Balancing and Managing Flood Risks and Droughts Now and in the Future

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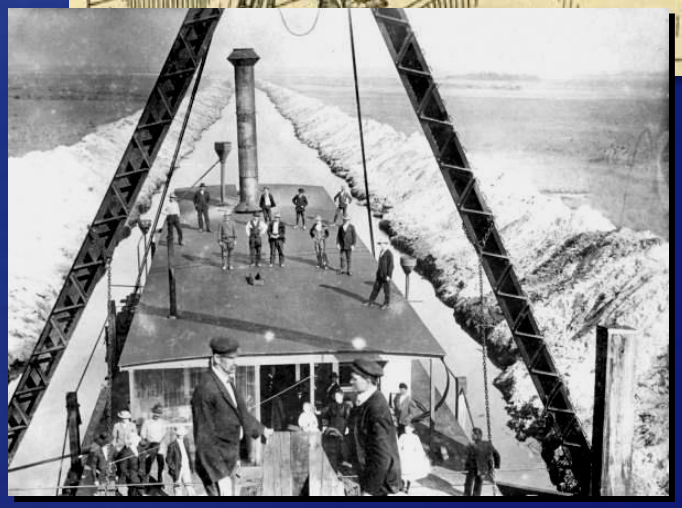
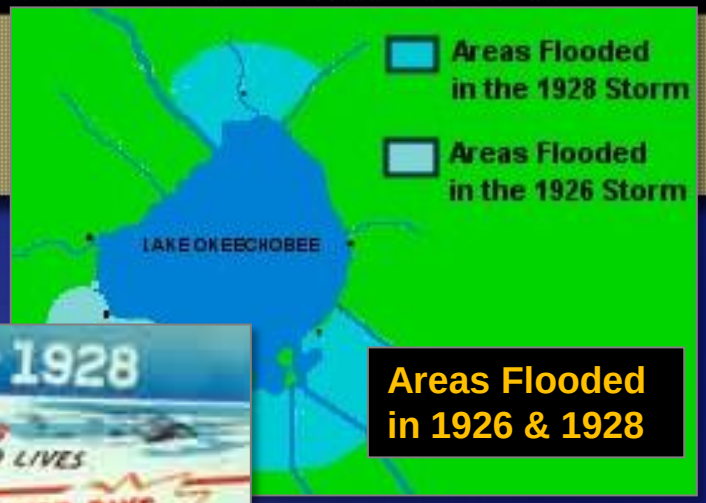
A Brief History of Water Management in South Florida

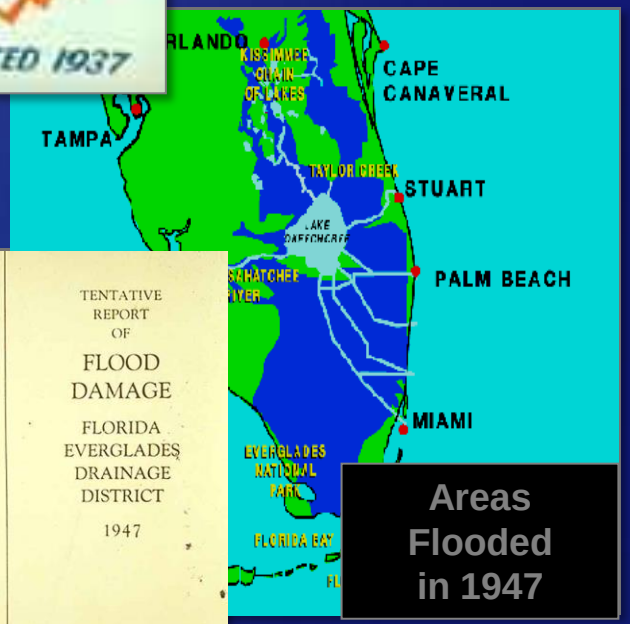
- Early explorers in south Florida recognized its value and challenges
  - Unique sub-tropical climate in North America offered a prime agricultural opportunity
  - Vast extent of flooded lands precluded settlement
- As development progressed in the early 20th century, pressure increased to drain the region
- The early efforts to reclaim these flooded areas were largely ineffective
  - Flooding and droughts persisted
  - Soil subsidence increased

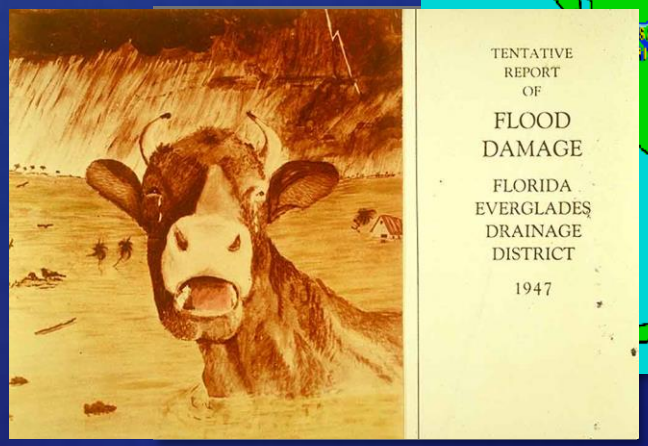


Historic Water Resource Problems

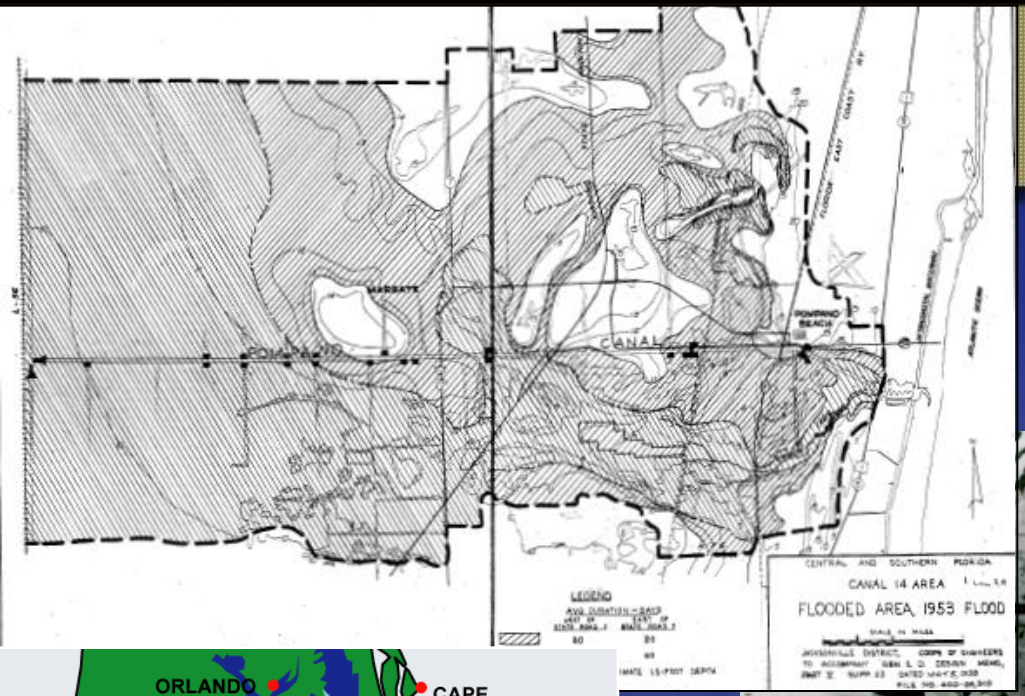
- Flood Control
  - 1926/1928: Lake Okeechobee Levee Failure
  - 1947: Hurricane Flooding
- Water Supply
  - 1931 - 1945: Lower East Coast saltwater intrusion threat identified
- State of Florida requested federal assistance

