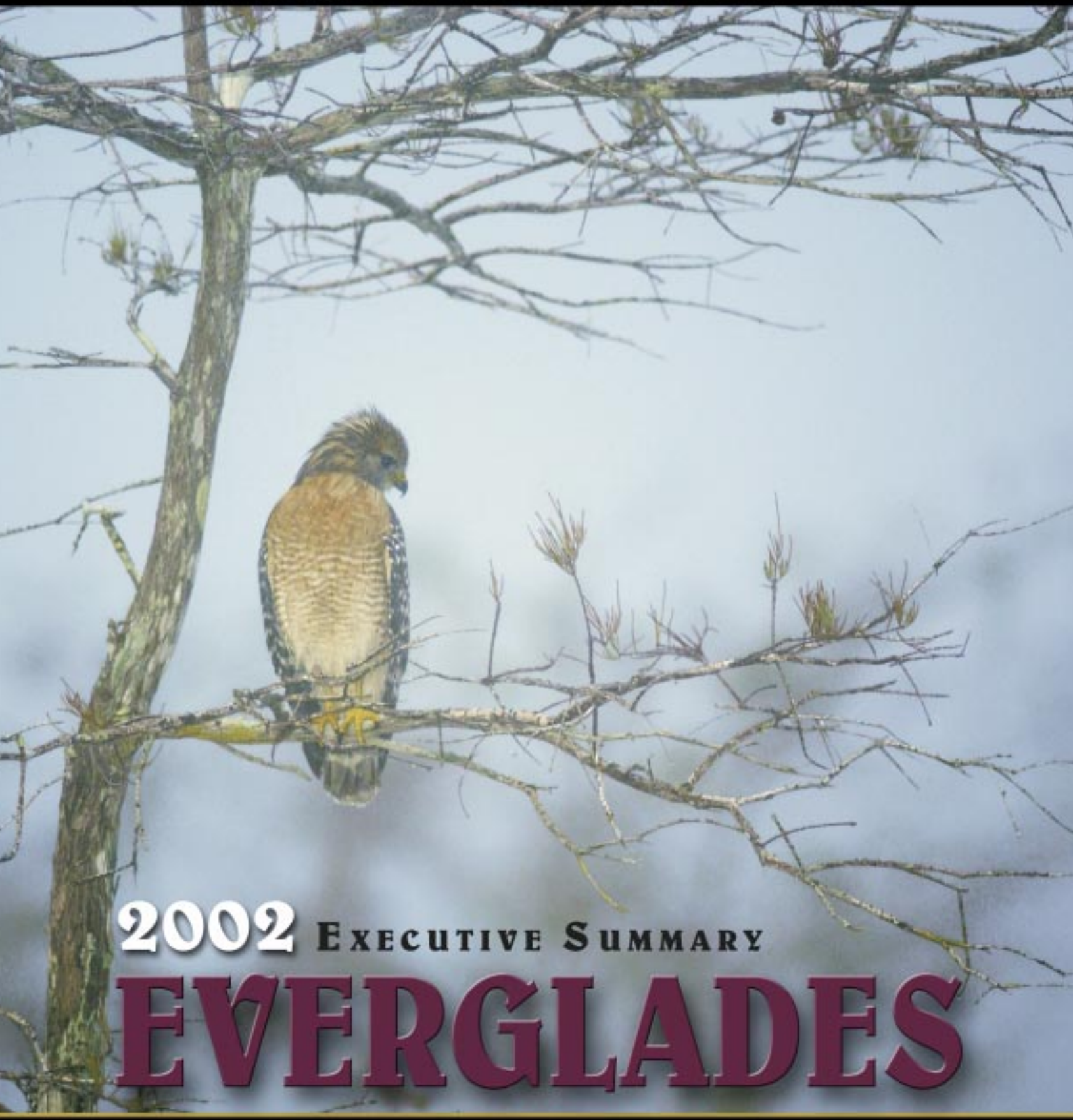
SOUTH FLORIDA WATER MANAGEMENT DISTRICT



2002 Executive Summary
EVERGLADES

Consolidated Report

January 1, 2002

sfwmd.gov

On behalf of the South Florida Water Management District and the Florida Department of Environmental Protection, we are pleased to present the *2002 Everglades Consolidated Report*. This year's *Report* conveys the welcome news that Everglades restoration programs continue to progress on schedule. Stormwater Treatment Areas and agricultural Best Management Practices show effectiveness beyond expectations in reducing phosphorus from water moving southward into the Everglades Protection Area. Wading bird nests in South Florida were estimated at over 38,000 making the year 2001 one of the best in a decade. Many additional examples in the *2002 Report* demonstrate that the scientific underpinning and environmental planning for Everglades restoration efforts remain strong. The utility of information in this *Report* will continue into the era of the Comprehensive Everglades Restoration Plan.

