



VIRTUAL WORKSHOP AGENDA
BROWARD COUNTY PLANNING COUNCIL
JULY 27, 2023
10:00 A.M.
ZOOM LINK ONLY

Call to Order – Chair Thomas H. DiGiorgio, Jr.

- ➡ **Introduction – Barbara Blake Boy**
- ➡ **Presentation: Climate Resilience: Shared Challenges, Regional Planning and County-wide Action (45 minutes)**
 - ➡ **Jennifer L. Jurado, Ph.D., Deputy Director and Chief Resilience Officer, Broward County Resilient Environment Department**
- ➡ **Planning Council Member Comments and Questions (45 minutes)**

Adjournment

The presentation materials will be posted at the following link on Tuesday, July 25, 2023:
<https://www.broward.org/planningcouncil/Pages/Default.aspx>

Notice to Members of the Public: This is a virtual workshop only and can be viewed via the following Vimeo link: <https://vimeo.com/showcase/7896825>

Next Regular Scheduled Planning Council Meeting – August 24, 2023, at 10:00 a.m., in Room 422 of the Broward County Governmental Center.

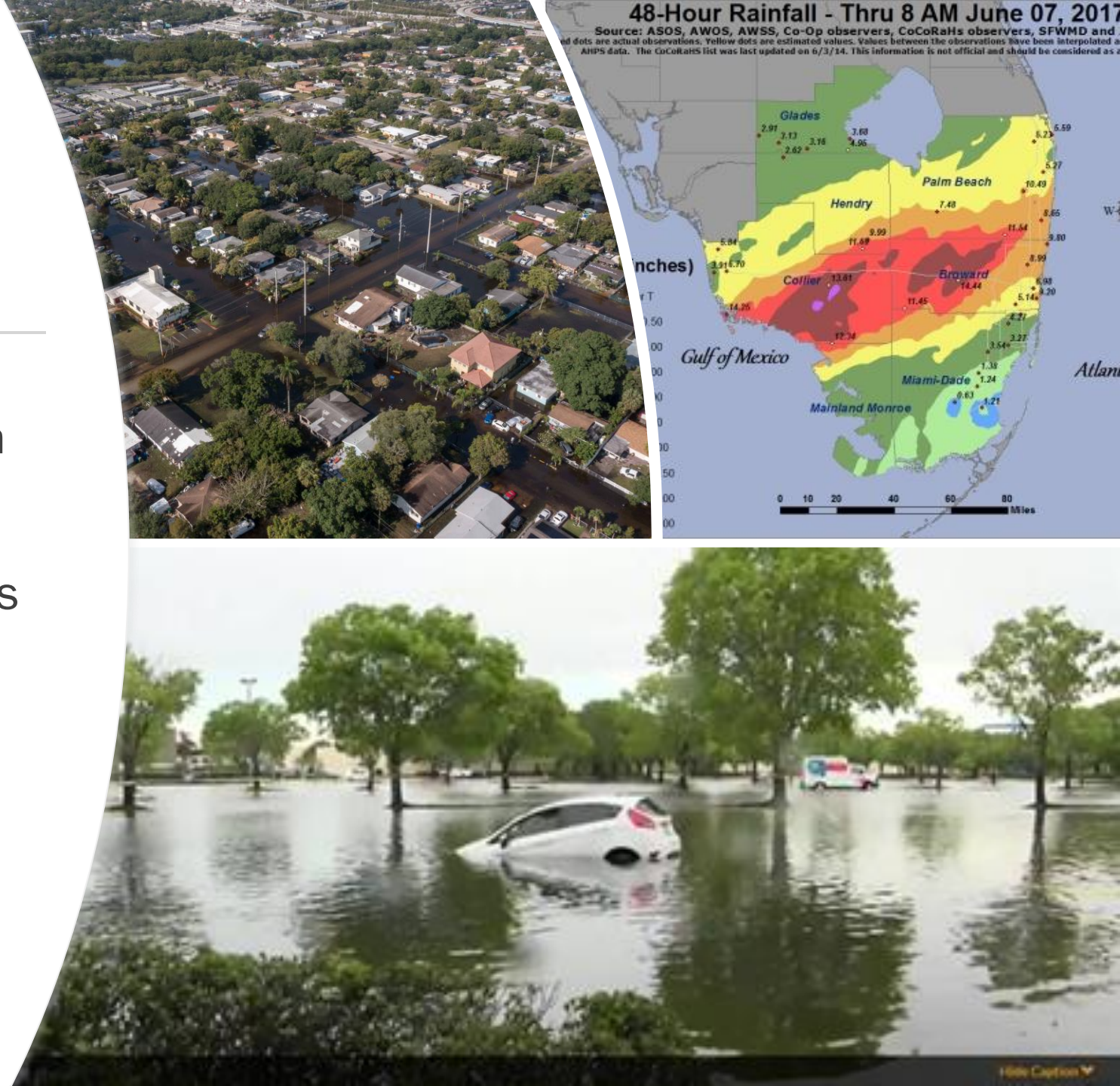
Planning for Sea Level Rise and Resilience in Broward County

Presented to the
Broward Planning Council
July 27, 2023



Community Resilience Challenges

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



Implications: Planning and Investments

- Land Use
- Infrastructure Siting
- Design Standards
- Drainage
- Level of Service
- Finished Floor Elevations
- Development Strategies
- Shoreline Management



Flood Risk is Prominent, and On the Rise

Climate change is already making parts of America uninsurable

"It's actually reinsurers that have been sounding the alarm about climate change and disaster risk for decades," said Hecht ... The federal government created the National Flood Insurance Program to ...

How climate change, rising sea levels are transforming coastlines around the world

Long-term erosion and strong storms are chipping away at the shore.



Storm surge in Naples, Fla. (Photo: Naples Fire Department)

WEATHER

Area waterways will see impacts days after Ian's landfall

Local News

'This is a nightmare': Flooding in Fort Lauderdale brings frustration, homelessness



Severe Community and Economic Disruptions

🕒 SEPTEMBER 6, 2021

Sea-level rise becoming a hazard for South Florida neighborhoods miles from ocean

by David Fleshler



Credit: CC0 Public Domain



By –
Stacy
Morford, The
Conversation

By –
Angela
Antipova,
The
Conversation

By –
Dorian J.
Burnette,
The
Conversation

By –
Matthew

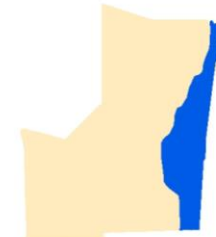
Climate change helped fuel 18 billion-dollar disasters in 2022, NOAA says

Saltwater Intrusion and Water Supplies



1994

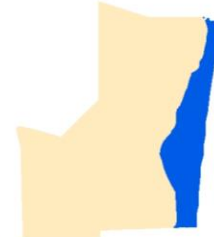
72 Miles²



Source: Broward County

1996

71 Miles²



Source: usgs

2009

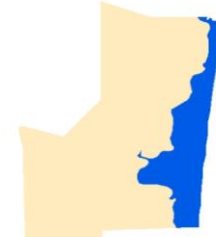
78 Miles²



Source: sfwmd

2014

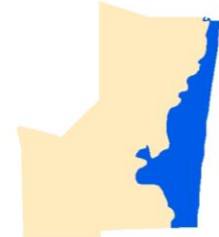
83 Miles²



Source: sfwmd

2019

90 Miles²



Source: sfwmd

Climate Consequences for the Environment

**CORAL REEFS AND
CLIMATE CHANGE:
FROM CRADLE TO
AN EARLY GRAVE**



SCIENCE

Miles of Algae and a Multitude of Hazards

By LES NEUHAUS JULY 18, 2016



How pollution and climate change may have caused the Florida seaweed blob

2.6k



Ben Adler · Senior Editor

Updated March 17, 2023 · 4 min read



SCIENCE • ENVIRONMENT

Red Tide Is Spreading to Florida's East Coast. Here's What to Know About It

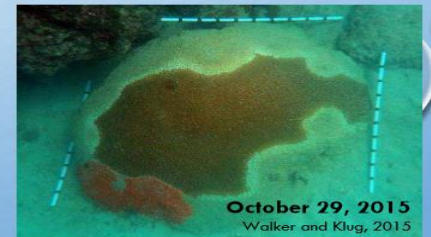


THE STATUS OF CORAL HEALTH IN SOUTHEAST FLORIDA



October 2, 2015

Walker and Klug, 2015



October 29, 2015

Walker and Klug, 2015

Reinforcing the Need for Investments



Climate Risk and Economics – A Strong Basis for Action

Moody's warns cities to prepare for climate change. Here's why it matters

Business | Climate
Changed

Moody's Warns Cities to Address Climate Risks or Face Downgrades

- Communities in Texas, Florida, other coastal states at risk
- Credit rating agency says it's adding climate to credit risks

Water management risks pose growing credit threats as demand soars, climate change intensifies: Moody's

1 min read • 11 Jul 2023, 06:04 PM IST

[Saurav Anand](#)

CLIMATE

Here are the U.S. cities most vulnerable to climate change, according to Moody's

PUBLISHED FRI, FEB 24 2023•4:02 PM EST

- “Absent policy changes, large coastal states like California, Florida and New York are especially vulnerable, while more inland northern economies will emerge only slightly worse off,” wrote Adam Kamins, senior director at Moody's.

MOODY'S

Acute Local Needs and Economic Drivers

- Protect infrastructure
- Reduce flood risk and property losses
- Improve insurance affordability
- Protect property values/tax base
- Protect credit ratings

Cities and states could see their credit ratings crash if they don't start preparing for climate change



Jeremy Berke

Dec. 1, 2017, 9:16 AM

2,407



National Institute of
BUILDING SCIENCES

Natural Hazard Mitigation Saves:
2017 Interim Report



An Authoritative Source of Innovative Solutions for the Built Environment

BUSINESS
INSIDER



Bloomberg

MOODY'S
INVESTORS SERVICE

SECTOR IN-DEPTH
28 November 2017

Rate this Research >>

Environmental risks

Evaluating the impact of climate change on
US state and local issuers

Engaging on Economic Resilience



SE FL – Resilience Business Case Analysis

Project Purpose

To identify the **return on investment** for resilience and adaptation measures in Southeast Florida.



Key Findings



There is a **regional business case** for resilience in Southeast Florida.

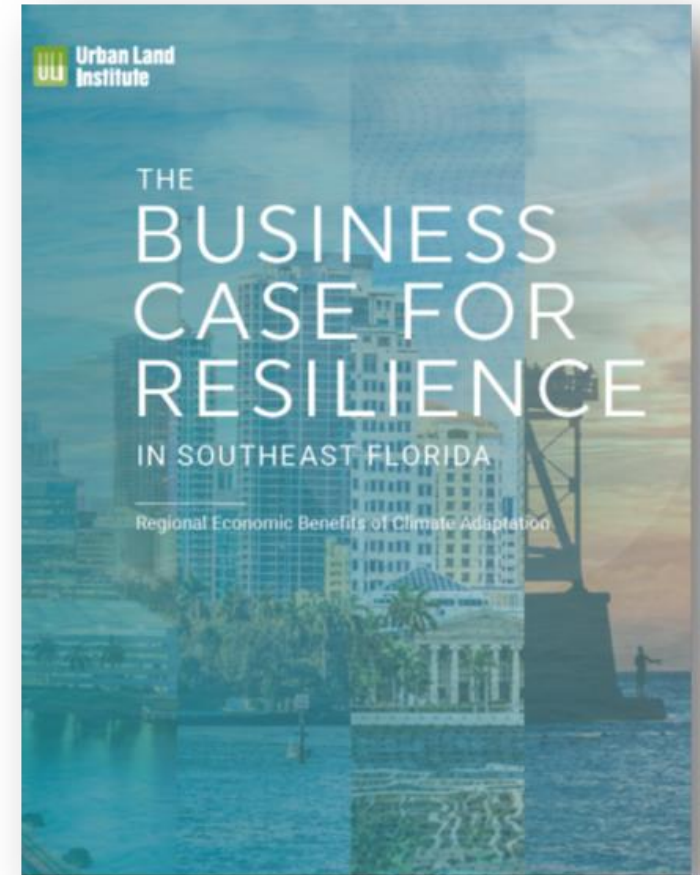
4:1

Building-level
adaptation
strategies outweigh
the costs 4:1

2:1

Community-wide
adaptation
strategies
outweigh the
costs 2:1

Note: Community-wide and building-level adaptation strategies work together.



Community-wide Adaptation

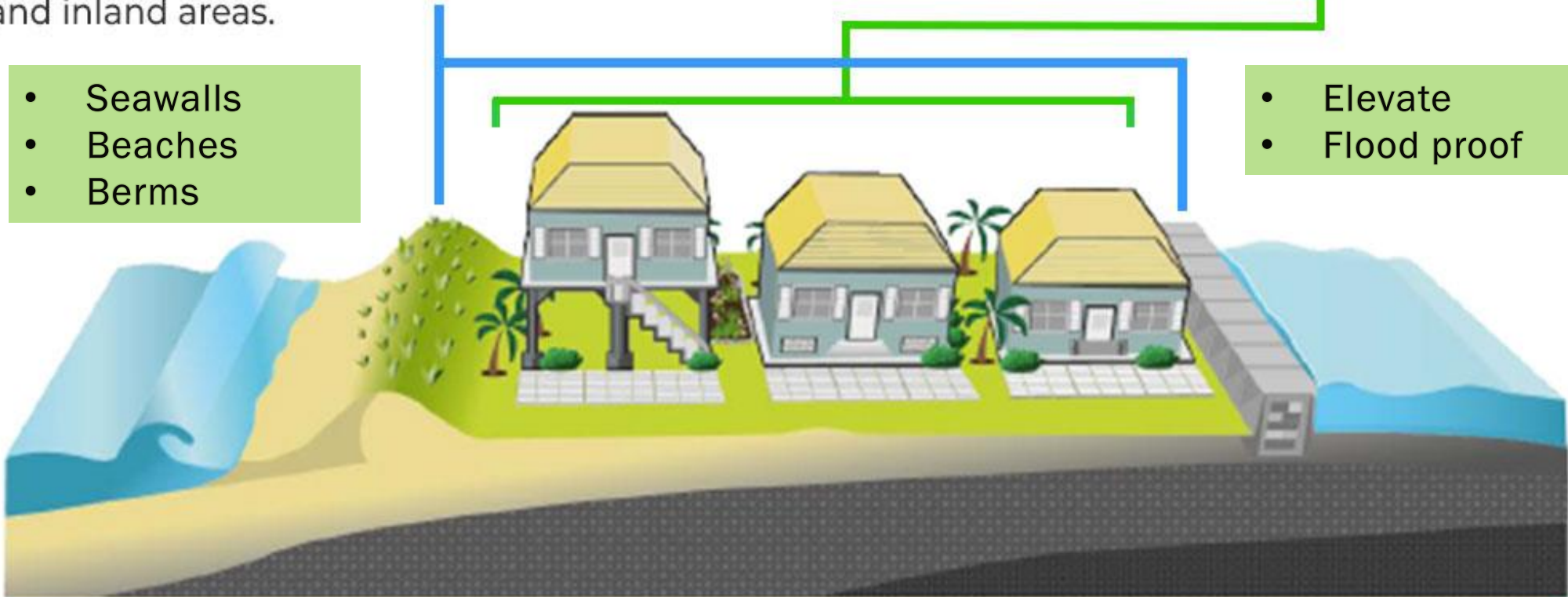
- A combination of soft and hard engineering investments at the open coast, intracoastal and inland areas.