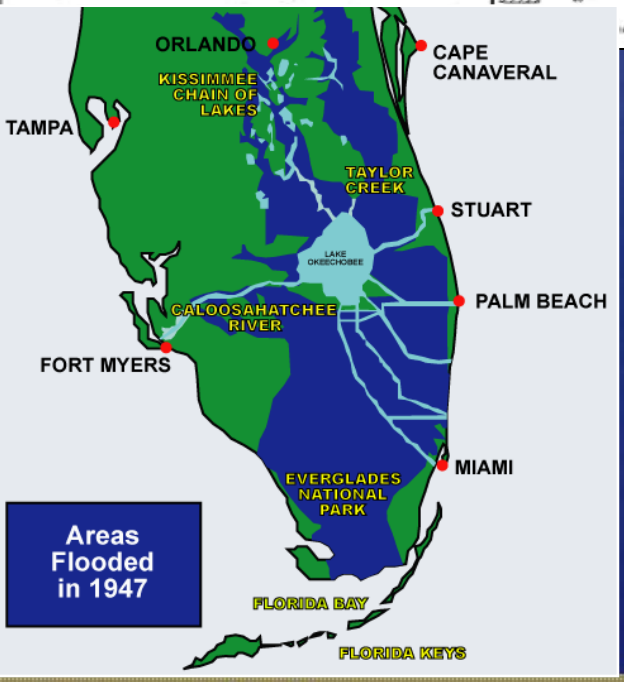


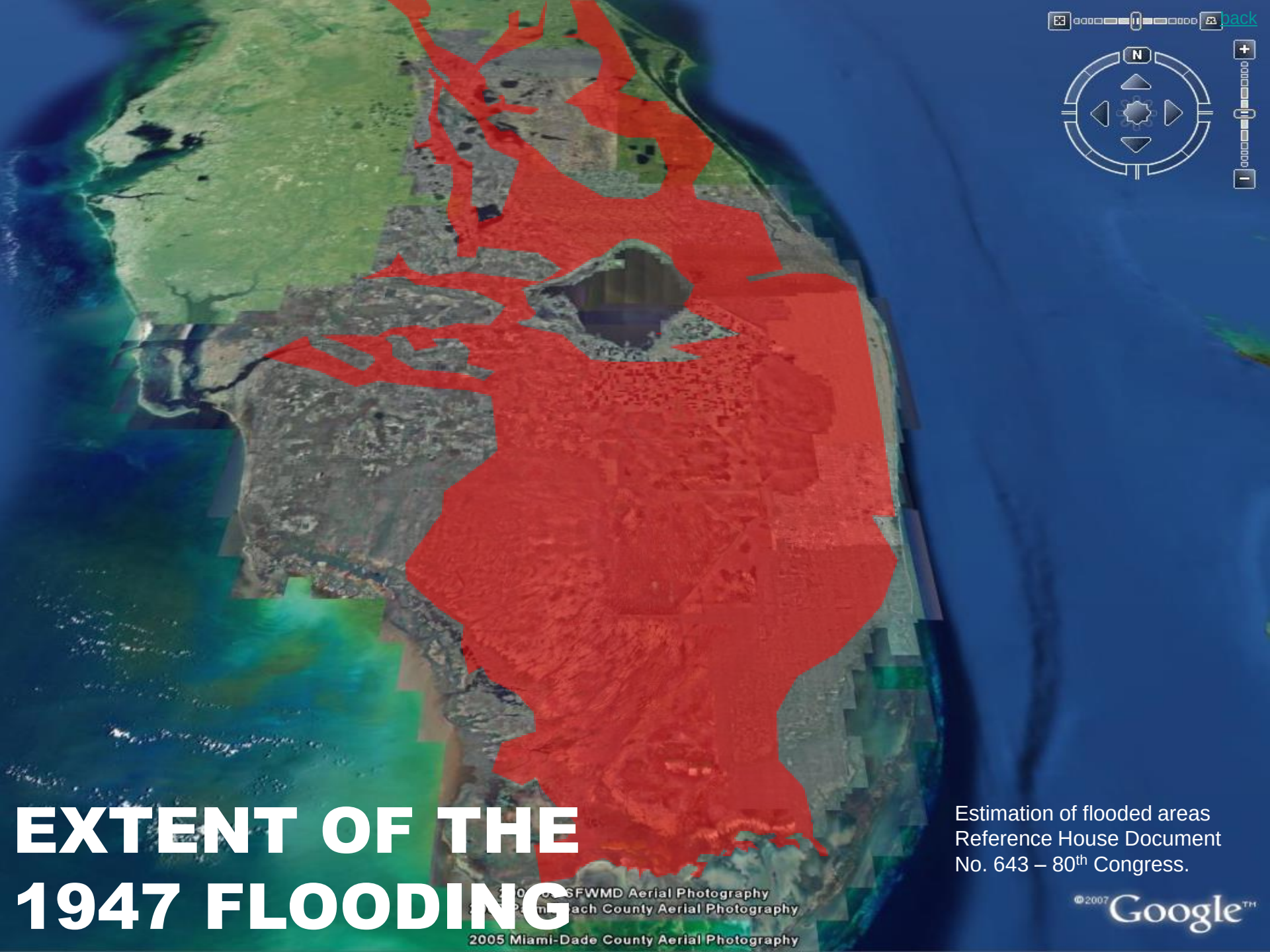




The Entire Region Flooded in 1947, 1950 & 1951





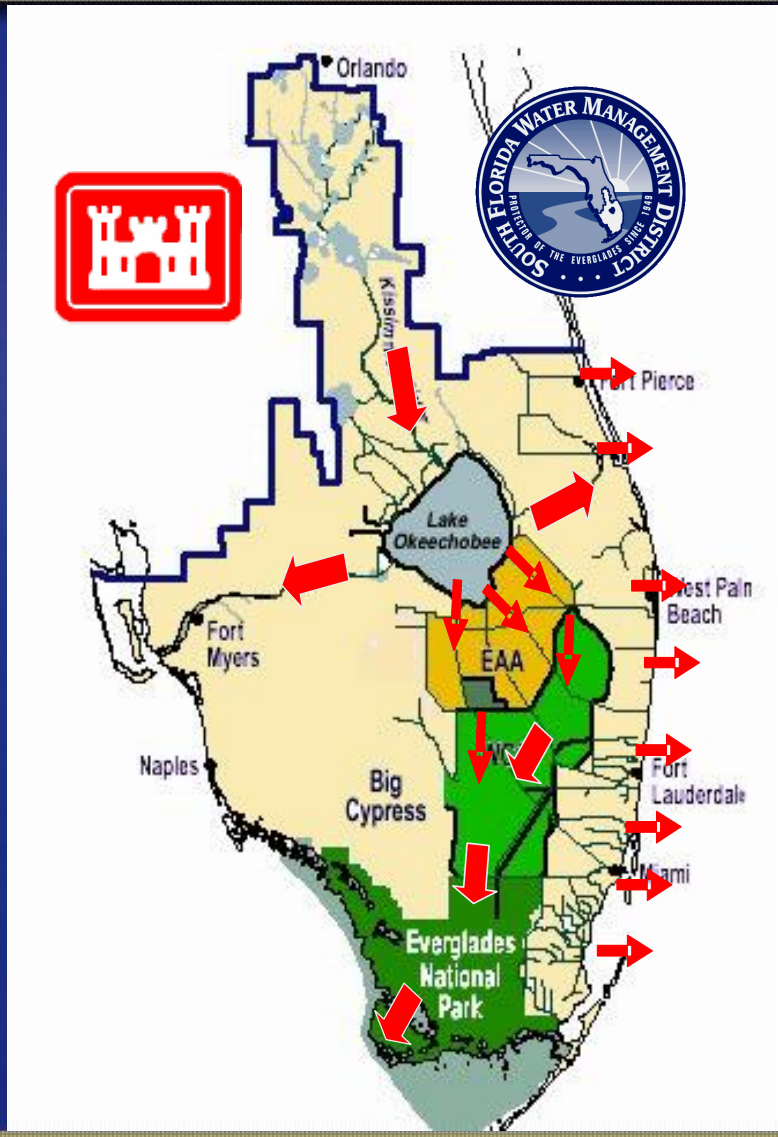


EXTENT OF THE 1947 FLOODING

Estimation of flooded areas
Reference House Document
No. 643 – 80th Congress.

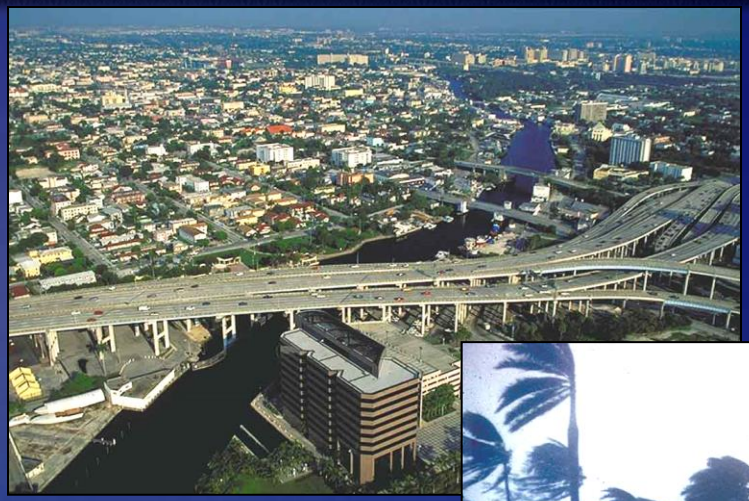
Central and Southern Florida Project

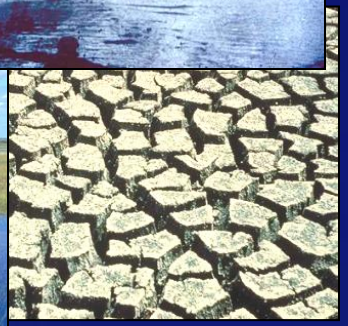
- Designed for multiple purposes
  - Flood Control
  - Water Supply
  - Navigation
  - Prevention of Saltwater Intrusion
  - Protection of Fish & Wildlife
- Constructed by the U.S. Army Corps of Engineers between 1949 and 1970
- Operated and maintained by the South Florida Water Management District
- Recent improvements include regional stormwater treatment projects to improve water quality entering the Everglades



The "Project Purpose"

- **Flood Control**
- **Water Supply**
  - Agriculture
  - Urban
  - Everglades National Park
  - Saltwater Intrusion
- **Navigation**
- **Protection of "fish and wildlife"**

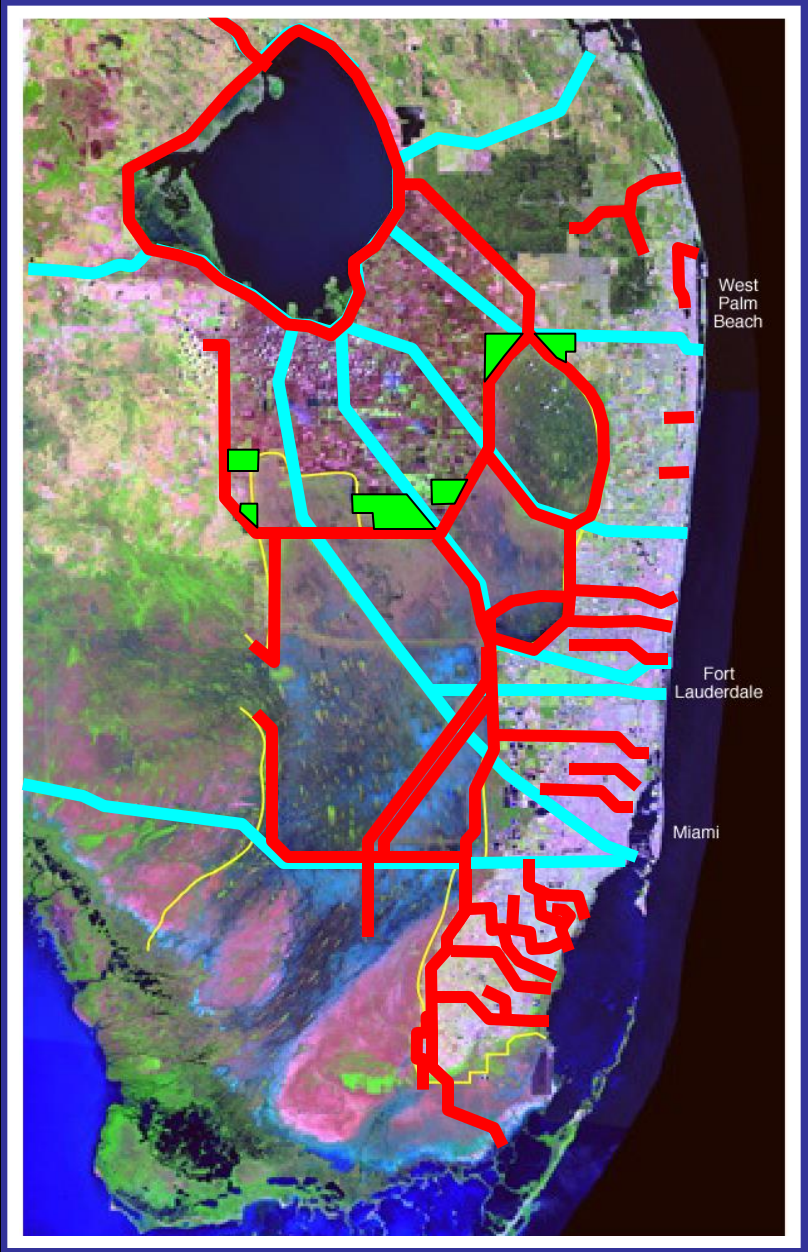




Water Management System

- 2,700 miles of canals and levees
- 160 major drainage basins
- 1,290 water control structures
- 69 stormwater pumping stations
- 1,227 vehicles and pieces of heavy equipment
- Regional telemetry system
- 60,000 acres of regional wetland Stormwater Treatment Areas
- Lake Okeechobee
  - 450,000 acre water storage area
- Water Conservation Areas
  - 959,000 acre water storage

Chronology of Water Management Changes



Managed System (2003)

Pre-Central & South Florida Projects

- Caloosahatchee/Kissimmee Rivers 1881-93
- East Coast Canals/St. Lucie Canal 1905-24
- Tamiami Trail – 1915-28
- Lake Okeechobee HH Dike – 1932-38

