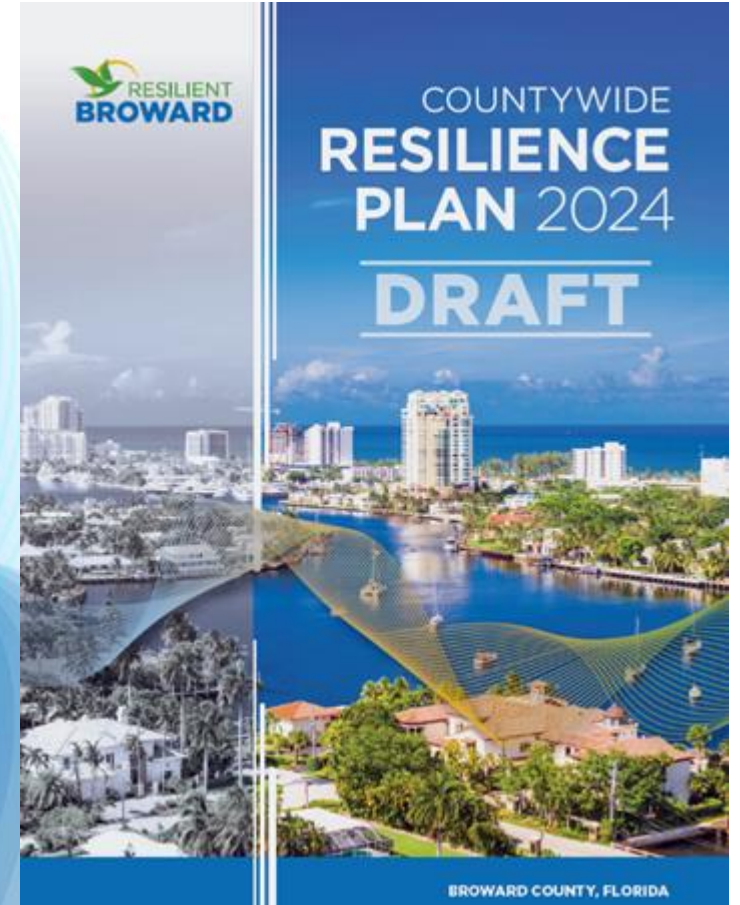




Climate Trends, Resilience Challenges, and a Plan for Broward County

Presented to the Broward
County Board of County
Commissioners

February 4, 2025



Climate Resilience Stage-setting



Our Community Resilience Challenges

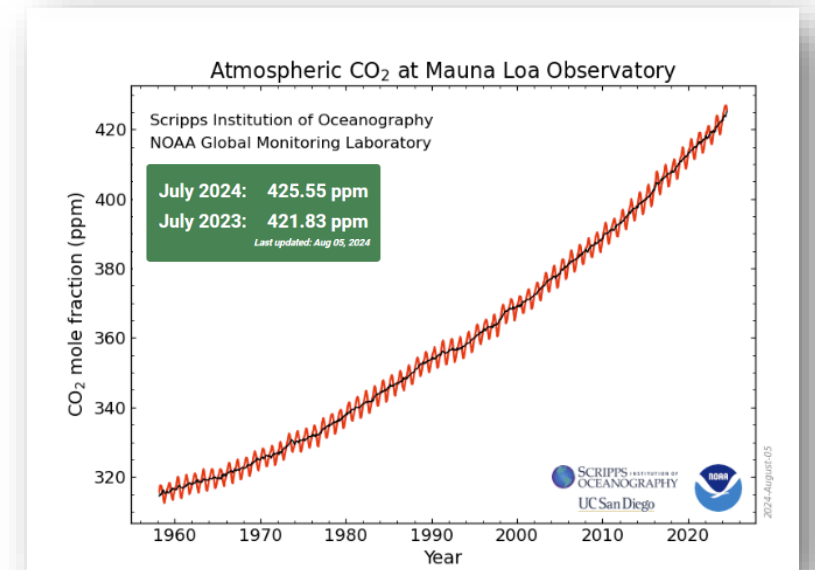
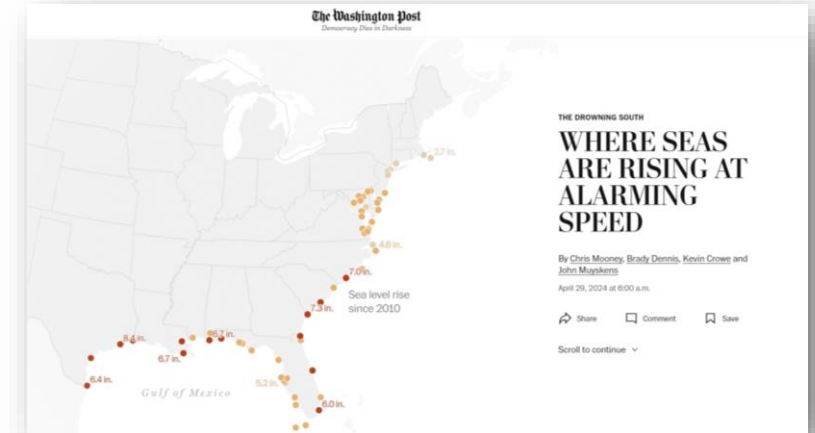
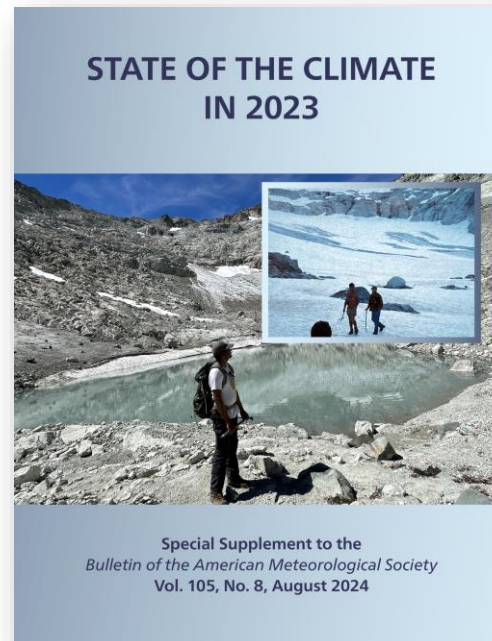
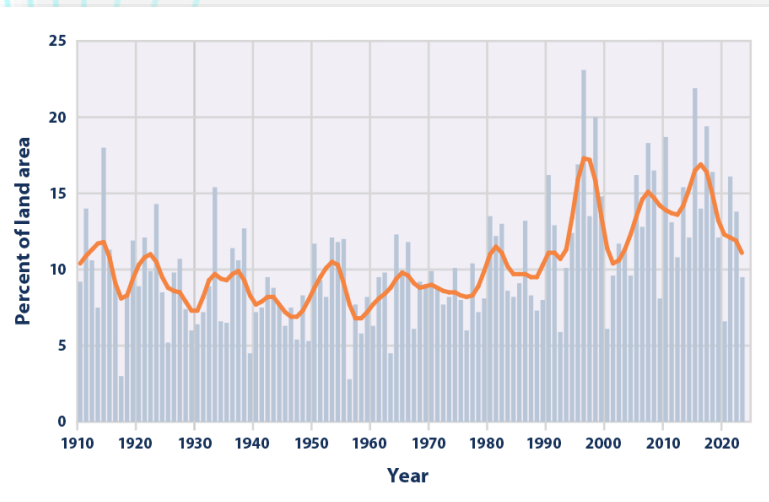
- Rising sea level, rainfall and storm surge
- Increases in flood severity, impacts and disruptions
- Extreme heat
- Infrastructure damage and safety concerns
- Economic implications
- Quality of life and public health considerations



Global Climate Trends

- Greenhouse gas concentrations, global temperature across land and oceans, global sea level and ocean heat content all reached record highs in 2023
- The rate of sea level rise increase over the last 10 years is more than twice the rate from 1993 to 2002.

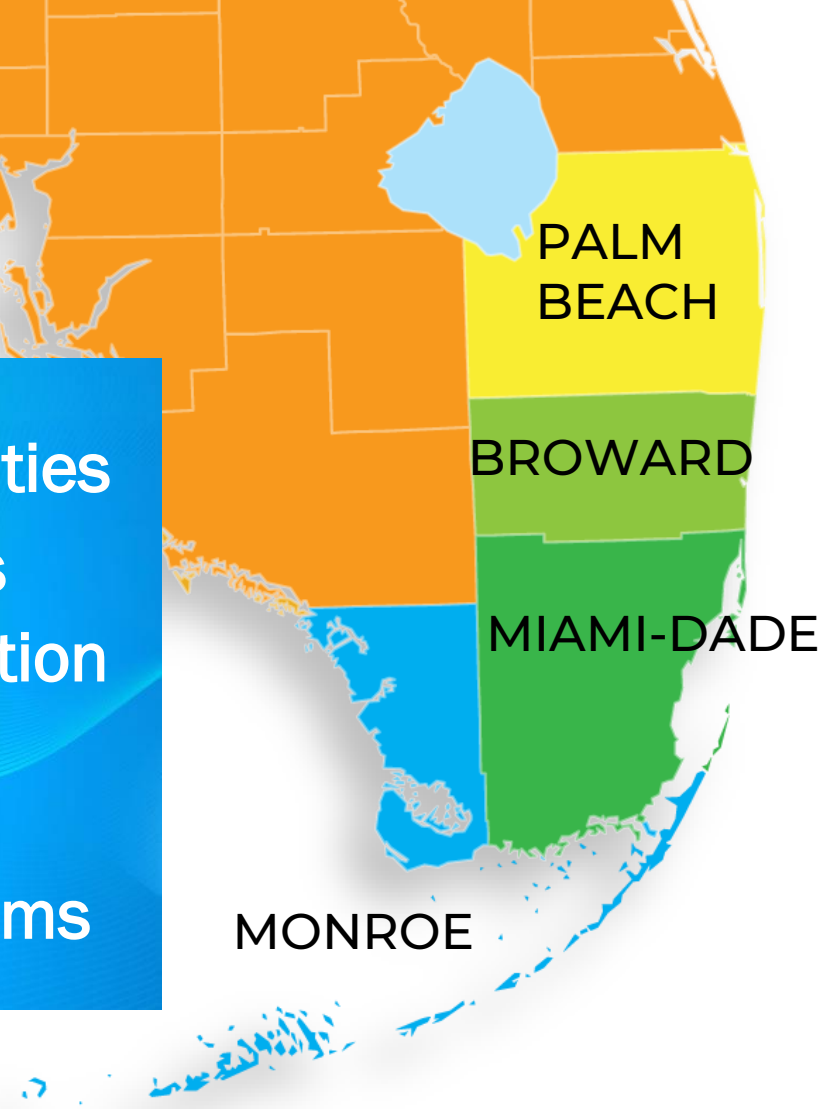
Extreme One-Day Precipitation Events in the Contiguous 48 States, 1910–2023



Southeast Florida Regional Climate Change Compact

- Ratified January 2010
- Voluntary response to shared challenges, needs and opportunities
- Regional collaboration to address shared climate impacts and solutions at scales beyond local boundaries

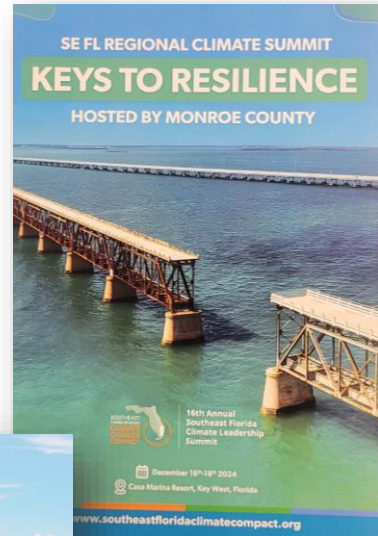
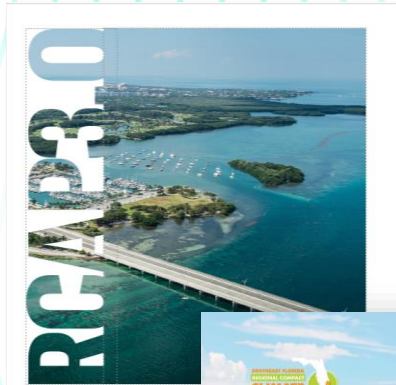
4 counties and 109 cities
6 million residents
~30% of state population
A third of state economic activity
Interconnected Systems



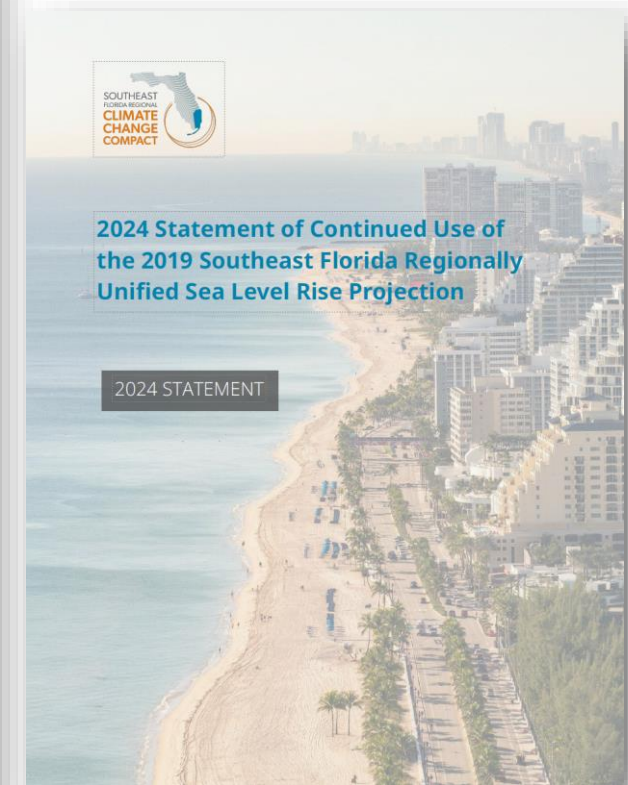
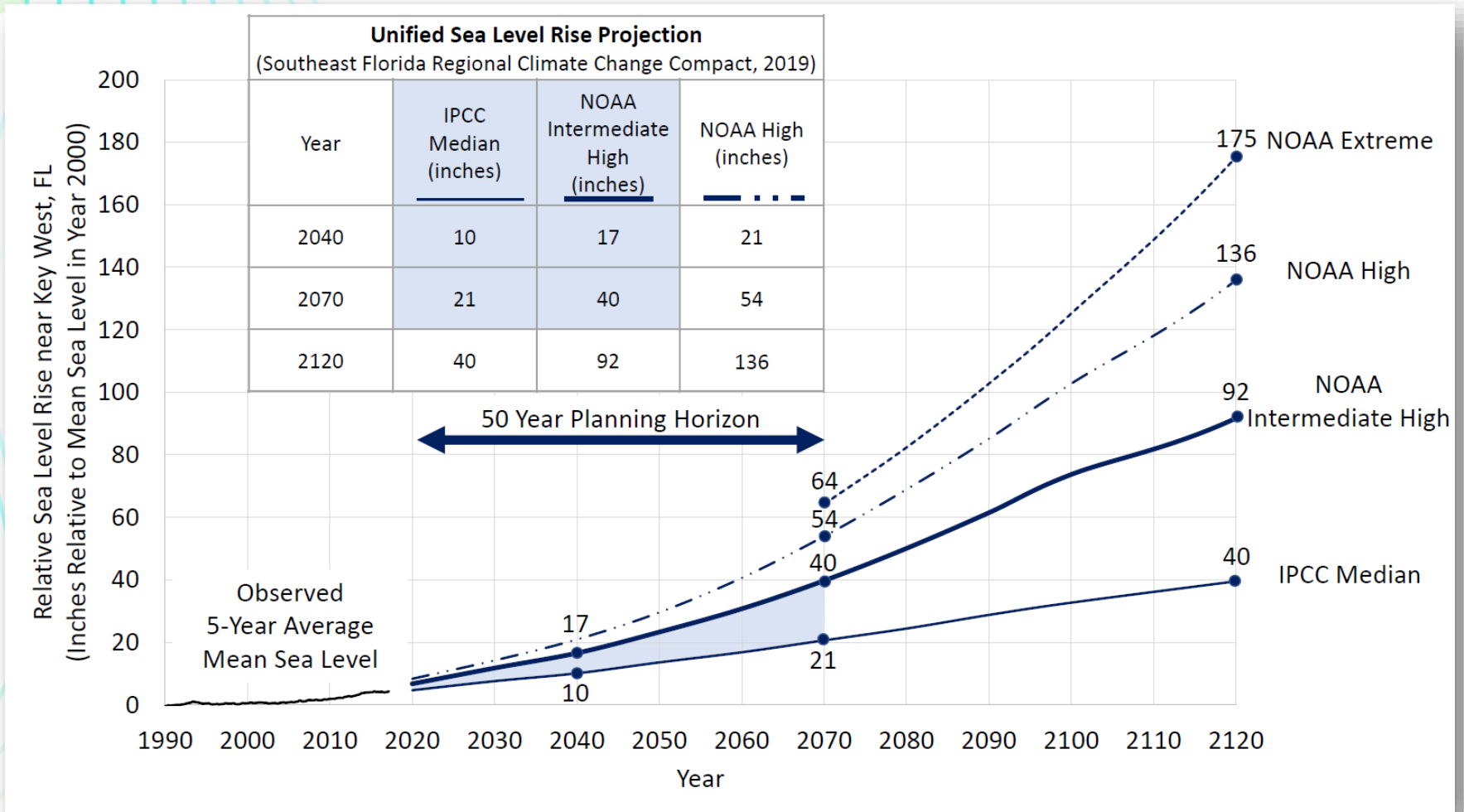
www.southeastfloridaclimatecompact.org



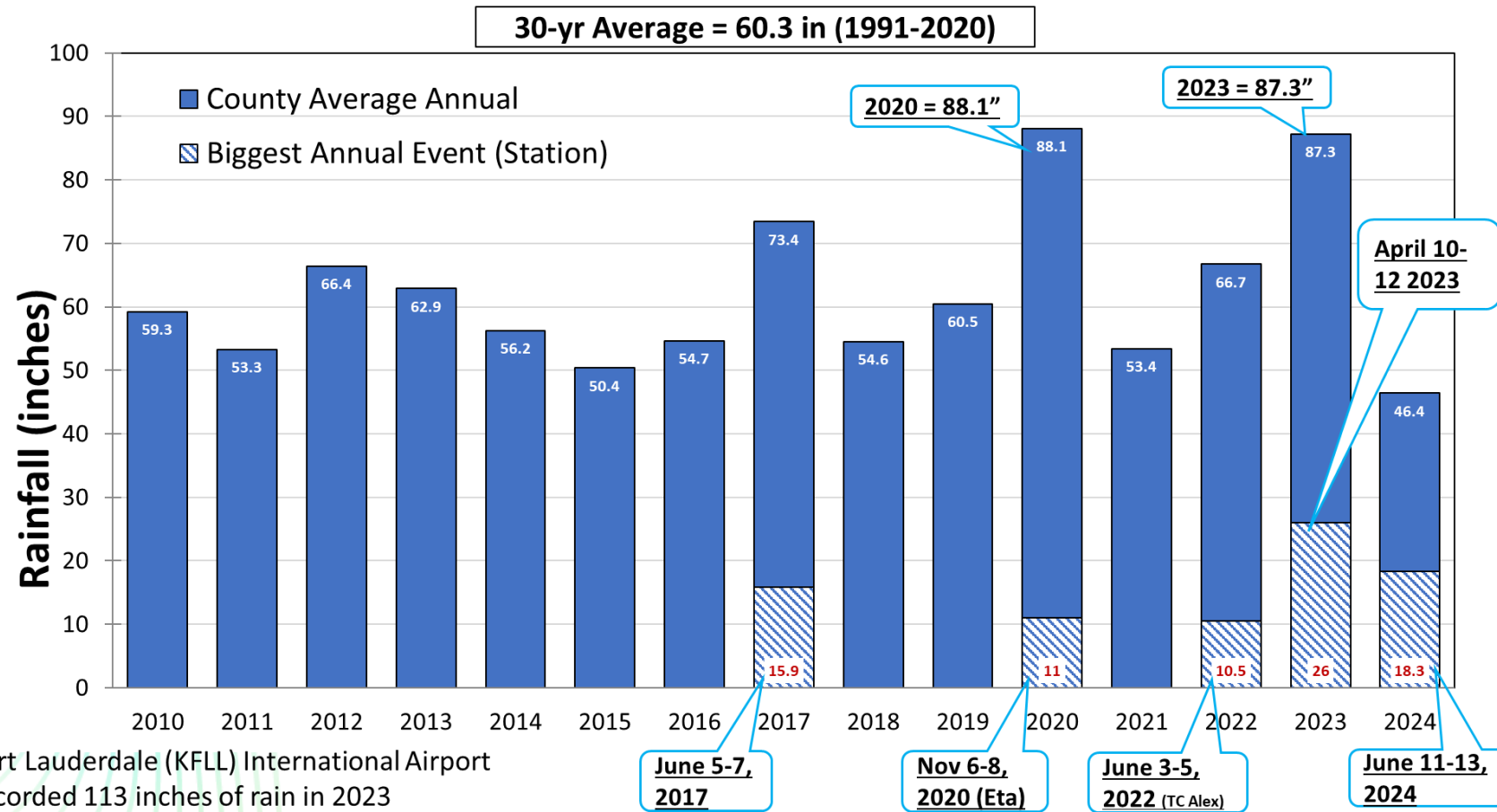
16 years of Regional Collaboration



2019 Regional Sea Level Rise Projection (2024 Statement of Continued Use)



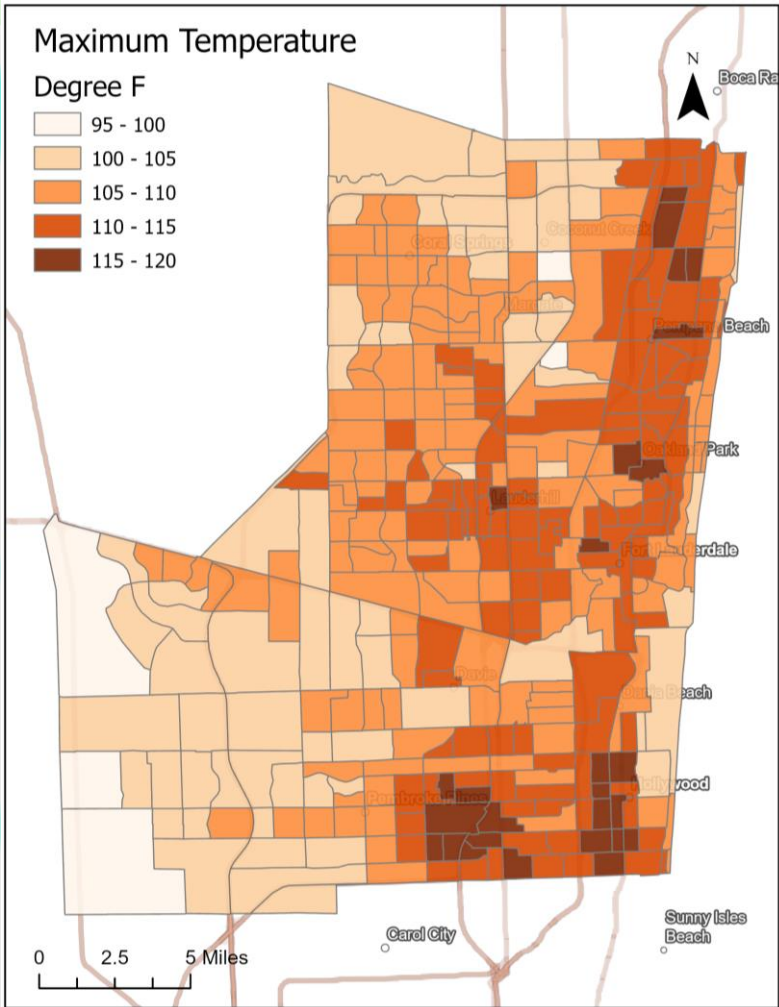
Local Increase in Intense Rainfall Events



