Comprehensive Everglades Restoration Project

U.S. Army Corps of Engineers

South Florida Water Management District

Other Agencies and NGOs

Everglades Restoration Overview

Past, Present, and Future

South Florida Natural Resources Center
Everglades National Park

Key Tenets of South Florida Restoration

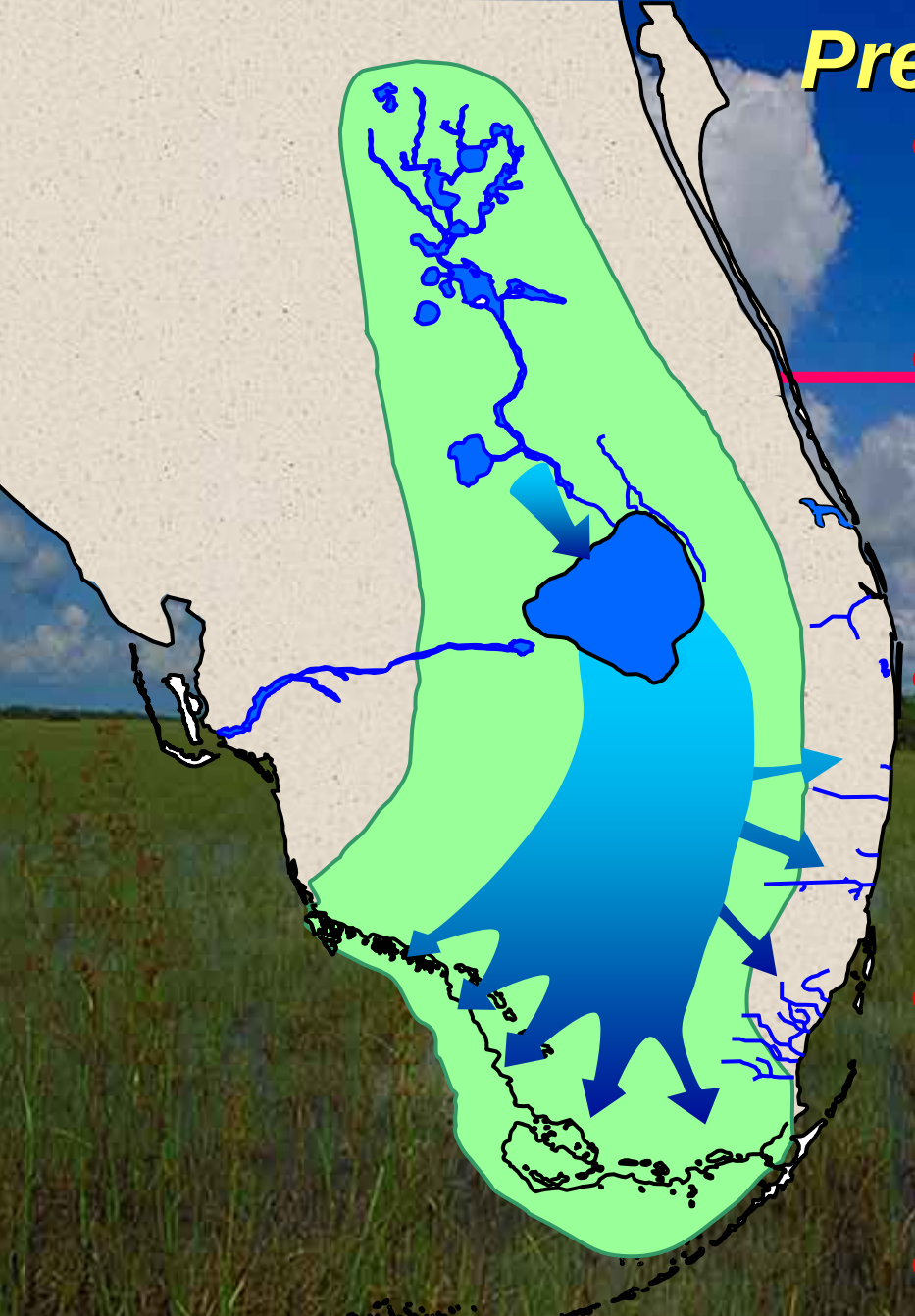
- Hydrological restoration is a necessary prerequisite to ecological restoration.
- The structure, composition, and dynamics of the resulting landscape will be self defining and not fully predictable.
- The challenge is to understand the new system trajectories and guide them toward the goal of a healthy and self-sustaining ecosystem.

Source: Federal Objectives for South Florida Restoration, Science Sub-Group, 1993

Everglades Restoration

- Ecosystem Regimes
- Pre-Drainage Everglades
- Effects of Water Management and Development
- The Comprehensive Everglades Restoration Plan
  - Overall plan
  - Potential affects on Everglades, Biscayne, and Big Cypress National Parks
  - Future Directions

Pre-Drainage Ecosystem

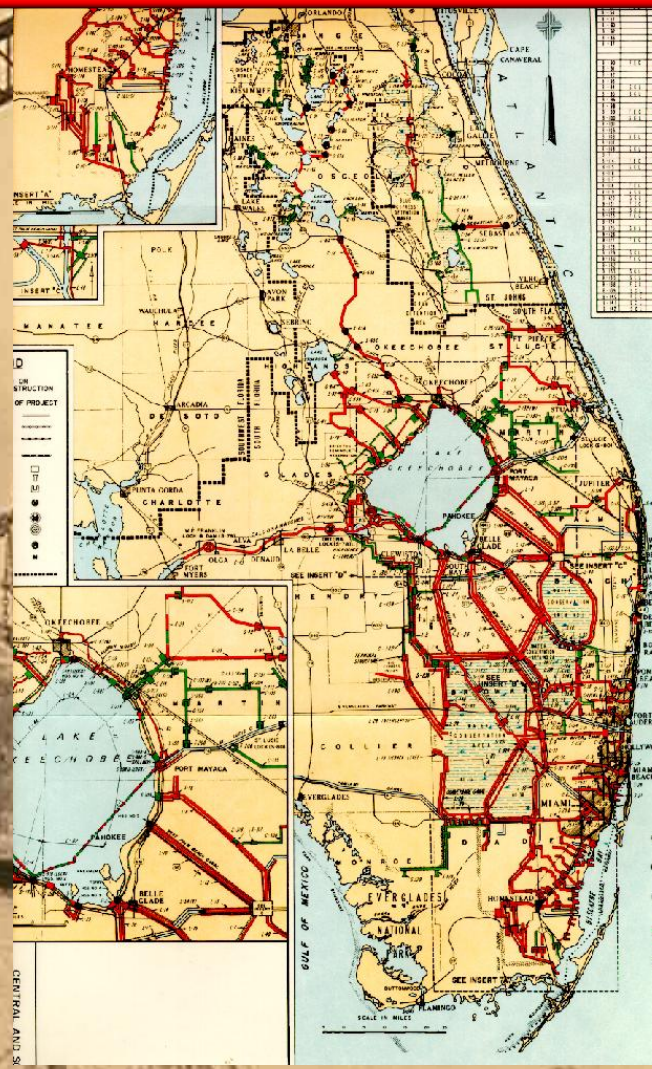


- Large Spatial Scale - high aquatic production, large feeding range, providing population resiliency.
- Dynamic Storage and Sheetflow - expansive vegetation, low gradient, and peat/limestone substrates result in slow flow rates and wet season carryover.
- Wet and Dry Hydrologic Cycles - seasonal and annual patterns of production, dispersal, survival tied to rainfall and the depth/duration of flooding and estuarine inflows.
- Heterogeneity of Habitats - diverse mosaic of plant communities made up of marshes, uplands, coastal and marine habitats.
- Oligotrophic System - vegetation adapted to low nutrients (rainfall).

Source: Science Sub-Group, 1993

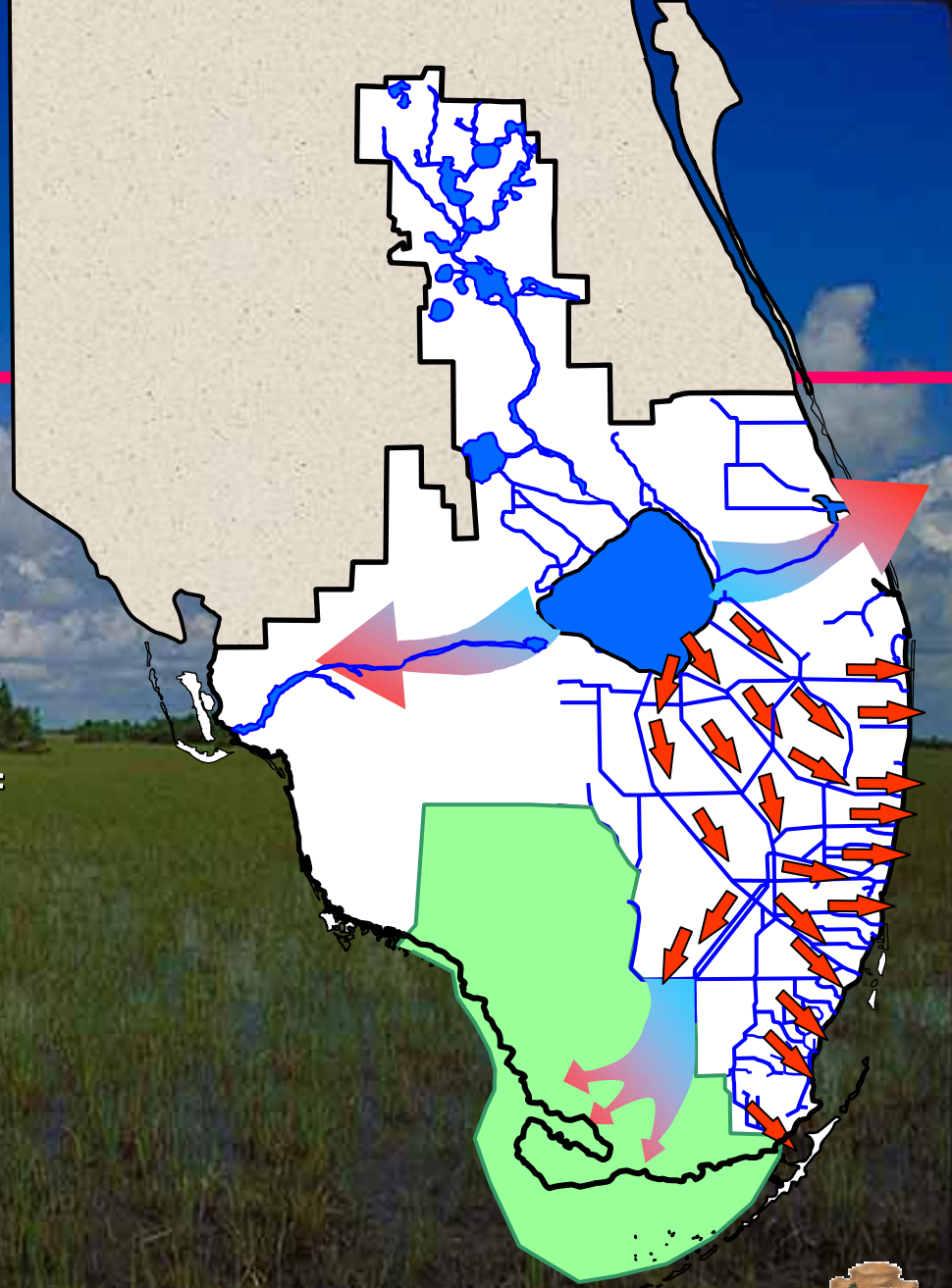
Drainage of the Everglades

- Drainage began in 1880
  - Hamilton Disston drainage areas around Lake Okeechobee
- Continued through 1920's
  - four major canals from Lake Okeechobee through the Everglades to Atlantic Ocean
- C&SF Project Authorized in 1948