- Seawalls
- Beaches
- Berms

Building-level Adaptation

- A combination of structural improvements to property itself.

- Elevate
- Flood proof

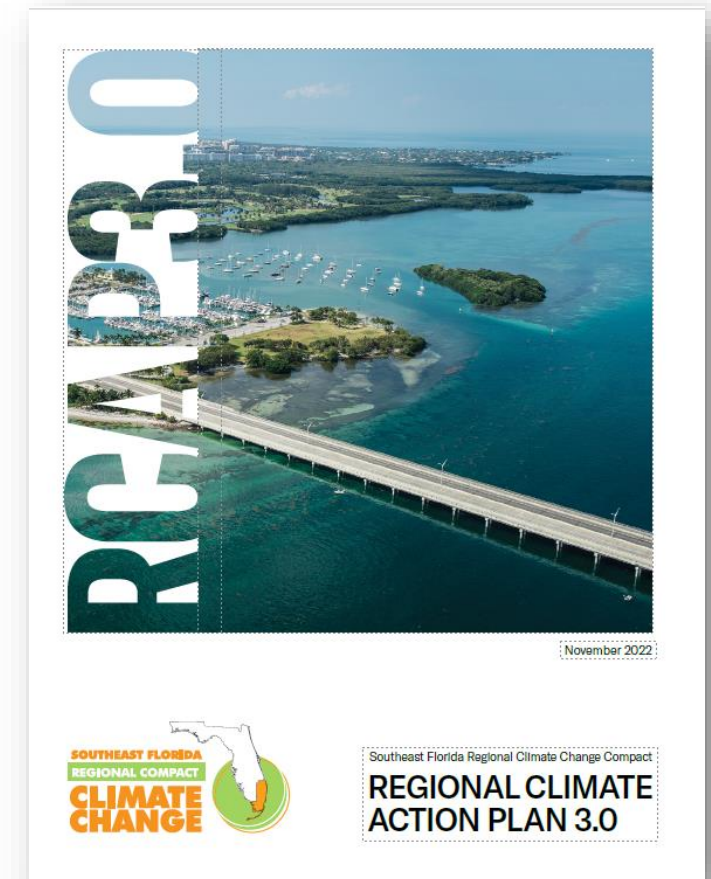
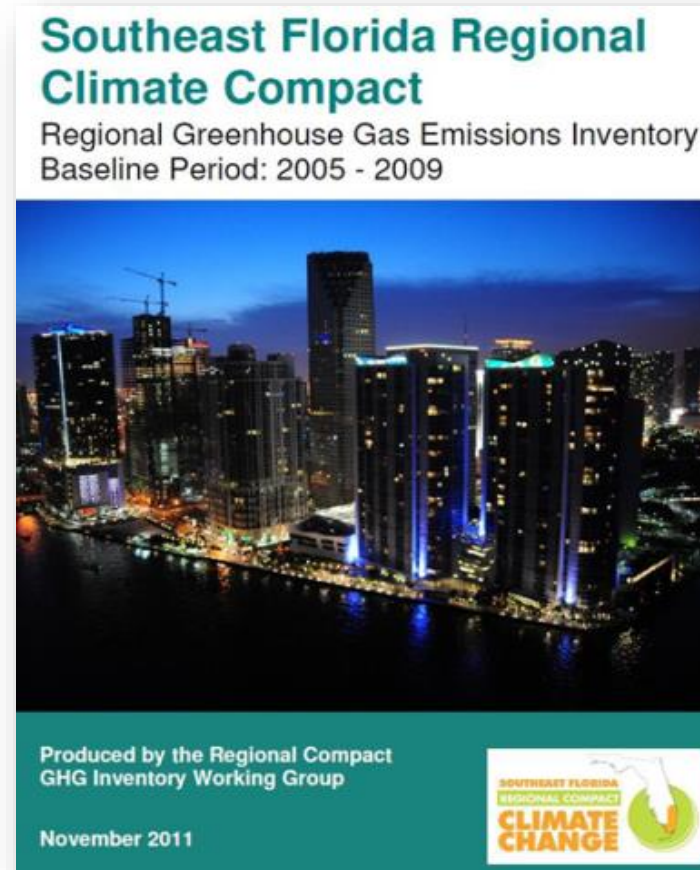
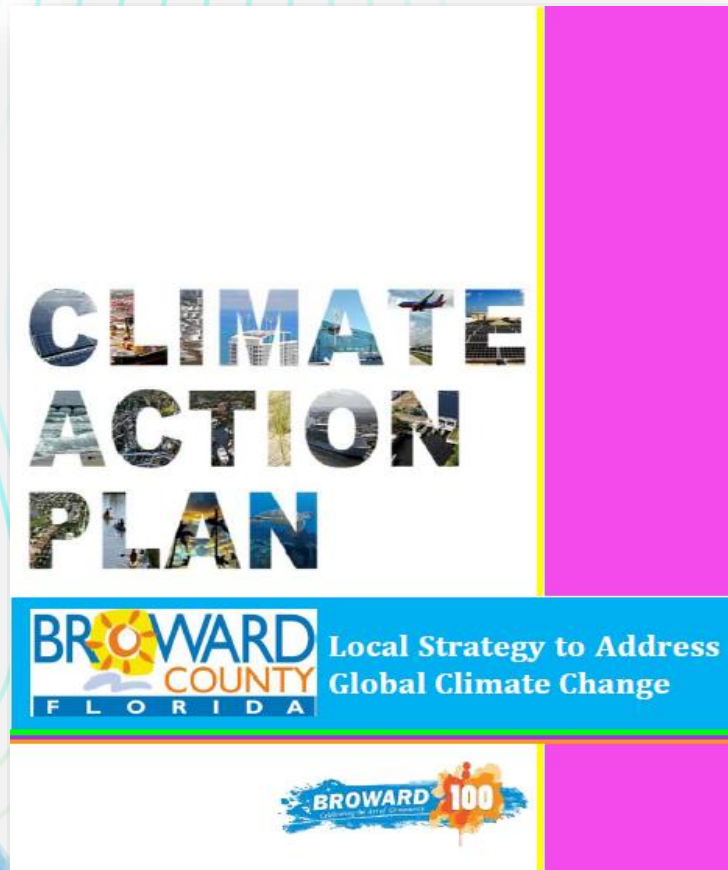


Building-level adaptation will not provide benefit to regional infrastructure or to coastal resources such as beaches.

Highlight of No Action with Rising Seas	Permanent Damages 2040	Permanent Damages 2070
 Direct Property Impacts	\$4.2bil In property value exposed to daily tidal inundation in 2040.	\$53.6bil In property value exposed to daily tidal inundation in 2070.
 Business and Employment Impacts	720 Impacted by daily tidal inundation in 2040.	17,800jobs Impacted by daily tidal inundation in 2070.
 Fiscal Impacts	\$28mil Fiscal loss from daily tidal inundation in 2040.	\$384mil Fiscal loss from daily tidal inundation in 2070.

**Results shown here are not adjusted to account for financial discounting. Parcels impacted by daily tidal inundation are excluded from the 10-year tide damages. The 10-year tide results account for the impacts of one storm event and are not adjusted for probability of the storm event occurring.*

Comprehensive Action: Climate Policy and Planning

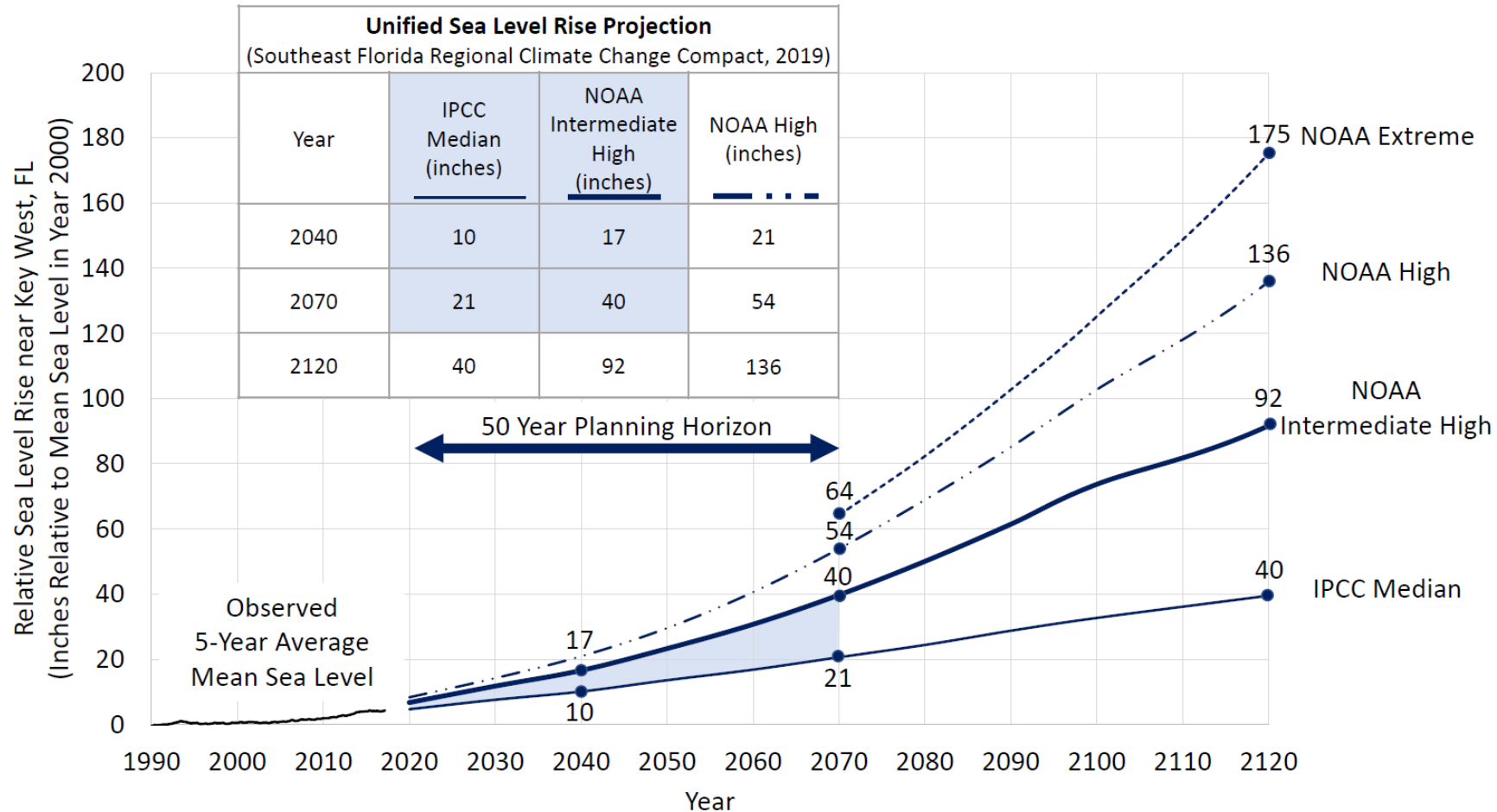


Resilience Planning and Standards

- Sea Level Rise Projection – 2012, 2015, 2019
- Priority Planning Area Map – 2012, 2015, 2020
- Future Conditions Map Series – 2017
- Resilience Standards
 - Drainage infrastructure - 2017
 - Tidal flood barriers - 2020
 - 100-Yr Flood elevations – 2021
 - Design storms–2021

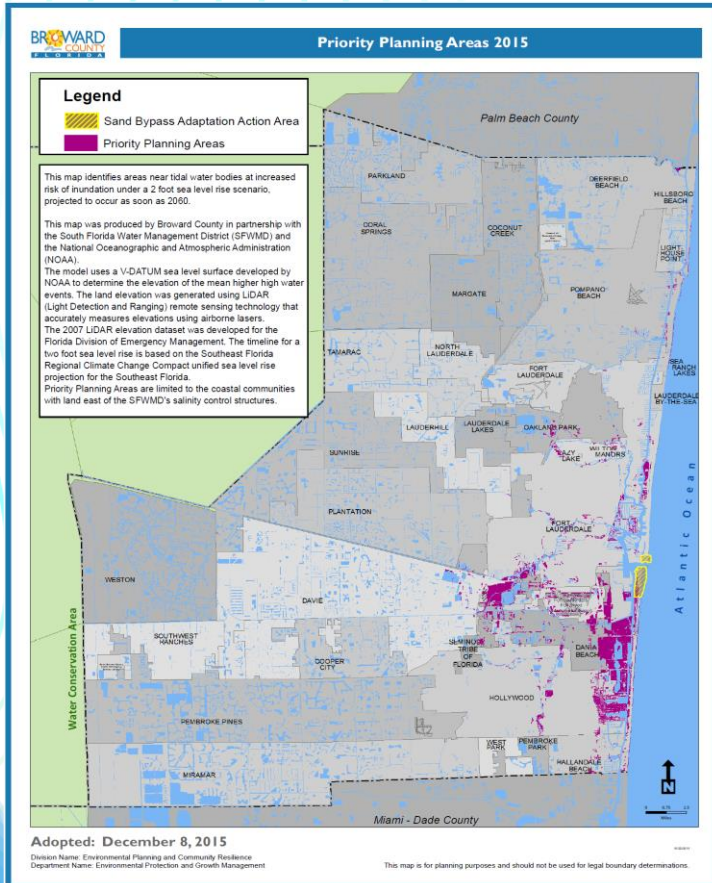


2019 Regional Sea Level Rise Projection

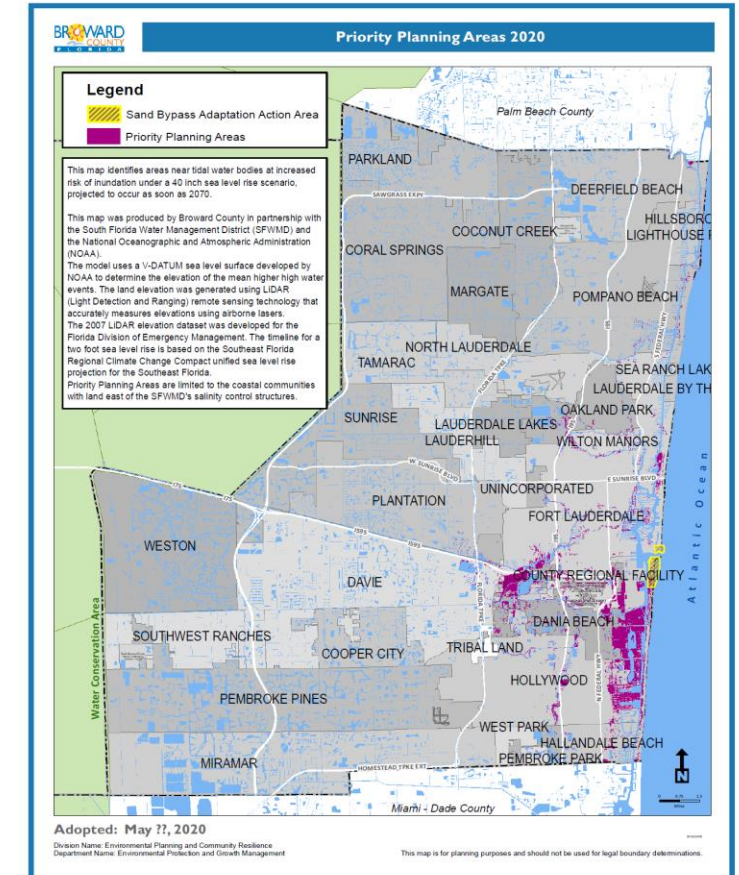


Priority Planning Area Map

2015 Adopted Map
2 ft SLR = 6.8 mi²



2020 Updated Map
3.3 ft SLR = 17.6 mi²



County Land Use Plan:

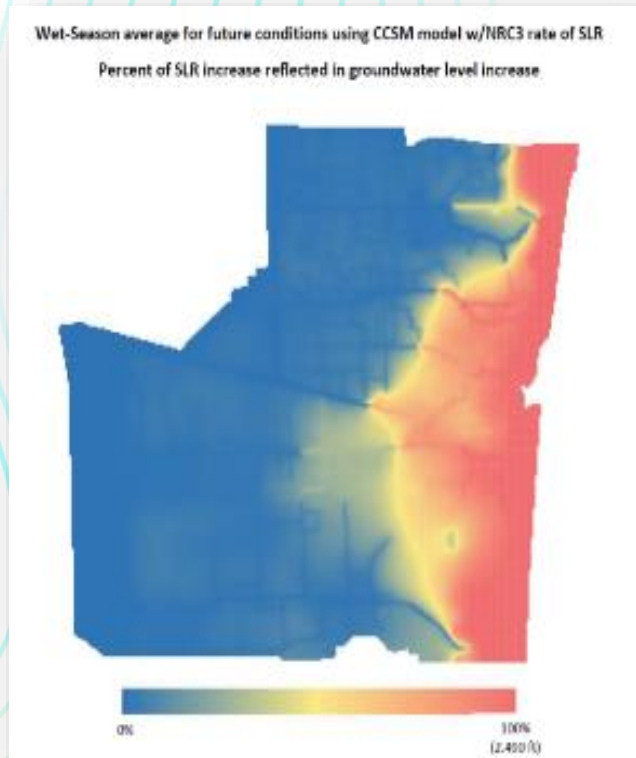
- Delineates areas at increased risk of flooding with Sea Level Rise (SLR)

Application:

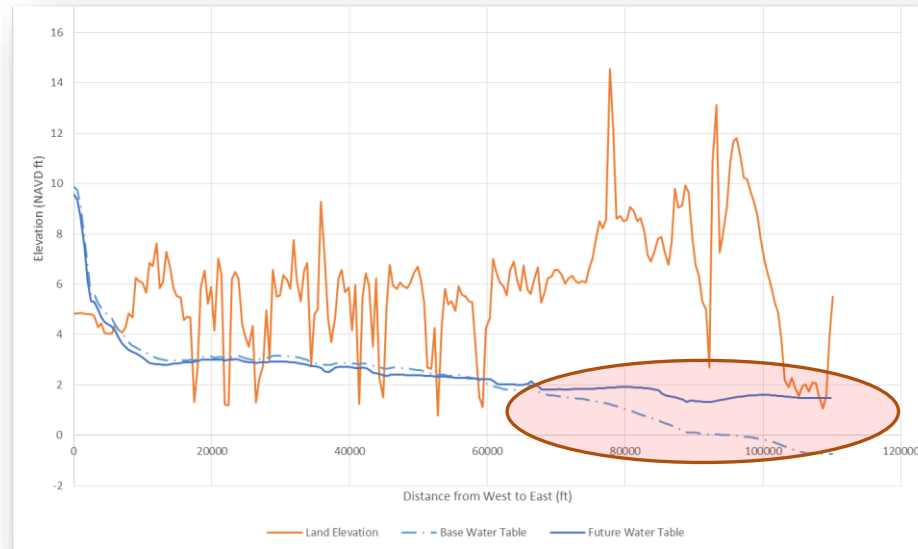
- Criteria Applied to Land Use Amendments
- County Capital Project Planning
- Elevation and Location

Future Conditions Groundwater Table Map

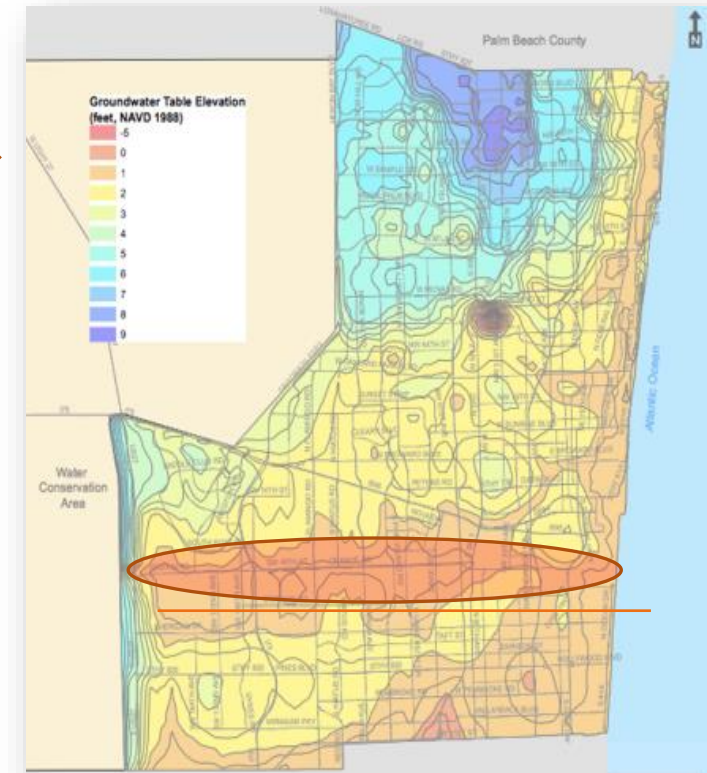
Effective July 1, 2017
Section 27-200, Plate WM 2.1
Code of County Ordinances



Modeled Change



Modeled W-E Cross Section



Future Conditions
Wet Season
Groundwater Table Map

Resilience Standard for Tidal Flood Barriers

- Approved March 31, 2020
- Modeled water levels:
 - 2 feet sea level rise
 - High tides
 - 25-yr storm surge
- Requires **5 feet NAVD by 2050**, allows **4 feet NAVD until 2035**
- Requires municipal adoption in 2 years and real estate disclosure.



Hollywood Marina

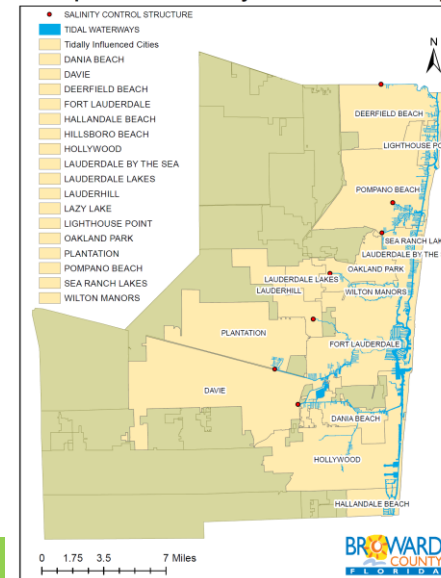


Before – 1.7' NAVD



After – 4.5' NAVD

Municipalities with Tidally Influenced Waterways



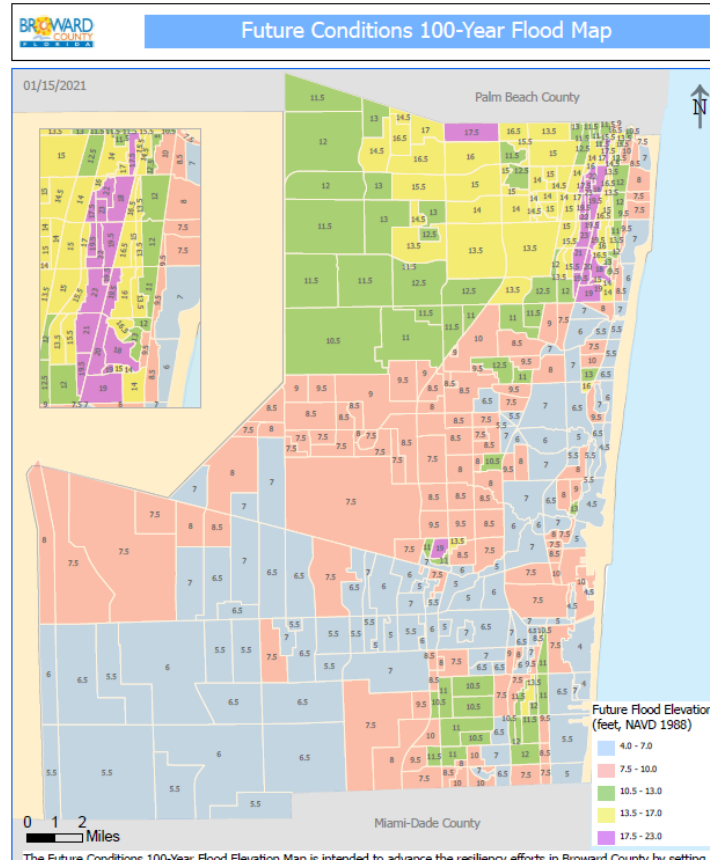
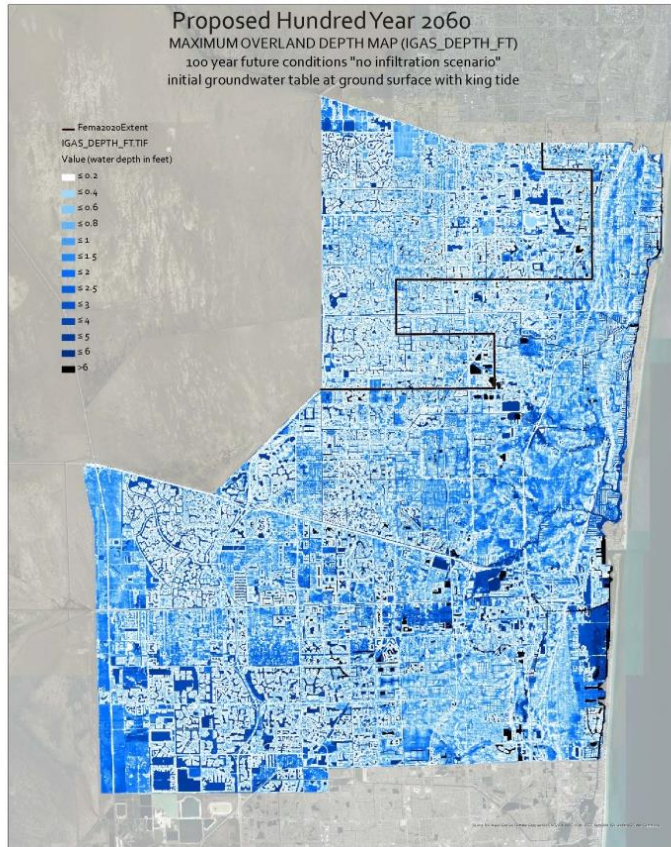
Finished Floor Elevations and the NFIP

County code NOW requires higher of the following:

- Current 100-yr flood map developed in 1977
- Future Conditions 100-year Flood Map
- FEMA maps - existing conditions
- Site specific 100-year calculation
- 18 inches above crown of road



Future Conditions 100-Year Flood Map

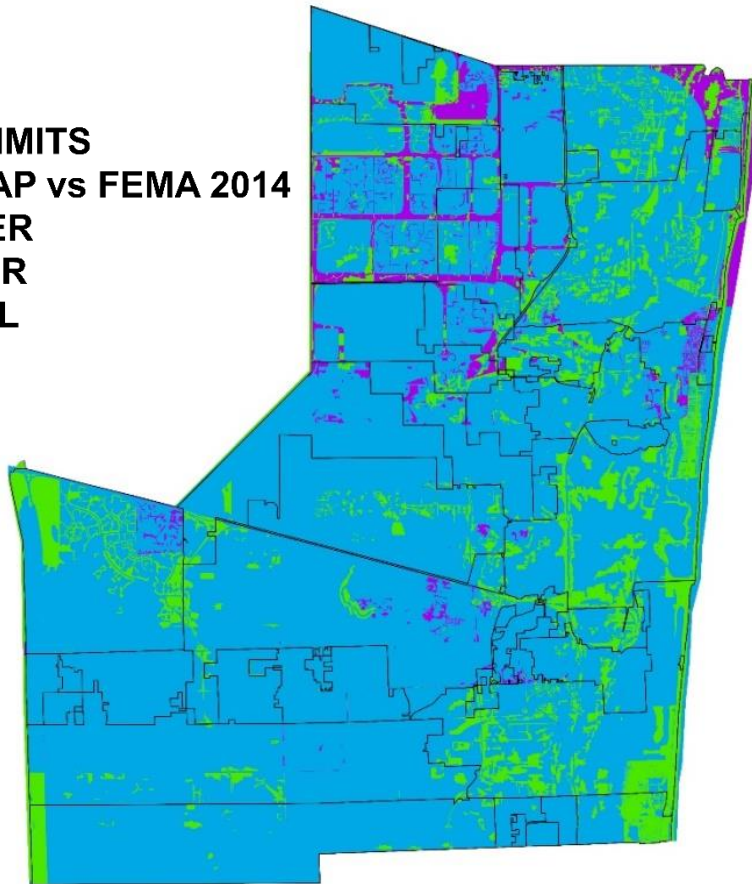


- Accounts for:
 - 2 Feet SLR
 - King tides
 - Ground saturation
 - Increase rainfall (13%)
- Advanced down-scaling techniques
- 368 discrete flood areas
- Informed by basins, topographic features, drainage