Top 10 Wettest 1-Day Events – County Average

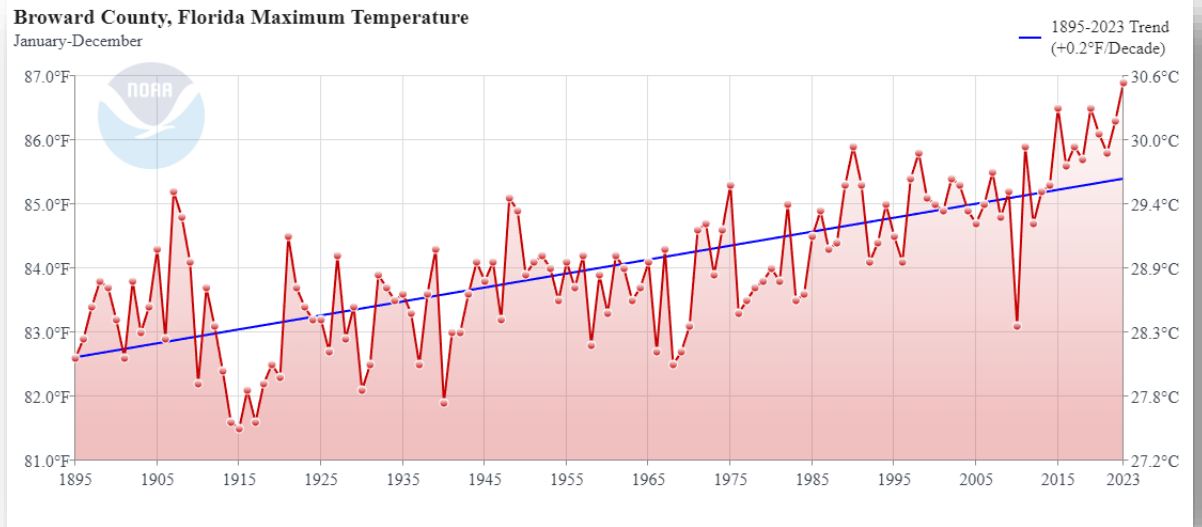
Rank	Precipitation (in.)	Date
1	8.42"	12 April 2023
2	6.99"	6 June 2017
3	6.72"	3 October 2000
4	6.51"	3 June 2022
5	6.39"	12 June 2024
6	6.05"	15 November 2023
7	5.97"	4 November 1998
8	5.96"	8 November 2020
9	5.38"	27 May 2003
10	4.69"	7 June 1999

Temperature Trends and Predictions



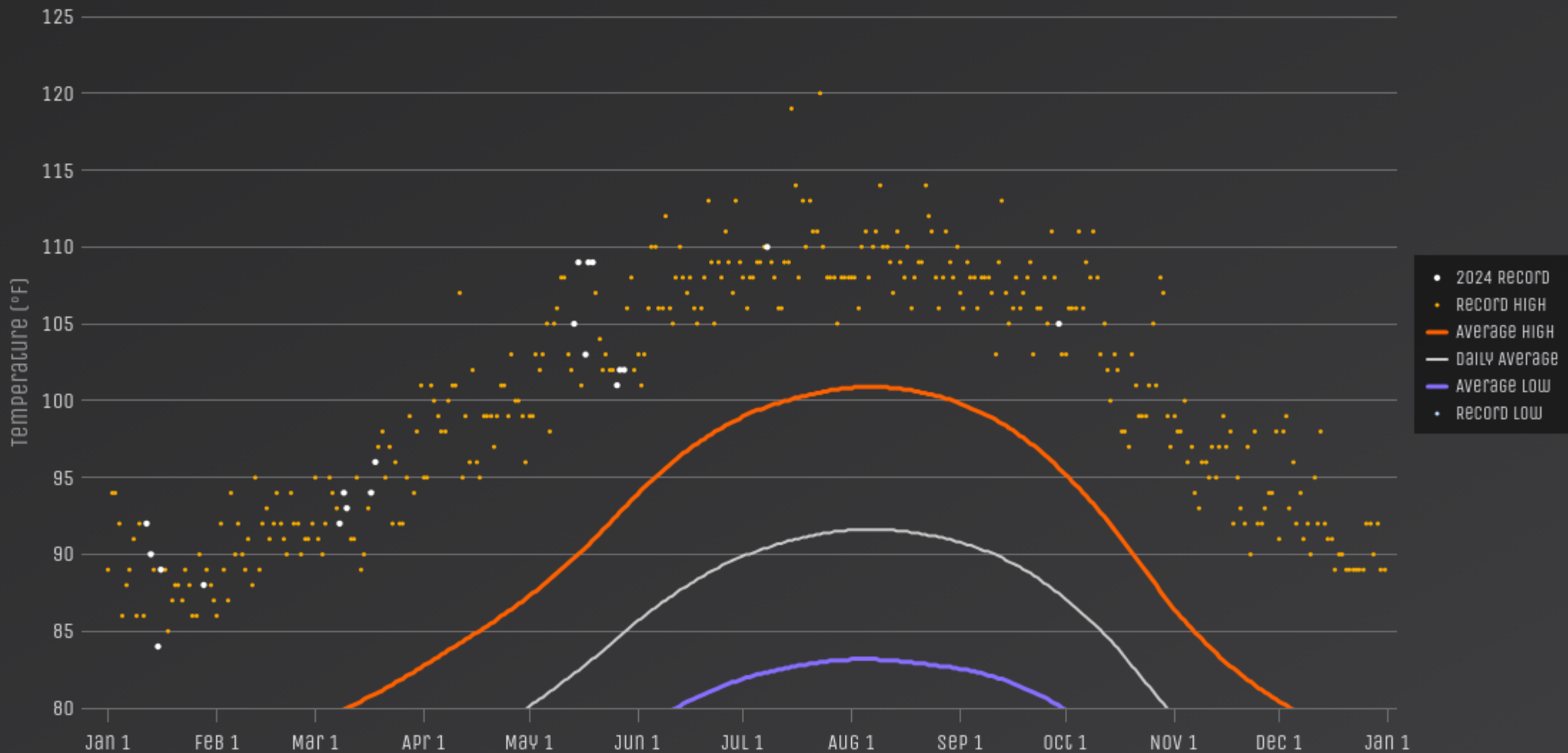
Maximum Temperature 2022 (Satellite Image, Census Block Scale)

BROWARD COUNTY				
Heat Index above	Historical (1971-2000)	By midcentury (2036-2065)	By late century (2070-2099)	By late century, if we limit warming to 2°C (2070-2099)
90°F -----	152 days	184 days	198 days	180 days
100°F -----	34 days	128 days	162 days	109 days
105°F -----	5 days	80 days	132 days	52 days
Off the Charts	0 days	1 days	14 days	0 days



DAILY HEAT INDEX CLIMATOLOGY FOR FORT LAUDERDALE, FL

KFLL, WBAN SITE 12849, 1/1/1973 - 12/23/2024



Project Introduction

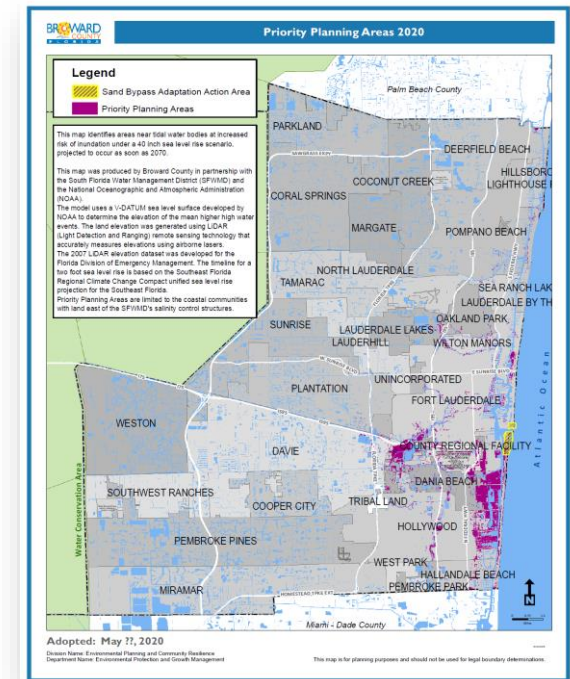


Actions: Resilience Standards



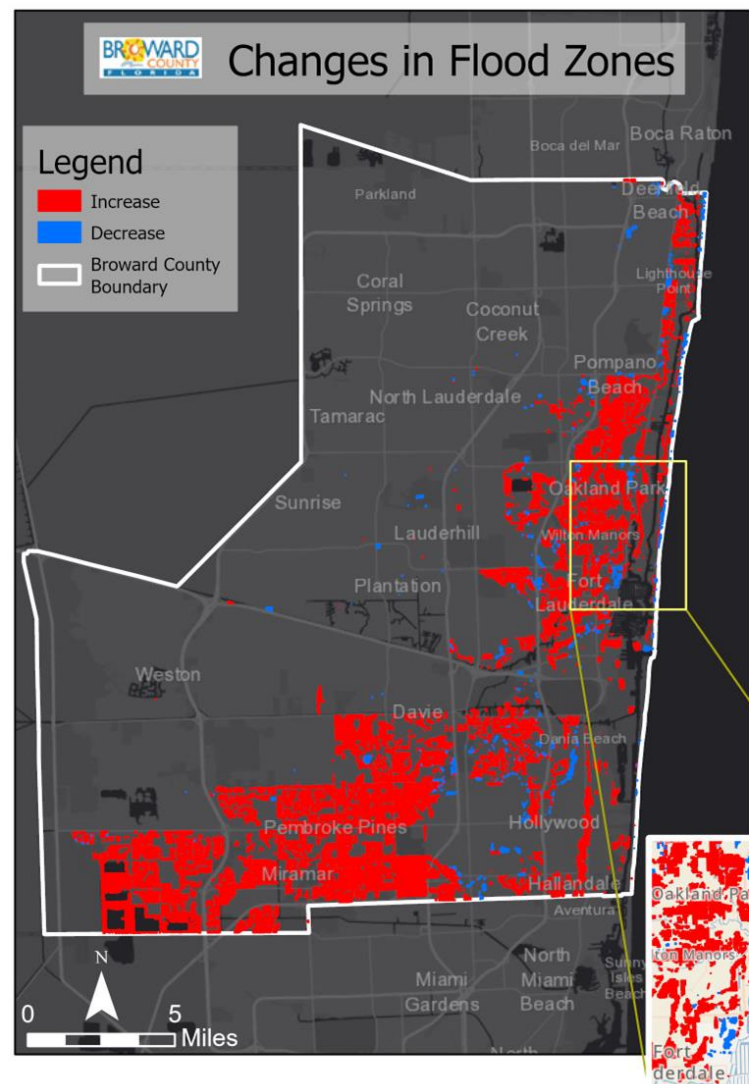
Priority Planning Area Map

- Sea Level Rise Projection - 2012, 2015, 2019
- Priority Planning Area Map - 2012, 2015, 2020
- Future Conditions Map Series - 2017
- Resilience Standards
 - Drainage infrastructure – 2017, 2024
 - Tidal flood barriers - 2020
 - 100-Yr Flood elevations – 2021
- FEMA Flood Maps – July 2024 (90K new parcels)

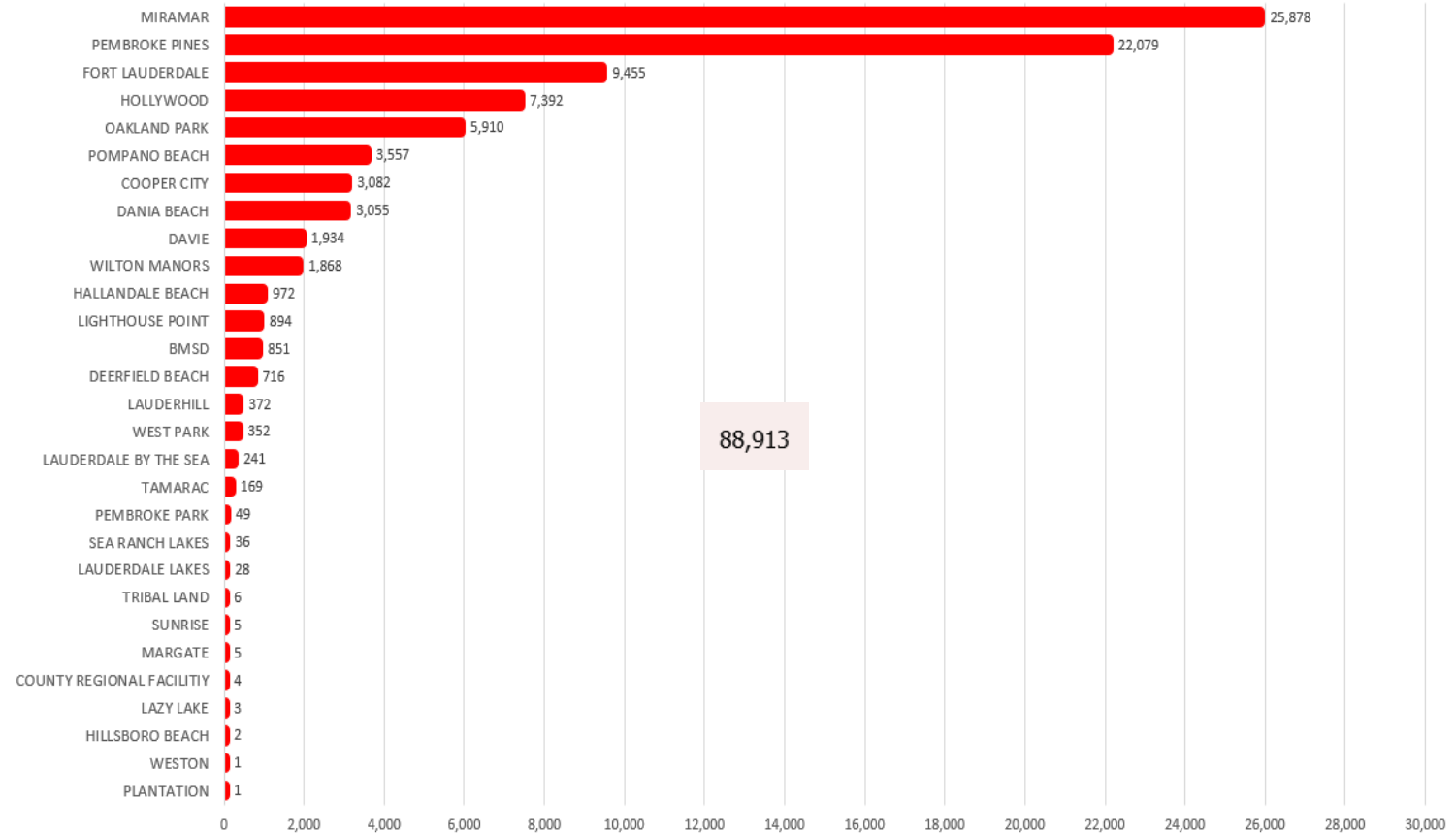


NFIP Update: 90K Parcels added to 100-yr Flood Zone

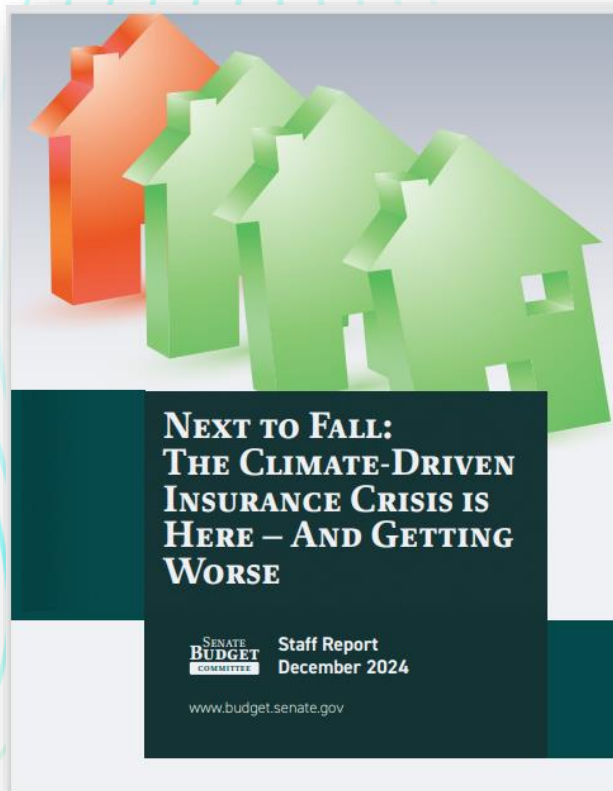
50% of parcels now in Special Flood Hazard Area



Flood Insurance NOW needed
("Added to Flood Zone")



Today: Ever-Increasing Resilience Drivers and Community Exposure



Flooding causes property damage, covers roads, prompts evacuations in areas of Miami-Dade, Broward counties

Flood watch in effect until 8 p.m., on Saturday



FEMA

FEMA Policy: Federal Flood Risk Management Standard (FFRMS)

FEMA Policy 206-24-005



Fort Myers Beach loses National Flood Insurance Program discount

BY GULFSHORE BUSINESS NOVEMBER 22, 2024 PHOTO CREDIT: WINK NEWS

Fueling Endorsement of County-wide Resilience Planning Effort



2017 Broward Leaders Resilience Roundtable

Setting the Stage for a Coordinated Resilience Plan



COMMUNITY
OUTREACH



RISK
ASSESSMENT



ECONOMIC
MODELING



ADAPTION
PLAN



ONLINE
PLATFORM

Project Team



Guided by a Project Steering Committee



Informed by Stakeholder Input and through Community Engagement

Contributing Partners

- Municipalities
- Drainage/Water Districts
- South Florida Water Management
- U.S. Army Corps



Community Input

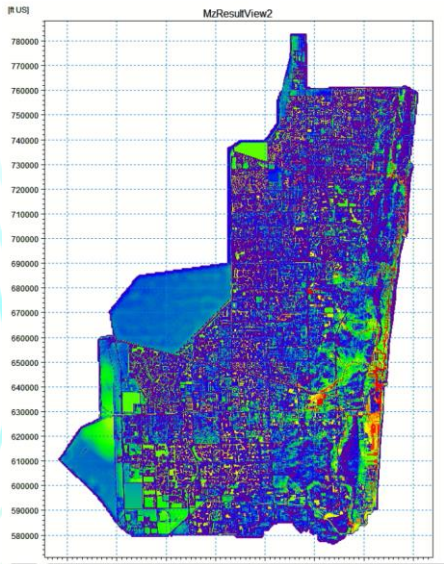
- Youth and Stakeholder Groups
- Central County Climate Conversation
- Community Organizations
- Social media and on-line portal
- Listening Sessions

Forums

- Sub-regional workshops
- One-on-one meetings
- Local venues
- Presentations




Approach: Extensive Flood Scenario Modeling



**BOUNDARY
CONDITIONS**

TIDAL

GROUND
WATER

**MODEL
DRIVERS**

RAINFALL

**INITIAL
CONDITIONS**

GROUND
WATER

KING TIDE - 2.0ft

STORM SURGE 20 yr - 2 ft

STORM SURGE 100 yr - 2.0 ft

KING TIDE - 3.3 ft

STORM SURGE 20 yr - 3.3 ft

STORM SURGE 100 yr - 3.3 ft

SATURATED

VARIABLE

10 yr STORM

25 yr STORM

100 yr STORM

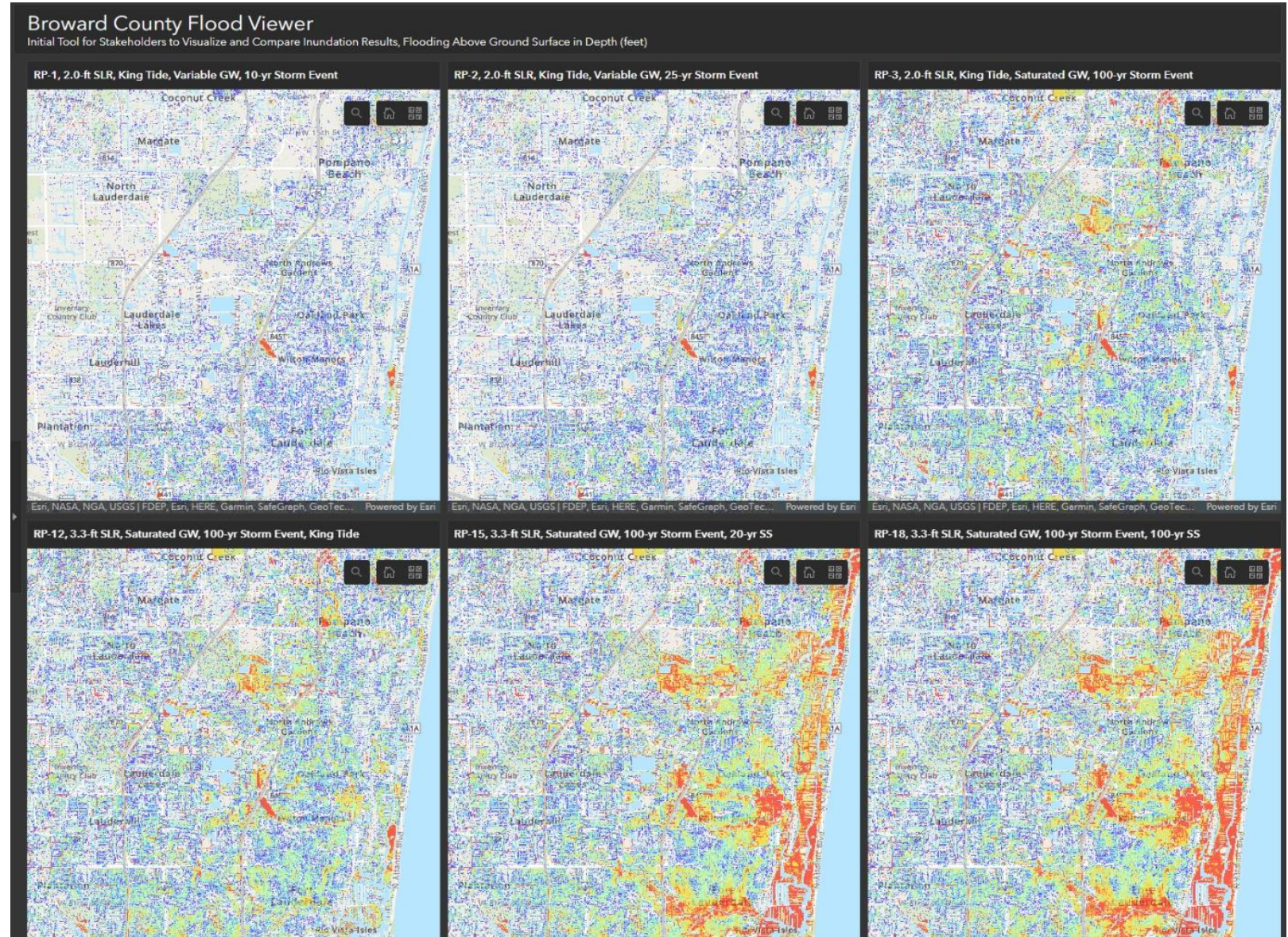
+20%
Increase

SATURATED

VARIABLE

Flood and Risk Analyses

Site-based information to support adaptation planning



Identification of Exposures



HAZARD EXPOSURE

- Frequency, duration, extent of flooding – properties, roads, essential infrastructure
- Flood damage repair costs
- Heating degree days
- Socio-economic projections



