SOUTH FLORIDA WATER MANAGEMENT DISTRICT

University of Florida Water Institute Symposium

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FPLOS - A PROGRAMMATIC APPROACH TO IDENTIFYING AND ADDRESSING FLOOD RISK IN SOUTH FLORIDA

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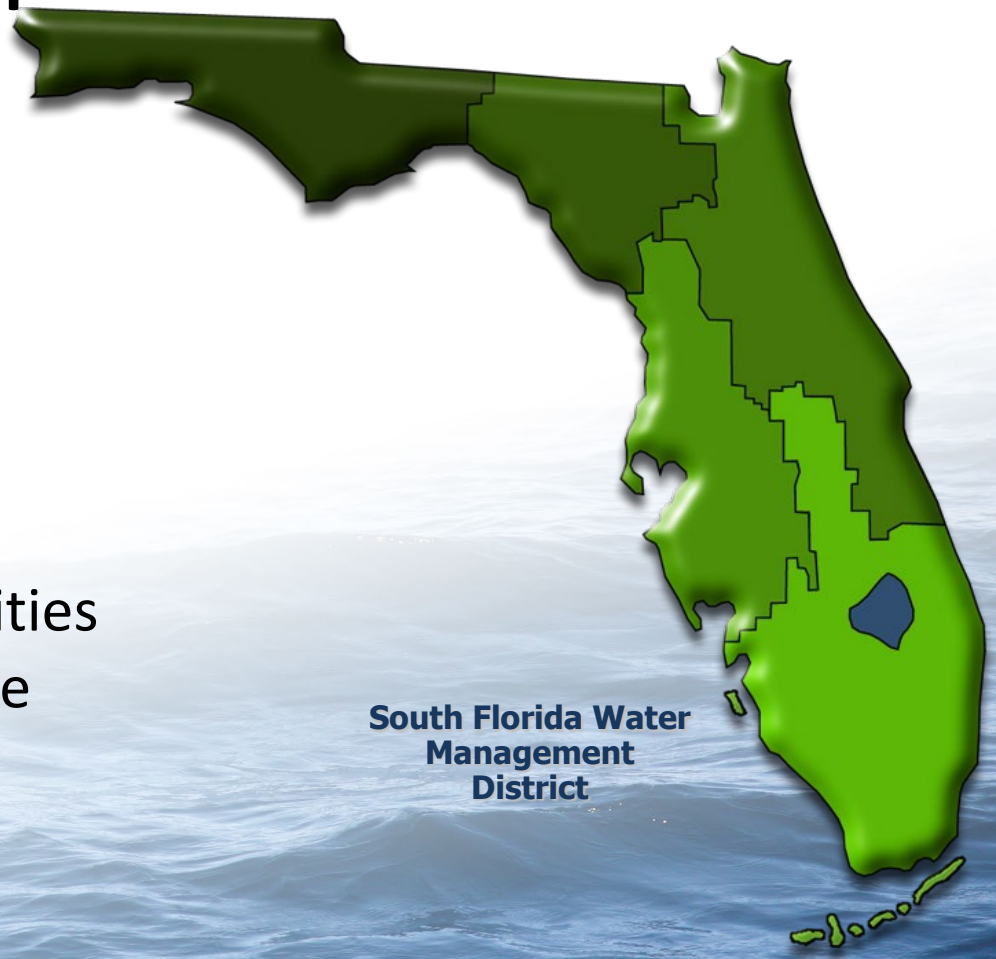
sfwmd.gov

SFWMD - Who We are and What we do

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

- Oldest and largest of the state's five regional water management districts
- Protecting water resources in the southern half of the state since 1949
- Our mission: To safeguard and restore South Florida's water resources and ecosystems, protect our communities from **flooding**, and meet the region's water needs while connecting with the public and stakeholders

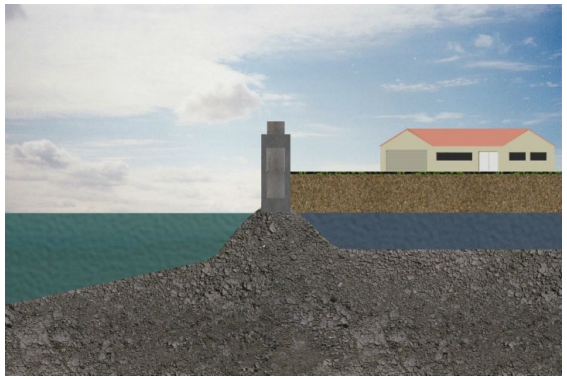


Water Management System

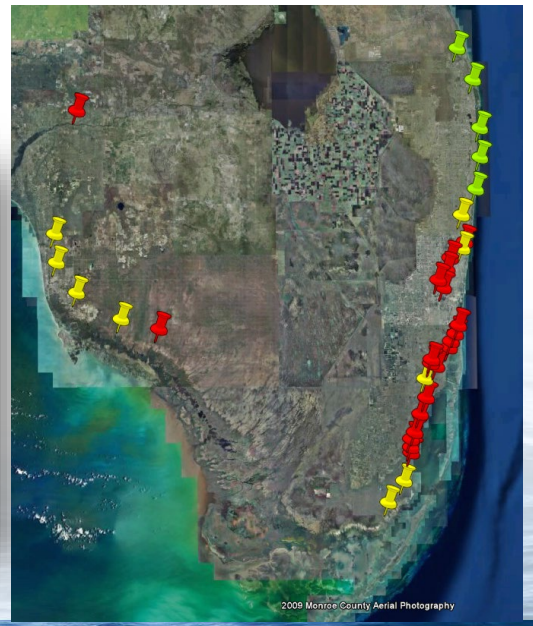
- 2,175 miles of canals
- 2,130 miles of levees
- 160 major drainage basins
- 1,413 water control structures / project culverts
- 89 pumping stations
- 60,000 acres of regional wetland Stormwater Treatment Areas
- Lake Okeechobee
  - 450,000 acres surface area
- Water Conservation Areas
  - 959,000 acres for water conservation