Flood Elevation Change Comparison

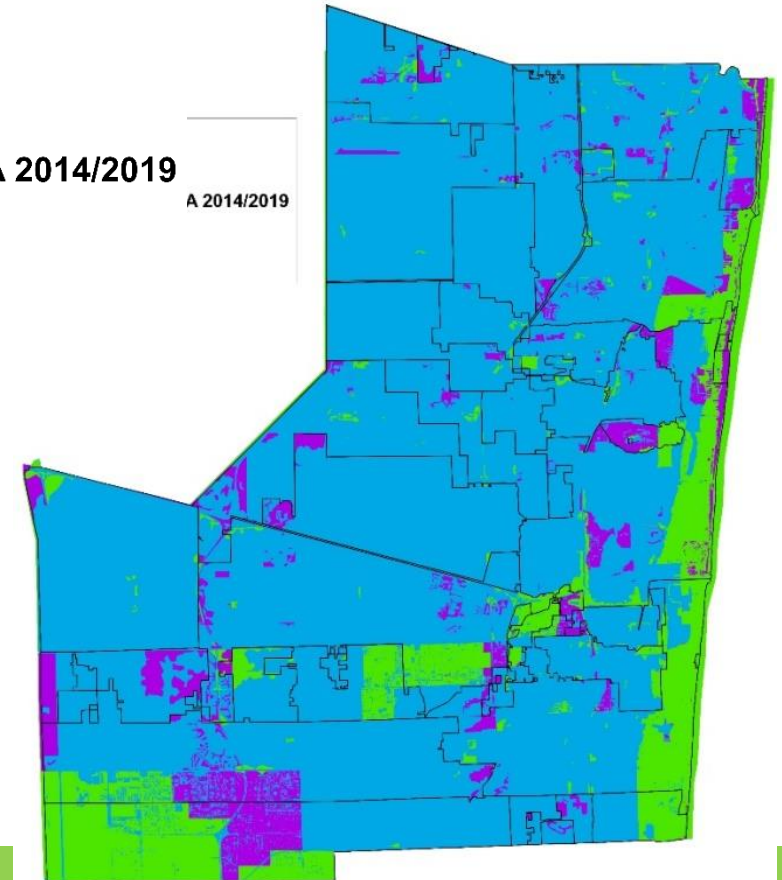
1977 COMMUNITY MAP COMPARED TO
ADOPTED FEMA 2014 FLOOD ELEVATIONS

Legend
=CITY LIMITS
1977 MAP vs FEMA 2014
■ HIGHER
■ LOWER
■ EQUAL

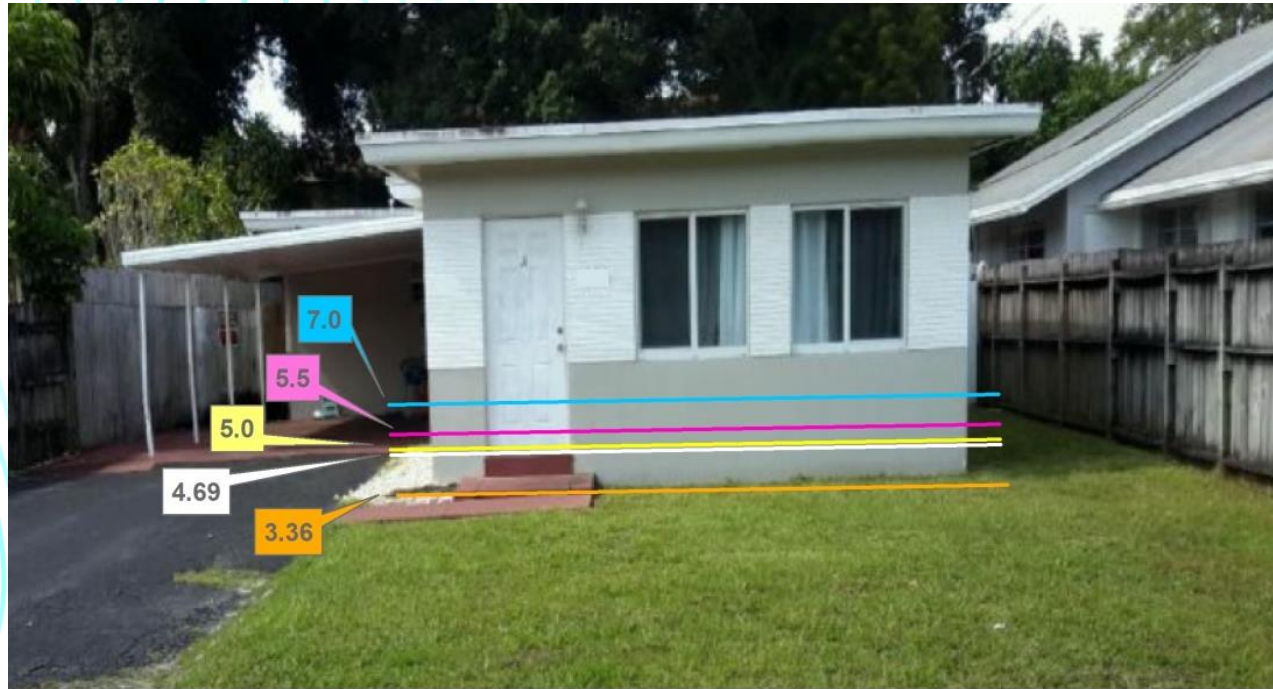


PROPOSED FUTURE FLOOD MAP COMPARED
TO HIGHER OF
ADOPTED FEMA 2014 / PROPOSED FEMA
2019 FLOOD ELEVATIONS

Legend
=CITY LIMITS
FLOOD_UNION
NEW MAP vs FEMA 2014/2019
■ HIGHER
■ LOWER
■ EQUAL



Commercial and Residential Relevance



Future Conditions 100-Year Flood Map 7.0 Ft
 Existing 100-Year flood map 5.5 Ft
 FEMA 2014 Flood Elevation 5.0 Ft
 Finished Floor Elevation 4.69 Ft
 Lowest Adjacent Grade next to Building 3.36 Ft

County Property Appraiser
 AVD 1988



Photo: Broward County Property Appraiser
 All Elevations NAVD 1988

Future Conditions 100-Year Flood Map: 7.0 Feet
 Minimum Floor Elevation per SFWMD ERP: 6.5 Ft
 FEMA 2014 Flood Elevation 6.0 Feet
 Existing 100-Year Flood Map 5.5 Feet

Financial Benefits vs. Liabilities



Credit: L. Vialpando

Resilience and Land Use Planning Considerations

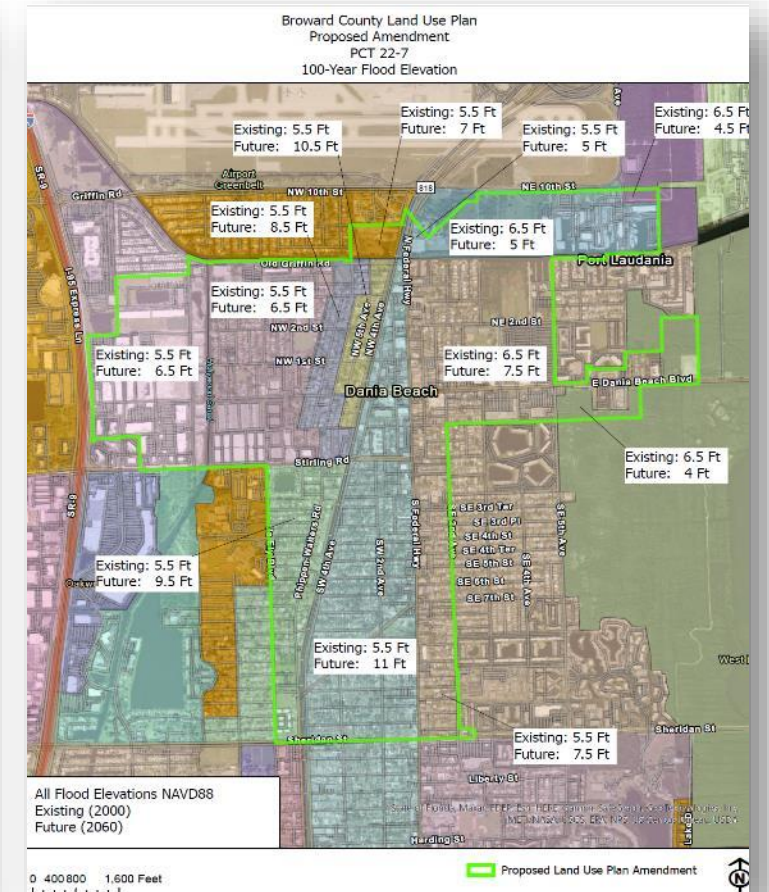
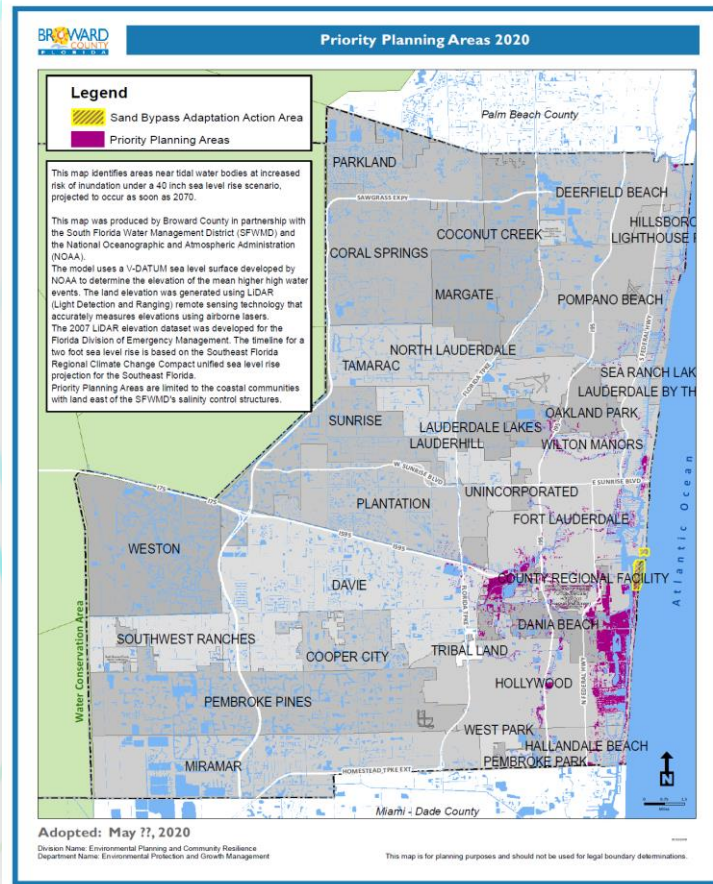
Broward County shall designate areas that are at increased risk of flooding due to, or exacerbated by, sea level rise within the Broward County Land Use Plan Priority Planning Areas for Sea Level Rise Map (and others), and work to make these areas more climate resilient by encouraging the use of adaption and mitigation strategies or discouraging density increases (CC 2.14)

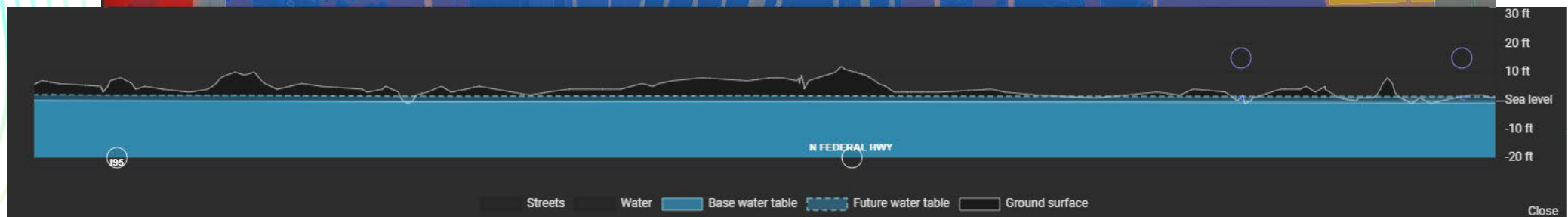


Resilience and Land Use Policy

- Broward County shall evaluate plan amendments within Priority Planning Areas for Sea Level Rise...In review of such amendments, the county shall consider a. Sea level rise/flood protection mitigation strategies and requirements included within local comprehensive plans and/or development regulations; or b. Flood protection improvements committed to by amendment applicants which could mitigate or enhance flood protection and adaption from rising sea levels. (2.21.1)
- Broward County shall, prior to approving land use plan amendments in the areas prone to flooding and/or the impacts of sea level rise, as identified on Priority Planning Areas for Sea Level Rise Map, determine that the subsequent development will be served by adequate storm water management and drainage facilities, not adversely affect groundwater quality or environmentally sensitive lands or increase saltwater intrusion or areawide flooding. (2.21.5)

Resilience Assessments and Land Use Considerations



[illegible]

Notable Examples and Outcomes

- Private Developer with Municipal Commitment - Commitment to adopt resilience standards under development
- Private Developer with Developer Commitment – Forego existing permit conditions, apply future conditions
- Municipal Applicant with Municipal Commitment – Commitment to update city-wide stormwater plan and adopt interim standards supporting resilience and addressing future conditions
- Municipal Application on behalf of Developer – Application withdrawn

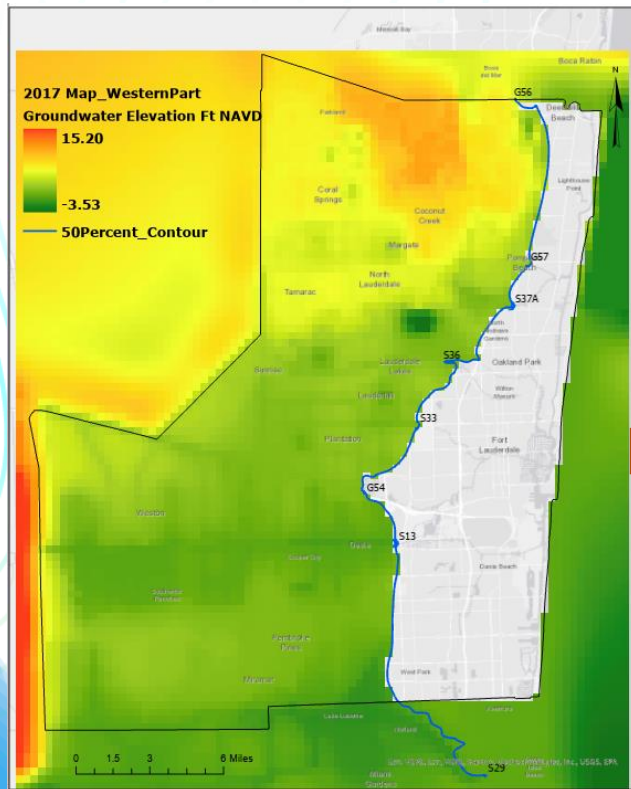
Efforts Underway

- Update to Future Conditions Groundwater Table Map
- Update to Future Conditions Flood Map
- Completion of County-wide Adaptation Plan
- Launch of Shared Planning Platform