FIRST PARTY LOSS

- Building and asset damage
 - Lost income from business interruption
 - Cost of lost access to services
 - Humanitarian (health) impacts



INDIRECT IMPACTS

- Resident and business income
- Population, Jobs, Investment
 - Economic Growth
- Beaches, recreation areas
 - Natural environment
 - Insurance availability and affordability
 - Real estate values
- Tax revenue and government spending/Credit quality



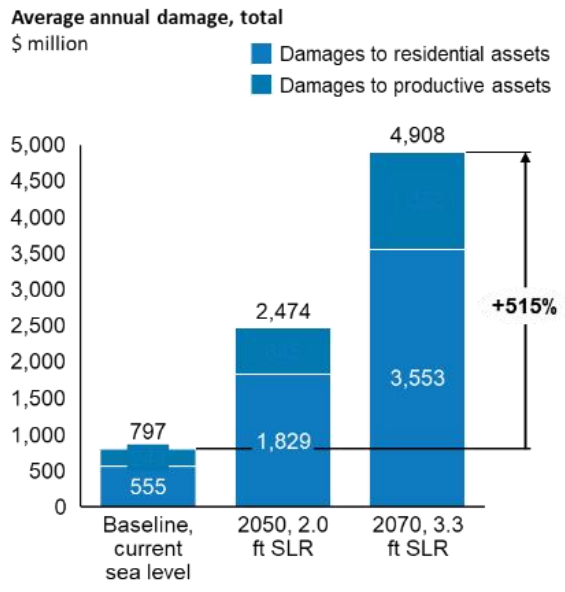
KEY IMPACT METRICS

- Economic activity (by sector)
- Household impacts
 - Asset values
 - County finances
- Distribution of impacts

Risk Assessment and Economic Modeling

NO ADAPTATION INCLUDED

By 2070, residential/productive asset damage could increase 6.4x/5.6x times compared to baseline



Most flood damage is concentrated along the coast

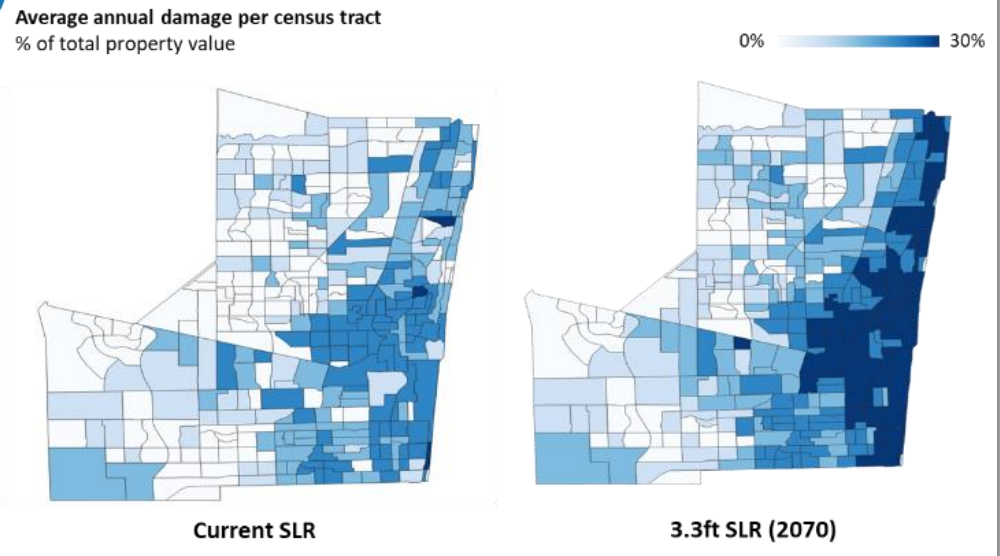
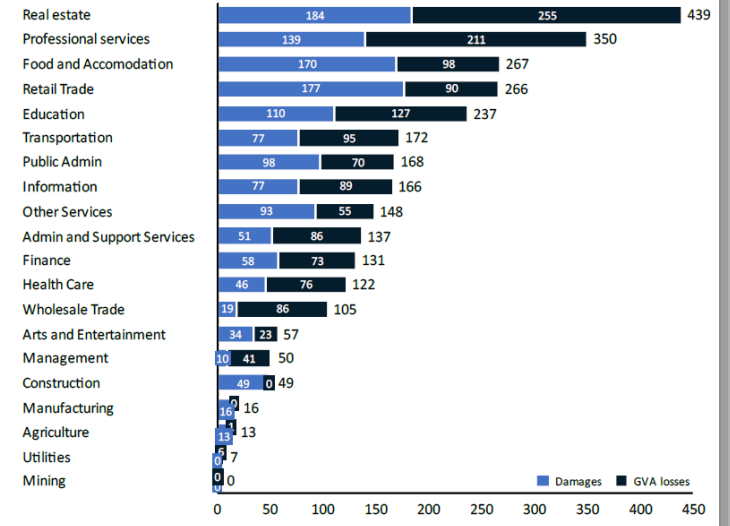


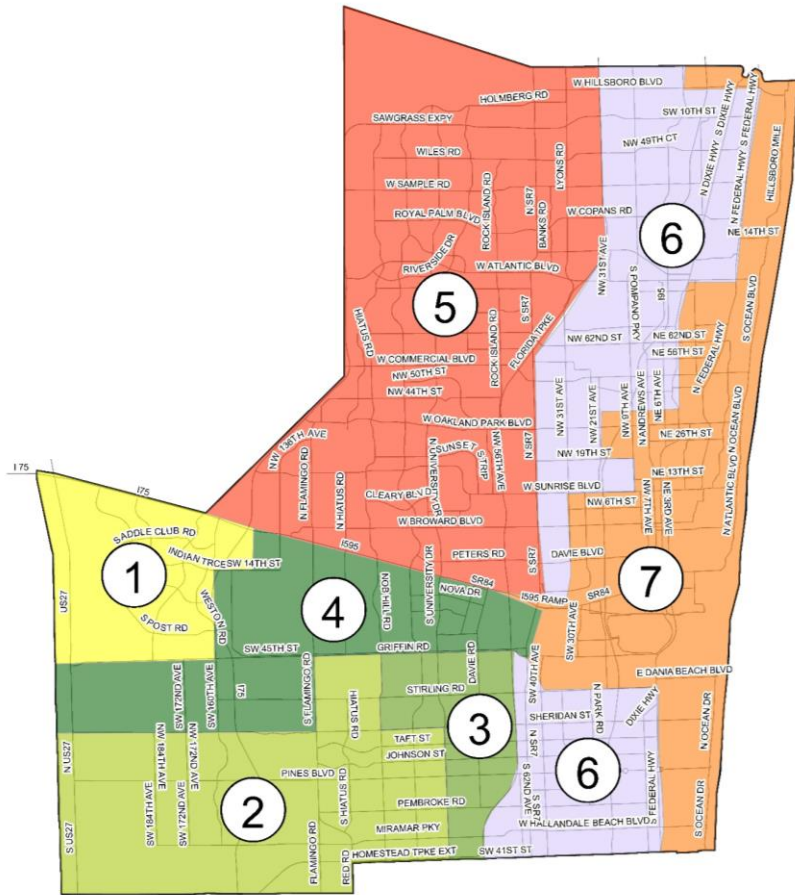
Exhibit 15: Damages and losses from flooding are unevenly distributed

Average annual damages and GVA losses by sector, \$ million, 3.3ft SLR (2070)



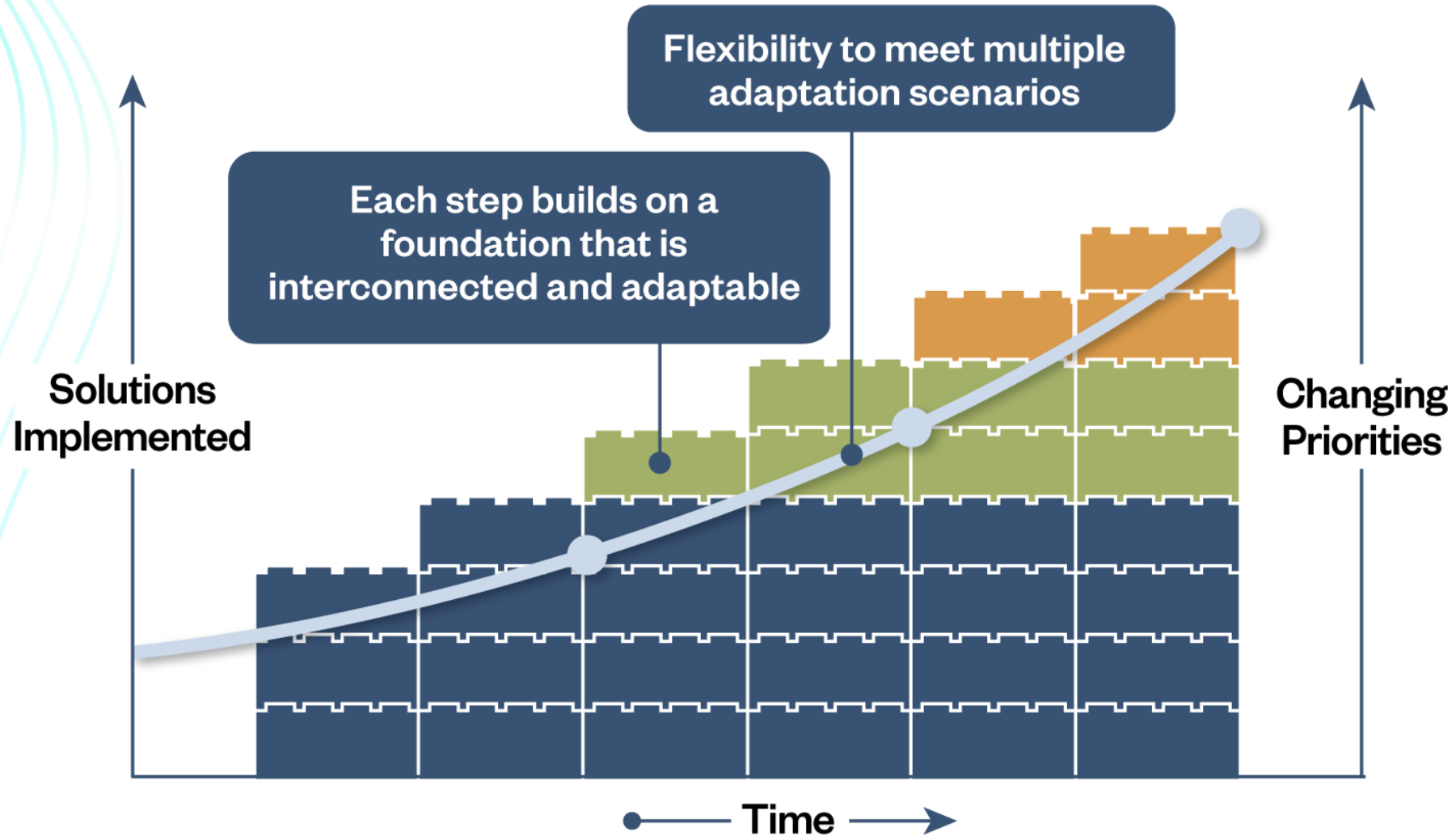
1. Total losses represent the sum of damages to assets and GVA losses.
2. Excluding potential gains from reconstruction.

Initial Adaptation Approach



Zone	Preliminary Strategy
1	<ul style="list-style-type: none"> • Explore Pre-storm operations to gain storage ahead of storm. • Manage discharges to allow other areas to drain.
2	<ul style="list-style-type: none"> • Explore Pre-storm operations to gain storage ahead of storm. • Manage discharges to allow other areas to drain. • Maintain beneficial site storage.
3	<ul style="list-style-type: none"> • Add conveyance improvements, probably based on energy. • Identify storage opportunities.
4	<ul style="list-style-type: none"> • Maintain beneficial site storage. • Target flooding spots based on cost of damages. • Explore Pre-Storm Operations to gain storage.
5	<ul style="list-style-type: none"> • Identify storage to reduce runoff. • Manage storage ahead of the storm.
6	<ul style="list-style-type: none"> • Minor opportunities for storage. • Improve gravity-based conveyance. • Add energy.
7	<ul style="list-style-type: none"> • Manage and protect coast. • Add artificial and natural barriers. • Incorporate energy-based conveyance improvements.

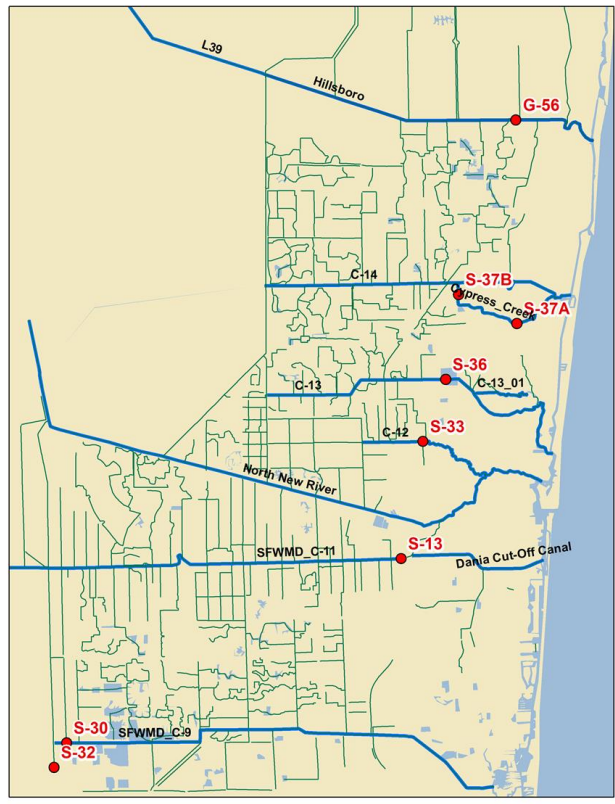
Implementation of Adaptable Solutions



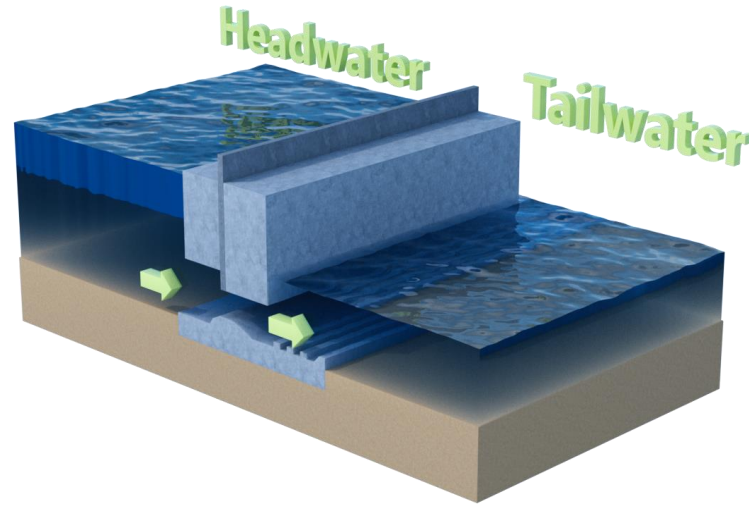
Functional Water Management System



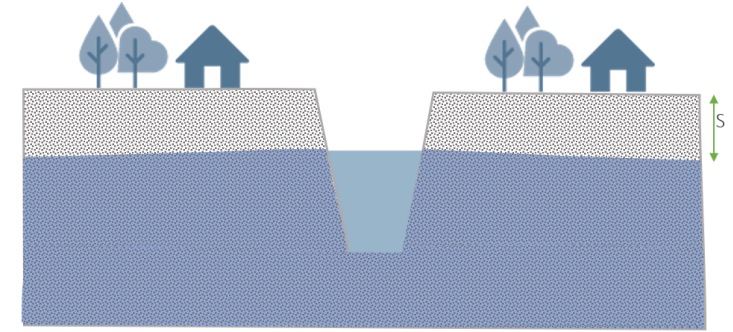
Role of the Central and Southern Flood (C&SF) Control Project



Original Design

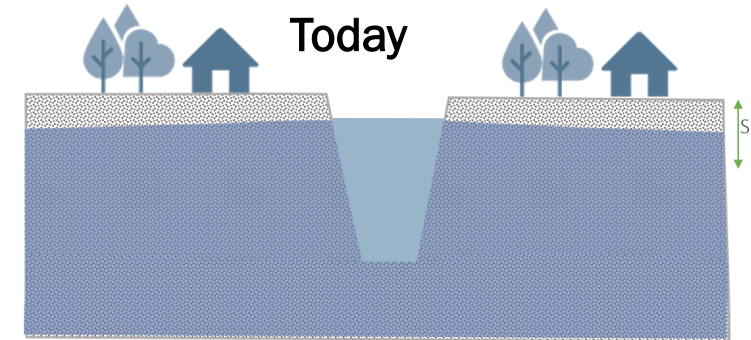
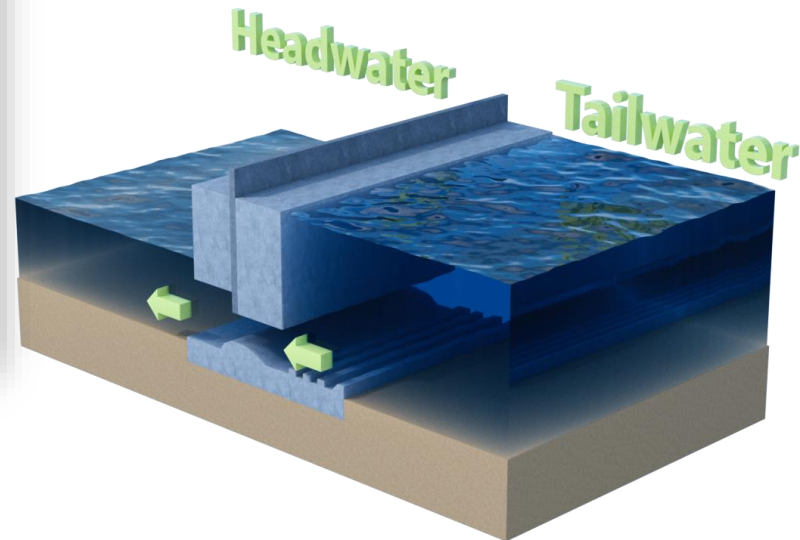


Initial Function



The storage capacity will be reduced as the headwater elevation increases to limit saltwater intrusion as the sea level rises over time.

With Sea Level Rise





The storage capacity will be reduced as the headwater elevation increases to limit saltwater intrusion as the sea level rises over time.

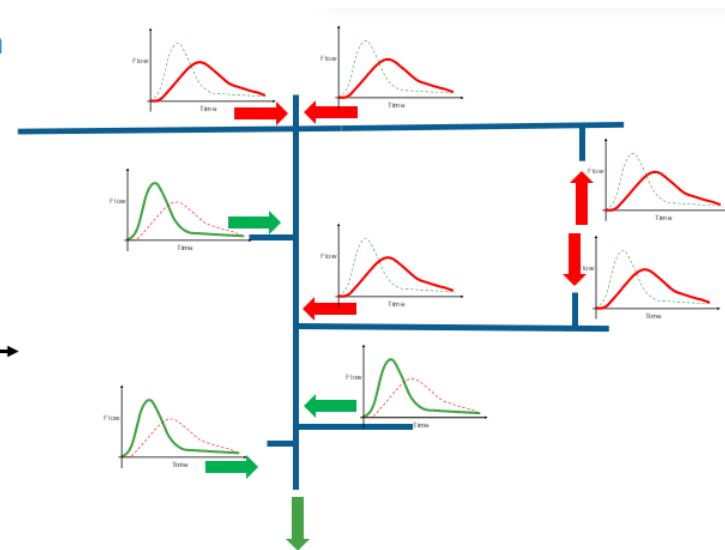
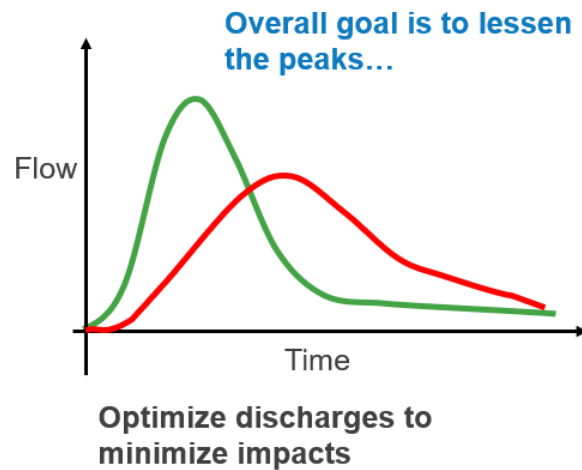
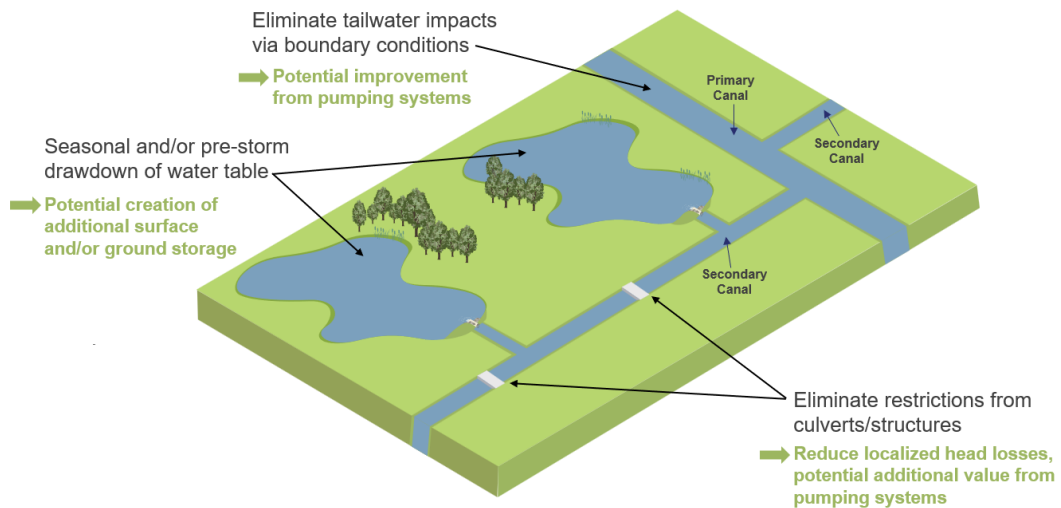
With reduced storage, increased rainfall, and sea level rise



System backs up with widespread flooding

Stormwater Storage and More Active Management are Key

 Green Arrows represent uncontrolled discharges
 Red Arrows represent controlled discharges



Adaptation Strategies



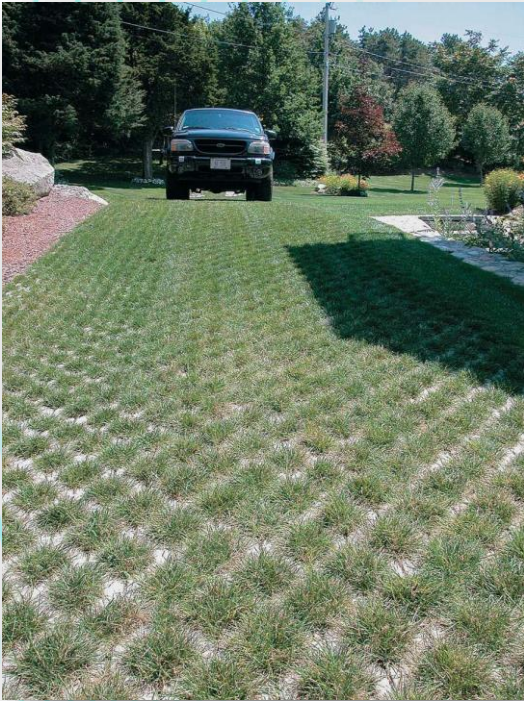
Adaptation Strategies Evaluated

- Storage
 - Above ground storage (large)
 - Recovering underground storage
- **Green Infrastructure** ←
- Reducing Impervious area
 - Adding localized surface storage
- Conveyance
 - Improving existing conveyance structures (canals, culverts, etc.)
 - Additional pumping
- Barriers
 - Property level seawalls
 - Nature-based and/or engineered structures
 - Large scale levees and other close out structures

This adaption strategy is linked to the development of Green Infrastructure. Most Green Infrastructure solutions are based on the idea of increasing infiltration by reducing impervious area. Infiltration can only be increased if there is available ground storage to receive rainwater.