Coastal Structures and Flood Protection

Potentially impacted gravity coastal structure in Miami-Dade County



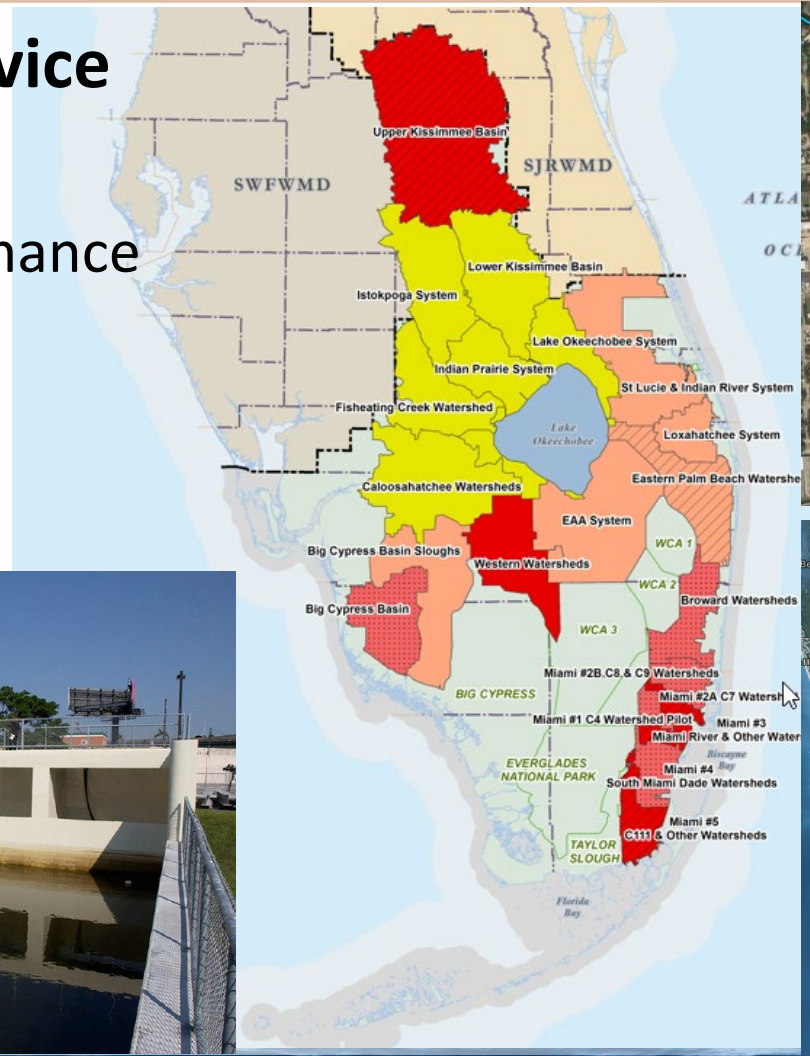
Aerial Map of Coastal Miami

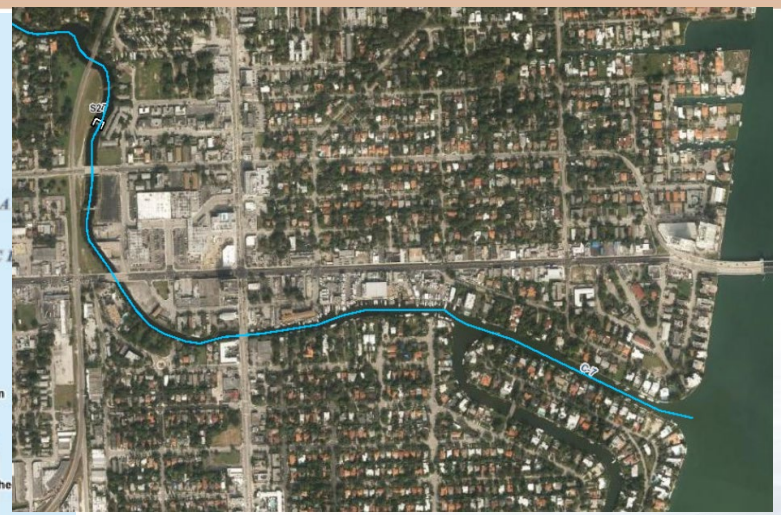


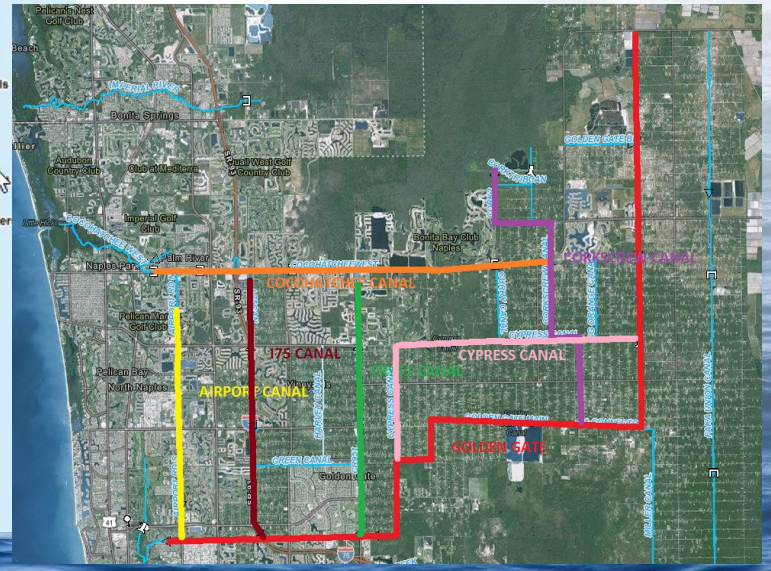
- Gravity Coastal structures on primary canals (also known as Salinity Barriers") showing inefficiency during high tide
  - Designed and built in the 1950s
  - Finding from initial screening: Miami-Dade County most potential to be impacted
- Future potential rise in water table due to sea level rise will further impact flood protection
- Future potential increase in extreme rainfall and the projected increase in intensity and frequency of hurricanes will exacerbate sea level rise impacts

Flood Protection Response

- **Flood Protection Level of Service program:**
  - Assess flood protection performance of flood control infrastructure
  - Support decision making on prioritizing improvements and adaptation

