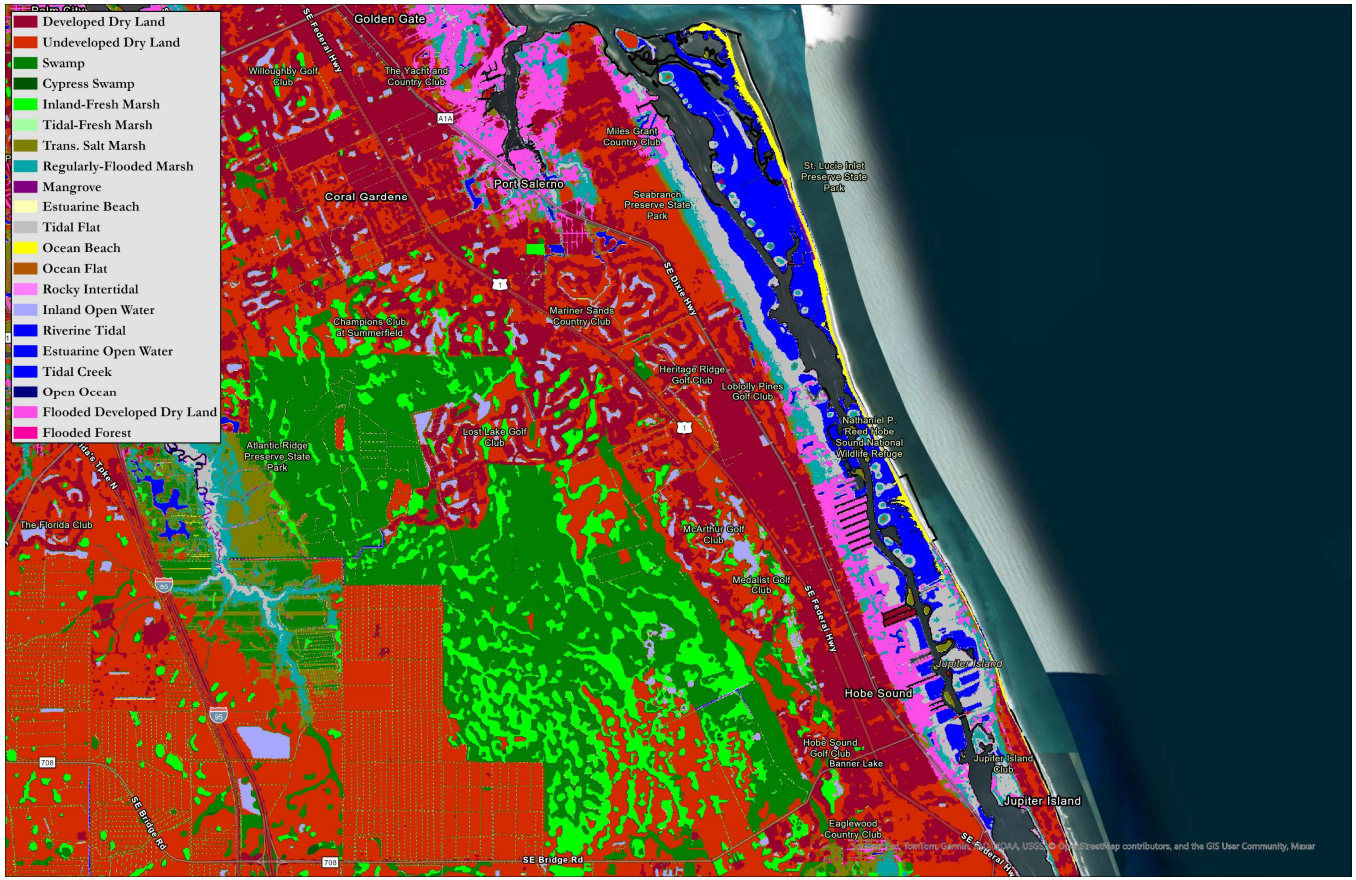
AREA 2 – PRESENT DAY (NIL – 2.33'NAVD – 0 RISE)



AREA 2 – 2040 (NIL – 2.69’NAVD – 0.69’ RISE)