Green Infrastructure and Telemetry-Supported Operations



Increased Pervious



Swales



Bio Swales



Canal Operational Improvements



Stormwater Storage

Suites of Adaptations were developed incorporating three adaptation zones

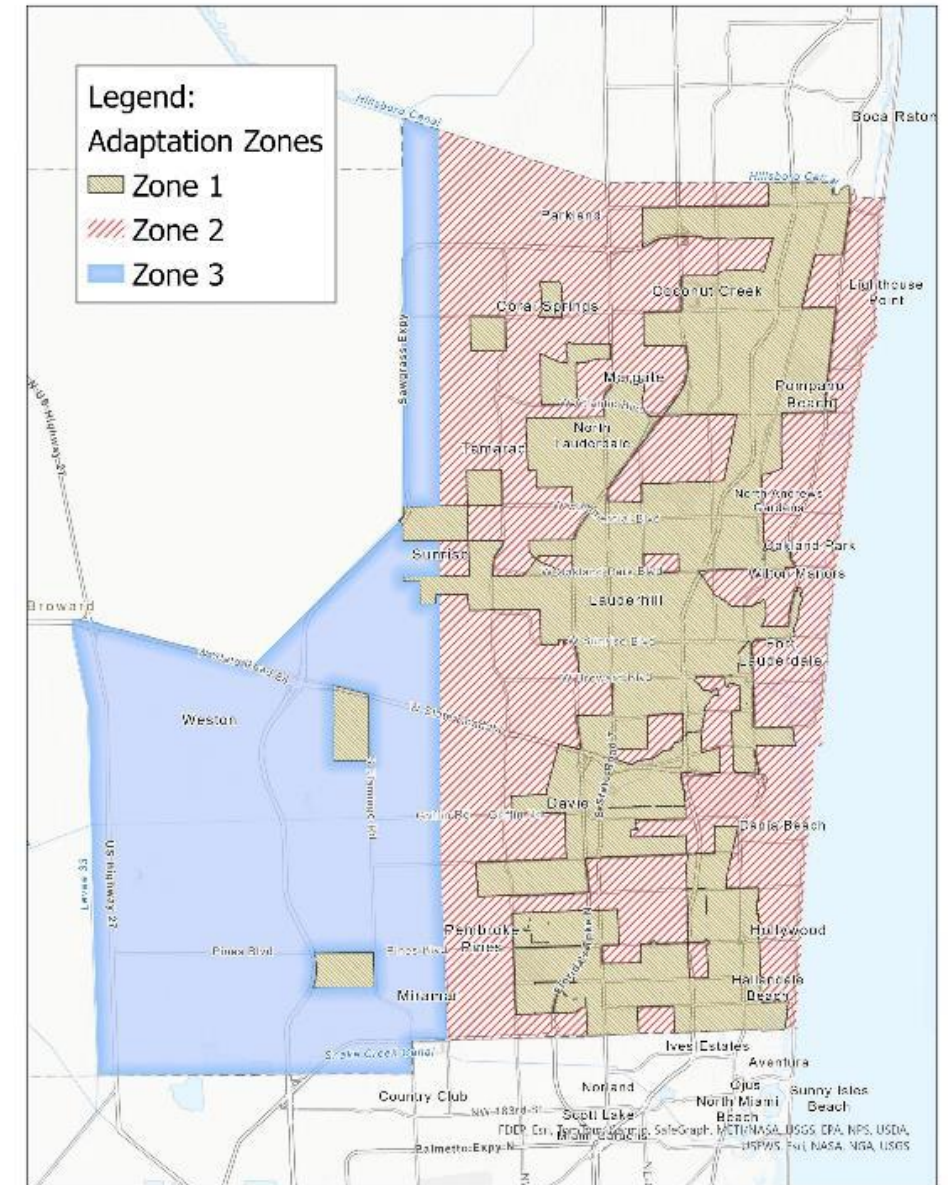
Zone 1 – Highest Vulnerability Areas
(*Intersection of Flood, Heat, and Social)

Zone 2 – Coastal

Zone 3 – Inland

Six Suites of Adaptations were evaluated using the Hydraulic & Hydrologic Model to define the adaptation plan components and sequence

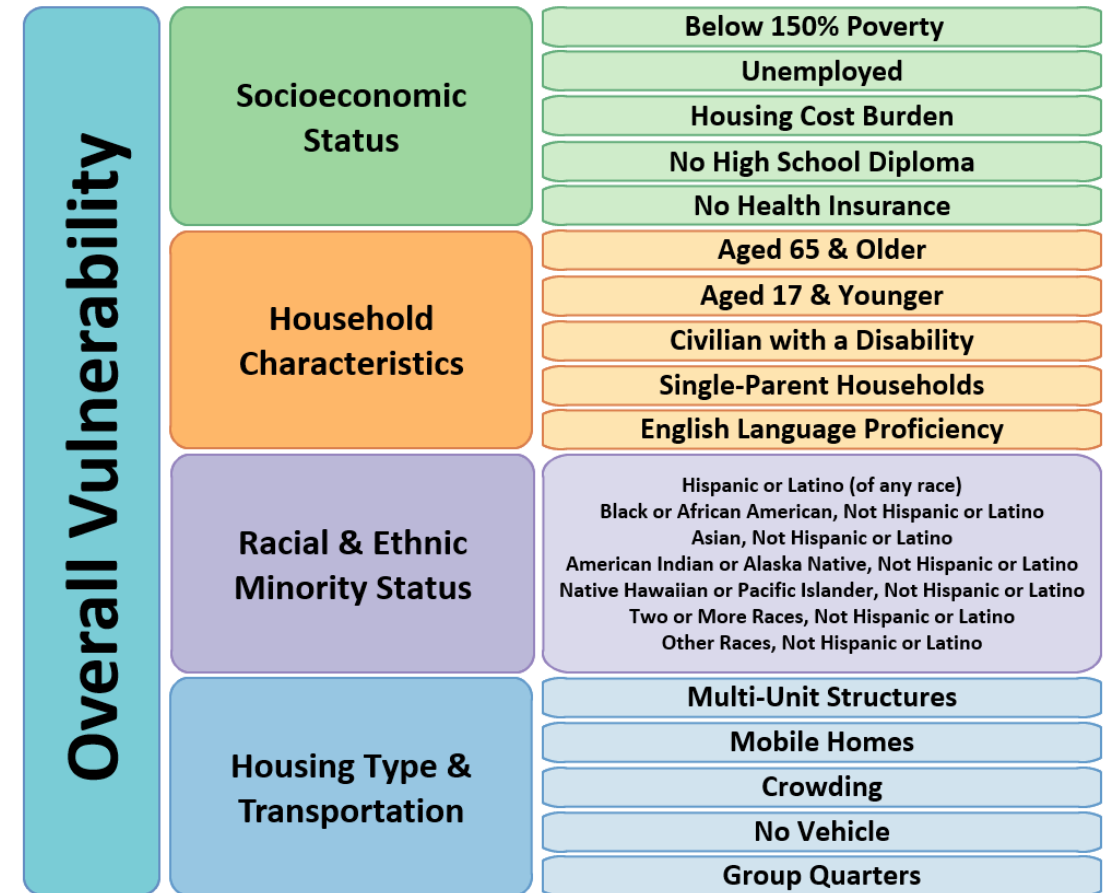
A seventh suite was defined to address gaps in the simulation and after receiving feedback from stakeholders.



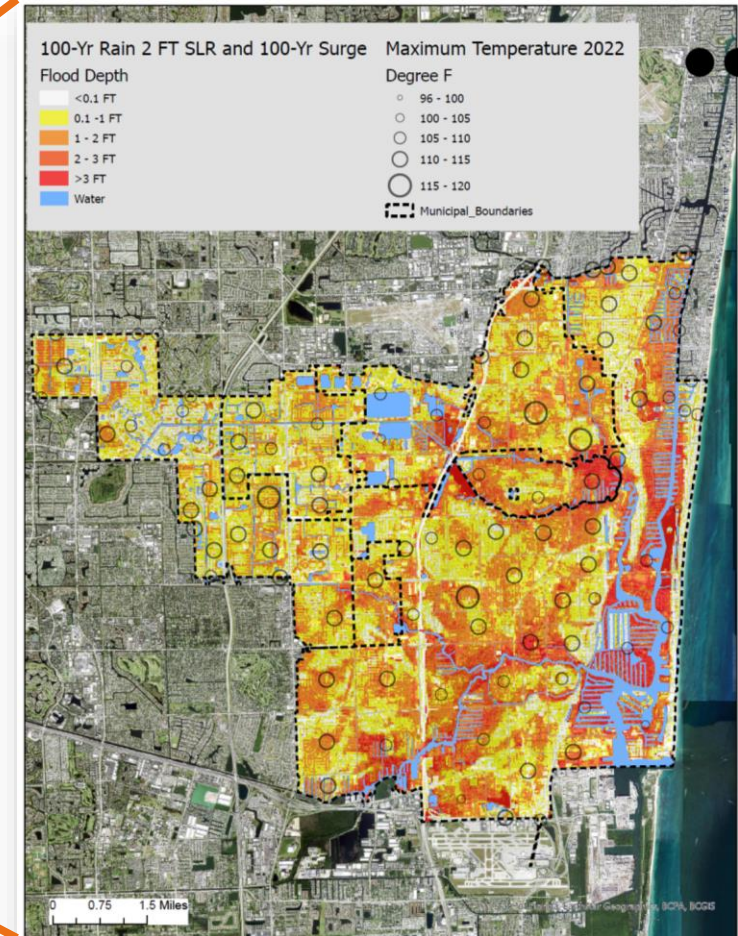
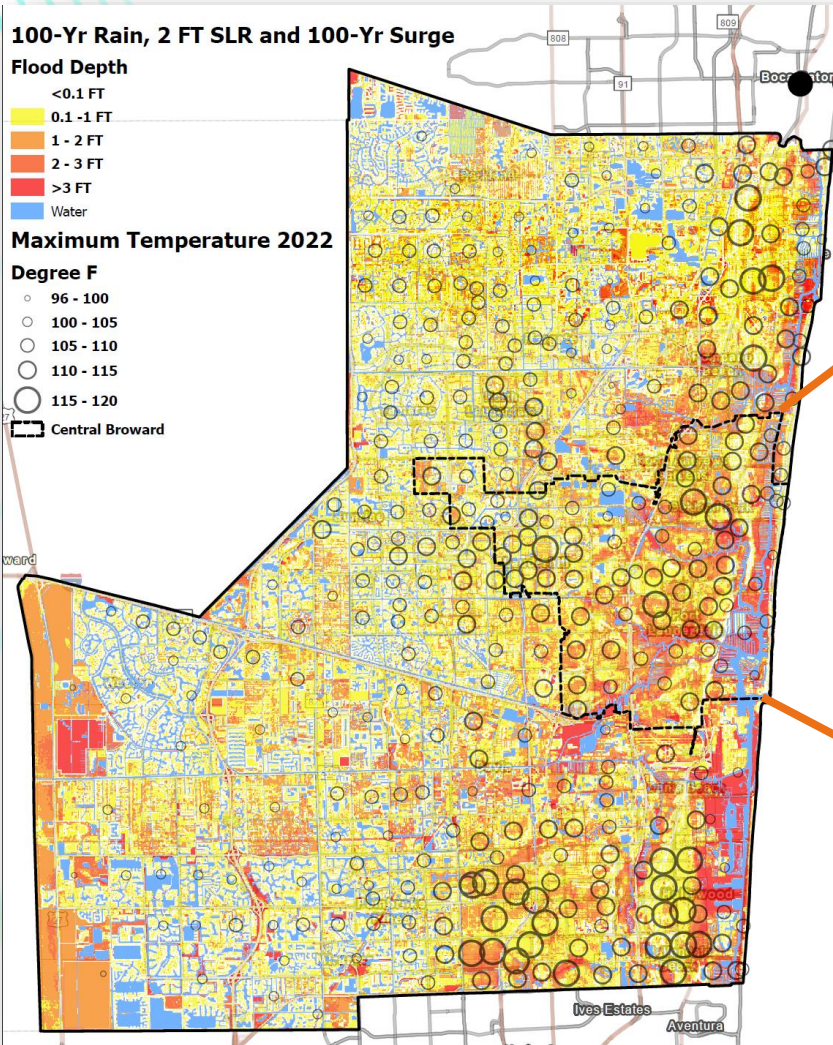
Zone 1 Designation – Emphasis on Social Vulnerability

- SVI indicates the relative vulnerability of every U.S. census tract.
- SVI ranks the tracts on 16 social factors and 4 related themes
- Incorporated in the Zone 1 are:
 - Justice 40 census tracts
 - FEMA-designated community disaster resilience zones,
 - Areas of critical infrastructure dependency
- Analyses within zone 1 emphasize SVI, flood and heat risk

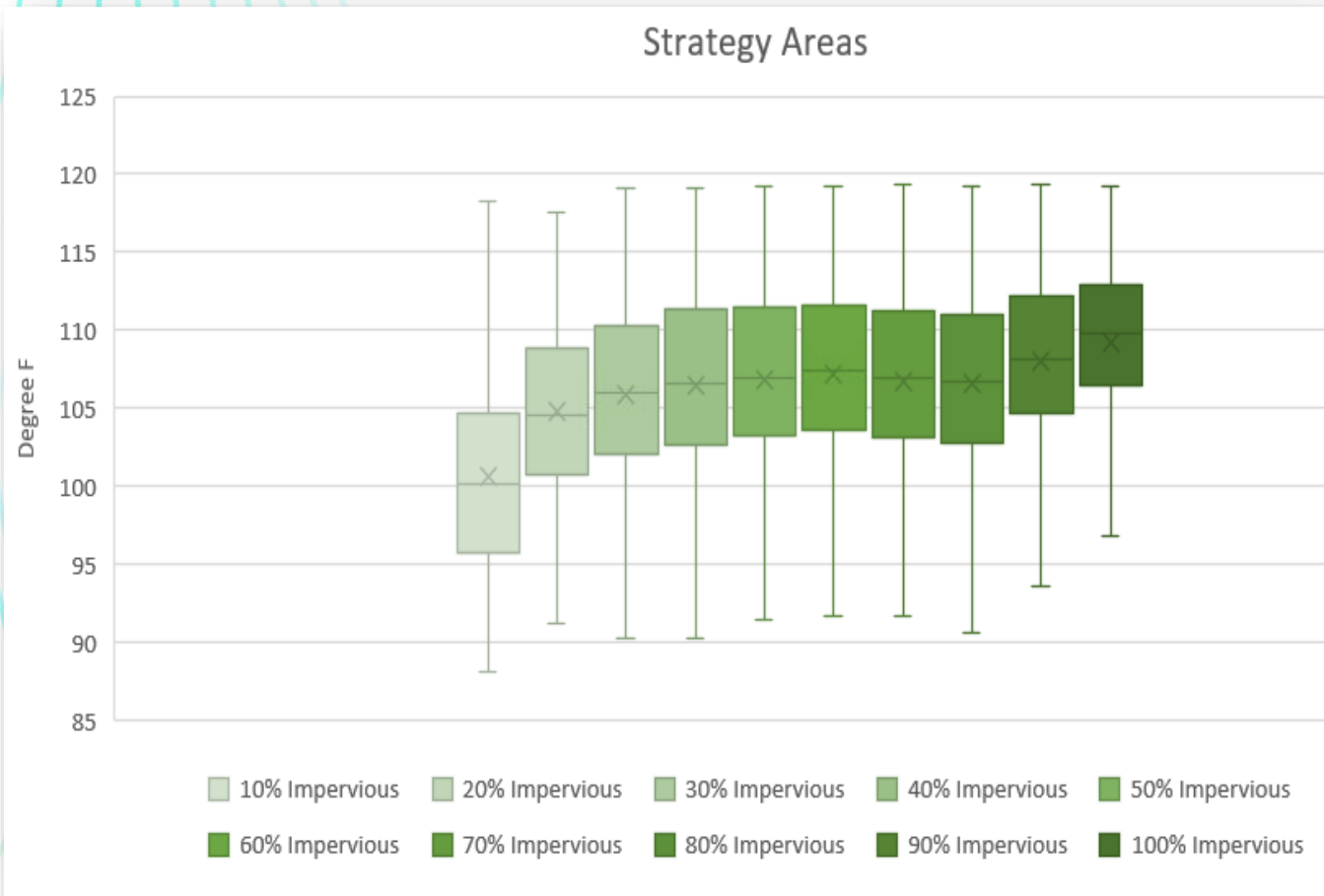
Social Vulnerability Index (SVI)
U.S. Centers for Disease Control and Prevention



Evaluated: Intersection of Flood and Heat Risk



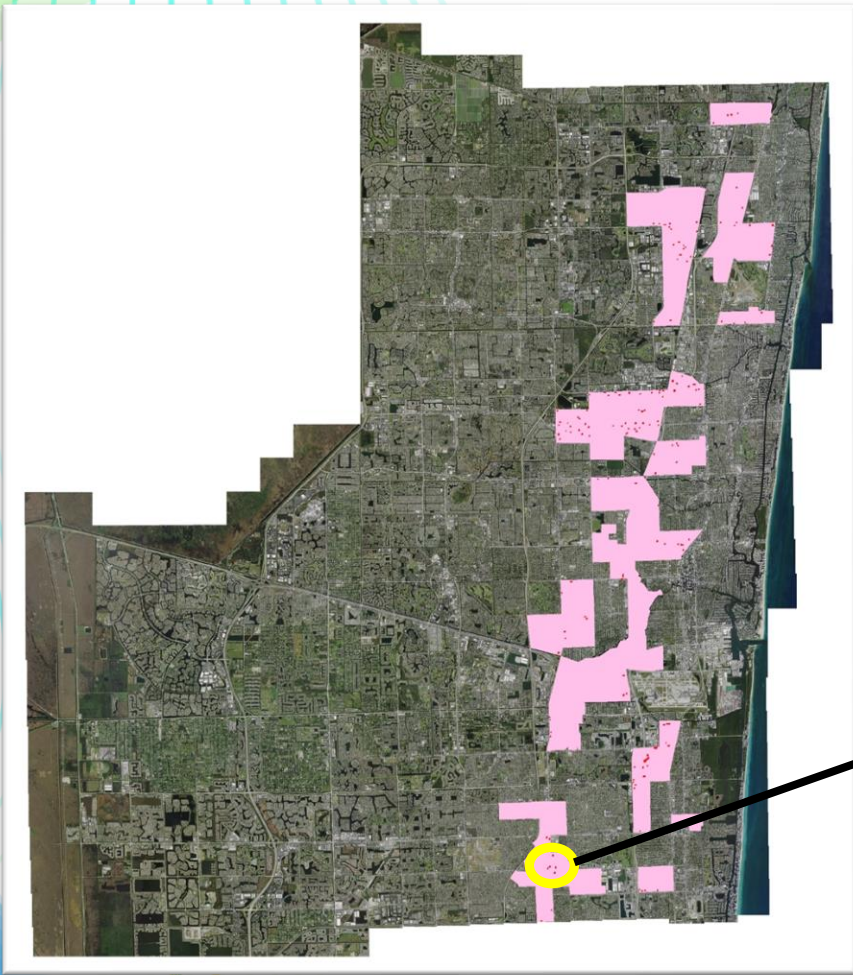
Correlation between Pervious Areas and Land Surface Temperature



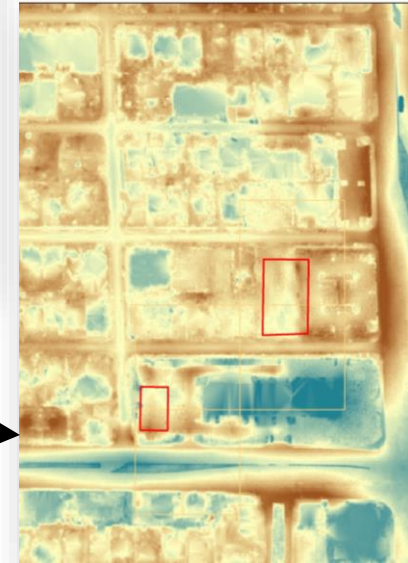
- Potential 10-13° F difference between pervious and impervious area



Emphasis on Storage Opportunities and Green Infrastructure Cooling in Priority Areas



Pembroke Road and SR 7

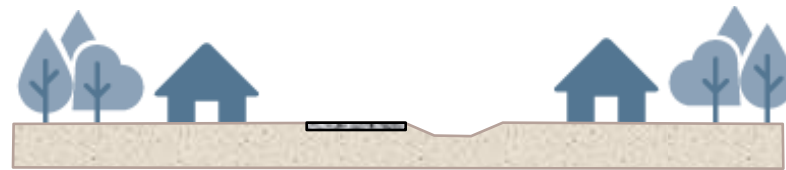
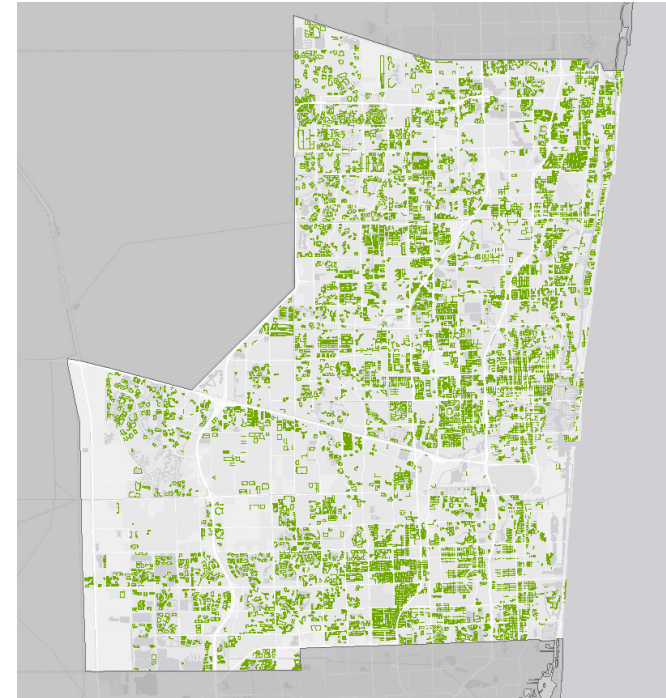


Green Infrastructure – One-way roads/swale recovery

All local roads in the County were reviewed to analyze the potential conversion from two-way roads to one-way road.