Current Ecosystem

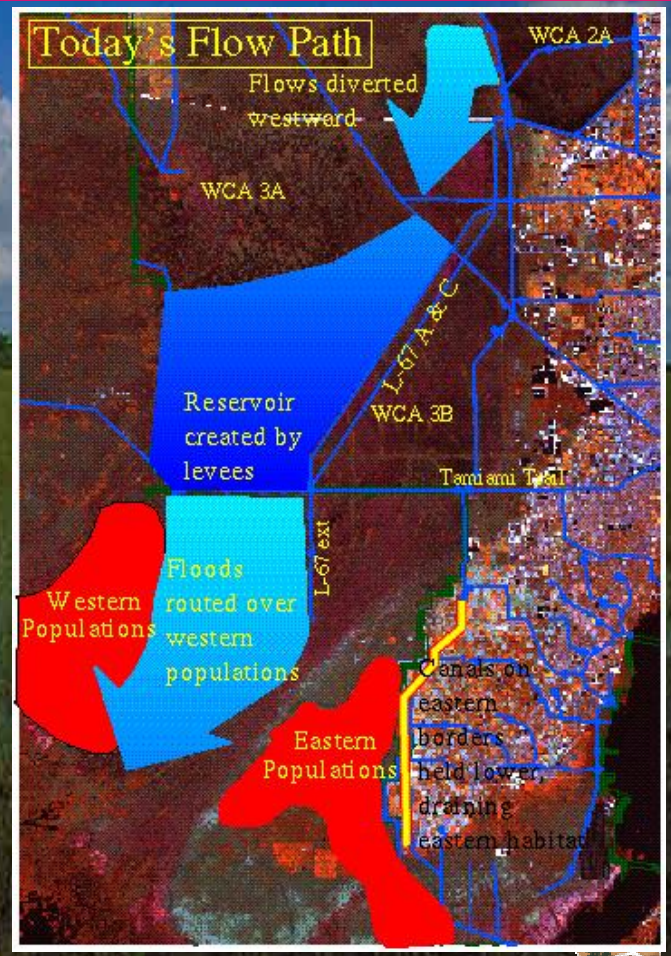
- Reduced Spatial Scale - > 4.5 million acres of wetlands have been drained for development, greatly reducing water availability and population resilience.
- Loss of Sheet Flow - Canal and levee systems channelized flow, created artificial impoundments, and fragmented the landscape.
- Loss of Key Habitats - Six major habitats are now only remnants of their original spatial extent.
- Uncoupling of the System from Rainfall - Water supply and flood control demands shift water flow patterns/biological responses.
- Nutrient Enrichment and Contaminants - Altered plant and animal communities, and health advisories.



Source: Science Sub-Group, 1993

Changes in Timing and Distribution of Flow

- Sheetflow impounded, then released via canals, structures into EVER
- Flows shifted from center of slough to marl prairie overbanks
- Eastern marl prairies overdrained



Hydrologic Modifications

- Loss of Spatial Flow Patterns
- Changes in Volume and Timing of Flow
- Changes in Inundation Patterns
- Changes in Water Level Variability
- Loss in Landscape Heterogeneity
- Loss of Soil Substrate
- Water Quality Deterioration

Hydrologic Characteristics of the Southern Everglades

Early hydrologists characterized the Everglades flow patterns and water levels during the 1940's (Pre C&SF Project).

Broad spatial extent and sheetflow

Large-scale connectedness:

Everglades and the Atlantic Coastal Ridge

Shark Slough / Taylor Slough

Everglades and Big Cypress

Dominant central flow way, WCAs into Shark Slough

From Parker *et al.* (1955)

Hydrologic Changes affecting the Southern Everglades

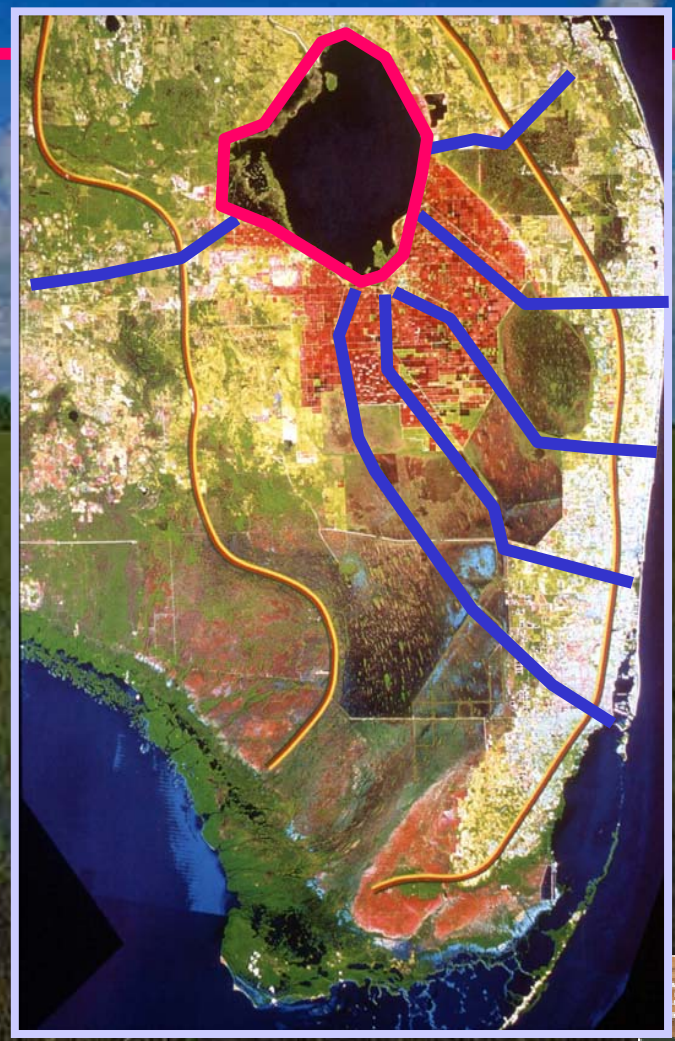
- **The Everglades were already affected by major water management changes, prior to the C&SF Project.**

  Caloosahatchee outlet from Lake Okeechobee completed by 1894.

  West Palm Beach, Hillsboro, North New River and Miami Canals completed by 1917.

  St. Lucie Canal and Hoover Dike completed by 1938.

- **These actions largely disconnected the Everglades from Lake Okeechobee, and over-drained the Everglades wetlands and downstream estuaries.**



Hydrologic Changes affecting the Southern Everglades

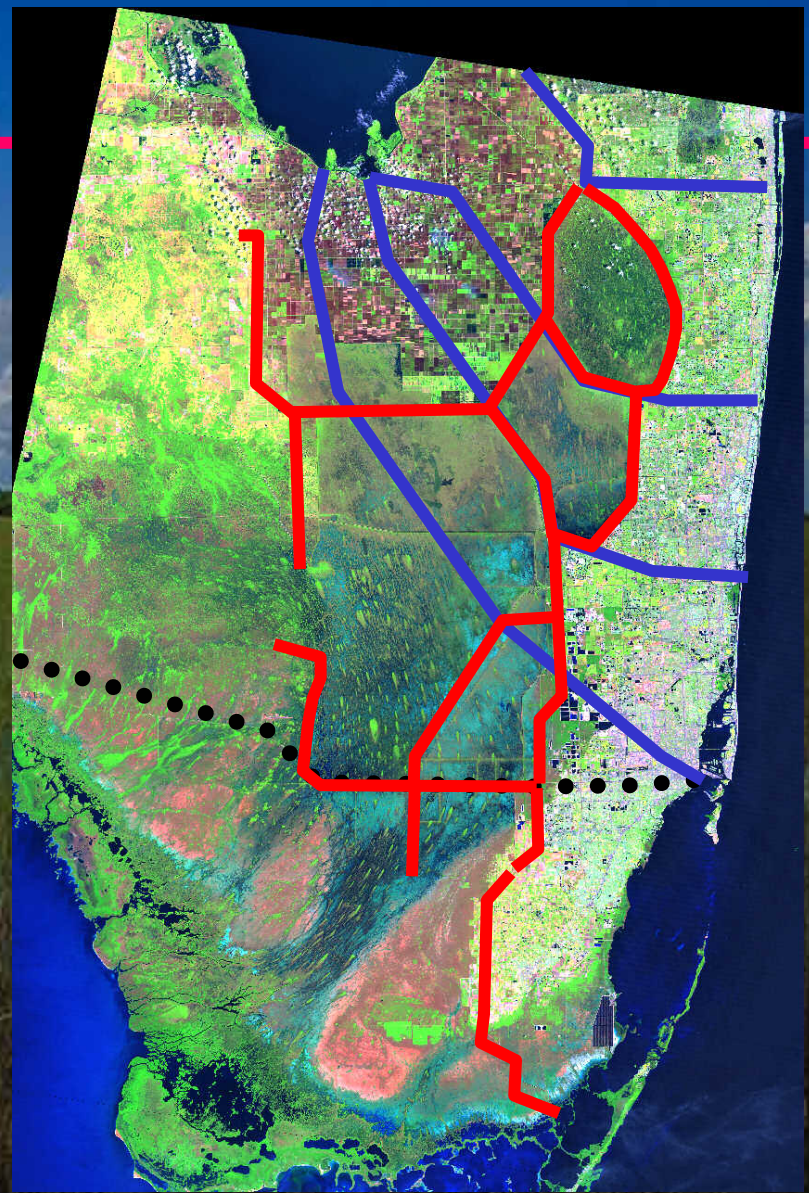
The C&SF Project Changes:

Eastern Protective Levee System separated the deeper Everglades from the transitional wetlands behind the Atlantic Coastal Ridge (1952).

EAA Levees further disconnected the Everglades from their headwaters (1959).

The remaining northern and central Everglades were compartmentalized and cutoff from ENP (1963).

The C-111 Canal and South Dade Conveyance System over-drained the south Dade wetlands (1965-81).



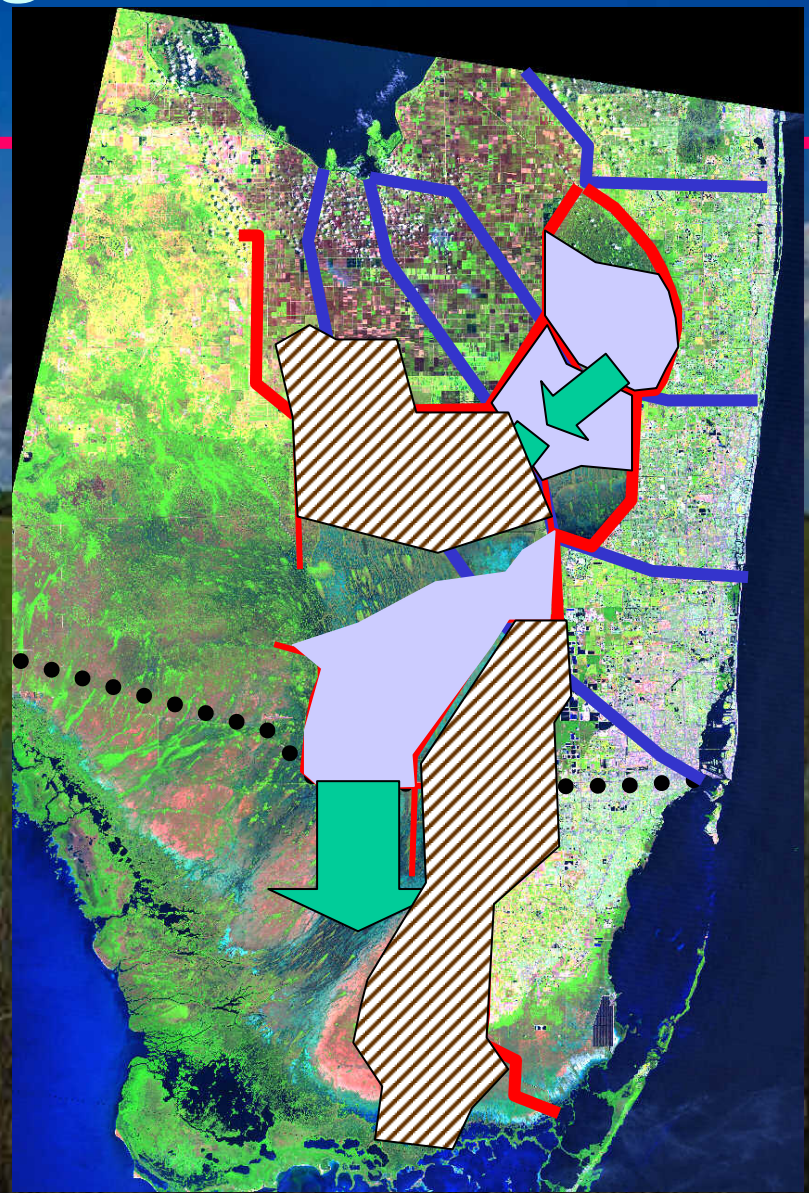
Hydrologic Changes affecting the Southern Everglades

The C&SF Project, essentially converted the "River of Grass" into a series of linked reservoirs.