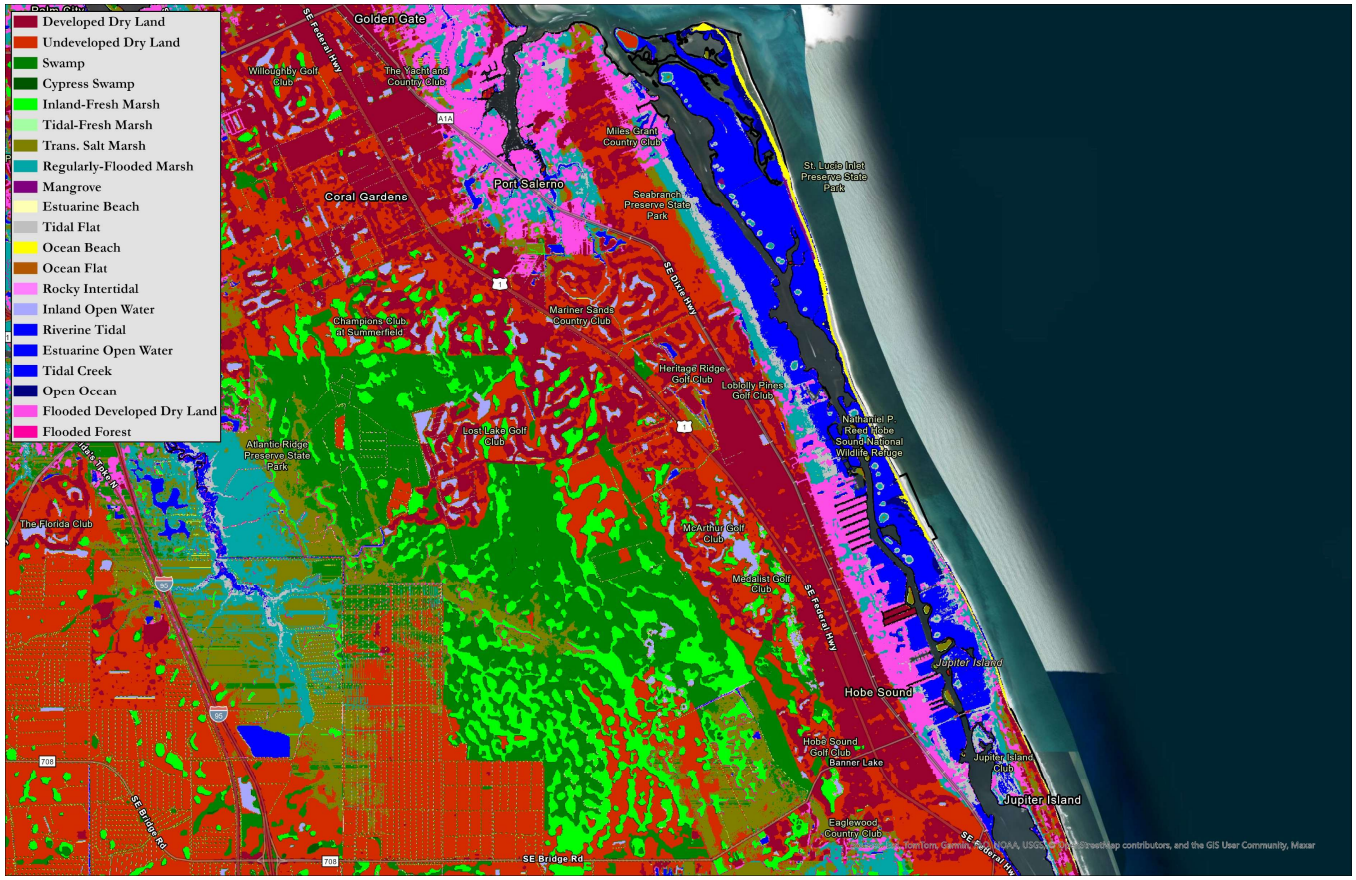


AREA 2 – 2070 (NIL – 3.25’NAVD – 1.25’ RISE)



RESILIENT MARTIN

AREA 2 – 2100 (NIL – 3.77’NAVD – 1.77’ RISE)