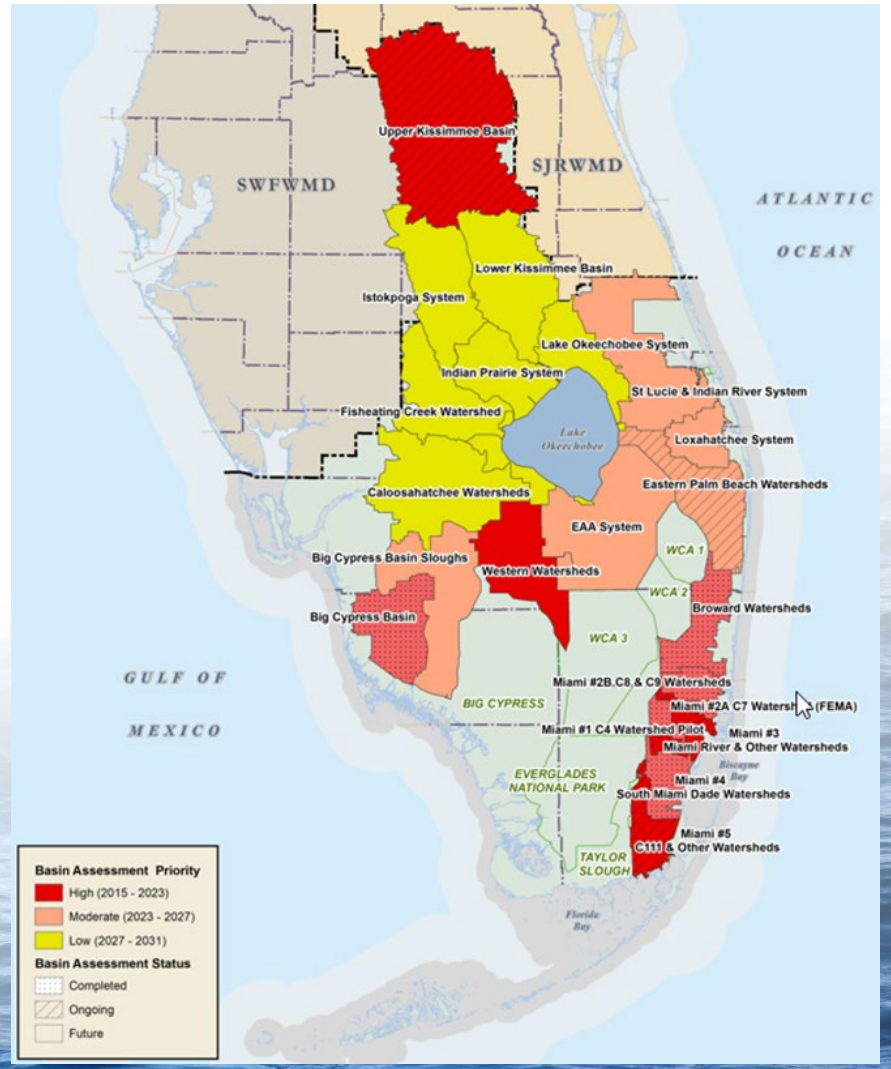






Flood Protection Level of Service Program

- Identify and prioritize long-term flood control infrastructure needs for the District
- Assess level flood protection throughout the 16-counties of the SFWMD – relative to design
- Identify at-risk structures and needed improvements to operations, canal conveyance or structures
- Provide a formal process to initiate retrofit and adaptation efforts for future infrastructure improvements and/or modification of regulatory criteria
- Incorporate resilient design and construction standard
- Coordinate with SFWMD Operations, local government entities, drainage districts and other agencies with flood control or related responsibility



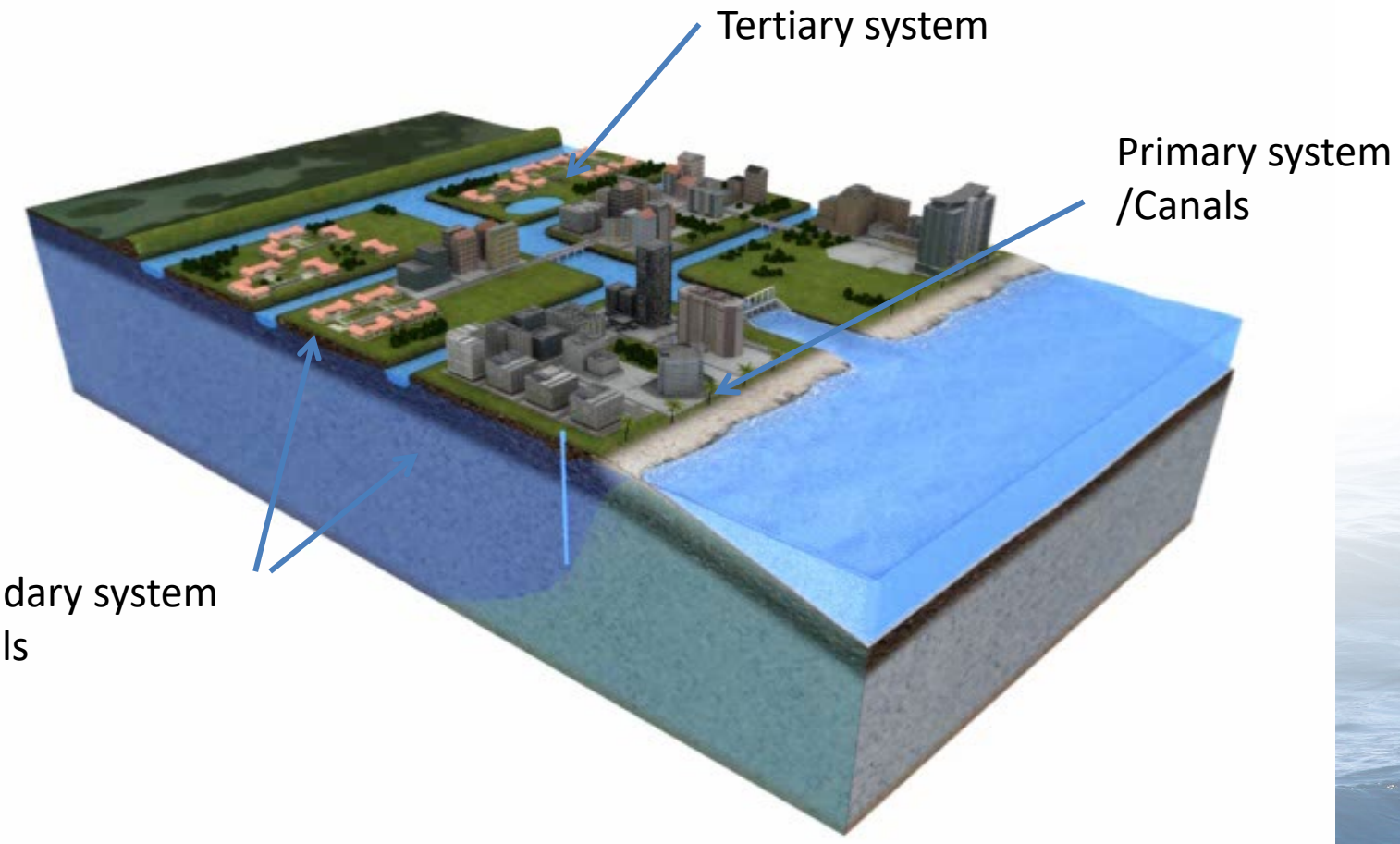
Three-Tiered System

FPLOS Assessment

- Primary
- Existing assets

FPLOS Adaptation

- Full System
- New assets and operations



Three Phases of the FPLOS Program

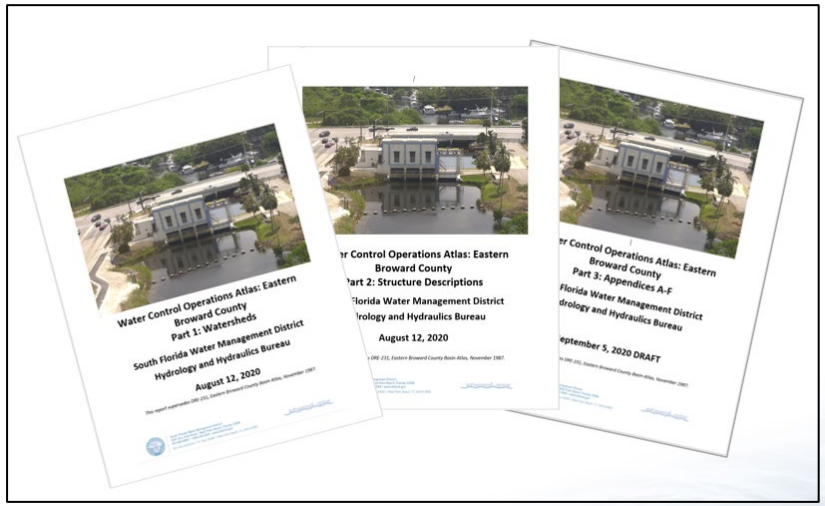
- Focus on Flood Control Assets in Primary system
- Identify flood vulnerable assets and regions