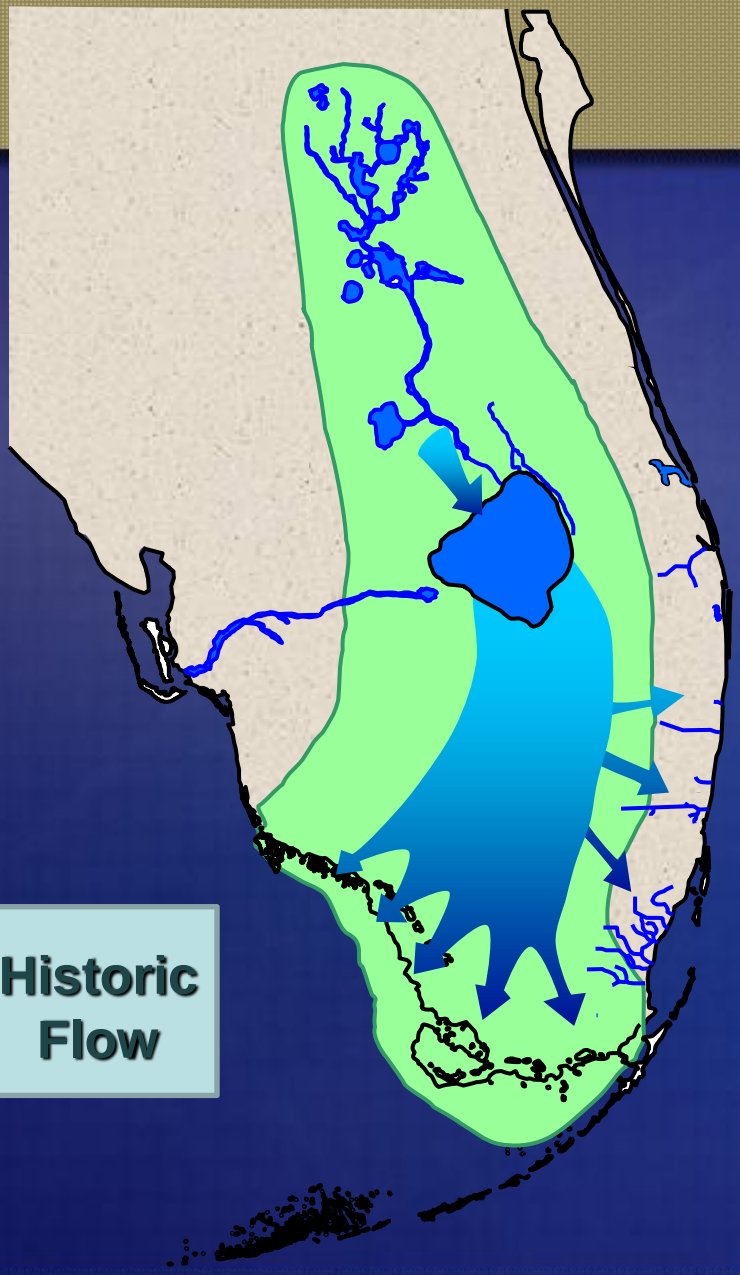
Central & Southern Florida Project

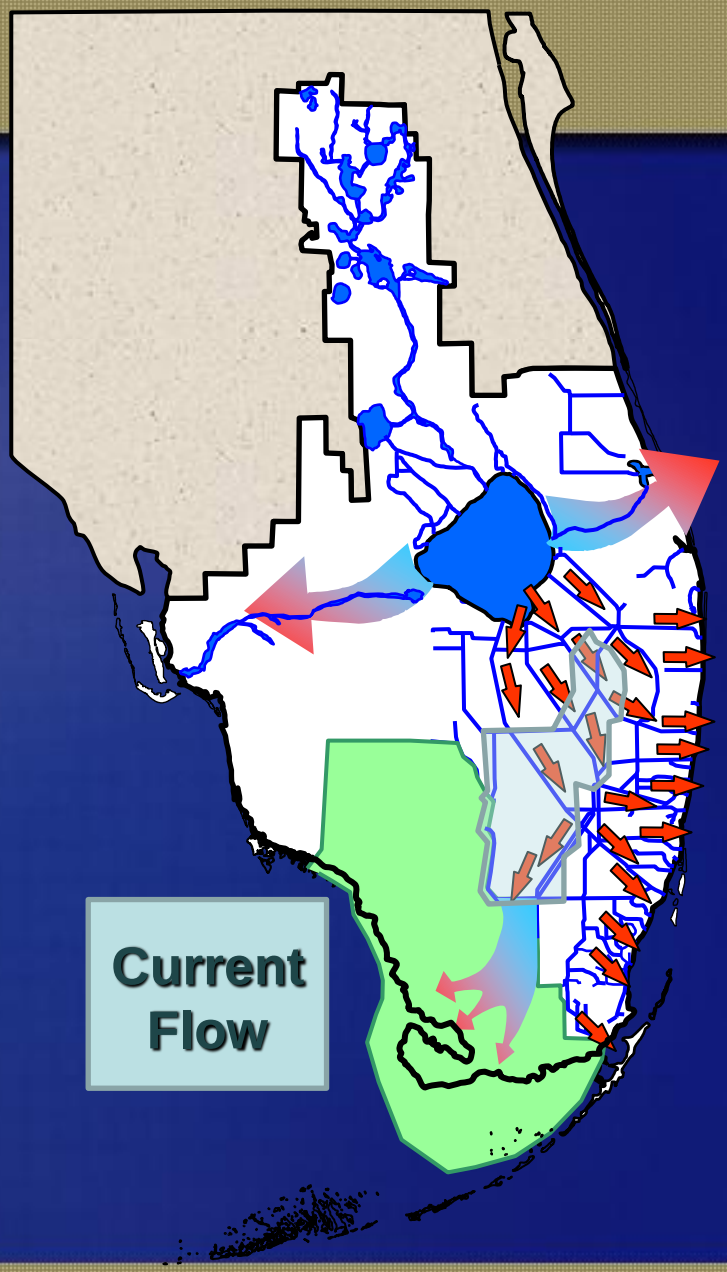
- Eastern Protective Levee System – 1952-54
- Everglades Agricultural Area – 1954-59
- Water Conservation Area Levees – 1960-63
- Lower East Coast Canals – 1954-65
- Lake Okeechobee Levees – 1960-64
- Kissimmee River Channelization – 1962-71
- South Dade System – 1965-83

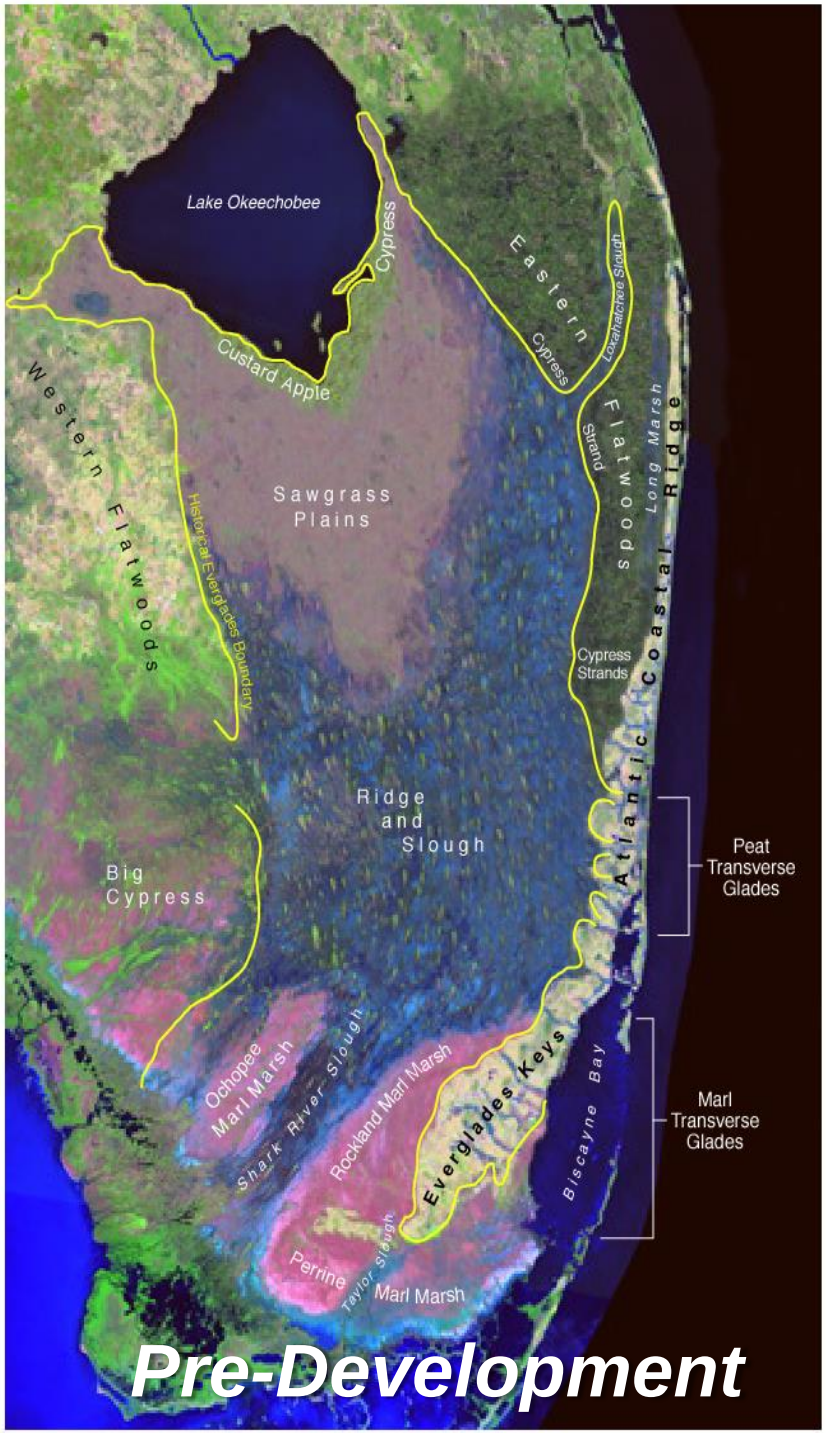
Everglades Construction Project

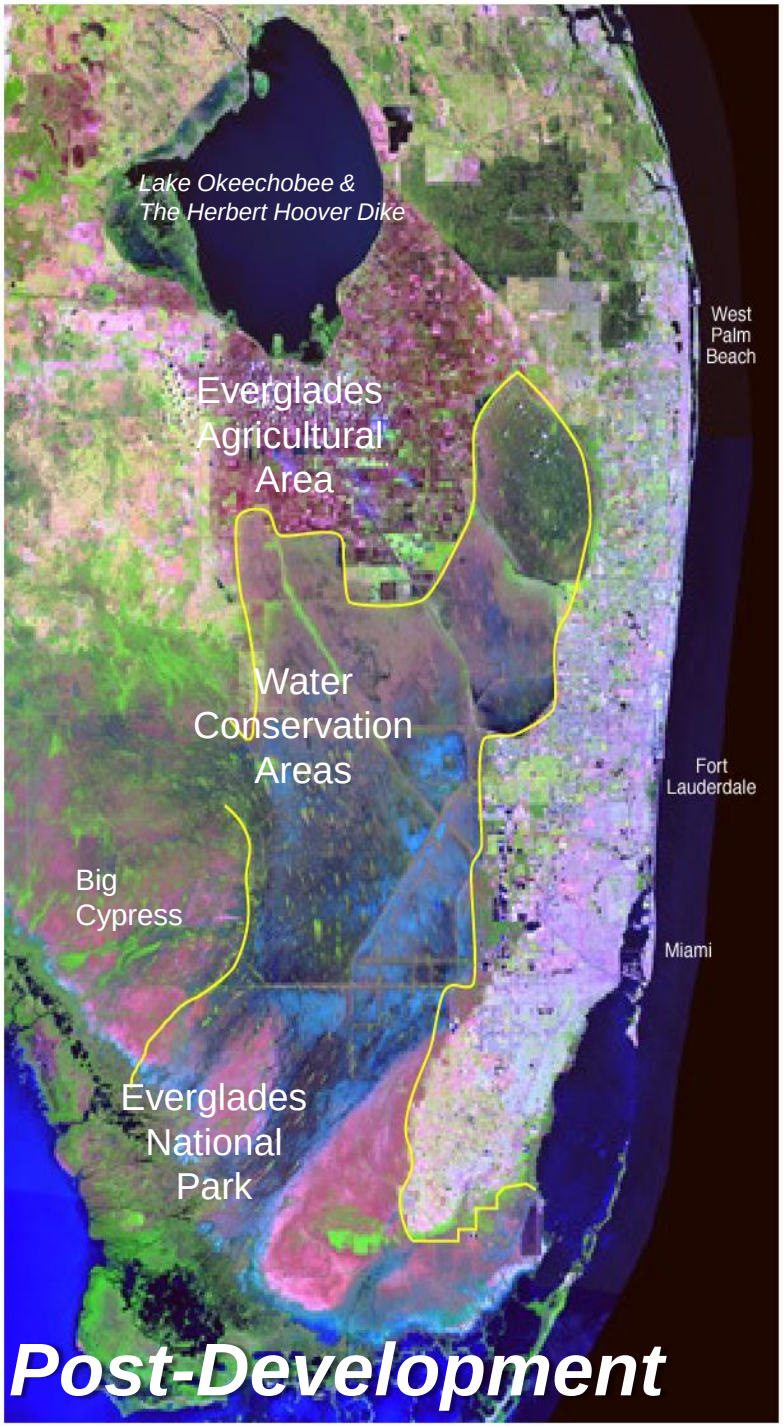
- Stormwater Treatment Areas – 1994-2003

Source: Light and Dineen, 1994; SFWMD & USACE, 2008

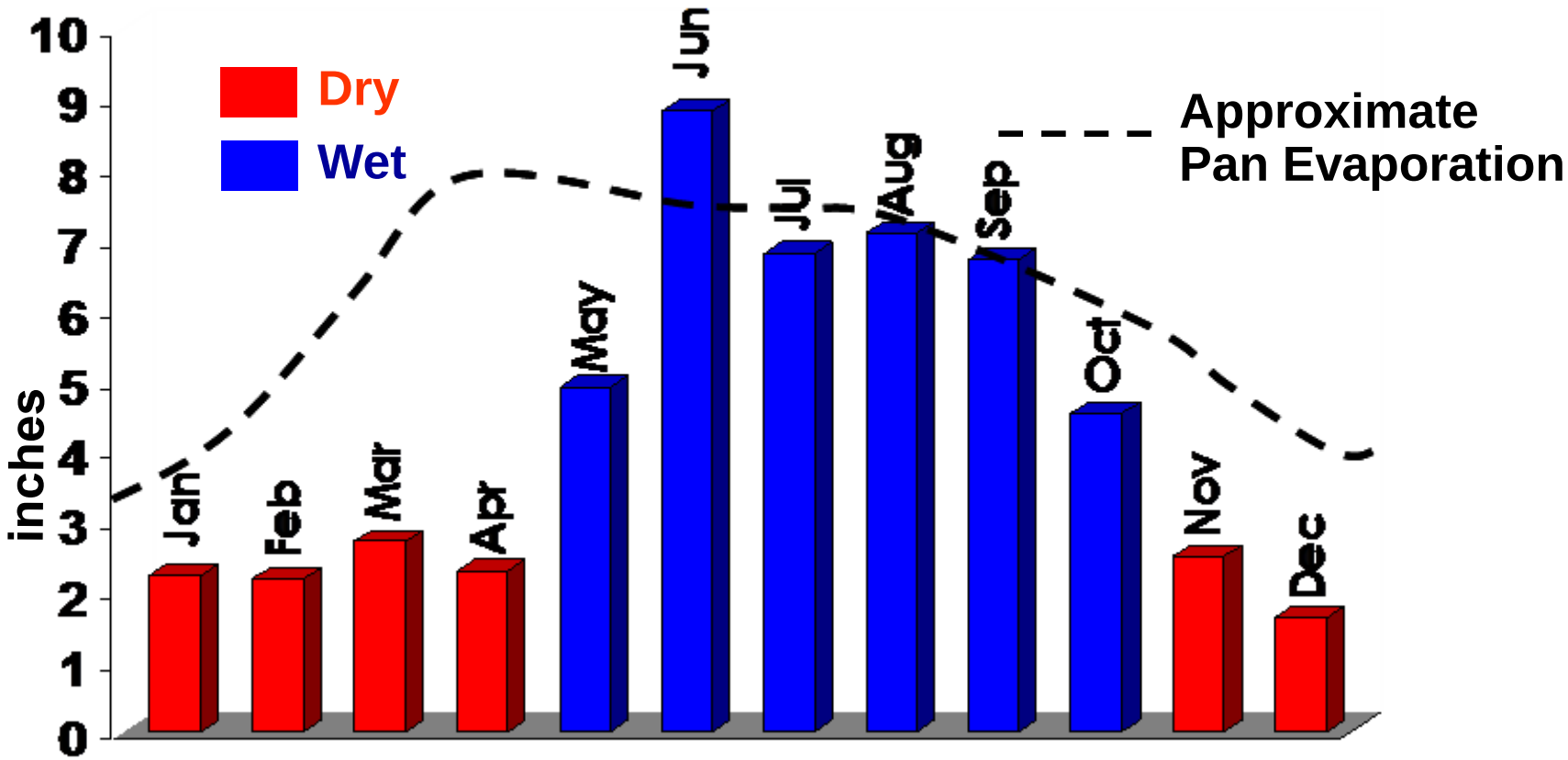

Historic Flow


Current Flow


Lake Okeechobee
Cypress
Custard Apple
Eastern
Cypress
Loxahatchee Slough
Western Flatwoods
Sawgrass Plains
Historical Everglades Boundary
Flatwoods
Strand
Long Marsh
Ridge
Coastal
Cypress Strands
Ridge and Slough
Atlantic
Peat Transverse Glades
Big Cypress
Ochopee Marl Marsh
Shark River Slough
Rockland Marl Marsh
Everglades Keys
Biscayne Bay
Marl Transverse Glades
Perrine
Taylor Slough
Marl Marsh
Pre-Development