The central Everglades became "Water Conservation Areas" to store wet season runoff for dry season water supply. This created deep pools in the downstream portions of the WCAs.

Sheetflow was largely replaced by canal and structure flows to regulate the WCA reservoirs and Lake Okeechobee.

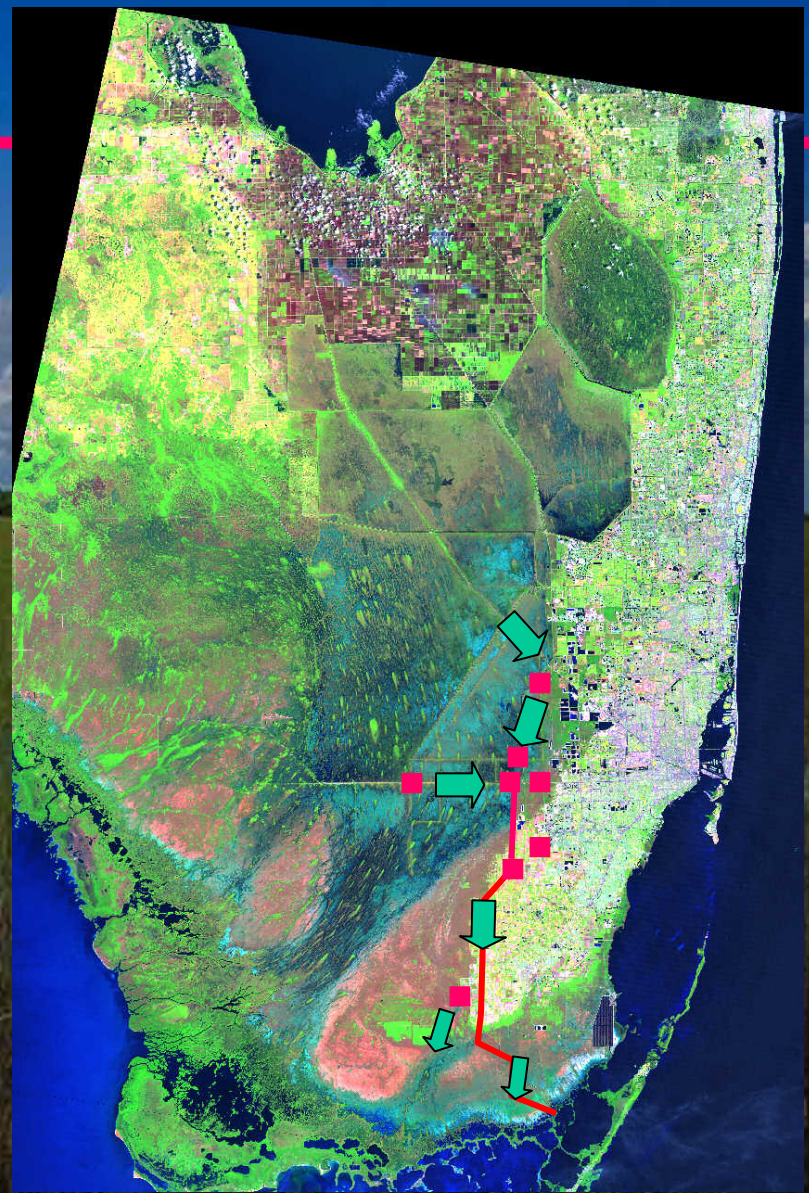
Large areas of the remaining Everglades were disconnected and over-drained.



Major Federal and State Restoration Actions

ENP-South Dade Conveyance System (1968, PL 90-483)

Authorized to promote conservation and conveyance of water supplies to eastern ENP and expanding south Dade urban and agricultural areas.



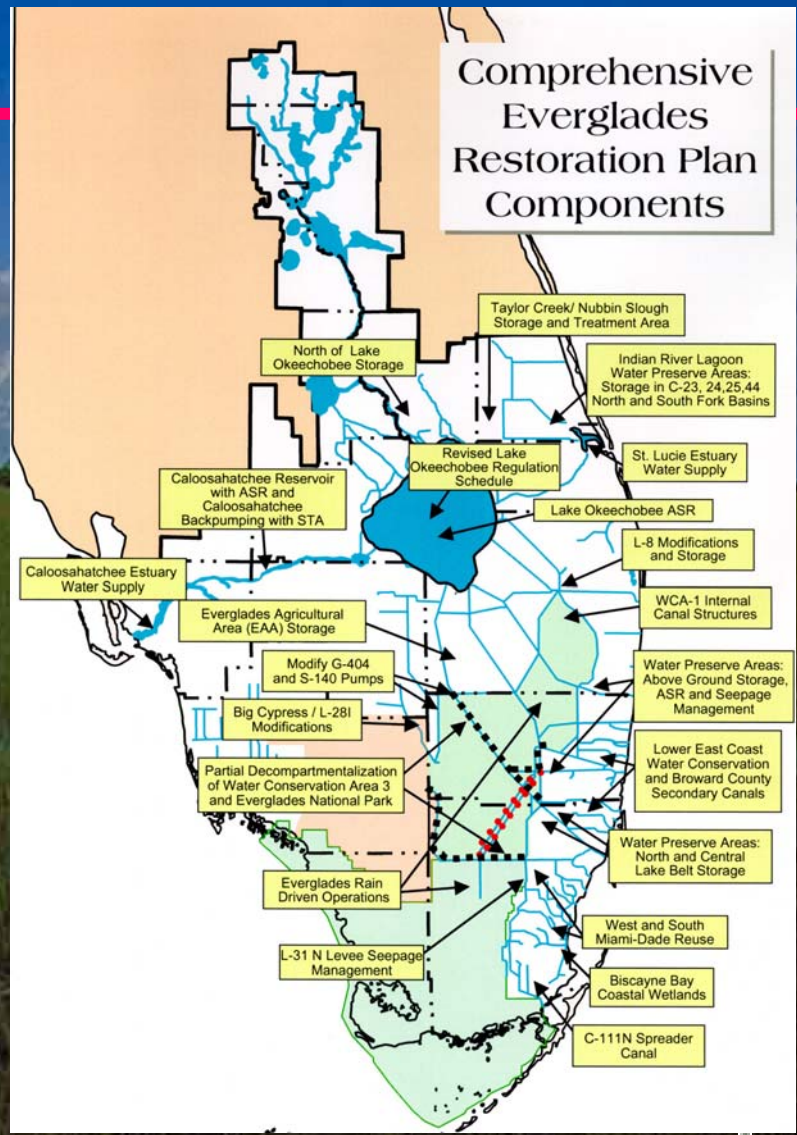
The Restudy

- **C&SF Project Comprehensive Review Study (Restudy) first authorized by Congress in 1992**
- **Reexamination of C&SF Project to:**
  - **Restore south Florida ecosystem**
  - **Enhance water supplies**
  - **Maintain flood control**
- **Comprehensive Plan sent to Congress on July 1, 1999**

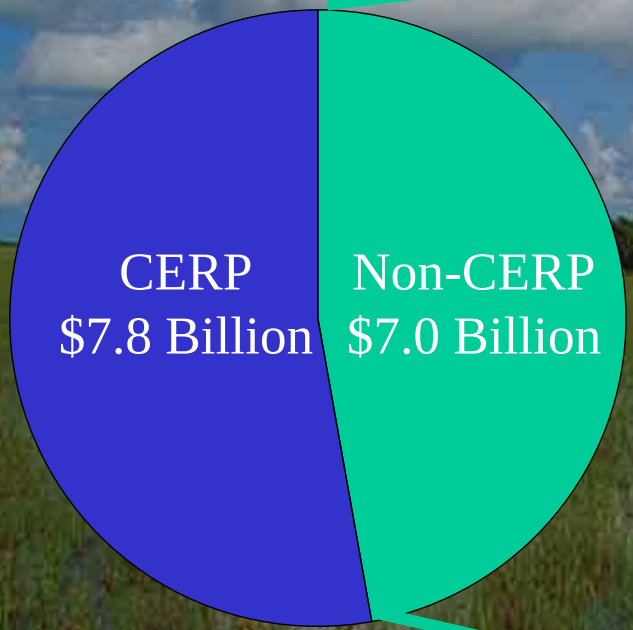
Major Federal and State Restoration Actions

Comprehensive Everglades Restoration Plan (CERP)
(WRDA 2000, PL 106-541)

Authorized $7.8 billion for a 36 year restoration project consisting of 68 components to be cost shared 50/50 by the federal government and the state.