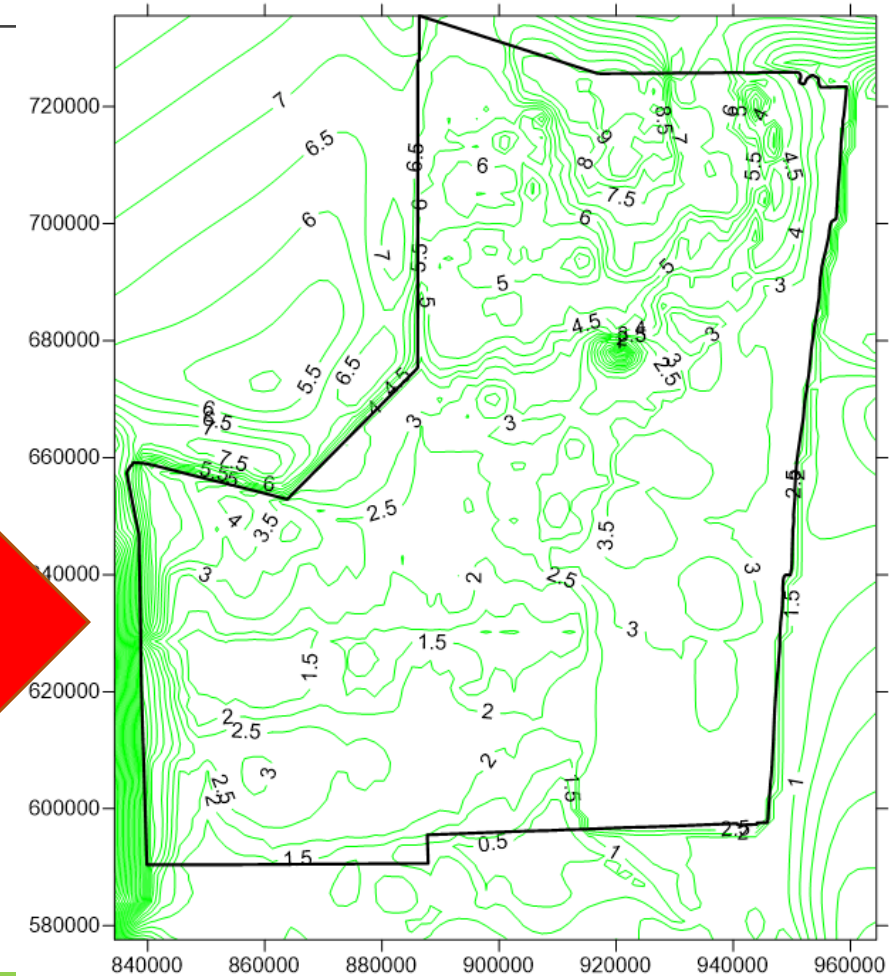
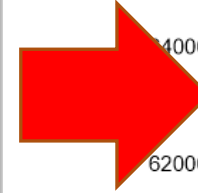
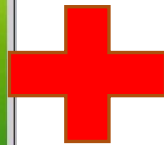
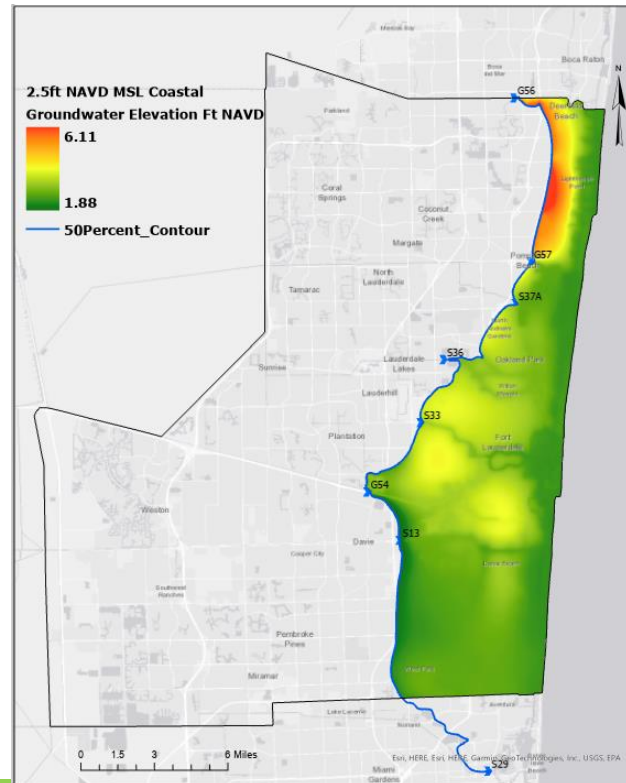


Wet Season Groundwater Table Map (2070)

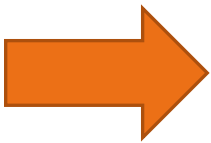
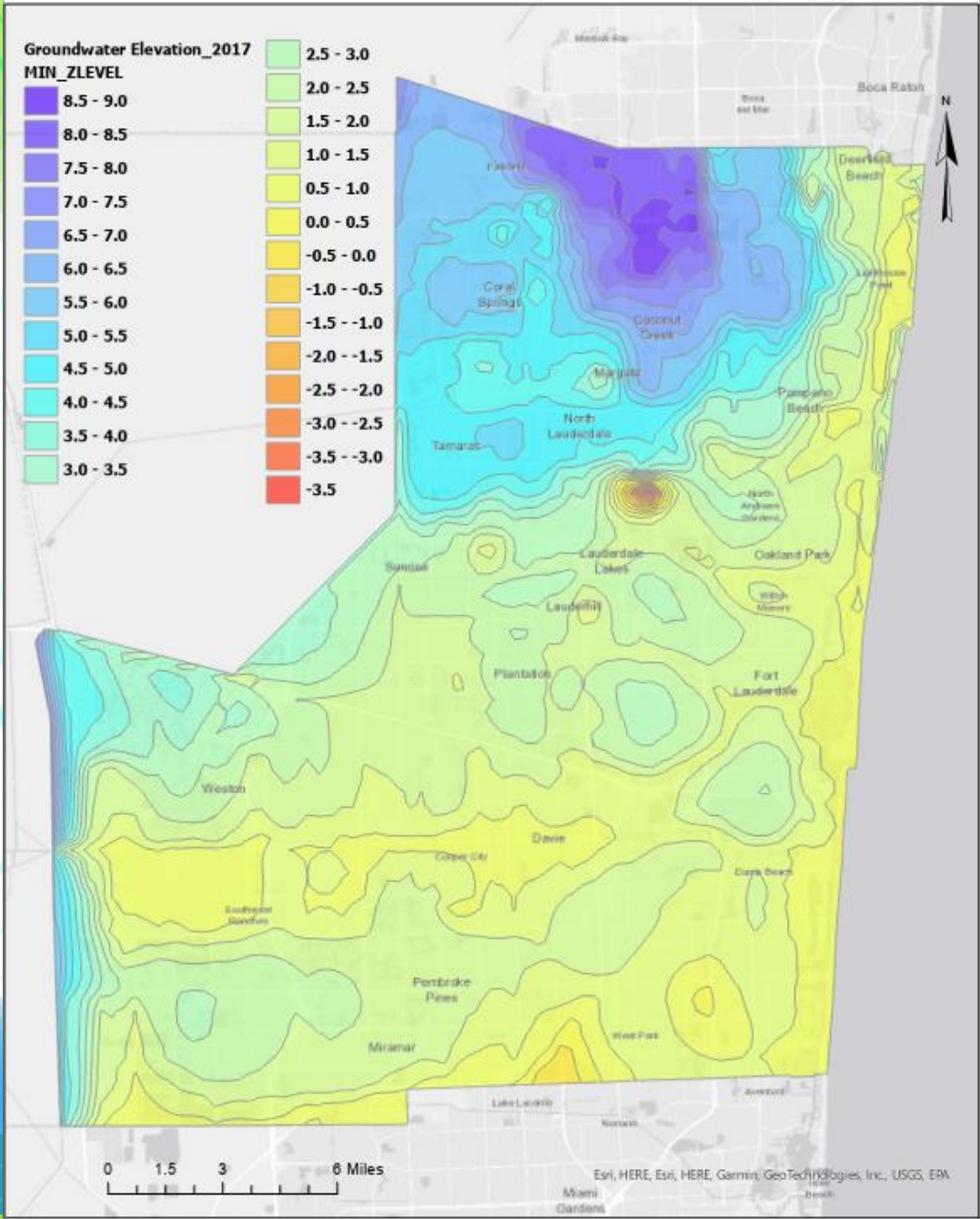
2017 Map Modeling



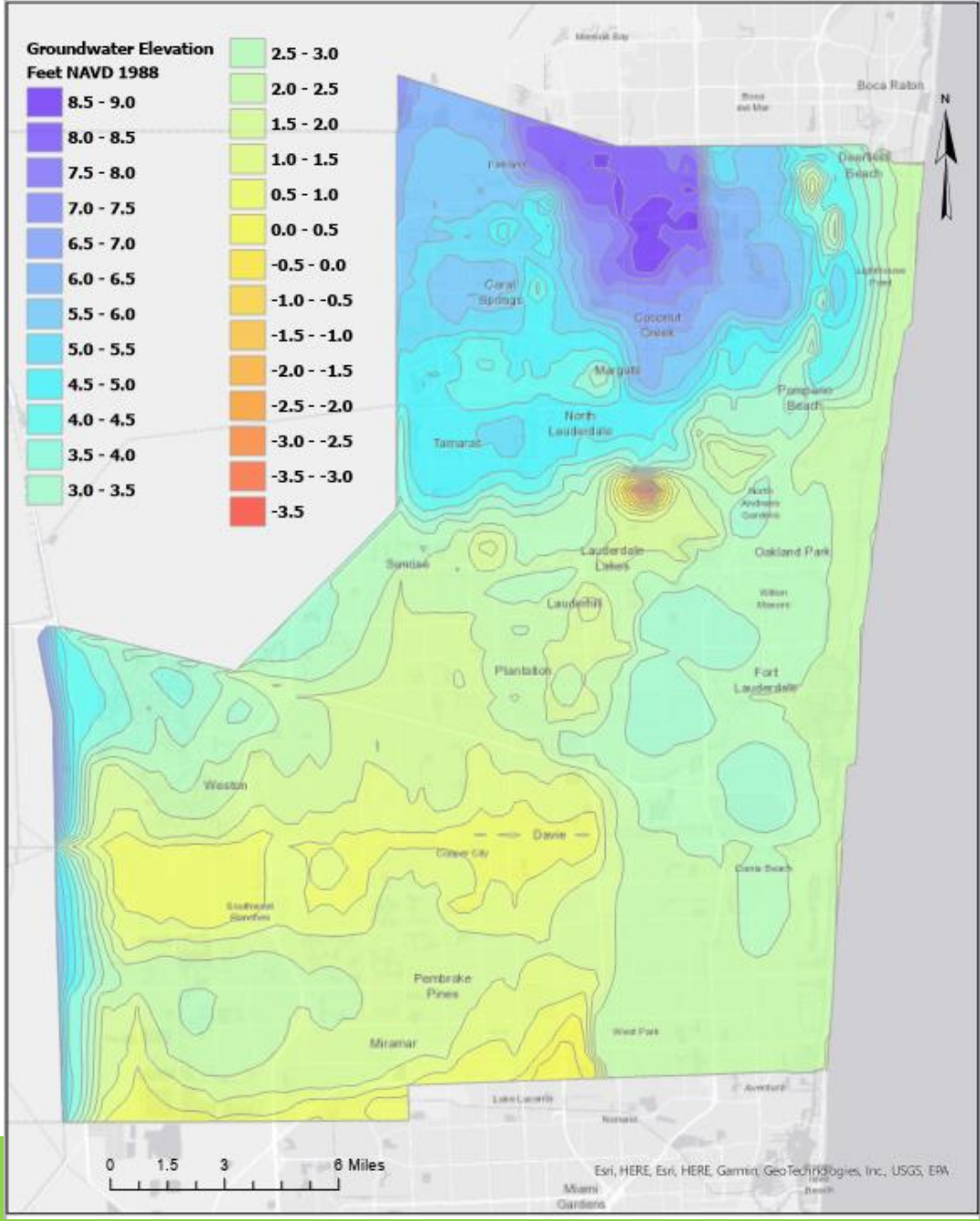
2023 Modeling



2017 – Future Conditions Groundwater Elevation

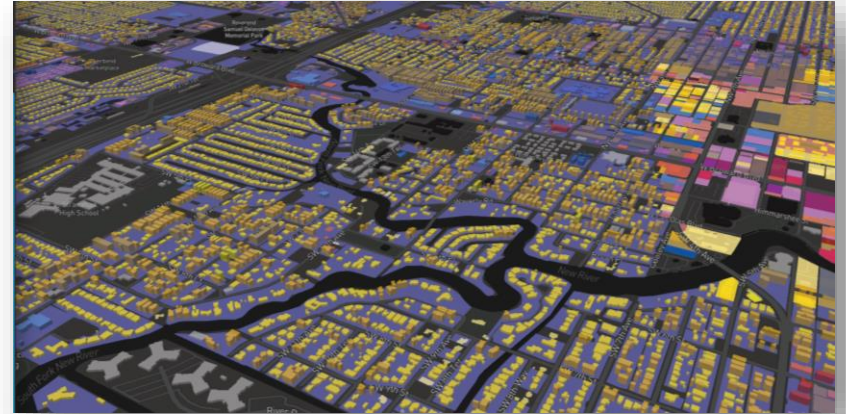


2023 Update – Future Conditions Groundwater Elevation



County-wide Resilience Plan

- Climate Risk Assessment and Resilience Plan
 - Basin-level analysis
 - Critical infrastructure and services
 - Mitigation strategies
 - Planning level cost estimates
 - Redevelopment strategies
 - Priority capital improvements
 - Quantified risk reduction
 - Alternative planning scenarios