Lake Okeechobee &
The Herbert Hoover Dike
West Palm Beach
Everglades Agricultural Area
Water Conservation Areas
Fort Lauderdale
Big Cypress
Miami
Everglades National Park
Post-Development

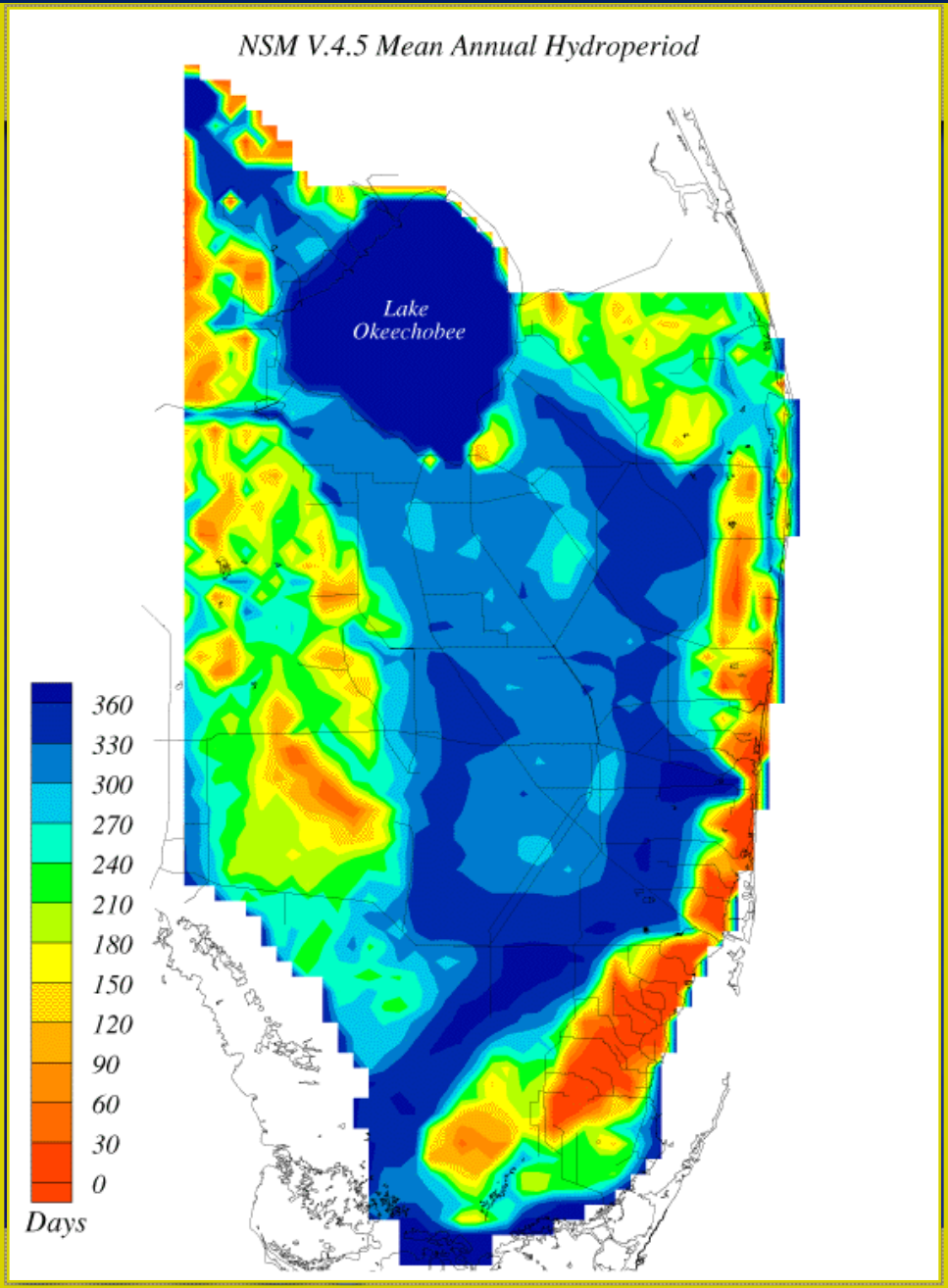
Seasonal Rainfall Variation in South Florida

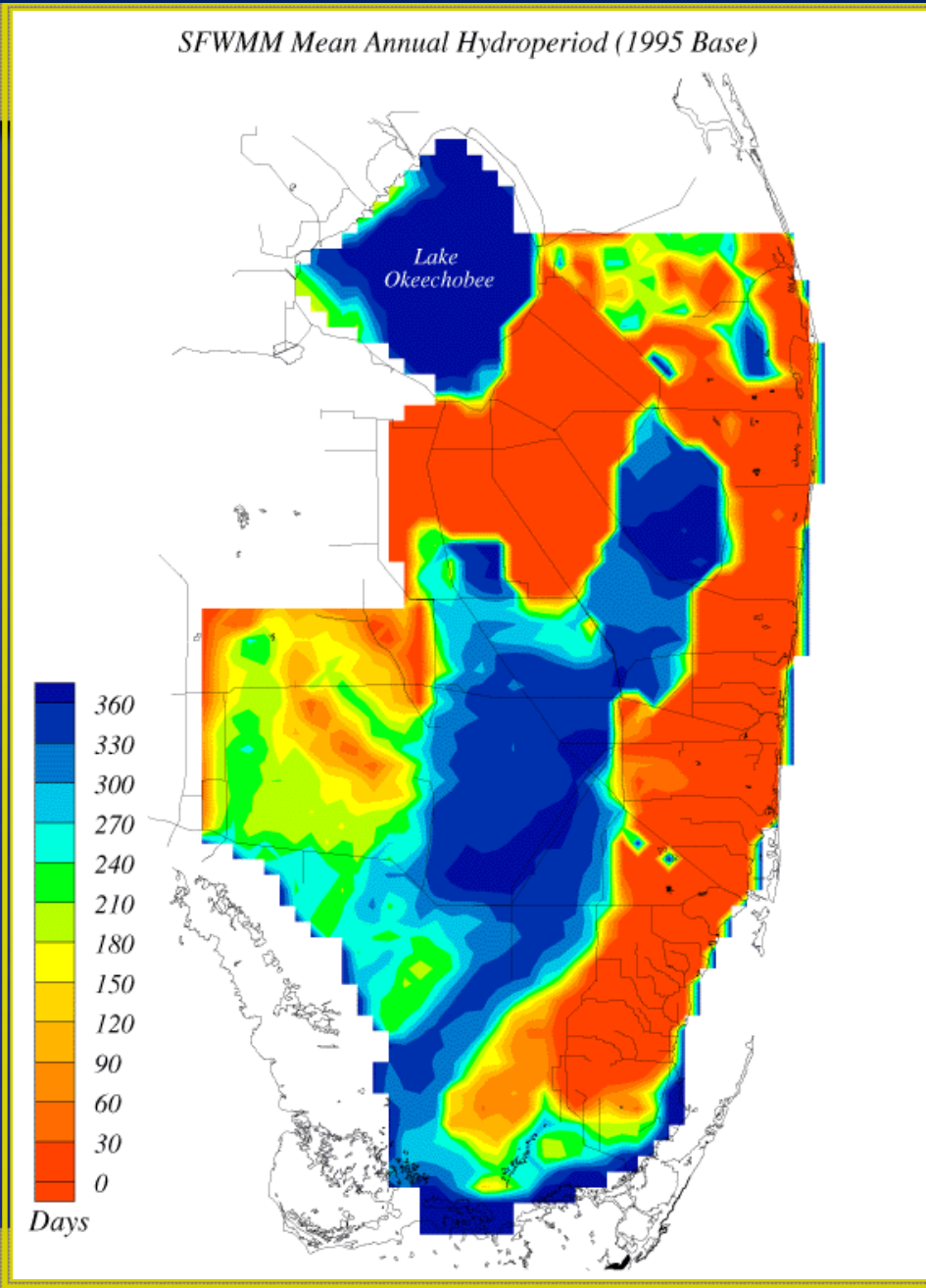


Average Monthly Rainfall 1965-1995

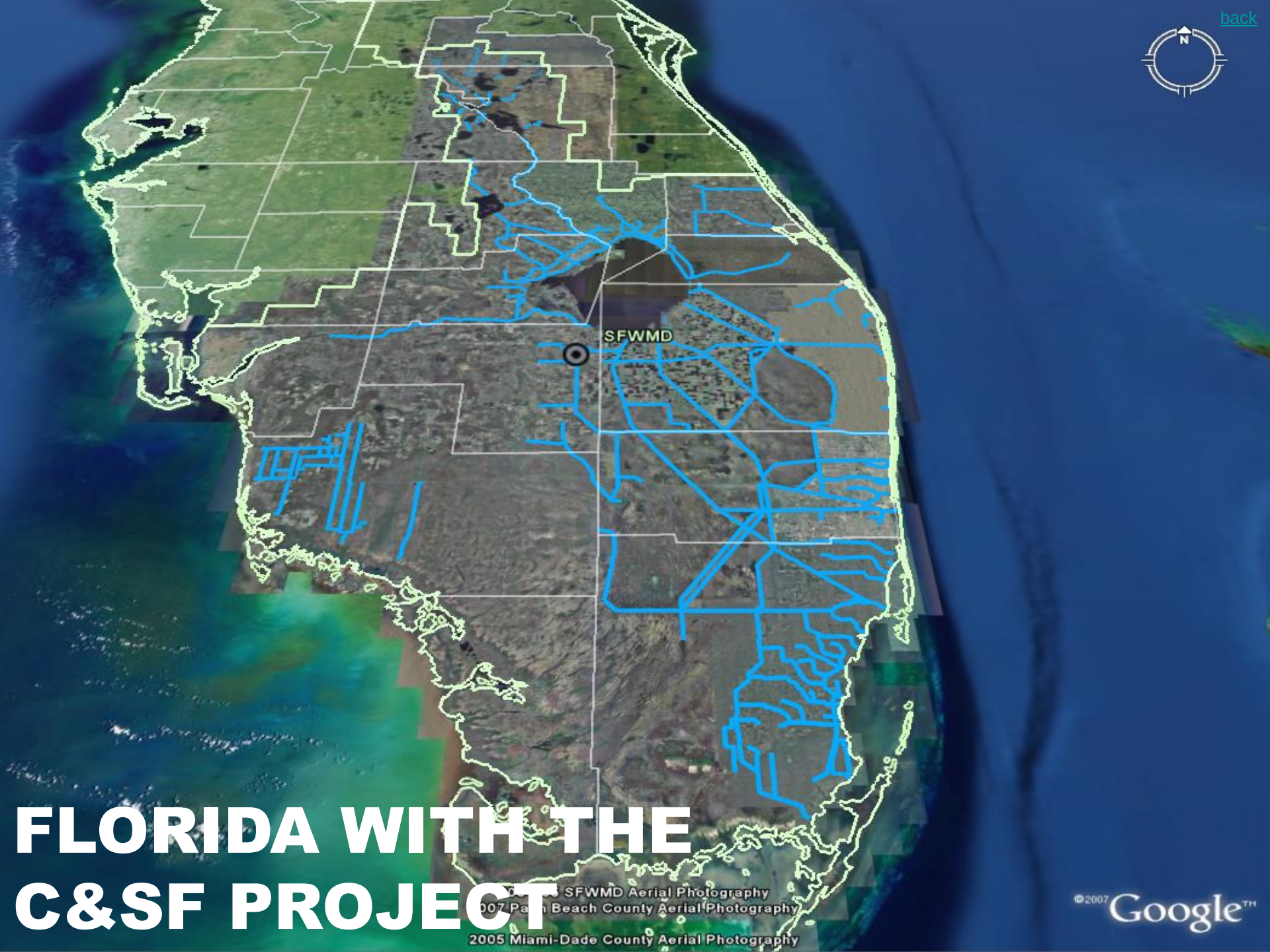
Annual Rainfall averages 52” and varies historically from less than 40” to over 78”