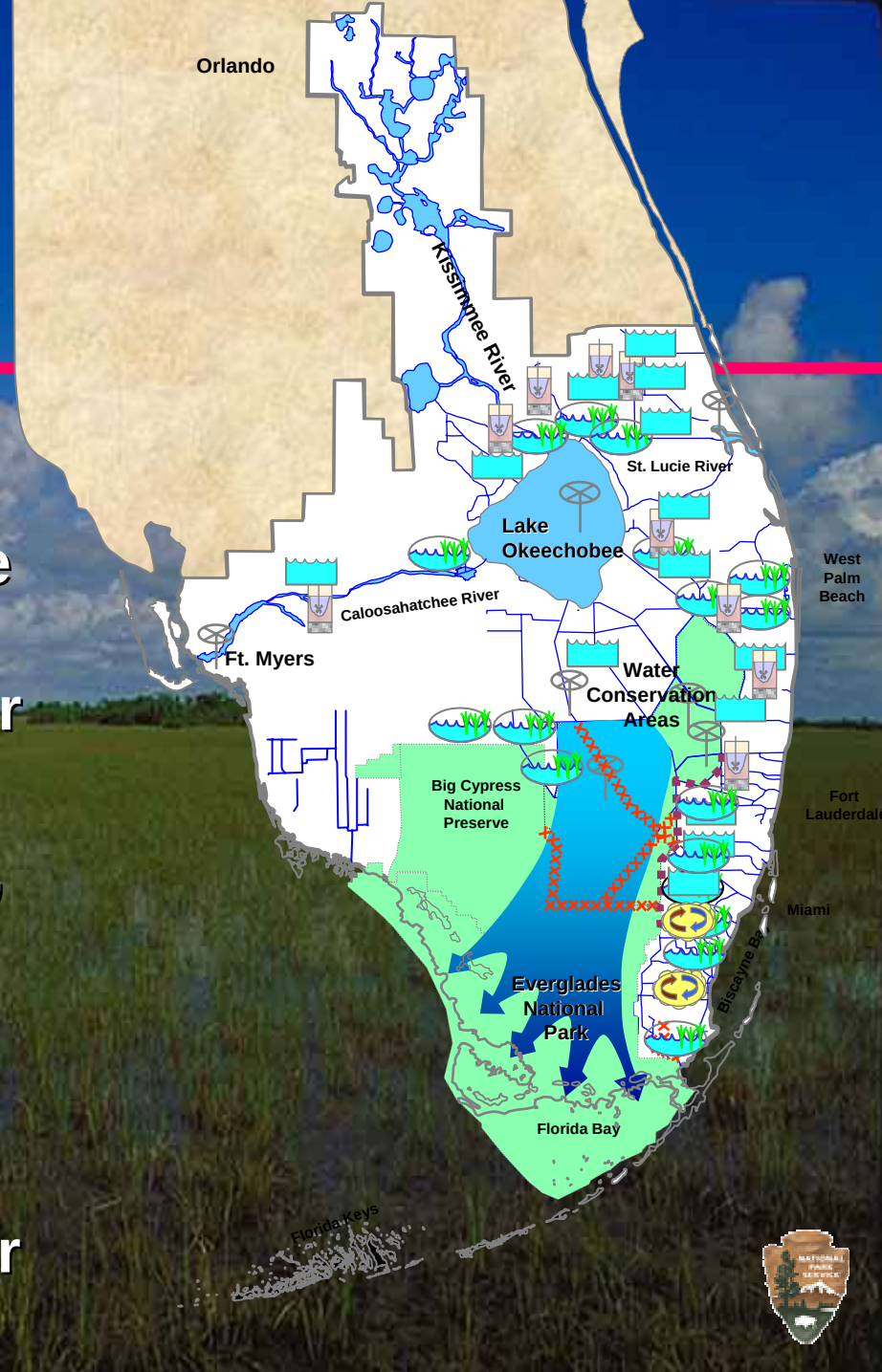
On-Going Projects



- Everglades Construction Project
- C&SF Project (C-111, C-51, etc…)
- ENP/Modified Water Deliveries
- Kissimmee River Restoration Project
- Critical Projects
- Multi-Species Recovery Plan
- State Water Quality Plans
- State Land Acquisitions SOR/CARL
- Federal Land Acquisitions NPS/FWS

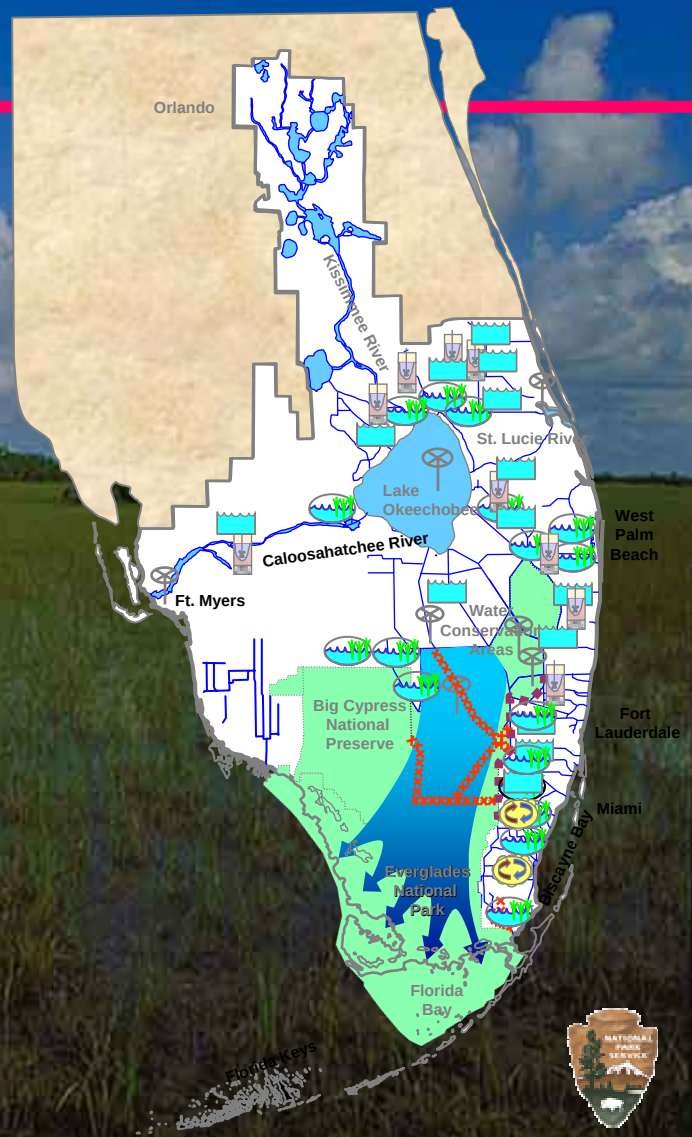
The Comprehensive Everglades Restoration Plan

- CERP includes 68 projects extending from the Kissimmee Basin to the Florida Keys, and from the Caloosahatchee River to the Lower East Coast.
- Projects vary greatly in scope, complexity, and degree of environmental benefits.
- Approximately 24 of these projects directly impact DOI lands, or indirectly affect water inflows.



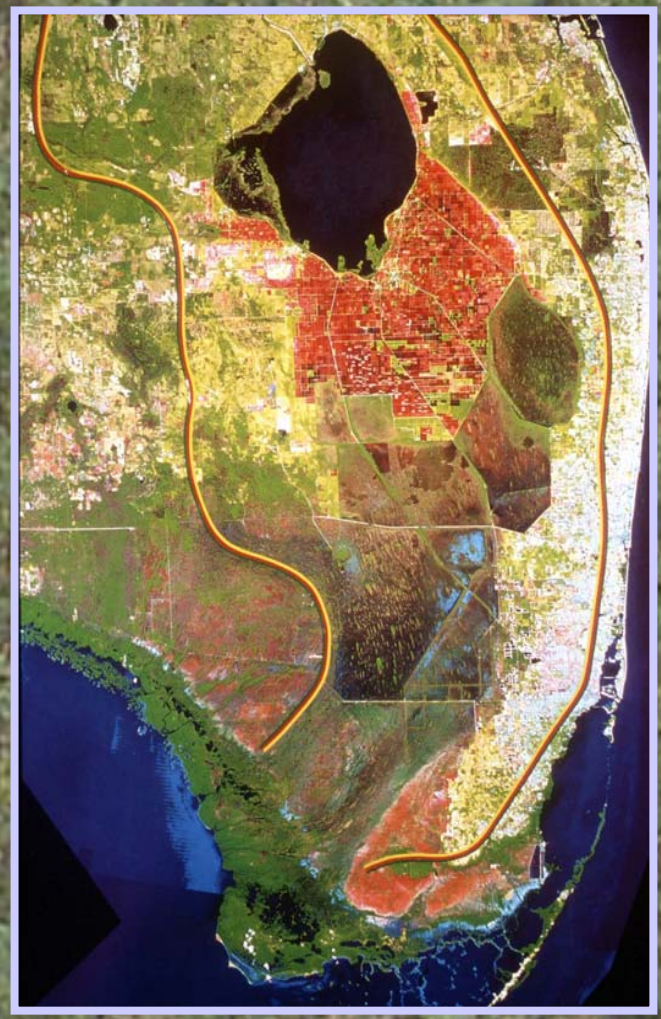
CERP Plan Features

- The Plan focuses on increased water storage and improved water management with project features that include:
  - 15 new above-ground reservoirs,
  - 330 Aquifer Storage and Recovery wells,
  - 2 new wastewater reuse plants,
  - 3 new subsurface reservoirs,
  - 19 stormwater treatment areas,
  - removal of 240 miles of canals and levees.

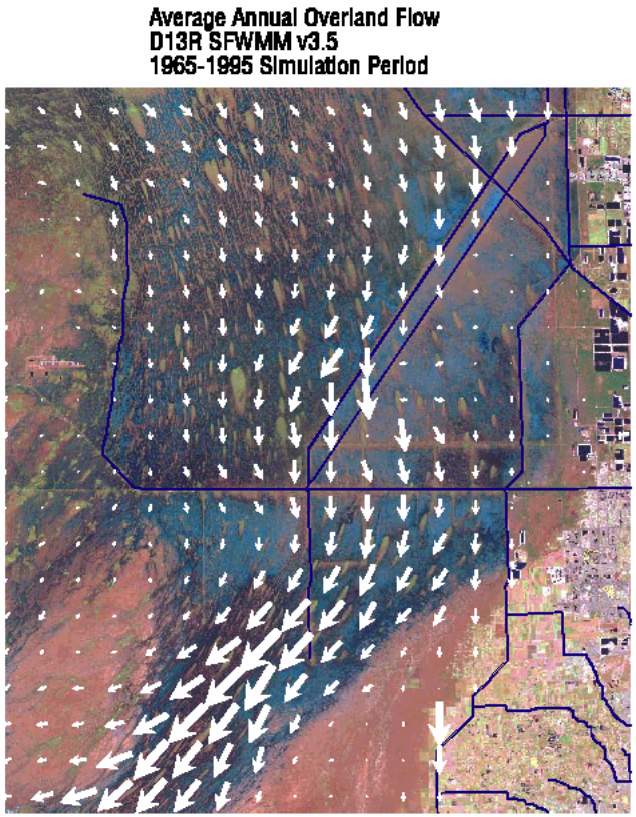


Ecological Consequences

- Of 7 pre-drainage landscapes, 3 have been lost, 1 at < 2 % of former extent, 2 at < 25% of former extent
  - 90% decrease in wading birds, fish biomass
  - 17 T&E species
- Large-scale ecological collapse
- Recovery of biofunction is purpose of restoration



