

# Know the Flow – Regional Water System and Sea Level Rise

Tommy Strowd, P.E. - Lake Worth Drainage District

Jeff Kivett, P.E. – South Florida Water Management District

Stormwater Management Workshop  
SE Climate Compact  
January 22, 2015



[sfwmd.gov](http://sfwmd.gov)



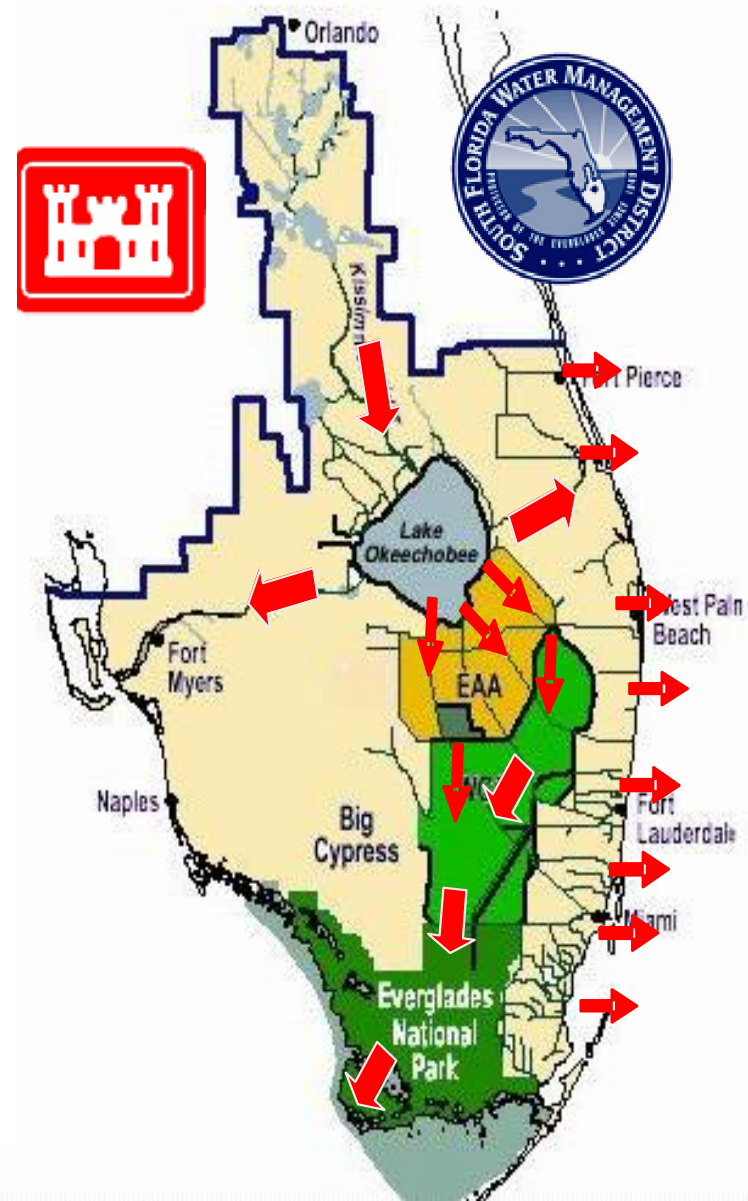
# Water Management is a Daily Balancing Act



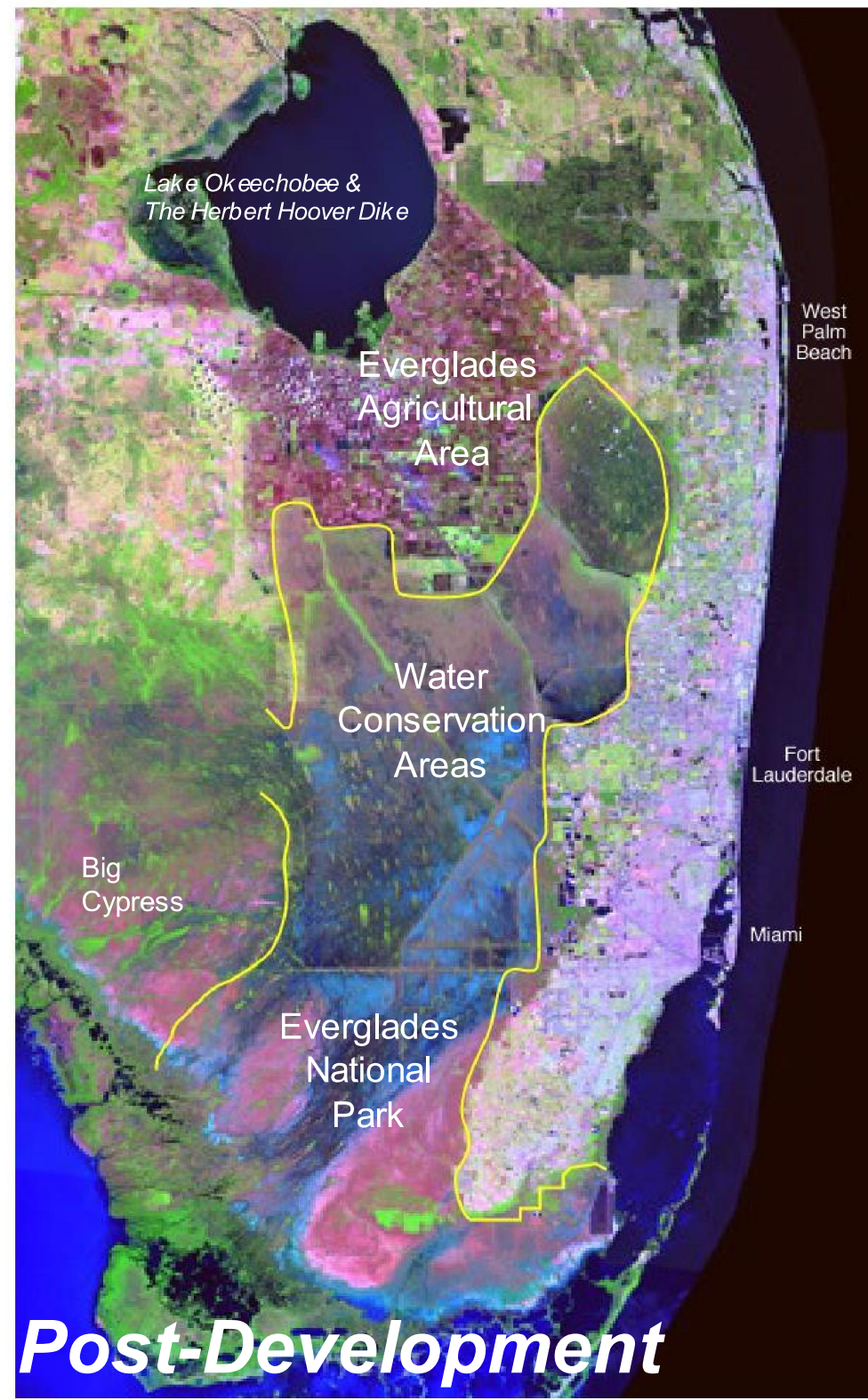
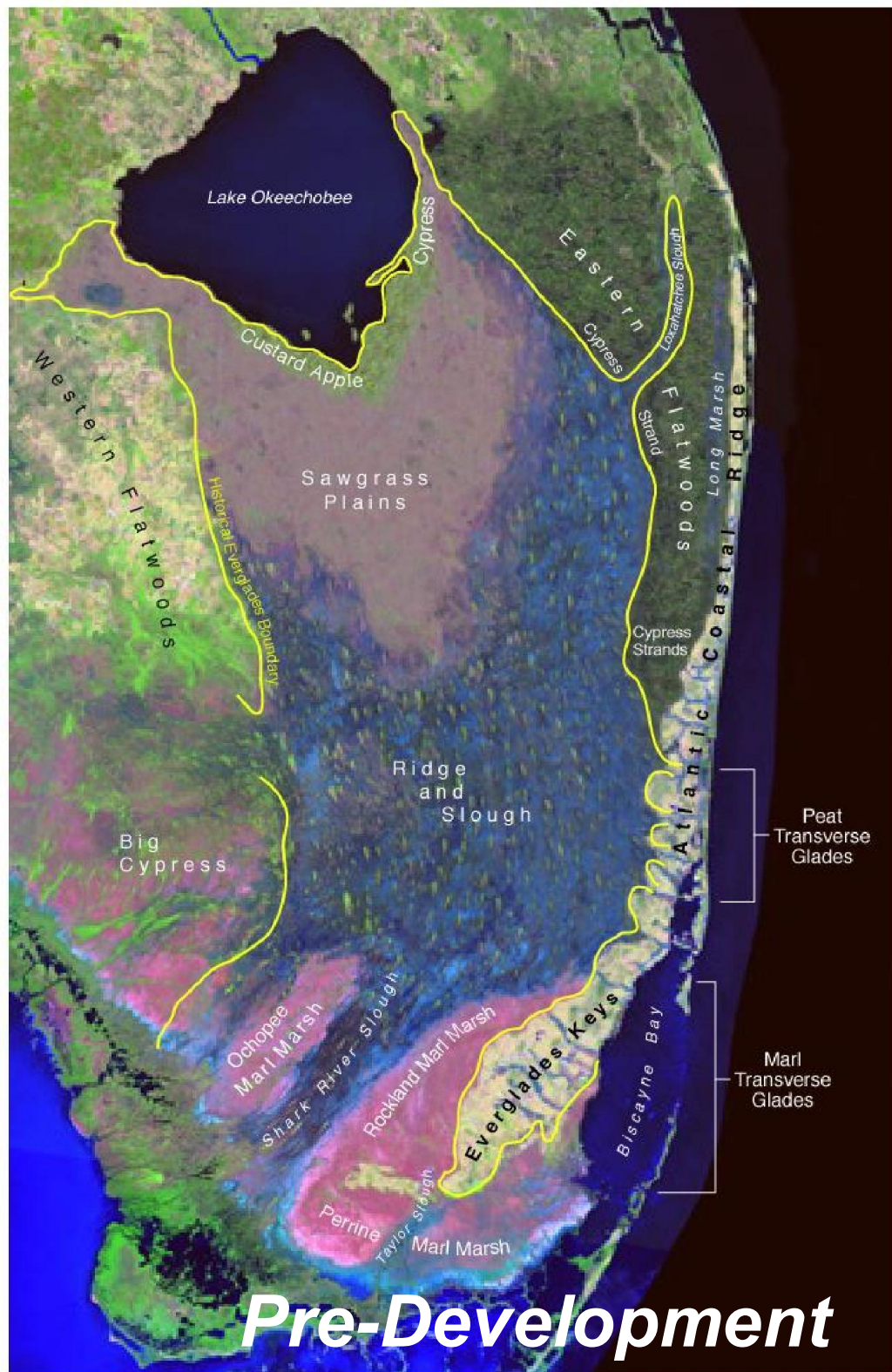