Natural vs. Altered Hydroperiod Patterns



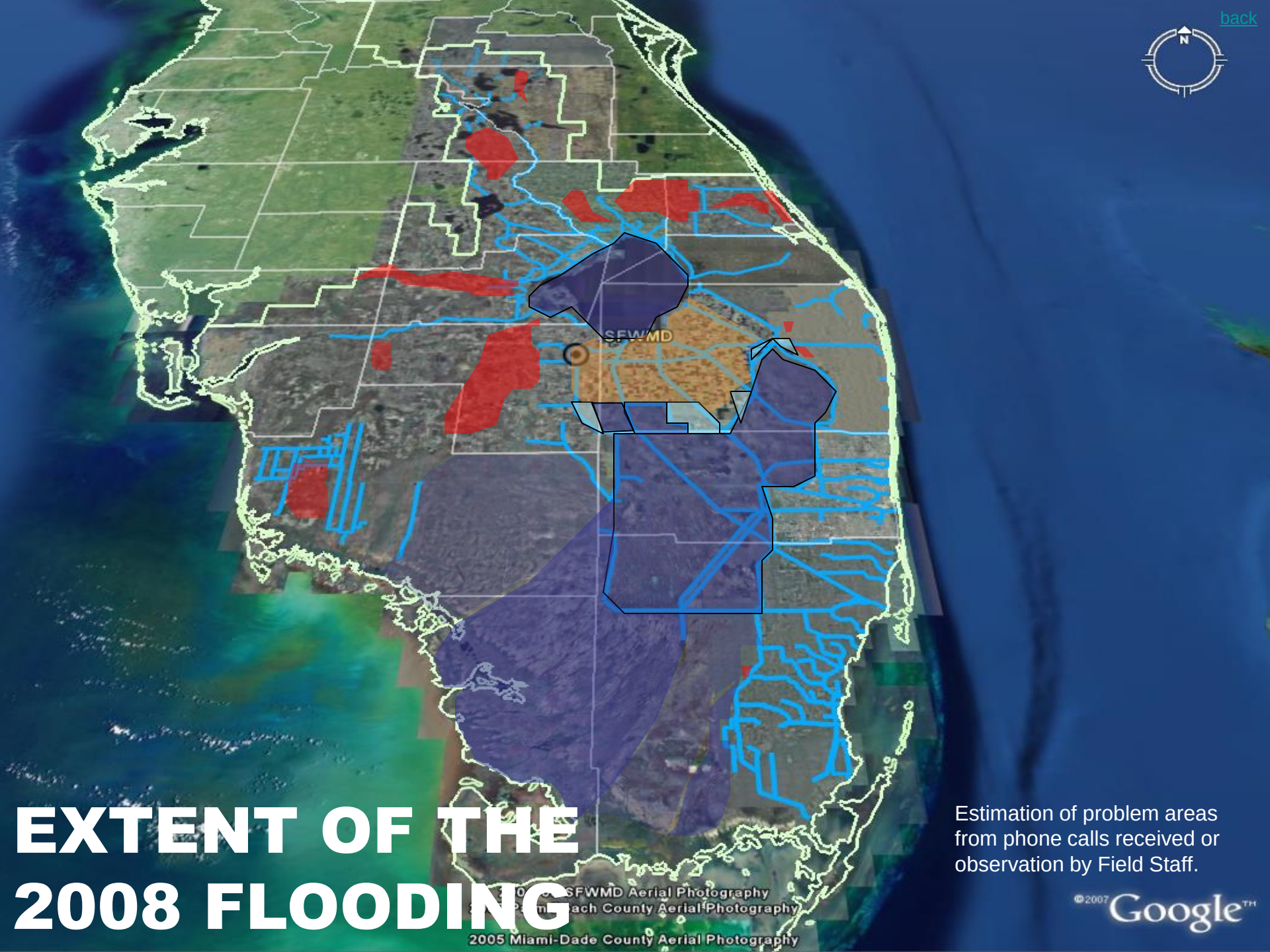


back



FLORIDA WITH THE C&SF PROJECT

back

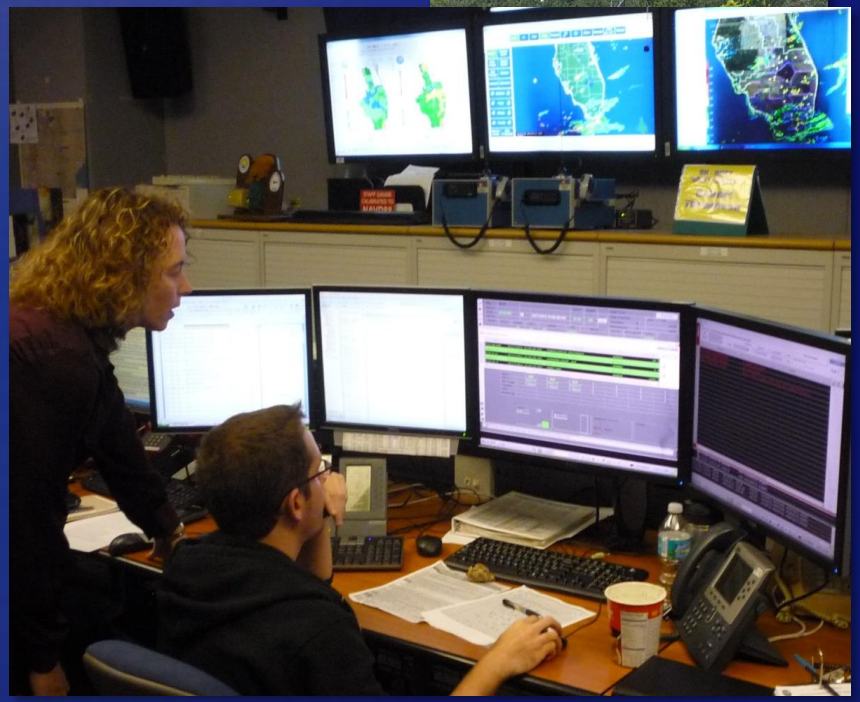


EXTENT OF THE 2008 FLOODING

Estimation of problem areas from phone calls received or observation by Field Staff.

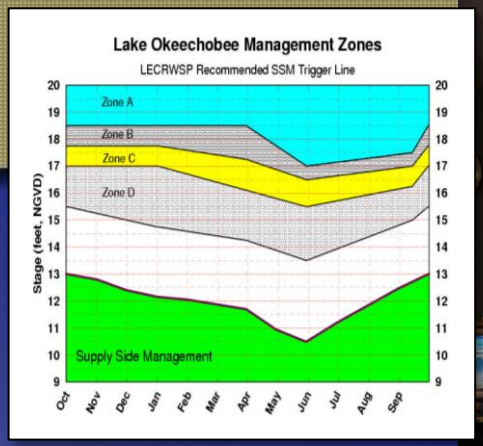
Leveraging Technology in Water Resource Management

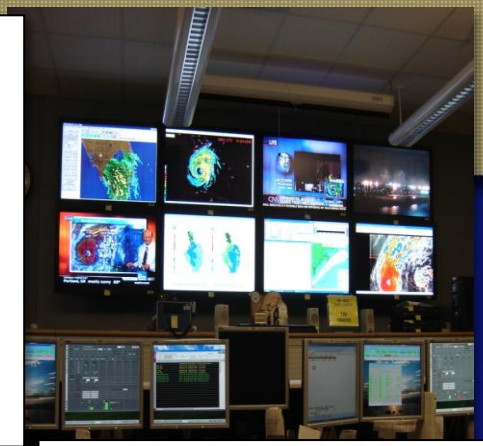
- Technology has been applied to increase the overall efficiency of the regional water resource management system
- A microwave telemetry system was developed to consolidate structure operations to a single location at the agency's Operations Control Center
- Automation of manual functions in the agency's growing fleet of stormwater pumping stations
  - Reducing staffing from 5 people per shift to 2
  - These functions were further consolidated to the point where multiple pump stations can be remotely operated by a single individual at a regional pump control center.

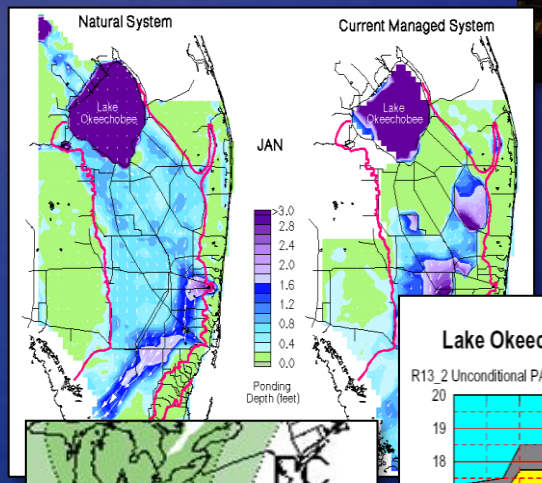


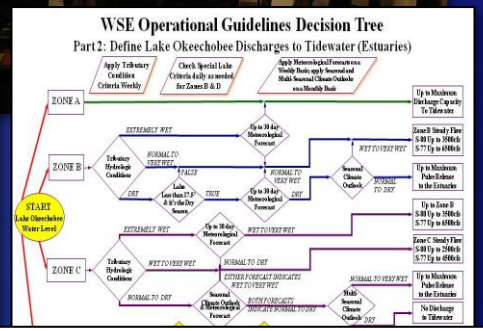
Decision Support

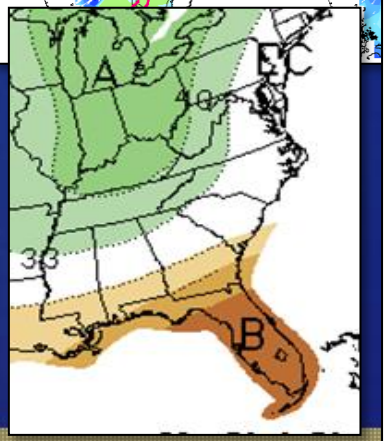
- Operations Control Center
  - Major water control structures are remotely controlled to optimize Flood Control and Water Supply operations
- Regional Operations
  - Utilize a multi-objective regulation schedule
    - Climate Outlooks
    - Computer based Position Analysis for projected Lake stages
    - Weekly agency coordination