Flow Patterns/Distribution

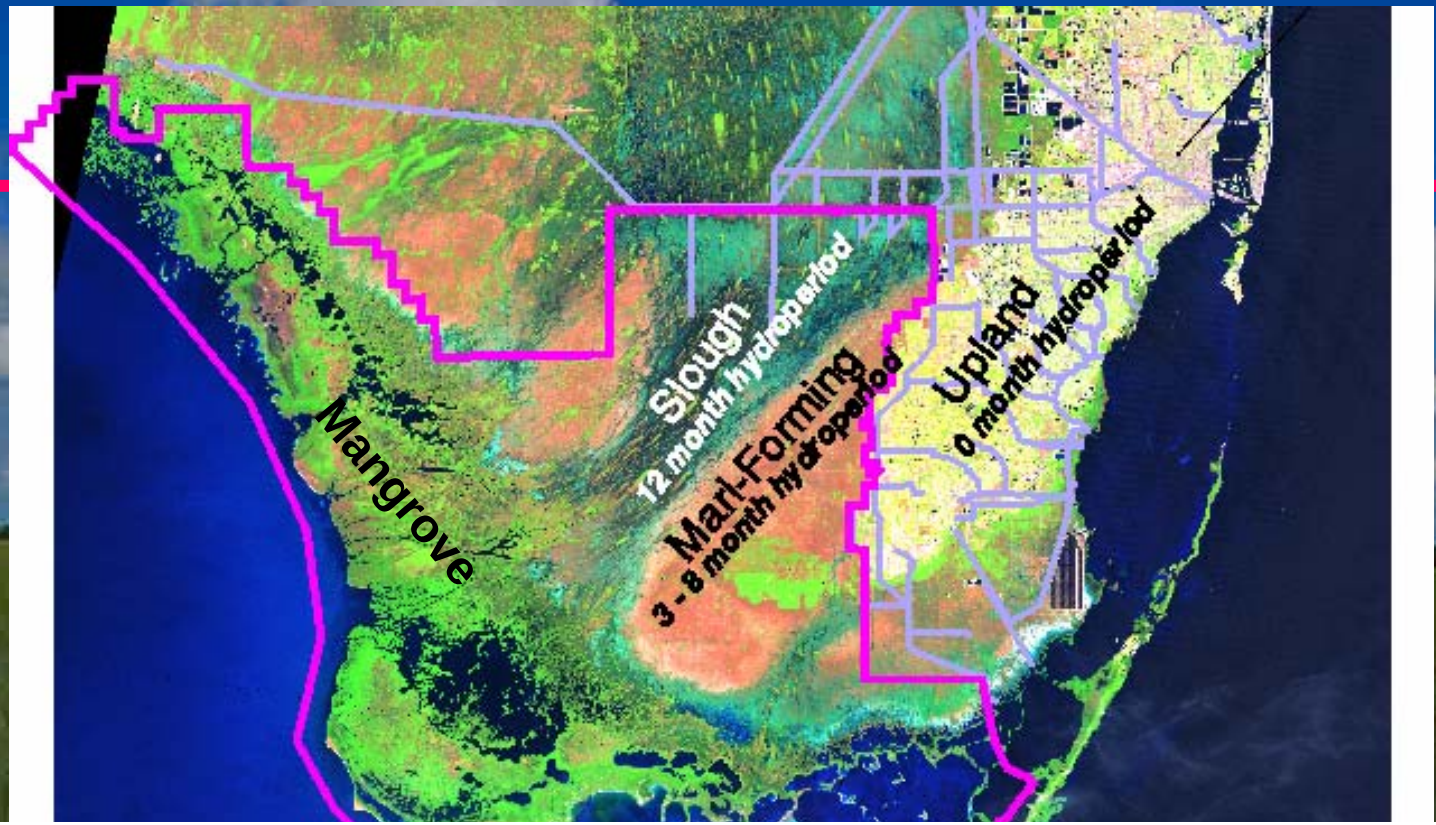


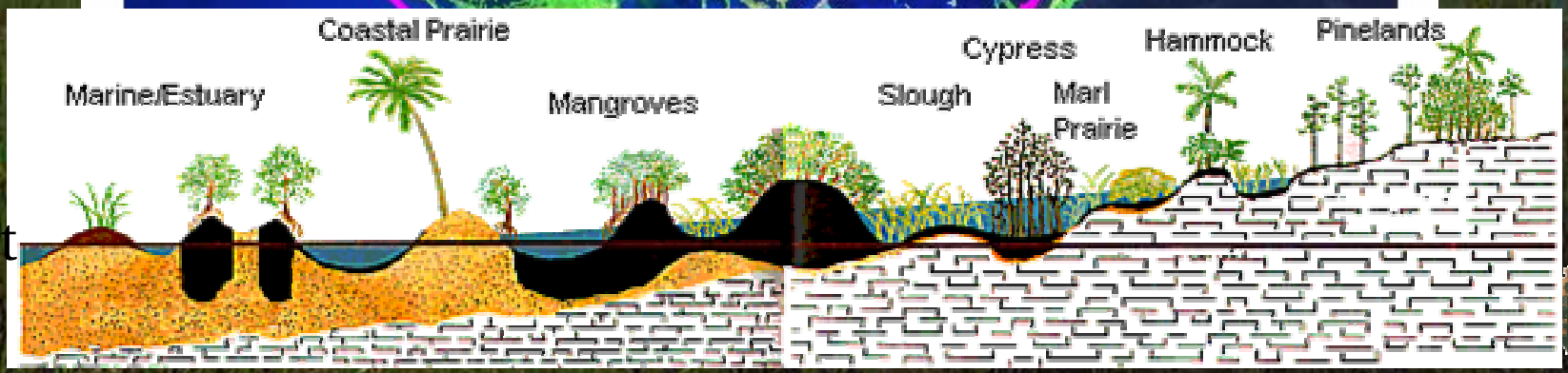
- **In CERP Plan (D13R), many of the internal levees and canals are removed or modified.**
- **Flow patterns do not yet match the landscape patterns in much of central Everglades.**

Affect on NPS Units
ENP: Flows to Shark Slough Estuaries

- Target average flow: 1,200,000 acre-ft/year
- Current: apx. 600,000 acre-ft/year
- CERP Plan: 850,000 acre-ft/year

Ecosystem Regimes

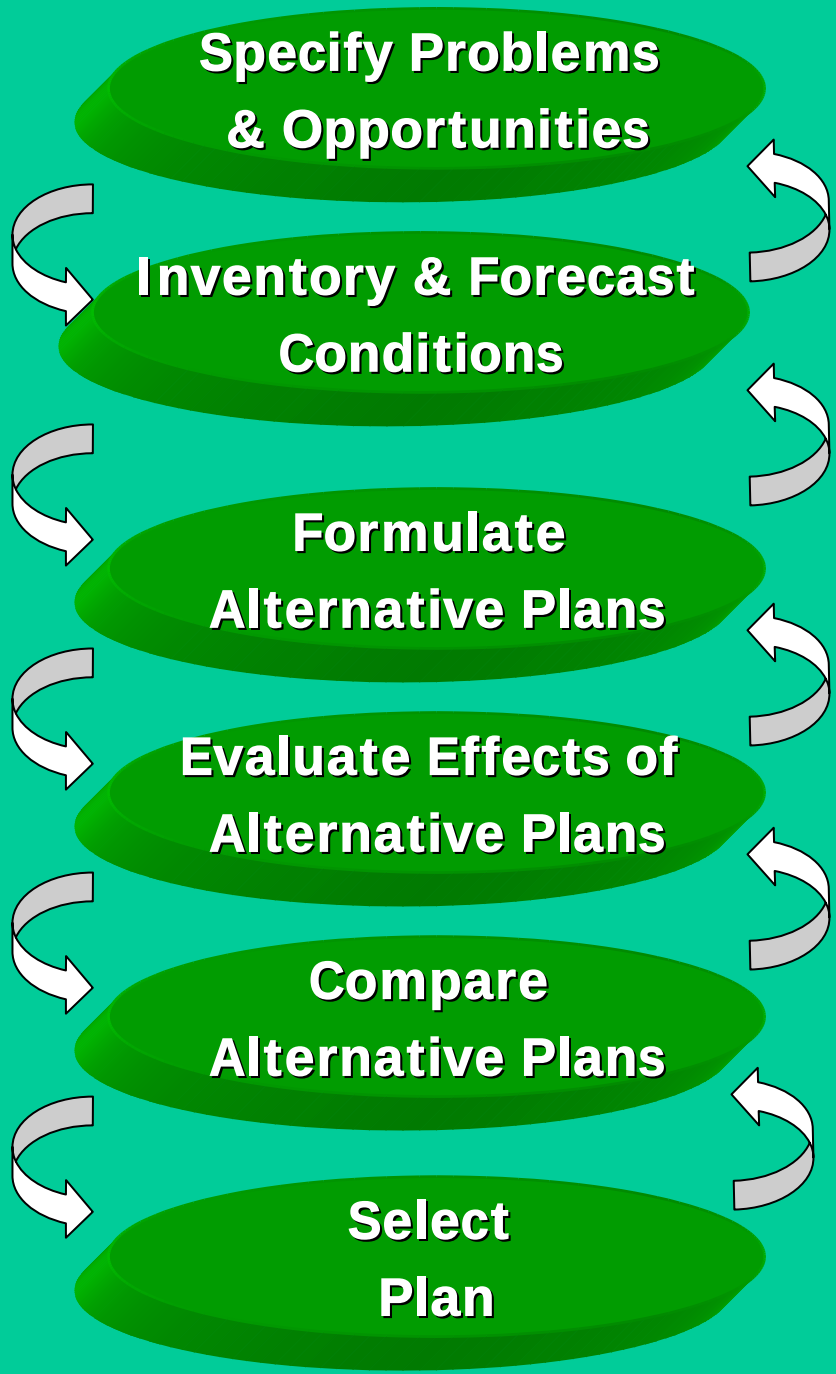




State Required Evaluations for CERP PIR's

- **Chapter 373, Florida Statutes**
  - **District local sponsor for projects**
  - **Project must meet all legal responsibilities in Chapter 373, F.S., for**
    - **Water supply**
    - **Water quality**
    - **Flood protection**
    - **Threatened & endangered species**
    - **Other water or natural resources**

Corps Planning Process: Six Steps

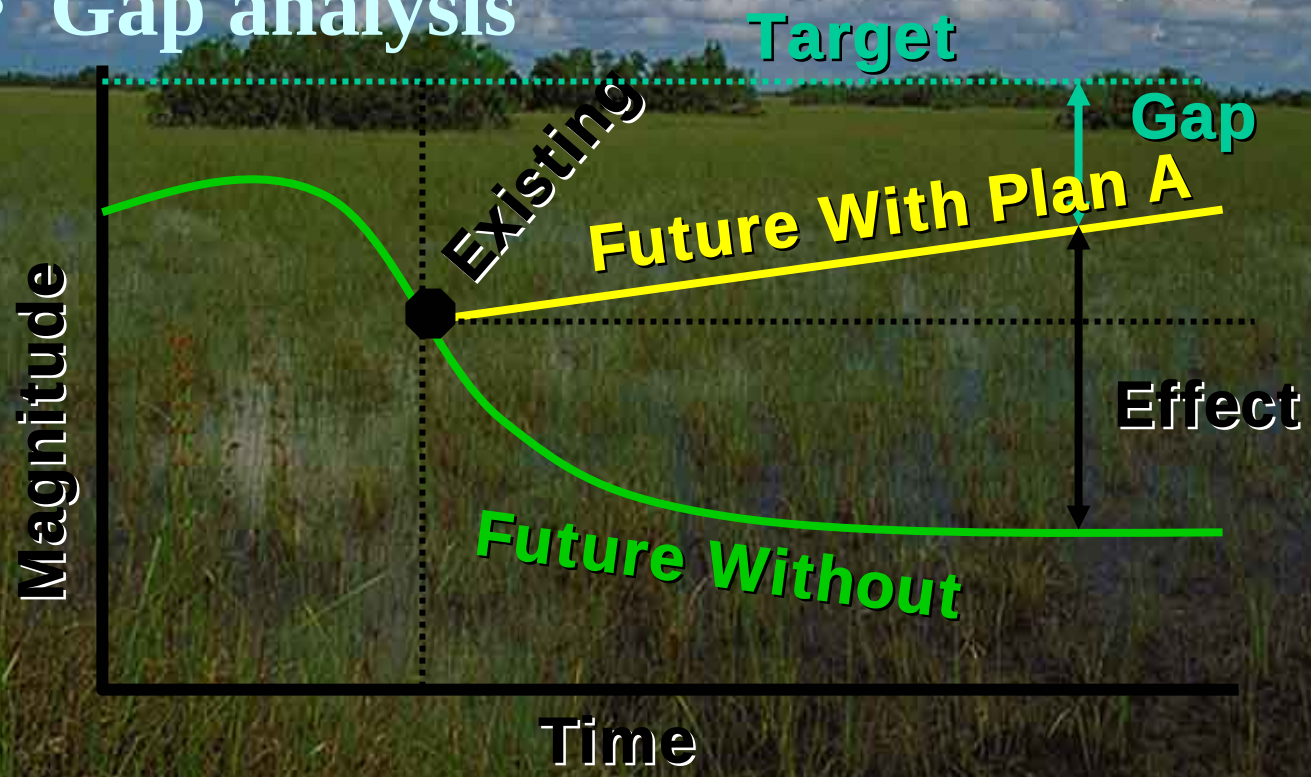


Evaluation: General

- A.k.a., “Evaluation of Effects”
- Comparing with-project & without-project conditions (“effects”) for each alternative
- Assess: measure differences
- Appraisal: judge differences
- Find value or worth of plans
- Identify plans for comparison