While these accomplishments are encouraging, water management challenges lie ahead. Achieving long-term water quality goals will require the integration of many research, planning, regulatory and construction activities. To meet the ambitious 2006 time frame mandated by the Everglades Forever Act, timely funding and completion of all these activities are crucial.

To ensure that the *Report* summarizes the best information available, rigorous agency review and 'peer review' by outside experts guided its development. Attached to the back cover of this Executive Summary is a compact disc containing the entire *Report* with hundreds of pages of data, findings, and discussion in support of Everglades preservation and management.

The *Report*, the fourth in an annual series, is a cooperative effort by our agencies to comply with reporting obligations under the Everglades Forever Act and other state and federal laws, and to support water resources decision making on a broad front.

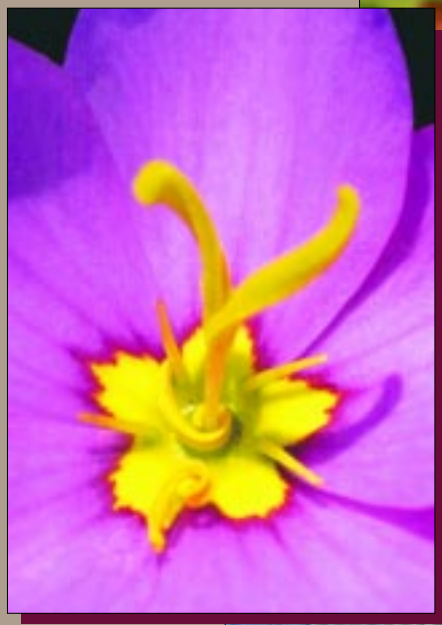
Henry Dean
Executive Director
South Florida Water Management District

David B. Struhs
Secretary
Florida Department of Environmental Protection

Foreword

Welcome to the fourth annual Everglades Consolidated Report. The Report conveys data and information on a wide variety of Everglades Forever Act programs and permits in support of Everglades restoration and protection. More than 50 staff from the South Florida Water Management District and the Florida Department of Environmental Protection, including scientists, engineers, field staff, chemists, managers, graphic artists and technical editors, participated directly in the creation of this 2002 Report. The interagency cooperation by staff from throughout the District and the Department was truly remarkable in making this year's Report the finest compilation of data and findings to date.

The ultimate responsibility for producing the annual Everglades Consolidated Report falls to the Environmental Monitoring and Assessment Department at the South Florida Water Management District. We all owe a debt of gratitude to the District's Dr. Garth Redfield, the professional in charge of report development, for his skillful integration, insightful editing and unswerving determination to see this project through each year. He is part of a collaborative departmental team that compiles all of the data in the Report into a readable format, arranges for an external peer review panel, edits the entire text and ensures that the Report is delivered on time to state officials.



In addition to meeting legal mandates, the ultimate aim is to give you, the reader, a snapshot of agency progress in restoring the Everglades and to provide a valuable guide for resource management decisions. We hope that you find this year's Report especially useful. Every effort has been made to make the data easy to access, the text easy to read and the Executive Summary easy on the eyes. The complete 2002 Everglades Consolidated Report with appendices has been made available on the attached compact disc and is on the District's Website at www.sfwmd.gov/org/ema/everglades Enjoy!

Naomi S. Duerr, P.G.
Director
Environmental Monitoring and Assessment Department
South Florida Water Management District

2002 Everglades Consolidated Report
The Bottom Line

Water Quality in the Everglades Protection Area

- Evaluation of deviations (excursions) from water quality criteria by the Florida Department of Environmental Protection for Water Year 2001 indicates that Everglades water quality generally meets state numeric criteria. A severe drought likely influenced the frequency of excursions during Water Year 2001.
- Stormwater Treatment Areas and agricultural Best Management Practices have reduced phosphorus concentrations leaving the Everglades Agricultural Area. However, further reductions of phosphorus inputs are being pursued as a critical Everglades restoration goal.
- Most mercury enters the Everglades Protection Area from the air and is processed rapidly in the ecosystem. Mercury emissions in Florida have been reduced greatly since 1990 to the benefit of the Everglades. Research and monitoring will continue to investigate the relationships between eutrophication, sulfur levels and mercury bioaccumulation in South Florida wetlands.
- Ongoing cooperative efforts between the South Florida Water Management District's Everglades Stormwater Program and local governments are developing water quality improvement plans for eight tributary basins to the Everglades Protection Area.