MARTIN COUNTY HABITAT CHANGE - NIL

SLAMM Category	Present Day Hectares	2040 Hectares	2070 Hectares	2100 Hectares	Change from Present Day to 2040	Change from Present Day to 2070	Change from Present Day to 2100
Developed Dry Land	11081	10052	8906	7522	-9.28%	-19.63%	-32.11%
Undeveloped Dry Land	91821	90384	88653	85754	-1.56%	-3.45%	-6.61%
Swamp	13940	13066	12451	11587	-6.27%	-10.68%	-16.88%
Cypress Swamp	2559	2453	2365	2260	-4.16%	-7.59%	-11.69%
Inland-Fresh Marsh	12265	12129	12099	12079	-1.11%	-1.35%	-1.52%
Tidal-Fresh Marsh	138	128	127	124	-7.32%	-8.26%	-9.93%
Trans. Salt Marsh	1893	2469	2525	3731	30.40%	33.33%	97.03%
Regularly-Flooded Marsh	798	1927	3190	4928	141.36%	299.58%	517.23%
Mangrove	30	24	24	24	-18.97%	-19.30%	-19.30%
Estuarine Beach	17	16	14	13	-8.64%	-19.55%	-25.90%
Tidal Flat	313	1010	1314	1451	223.06%	320.39%	364.04%
Ocean Beach	1138	1129	1104	1076	-0.85%	-3.01%	-5.49%
Ocean Flat	797	786	767	743	-1.45%	-3.84%	-6.84%
Rocky Intertidal	605	599	592	582	-0.92%	-2.23%	-3.74%
Inland Open Water	4445	4361	4258	4107	-1.87%	-4.19%	-7.60%
Riverine Tidal	407	404	402	394	-0.62%	-1.32%	-3.20%
Estuarine Open Water	163	319	1197	2081	96.34%	636.20%	1180.11%
Tidal Creek	0	0	0	0	0.00%	0.00%	0.00%

Decline in Swamp and Cypress Swamp Areas

- **Current Extent:** Swamps: 13,940 hectares, Cypress Swamps: 2,556 hectares
- **2040 Projections:** NIL (-6.27%, -4.16%), NIH (-8.85%, -6.68%)
- **2100 Projections:** NIL (-16.88%, -11.69%), NIH (-73.23%, -80.68%)

Transition of Coastal Wetlands:

- **Transitional Salt Marsh:**
  - **Current:** 1,893 hectares
  - **2100:** NIL (+97.03%), NIH (+2903.08%)
- **Mangroves:**
  - **Current: 30 hectares**
  - **2100:** NIL (-19.30%), NIH (-94.92%)

MARTIN COUNTY HABITAT CHANGE - NIL

SLAMM Category	Present Day Hectares	2040 Hectares	2070 Hectares	2100 Hectares	Change from Present Day to 2040	Change from Present Day to 2070	Change from Present Day to 2100
Open Ocean	5	26	64	109	389.84%	1131.72%	1991.19%
Irreg.-Flooded Marsh	1	2	2	1	58.54%	55.24%	12.84%
Inland Shore	0	0	0	0	-5.80%	-38.99%	-76.65%
Tidal Swamp	8	6	3	2	-33.61%	-61.65%	-80.52%
Flooded Developed Dry Land	1203	2232	3379	4762	85.45%	180.75%	295.68%
Flooded Forest	32	138	226	331	332.75%	607.34%	935.79%
Aggregated Non Tidal	104105	102669	100937	98039	-1.38%	-3.04%	-5.83%
Freshwater Non-Tidal	28765	27648	26915	25926	-3.88%	-6.43%	-9.87%
Open Water	5019	5111	5921	6691	1.82%	17.96%	33.30 %
Low Tidal	2871	3540	3791	3865	23.31%	32.04%	34.62%
Saltmarsh	798	1927	3190	4928	141.36%	299.58%	517.23%
Transitional	1956	2633	2777	4087	34.60%	41.92%	108.91%
Freshwater Tidal	147	134	130	126	-8.83%	-11.33%	-14.00%

Expansion of Marshes and Open Water:

- **Regularly Flooded Marsh:**
  - **Current:** 798 hectares
  - **2100:** NIL (+517.23%), NIH (+2417.38%)
- **Estuarine Open Water:**
  - **Current:** 163 hectares
  - **2100:** NIL (+1180.11%), NIH (+3269.77%)

ADAPTATION STRATEGIES

TYPES OF ADAPTATION STRATEGIES

Once major needs and priorities are defined, specific adaptation strategies can be developed, vetted, and defined.

4:1
Building-level adaptation strategies outweigh the costs 4:1

2:1
Community-wide adaptation strategies outweigh the costs 2:1

01 Protection
Protection strategies are structurally defensive measures that directly protect vulnerable structures, allowing them to be left largely unaltered.

02 Accommodation
Accommodation strategies alter physical design of vulnerable structures to allow the structure or land use to stay in place with modification.