# Central and Southern Florida Project for Flood Control and Other Purposes

- Authorized in 1948
- Designed for multiple purposes
  - Flood Control; Water Supply; Navigation; Prevention of Saltwater Intrusion; Protection of Fish & Wildlife
- Constructed by the U.S. Army Corps of Engineers between 1950 and 1970
- Operated by the South Florida Water Management District



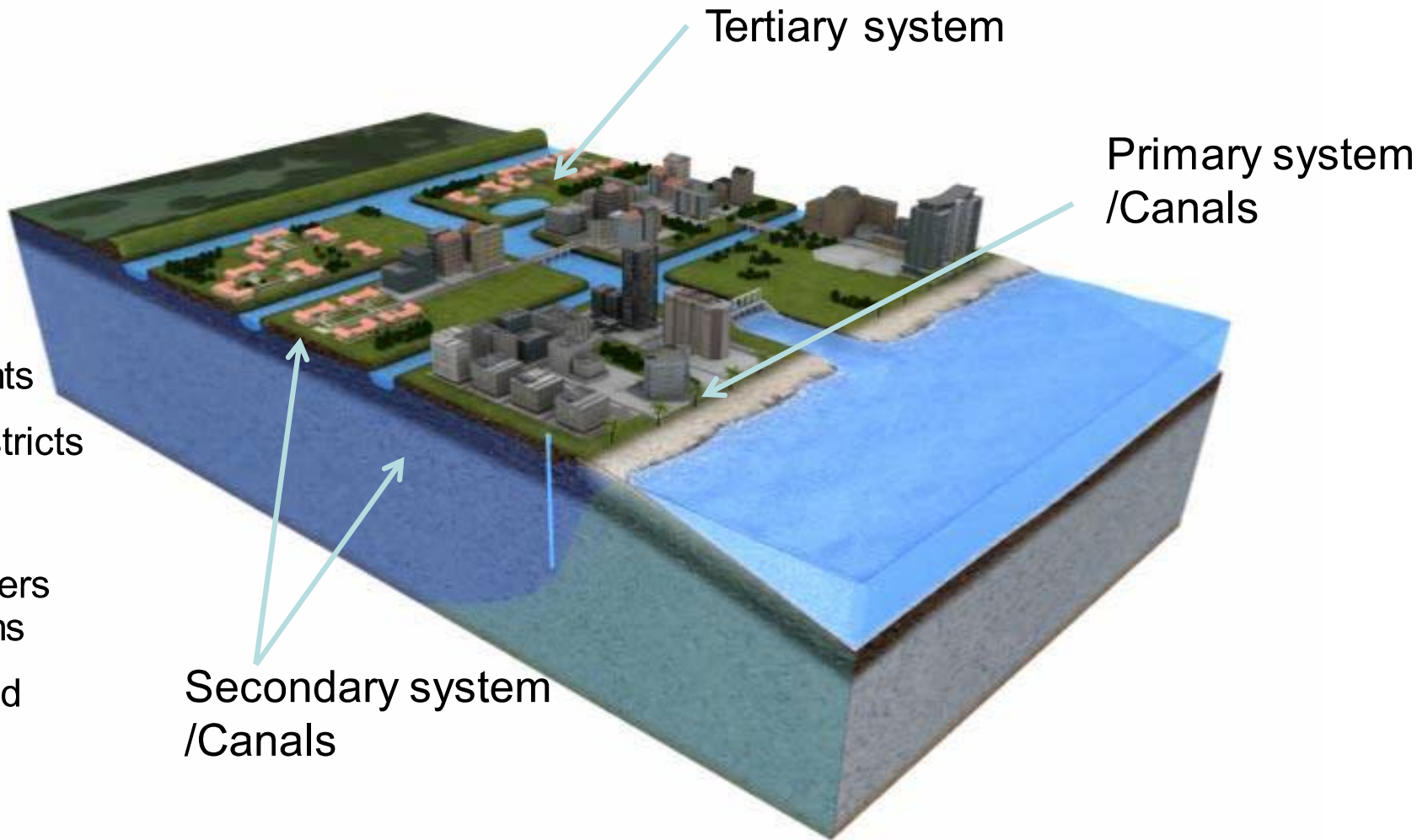






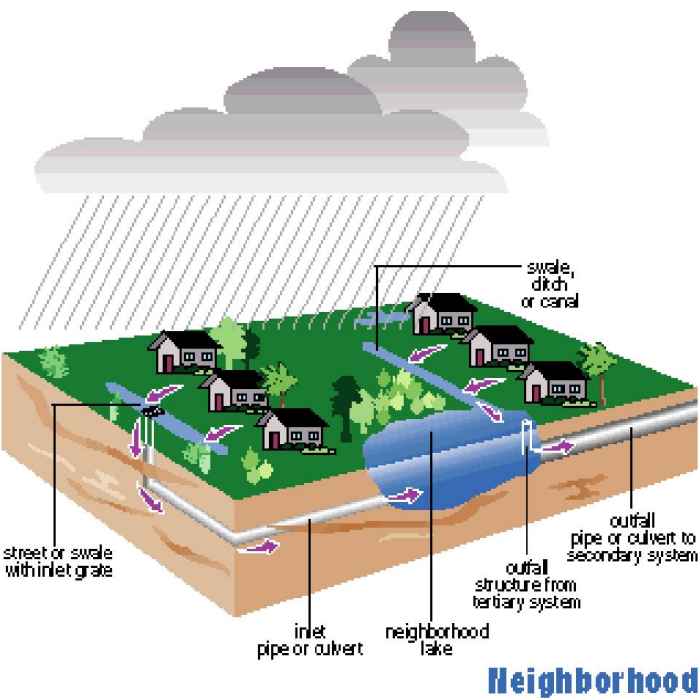
# Three-Tiered System

- Primary
  - USACE
  - SFWMD
- Secondary
  - Local Governments
  - Special Districts
- Tertiary
  - Home Owners Associations
  - Private Land Owners