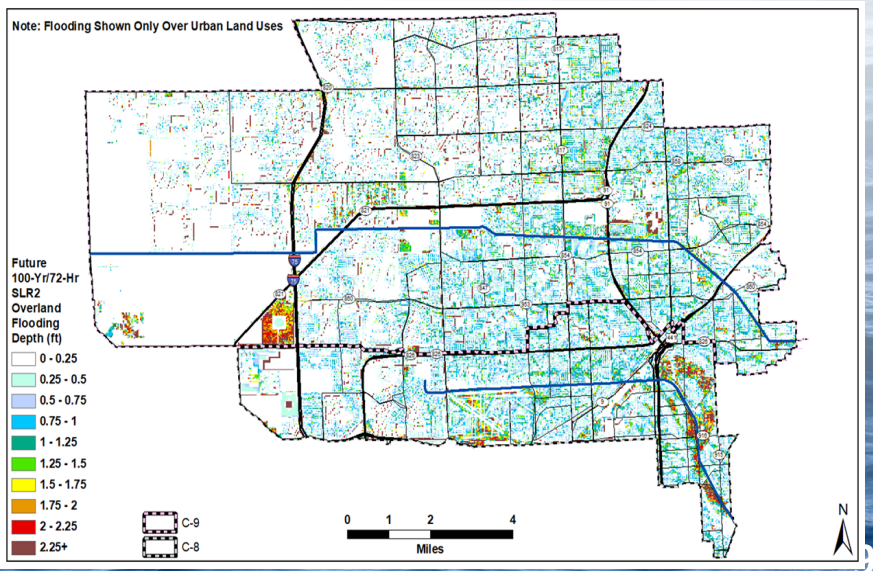
- Focus on Primary, Secondary and Tertiary systems
- Collaboratively identify projects, operations or regulations to meet flood control needs

- Design, permit and build identified projects to achieve resilient flood protection goals, integrated into the Sea Level and Flood Resiliency Plan

Activities Completed in a Typical FPLOS Assessment

- Focus on primary system
- Compilation and publishing of a multi-volume water control operations atlas of the basin
- Hydraulic and hydrologic model of basin including structures, pumps stations and canals
- Assessment of current conditions using different severity of storm events (rainfall) plus storm surge
- Simulation of future conditions with three different Sea Level Rise projections also with rainfall and storm surge
- Identify underperforming or at-risk segments or components
- Coordination with counterparts in the County





Flood Vulnerability based on Six Performance Metrics

Canal

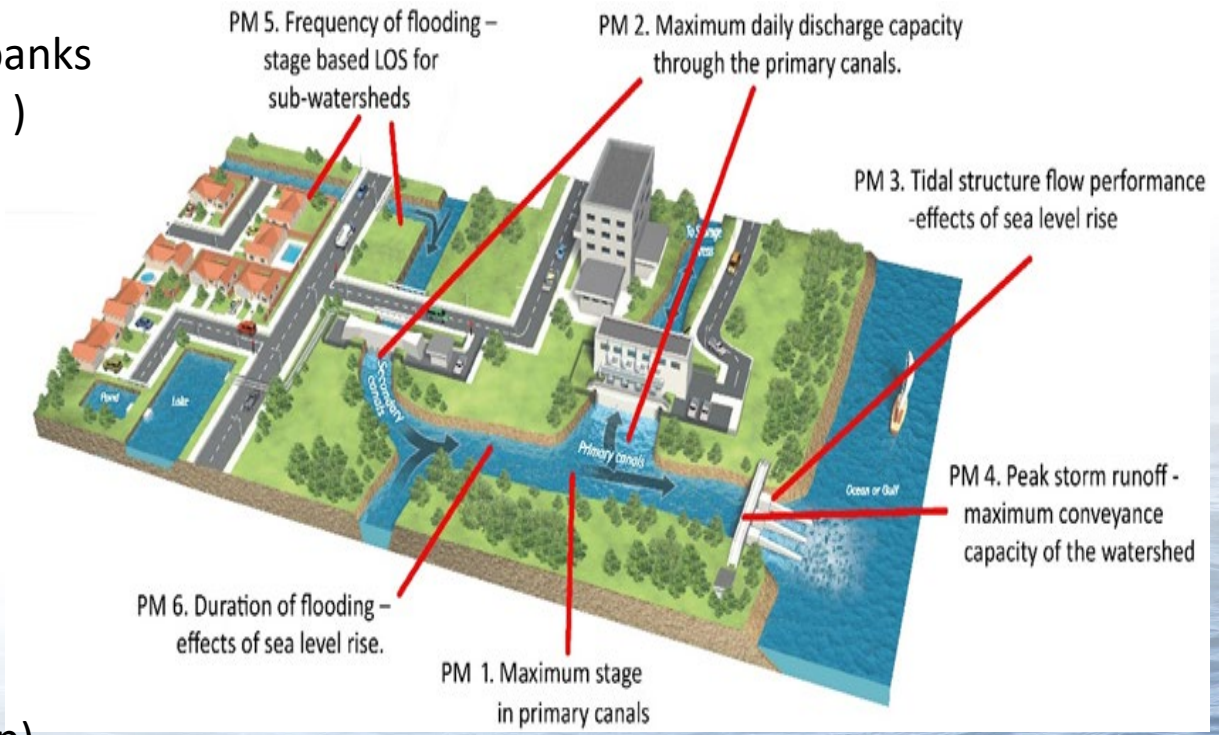
- What is the maximum stage reached, does it exceed the banks or other critical elevation? (PM1: Maximum stage profiles)
- What is the discharge capacity of each sub-basins (PM2: measured in units of cfs/sq mile)

Tidal Structure (Sea Level Rise)

- What is the structure flow capacity during surge (PM3)
- What peak stage is reached upstream of the structure due to surge and Sea Level Rise (PM4)