Courtesy of MIT and U Toronto

Resilience Plan Components



COMMUNITY
OUTREACH



RISK
ASSESSMENT



ECONOMIC
MODELING

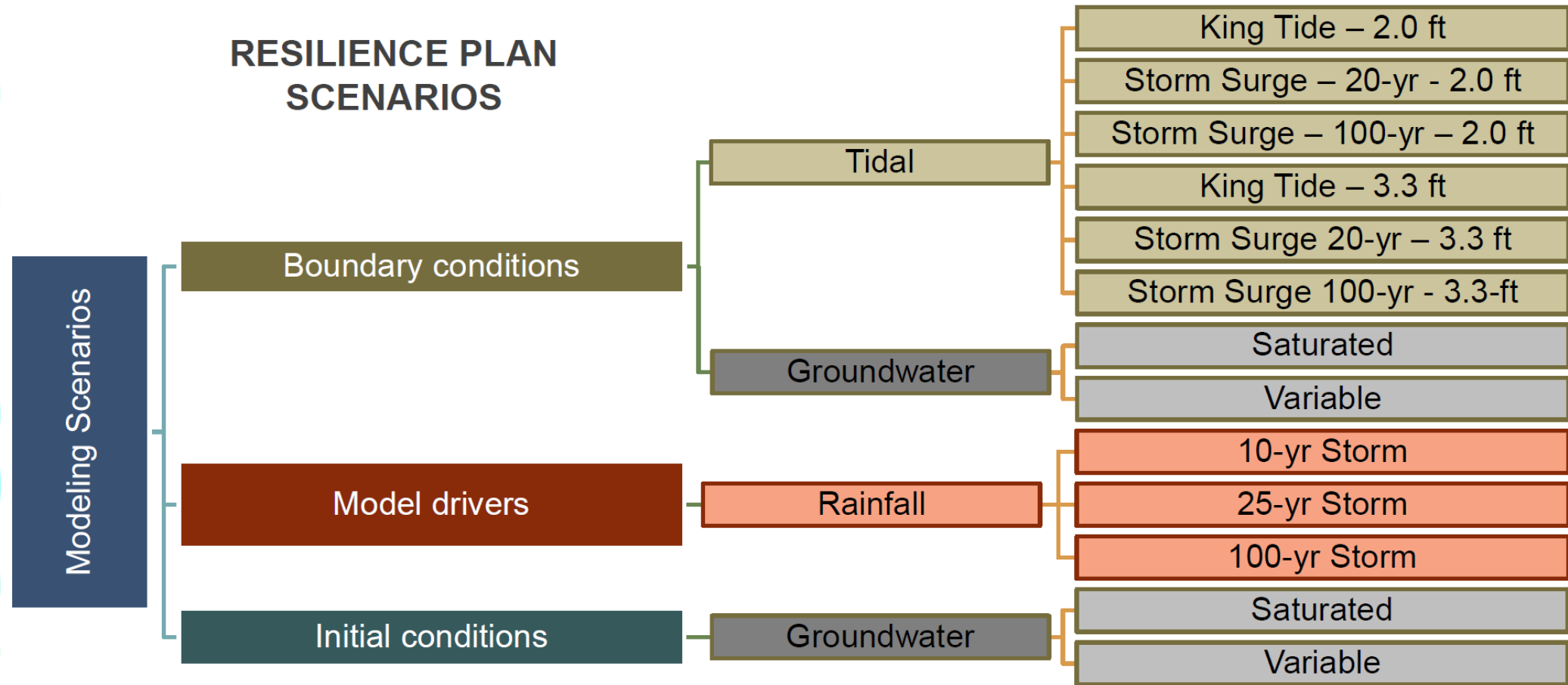


ADAPTION
PLAN



ONLINE
PLATFORM

Planning Scenarios



+ 20%
Change
Factor

Beyond Vulnerability...What are our 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

And...What are the Benefits?

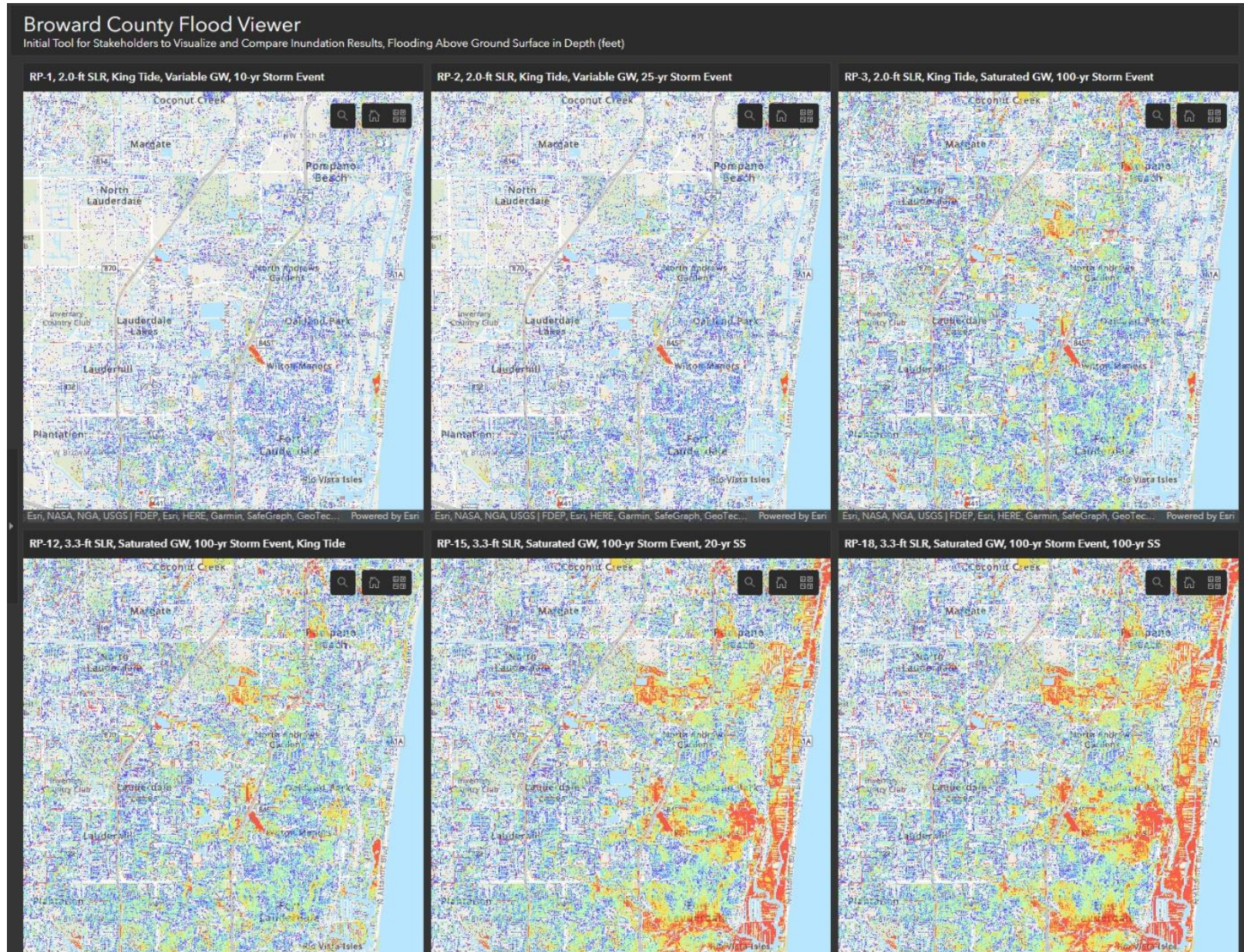
Avoided Loss in:	Avoided Cost of:	Avoided Reduction in:
Resident and Business income	Emergency services	Property values
Neighborhood amenities (a.k.a. - Increases in quality and availability of goods and services)	Property insurance premiums	Value of Recreation days (willingness-to-pay)
	Mortgage interest rates	Value of Environmental amenities (willingness-to-pay)
	Electricity cost to cool properties	
Tax revenue to County and local governments	County borrowing and credit	Government services



Flood and Risk Analyses

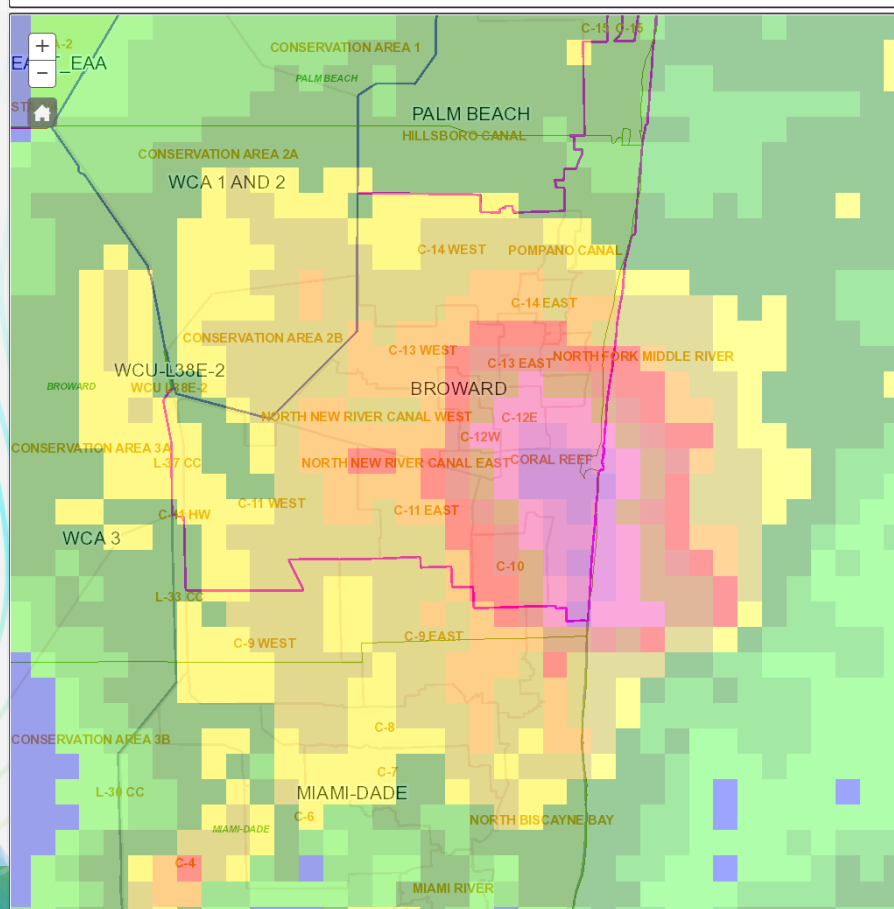
Site-based information to support adaptation planning

bit.ly/RiskAnalyses



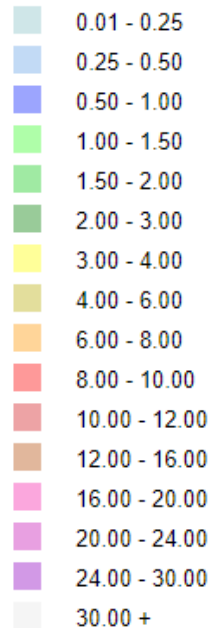
Results Mirror Flooding April 12, 2023

NEXRAD Viewer : RainGrid Radar Rainfall estimates from 4/12/2023 7:00:00 AM to 4/13/2023 7:00:00 AM - Report Run date : 4/13/2023, 9:08:18 A



Legend

Result Rain Grid Layer Raingrid - Query Selection

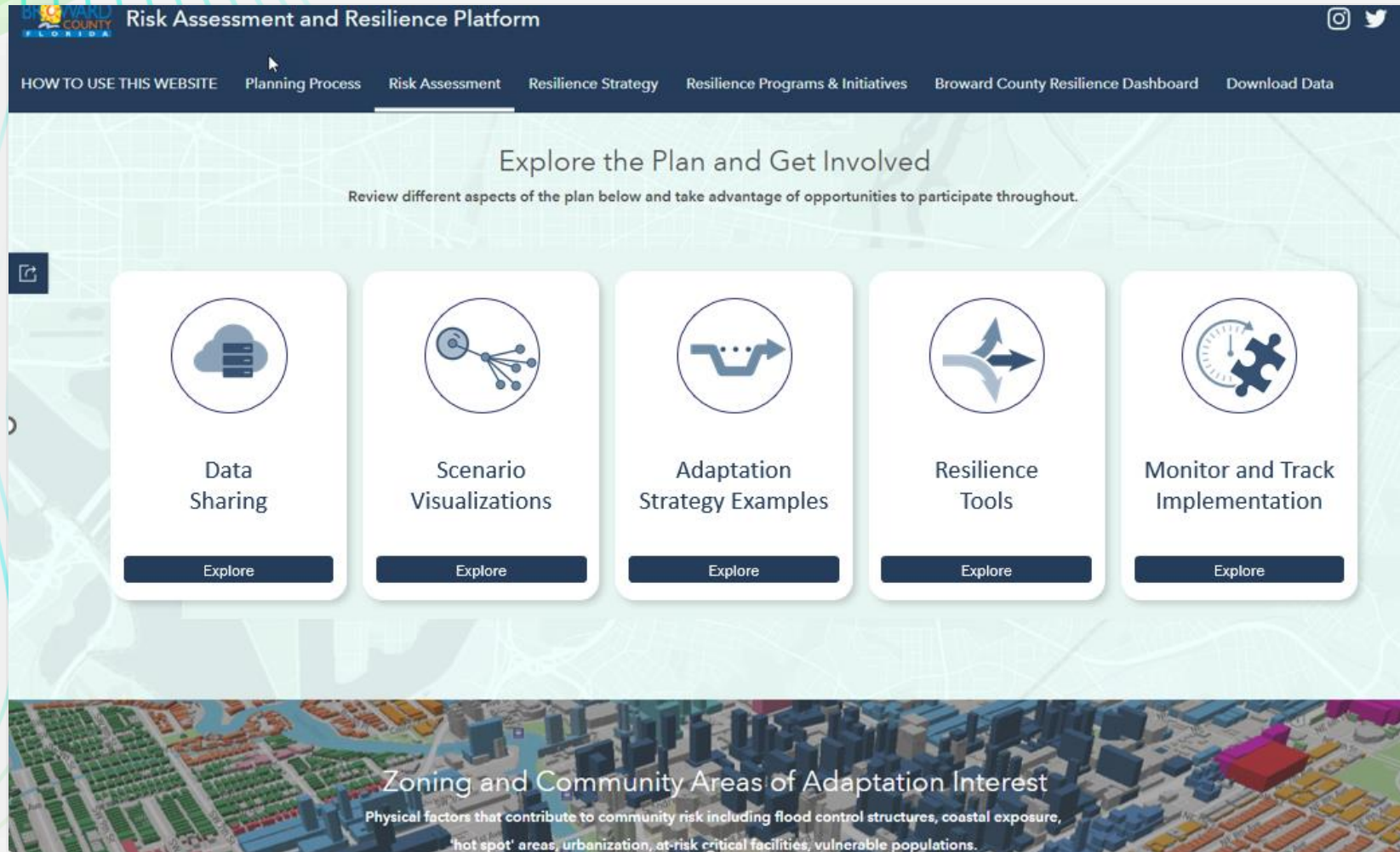




Resilience Plan Elements

- Prioritized adaptation roadmap
- Redevelopment strategies
- Green infrastructure emphasis
- Measured benefits and outcomes
- Planning level cost estimates
- On-line platform with project tracking
- Phased multi-decade implementation
- Funding strategies and cost-share