Converting
1,760
Miles of two-way roads to one-way road plus swales



Residential Lane Conversions



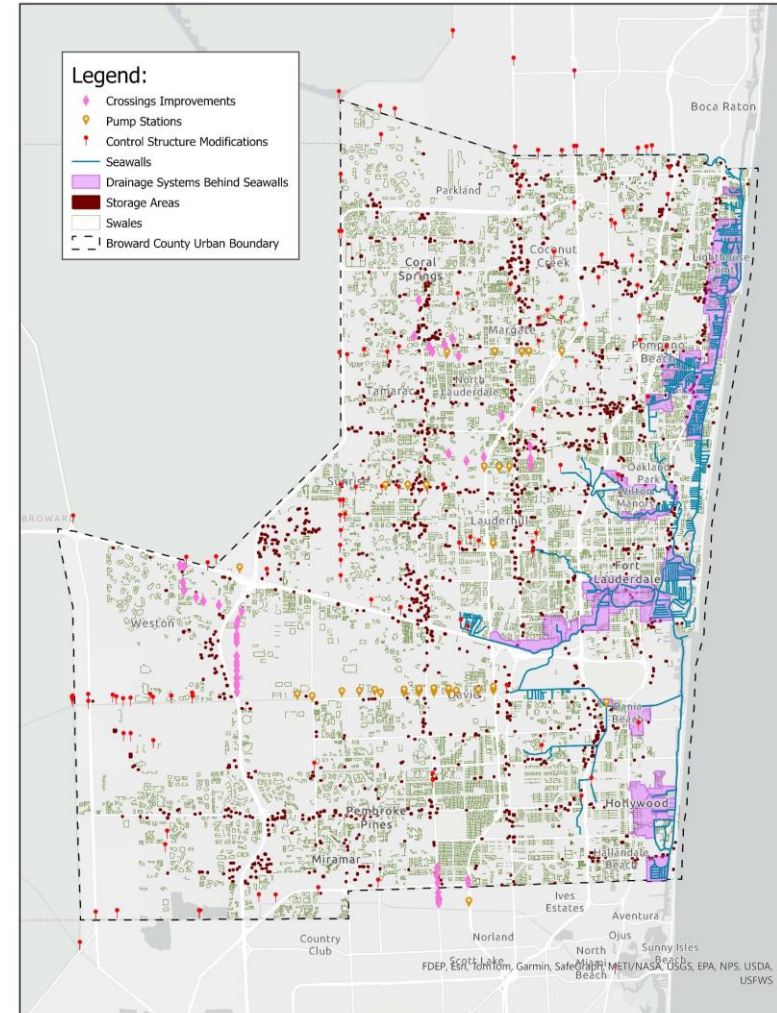
Boca Raton, Florida



Ann Arbor, Michigan

Phased Adaptation Strategies through 2070

- Tier 1
 - Pumping stations
 - Culvert improvements
 - Storage areas
 - Control structures
 - Two-way road conversions (swales)
 - 5-ft. sea walls
- Tier 2
 - Drainage systems
 - Seawall elevated to 7 ft.



190+ Miles enhanced Seawalls

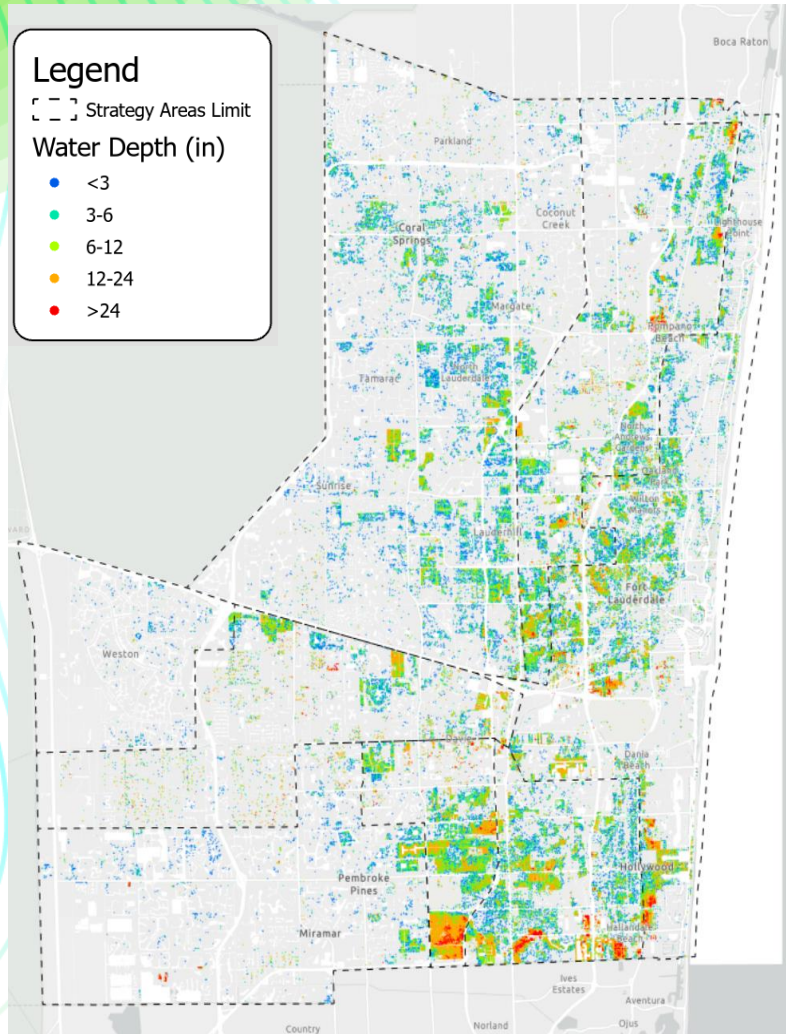
169 Controls Structures

28 New Pump Stations

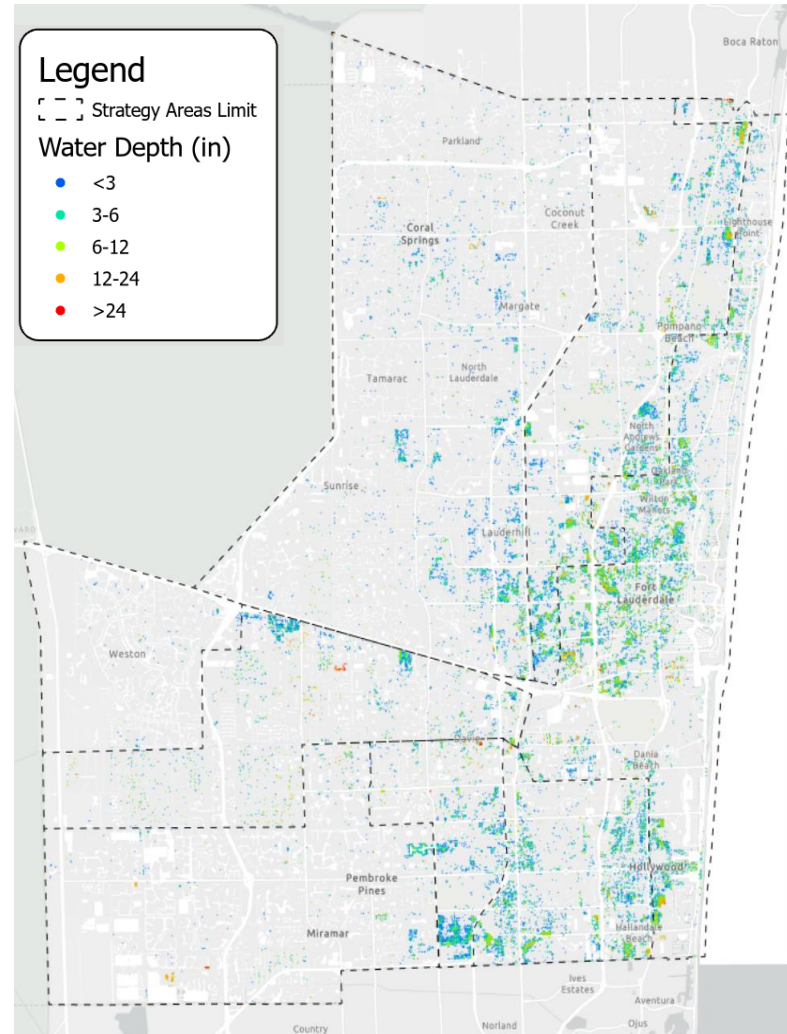
50 Upgraded Crossings

1,247 Acres-ft of storage

Full Adaptation Suite – 2ft SLR, 100-yr Rain, No Surge



Base Scenario Water Depth (in)



Tier 2 Adaptation Water Depth (in)

Distribution of Structures by Flood Depth Impact

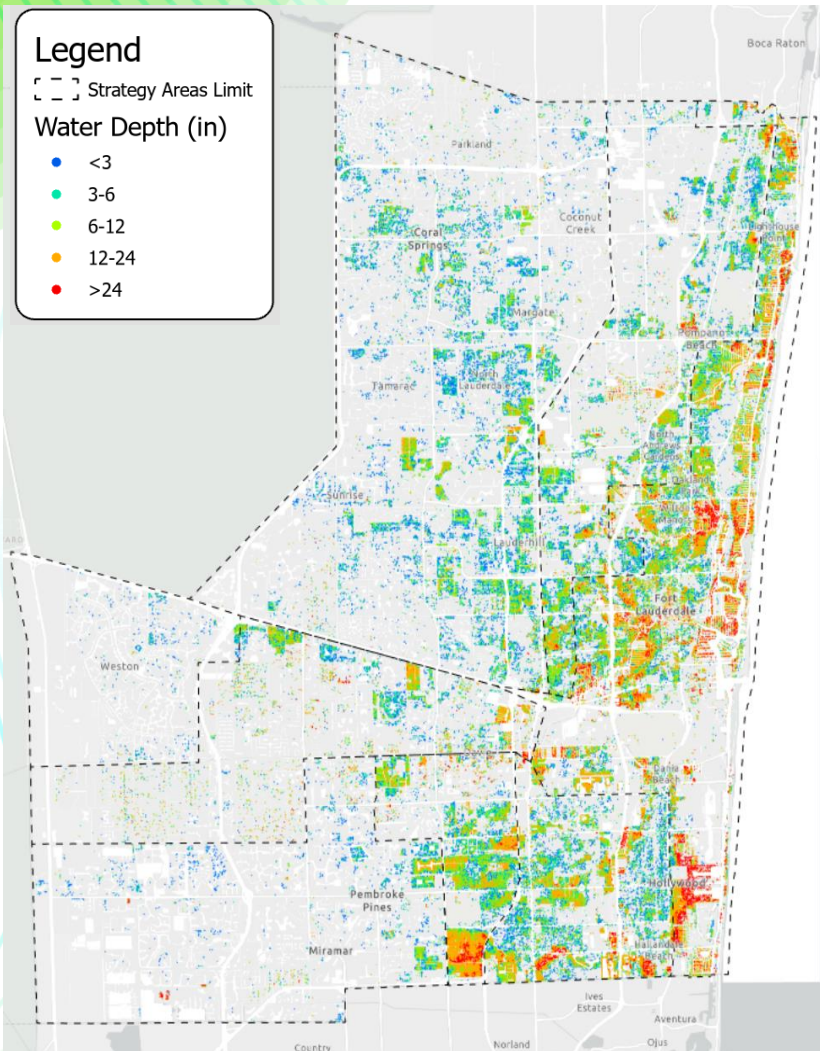
Flood Depth (in)	BASE (NO ADAPTATION)	ADAPTATION
<3"	28,209	13,982
3"-6"	32,056	12,252
6"-12"	38,166	8,949
12"-24"	25,254	2,607
>24"	33,757	169
TOTAL	157,442	37,959

76% Reduction

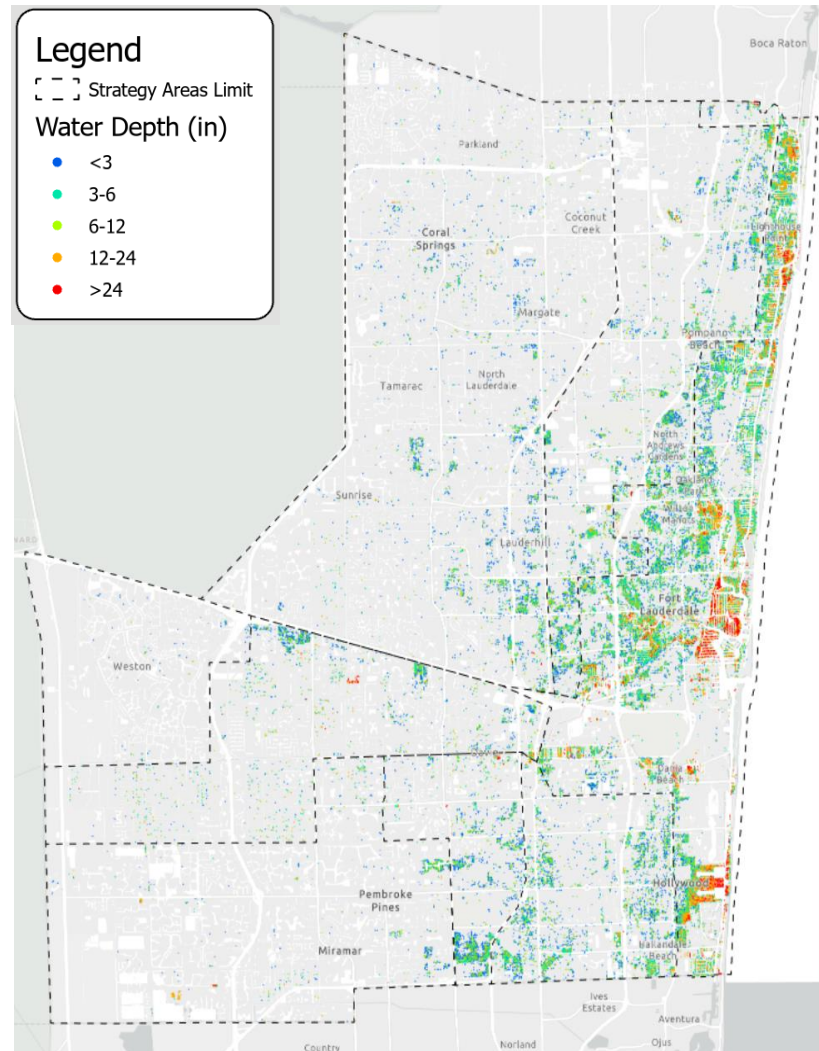
Scenario

Rain	SLR	Tidal
100-yr. 3d	2 ft	King Tide, No Surge

Full Adaptation Suite – 2ft SLR, 100-yr Rain, 100-yr Surge



Base Scenario Water Depth (in)



Tier 2 Adaptation Water Depth (in)

Distribution of Structures by Flood Depth Impact

Flood Depth (in)	BASE	ADAPTATION
<3"	27,548	15,587
3"-6"	32,942	15,449
6"-12"	44,440	15,401
12"-24"	39,883	10,584
>24"	12,784	3,027
TOTAL	157,597	60,048

62% Reduction

Scenario

Rain	SLR	Tidal
100-yr. 3d	2.0 ft	King tide, 100-yr. Surge

1a. Adaptation Scenario

Tier 1	Tier 2	None
--------	--------	------

1b. Adaptation Scenario

Tier 1	Tier 2	None
--------	--------	------

2a. Sea Level Rise

Current SLR	2.0 ft	3.3 ft
-------------	--------	--------

2b. Sea Level Rise

Current SLR	2.0 ft	3.3 ft
-------------	--------	--------

3a. Rainfall Amount

5-yr	25-yr	10-yr
100-yr		

3b. Rainfall Amount

5-yr	25-yr	50-yr
100-yr		

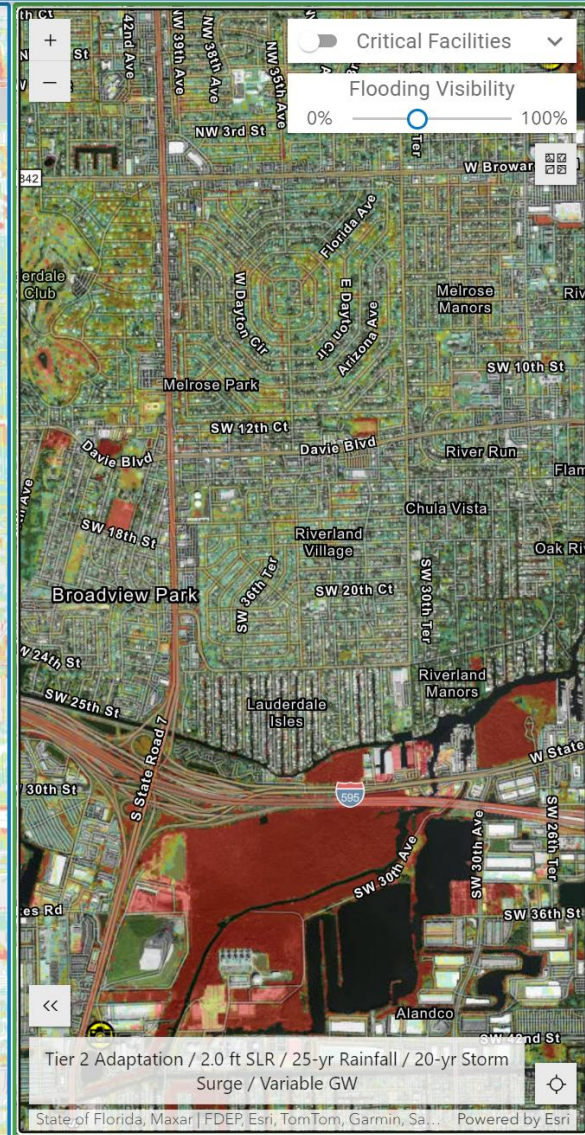
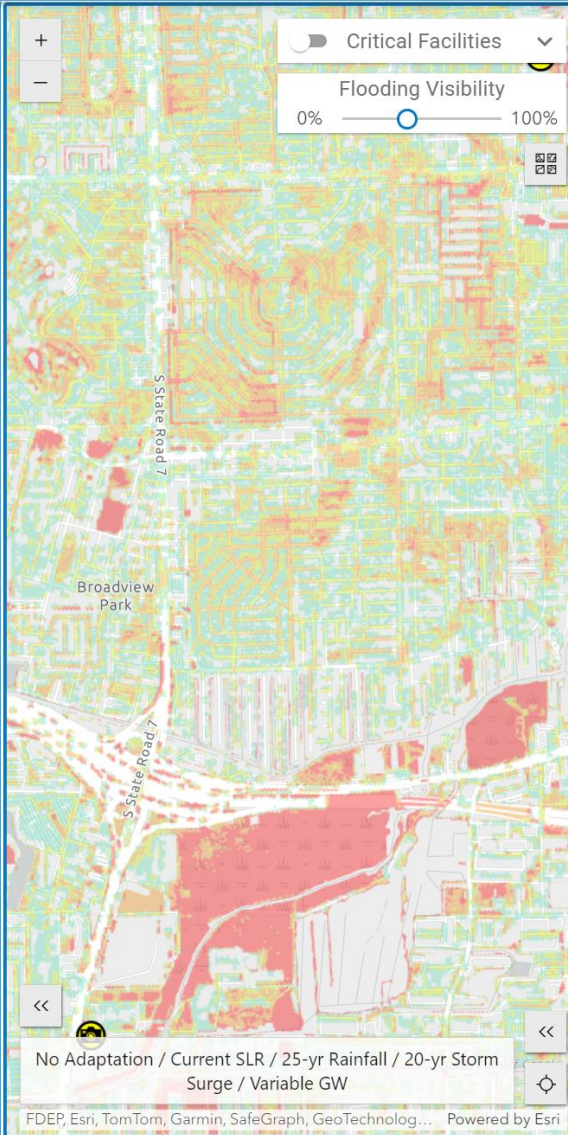
4a. Storm Surge

20-yr Storm Surge	100-yr Storm Surge
-------------------	--------------------

4b. Storm Surge

20-yr Storm Surge	100-yr Storm Surge
-------------------	--------------------

Compare two scenarios



1a. Adaptation Scenario

Tier 1	Tier 2	None
--------	--------	------

1b. Adaptation Scenario

Tier 1	Tier 2	None
--------	--------	------

2a. Sea Level Rise

Current SLR	2.0 ft	3.3 ft
-------------	--------	--------

2b. Sea Level Rise

Current SLR	2.0 ft	3.3 ft
-------------	--------	--------

3a. Rainfall Amount

5-yr	25-yr	50-yr
	100-yr	

3b. Rainfall Amount

5-yr	25-yr	50-yr
	100-yr	

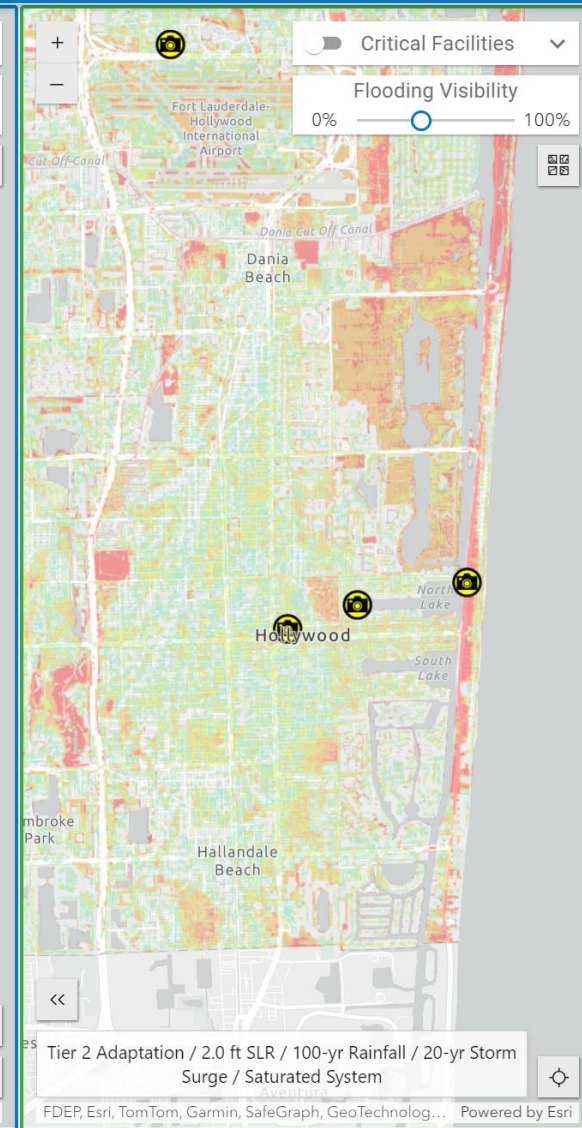
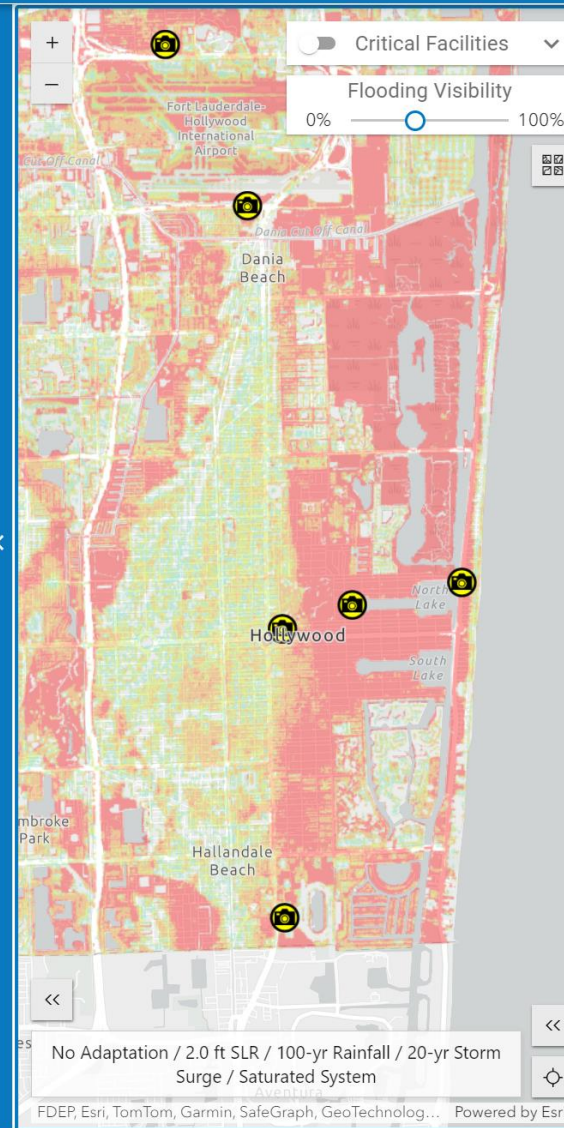
4a. Storm Surge