## Neighborhood System (Tertiary)

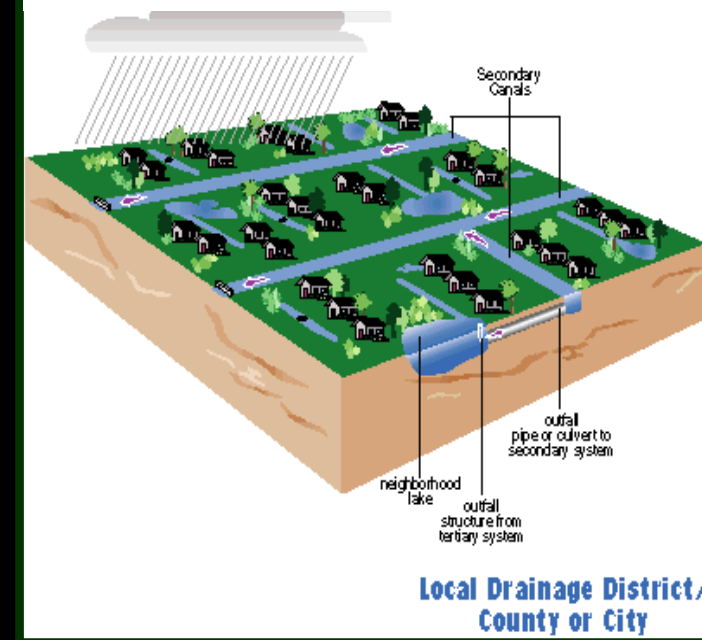


*...Tertiary to  
Secondary...*

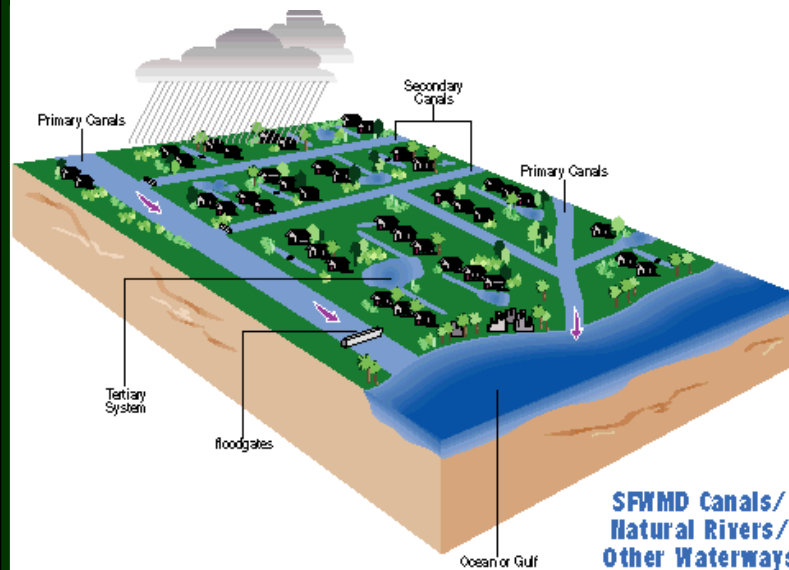
*Secondary to  
Primary...*

*Primary to  
Ocean or  
Everglades*

## Local Drainage District (Secondary)



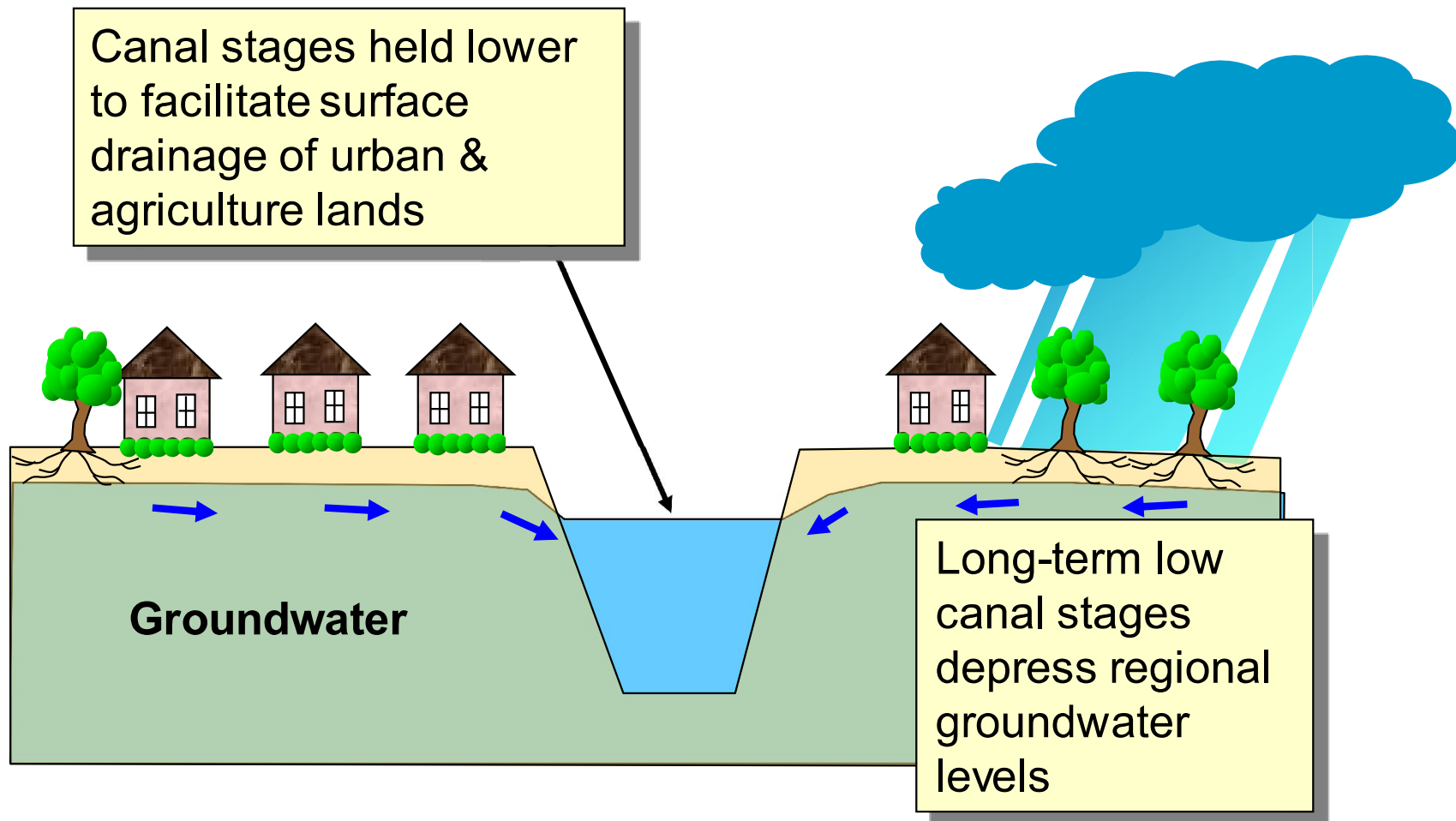
## SFWMD Canals (Primary)



**Every drainage system  
flows into a  
larger system**

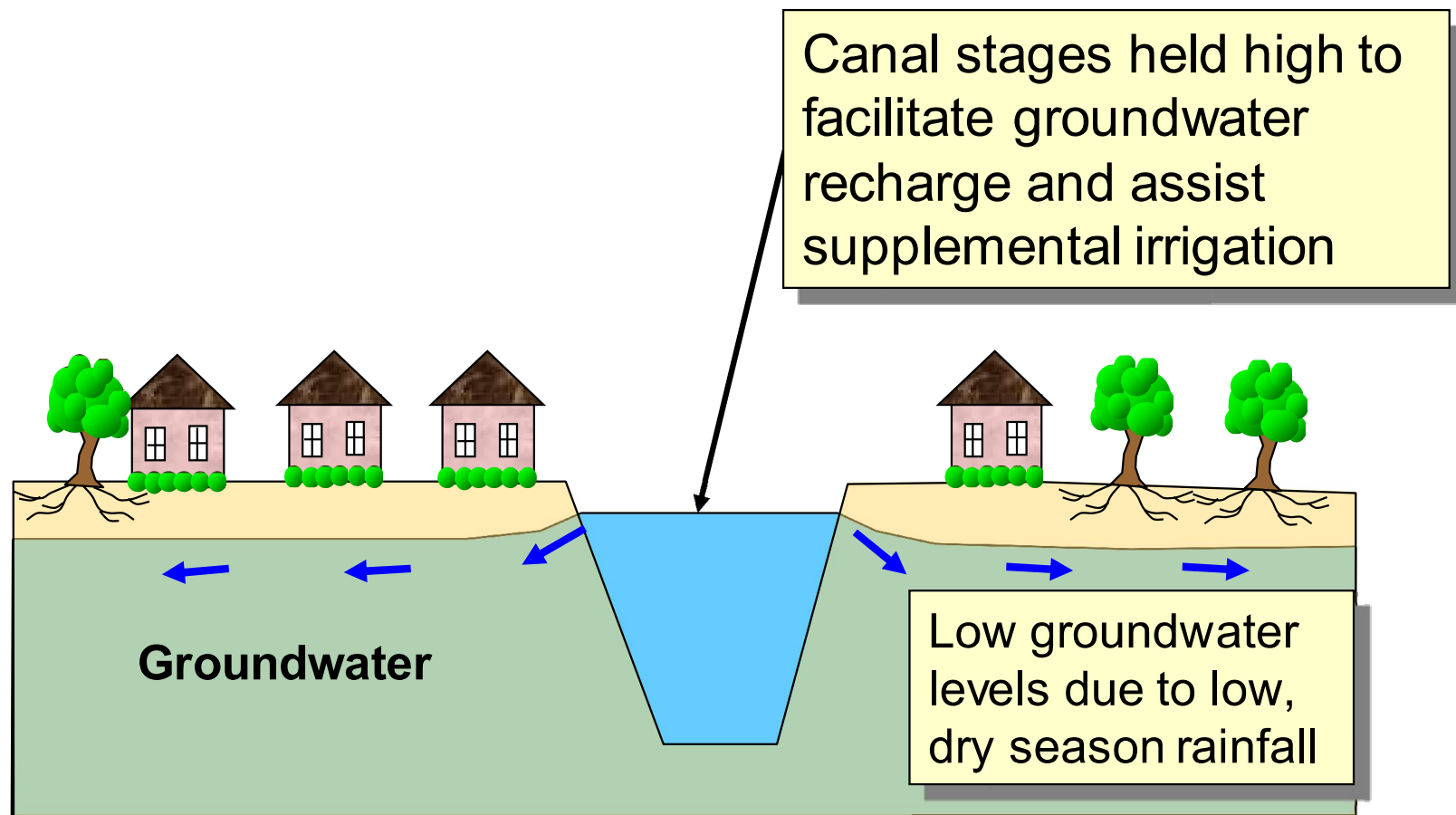


# Canal / Groundwater Interaction





# Dual Role of Primary Canals





This area was assumed to remain agricultural (& dairy)