Ecological and Hydrological Needs of the Everglades Protection Area

- Evaluation of data from Water Conservation Areas 1 and 2A indicates that the Everglades Forever Act default total phosphorus criterion of 10 parts per billion (ppb) would be protective of the natural flora and fauna in both areas, without being overly protective or below the natural background levels.
- Evaluation of the limited data available for Water Conservation Area 3A and Everglades National Park indicates that these areas contain biological communities comparable to those of Areas 1 and 2A, and suggests that biological communities in all areas of the Everglades Protection Area exhibit similar responses to phosphorus enrichment.
- Improved understanding of how nutrients and water levels affect tree island health and development will help guide management and restoration of the Everglades.
- Drought conditions were a dominant factor influencing Everglades ecology for Water Year 2001. In spite of this stress, ecosystems in the Everglades functioned quite well. Nesting activity was very successful for several key wading bird species during the year, and fires were limited to rejuvenating surface burns.
- Information from Everglades research was used to develop four models to predict drought effects in the Everglades Protection Area. Monthly reports using these models aided water managers in responding to ever-changing conditions during the 2001 drought.
- Although many exotic plants and animals may have negative impacts on the Everglades, Old World climbing fern now represents the single greatest exotic threat to the ecosystem. Successful management of this species will require dedicated funding and the same intensity of interagency coordination as was given to controlling melaleuca.

Performance of Agricultural Best Management Practices

- For the sixth consecutive year, Best Management Practices have reduced phosphorus loads from the Everglades Agricultural Area to a greater extent (73 percent) than is required by the Everglades Forever Act (25 percent).
- Implementation of agricultural Best Management Practices has been shown effective at reducing phosphorus transport through ongoing studies in the Everglades Agricultural Area and by measured load reduction from the basin as a whole.

Comprehensive Everglades Restoration Plan (CERP)

- The Comprehensive Plan includes six pilot projects and 56 cosponsored components spanning 38 years and cost-shared equally by the District and the U.S. Army Corps of Engineers.
- The RECOVER program is designed to ensure that high quality science is continuously available during implementation of the Comprehensive Plan. RECOVER encourages the participation of diverse agencies and stakeholders in adaptive management and ongoing refinement of the Plan.

Performance and Optimization of Stormwater Treatment Areas

- Stormwater Treatment Areas 1 West, 2, 5 and 6 have been constructed and are fully operational. The remaining two, 1 East and 3/4, are under construction and will be complete by October 2003. Although the performance of Stormwater Treatment Areas was influenced by the severe

drought during the past year, more than 24 metric tons of phosphorus were removed from inflows to the Everglades Protection Area.

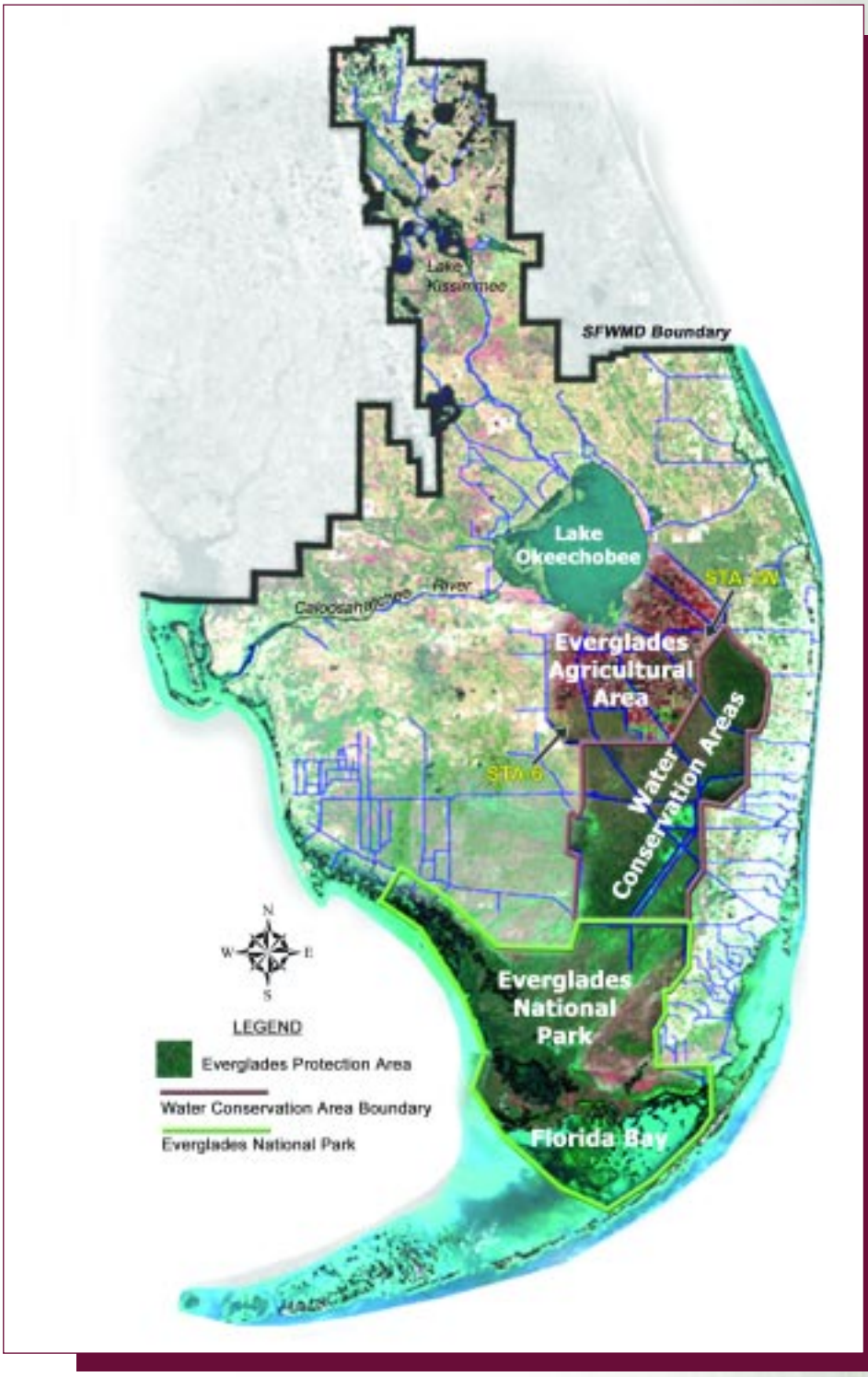
- Mercury levels were highly variable in the Stormwater Treatment Areas, and it is very unlikely that they will produce unacceptable mercury risks downstream in the Everglades Protection Area.
- The regional drought afforded an opportunity to initiate investigations on the influence of phosphorus removal performance within the Stormwater Treatment Areas. Results should yield guidance on optimizing performance during dry periods.
- Calibration continued on the next-generation simulation model for wetland treatment systems, the Dynamic Model for Stormwater Treatment Areas (DMSTA). This model will be used to evaluate alternative long-term water quality solutions for the Everglades Protection Area.

