August 11, 2010
Governing Board Workshop

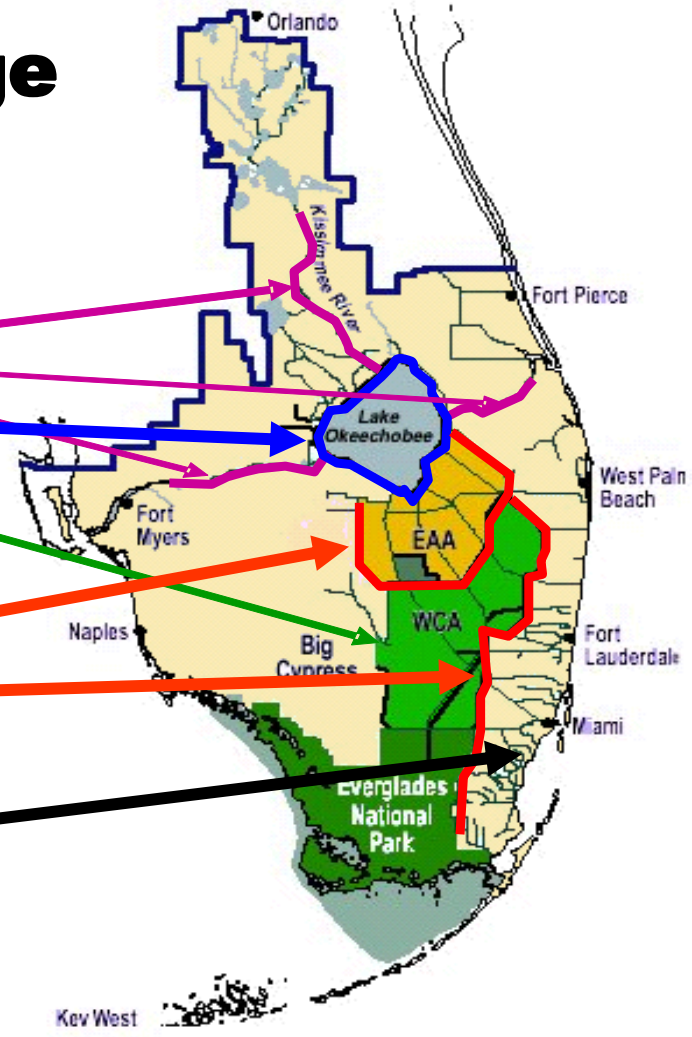
Regional Water Quality Issues in South Florida

Linda Lindstrom, P.G.
Director, Restoration Sciences Department

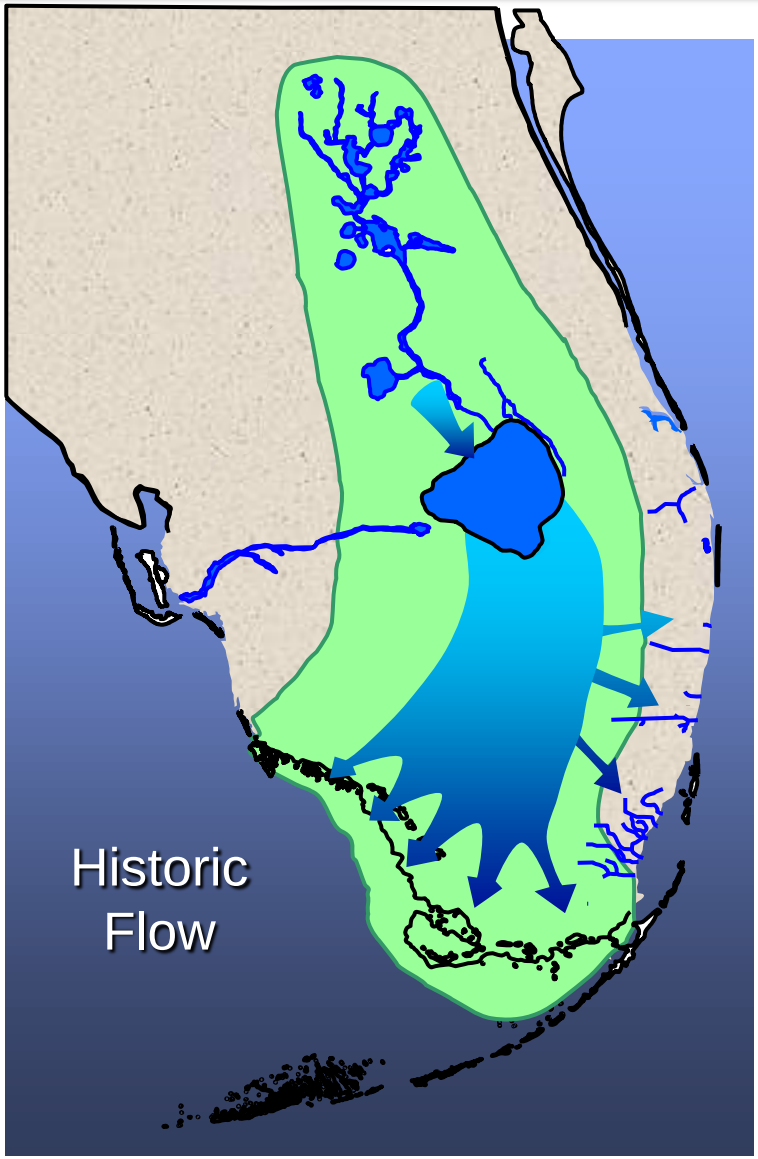
Water Quality – A Regional Problem

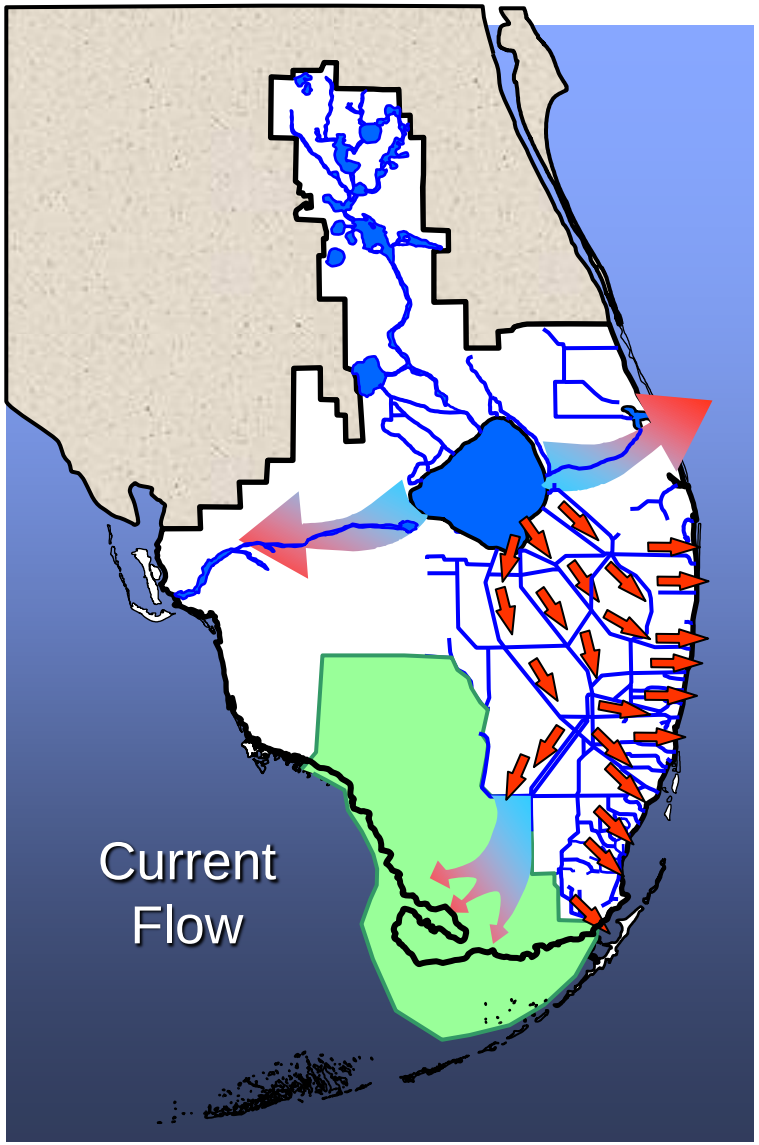
Water Quality is a challenge throughout the region

- River Channelization
- Herbert Hoover Dike
- Water Conservation areas
- Protective Levees
  - *Everglades Agricultural Area*
  - *Lower East Coast*
- Drainage Facilities and Network
  - *Salinity Structures*