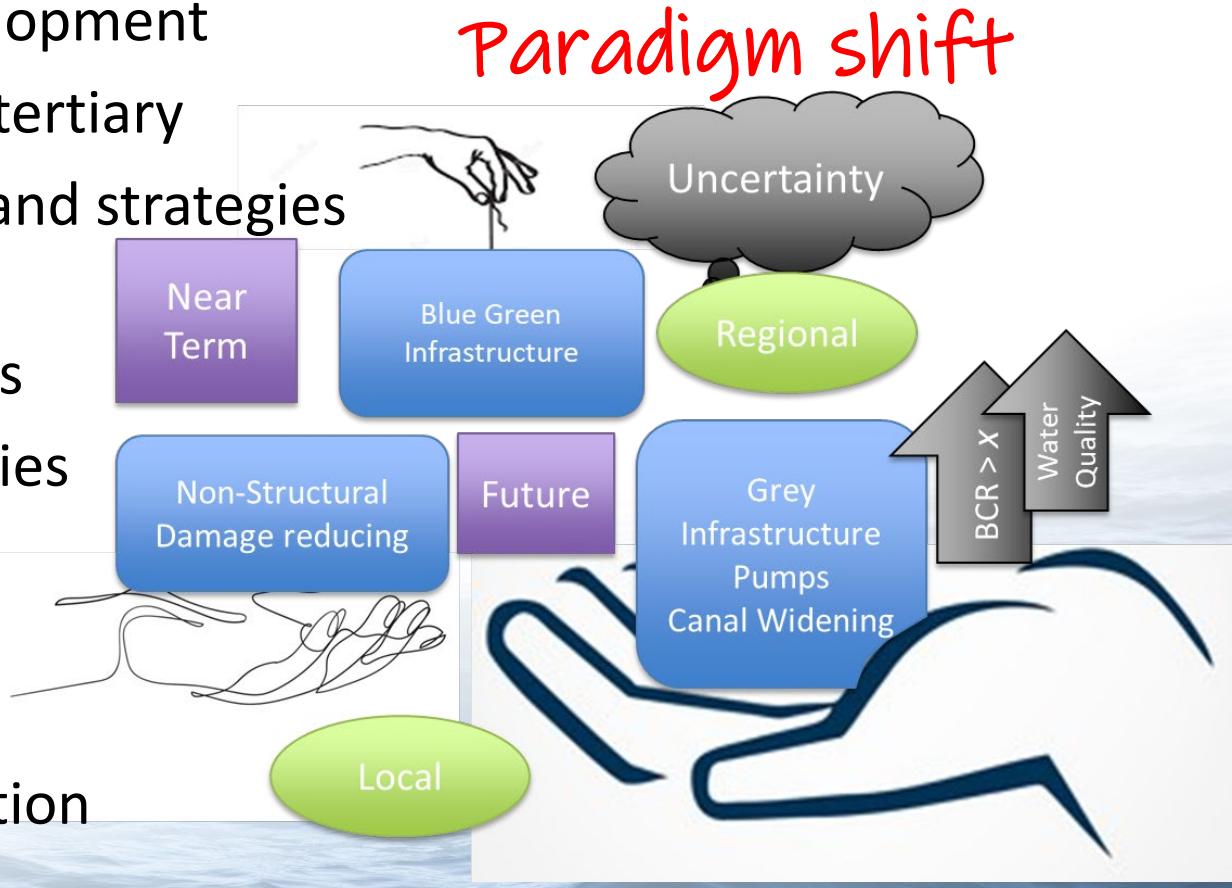
Land

- What is the maximum flood depth (PM5: Flood depth map)
- How long did the flooding persist (PM6: Flood duration map)



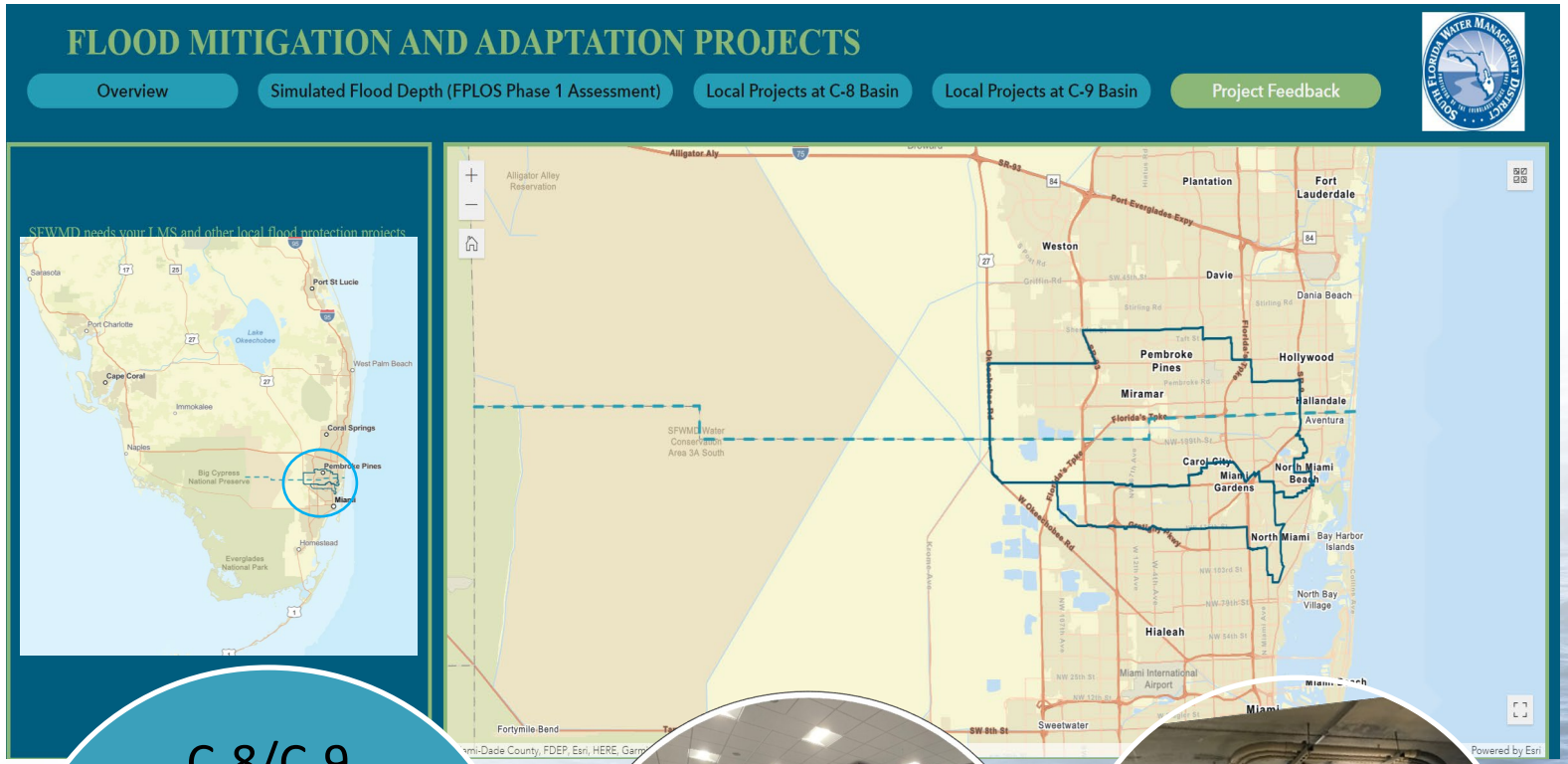
Activities Completed in a Typical FPLOS Adaptation and Mitigation Planning Study

- Plan for future extreme rainfall, SLR and development
- Focus on full system, primary, secondary and tertiary
- Public planning process that integrates input and strategies in all three tiers
- Mitigation and adaptation strategies in all tiers
- Hydraulic and hydrologic model of the strategies
- Damage assessment without adaptation and with each identified strategy or combination of strategies
- Sequencing and combination of courses of action
- Selection of optimal course of action
- Basis of design level evaluation of selected plan



Case Study: C-8/C-9 FPLOS Adaptation and Mitigation Study

- Straddles Miami Dade and Broward County, Municipalities and 298 Districts
- Public Planning Process:
  - Workshop
  - 41 technical team meetings
  - Present the findings in a public workshop
- Comprehensive Assessment Strategy
- Paradigm shift in stakeholders' expectations for flood protection strategies



C-8/C-9 Watersheds: C-8 C-9 Basins FPLOS (buildcommunityresilience.com)

Example Regional Strategies

Regional (M2A)

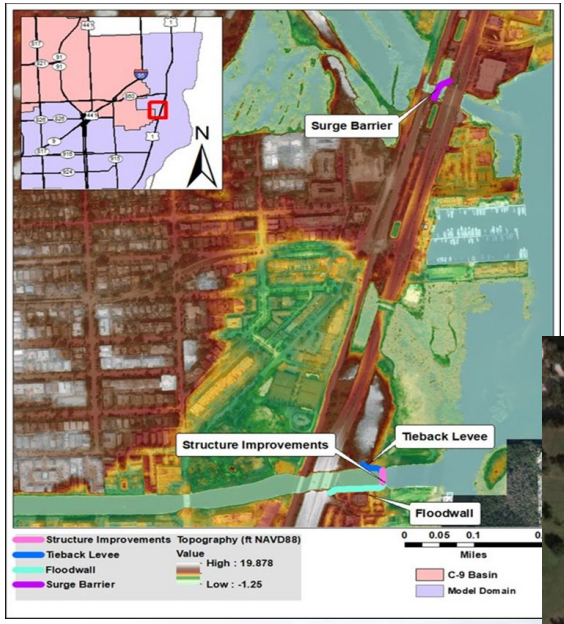
- S28 and S29 forward pumps (1550 cfs)
- Gate improvement- raised top elev. to 9.0 ft NGVD29
- Tieback levees/floodwalls
- Total of 500 ac-ft distributed storage