Advanced Treatment Technologies

- Current research indicates that Periphyton-based Stormwater Treatment Areas and Submerged Aquatic Vegetation should achieve average phosphorus concentrations of 15 to 20 ppb under certain conditions. Investigation is underway on these technologies to address full-scale implementation issues.

- In small-scale experiments, chemical treatment produced outflow phosphorus concentrations of less than 10 ppb and may be applicable to smaller urban basins where land availability is limited. Further investigation is proposed to address full-scale implementation issues.

Major Everglades Areas



Chapter 1: Introduction to the Everglades Consolidated Report

Consolidation and Peer Review Maintain Credibility and Efficiency

Building upon earlier editions of the Report, the *2002 Everglades Consolidated Report* updates available data and findings from Everglades research, monitoring and restoration activities to support water resources management. The *2002 Report* continues to satisfy many reporting requirements in a single, integrated document, including:

- Two annual reports required by the Everglades Forever Act
- Information required by the Joint Legislative Committee on Everglades Oversight
- Several state and federal reports required by permits from the U.S. Army Corps of Engineers and Florida Department of Environmental Protection (Department) for the Stormwater Treatment Areas and for areas under the Everglades Stormwater Program.

The consolidation of these many related reporting requirements into one document provides technical information and status reports relating to all the major programs in the Everglades Protection Area.

The *Report* receives intensive review by a panel of six external, independent experts as well as and thorough discussion at public workshops. The Internet is used as a means for conveying all comments on the *Report,* allowing the deliberative review process to be conducted in accordance with Florida's Government-in-the-Sunshine statutes. This scrutiny ensures that the *Report* communicates the best information available in support of Everglades programs. The final product reflects the authors' changes in response to the input of the public and peer review panel.

Report Supports Multiple Everglades Protection Area Programs

- The Everglades Construction Project, as mandated by the Everglades Forever Act, is composed of six Stormwater Treatment Areas. These constructed wetlands cover 47,000 acres and will treat nearly 1.4 million acre-feet per year of stormwater runoff from the Everglades Agricultural Area and other sources. The wetlands will direct the treated water to the Everglades Protection Area to improve water flow, timing, quantity and quality.
- Upstream of the Stormwater Treatment Areas, the Everglades Best Management Practices Regulatory Program works in close cooperation with the agricultural industry to implement a program of farming practices to reduce the load of phosphorus moving southward from the Everglades Agricultural Area into the Everglades Protection Area.
- In basins contributing to the Everglades Protection Area outside the Everglades Construction Project, the Everglades Stormwater Program supports strategies based on monitoring, assessment, cooperation with stakeholders and regulation to ensure compliance with state water quality standards by December 31, 2006.
- The *Report* also provides information that directly supports the far-reaching Comprehensive Everglades Restoration Plan (CERP). This long-term plan for restoring, protecting and preserving the South Florida Everglades ecosystem includes more than 60 components and six pilot projects being implemented in close partnership with the U.S. Army Corps of Engineers. The state-federal partnership was solidified in the 2000 Water Resources Development Act that included Title VI, Comprehensive Everglades Restoration.