Only area assumed to be urban

INTRACOASTAL WATERWAY

POMPANO CANAL

CORAL REEF

G-57

S-37B

S-37A

C-14 WEST

C-14 EAST

C-14

L-36

S38B

Google earth

2004-05 SFWMD Aerial Photography  
SFWMD Enterprise GIS Layers

2012 Broward County Aerial Photography

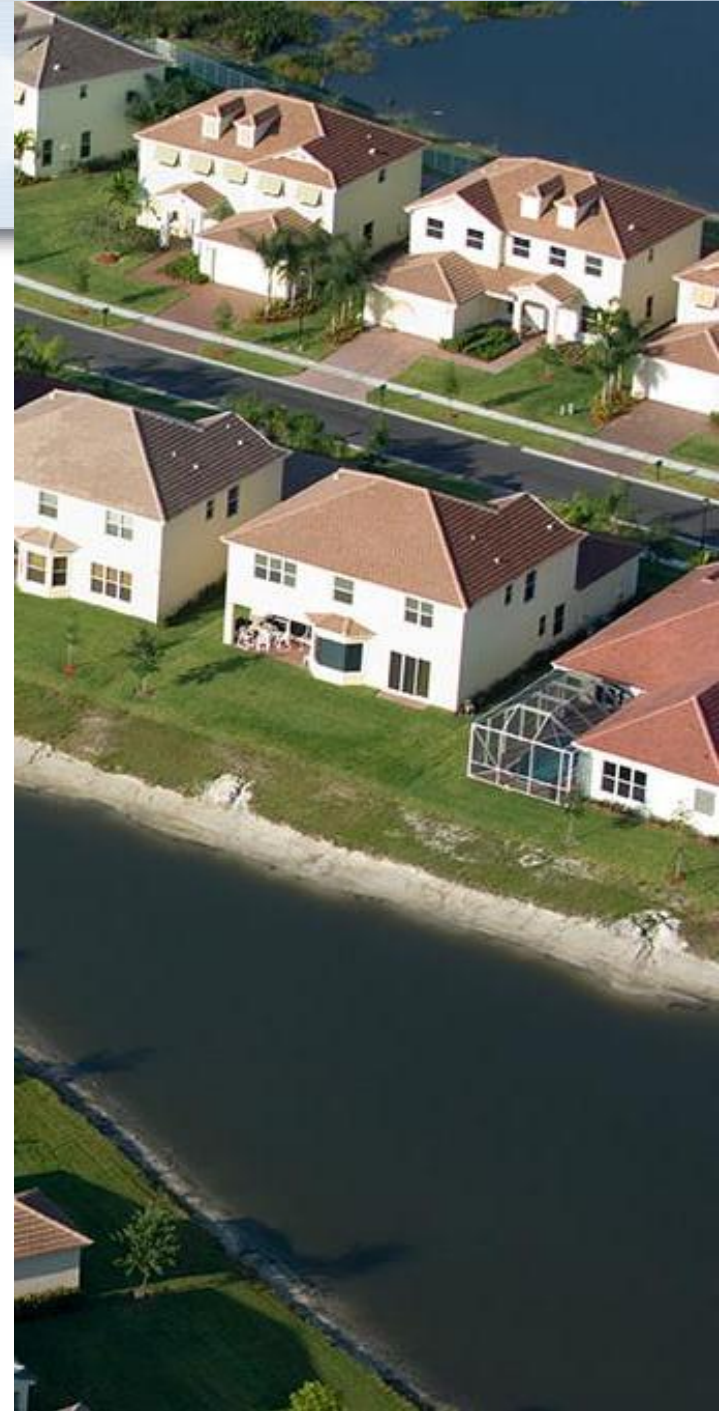
Only area assumed to be urban





# Surface Water Regulation

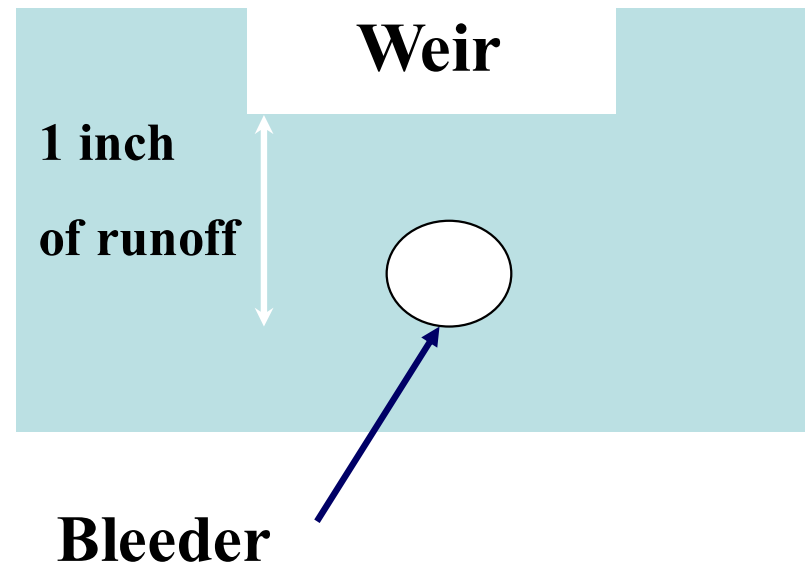
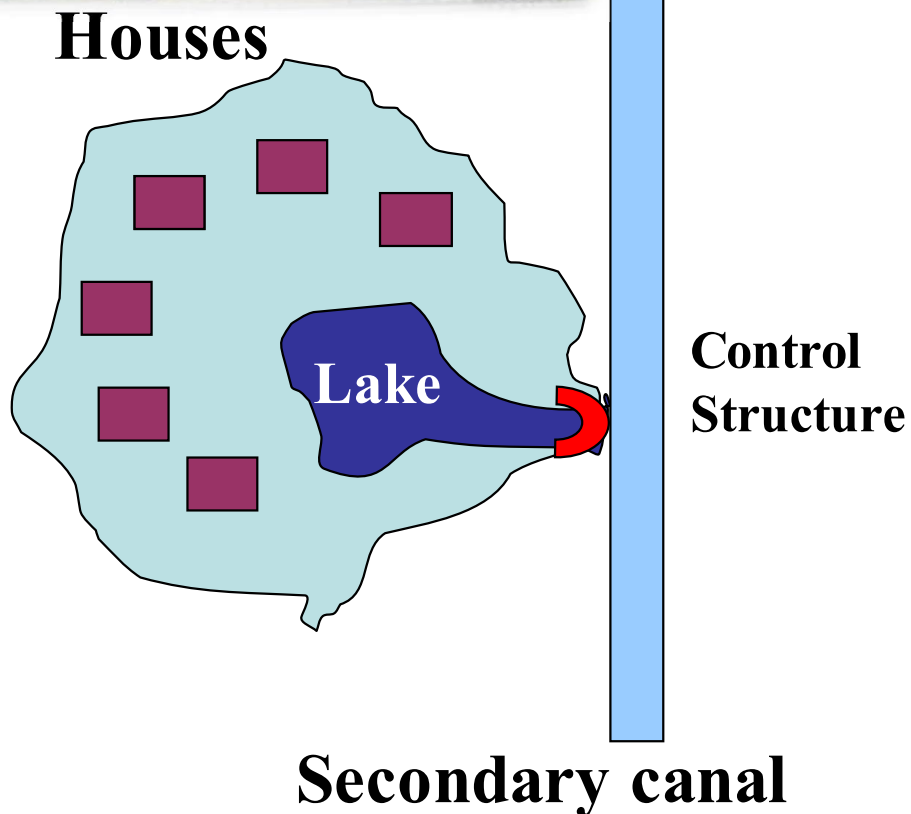
- Enhanced benefit of the C&SF system by limiting inflows to avoid overwhelming the system
- Requires water storage systems for new development to limit storm flows into the primary canal system
- This insures that no increase in the peak rate of flow is discharged to the canals after development occurs
  - Has been a key in avoiding having to increase canal capacity over time (unlike the highway system)





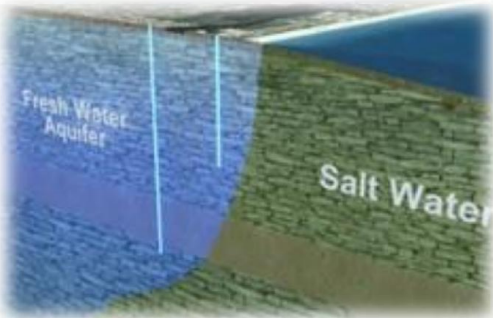
# Stormwater Permitting Considerations

- Water Quality Considerations
- Allowable Discharge

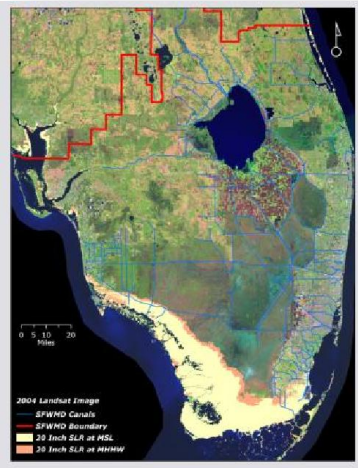




# Potential Impacts of Sea Level Rise on Water Management



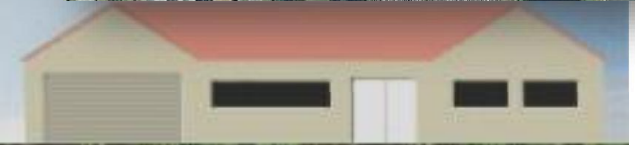
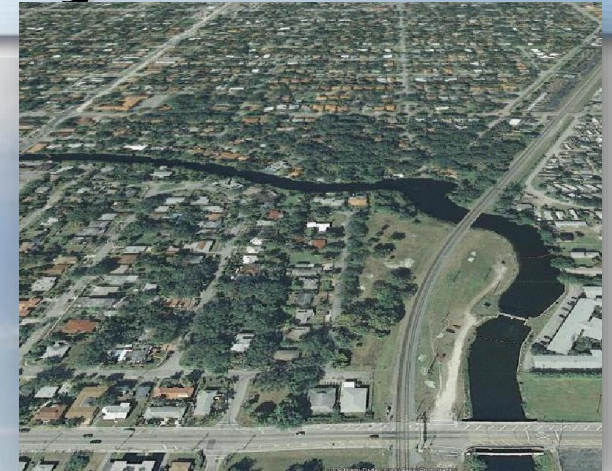
- Flood Protection (flooding, storm surge, interior flooding, hurricanes, coastal structures)
- Drinking Water Supply (saltwater intrusion, freshwater wells)
- Natural Environment (Southern Everglades, coastal wetlands)