Regional (M2B)

- All the M2A components
- Additional 1000 cfs for S28 and S29 (2550 cfs)
- Canal improvements – improved geometry and raised banks
- Internal drainage system along primary canals to drain water through raised banks

Regional (M2C)

- All the M2B components
- additional 1000 cfs for S28 and S29 (3550 cfs)
- Canal improvements – widened cross sections



work in progress, subject to change

Distributed Storages / Green Infrastructures and Nature-Based Solutions

Potential Distributed Storages

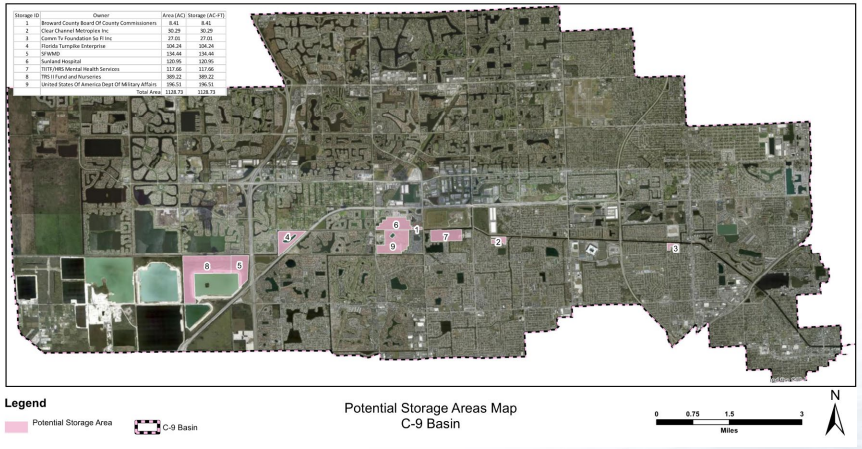
- Flood control benefits
- water quality benefit by capturing the pollutants from the first flush
- Identified 19 areas in C-8 watershed
- Identified 9 areas in C-9 watershed

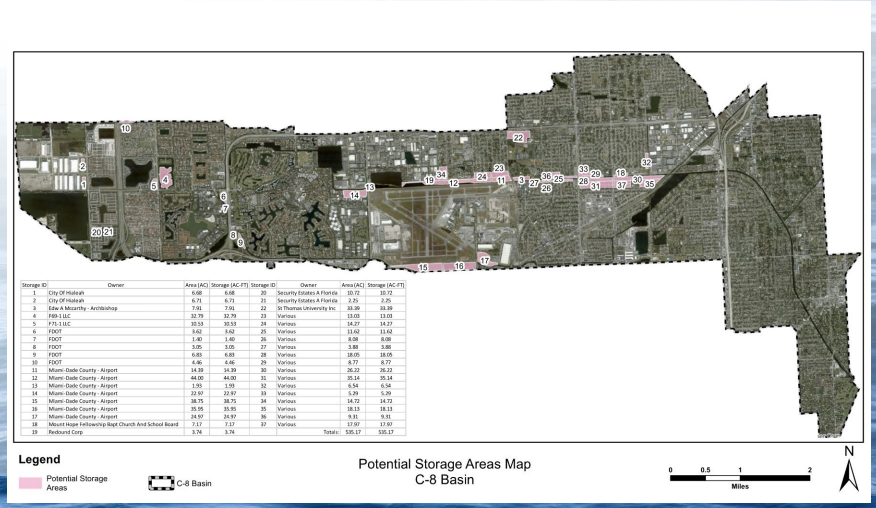
Green Infrastructures and Nature-Based Solutions

- Being constructed as a green infrastructure
- Vegetated flood berms to enhance flood protection through retention/detention
- Green Spaces (bioretention and infiltration)
- Enhanced infiltration/Groundwater recharge and storage

Other Opportunities for Green Infrastructures

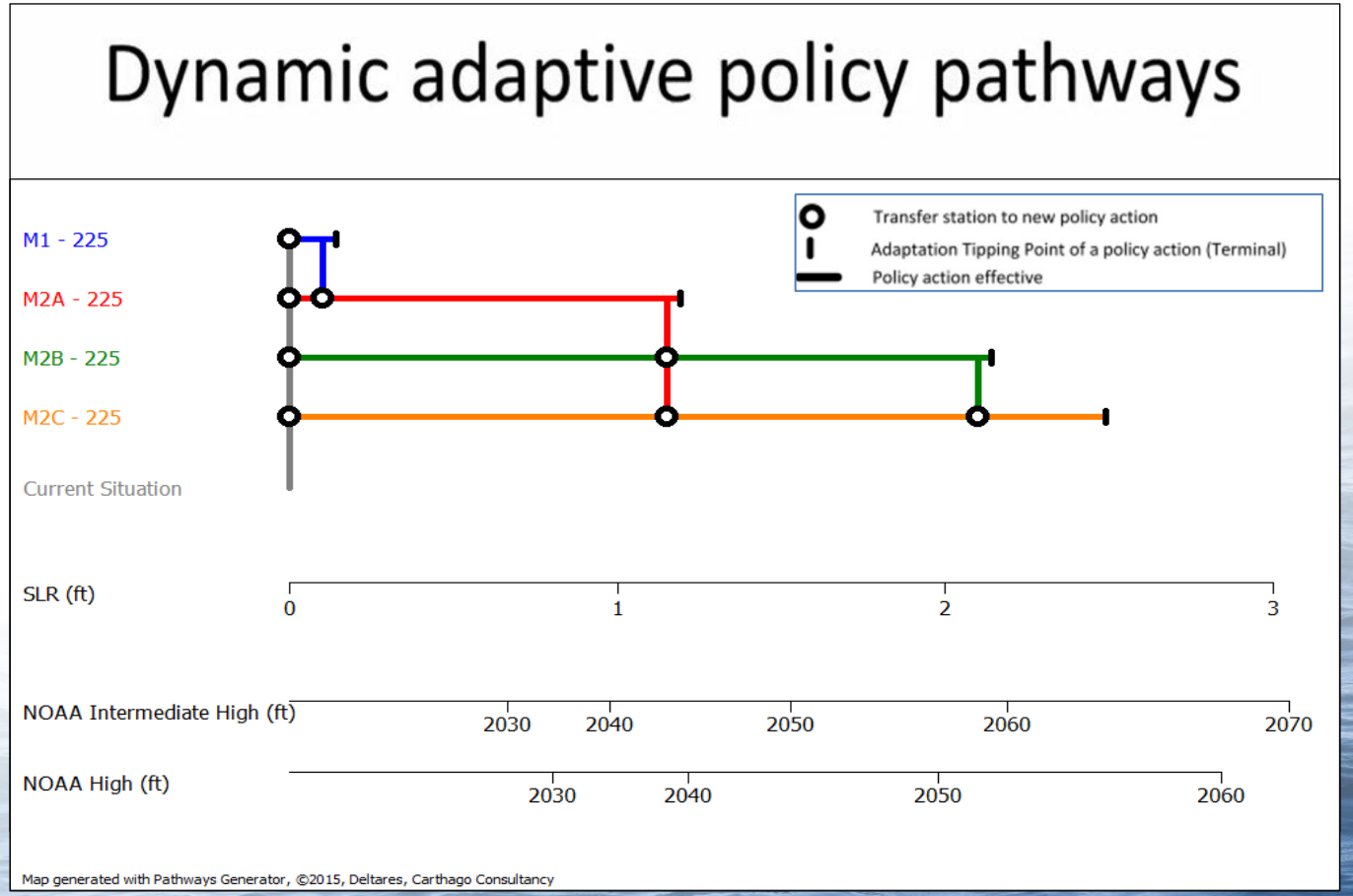
- Installation of living shoreline along a canal
- Including more green features during implementation phase