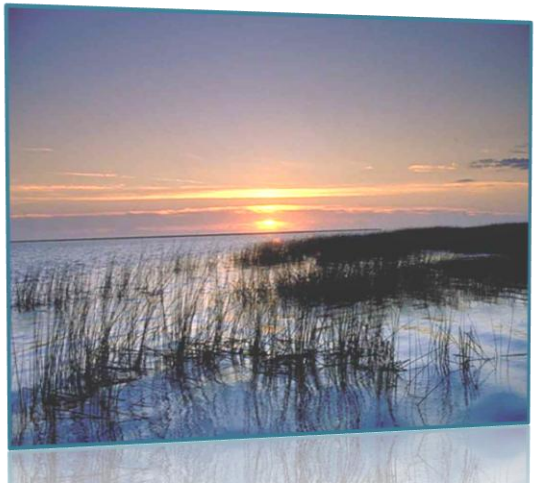
System Modifications Alter Quality



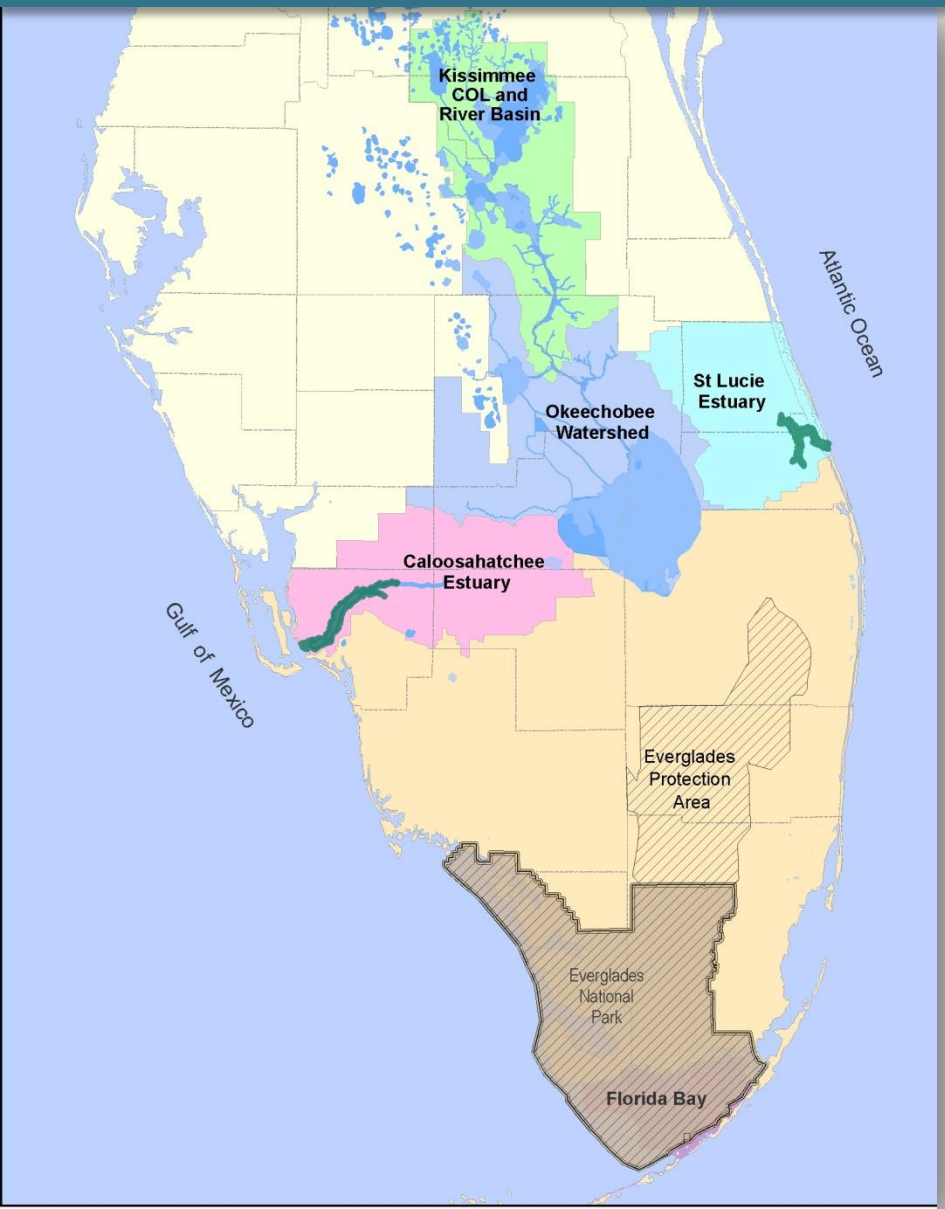


Other Factors Impact Water Quality

- Florida's subtropical climate, which is one of extremes
- Population growth
- Intensive urban and agricultural land use
- Stormwater runoff
- Atmospheric deposition



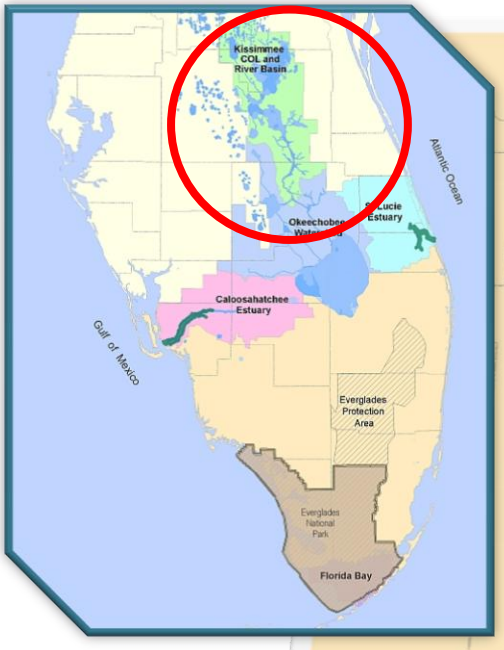
Regional Water Quality Issues

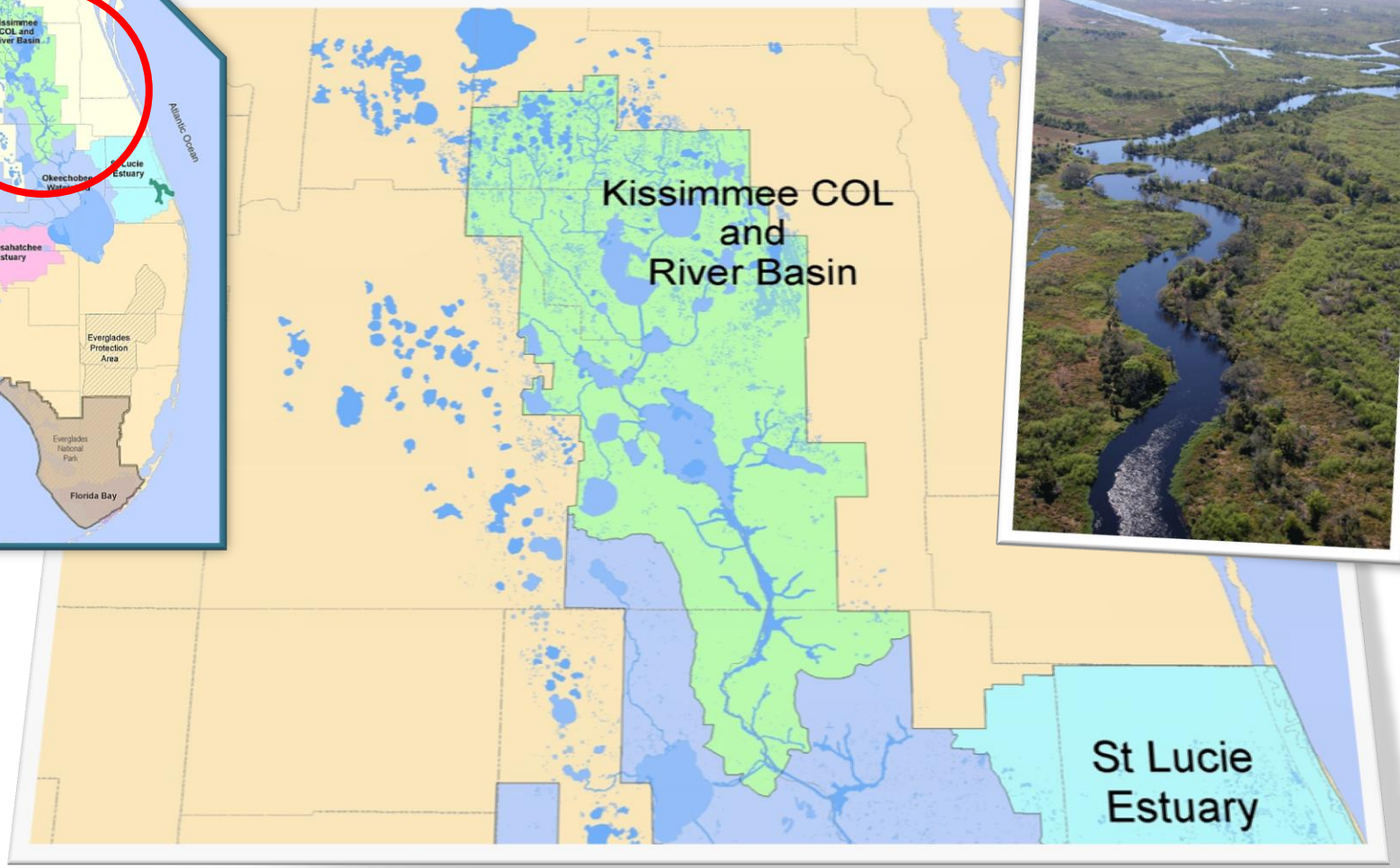


Region-by-Region Focus

- Water Quality Issues
- Water Quality Challenges
- Water Quality Improvement Actions and Efforts