# Potential Implications of Sea Level Rise on Flood Protection: Salinity Barriers

Coastal Structure



Saltwater front



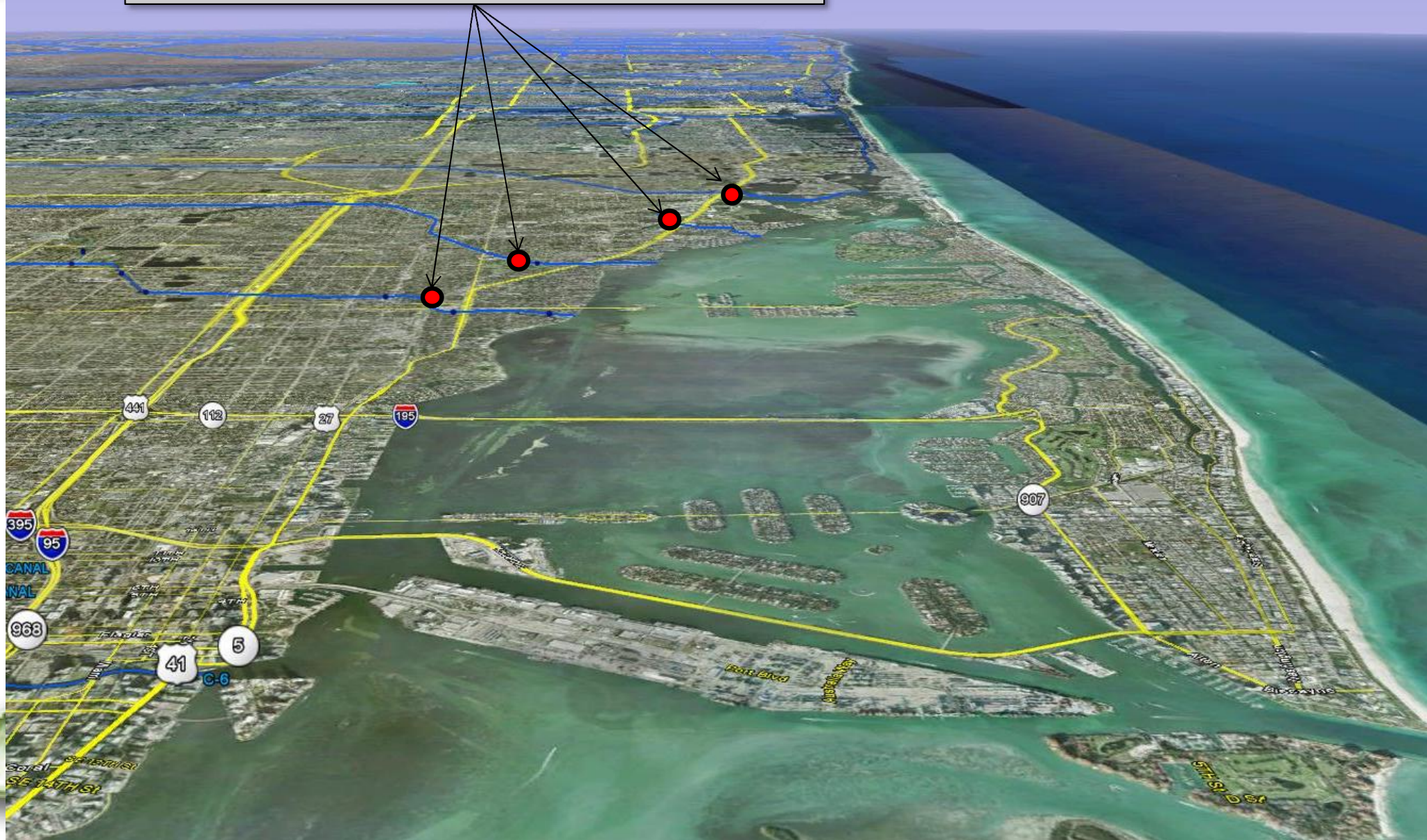
# What could happen when the primary system capacity is limited: Flooding



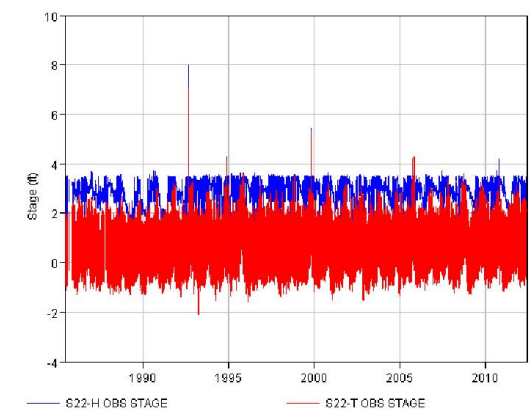
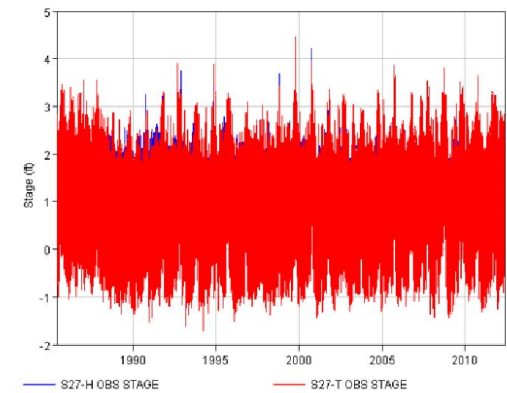
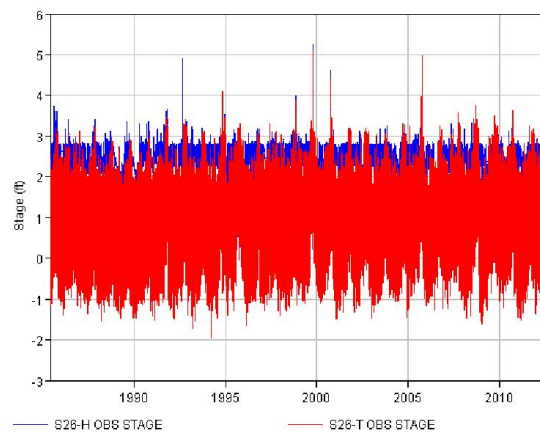


# Coastal Water Control Structures

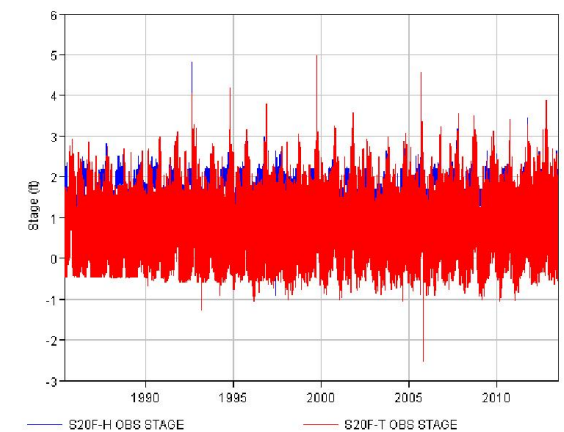
Regional Coastal Water Control Structures