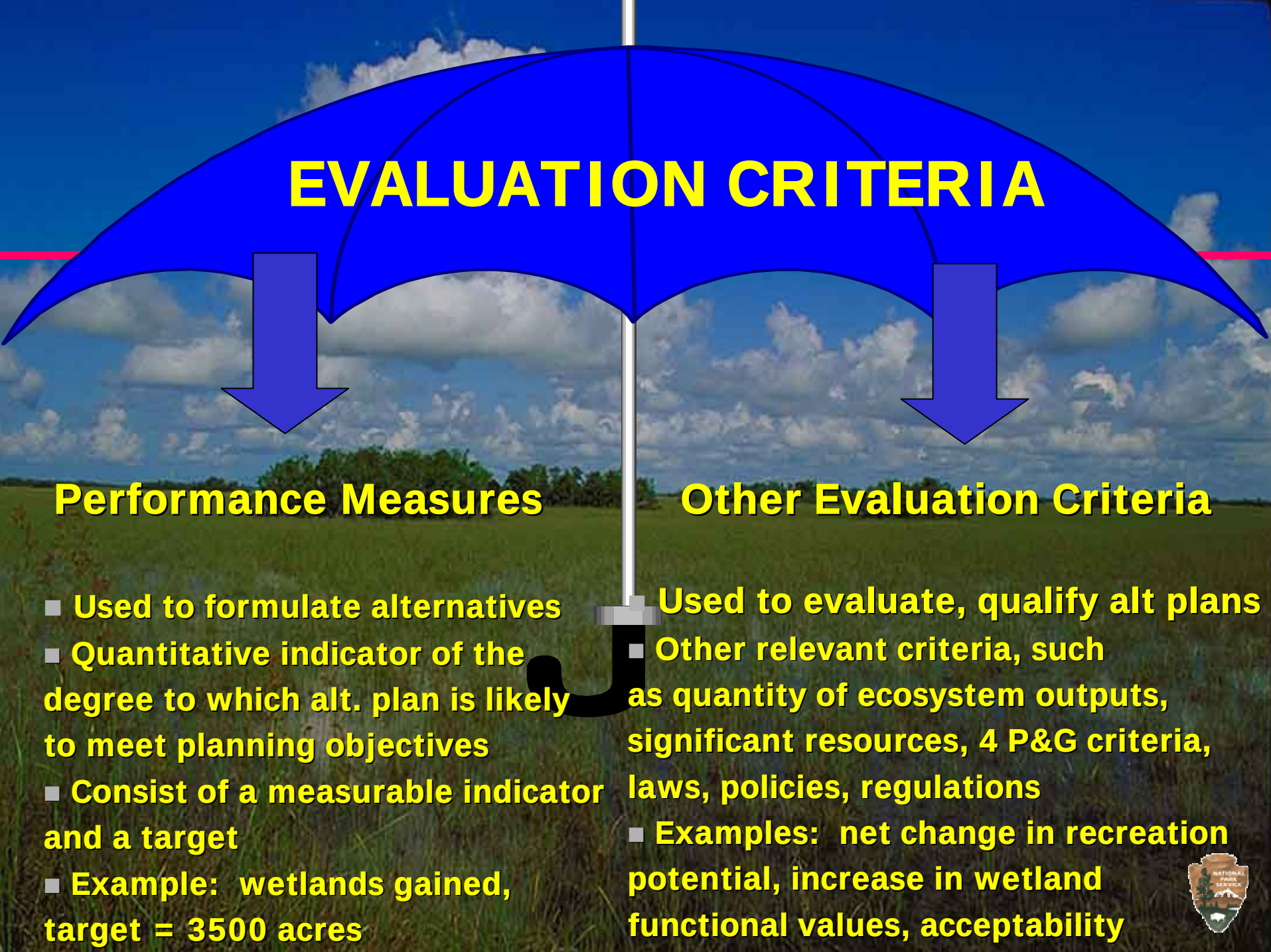
Types of Condition Comparisons

- **With project vs. without project**
- With vs. existing (before vs. after)
- Gap analysis



In Summary

- Modified Water Deliveries Project - shift water through historic flow way, Northeast Shark Slough.
- CERP - increase storage to provide water for urban and agricultural needs and for the natural system.
- Can not replace the spatial extent and ecological diversity of the historic system.


EVALUATION CRITERIA
Performance Measures
Other Evaluation Criteria
■ Used to formulate alternatives
■ Quantitative indicator of the degree to which alt. plan is likely to meet planning objectives
■ Consist of a measurable indicator and a target
■ Example: wetlands gained, target = 3500 acres
■ Used to evaluate, qualify alt plans
■ Other relevant criteria, such as quantity of ecosystem outputs, significant resources, 4 P&G criteria, laws, policies, regulations
■ Examples: net change in recreation potential, increase in wetland functional values, acceptability

Performance Measures

- **Subset of Evaluation Criteria**
- **A quantitative indicator of the degree to which alternative plans are likely to meet planning objectives**
- **PM's consist of a measurable indicator & target**
- **Used to formulate alternative plans**
- **Used to *represent, provide necessary conditions for, or establish link to* ecological (or other) outputs**

A Definition of Performance Measures

(from the Yellow Book)

Performance measures are the **quantitative indicators** of conditions in natural and human systems that have been selected as **targets** for restoration. Collectively, a well-selected set of performance targets provides a system-wide **characterization of restoration**.

A Definition of Performance Measures

Each performance measure identifies:

- An element to be measured (e.g., alligator nesting)
- The appropriate parameter (e.g., number of eggs that hatch per nest)
- The restoration target (e.g., 75% average hatching rate)

Mangroves

- Located on the coastlines
- Affected by shifts in salinity due to changes in freshwater inflows
- Destroyed by waterfront development
- Important as a fishery and for aquatic mammals

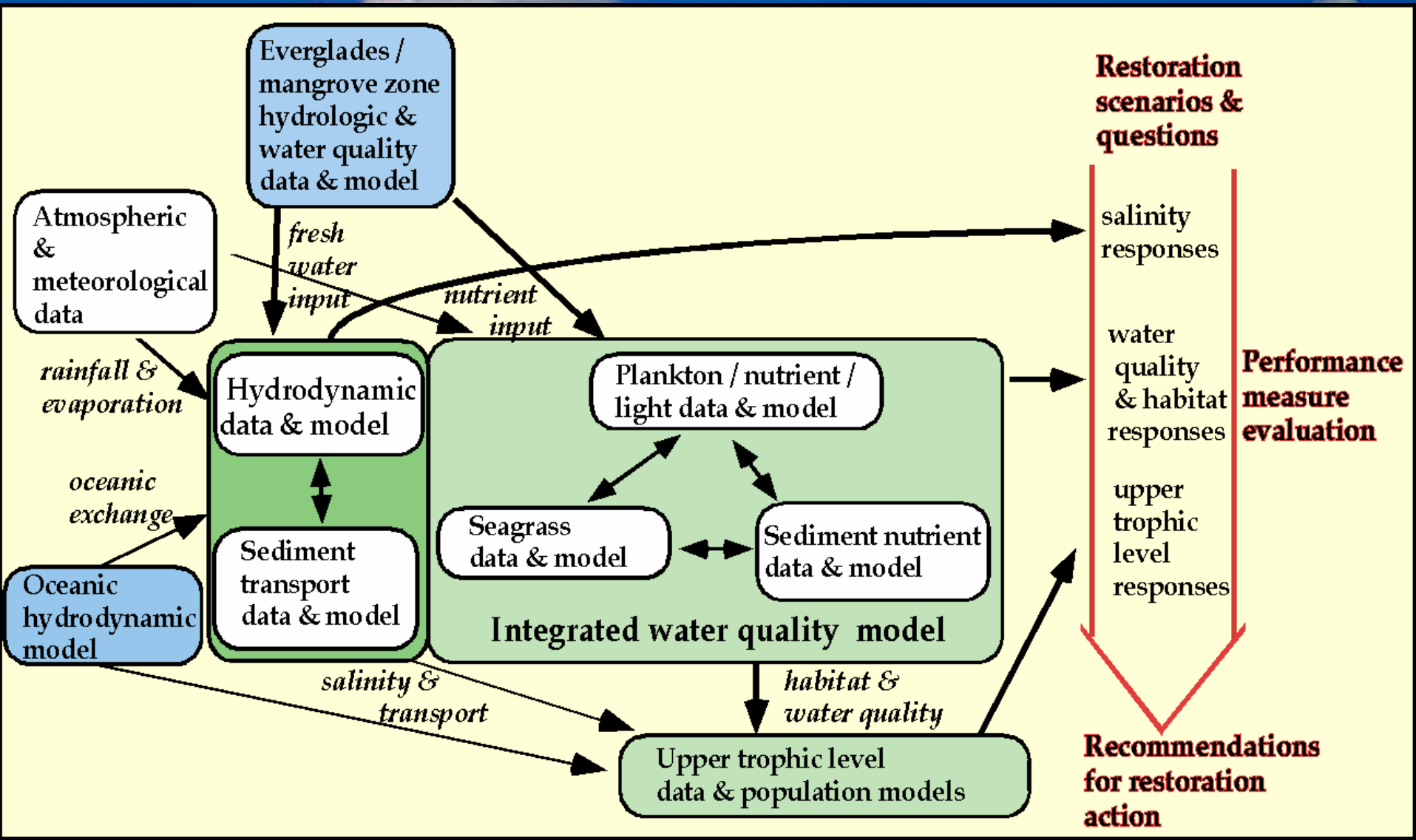

Manatee

Effects on Biscayne

- BISC should receive improved flow volume and timing patterns
- Large component of inflow will be wastewater reuse