Kissimmee Water Quality
Chain of Lakes and River Basin





Kissimmee Water Quality

Issues

- **Nutrients**
  - Eutrophication of Kissimmee Chain of Lakes (KCOL); magnitude of Okeechobee enrichment varies from lake to lake
  - Kissimmee River contributes > 30% of phosphorus (P) load to Lake
    - 50% from KCOL and 50% from agricultural watershed along the river
    - River included in L.O. Tributary TMDL (USEPA 2008): TP – 113 ppb and TN – 1.2 ppm
    - TMDL for River and KCOL to be developed by FDEP in 2011
- **Low Dissolved Oxygen (<2 mg/L)**
  - Pre-restoration river channel characterized by low levels (1-3 mg/L)
  - Natural processes can also cause low oxygen levels
- **Mercury**
  - bioaccumulation is widespread in the river basin, but levels are lower than in the Everglades

Kissimmee Water Quality

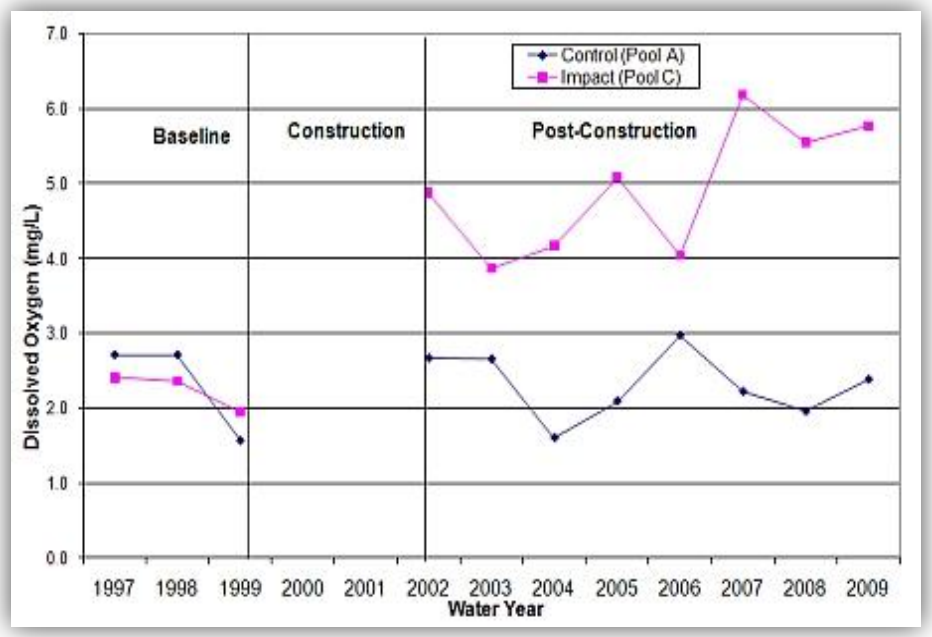
Challenges

- Implementation of L.O. Tributary TMDL and future TMDLs for KCOL and River
- Nonpoint source nutrient runoff to KCOL and River
- Legacy P
- Changes to and intensification of land use

Kissimmee Water Quality

Improvement Actions and Efforts

- Wastewater treatment effluents removed from KCOL in 1980s
- River restoration has been successful at increasing dissolved oxygen to favorable levels
- Source Controls (FDEP, FDACS and SFWMD)
- Local stormwater projects
- Restoration of floodplain sloughs and marshes may increase retention and assimilation of P
  -Phosphorus Dynamic Study



Lake Okeechobee Watershed Water Quality

St Lucie Estuary

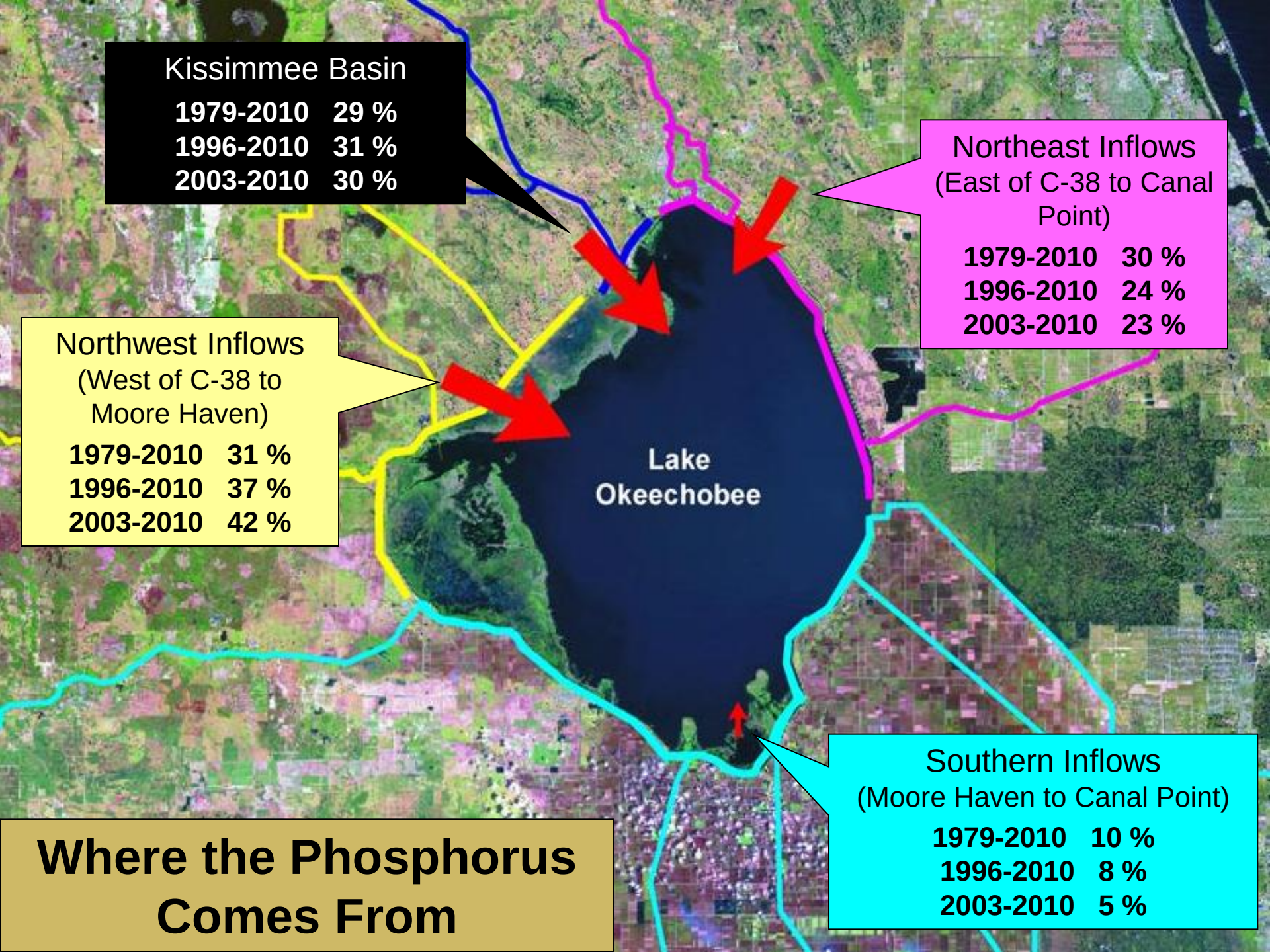
Okeechobee Watershed

Lake Okeechobee Watershed Water Quality

Issue

Phosphorus: A Significant Problem

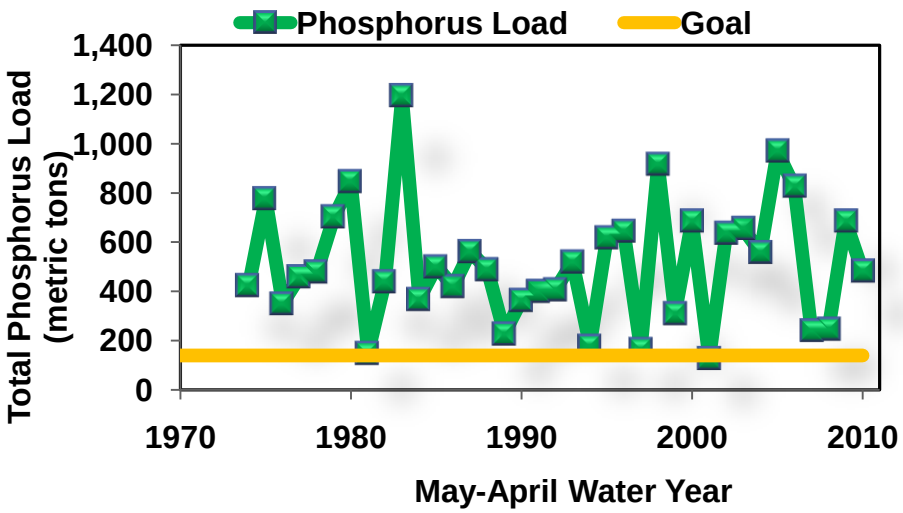
- The estimated annual net P import to the LO watershed is approximately 5,330 metric tons (mt) through anthropogenic activities
- This is a 34% decrease since 2002-2003 which was at 8,085 mt annually.
- Of the 5,330 mt, an estimated 4,450 mt is retained annually in the soils as legacy P; 176,000 mt has accumulated in the system
- Source of imported phosphorus is from several major land uses including dairy/cattle farms, improved pasture, citrus, low and medium density residential areas, and sugarcane
- LO Tributary TMDL (USEPA)