Supporting Decision Making under Deep Uncertainty

- Infrastructure cost is high, so is the cost of doing nothing
- There is significant uncertainty
- How to make informed near-term decisions that do not preclude other courses of action
- The difference between a good plan and an *implemented* good plan



Free Book

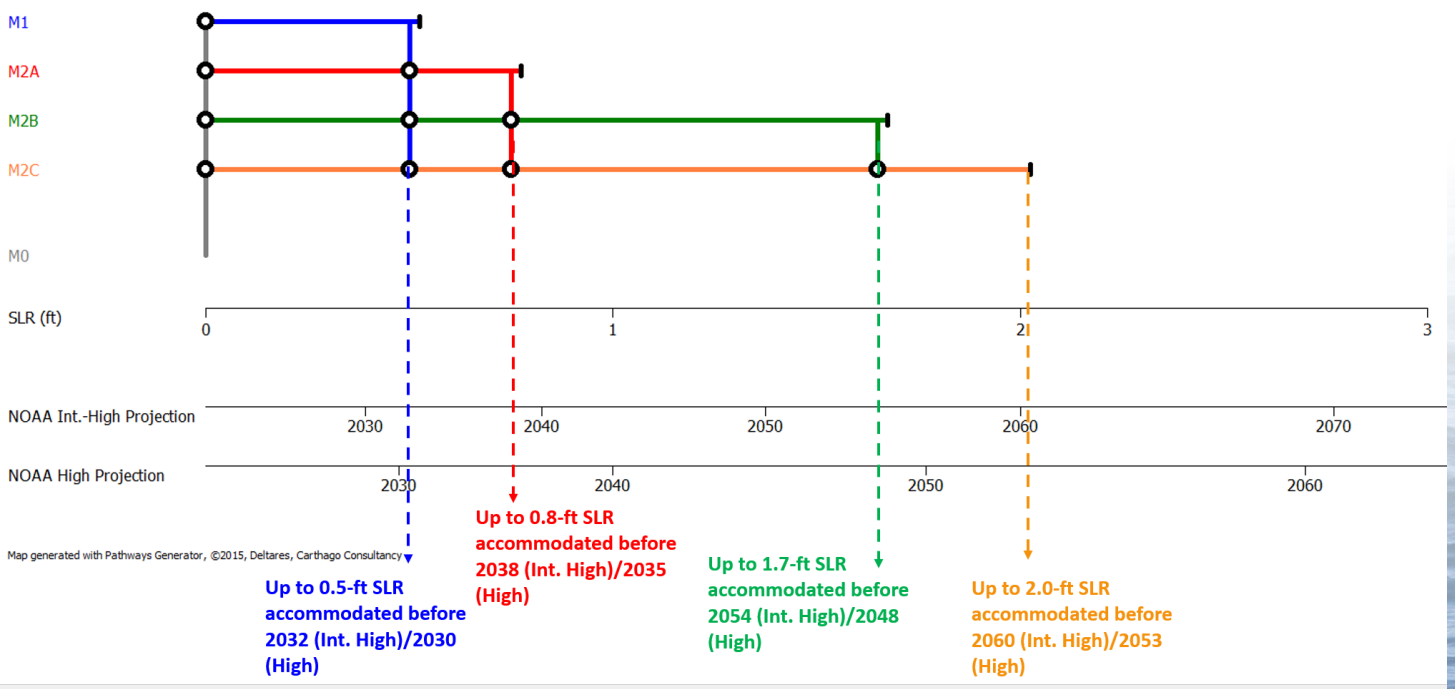
https://link.springer.com/content/pdf/10.1007%2F978-3-030-05252-2.pdf

Decision Making under Deep Uncertainty; From Theory to Practice

Mitigation Projects – Adaptation Pathway Planning – C-8 Watershed

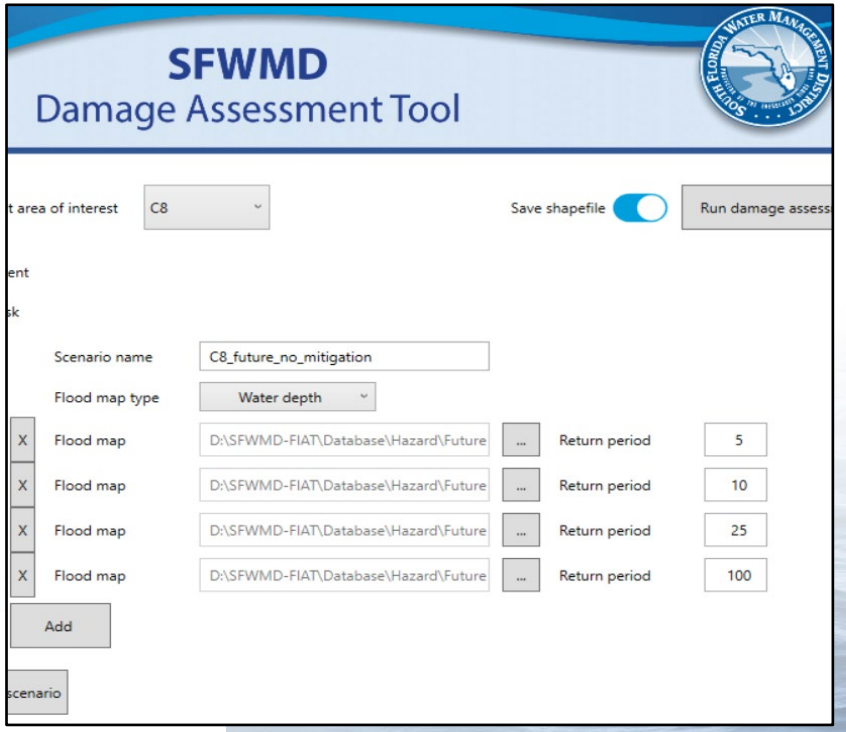
- M1: It can accommodate up to 0.5 ft SLR
  - As early as 2030 based on NOAA High and as late as 2032 based on Intermediate High
- M2A: It can accommodate up to 0.8 ft SLR
  - As early as 2035 based on NOAA High and as late as 2038 based on Intermediate High
- M2B: It can accommodate up to 1.6 ft SLR
  - As early as 2048 based on NOAA High and as late as 2054 based on Intermediate High
- M2C: It can accommodate up to 2.0 ft SLR
  - As early as 2053 based on NOAA High and as late as 2060 based on Intermediate High