No Surge	20-yr Storm Surge	100-yr Storm Surge
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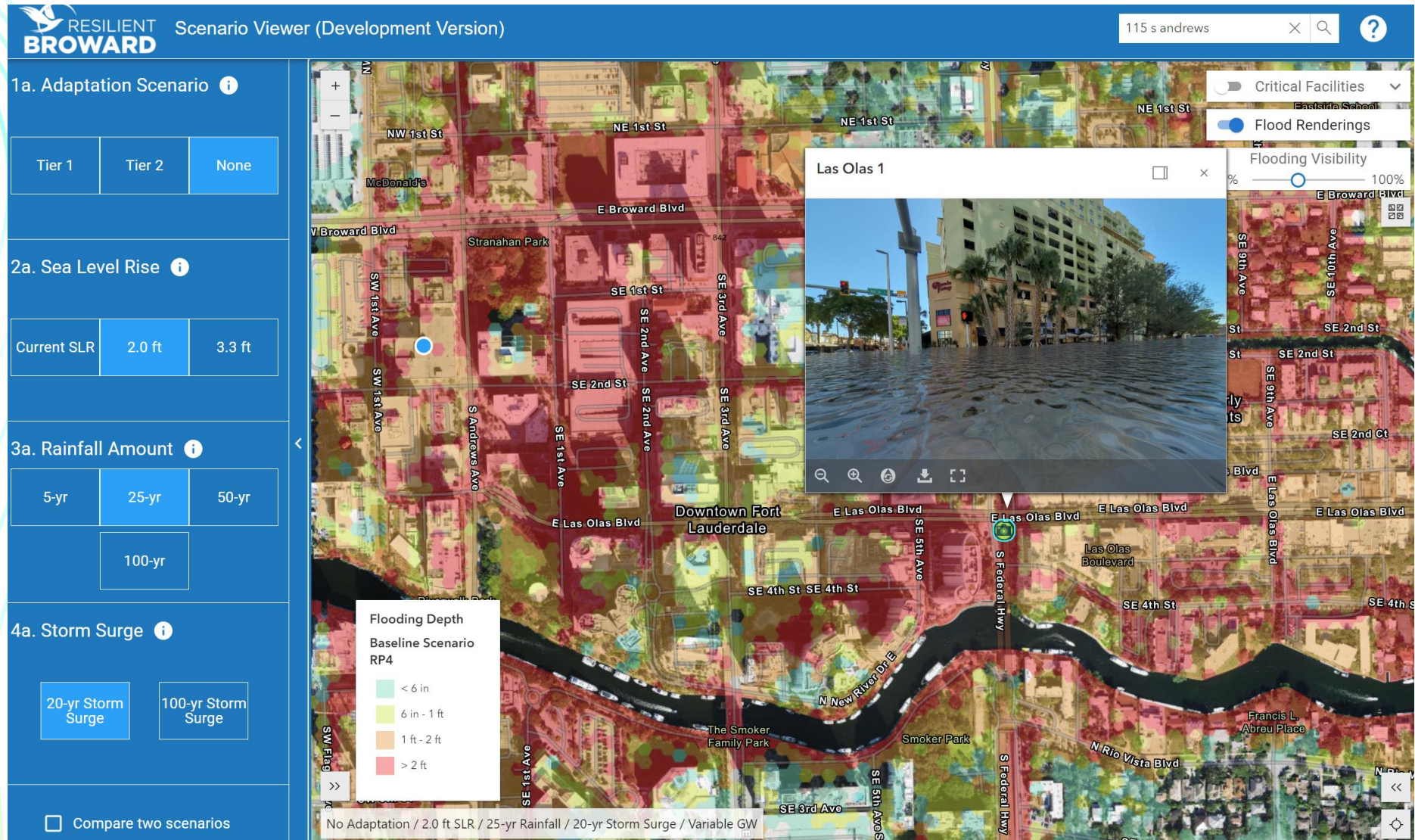
4b. Storm Surge

No Surge	20-yr Storm Surge	100-yr Storm Surge
----------	-------------------	--------------------

Compare two scenarios



Higher Resolution Neighborhood Level View



1a. Adaptation Scenario ⓘ

Tier 1	Tier 2	None
--------	--------	------

1b. Adaptation Scenario ⓘ

Tier 1	Tier 2	None
--------	--------	------

2a. Sea Level Rise ⓘ

Current SLR	2.0 ft	3.3 ft
-------------	--------	--------

2b. Sea Level Rise ⓘ

Current SLR	2.0 ft	3.3 ft
-------------	--------	--------

3a. Rainfall Amount ⓘ

5-yr	25-yr	50-yr
100-yr		

3b. Rainfall Amount ⓘ

5-yr	25-yr	50-yr
100-yr		

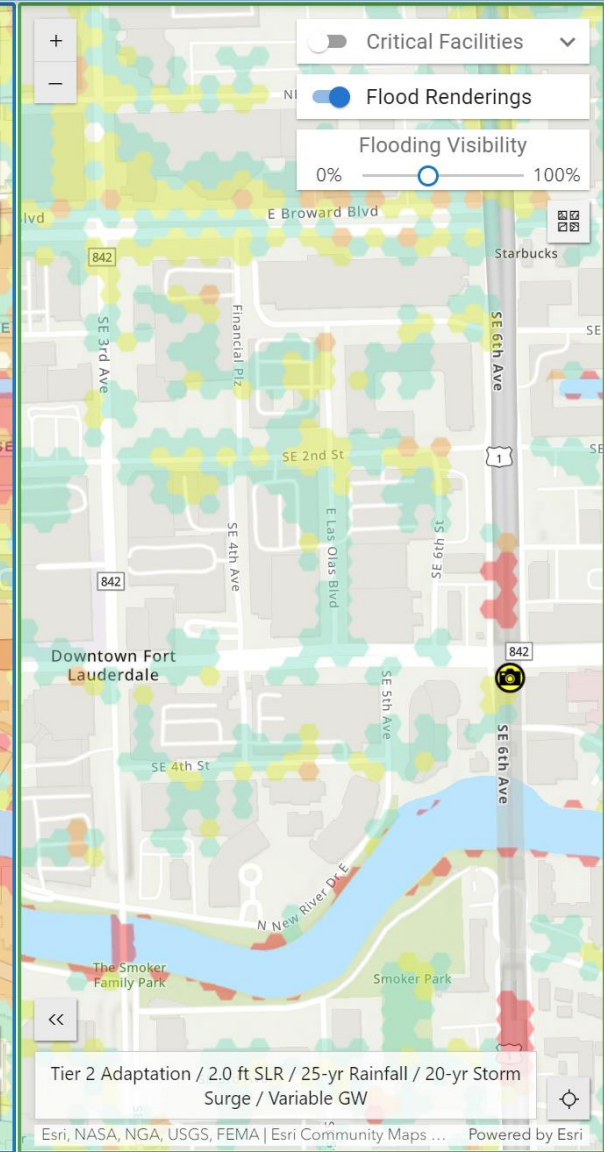
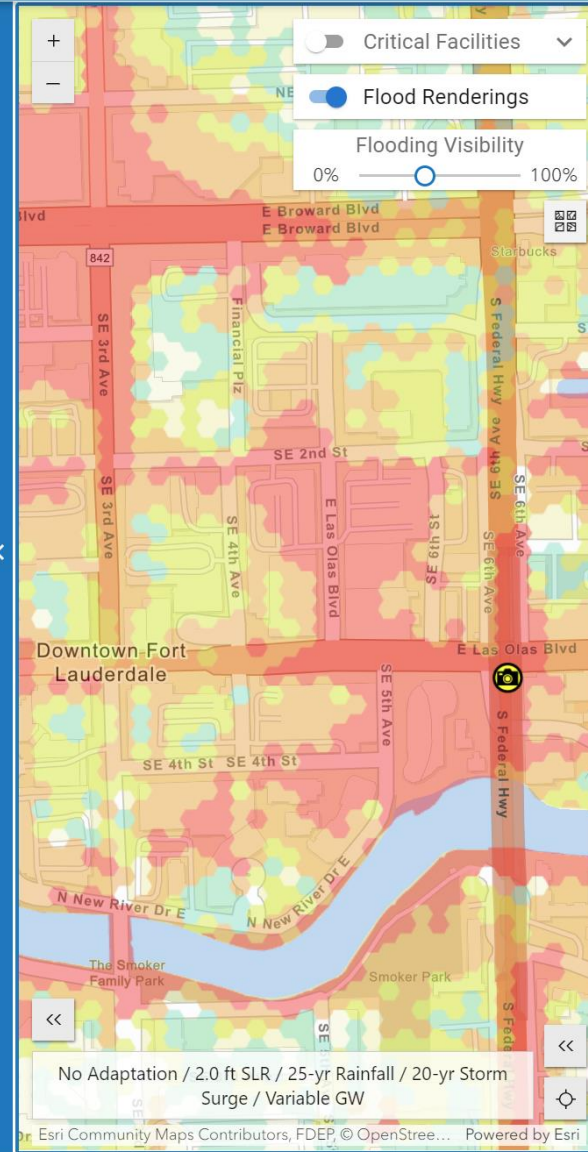
4a. Storm Surge ⓘ

20-yr Storm Surge	100-yr Storm Surge
-------------------	--------------------

4b. Storm Surge ⓘ

20-yr Storm Surge	100-yr Storm Surge
-------------------	--------------------

Compare two scenarios



Economic Analyses



Dollar value of five benefit categories



Property damage savings from avoided costs of repairing and replacing assets damaged by floods



Economic activity (Gross Value Added) benefits from avoided business and transport disruption



Increased Flood Insurance Coverage as risk and premia are lower due to flood mitigation



Increased Real Estate Value resulting from lower flood damage costs, insurance premia savings, and rental income losses

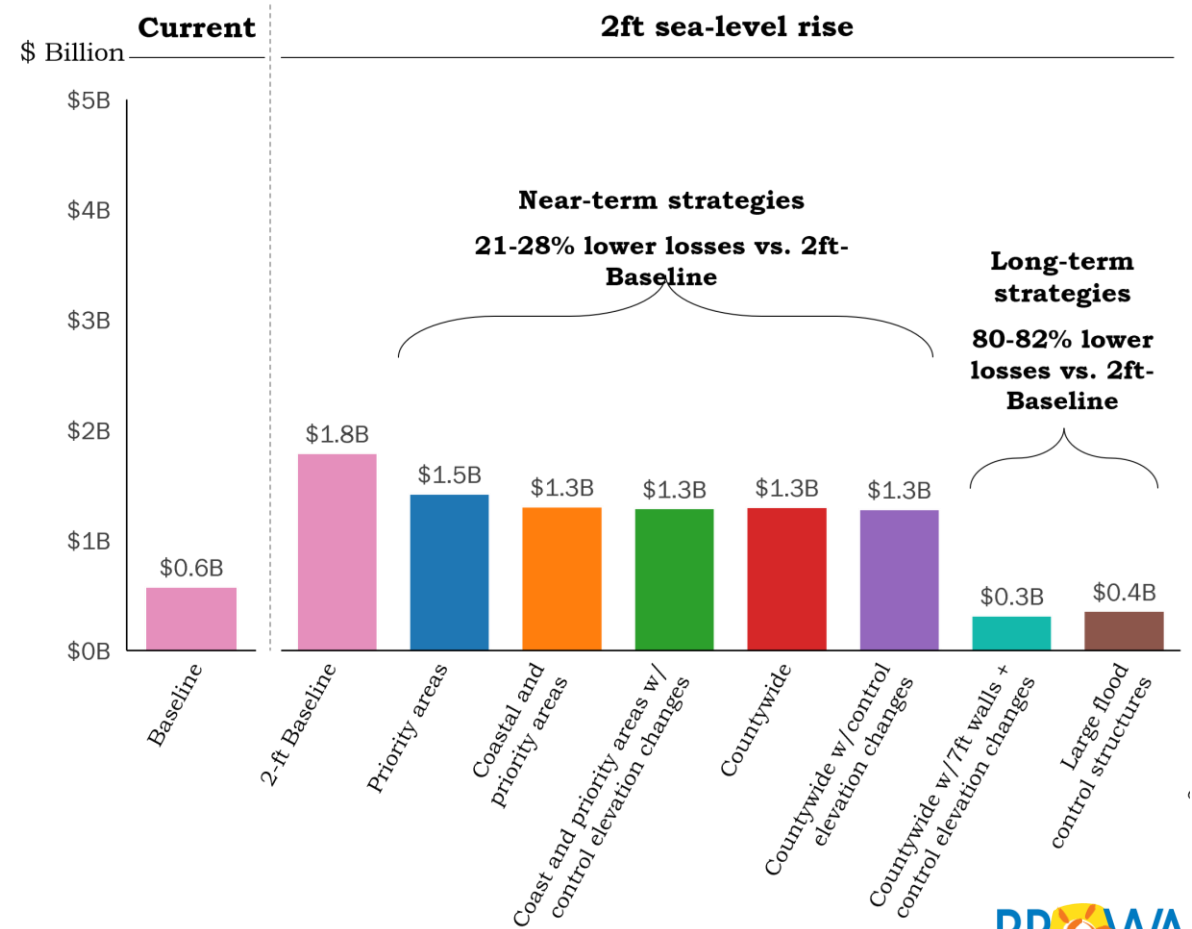
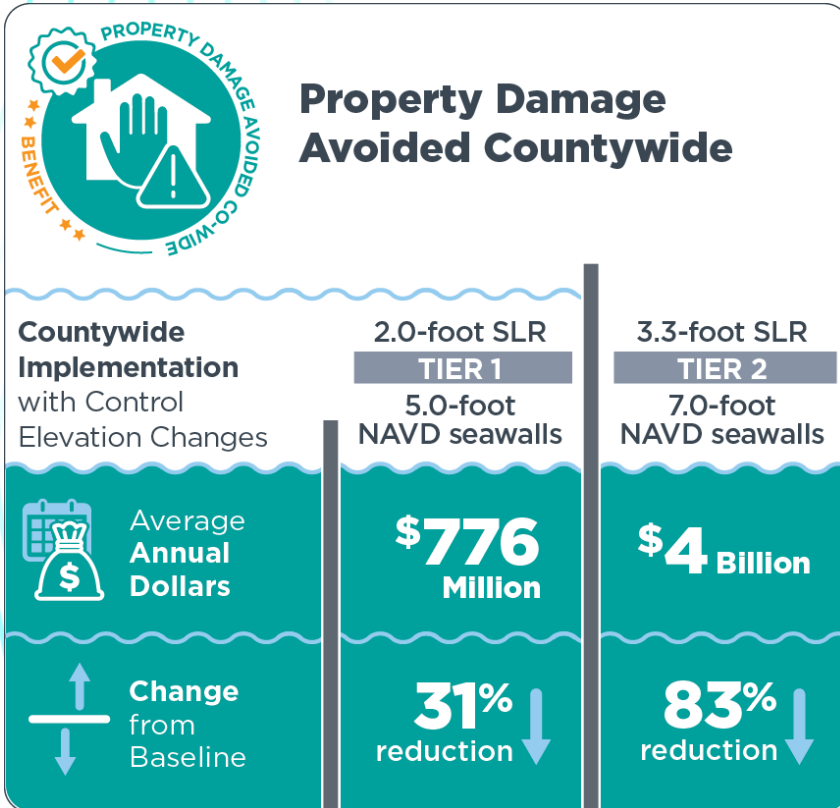


Increased Property Tax collections to County and cities because of higher property values

All dollar values are in 2024 (today's) dollars.

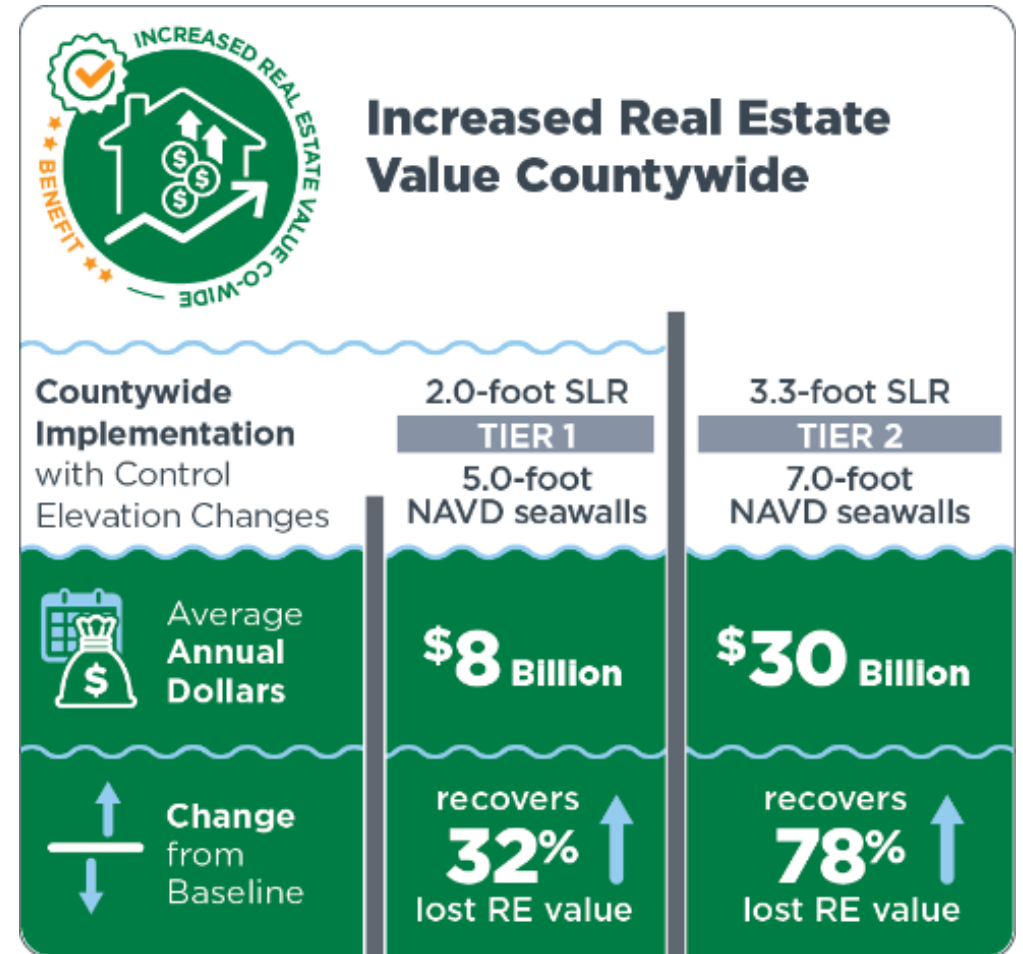
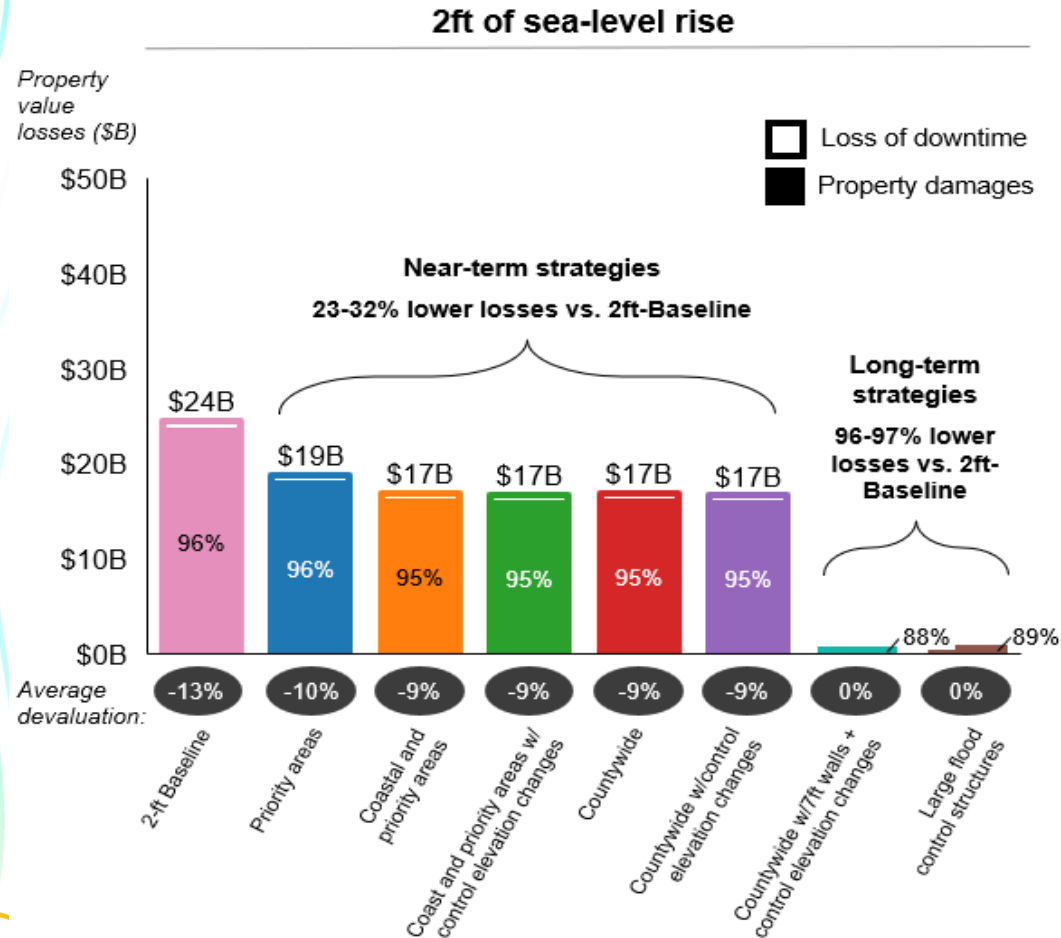
Reduces Direct Property Losses & Protects Property Value

Avoided residential damages relative to baseline (\$M)



Preserves residential property value - \$8B near-term to \$30B long-term

Residential Real Estate Devaluation



Tier 1 and Tier 2 reduce property damage across much of Broward County with significant countywide benefits realized under Tier 2

Annual average damages to residential assets as share of property value across the county