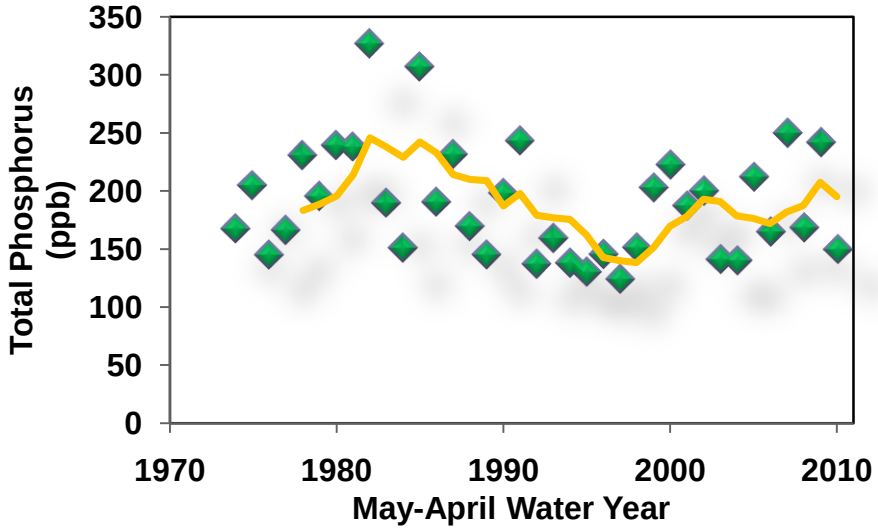

Kissimmee Basin
1979-2010 29 %
1996-2010 31 %
2003-2010 30 %
Northeast Inflows
(East of C-38 to Canal Point)
1979-2010 30 %
1996-2010 24 %
2003-2010 23 %
Northwest Inflows
(West of C-38 to Moore Haven)
1979-2010 31 %
1996-2010 37 %
2003-2010 42 %
Lake Okeechobee
Southern Inflows
(Moore Haven to Canal Point)
1979-2010 10 %
1996-2010 8 %
2003-2010 5 %
Where the Phosphorus Comes From

Lake Okeechobee Watershed Water Quality

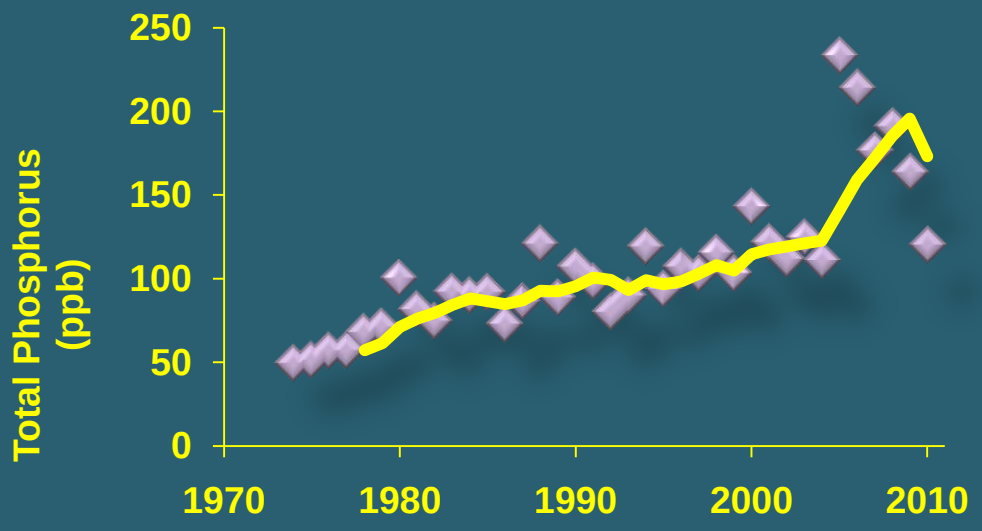
External Loads and P Concentrations

- LO TMDL of 140 mt per year (five year rolling average) - by 2015
- To reach the TMDL, external loads must be reduced by 300 to 400 mt annually
- Lake concentrations will gradually decrease to 40 ppb - 30 to 40 years after TMDL met
- Inflow concentrations and loads have declined somewhat as various source controls efforts have been implemented in the watershed





Lake Okeechobee Watershed Water Quality



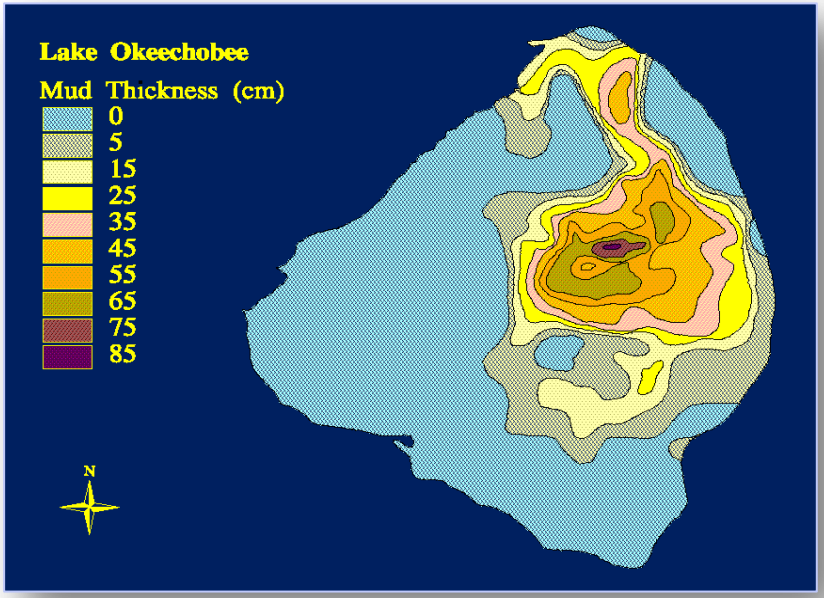
In-Lake Phosphorus and Algal Blooms

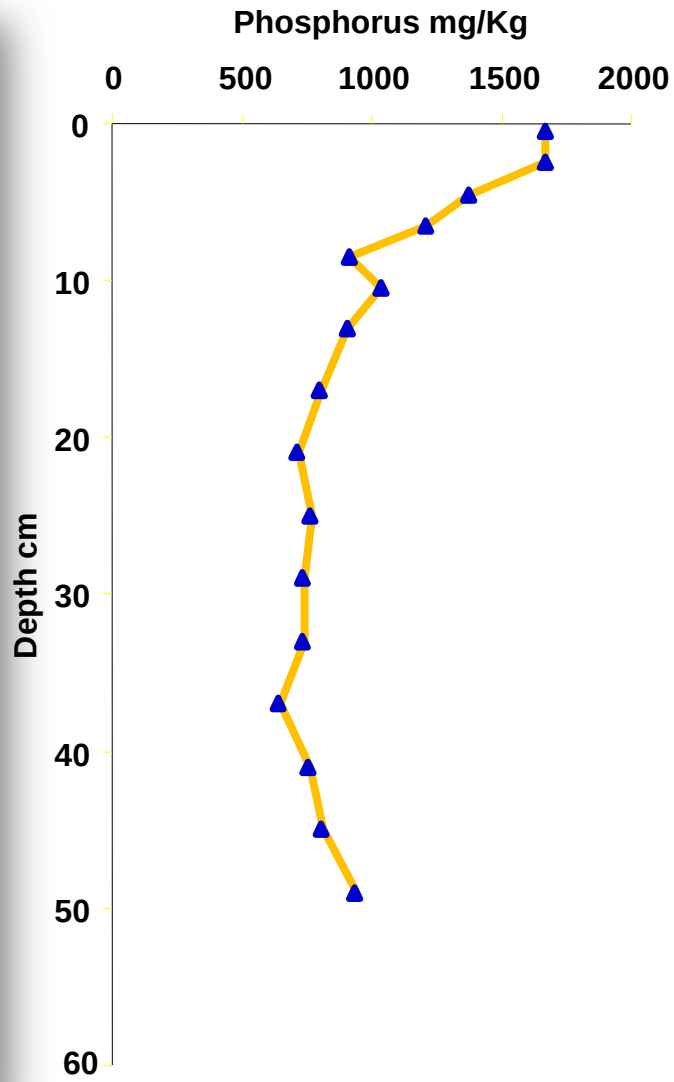
- P concentrations increased from 40 ppb in 1970s to over 100 in 1990s, and in 2004 to over 200 ppb due to turbid water from major storm events
- Concentrations are returning to levels driven by external loading
- Algal blooms in 1986 and 1987 covered 30-40% of open water; in 2005 microcystin toxin levels were above 20 ppb due to turbid water and warm weather
- Since summer of 2005, only minor isolated blooms have occurred, and levels of microcystin have been below the analytical limit of detection (0.2 ppb)