Other topics addressed in the *2002 Everglades Consolidated Report* include Everglades hydrology, land acquisition, fiscal management, mercury concerns and exotic species management. While this Executive Summary is a stand-alone document, it is merely a summary of the main *Report* and its extensive appendices. All these documents are available on the compact disc attached to this Executive Summary.

Everglades Restoration Efforts are Progressing in Concert

The Florida Everglades has been altered greatly in land area, hydrology and water quality. This subtropical wetland has been reduced to about 50 percent of its original extent, and its water supply has been modified dramatically in both quantity and quality. The nutrient element phosphorus has been identified as a major pollutant of the ecosystem, and its diverse, far-reaching impacts are evaluated throughout the pages of this *Report.*

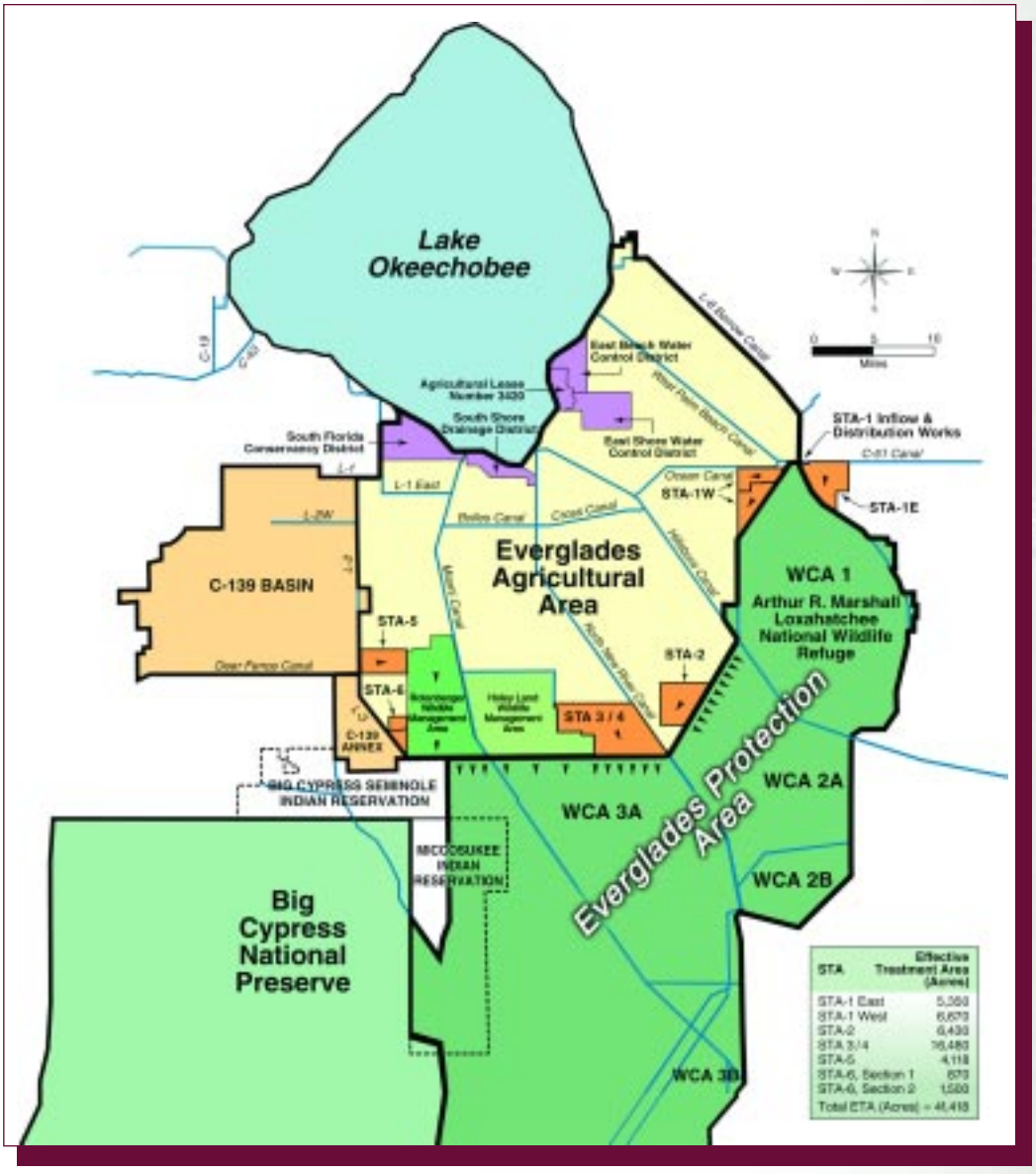
Everglades restoration is a national imperative, unique in scale and complexity. At a cost in excess of $867 million, the Everglades restoration efforts undertaken by the District and the Department in accordance with the 1994 Everglades Forever Act are highly ambitious. In addition, since 1994 there has also been a multimillion dollar investment in the Everglades-based research described in the *Report*. This research addresses improving agricultural Best Management Practices, optimizing performance of the Stormwater

Treatment Areas, establishing a numeric state water quality criterion for phosphorus and documenting Advanced Treatment Technologies capable of further reductions in phosphorus.