Manatee

Model development and application for Florida Bay restoration



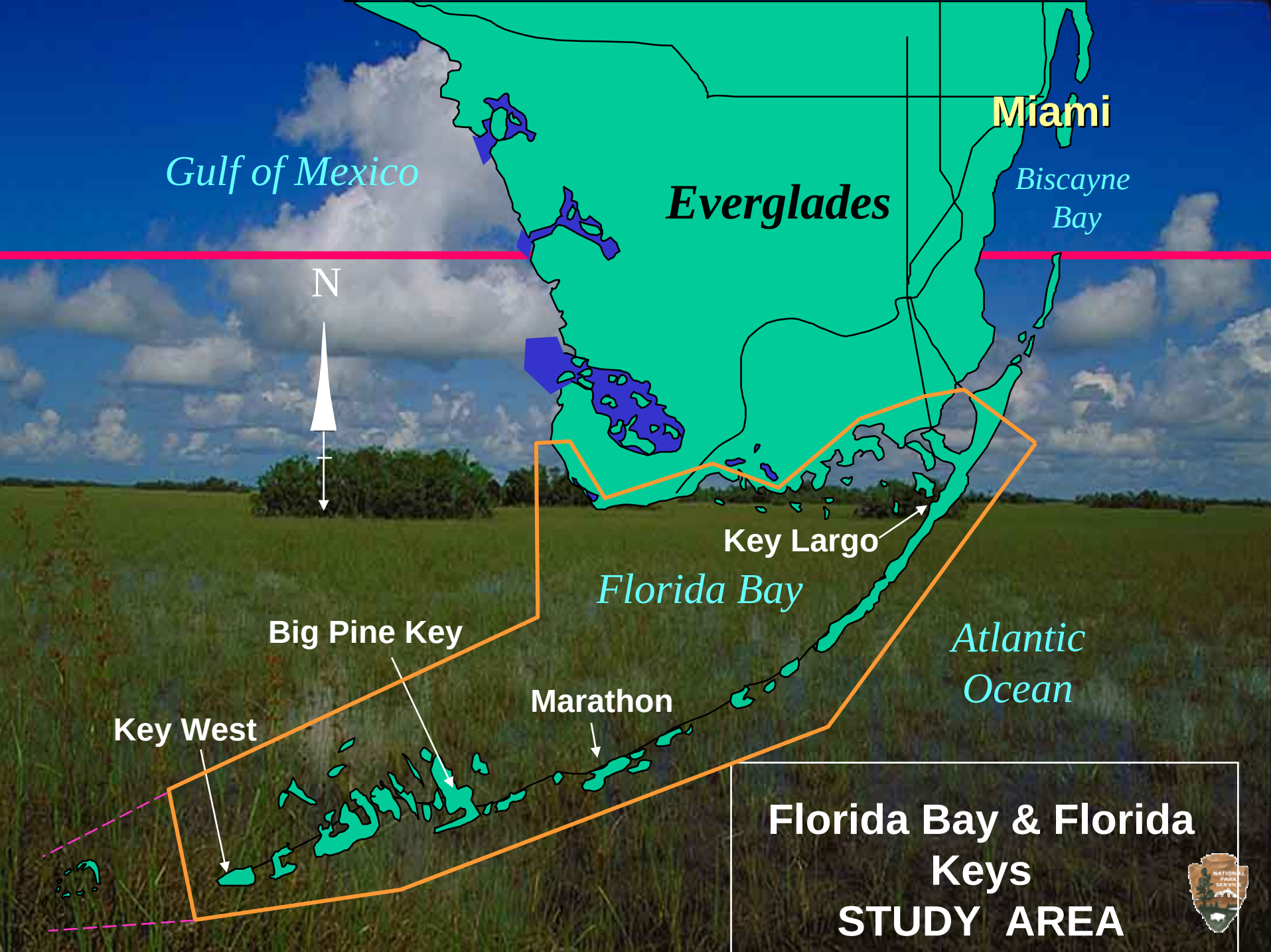
Model development and performance measures for Florida Bay restoration

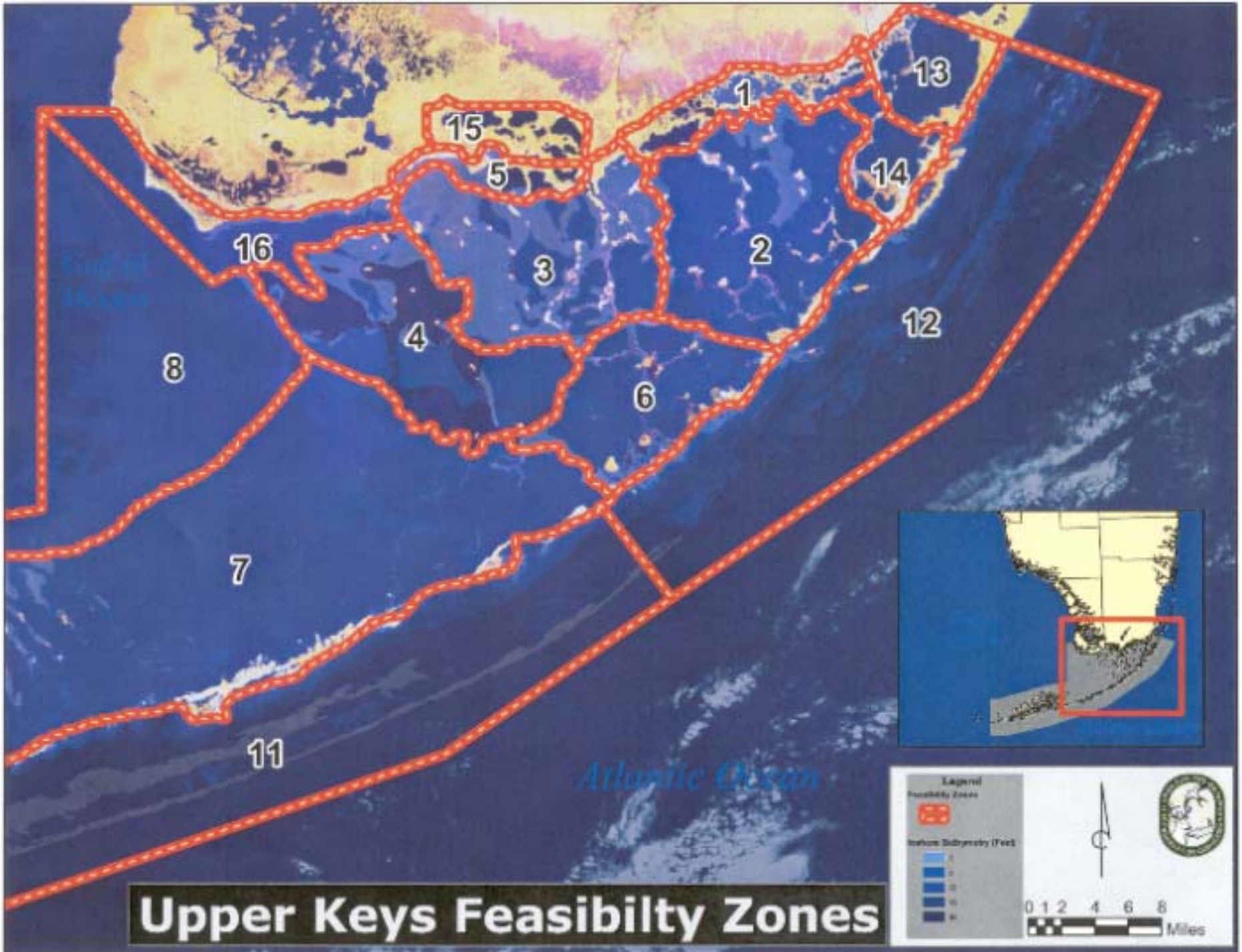
Models:

- **Southern Everglades hydrology (TIME/SICS)**
- **Gulf of Mexico and Atlantic Ocean boundary (HYCOM)**
- **Florida Bay hydrodynamics (EFDC)**
- **Florida Bay water quality (EFDC) with seagrass module (Madden/McDonald)**
- **Upper trophic level species models**

Perfomance measure categories:

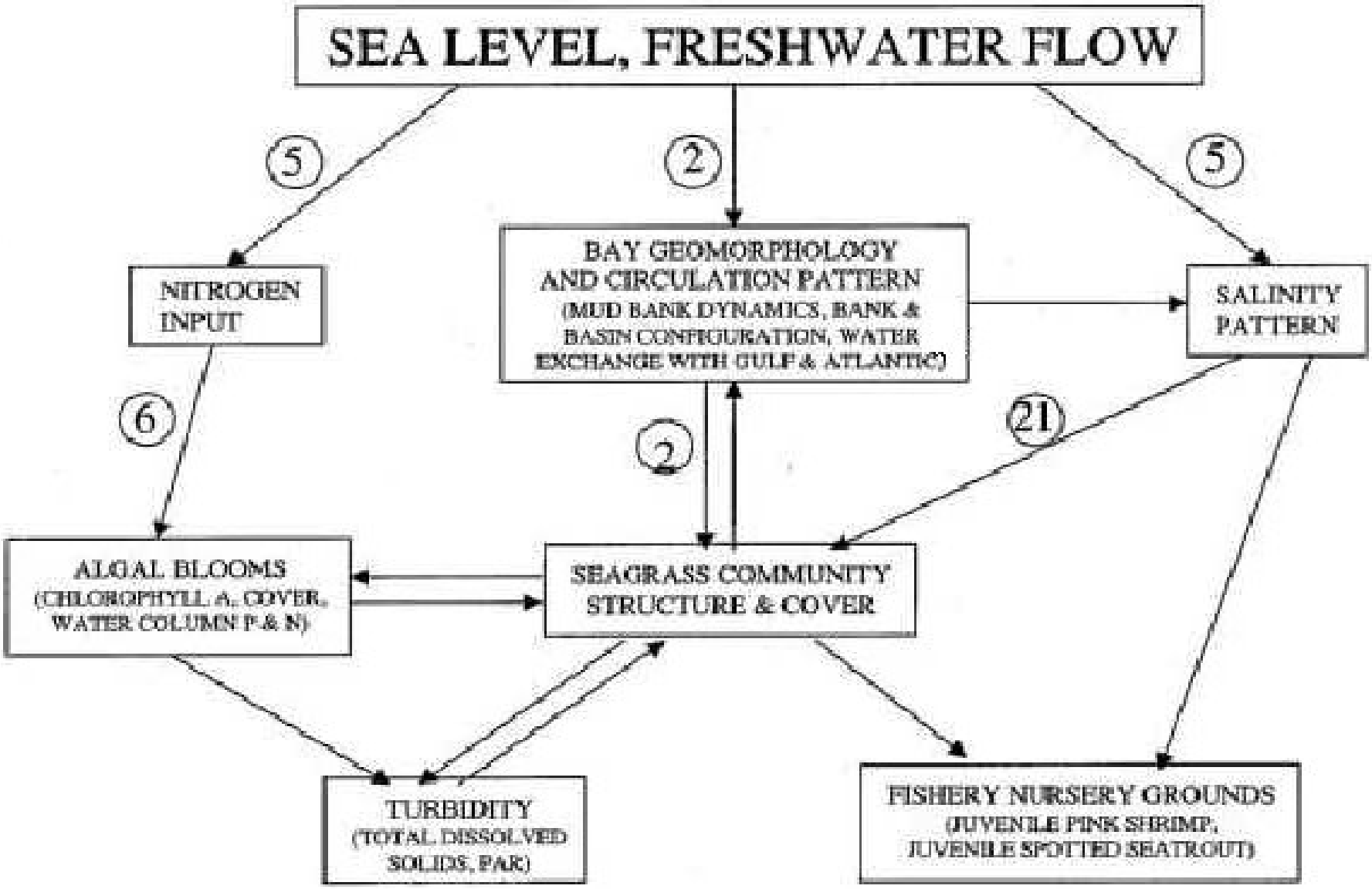
- **Physical characteristics (salinity, light)**
- **Water quality**
- **Habitat (SAV, coral reef)**
- **Fish and shrimp species**


Miami
Gulf of Mexico
Everglades
Biscayne Bay
N
Key Largo
Florida Bay
Big Pine Key
Atlantic Ocean
Marathon
Key West
Florida Bay & Florida Keys
STUDY AREA



Upper Keys Feasibilty Zones

RECOVER Monitoring and Assessment:
Florida Bay Conceptual Model



Coastal Performance Measures

- Characteristics of water releases
  - Volume
  - Timing
  - Distribution
- Salinity patterns
  - Envelopes
  - Gradients
  - Placement
  - Fluctuation
- Biological
  - Oyster reestablishment
  - Seagrass cover, density, and diversity
  - Estuarine and oligohaline fish communities
  - Density and abundance of forage fish, shrimp, and crabs
  - Prevalence of abnormal fish

FBFKFS Performance Measure Development

Physical Characteristics :

- Salinity
- Light

Water Quality:

- Dissolved oxygen
- P (concentration and loading)
- TN (concentration and loading)
- DIN (concentration and loading)
- Algal blooms

Submerged Aquatic Vegetation:

- Biomass
- Community coverage
- Species composition & density

FBFKFS Performance Measure Development

Higher trophic level species:

- Juvenile pink shrimp abundance
- Pink shrimp harvest
- Juvenile lobster survivorship
- Forage fish (FL Bay and transition zone)
- Juvenile seatrout abundance
- Adult seatrout catch
- Juvenile snook abundance
- Adult snook catch
- Roseate Spoonbill nest numbers
- Roseate Spoonbill nesting success
- Crocodile nesting success and juvenile growth

Higher Trophic Level Performance Measures (HTLPM)

HTL.SST – pre-adult spotted seatrout

Targets:

- Maximum increase to densities in Zone 3.
- Moderate increase to densities in Zones 4 and 16 (systems buffered by Gulf influence).
- No change to baseline densities in Zones 1, 2, 5, 6, 13, 14, and 15 (little expectation for these areas to become significant nurseries; present-day densities very low to 0).