Lake Okeechobee Watershed Water Quality

In-lake Sediments

- P - laden mud sediments cover over 40% of lake bed
- Excess P loads from watershed continue to accumulate in these mud sediments
- Resuspension of sediment results in turbid conditions and contributes to increase in P concentration and algal blooms





Lake Okeechobee Watershed Water Quality

Challenges

- Achieving the Lake and Tributary TMDLs and proposed Numeric Nutrient Criteria
- Legacy P in the lake and watershed - cumulative impacts are very difficult to overcome due to internal recycling and P storage
- Magnitude of the problem: massive spatial scale of the watershed and lake
- Impacts of Lake water and its constituents cascading to downstream areas (e.g. estuaries)
- Effectiveness of advanced technologies at different scales and P concentrations

Lake Okeechobee Watershed Water Quality

Chronology of Watershed Legislation and Regulatory Programs

- 1987: SWIM Act/FDEP Dairy Rule
- 1989: Dairy Buy-out Program
- 1989: L.O. SWIM Plan/WOD Regulatory Program
- 1998: South Florida Ecosystem Task Force L.O. Issue Team Action Plan
- 1999: CERP and L.O. Watershed Project
- 2000: L.O. Protection Act (LOPA)
- 2001 FDEP sets L.O. TMDL for Phosphorus
- 2004: L.O. Protection Plan (LOPP)
- 2005: L.O. & Estuary Recovery Plan (LOER)
- 2007: Northern Everglades and Estuaries Legislation
- 2008: USEPA Sets TMDL for L.O. Tributaries

Lake Okeechobee Watershed Water Quality

Improvement Actions and Efforts

Northern Everglades Program - A comprehensive and coordinated watershed-based approach to restore and protect the Lake, Watershed and northern Estuaries:

- Continue Lake Okeechobee Protection Program Implementation
- Lake Okeechobee Watershed Phase II Technical Plan (2008)
- Capital Projects – Lakeside Ranch, Taylor Creek, and Nubbin Slough STAs
- Natural Wetland Restoration
- Enhanced Source Controls
- Regulatory Changes
- Local Stormwater Projects
- Advanced Technologies
- Dispersed Water Management and Treatment
- Sediment Removal Analyses
- CERP Lake Okeechobee Watershed Project


Lake Okee Looking North

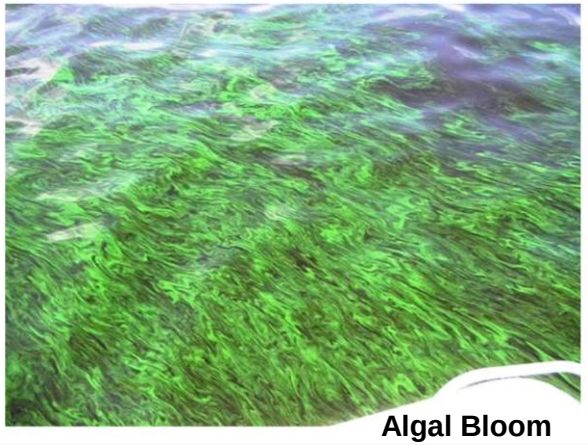
St. Lucie Estuary Water Quality

St. Lucie Estuary Water Quality

Issues

- **Nutrients**
  - N and P concentration and loads
  - L.O. releases and local basin runoff
  - Contribute to elevated chlorophyll *a* and algal blooms
  - TMDL s (FDEP 2009)
    - TP-81 ppb (annual load – 62 mt/y)
    - TN-74 ppm (annual load – 555 mt/y)
- **Low Dissolved Oxygen**
  - TMDL (FDEP 2009) – linked to nutrient TMDLs
- **Water Clarity/Transparency**
  - Decreases with increases in discharge
  - Some turbidity from local runoff
  - Legacy sediments in the estuary


Heavy algal growth on an urchin in the Indian River Lagoon, May 2010


Algal Bloom

St. Lucie Estuary Water Quality

Challenges

- Implementation of TMDLs and proposed estuarine numeric nutrient criteria
- Lake Okeechobee releases and regulation schedule
- Agricultural and urban basin runoff
- Land use changes
- Advanced treatment technology


St Lucie Estuary

St. Lucie Estuary Water Quality

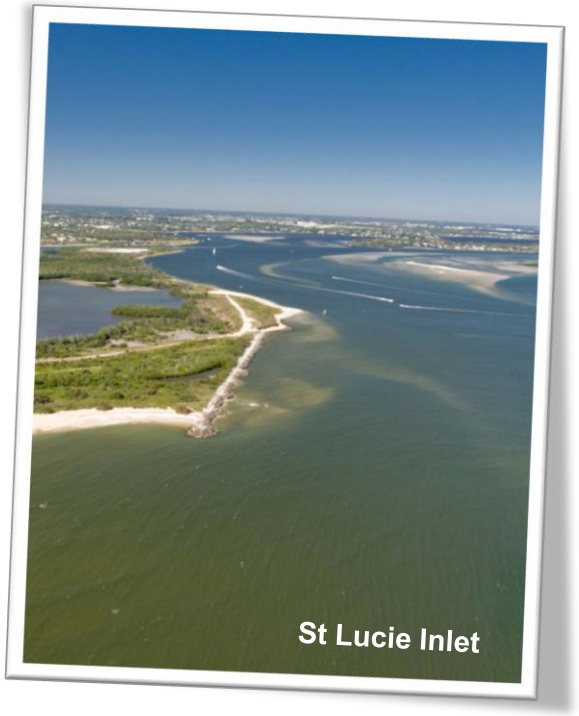
Improvement Actions and Efforts

- Surface Water Improvement Management (SWIM) Plan
- CERP Indian River Lagoon – South
  - C-44 Reservoir and Stormwater Treatment Area
  - Natural Wetlands – Allapattah Ranch
  - Additional regional P treatment in C-23/24 Basin

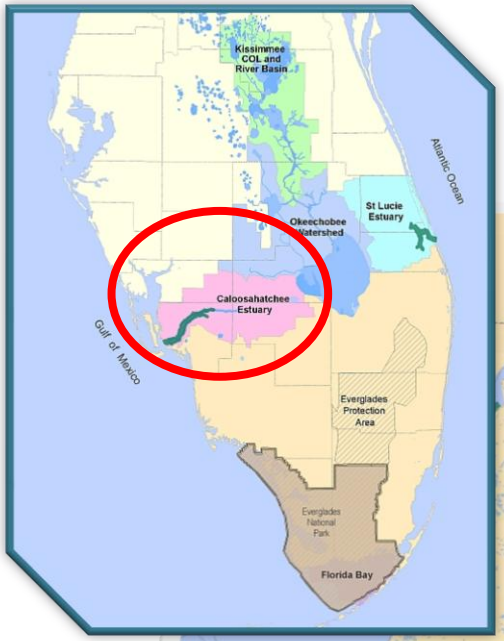
St. Lucie Estuary Water Quality

Improvement Actions and Efforts (continued)

- Northern Everglades: St. Lucie River Watershed Protection Plan (January 2009)
  - Basis for the Basin Management Action Plan (BMAP) to implement the TMDLs
  - Regional Water Quality Projects Emphasis on P
  - Development of Source Control Program
  - Local stormwater retrofits; septic tank conversions
  - Dispersed water management and treatment
  - Research and Water Quality Monitoring Plan



Caloosahatchee Estuary Water Quality



Caloosahatchee Estuary Water Quality

Issues

- **Nutrients**
  - N Loads
  - L.O. releases and local basin runoff
  - Contributes to elevated chlorophyll *a* and algal blooms
  - Estuarine TMDL (FDEP 2009) – 4121 mt of N per year
  - Freshwater (watershed) TMDL under development (FDEP)
- **Red Tides – from Gulf of Mexico**
- **Low Dissolved Oxygen**
- **Water Clarity/Transparency**


Caloosahatchee Estuary

Caloosahatchee Estuary Water Quality

Challenges

- Implementation of TMDLs and proposed estuarine numeric nutrient nriteria
- Lake Okeechobee releases and regulation schedule
- Agricultural and urban basin runoff
- Land use changes
- Advanced treatment technology for N