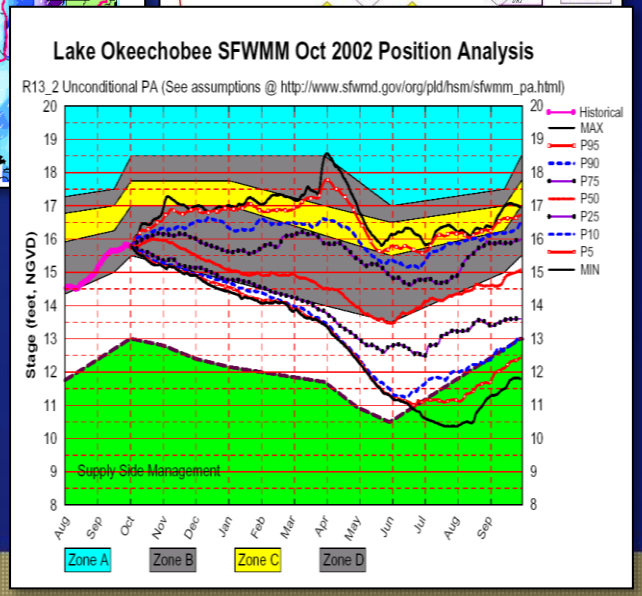




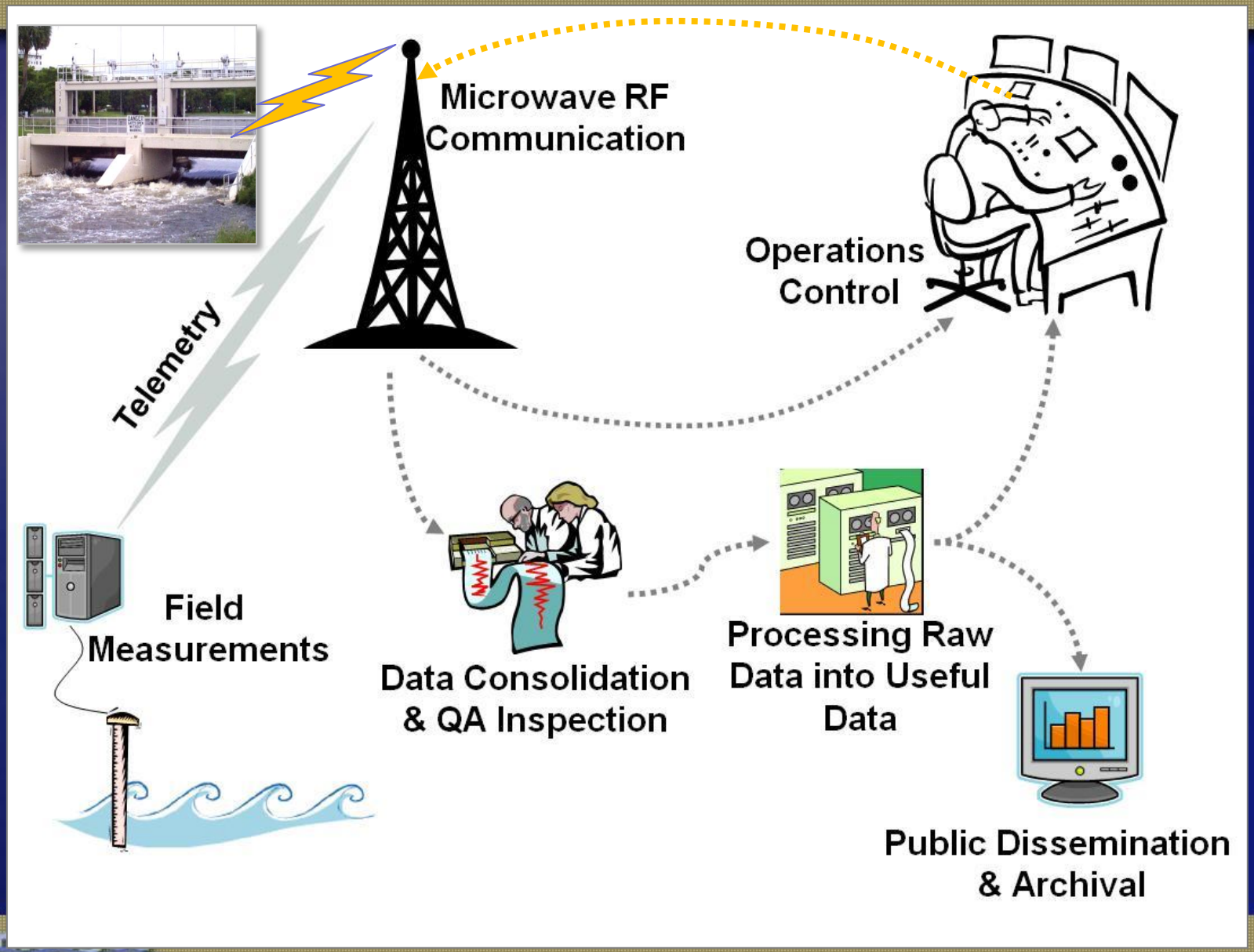








Data Acquisition & Automation

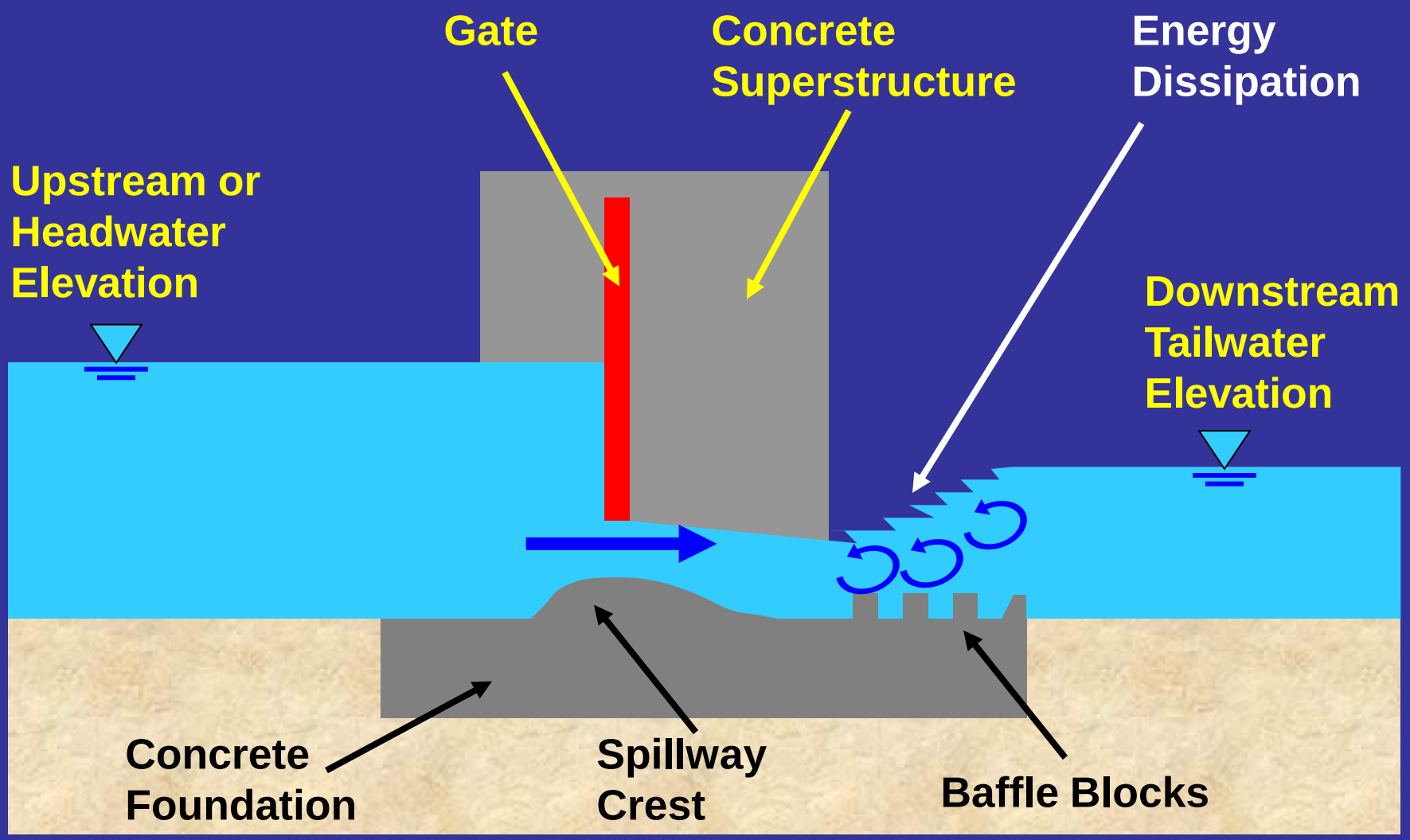


Basin Operations in Broward Co.

- Canal levels are regulated by opening and closing of water control structures.
- Structures have automatic controls and opening and closing are determined by headwater levels.
- Canal level optimum generally measured at coastal structure headwater.
- Water is supplied, in so far as possible from WCA-1 via S39 (Hillsboro) & WCA-2 via S-38 (C-14)

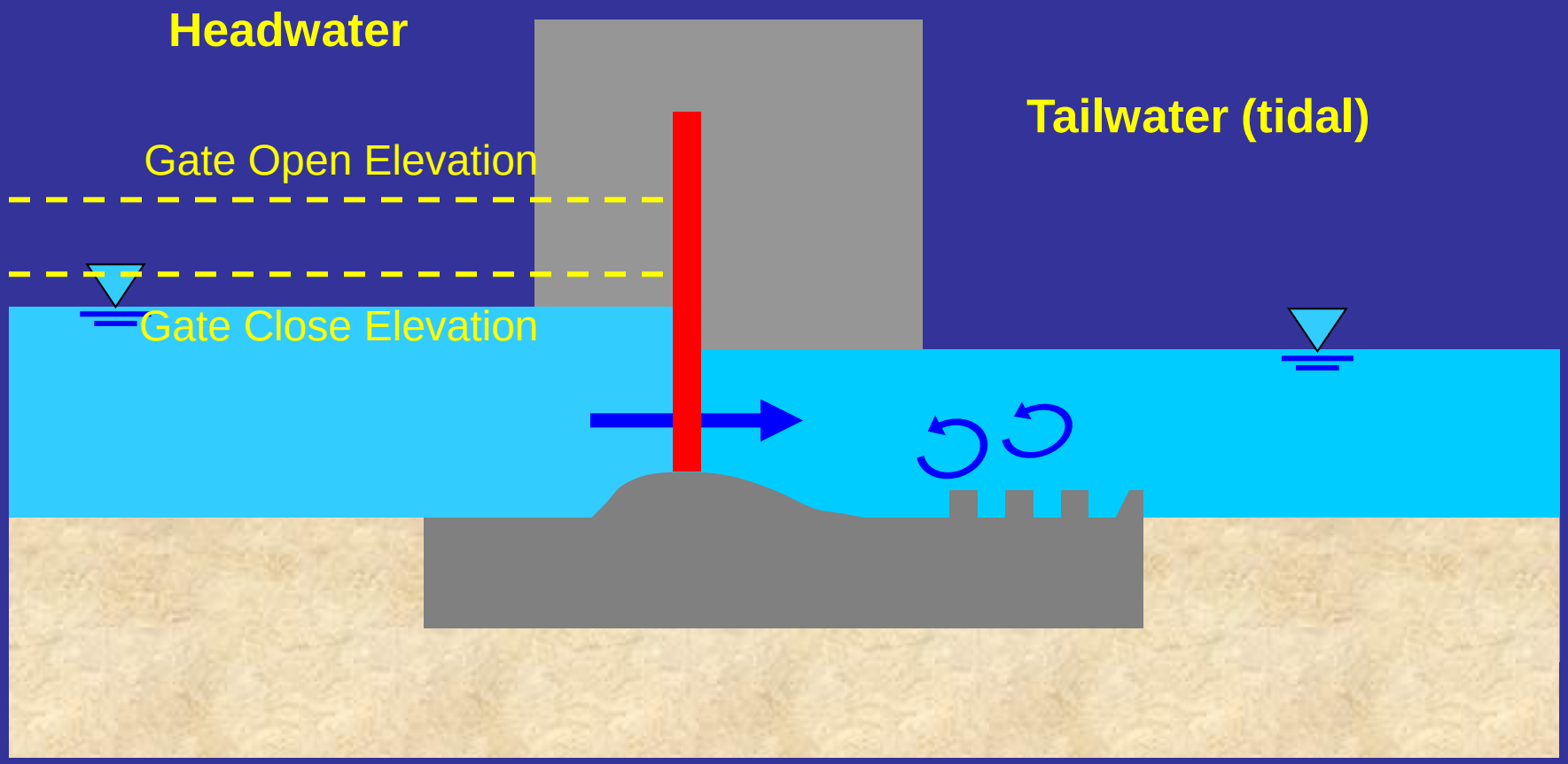
Gated Spillway Basics

Gated Spillway Basics



Gated Spillway

(coastal structures)