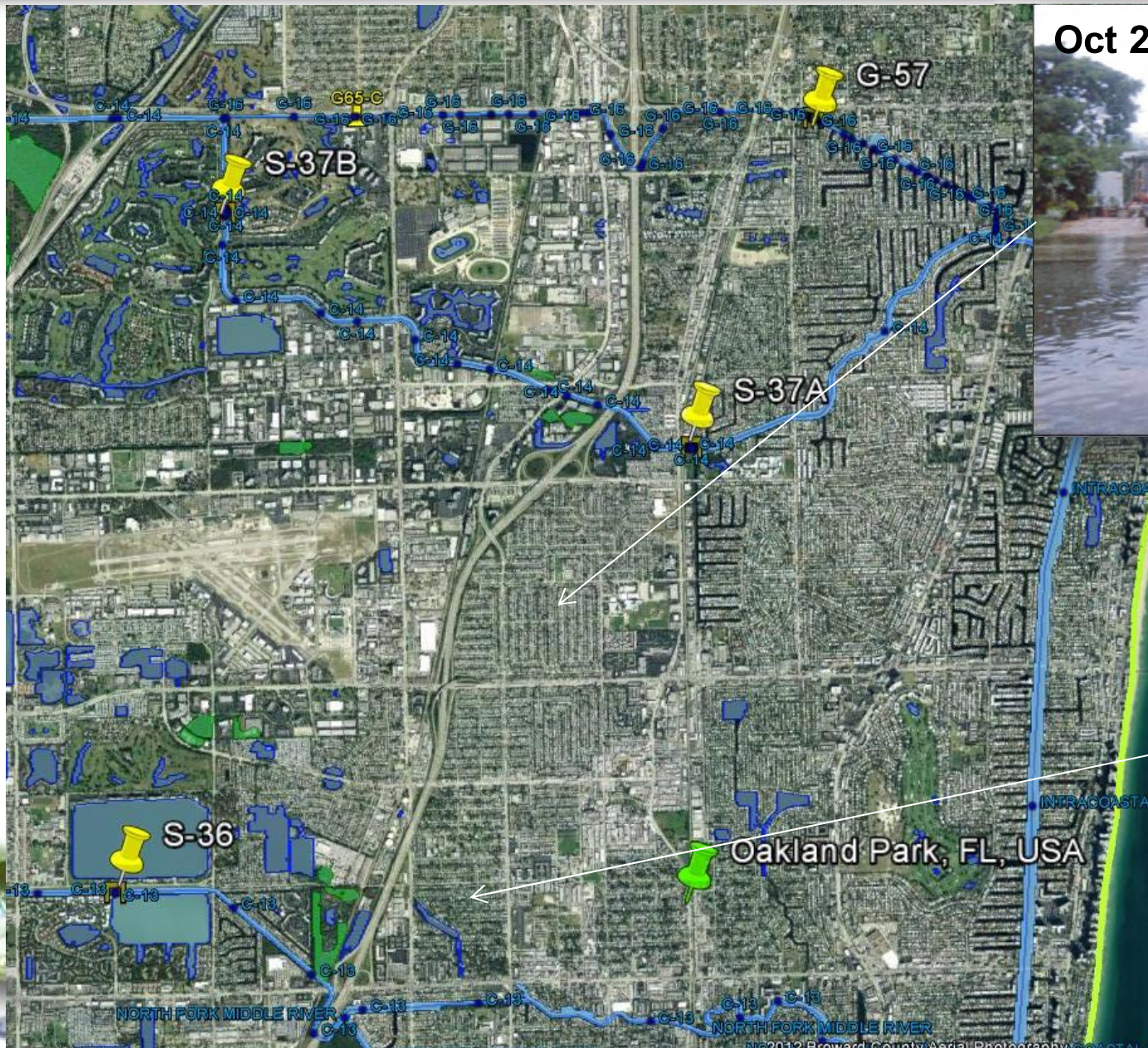


water levels across the





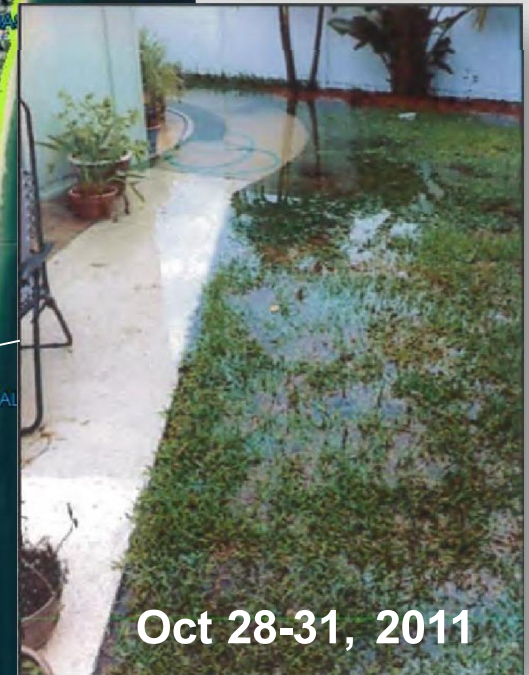
# Why Broward situation is more complex? (Communities east of SFWMD structures)



Oct 28-31, 2011



Oct 28-31, 2011





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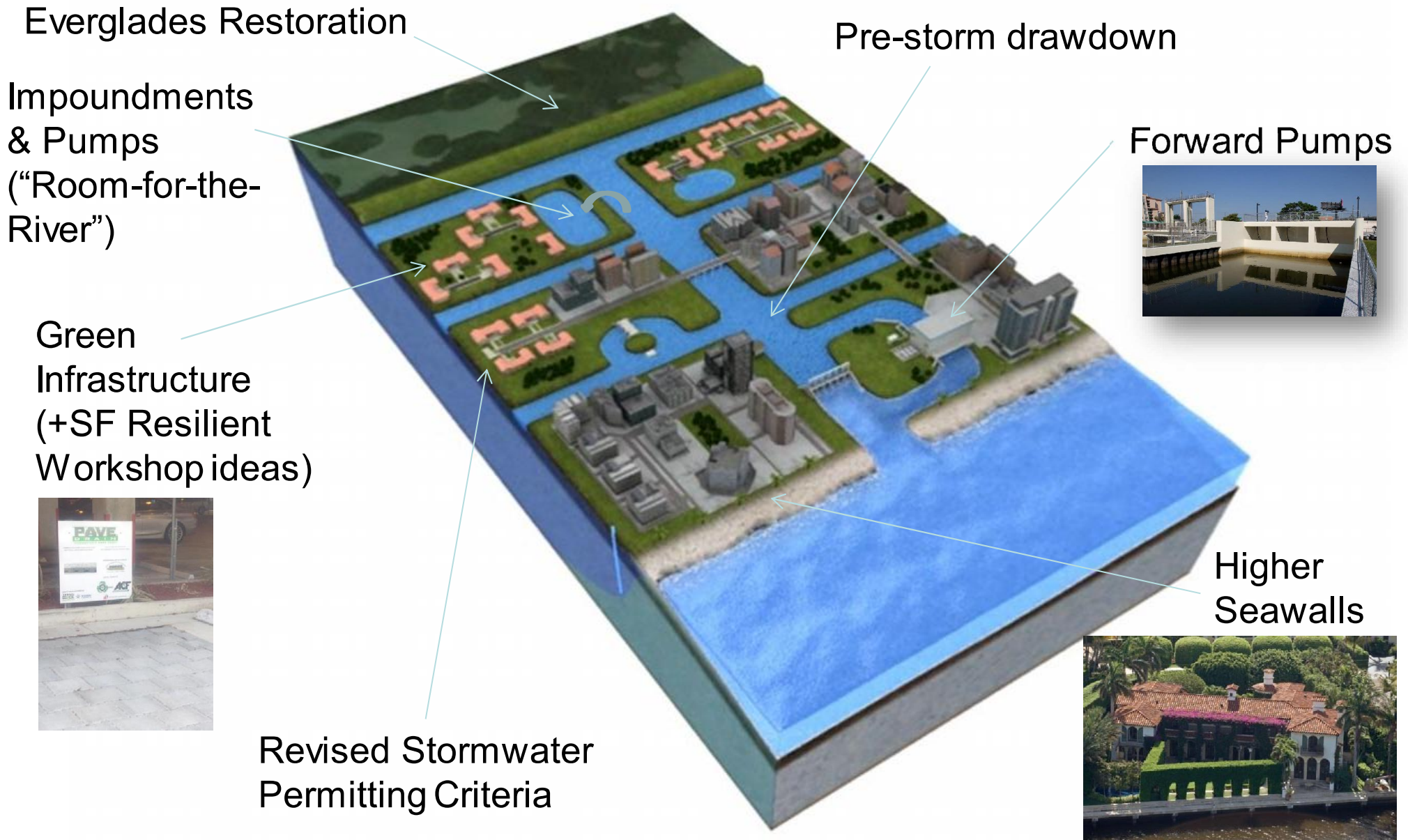
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**LWDD**  
LAKE WORTH DRAINAGE DISTRICT

**sfwmd.gov**



# Adaptation – Basin Scale





# Adaptation Example: Forward Pumping at S-26 Structure (not so 'green'!)





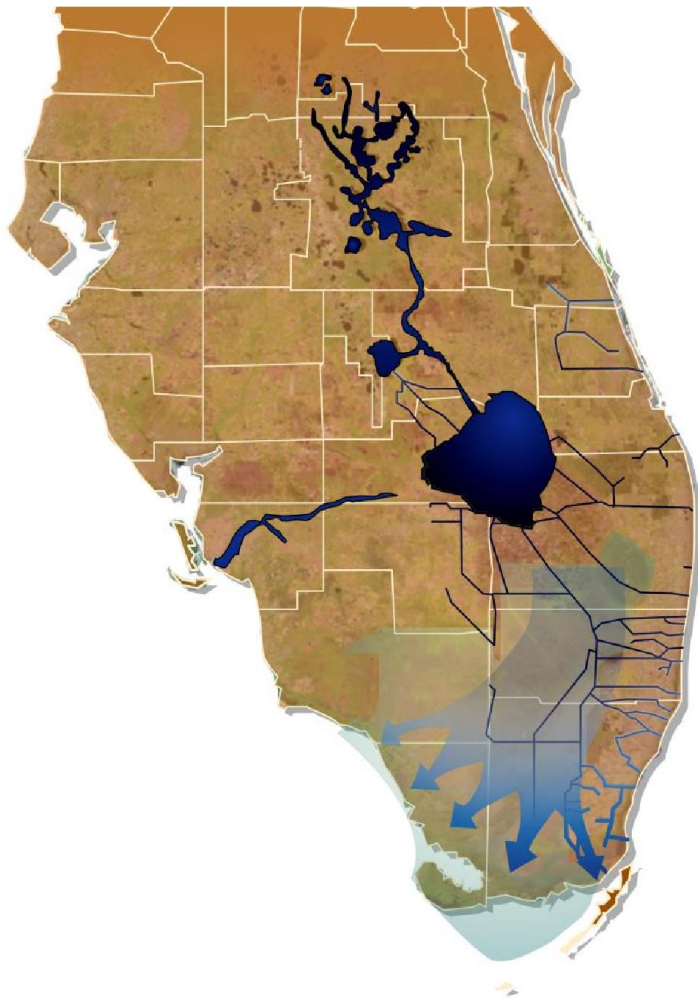
# Adaptation: Western C-4 Impoundment: Room for storage of excess flood waters