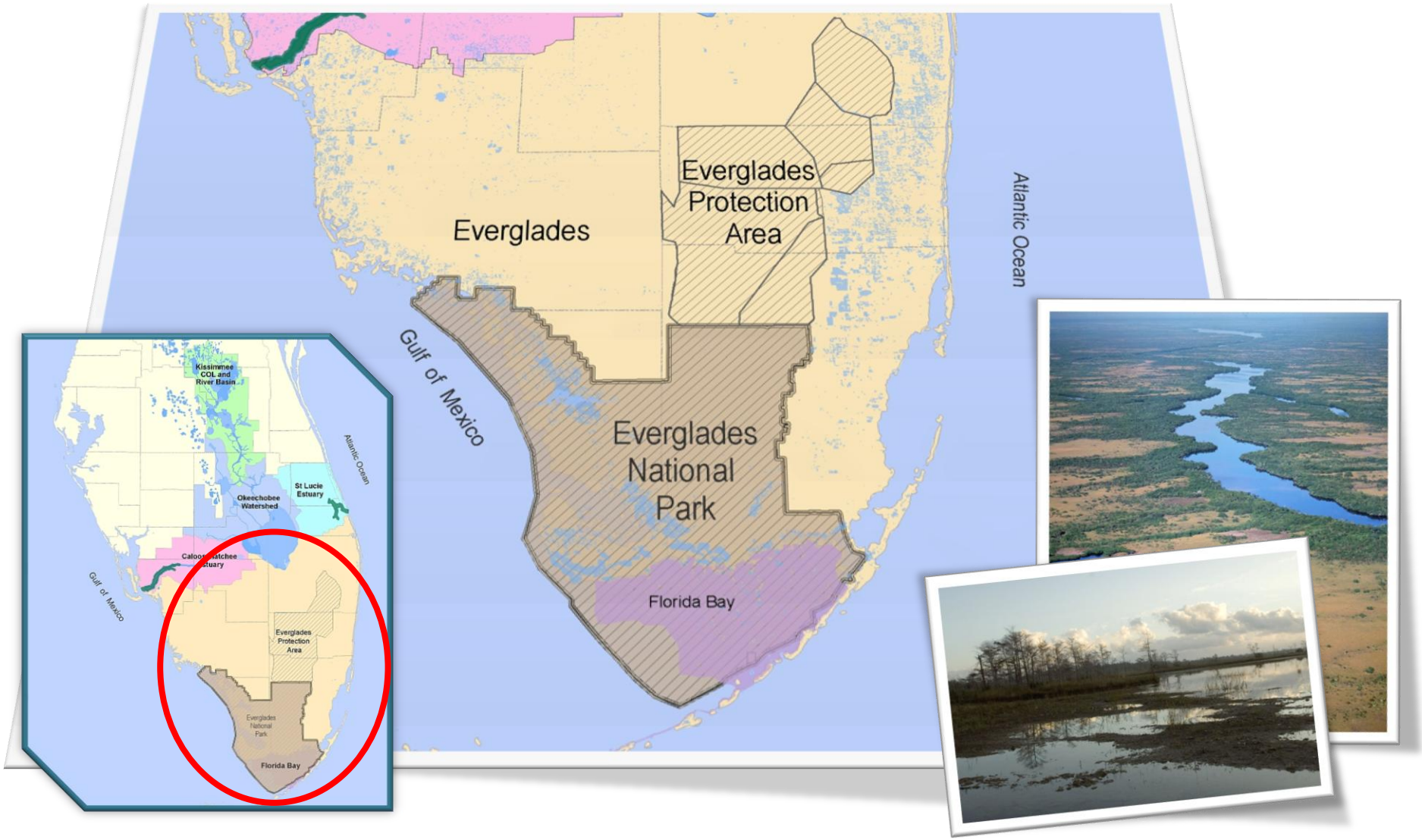
Mouth of the Caloosahatchee

Caloosahatchee Estuary Water Quality

Improvement Actions and Efforts

- **Northern Everglades: Caloosahatchee River Watershed Protection Plan**
  - Basis for the BMAPs to implement the TMDLs
  - Regional Water Quality Projects – emphasis on N
    - C-43 Water Quality Treatment and Testing Facility
  - Development of Source Control Program
  - Local Stormwater Retrofits; septic tank conversions
  - Dispersed Water Management and Treatment
  - Research and Water Quality Monitoring Plan
- **CERP C-43 West Reservoir**

Everglades Water Quality



Everglades Water Quality

Issues

- **Phosphorus – Most Critical Problem**
  - Elevated P concentrations and loads resulted in the conversion of thousands of acres of marsh habitat into dense stands of cattail
  - P inputs have been significantly reduced through combined efforts of BMPs and six STAs
    - Removed over 3500 mts of P to date
    - STAs treated over 1.4 million acre-ft water in Water Year 2010
      - Inflow P concentrations 147 ppb reduced to 33 ppb
      - Loads reduced by 76%

Everglades Water Quality

Issues (continued)

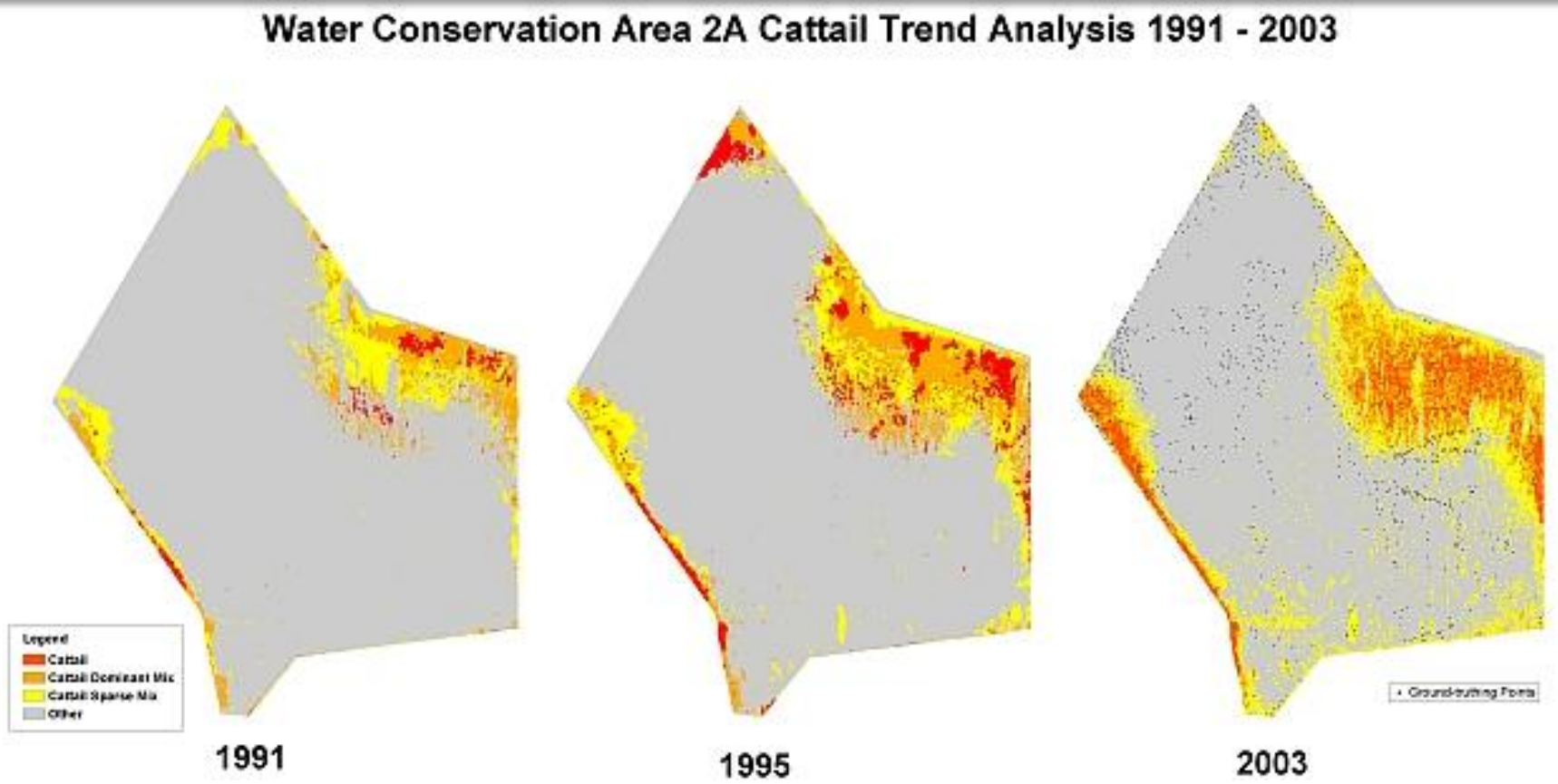
- Despite this significant progress, inflow concentrations into the Everglades Protection Area are higher than the established 10 ppb criterion