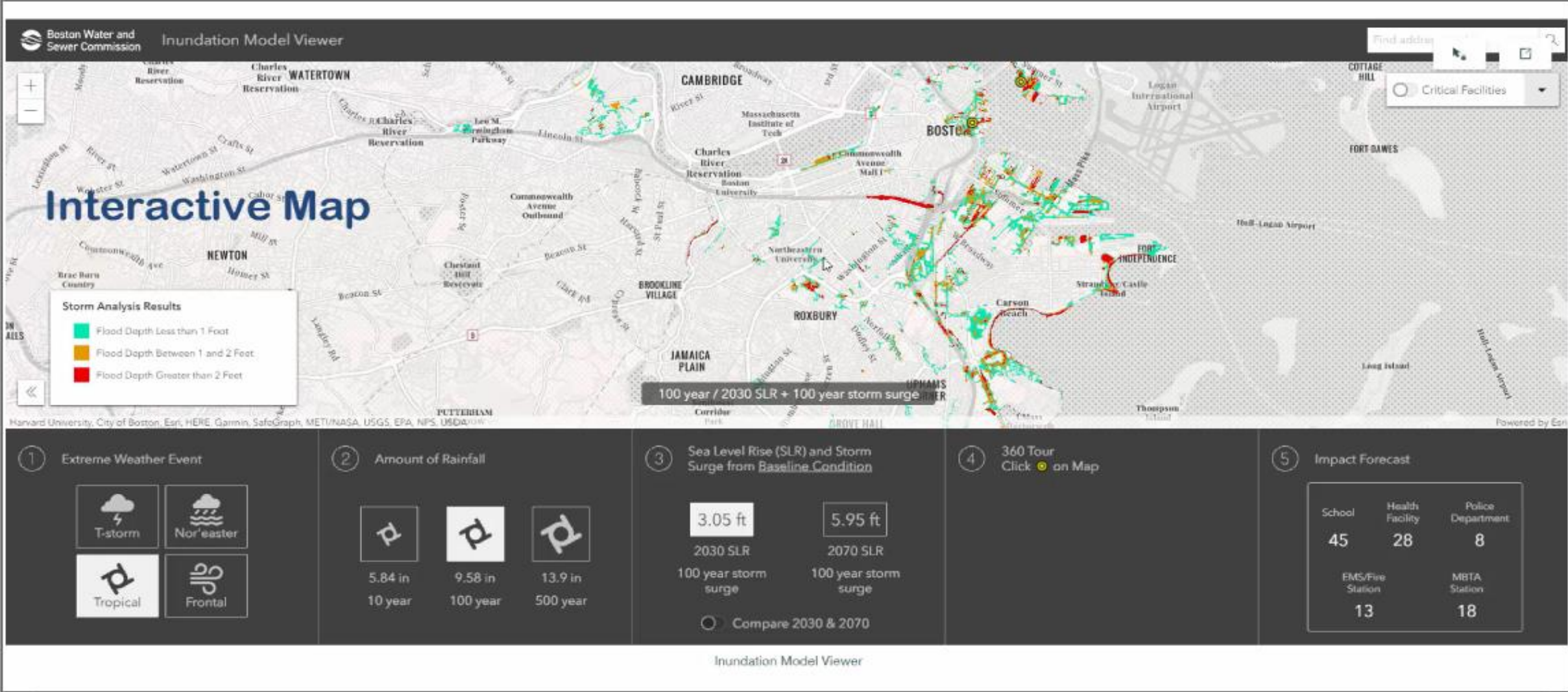
Dashboard Template



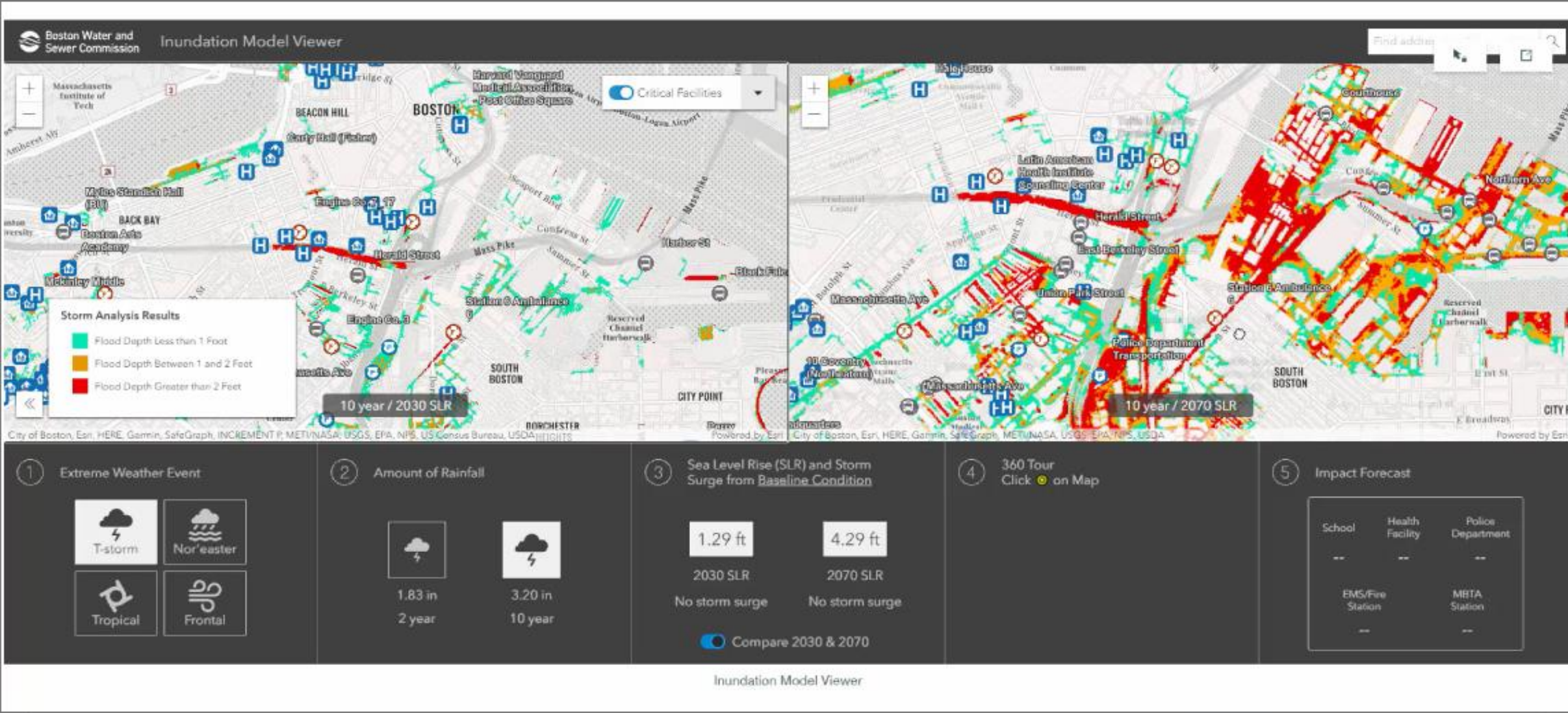
Public and Agency Portals

- County Agency
- Municipalities
- Water Districts
- Planning Agencies
 - Planning Council
 - RPC
 - MPO
 - DOT
 - SFWMD

Boston Inundation Model Viewer



Boston Inundation Model Viewer

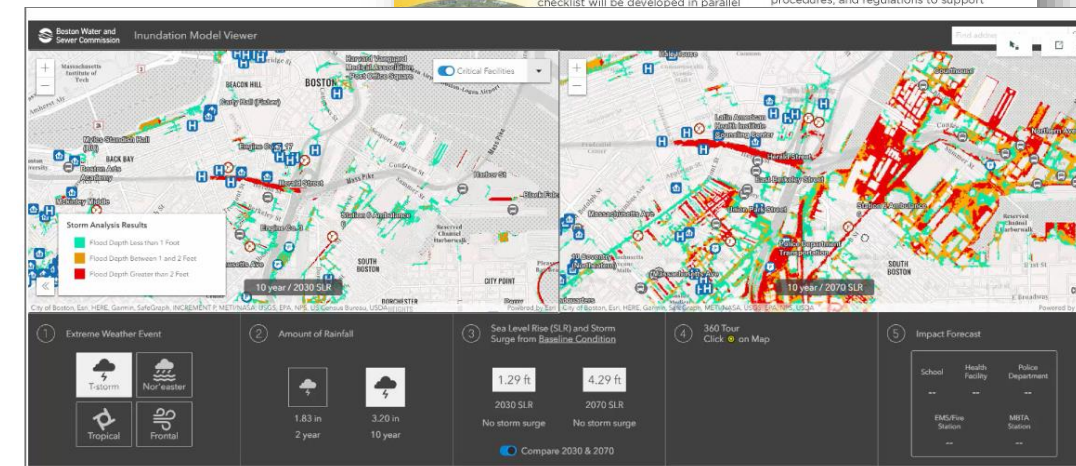
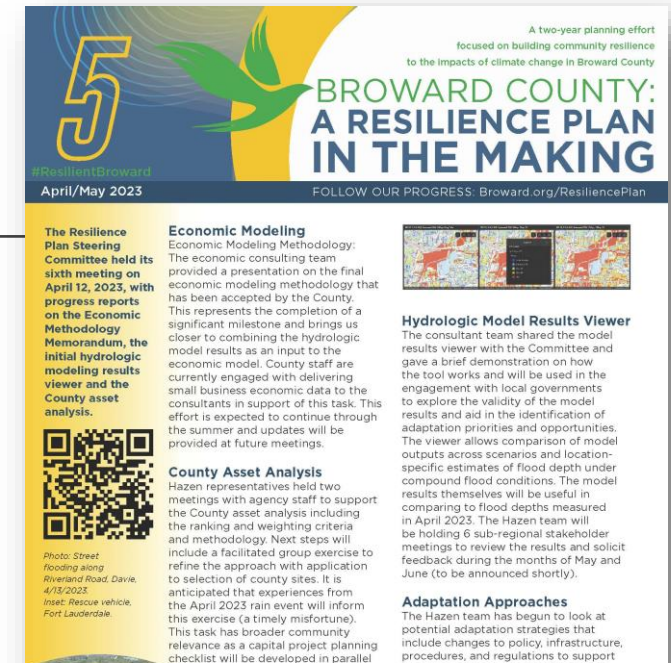


02:20.42



What next?

- No Action Model Scenarios - Complete
- Economics Exposure - Summer
- 1st Stage Adaptation Alternatives – Fall/Winter
- Alternative Workshops – Winter
- Economic Benefits - Spring
- Shared Web Platform - Underway
- Project Finalization – June 2023



Finally, Need for Upgrade of the Reginal Flood Control System

Gravity driven structure



Gravity driven discharge

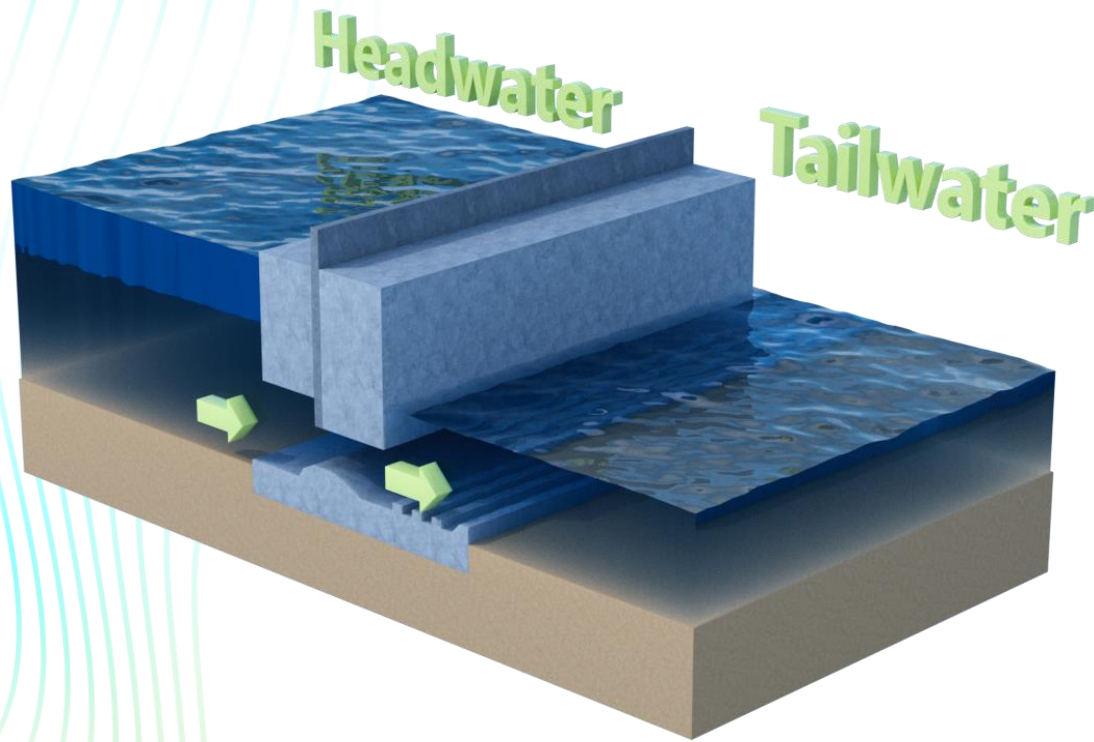


What happens if gates can't open?
What if the gates do open?