Florida Bay and Florida Keys Feasibility Study

Performance Measure Summary for RECOVER Review

4/30/04

David Rudnick, Ph.D.
Robin Bennett
Coastal Ecosystems Division
SFWMD

What is RECOVER?

- RECOVER - Restoration Coordination and Verification

- Role - Organize and apply scientific and technical information to support the objectives of CERP; i.e, implement the applied science strategy

RECOVER System-wide Performance Measure Document

- Purpose and application of Performance Measures
- Includes evaluation and assessment performance measures
- Doc Sheet for each PM: restoration target, justification, evaluation protocol
- Internal draft complete. Expecting external draft to be completed in Feb ‘03

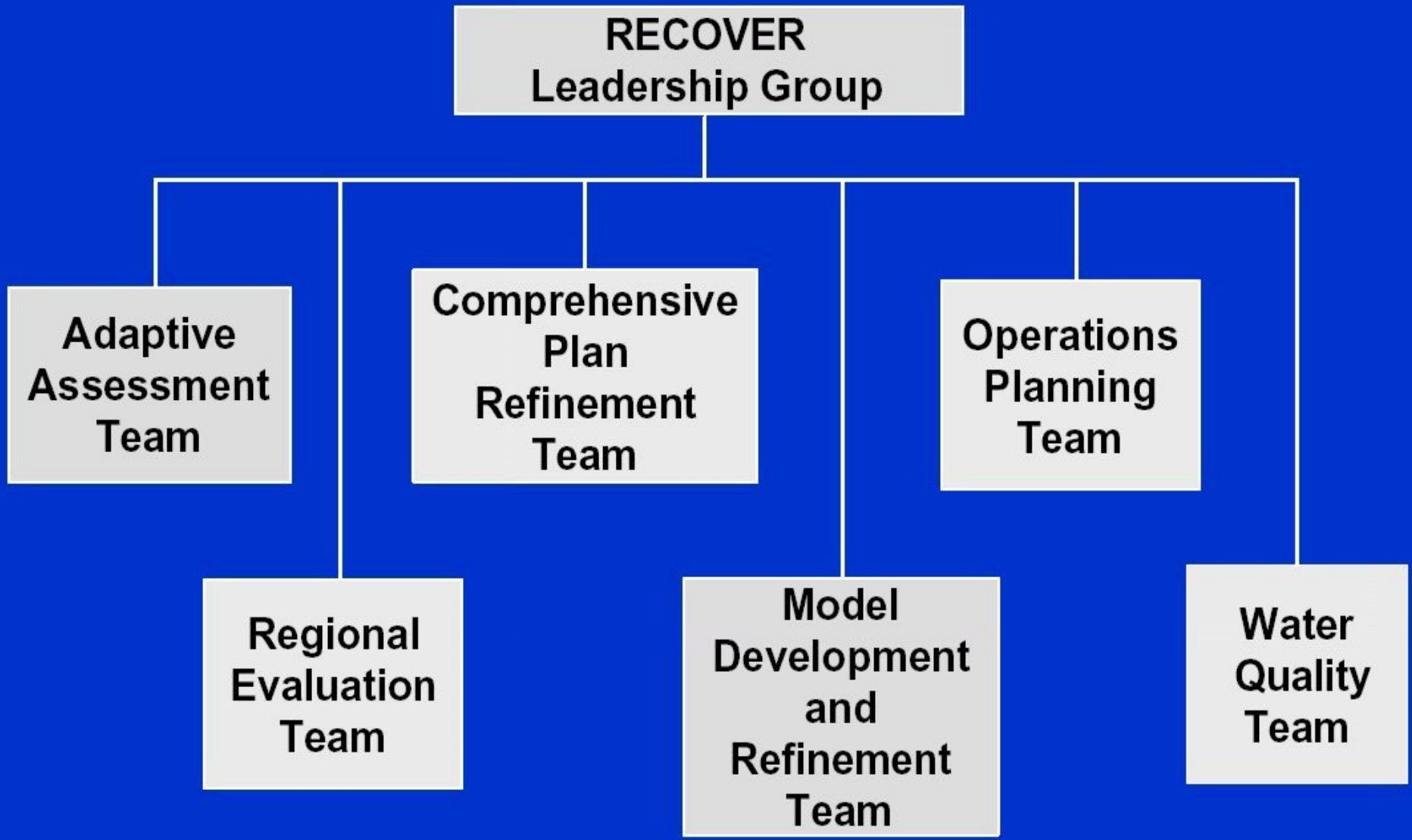
RET Evaluation

- Completed by Interagency Team
- Currently use SFWMM, may use other models in future
- Apply “accepted” system-wide performance measures
- Developing Standard Evaluation Methodology

RECOVER Review of Performance Measures

- **RET and WQT will review the project level performance measures to ensure consistency with the system-wide performance measures**
- **Project Managers (or designee) to coordinate with the RECOVER liaisons**
  - **Schedule review and coordinate comments**
- **RECOVER Liaisons**
  - **Jenni Hiscock**
  - **Lisa Smith**

RECOVER Teams



RECOVER Teams

Adaptive Assessment Team

1. Develop & revise conceptual models
2. Design & implement system-wide monitoring plan
3. Prepare annual adaptive assessment report
4. Coordinate science peer review
5. Develop & revise biological performance measures

Regional Evaluation Team

1. Develop & revise hydrological & water supply performance measures
2. Conduct performance evaluations of Comprehensive Plan & its individual projects

Comprehensive Plan Refinement Team

1. Document updates to the Comprehensive Plan
2. Revise and document planning assumptions
3. Serve as primary point of contact for RECOVER team members and project delivery teams

RECOVER and the Project Delivery Teams

RECOVER will assist the project delivery teams in the following:

- Development of the existing condition and without project condition
- Development of performance measures
- Development of water control plans
- Development of monitoring plans
- Evaluation of projects within the system-wide context

Adaptive Assessment

- A process for measuring how well a restoration plan achieves its predicted targets or desired objectives, and for using these assessments as a basis for making improvements in the design or operations of the plan

- Provides a means for continually reducing the levels of uncertainty, and for adjusting to unexpected responses, by refining the design of the restoration plan in response to improving information databases (including the learning that comes from monitoring and researching actual system responses)

Applied Science Strategy

Major components -

- Conceptual Ecological Models
- Hydrological and Ecological Simulation Models
- Performance Measures and Targets
- Regional Monitoring Program
- Adaptive Assessment Protocol

CERP System-Wide Monitoring and Assessment Plan

Overall goals -

- To identify the parameters of the natural and human systems that should be measured to determine the progress and success of CERP
- To implement an integrated system-wide monitoring and assessment program that will be used and supported by all agencies as the primary means of tracking the success of CERP
- To support an adaptive assessment protocol for making improvements in CERP

Evaluation and Assessment

- Evaluation - Analysis of proposed plans or projects to determine expected performance (pre-construction modeling)

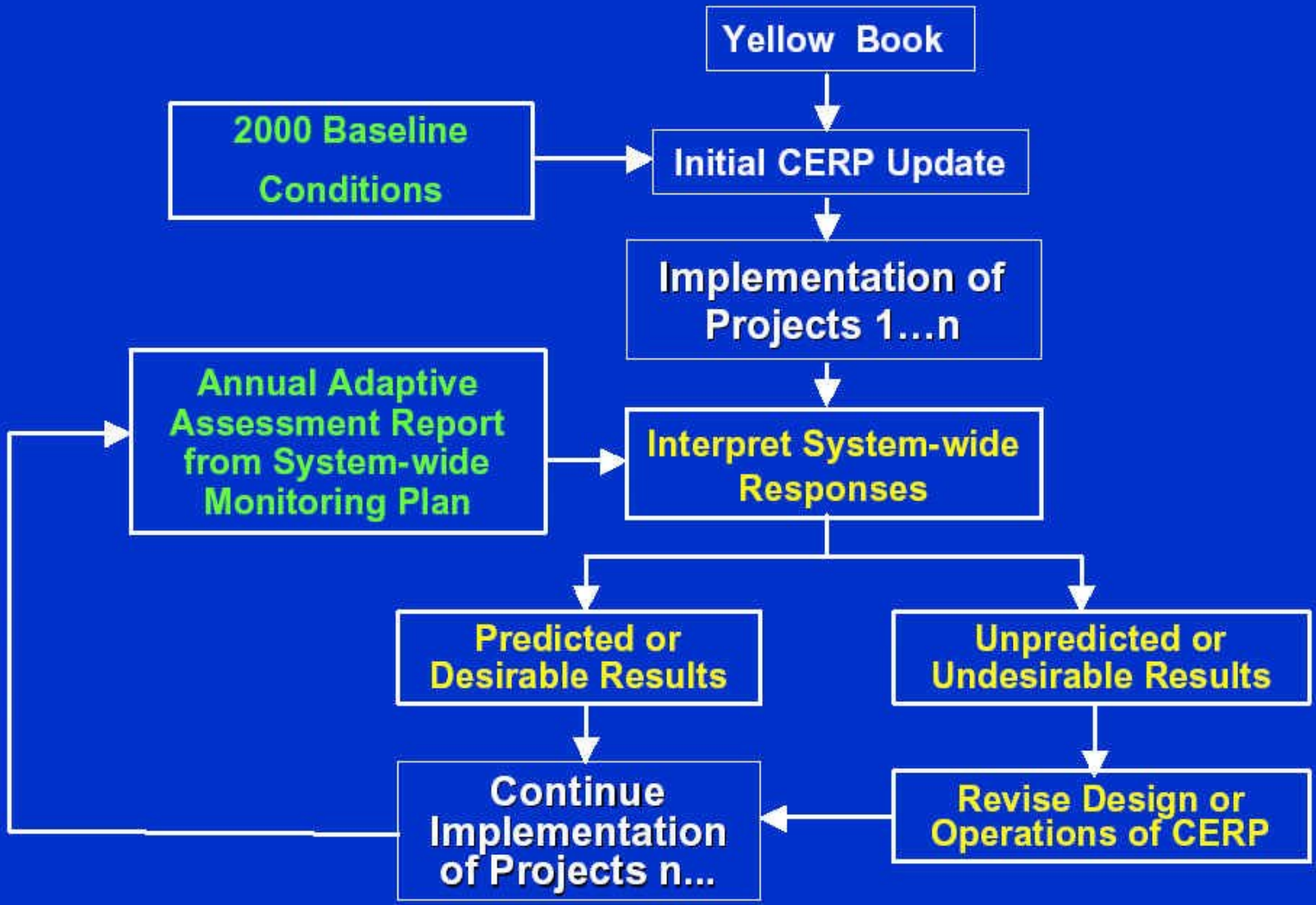
- Assessment - Analysis of actual performance of projects (post-construction monitoring)

Develop Assessment Criteria: Requirements

- **Restoration of Hydropatterns**
- **Mitigation of increased water depths and hydroperiods**
- **Protection of State and Federal Endangered Species**

Draft July 31, 2001

CERP Updates Through the Adaptive Assessment Process



Summary

- **Legislation**
- **Components**
- **Alternatives assessed using scientific performance measures**
- **Alternatives are ranked**
- **Environmentally preferred alternative is chosen**
- **Federally Preferred Alternative is negotiated**

The Environmentally Preferred Alternative is rarely the Federally Preferred Alternative due to money or politics