- Because of legacy P and the process of P reflux (release of P from soil to the water column), areas currently nutrient enriched will respond very slowly to reduced P loads

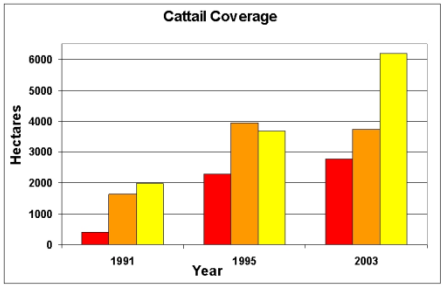
- Effects on plant growth, composition and nutrient will be significant for decades to come


Everglades Cattail

Everglades Water Quality



Cattail distribution has continued to increase through 2003; however, the <u>rate of expansion has decreased</u>



Everglades Water Quality

Issues (Continued)

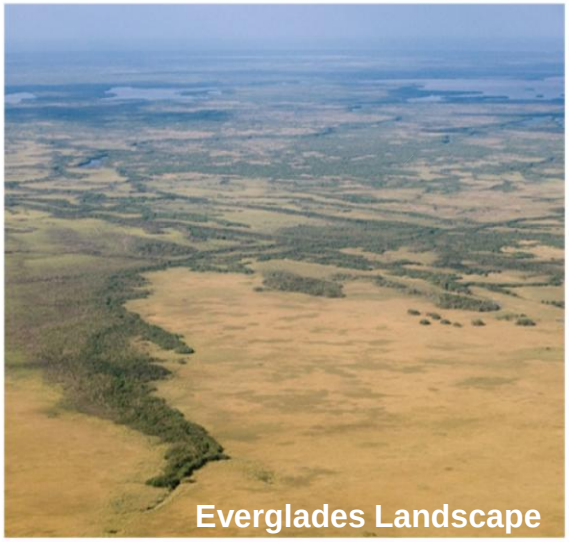
Other water quality parameters in the Everglades must meet Class III criteria - protect recreation and the propagation and maintenance of a healthy well-balanced population of fish and wildlife

- **High conductivity**
  - Hard (highly conductive, highly mineralized) water entering soft water (low conductivity) areas (e.g. WCA-1) can result in species changes, e.g., algal shifts and increased decomposition
- **Sulfate**
  - Elevated inputs of sulfate can promote mercury methylation and increase concerns over mercury in the food web
- **Mercury**
  - Bioaccumulation in fish and wildlife is a continuing water quality problem
  - Reminder, almost all mercury in the Everglades comes from the atmosphere and is under FDEP purview

Everglades Water Quality

Challenges

- Technologies to achieve P levels < 10 ppb
- Trade offs between water quantity (hydropattern restoration) and water quality
- Operational and/or regulation schedule changes (e.g., Everglades Restoration Transition Plan)
- P reflux (legacy P) – its magnitude, duration and implications for ecosystem recovery
- Implementation of canal nutrient criteria
- Setting priorities to get maximum benefit out of limited resources


Everglades Landscape

Everglades Water Quality

Improvement Actions and Efforts

- **1994: Everglades Forever Act (EFA) – restore ecosystem through construction, regulation and research**
  - Everglades Construction Project- Storm Water Treatment Areas
  - Source Controls and Best Management Practices (EAA and C-139 Basins)
  - Non-Everglades Construction Project Basins and Everglades Stormwater Program
- **2003: Long-Term Plan to achieve water quality goals in the Everglades Protection Area and subsequent revisions**
  - Expansion (Compartments B & C) and optimization of STAs
  - Enhanced Source Control Programs
  - Assessment and implementation of strategies to accelerate the recovery of impacted areas

Everglades Water Quality

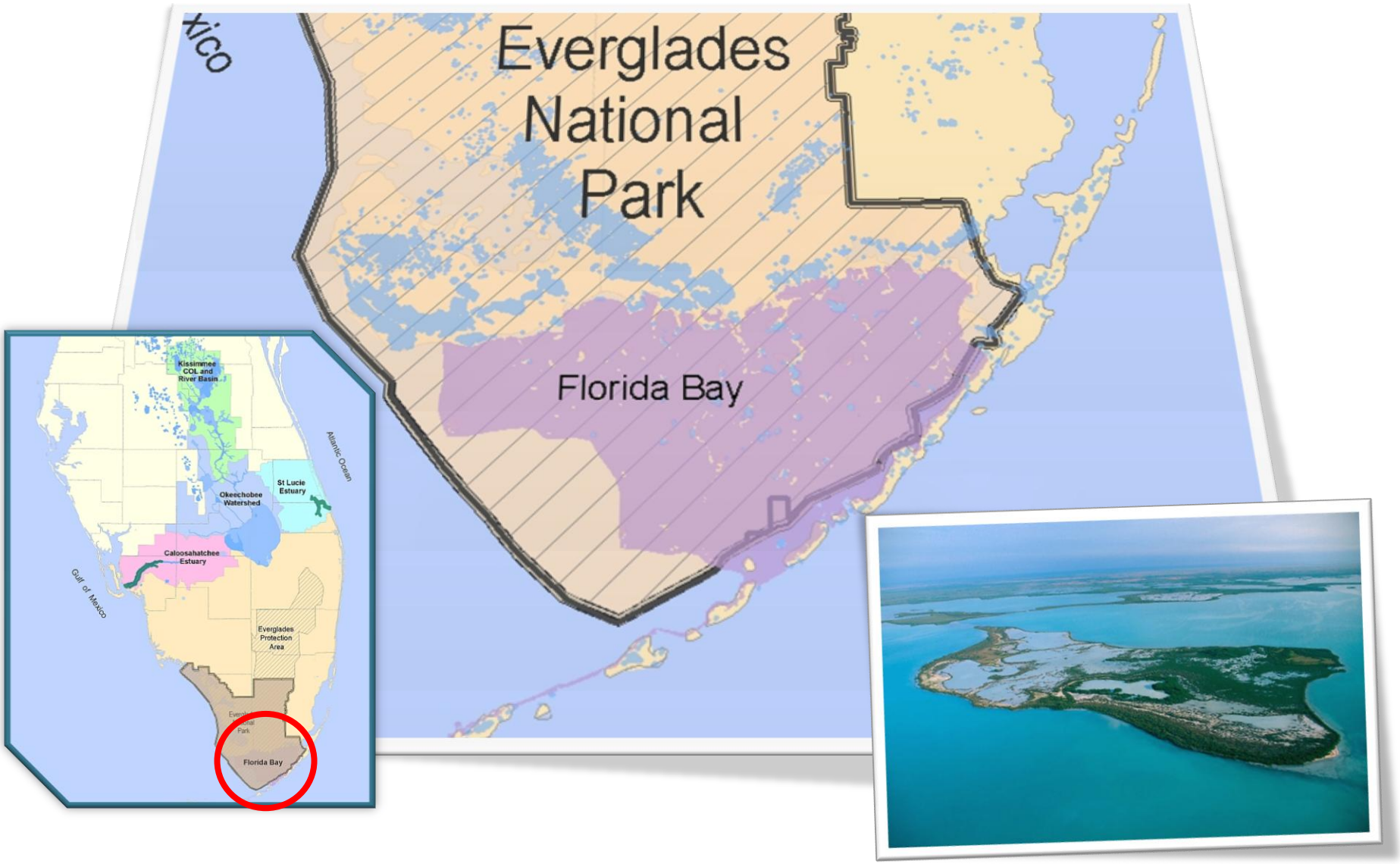
Improvement Actions and Efforts (continued)

- CERP and other regional projects: primary focus is water quantity and distribution, with some water quality benefits
  - Site 1, C-11, C-9 Impoundments
  - WCA 3 De-compartmentalization