Today - Overtopping
Due to Sea Level Rise

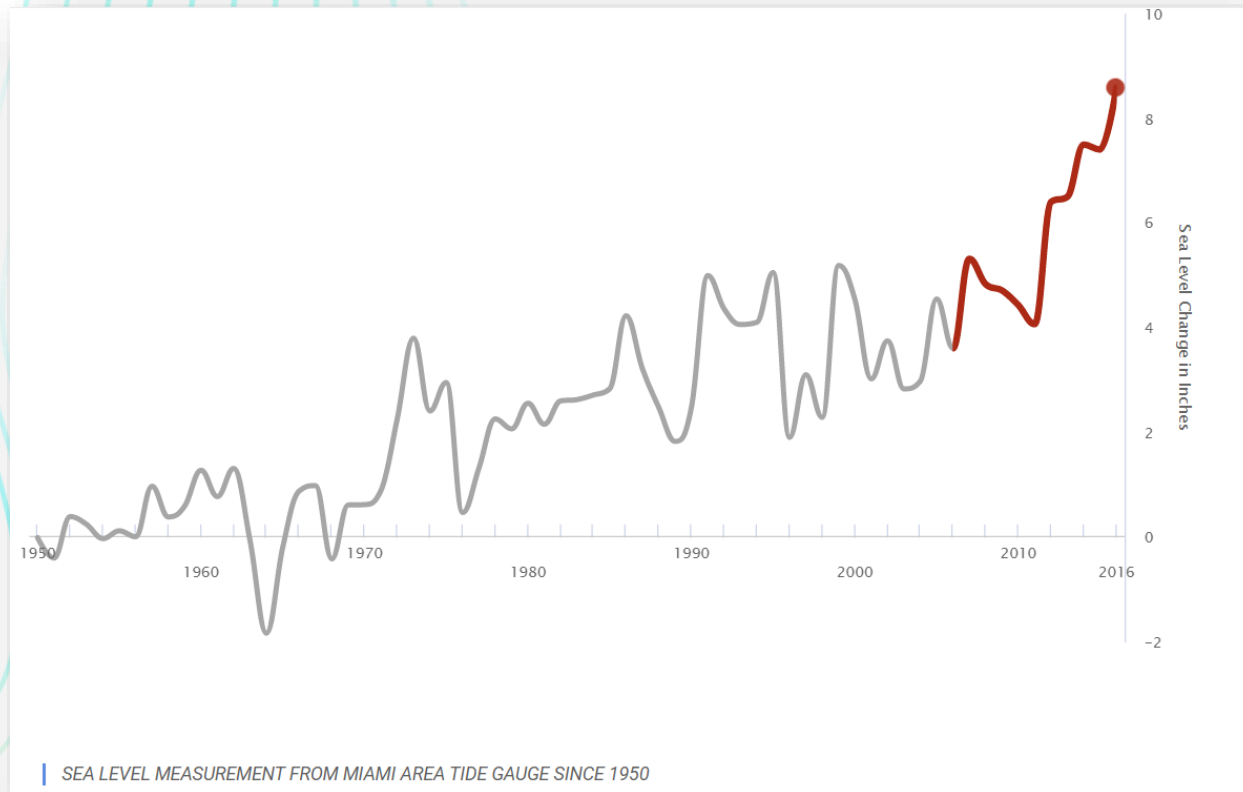


How it Works - Gated Coastal Structure for Water Management

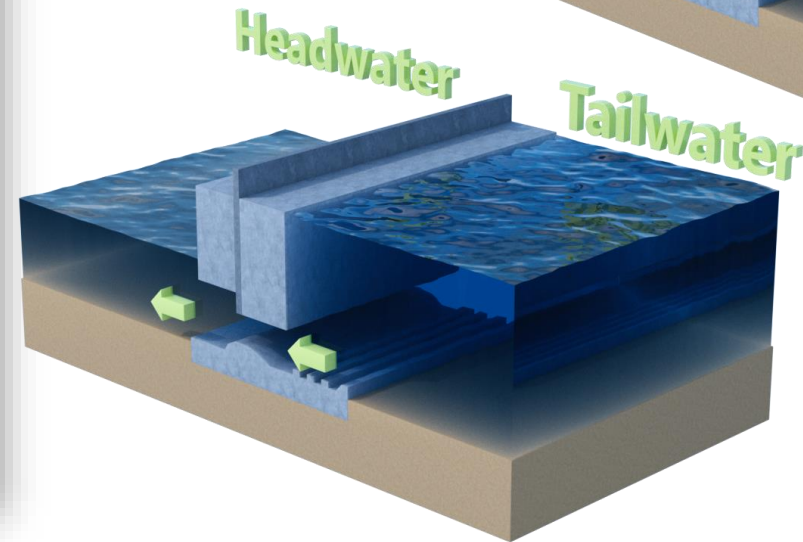
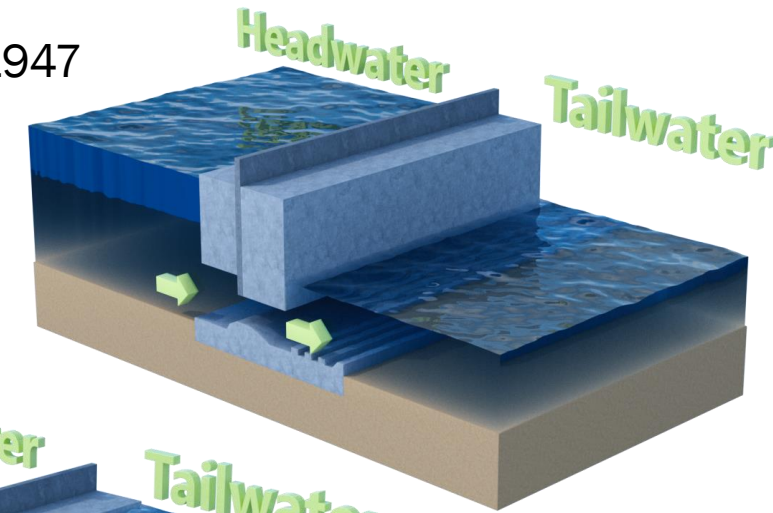


- Gated Structures are used to control water level upstream, preventing salt water from moving inland.
- The gate is lifted so the canal waters drains from the bottom, from the high water side (inland) to low water side (coast).

What has Changed ? Sea Level.



Design Condition - 1947



Current King Tide Condition

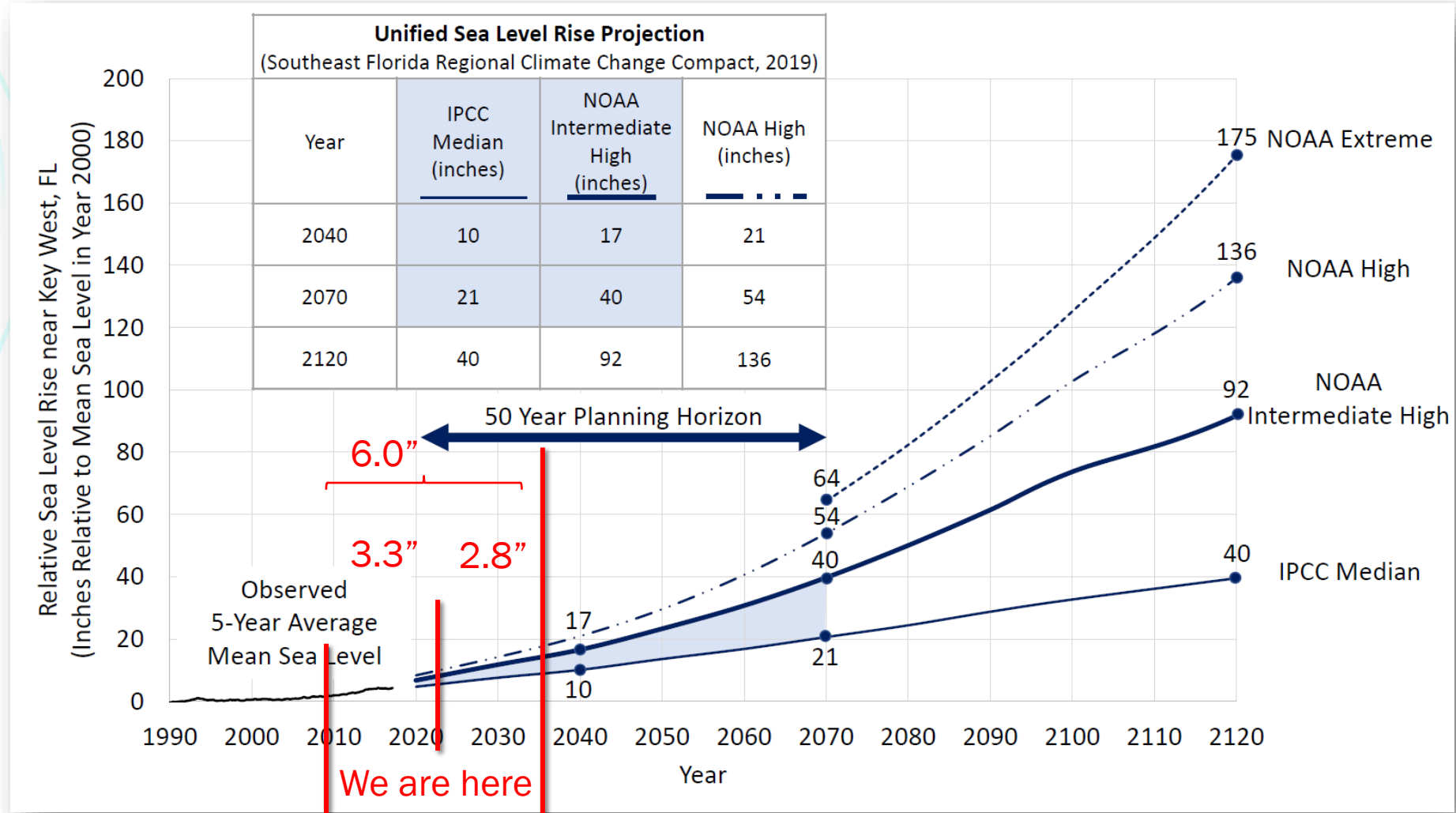
Functional Water Management System



With reduced storage, increased rainfall, and sea level rise



Significant Risk is Here

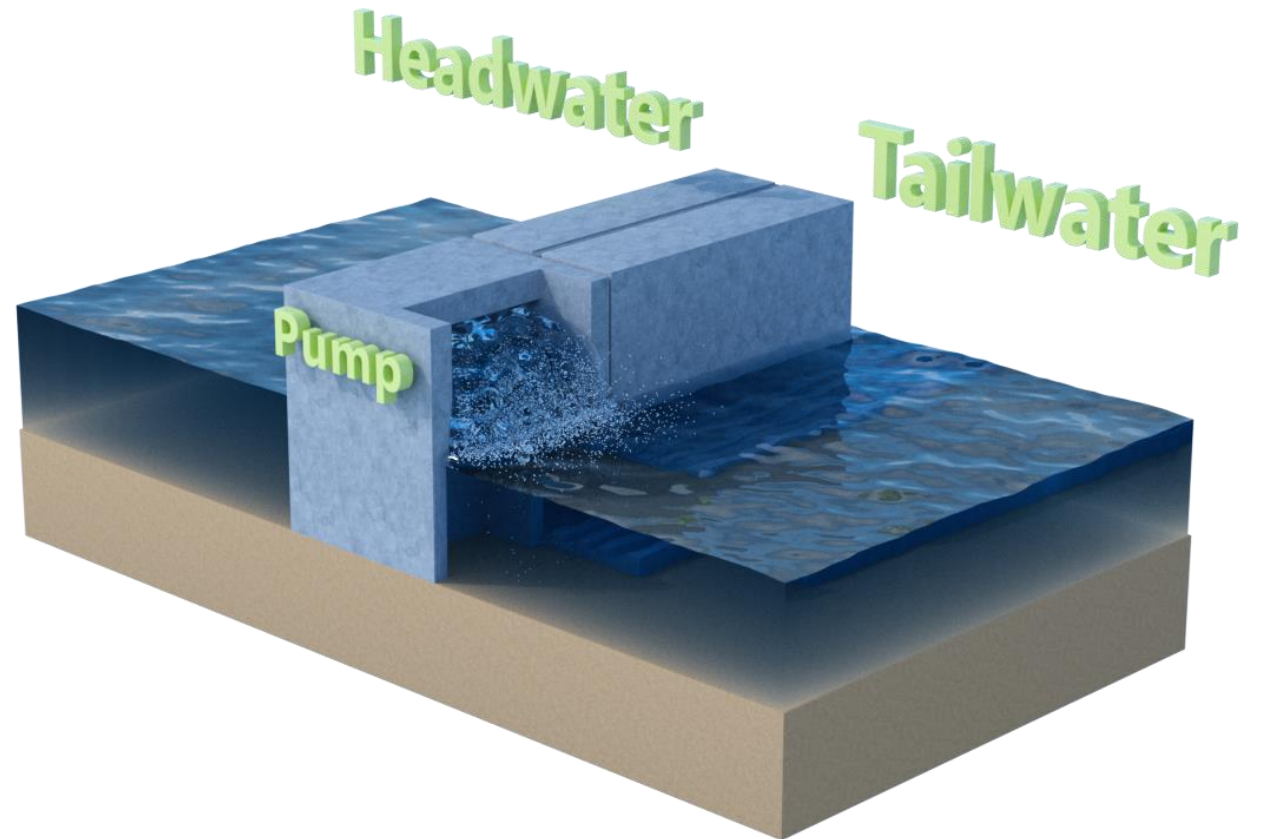


Early Warning
6" to threshold

Deadline for
Improvements

Requiring Adaptation and Storage

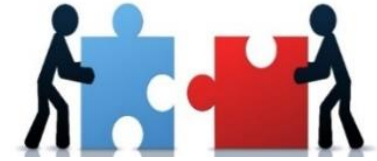
- **Scenario:** Tailwater is equal to or greater than headwater.
- **Solution:** Forward pumps could be added to existing structures to continue to move water when gates are closed.
- **Result:** Water can still be moved to tide, maintaining the ability to drain.



C&SF Status and Needs

- Section 216 Resilience Study underway but underfunded
- Comprehensive Study authorized but not funded
- Urgent need to complete Section 216 Study, and then authorize, fund and construct project recommendations (pumps)
- Section 216 Study Status:
 - Original study only authorized for \$3 M
 - Amended scope requires \$11.3 M
 - Pending Headquarters Approval and Additional Funding
- As a region we need to:
 - Express importance of project to resilience of region
 - Urge full funding of 216 Study
 - Note critical timeline for construction
 - Seek opportunities to acquire land for storage, throughout County

Summary



- Evolving and compound flood risk is one of South Florida's most pressing climate-related challenges
- Regional collaboration via Compact and Cities has accelerated planning and aided implementation
- Risk reduction requires a tiered approach addressing future conditions via standards, site specific improvements, land use practices, redevelopment strategies, systems, and storage
- Near-term economic consequences and benefits provide expanded basis for immediate action
- County-wide resilience plan will aid entire community but requires shared, coordinated, and sustained implementation

Questions ?

DR. JENNIFER JURADO

Chief Resilience Officer, Deputy Director
Resilient Environment Department

jjurado@broward.org

954-519-1464



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