- C-4 Impoundment to excess flood waters temporarily
- Improves flood protection & facilitates recharge





# Adaptation: Everglades Restoration



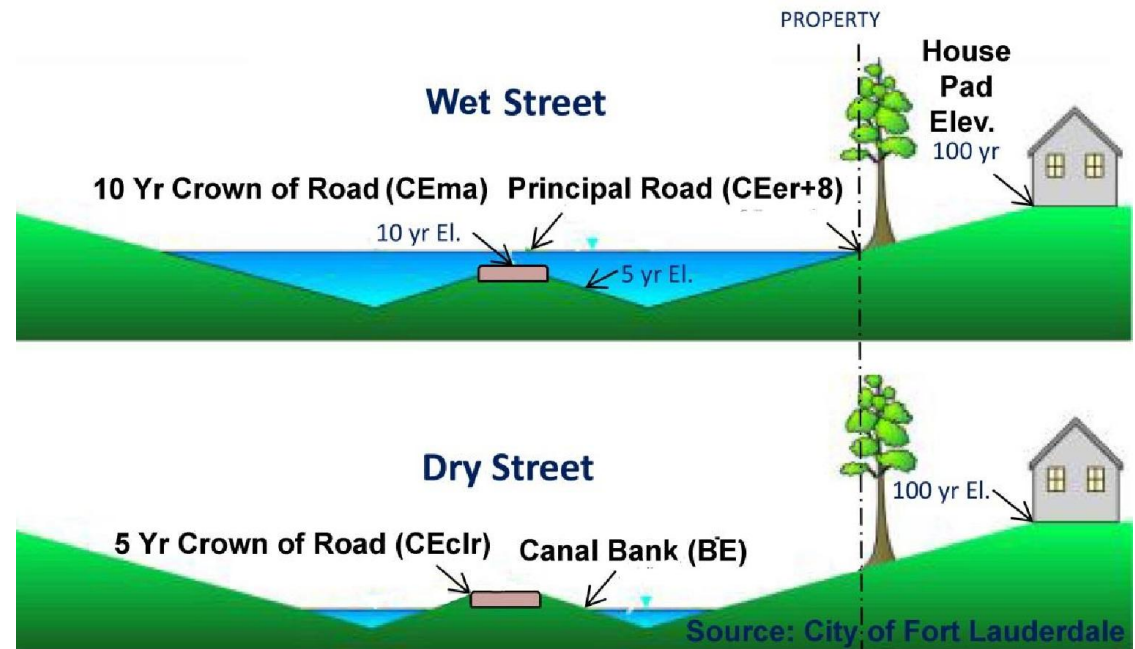
- National Academy of Sciences 2008 report: “Climate change should be a reason to accelerate Everglades restoration, not a reason for delays”
- Everglades restoration is an important adaptation response to sea level rise
- Ecosystem resilience can be enhanced through increased water flows through the Everglades and increased storage
- Increased flows into the southern estuaries will reinstate widespread organic soil formation and maintain the freshwater head in order to mitigate the effects of sea level rise and saltwater intrusion





# LOS Program Elements

- LOS Fundamentals
- Assessment Procedure
- Sea Level Rise
- Changing Rainfall
- Basin-Scale Assessment Projects:
  - LOS modeling for Basin
  - Basin Atlas (update)

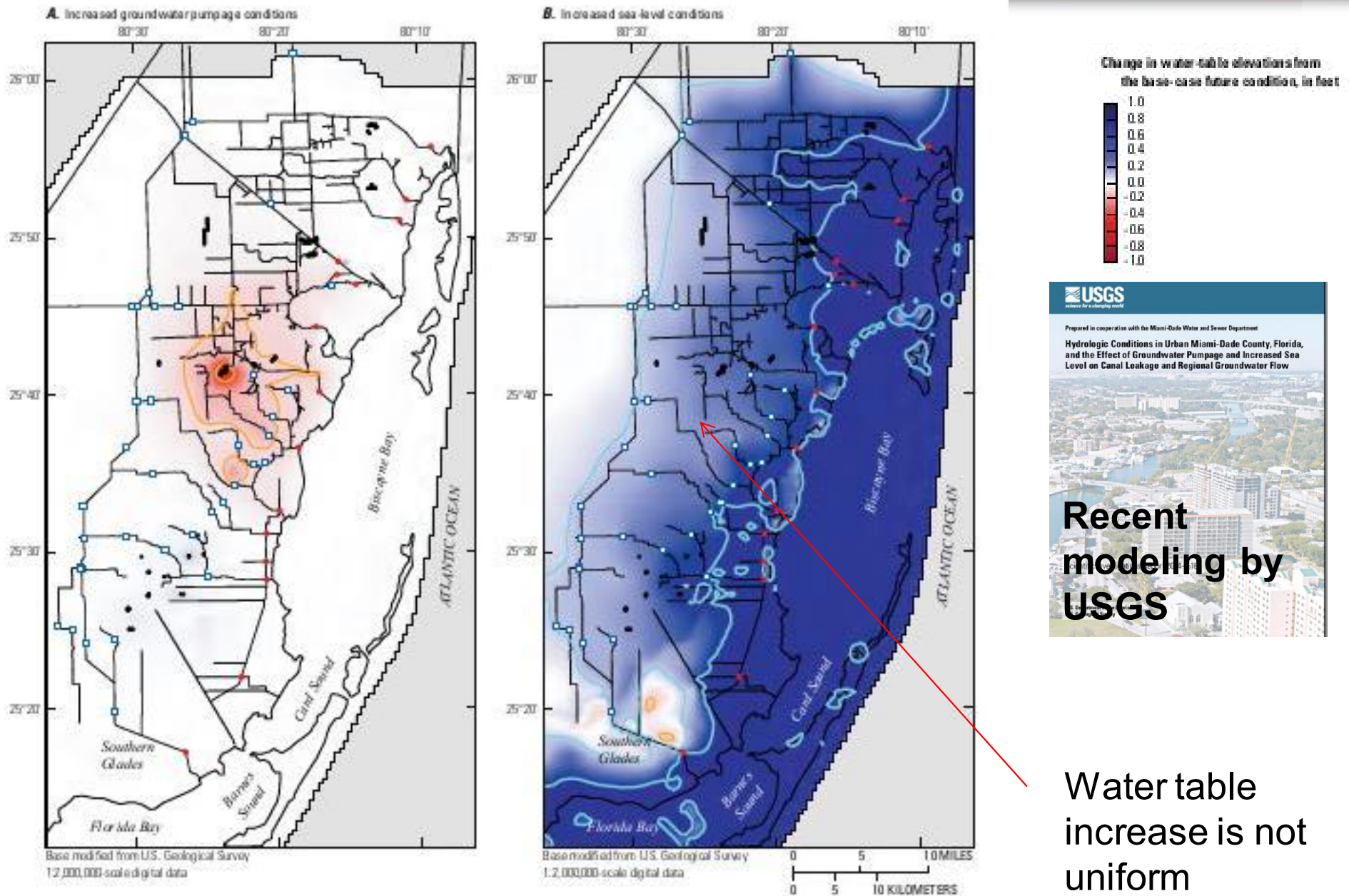


What is the desirable Level of Service for each feature within a basin?