Areas outlined in black relate to zone 1

Benefits of higher property values across the County are evident under both Tiers

Real estate value losses across the County (\$M losses)

Baseline – 2ft

Countywide adaptations w/
control elevation changes –
2ft

Baseline – 3.3ft

Countywide adaptations w/
control elevation & 7ft seawalls-
3.3ft



Property value loss as share of total building value, %

- 80-100%
- 40-80%
- 10-40%
- 1-10%
- <1%

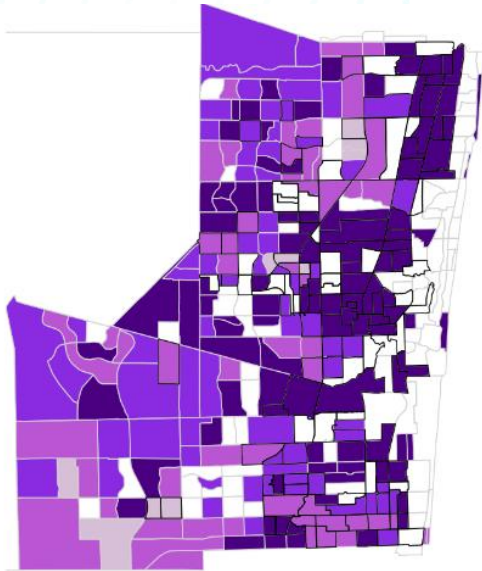
Areas outlined in black relate to zone 1

Source: Hazen, FEMA

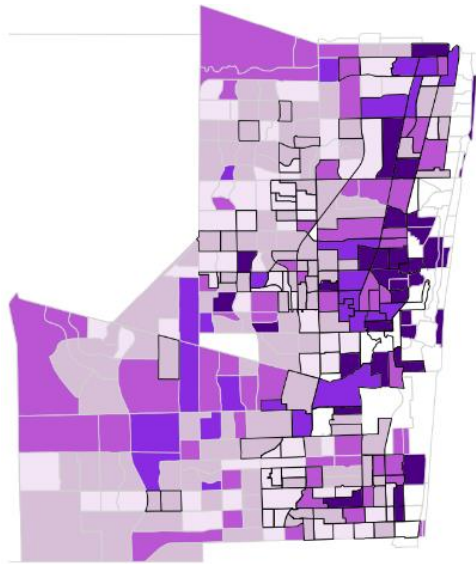
Benefits of reduced flood insurance premia (reflects uptake changes due to pricing)

Single-family home premiums (\$ premium cost) across the County

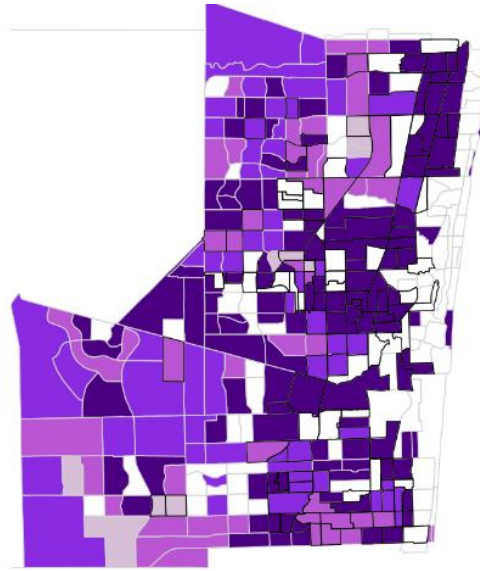
Baseline – 2ft



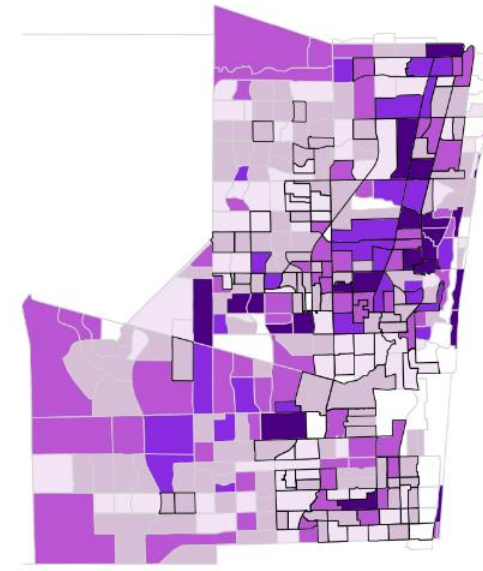
**Countywide adaptations w/
control elevation changes –
2ft**








Baseline – 3.3ft



**Countywide adaptations w/
control elevation & 7ft seawalls-
3.3ft**

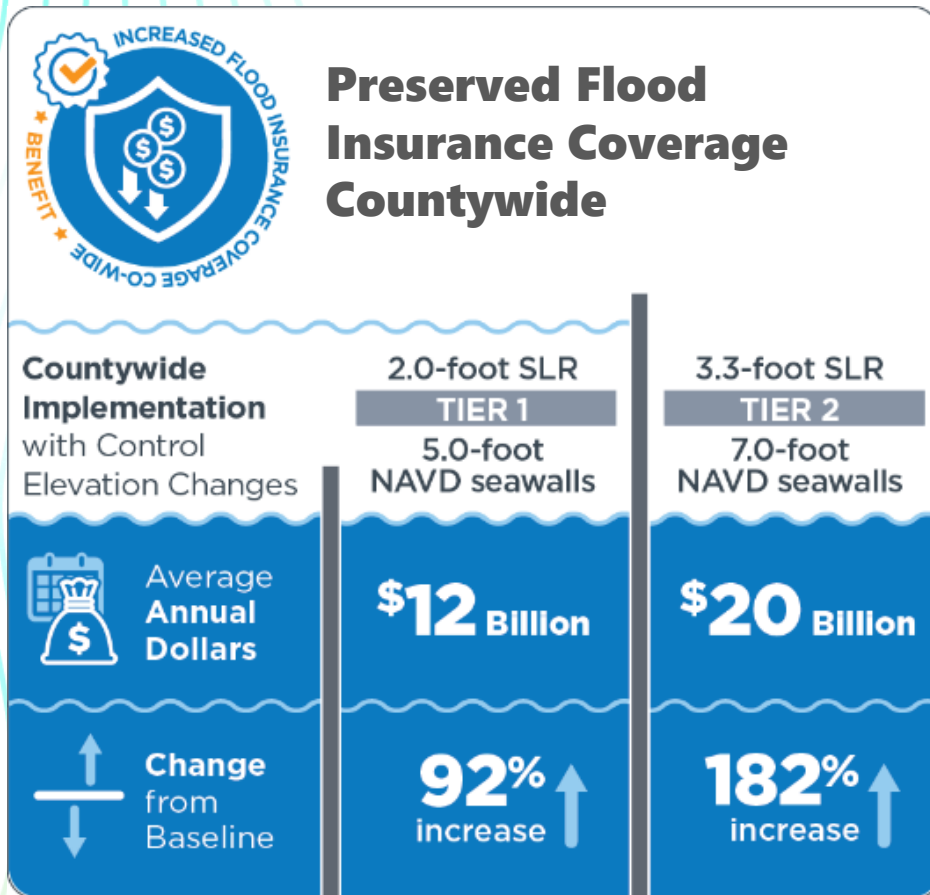


Average
premium for
single-family
home:

-  No policies due to high costs
-  >\$1,600
-  \$1,200-\$1,600
-  \$800-\$1,200
-  \$400-\$800
-  Up to \$400

Source: Hazen, FEMA

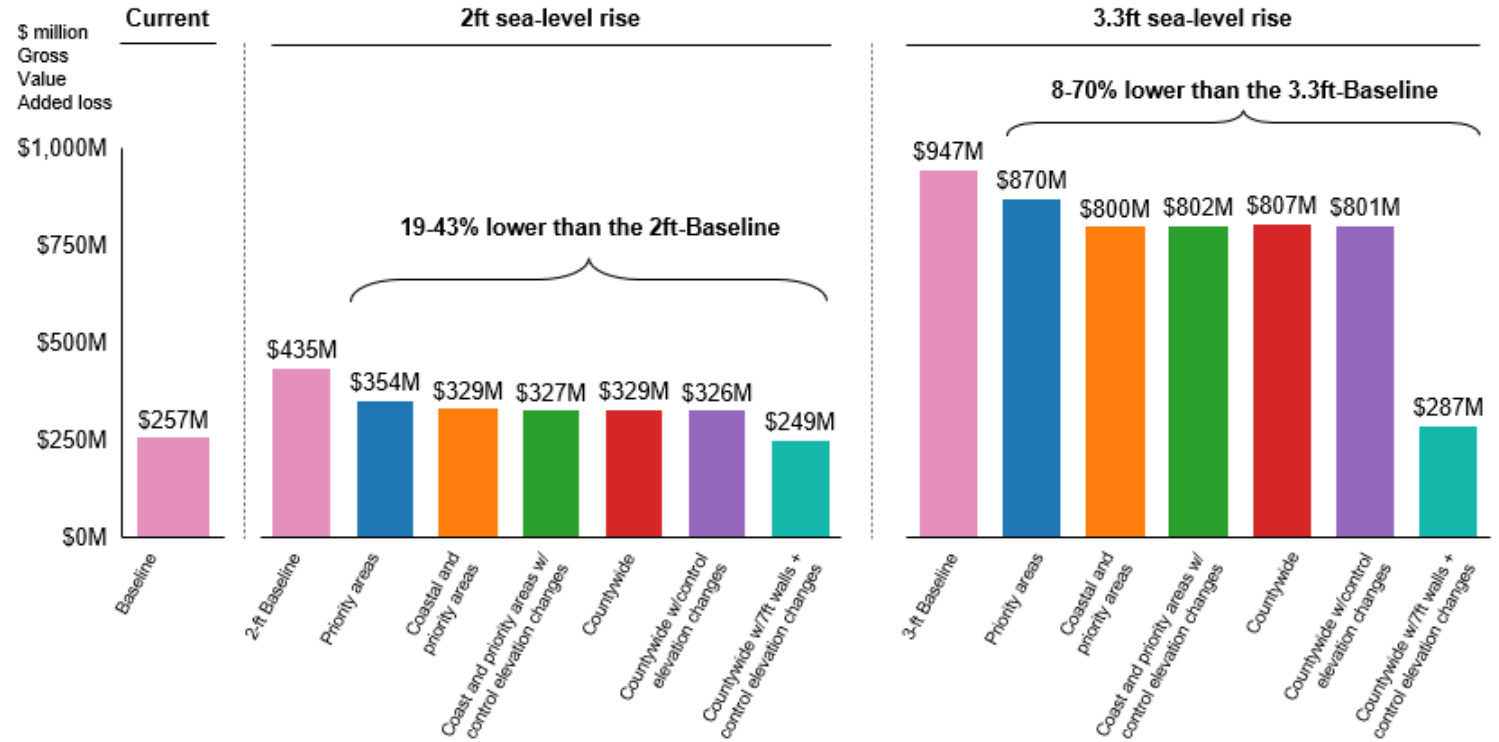
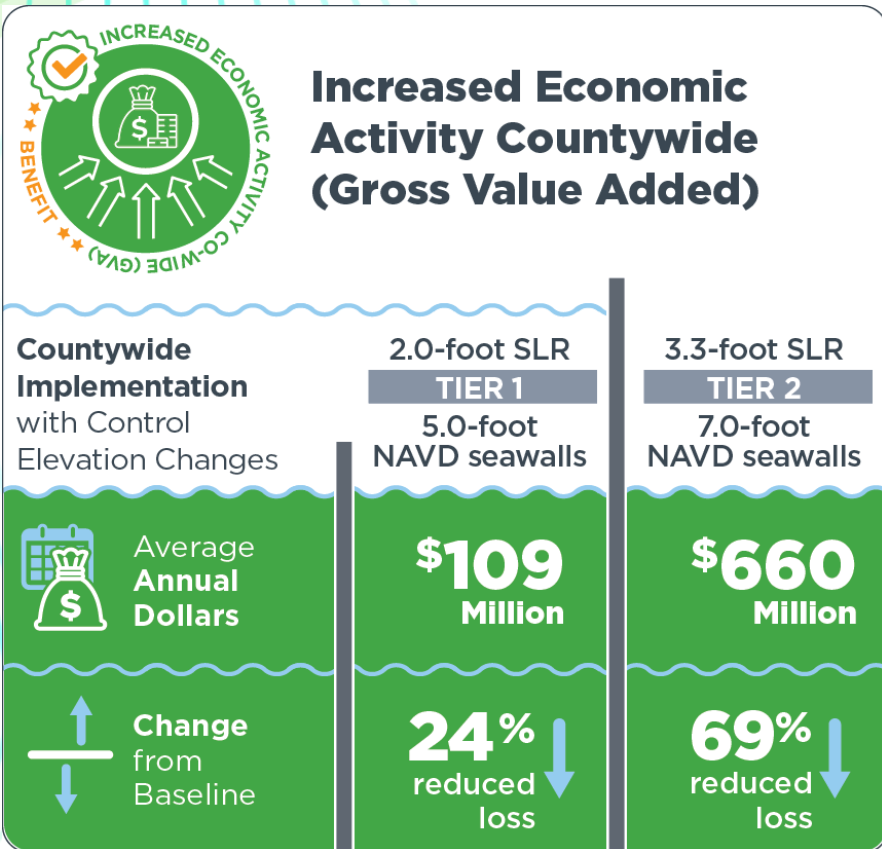
Tier 1 and Tier 2 Adaptation Strategies could increase flood insurance coverage countywide



Avoided flood damages could have several benefits for insurance markets including:

- Higher number of homes maintaining flood insurance policies (assuming pricing is risk-based)
- As a result, higher continued flood insurance coverage (and less uninsured costs to households)
- Lower average premiums for those that maintain insurance

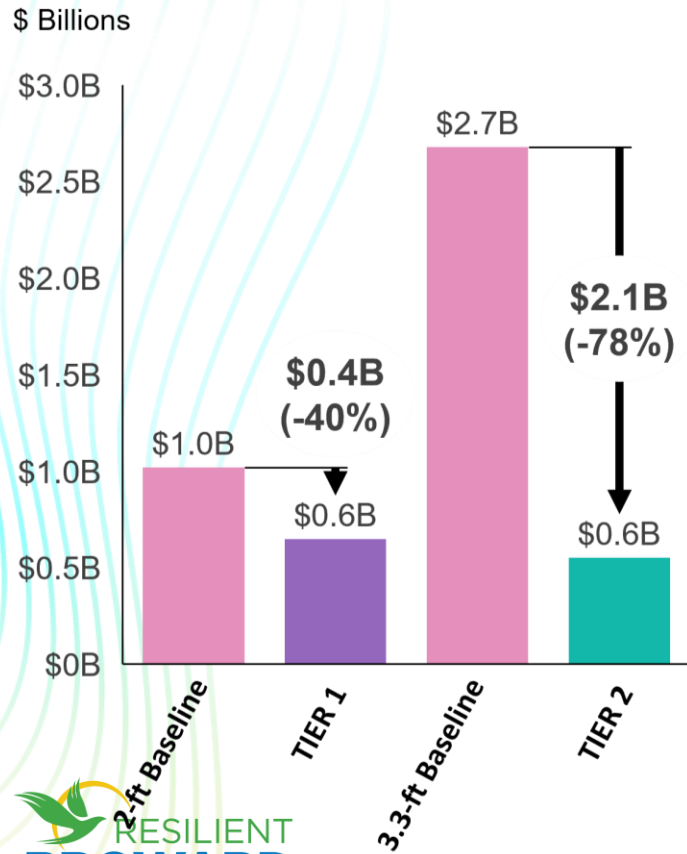
Delivers Increased Economic Activity - Gross Value Added Saves \$109 – \$660M Annually in Economic Production



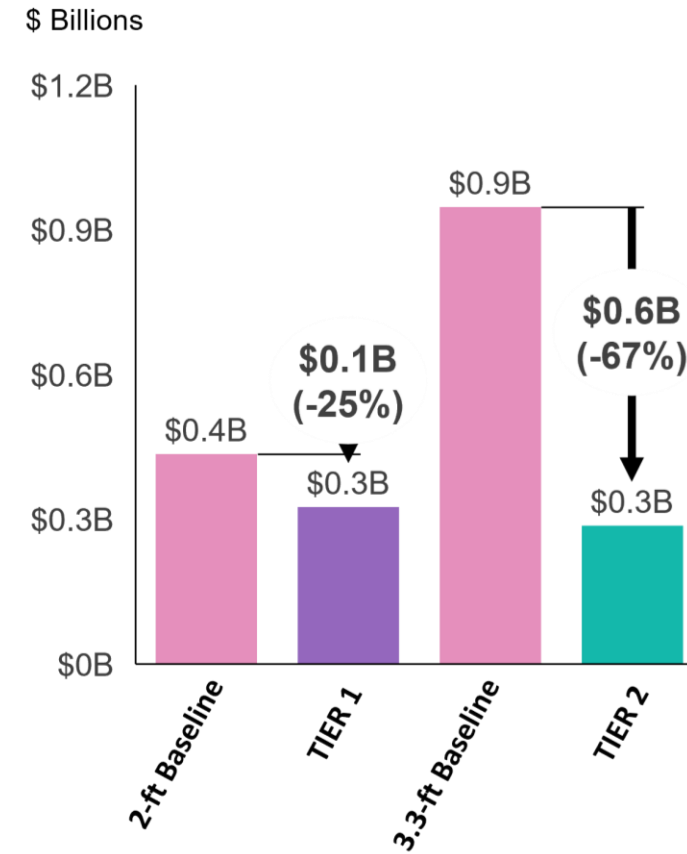
Adaption reduces revenue losses (\$0.4B to \$2.1B), preserves Gross Value Added (\$0.1B – \$0.7B) and protects jobs

Economic benefits under Tier 1 and Tier 2

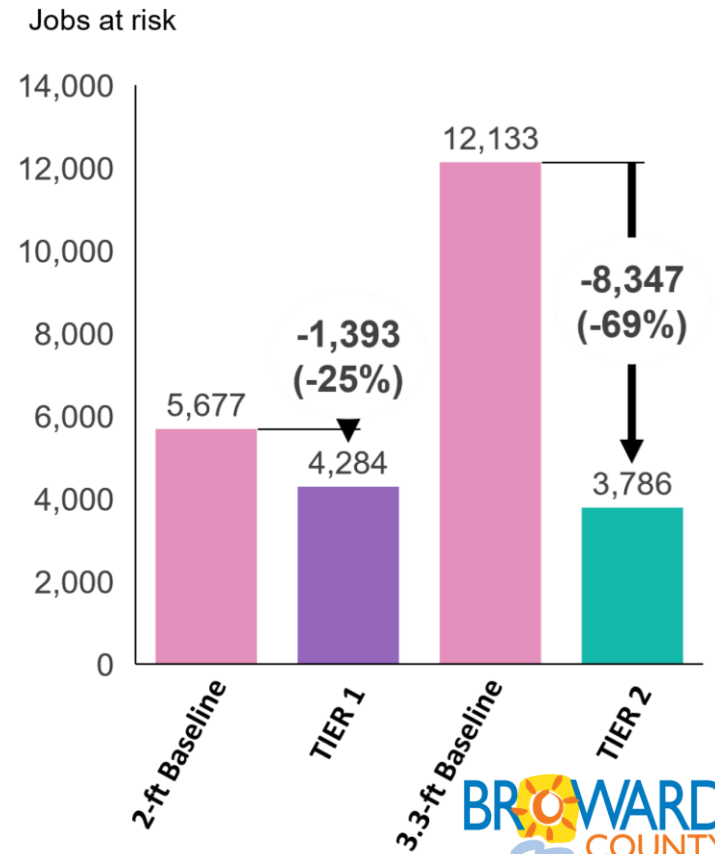
Max sales revenue losses from disruption



Average annual gross value added losses



Average annual jobs at risk



Summary of Modeled Damage Loss Reductions by Municipality for Tier 1 and Tier 2 Scenarios

Municipality	Baseline average annual flood damages and Tier 1 and Tier 2 percentage changes Relative to Baseline (negative % means reduction in property damage)				Municipality	Baseline average annual flood damages and Tier 1 and Tier 2 percentage changes Relative to Baseline (negative % means reduction in property damage)			
	Baseline under 2ft SLR (\$M in damages to residential homes)	Tier 1 % change - Countywide w/ control elevation changes under 2ft SLR	Baseline under 3.3ft SLR (\$M in damages to residential homes)	Tier 2 % change - County-wide measures, w/ control elevation changes and 7ft seawalls under 3.3ft SLR		Baseline under 2ft SLR (\$M in damages to residential homes)	Tier 1 % change - Countywide w/ control elevation changes under 2ft SLR	Baseline under 3.3ft SLR (\$M in damages to residential homes)	Tier 2 % change - County-wide measures, w/ control elevation changes and 7ft seawalls under 3.3ft SLR
Coconut Creek	\$3,690,000	-40%	\$3,710,000	-40%	Miramar	\$45,230,000	-57%	\$56,380,000	-63%
Cooper City	\$6,190,000	-55%	\$6,660,000	-58%	North Lauderdale	\$2,100,000	-87%	\$2,170,000	-88%
Coral Springs	\$15,160,000	-61%	\$15,290,000	-61%	Oakland Park	\$42,440,000	-41%	\$72,060,000	-75%
Dania Beach	\$44,850,000	-20%	\$94,890,000	-78%	Parkland	\$3,680,000	-26%	\$3,800,000	-28%
Davie	\$43,540,000	-34%	\$45,060,000	-23%	Pembroke Park	\$580,000	-90%	\$670,000	-89%
Deerfield Beach	\$69,920,000	-2%	\$157,630,000	-81%	Pembroke Pines	\$15,500,000	-67%	\$16,100,000	-67%
Fort Lauderdale	\$822,250,000	-19%	\$1,751,330,000	-79%	Plantation	\$20,470,000	-60%	\$21,740,000	-51%
Hallandale Beach	\$68,940,000	-23%	\$164,910,000	-49%	Pompano Beach	\$180,240,000	-20%	\$385,220,000	-82%
Hillsboro Beach	\$25,680,000	-10%	\$37,180,000	-10%	Southwest Ranches	\$2,920,000	-17%	\$2,950,000	-18%
Hollywood	\$322,520,000	-57%	\$610,540,000	-72%	Sunrise	\$4,830,000	-67%	\$5,290,000	-68%
Lauderdale By The Sea	\$40,610,000	-58%	\$99,250,000	-99%	Tamarac	\$3,890,000	-72%	\$4,170,000	-70%
Lauderdale Lakes	\$2,350,000	-75%	\$2,590,000	-69%	Unincorporated	\$16,190,000	-55%	\$28,030,000	-73%
Lauderhill	\$15,990,000	-67%	\$17,800,000	-48%	West Park	\$10,700,000	-68%	\$11,170,000	-67%
Lighthouse Point	\$58,620,000	-69%	\$176,000,000	-91%	Weston	\$2,590,000	-29%	\$2,680,000	-31%
Margate	\$13,170,000	-40%	\$13,270,000	-40%	Wilton Manors	\$85,740,000	-70%	\$165,030,000	-98%

Summary of Tier 1 and Tier 2 Benefit Value Estimates

Summary of Tier 1 and Tier 2 Benefit Value Estimates		
Benefit Category	Tier 1 Adaptation Strategy to Mitigate 2-foot SLR	Tier 2 Adaptation Strategy to Mitigate 3.3-foot SLR
Property Damage Avoided, average annual	\$776,000,000	\$4,000,000,000
Increased Short-term Economic Activity, average annual	\$109,000,000	\$660,000,000
Increased Property Tax Collected, average annual	\$211,000,000	\$962,000,000
Increased Flood Insurance Coverage	\$12,000,000,000	\$20,000,000,000
Increased Real Estate Value	\$8,000,000,000	\$30,000,000,000