- Proposed River of Grass Land Purchases in C-139 Basin and S5A Basin

Everglades Landscape

Florida Bay Water Quality



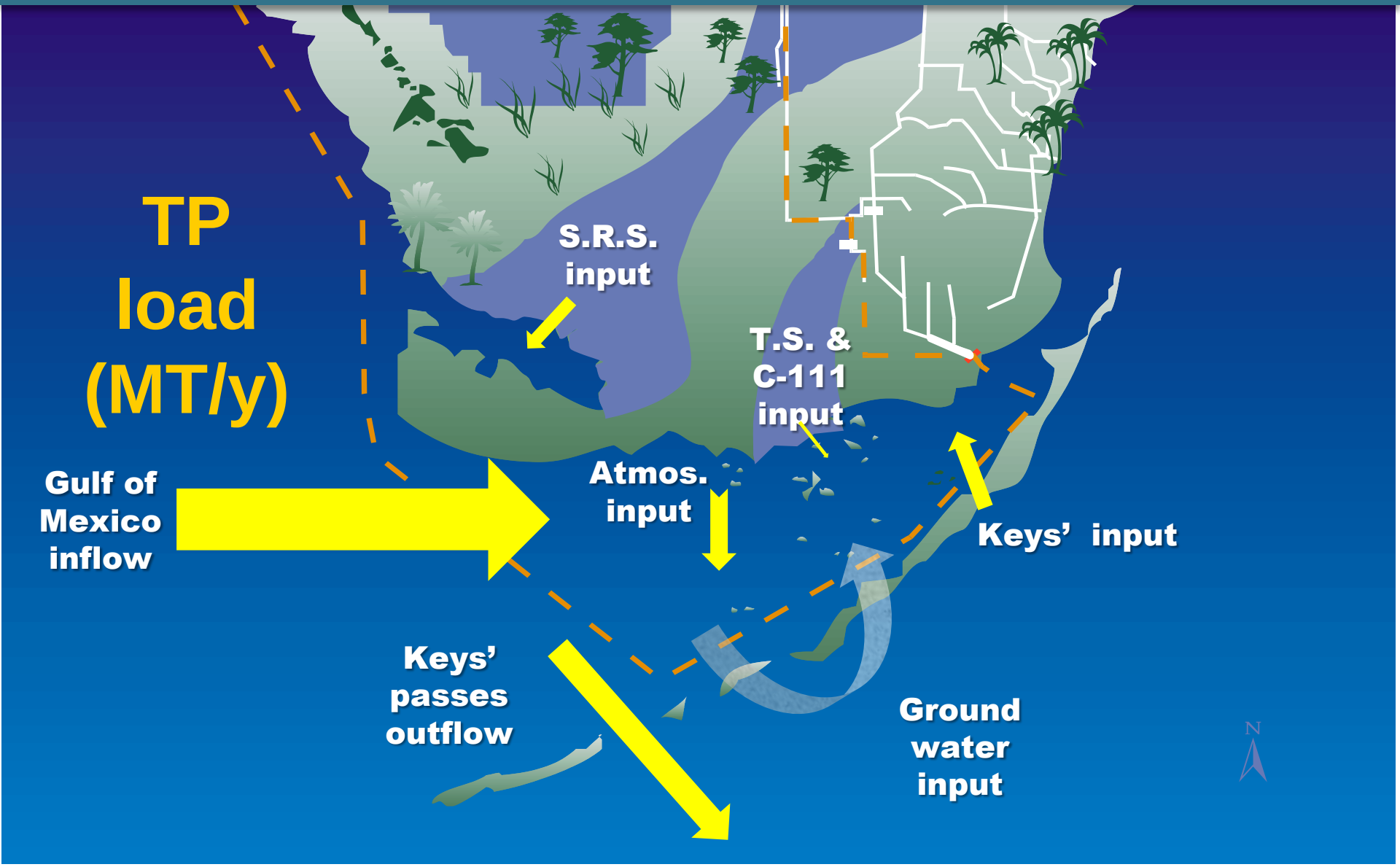
Florida Bay Water Quality

Issues

- **Nutrients**
  - There are numerous sources of nutrients (controlled and uncontrolled)
    - The Gulf of Mexico is the largest P source for the Bay, along with atmospheric deposition and groundwater
    - The Everglades is a major N source, but a minor P source
    - Pulsed watershed inputs of P and N (from C-111) with major storm events can contribute to the loading

Florida Bay

Florida Bay Water Quality



Florida Bay Water Quality

Issues (Continued)

- **Algal Blooms – linked to nutrients**
  - Algal blooms can cause die-off of seagrass and harm sponge habitat
  - Blooms are most common in the central and western Bay, where they are stimulated by a mix of P from Gulf of Mexico and N from many sources, including the Everglades
  - Internal cycling and long water residence time (= slow “flushing”) is another factor affecting blooms

Healthy Seagrass Bed

Die-off in Barnes Sound (2005)

Algal bloom in Manatee Bay at S-197 (2006)

Florida Bay Water Quality

Challenges

- Complexity of the system (e.g., many nutrient sources)
- Everglades restoration influence on water quality – change in nutrient inputs as a result of change in freshwater flow patterns
- Large nutrient inputs from the Gulf of Mexico and atmosphere are a national water quality concern
- Climatic disturbances (e.g., hurricanes)
- Saltwater intrusion and sea level rise
- Implementation of estuarine numeric nutrient criteria

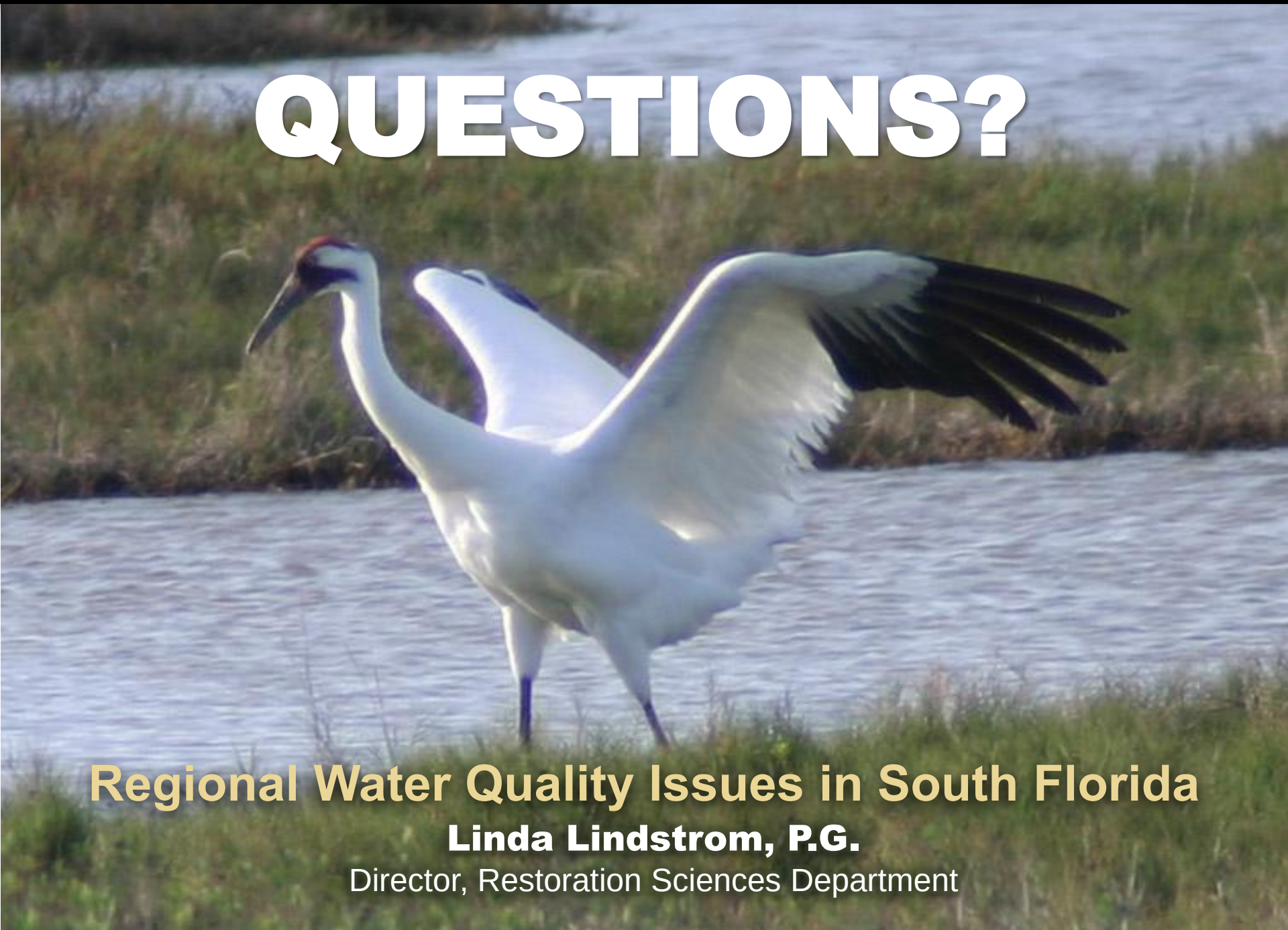

Rain in Florida Bay

Improvement Actions and Efforts

- Upstream Everglades water quality improvement
- Operations to minimize C-111 pulse discharges
- CERP C-111 Spreader Canal
- Florida Keys Stormwater/Wastewater Infrastructure

CLOSING COMMENTS

- Nutrient pollution is a vexing problem nationwide and worldwide – we are not alone; nationally, there 41,924 TMDLs in effect!
- Monumental progress has been made in reducing landscape-based nutrients (80%) in the Everglades with the STAs and BMPs since the early 1990s – no where else on earth has this been achieved
- The SFWMD is very proactive and at the cutting edge in environmental engineering and science, exploring a wide variety of technologies, concepts, tools and strategies, and is applying some of the best minds to South Florida's water quality problems
- Need to take stock in our restoration successes, regardless if they are water quality or quantity focused (e.g., Kissimmee River) - are there trade offs that need to be considered for the greater public benefit?



QUESTIONS?

Regional Water Quality Issues in South Florida

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