Gated Spillway

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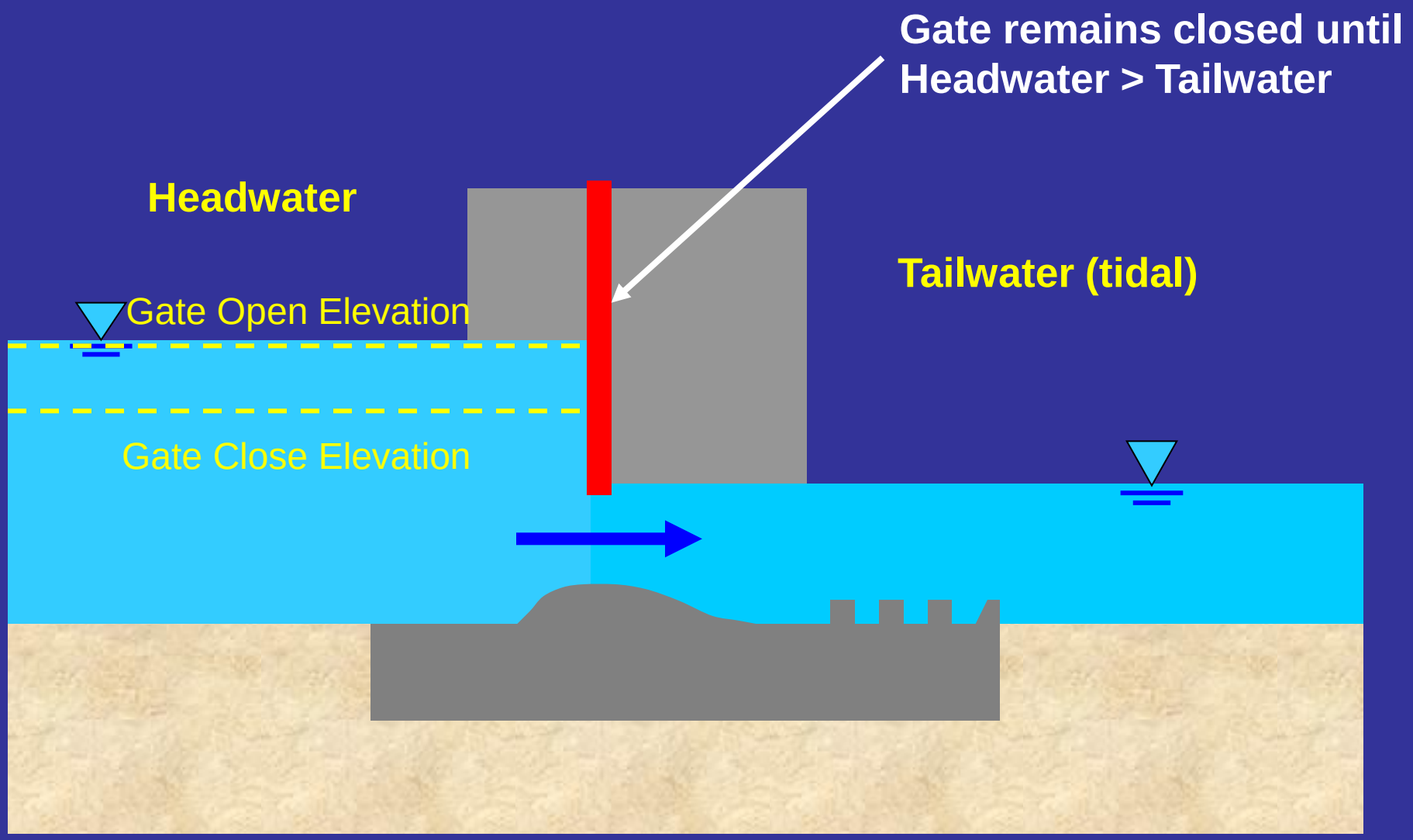


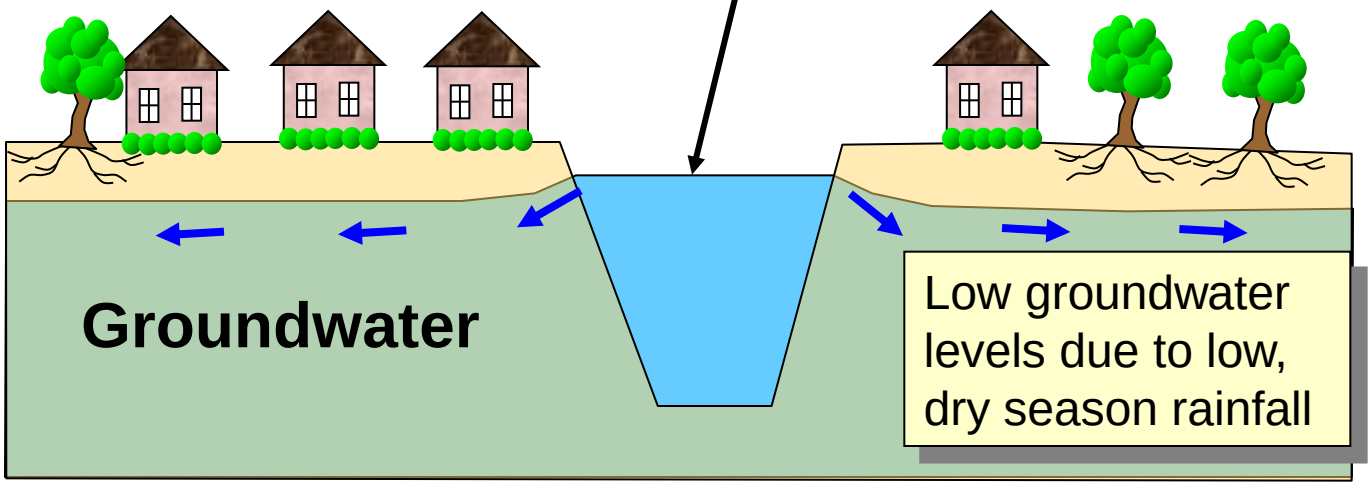
Canal / Groundwater Interaction

Normal Dry Season Operations

Canals serve two primary purposes….

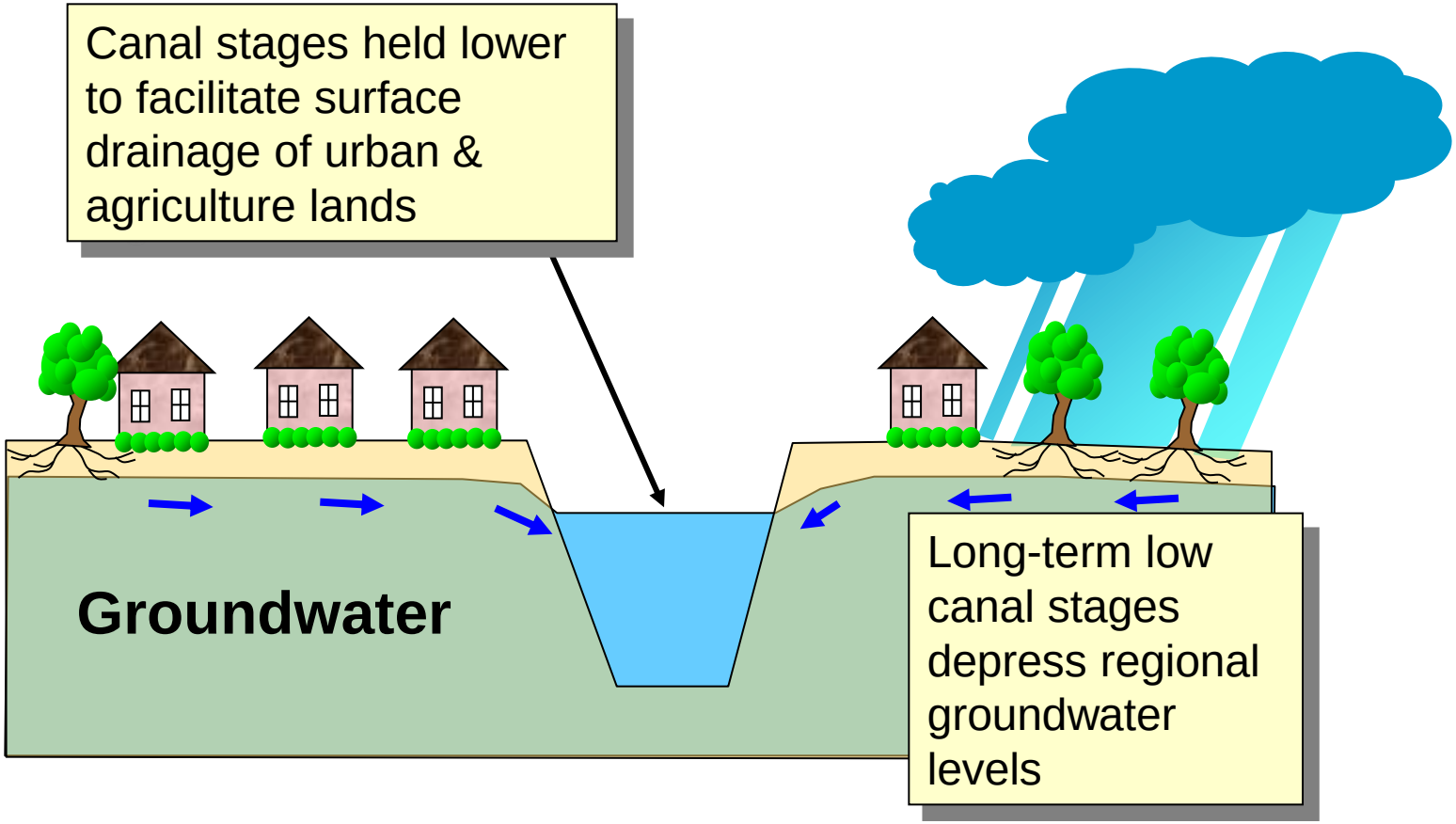
1. **Flood Control**
2. **Water Supply**

Canal stages held high to facilitate groundwater recharge and assist supplemental irrigation



Canal / Groundwater Interaction

Normal Wet Season Operations

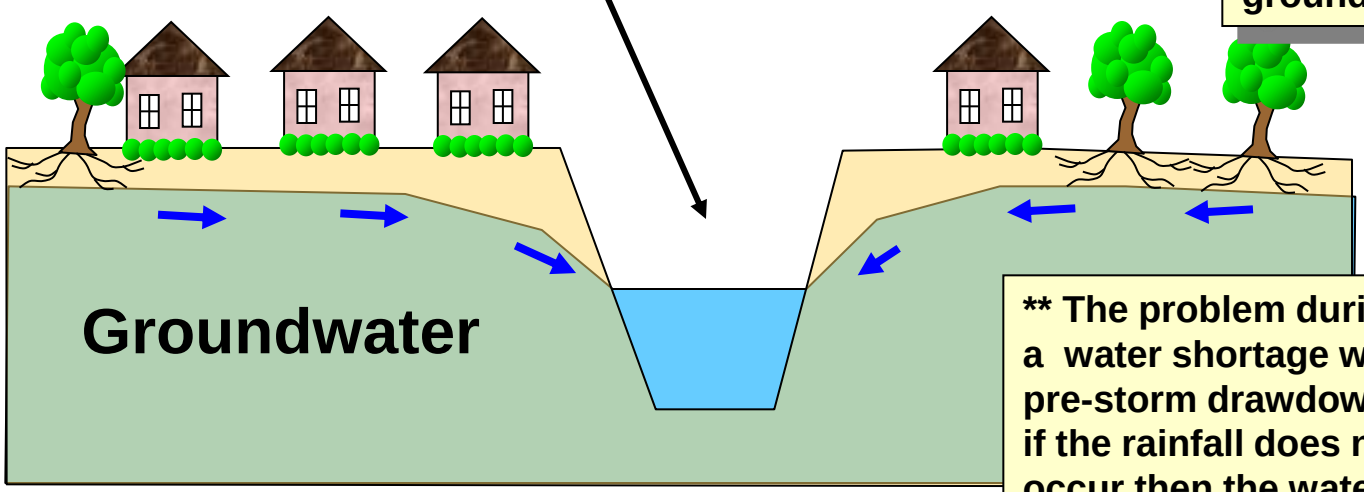


Canal / Groundwater Interaction

Wet Season Pre-Storm Drawdown Operations

Canal stages lowered up to an additional ~1 foot to increase **surface drainage** of urban & ag lands prior to forecasted storms

Short-term lowering of canal stages <u>generally does not</u> significantly decrease regional groundwater levels.**



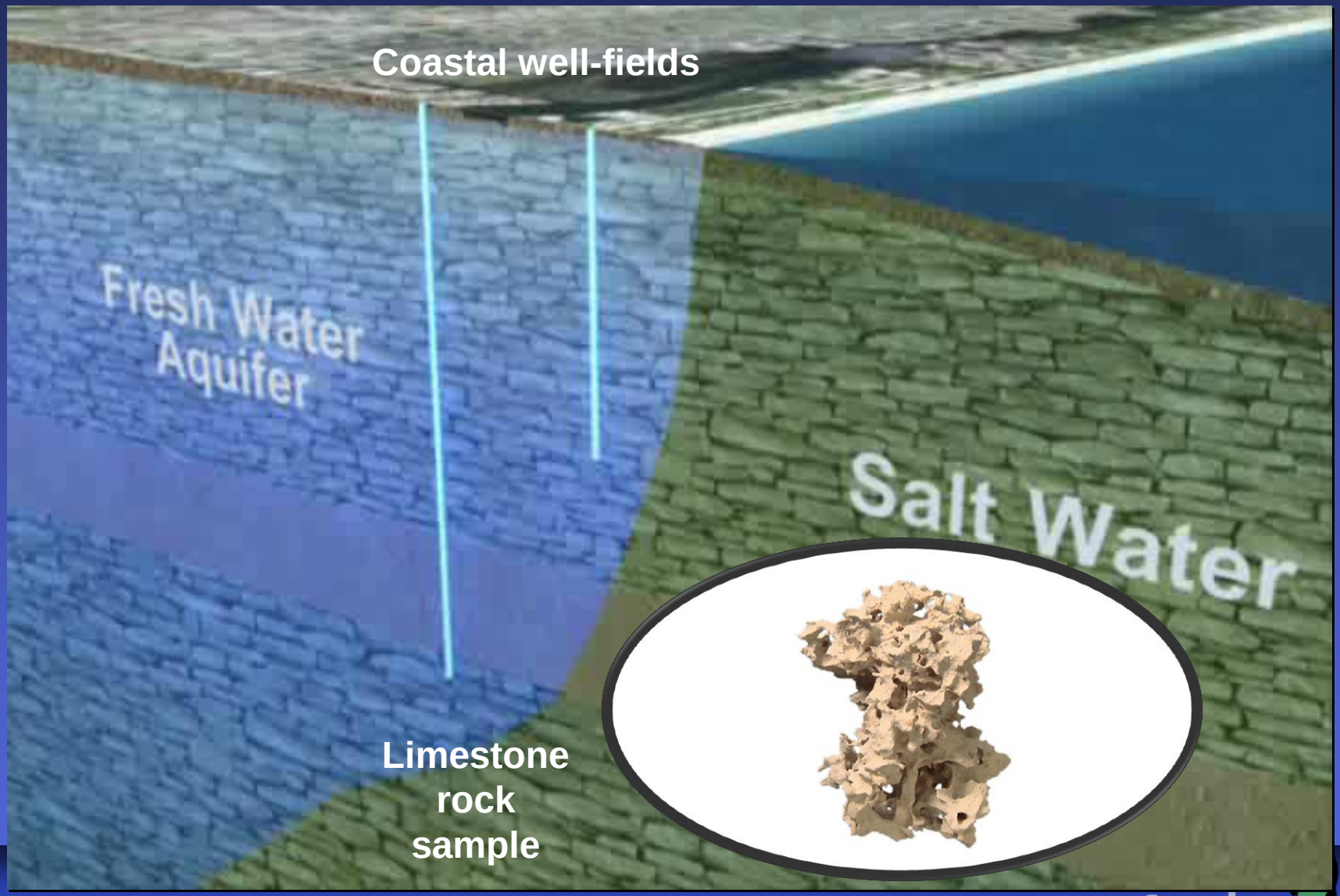
**** The problem during a water shortage with pre-storm drawdown is if the rainfall does not occur then the water is lost from the system.**