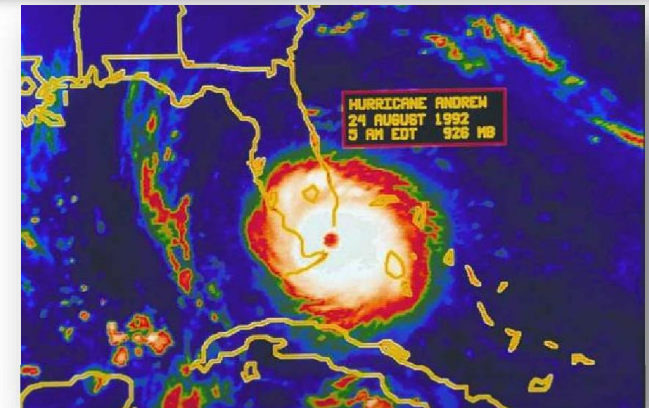
# Change in Water Table: Pumping (decrease) & Sea Level Rise (increase)



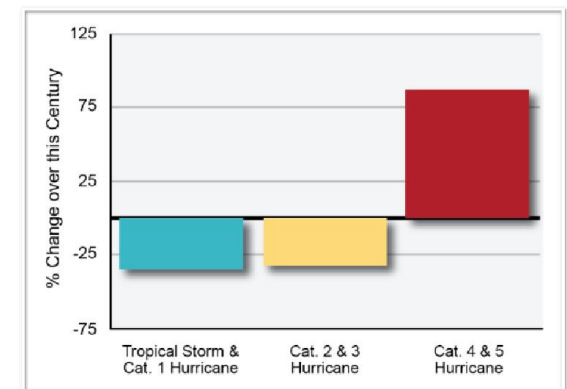


# Tropical Storms & Climate Change

- Tropical cyclones to shift towards strong storms (2-11% intensity increase by 2100)
- Decrease in global frequency of tropical cyclones (6-34%)-**recent paper says this will increase!**
- Increase in the frequency of the most intense cyclones
- Increase in rainfall rate, 20% within 100 km of storm center

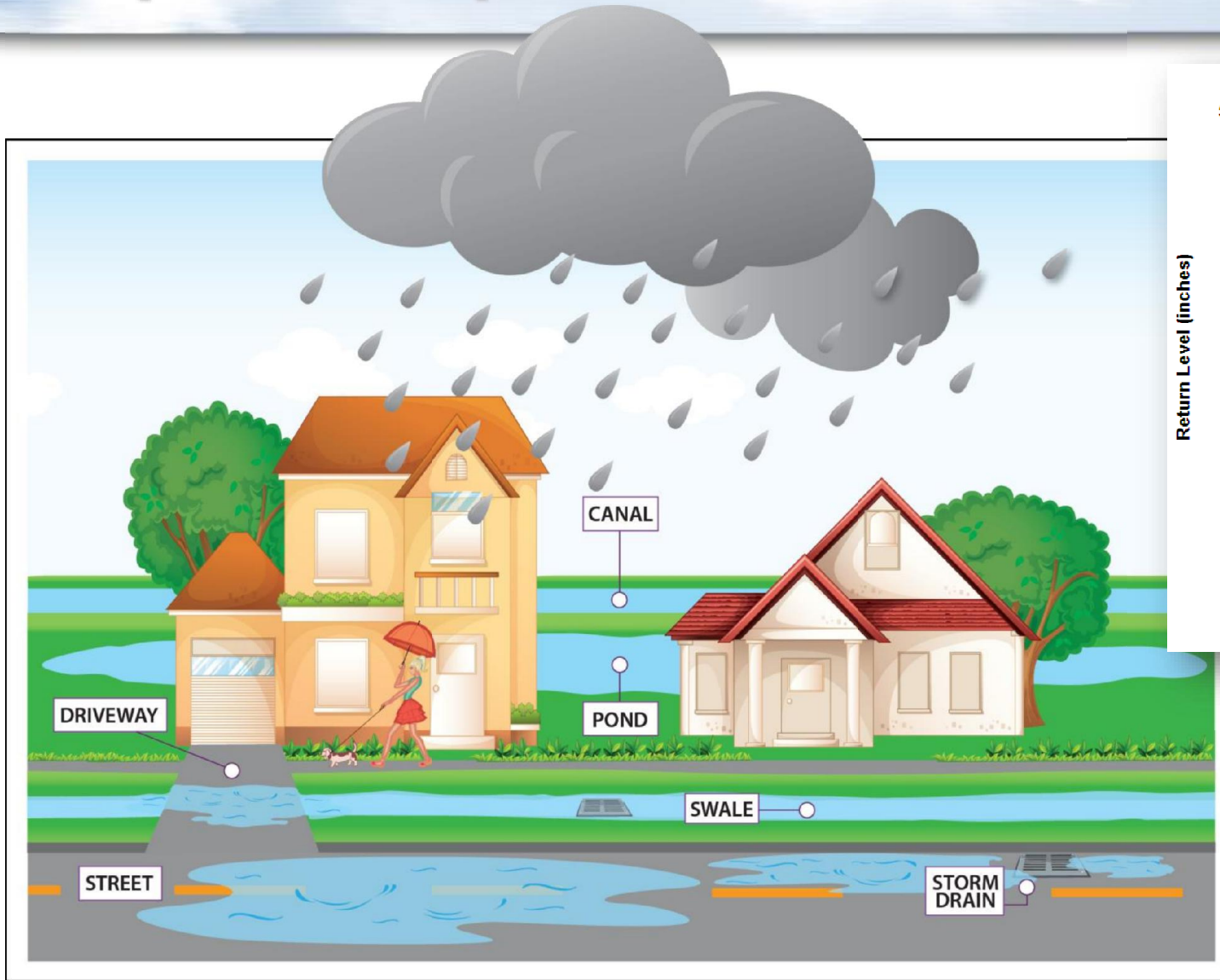


Projected Changes in Atlantic Hurricane Frequency by Category

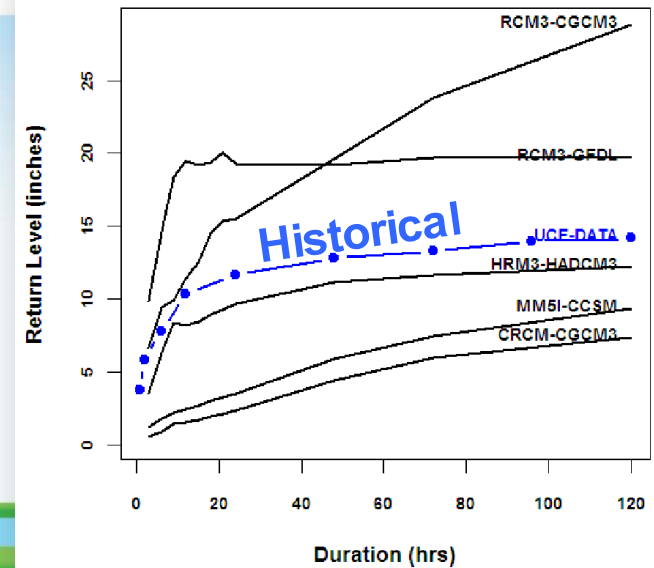




# Potential changes in Rainfall Extremes : update Depth-Area-Duration curves?



50-Year, Location: WEST PALM BEACH INTERNA



Uncertainty  
due to  
significant  
model  
spread!



# Pilot Project #1: Pilot (C-2, C-3, and C-4 basins)

- LOS Fundamentals (white paper and modeling guidance)
- Assessment Process (issues, info collection and exchange)
  - Sea Level Rise & Extremes - modeling guidance
  - Rainfall Change - literature review and assessment
- Basin-Scale Assessment
  - Basin Atlas
  - LOS modeling for one Basin
- Lessons Learned





# Resilient Redesign Workshop (August 2014)

## South Florida Resilient Redesign



Kingdom of the Netherlands



MIAMI CENTER FOR ARCHITECTURE & DESIGN



**AIA** Miami  
A Chapter of The American Institute of Architects



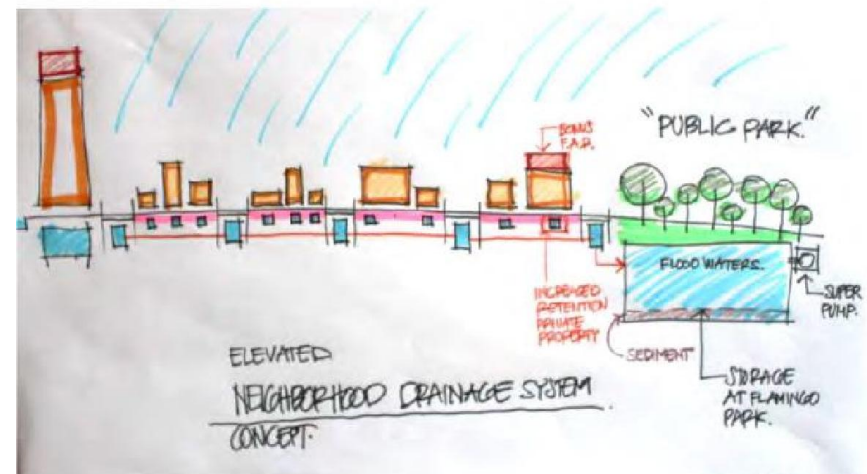


# Design Concepts: Dense Urban – Alton Road

- Protective Promenade Drainage System
- Raised streets/infrastructure
- Garden City Master Plan
- Underground storage (incentives)
- Urban Densification



Miami Beach



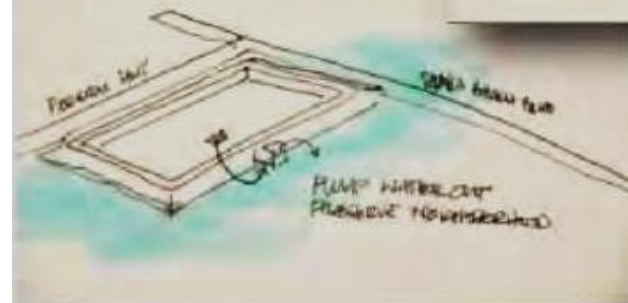


# Design Concepts: Urban – East Dania Beach Boulevard

- Interconnectivity
- City center on coastal ridge
- Multi-purpose natural infrastructure
- Polder flood control
- Dune (barrier island) enhancement with underground parking



The Polder



Dune





# Design Concepts: Suburban – Unincorporated Miami-Dade

- Land readjustment (voluntary)
- Restorative wetland park
- New waterfront property
- Floating trailer park
- Courtyard Islands, Town Center, Water Tiles



Miami-Dade County





# Questions?