Everglades restoration programs continue to progress. Stormwater Treatment Areas and agricultural Best Management Practices are proving to be very effective at reducing phosphorus from stormwater moving southward into the Everglades Protection Area. Many additional examples in the *2002 Report* demonstrate that the scientific underpinning and environmental planning for Everglades restoration efforts remain strong. While tremendous progress is being made, significant uncertainties remain that may prevent the District from complying with the mandate in the Everglades Forever Act to achieve compliance with all water quality standards by December 31, 2006. Among these uncertainties are the establishment of a numeric phosphorus criterion and associated compliance methodology, the complete evaluation of Advanced Treatment Technologies, the integration of ongoing programs with the CERP, the optimization of solutions in each basin and the identification of funding sources.

Ultimately, the technical information conveyed in the *2002 Everglades Consolidated Report* will contribute to the development of basin-specific solutions for all the areas discharging into the Everglades.

Everglades Construction Projects



CHAPTER 2: WATER QUALITY IN THE EVERGLADES PROTECTION AREA

CHAPTER 2A

COMPLIANCE WITH WATER QUALITY CRITERIA IN THE EVERGLADES PROTECTION AREA

The South Florida Water Management District (District) and the Florida Department of Environmental Protection (Department) continued comprehensive water quality monitoring programs in the Everglades Protection Area during Water Year 2001 from May 1, 2000, to April 31, 2001. In addition to reporting on water quality conditions, the *2002 Everglades Consolidated Report* includes an evaluation of water quality parameters not meeting Class III criteria during Water Year 2001. The *Report* also provides a discussion of the factors contributing to excursions from applicable water quality criteria and an evaluation of the natural background conditions where existing criteria are not appropriate for the unique environment in the Everglades marshes.

Water Quality Compliance in the EPA is Generally Very Good

Hydrologically, Water Year 2001 was dominated by a persistent and severe drought. Such droughts tend to cause changes in water quality associated with lower flows and marsh dryout. In addition to the drought, releases from Lake Okeechobee during the May 2000 drawdown, and a tropical disturbance in October 2000, were major hydrologic events during this water year. These conditions very likely influenced the frequency of excursions for certain water quality constituents over the year.

The nutrient element phosphorus is very important to the ecology of the Everglades. Median inflow phosphorus concentrations were lower than the historic period (1978-1998) in the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) and Water Conservation Areas 2 and 3. Everglades National Park received inflow concentrations at a median value of 13 ppb, up from 8 ppb during Water Year 2000 and 9 ppb during the historic period. The percentage of phosphorus measurements at or below 10 ppb was 24 percent for the Everglades Protection Area as a whole, down sharply from the Water Year 2000 level of 45 percent. At the same time, there was also a 24 percent decline since Water Year 2000 in the frequency of phosphorus concentrations greater than 50 ppb in Water Conservation Area 2A inflow waters. Many of the noted differences in phosphorus concentrations and frequency distributions can likely be attributed to drought conditions during Water Year 2001. As seen over earlier sampling periods, inflow phosphorus concentrations decreased from north to south, with the highest concentrations entering the Refuge (median = 47 ppb) and the lowest flowing into Everglades National Park (median = 13 ppb). As expected, interior marsh concentrations were again low for Water Year 2001. Median concentrations for interior marshes ranged from 6 to 12 ppb, depending on area, with the lowest levels being observed in Everglades National Park. The map on the following page summarizes phosphorus concentrations (ppb) moving into, out of and within the Everglades Protection Area for Water Year 2001.

The vast majority of water quality data collected in the Everglades Protection Area meets Class III water quality criteria; however, there were some excursions. Water quality analyses for Water Year 2001 reveal that constituent excursions vary greatly for different regions of the Everglades Protection Area. However, most of these regional differences are expected due to local environmental differences and water management activities. Excursions were reported for nine parameters, including dissolved oxygen, alkalinity, conductivity, pH, turbidity and un-ionized ammonia. Although eight pesticides were detected this year, only diazinon exhibited a single exceedance of its chronic toxicity guideline.

The majority of dissolved oxygen, pH and alkalinity excursions is the result of natural conditions within the marsh. The Department recognizes these conditions to be natural characteristics of the Everglades Protection Area and does not consider these excursions to be violations of state standards. The Department, with assistance from the District, intends to continue the evaluation of background water quality in the Everglades Protection Area to determine if current standards for these parameters are appropriate for the Everglades marshes.