03 Retreat
Retreat from areas or infrastructure where protection or accommodation will not be efficient or effective can be voluntary, incentivized, or done gradually.

04 Avoidance
Avoidance involves guiding new development away from areas that are subject to coastal hazards and can be done by implementing policy and/or offering of incentives.

Figure 19. Types of Adaptation Strategies.

RECOMMENDATIONS - THEMES

1. **Targeted Resilience Planning**: Develop tailored adaptation strategies for each hotspot based on the specific asset vulnerabilities identified. For example, prioritize wetland restoration in areas where natural resources are significantly exposed, and reinforce transportation infrastructure in highly impacted zones.
2. **Enhanced Shoreline Protection**: Focus on hotspots with high exposure to storm surge where there is evidenced documentation of recent shoreline erosion. Implement measures such as living shorelines, dune restoration, and improved drainage systems.
3. **Infrastructure Fortification**: Strengthen transportation networks and critical facilities in high-risk areas. Consider elevating roadways and improving drainage systems to reduce flood risks.
4. **Land Use Planning**: Utilize exposure data to inform zoning and land-use policies. Limit development in high-risk zones and encourage nature-based solutions for flood mitigation.

RECOMMENDATIONS – THEMES (CONT.)

5. **Community Engagement and Preparedness**: Educate local communities on the risks identified in the assessment. Promote disaster preparedness and encourage the adoption of resilient construction practices.
6. **Long-Term Monitoring**: Establish a framework for continuous monitoring of exposure metrics across hotspots and non-hotspot areas. Use updated data to refine adaptation strategies over time.
7. **Modeling of Sample Recommendations**: Integrate the findings from the "Hot Spot Results" section of the report into the broader resilience strategy. Use this data to prioritize actions and allocate resources effectively.
8. **Regional Coordination**: Collaborate with neighboring counties and regional agencies to address shared vulnerabilities, particularly for large-scale challenges like storm surge impacts and wetland conservation.

GRANT SUCCESS TO DATE

- Vulnerability Assessment **required** for continued Resilient Florida program funding eligibility

PLANNING GRANTS

- 2018 - $34,000
- 2019 - $75,000
- 2021 - $191,000
- 2022 - $75,000
- 2023 - $250,000

TOTAL = $625,100

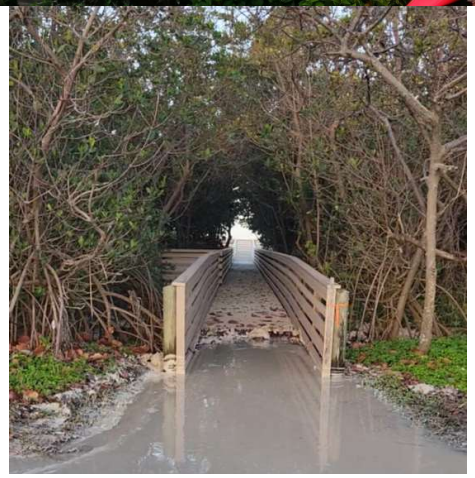
TOTAL = $10,963,918

2021-22 Grant Cycle Projects	Match Amount (50%)	2023-2024 Grant Cycle Projects	Match Amount (50%)
Cypress Creek Restoration Project	$750,000	MacArthur Boulevard Resilience Project	$1,235,000
Stormwater Backflow Preventer Installation	$198,380	Old Palm City North Neighborhood Improvements	$3,242,500
Golden Gate Stormwater Treatment Area North Outfall	$180,000	SW Mockingbird Lane Flood Mitigation	$1,807,000
Twin Rivers Park Shoreline Stabilization	$862,000		
Stormwater Backflow Preventer Installation Ph 2	$200,000		
Indian Riverside Park Living Shoreline Ph. 2	$1,863,938		
Total Program Funding to Date Awarded to Martin County from State of Florida: $10,338,818			

RESILIENCE IN ACTION

Bathtub Beach and MacArthur Boulevard

October 26, 2012
Tropical Storm Sandy



RESILIENCE IN ACTION

Bathtub Beach and MacArthur Boulevard

NEXT STEPS

- Finalize Vulnerability Assessment work products and submit to Florida Department of Environmental Protection
- Enhanced public outreach
- Adaptation planning efforts
- More refined modeling through stormwater master plan/watershed management plan

QUESTIONS/COMMENTS?