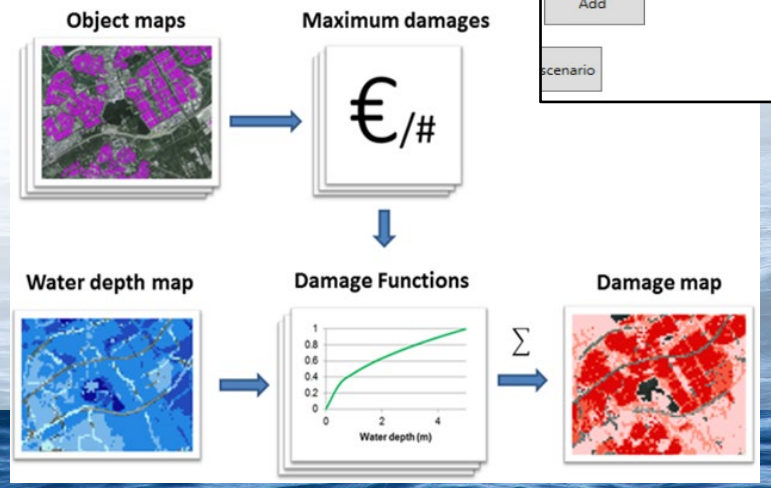
C-8 Basin



Damage assessments and Economic Analysis

- FIAT-SFWMD tool to Estimate the expected annual damage
- What liability or risk is the system exposed to – due to action or inaction?
- What is the cost/benefit ratio for different mitigation strategies
- Provide strong support in selecting the best cause of action

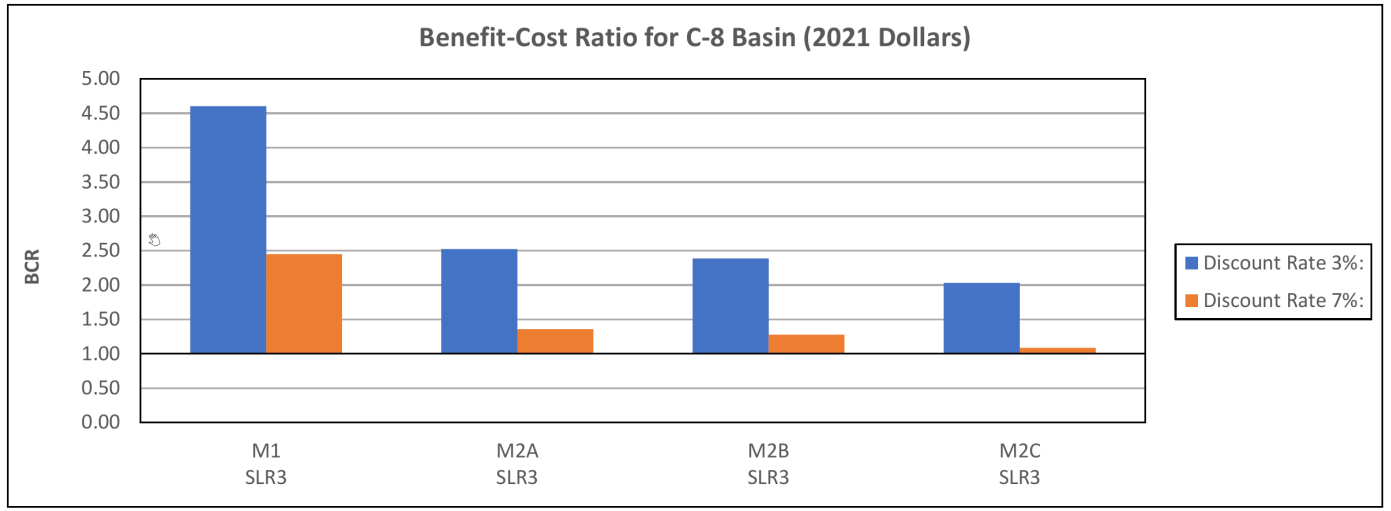


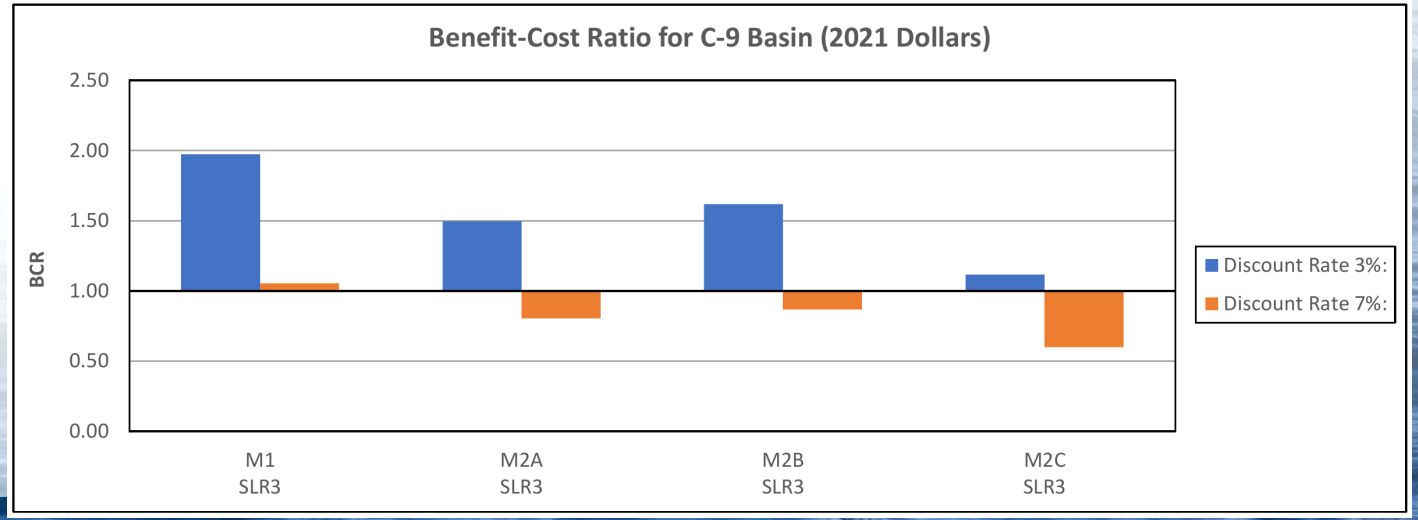


work in progress, subject to change

Mitigation Projects – Benefit/Cost Assessment

- Favorable BC ratios for M1 Projects at both discount rates (3% and 7%)
- C-8 Basin, The M2 projects achieved a favorable result at both discount rates (3% and 7%) (BCR>1)
- C-9 Basin, The M2 projects achieved a favorable result at 3% rate (BCR>1)
- M3: Raising all the buildings, roads, and infrastructures: favorable BCRs (>1)
  - Not feasible to raise the entire watershed
  - Require proactive and pragmatic redevelopment strategy at the local government level





Challenges

- Facilitating decision making with deep uncertainty
  - Future climate scenarios – including rainfall
  - Rate of sea level rise
  - Appropriate initial groundwater levels or antecedent conditions
  - Storm Surge projection at our coastal structures
  - Compound flooding (rainfall, storm surge and groundwater levels)
- How to fairly evaluate select a project with other ancillary and social benefits
- Evaluating solutions across project scale and flood control/management tiers
- Project sequencing
- Opportunity for phased implementation targeting no-regret strategies immediately
- Achieving a “remain functioning” condition with end state planning

Photo Credit: Miami Herald; Sea rise added to Hurricane Irma flooding