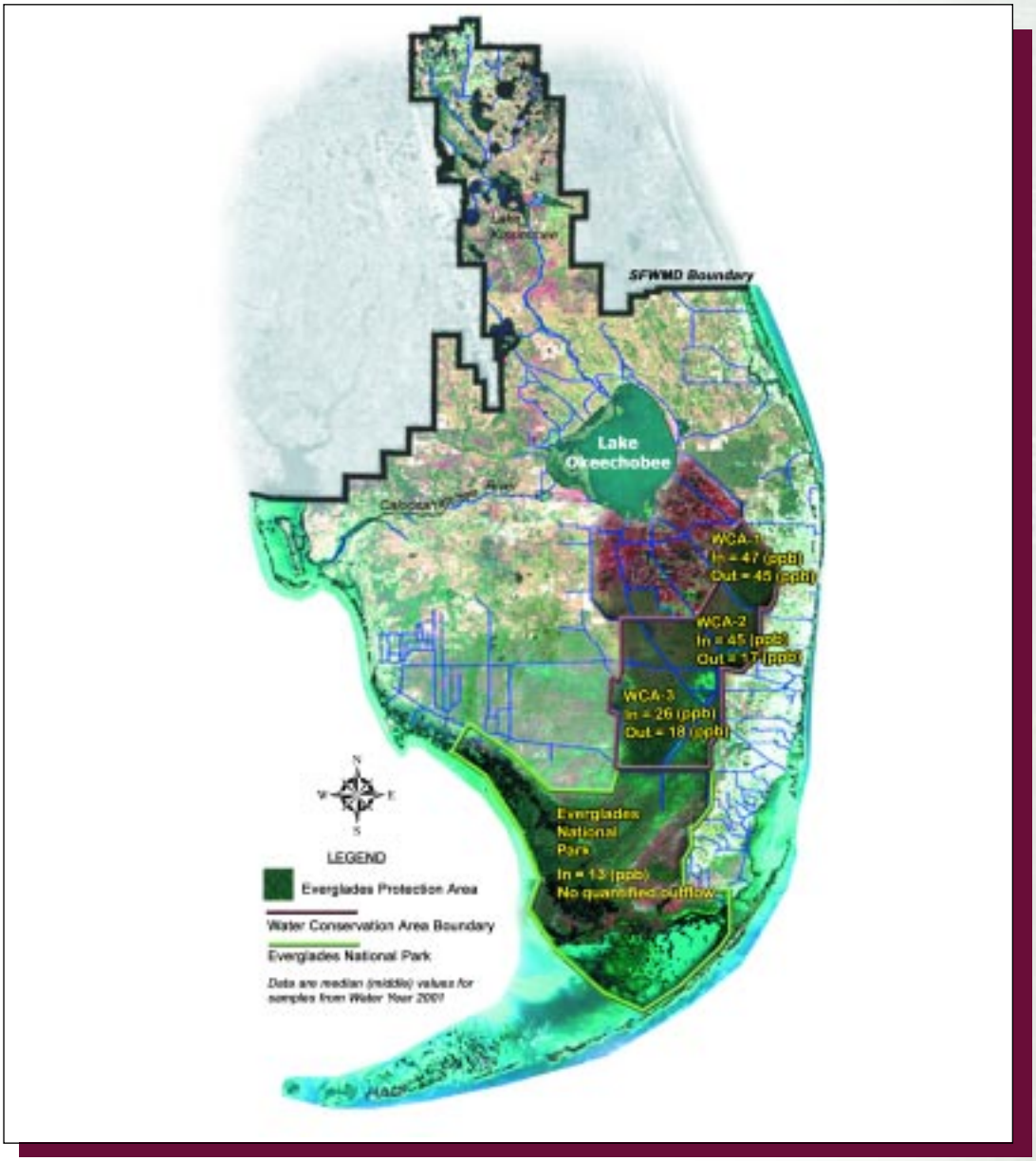
Dissolved oxygen was placed in the Category of Concern for all Everglades Protection Area regions and classes due to ubiquitous concentrations below the current 5.0 mg/L criterion. However, the Department developed a draft Site-Specific Alternative Criterion for dissolved oxygen in the Everglades to recognize the natural

background conditions in the marsh. Application of this proposed alternative criterion to the oxygen data collected during Water Year 2001 resulted in a reduction in the number of monitoring stations at which dissolved oxygen was identified as being a Concern from 121 to 24. Most of the remaining 24 sites appear to be influenced by either nutrient enrichment or groundwater infiltration and are accurately described as being below marsh background levels defined in the alternative criterion.

As reported earlier for Water Year 2000, excursion rates for parameters such as conductivity, turbidity, and iron are likely influenced by groundwater infiltration, construction, pumping activities and sample contamination. These parameters will continue to be monitored to determine whether these excursions represent natural or unabatable human-induced conditions, or if the excursions require corrective action.

Overall, water quality conditions evaluated within the Everglades Protection Area for Water Year 2001 were similar to those observed previously. The 2001 drought did result in some differences, but these were within the range of historic values. Since many of the observed Class III excursions can be attributed to natural marsh conditions, they do not represent an ecologic threat to the Everglades.