Current Water Management Challenges

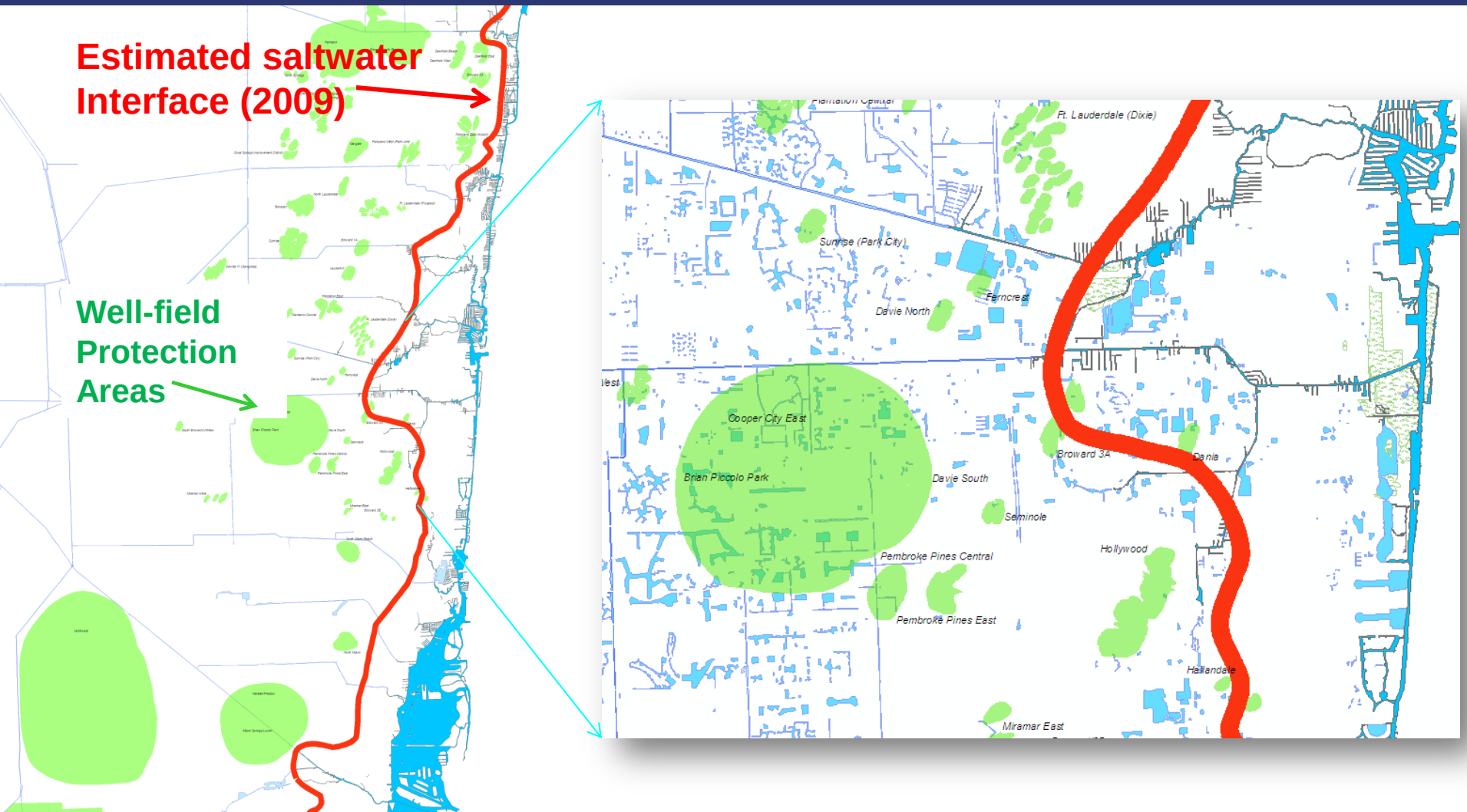
Considering Implications of Sea Level Rise

- Areas of south Florida lie any where from 1 to 6 feet above sea level
- Sea level has risen approximately 7 inches over the past 100 years
- The primary impact on District facilities will be the decrease in gravity head across the system
  - Reducing flood discharges
  - Increasing landward salinity encroachment
- Forward pumping systems may be a solution.
- But unprotected downstream areas will be more difficult to address

Exposure: Saltwater Intrusion

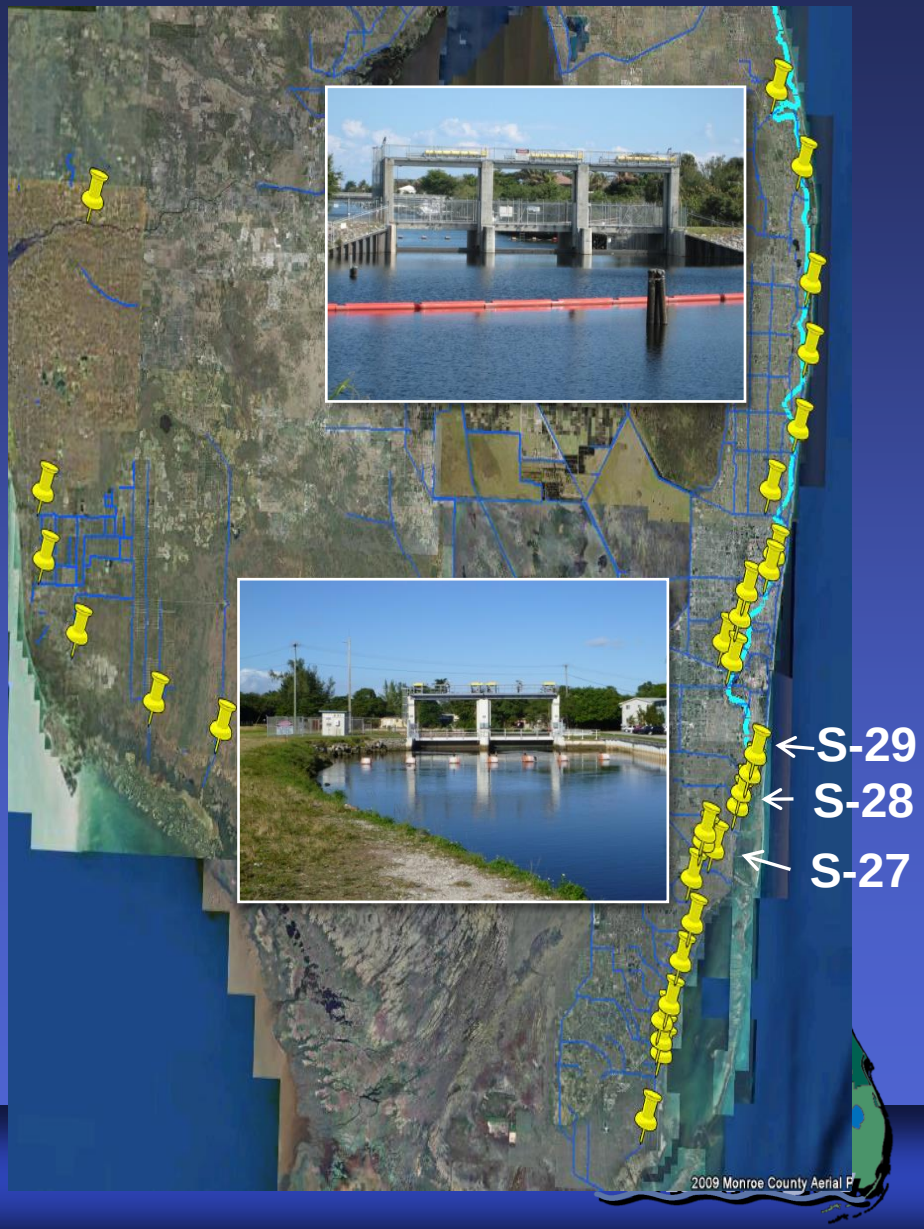


Exposure: Threat to Wellfields



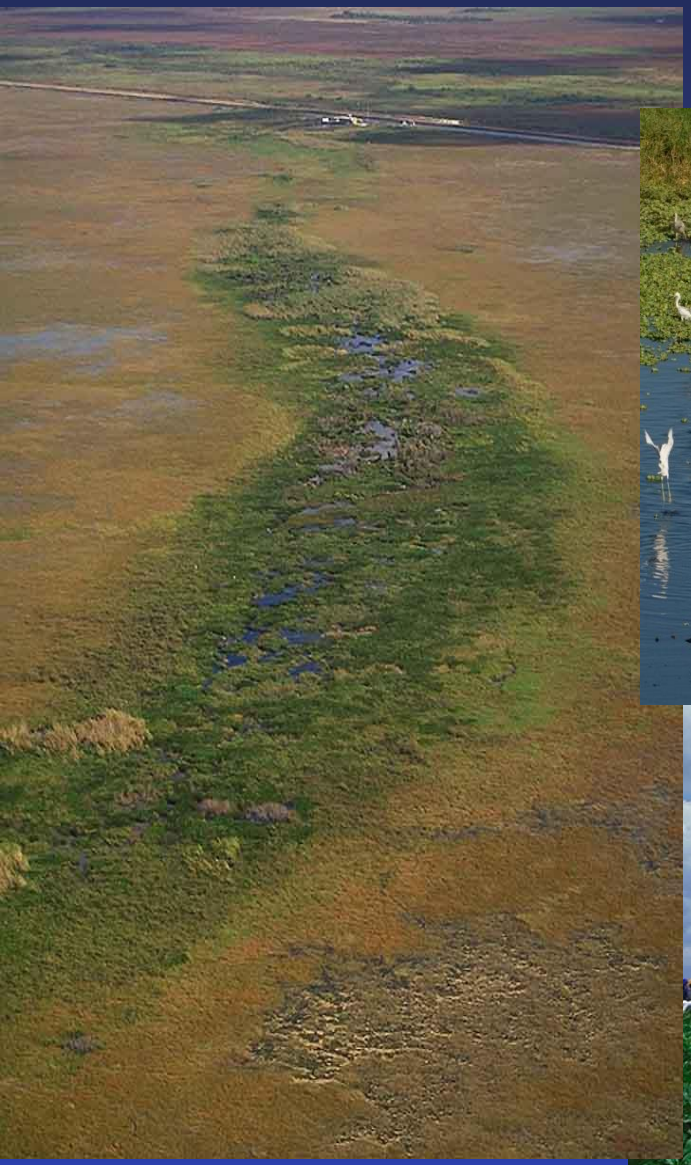
Review of Coastal Infrastructure

- Salinity Control Structures provide two primary functions: Barrier for saltwater intrusion and Flood Control
- C&SF system is approaching or exceeding design life expectancy. SFWMD routinely evaluates infrastructure on a 5 year cycle.
- 5 year and 10-year capital improvement budgets
- Complexity requires a thorough analysis: frequency and duration of flooding, impacts on downstream areas
- Coordination with local governments in dealing with local flooding



Adaptation to Rising Seas
Example: Forward Pumping at S-26 Structure

Water Management .....



…the challenge is balancing competing & conflicting objectives

Questions?