Summary

Resilience Strategies - Planning Level Cost Summary



Table 6-4A. Annual Operations, Maintenance, Renewal and Replacement Cost of the Tier 1 Investments - Estimates in 2024 Dollars

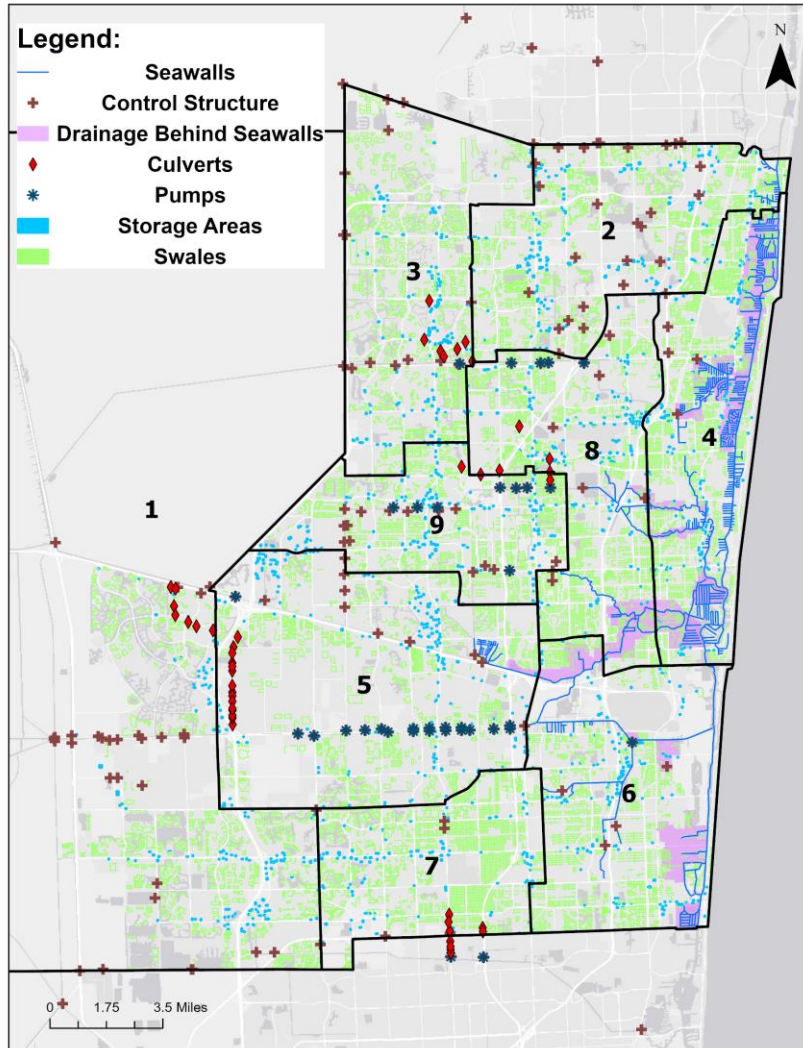
Sector	Capital Cost Estimate	Annual Cost as Proportion of Capital Cost	Annual Cost
(1)	(2)	(3)	(4) = (2) x (3)
Private	\$11,988,000,000	0.01	\$119,880,000
Public	\$8,145,000,000	0.01	\$81,450,000
Grand Total	\$20,133,000,000		\$201,330,000

Table 6-4B. Annual Operations, Maintenance, Renewal and Replacement Cost of the Tier 2 Investments - Estimates in 2024 Dollars

Sector	Capital Cost Estimate	Annual Cost as Proportion of Capital Cost	Annual Cost
(1)	(2)	(3)	(4) = (2) x (3)
Private	\$18,903,000,000	0.01	\$189,030,000
Public	\$9,098,000,000	0.01	\$90,980,000
Grand Total	\$28,001,000,000		\$280,010,000

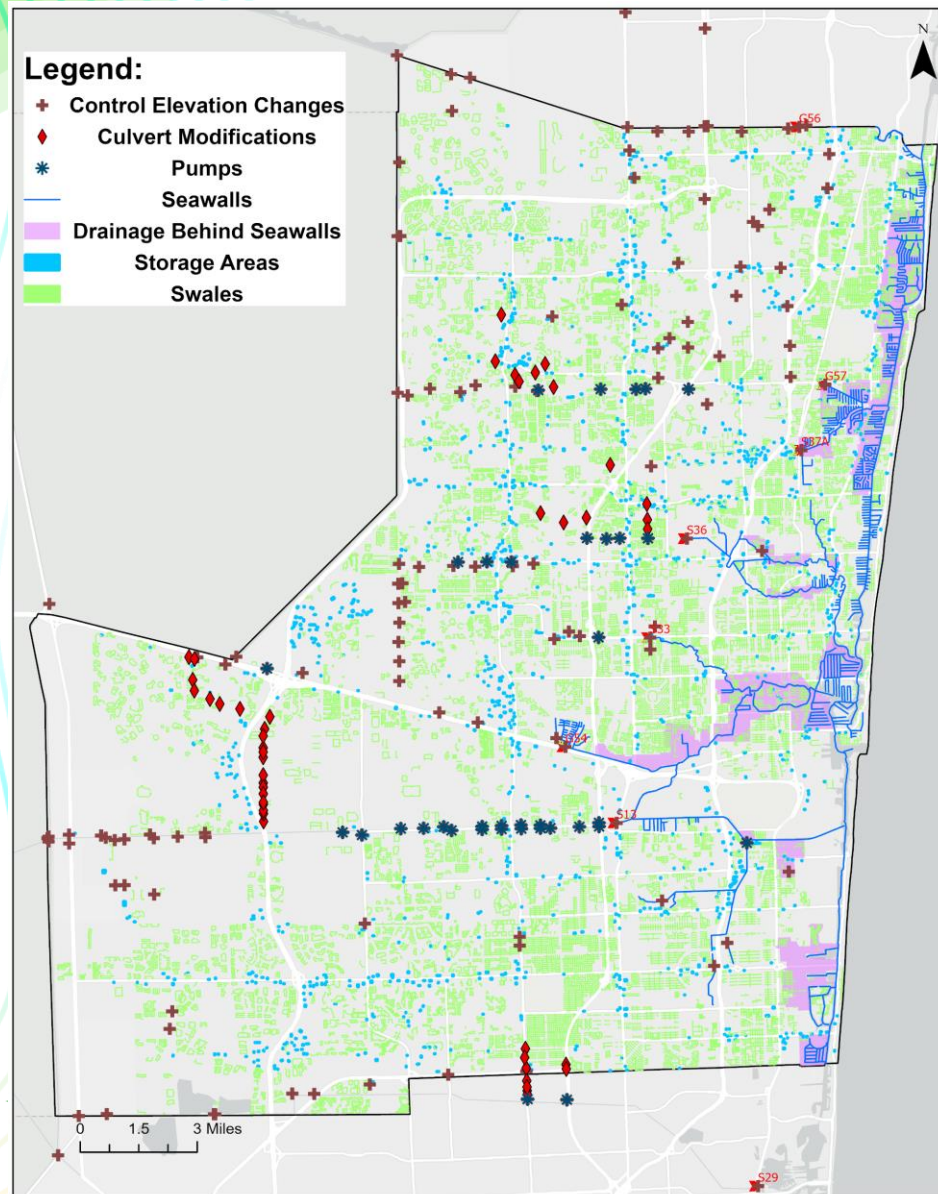
* Accounts for design, permitting, and construction with 30% contingency

County-wide Strategy Summary by Project Type



	Tier 1
Adaptation	Cost
Control Structure	\$387,562,500
Crossings	\$19,163,160
Pump Station	\$574,928,632
Seawall (Private)	\$9,596,637,946
Seawall (Public)	\$2,566,428,064
Storage (Private)	\$3,930,332,589
Swale (Private)	\$425,940,920
Swale (Public)	\$770,528,445
Subtotal Tier 1 (2050)	\$18,271,522,255
	Tier 2
Seawall 7ft (Private)	\$6,915,224,402
Seawall 7ft (Public)	\$952,689,205
Drainage Behind Seawalls	\$1,861,118,000
Subtotal Tier 2 (2070)	\$9,729,031,608
Total cost of Tier 1 and Tier 2 adaptations	\$28,000,553,863

Summary of All Modeled Adaptations by Municipality



City	Cost
COCONUT CREEK	\$203 M
COOPER CITY	\$131 M
CORAL SPRINGS	\$440 M
COUNTY REGIONAL FACILITY	\$39 M
DANIA BEACH	\$1737 M
DAVIE	\$601 M
DEERFIELD BEACH	\$983 M
FORT LAUDERDALE	\$9618 M
HALLANDALE BEACH	\$813 M
HILLSBORO BEACH	\$79 M
HOLLYWOOD	\$2376 M
LAUDERDALE BY THE SEA	\$232 M
LAUDERDALE LAKES	\$174 M
LAUDERHILL	\$281 M
LAZY LAKE	\$ 0.05 M
LIGHTHOUSE POINT	\$1771 M
MARGATE	\$224 M
MIRAMAR	\$292 M
NORTH LAUDERDALE	\$117 M
OAKLAND PARK	\$735 M
PARKLAND	\$56 M
PEMBROKE PARK	\$6 M
PEMBROKE PINES	\$508 M
PLANTATION	\$855 M
POMPANO BEACH	\$3596 M
SEA RANCH LAKES	\$4 M
SOUTHWEST RANCHES	\$46 M
SUNRISE	\$451 M
TAMARAC	\$185 M
TRIBAL LAND	\$3 M
UNINCORPORATED	\$438 M
WEST PARK	\$24 M
WESTON	\$138 M
WILTON MANORS	\$847 M
Grand Total	\$28 B

Adaptation Strategies by Commission District Through 2070

Commission District	1	2	3	4	5	6	7	8	9	Countywide Total
Tier 1										
Control Structure	\$66 M	\$78 M	\$29 M	\$12 M	\$78 M	\$12 M	\$10 M	\$44 M	\$59 M	\$388 M
Culvert Crossings	\$3 M	-	\$3 M	-	\$3 M	-	\$7 M	\$2 M	\$1 M	\$19 M
Pump Station	-	-	\$16 M	-	\$333 M	\$23 M	-	\$71 M	\$132 M	\$575 M
Seawall (Private)	-	\$452 M	-	\$6278 M	\$273 M	\$1797 M	-	\$797 M	-	\$9597 M
Seawall (Public)	-	-	-	\$957 M	\$199 M	\$1026 M	-	\$385 M	-	\$2566 M
Storage (Private)	\$384 M	\$530 M	\$445 M	\$328 M	\$542 M	\$413 M	\$328 M	\$471 M	\$489 M	\$3930 M
Swale (Private)	\$118 M	\$61 M	\$54 M	\$10 M	\$61 M	\$26 M	\$44 M	\$24 M	\$27 M	\$426 M
Swale (Public)	\$11 M	\$81 M	\$80 M	\$131 M	\$67 M	\$95 M	\$98 M	\$127 M	\$80 M	\$771 M
Sub total Tier 1	\$0.58 B	\$1.20 B	\$0.63 B	\$7.72 B	\$1.56 B	\$3.39 B	\$0.49 B	\$1.92 B	\$0.79 B	\$18.27 B
Tier 2										
Seawall 7ft (Private)	-	\$326 M	-	\$4524 M	\$197 M	\$1295 M	-	\$574 M	-	\$6915 M
Seawall 7ft (Public)	-		-	\$355 M	\$74 M	\$381 M	-	\$143 M	-	\$953 M
Drainage Behind Seawalls	-	\$24 M	-	\$1044 M	\$24 M	\$520 M	-	\$250 M	-	\$1861 M
Sub total Tier 2	-	\$349 M	-	\$5923 M	\$294 M	\$2196 M	-	\$967 M	-	\$9729 M
Grand Total	\$0.58 B	\$1.55 B	\$0.63 B	\$13.64 B	\$1.85 B	\$5.59 B	\$0.49 B	\$2.89 B	\$0.79 B	\$28.00 B

Overall Summary

\$28 Billion: Total cost to achieve modeled resilience.

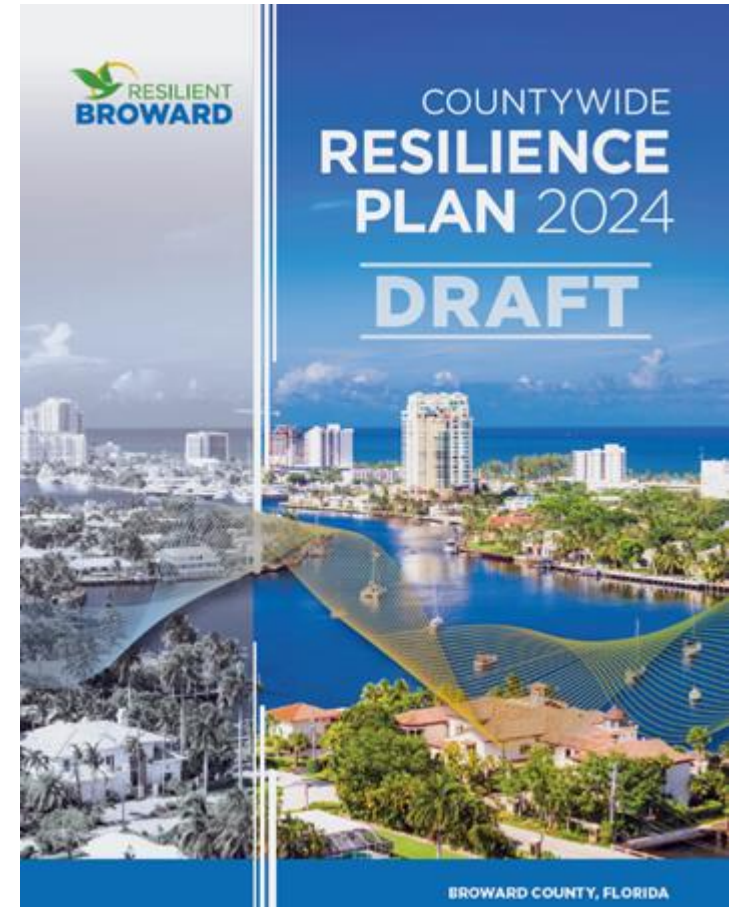
\$19 Billion (67.5%) achieved through redevelopment requirements.

\$9 Billion (32.5%) anticipated public investment, mostly in next 15 years.

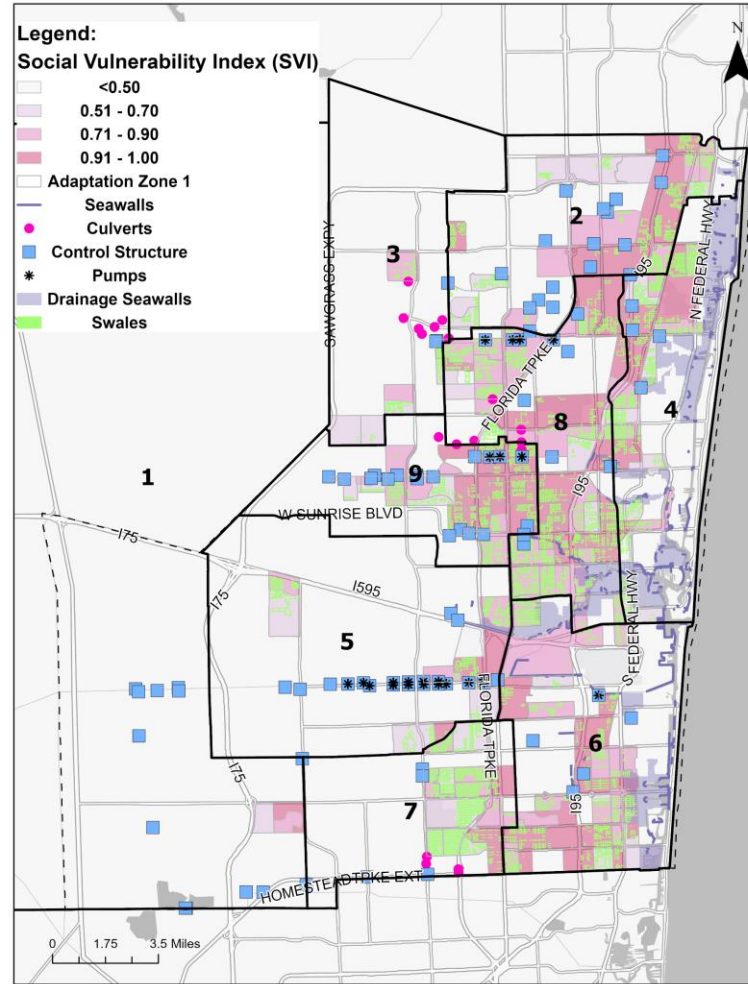
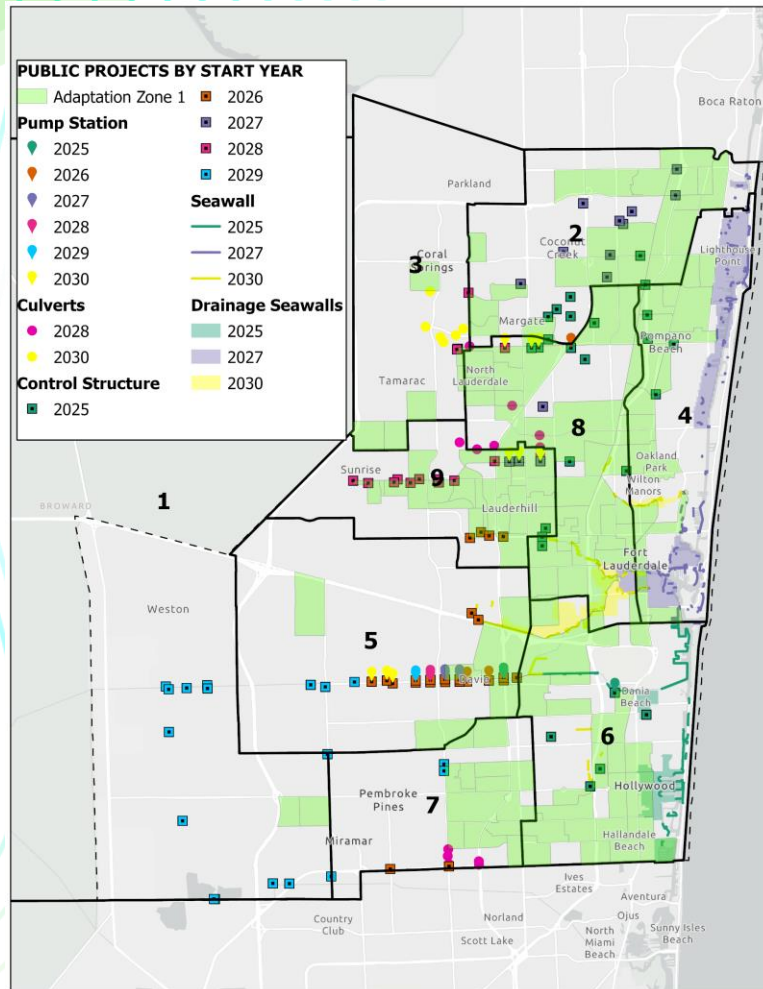
Project Type	2025 - 2040	2041 to 2070	Total
Seawall (Private)	\$9,596,637,946	\$0	\$9,596,637,946
Seawall 5-7ft (Private)	\$79,045,643	\$6,836,178,759	\$6,915,224,402
Storage (Private Funding)	\$1,965,166,294	\$0	\$1,965,166,294
Swale (Private)	\$425,940,920	\$0	\$425,940,920
Private Total	\$12,066,790,803	\$6,836,178,759	\$18,902,969,562
Control Structure	\$387,562,500	\$0	\$387,562,500
Crossings	\$19,163,160	\$0	\$19,163,160
Drainage Behind Seawalls	\$1,861,118,000	\$0	\$1,861,118,000
Pump Station	\$574,928,632	\$0	\$574,928,632
Seawall (Public)	\$2,566,428,064	\$0	\$2,566,428,064
Seawall 5-7ft (Public)	\$31,391,718	\$921,297,487	\$952,689,206
Storage (Public Funding)	\$1,965,166,294	\$0	\$1,965,166,294
Swale (Public)	\$770,528,445	\$0	\$770,528,445
Public	\$8,176,286,813	\$921,297,487	\$9,097,584,301
Grand Total	\$20,243,077,616	\$7,757,476,246	\$28,000,553,863

Broward Resilience Plan

- Tier 1 public infrastructure breakdown:
 - 32% seawalls
 - 24% storage accounts
 - 23% drainage enhancement
 - 10% swale improvements
 - 7% pump stations
 - 5% control structures
 - <1% culvert improvements



Near-term (2025-2030): Potential Focal Areas and Projects



Within Priority Zone 1

District	Estimated Population
1	36,172
2	216,557
3	98,101
4	152,019
5	108,143
6	206,897
7	132,082
8	222,341
9	191,693
Total	1,364,005

Near Term Projects (2025-2030)	Total	Cost
Culverts (#)	19	\$10 M
Control Structures (#)	118	\$288 M
Pumps (#)	23	\$433 M
Seawall (public) - (miles)	49	\$2340 M
Seawall Drainage (# projects)	49	\$1628 M
Swales Public (miles)	813	\$447 M
Storage (Acres)	36	\$340 M
Total		\$5486 M

Modeled Outcomes Rely Upon Policy, Regulation, and Active Investments

Apply the Scenario Viewer and Plan in Review of all Land Use Proposals: Evaluate all land use proposals for future flood risk and assignment of water management needs.

Establish Priority Zone 1 as an Adaptation Action Area: Emphasis on green infrastructure as part of redevelopment projects to achieve co-benefits of flood risk reduction and cooling. Enhance eligibility for funding.

Enhance Green Streets Requirements: Promote the conversion of selected neighborhoods from 2-way roads to 1-way roads with green infrastructure.

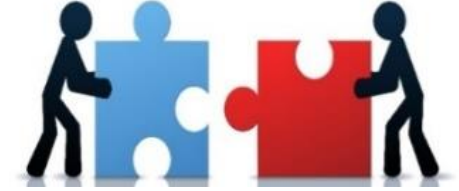
Identify Resilient Growth Priority Areas: Study and identify priority areas for development/redevelopment that advance the County's resilience goals. Might include areas of lower flood risk, connected to desired infrastructure and community services.

Reduce Impervious Cover: Provide incentives for property owners to convert impervious area to pervious area on private property for purposes of drainage.

Increase Stormwater Storage/Management Requirements: Increase required onsite storage on sites being developed or redeveloped.

Green Development Incentives - Facilitate development incentives and variances for providing additional storage at new developments and redeveloped properties if a "net benefit" to the community would be achieved, such as additional density bonuses for enhanced stormwater management or green infrastructure.

Summary



- Climate related flood and heat risk presents a growing physical hazard and economic exposure for Broward County.
- Proposed strategies deliver \$8 to \$30 Billion in residential property value preservation, avoid up to \$4 Billion in asset damages, and preserve \$20 Billion in flood insurance coverage, with an 83% reduction in damages county-wide.
- Some investments will happen organically, others will be more deliberate, but policy and regulations will be an important part of implementation.
- The flood scenario viewer provides a means for providing shared data for collective planning, prioritization, advocacy and accountability.

Discussion

Questions ?

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Resilient Environment Department

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954-519-1464



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ENVIRONMENT