Phosphorus Concentrations in the Everglades Protection Area



Median concentrations of phosphorus in the inflows and outflows to the Everglades Protection Area in Water Year 2001.

CHAPTER 2B

Mercury Monitoring, Research and Environmental Assessment

Since 1989, the Florida Department of Health has recommended limited consumption of several species of sport fish because of a risk to consumers associated with mercury levels. The high mercury levels present in fish could also be toxic to fish-eating wildlife species. The map on the following page illustrates the geographic extent of the mercury problem in South Florida based on health advisories.

A multi-agency group has guided research into the root causes of the mercury problem. Operating as the South Florida Mercury Science Program, their efforts have improved our predictive understanding of the sources, transformations and fate of mercury in the Everglades. The program has linked local information to that at regional and global levels to better support decision making and has improved the estimation of risks to fish-eating wildlife.

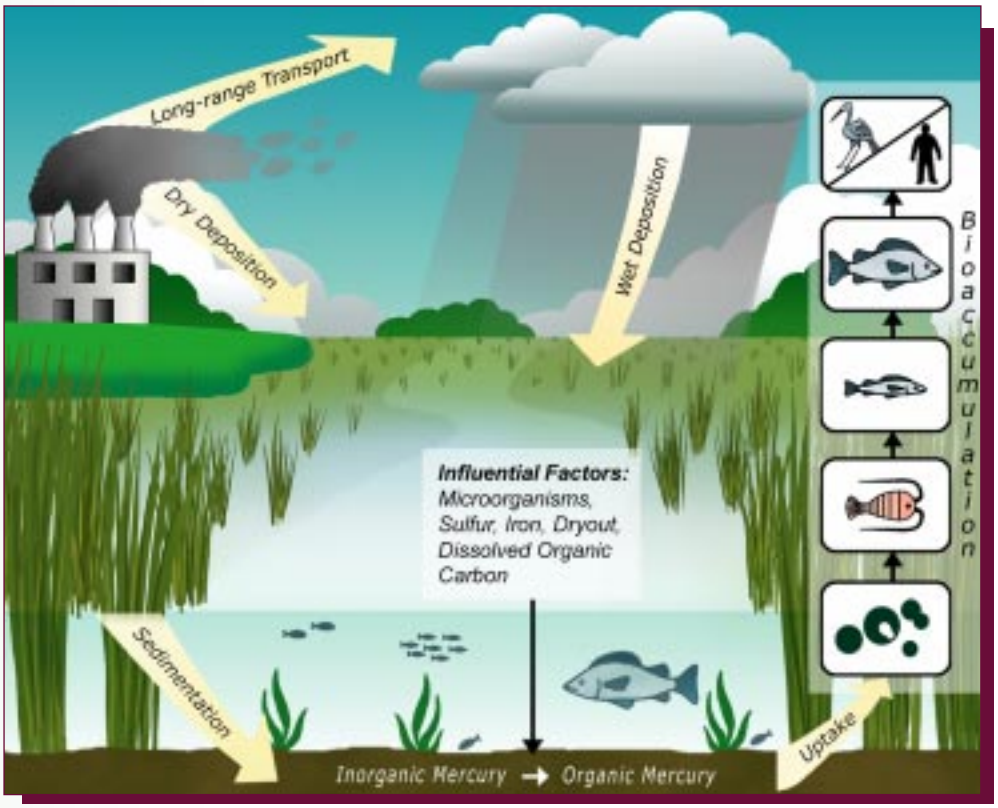
Mercury is Transformed in Everglades Marshes

Before providing updated findings from these efforts, it is important to highlight key facts on mercury, illustrated on the following page. The form of mercury found in fish and fish-eating animals, methylmercury, is primarily produced by bacteria naturally present in the sediment where oxygen is absent and the sulfate ion is present. The sulfate-reducing bacteria transform inorganic mercury into methylmercury as a byproduct of life processes. Methylmercury in water or food is readily absorbed into living tissue, by the process of bioaccumulation, much faster than it is released. This results in the buildup of concentrations in larger fish to levels millions of times higher than the surrounding water. Methylmercury in animals and humans can be toxic to many organ systems and can have adverse effects on fetal development.

Atmospheric Inputs are the Basis for the Mercury Problem

Atmospheric deposition accounts for greater than 95 percent of the external load of mercury to the Everglades. Once deposited, the effect of newly deposited mercury is quickly felt through a burst of methylmercury production occurring over a period of hours to days. The relative proportions of local and long-range transport of mercury to the Everglades remain an open question. The primary emissions sources of mercury in Southern Florida ca. 1990 were incineration (both municipal solid waste and medical waste) and power generation. Mercury emissions from incinerators of all types have declined greatly since the late 1980s in response to reduced mercury in wastes and to emissions controls. Monitoring of fish and wading birds from the mid-1990s to the present has indicated a significant decline in mercury in largemouth bass and wading birds, both by about 75 percent at some locations.

The Everglades Mercury Cycle



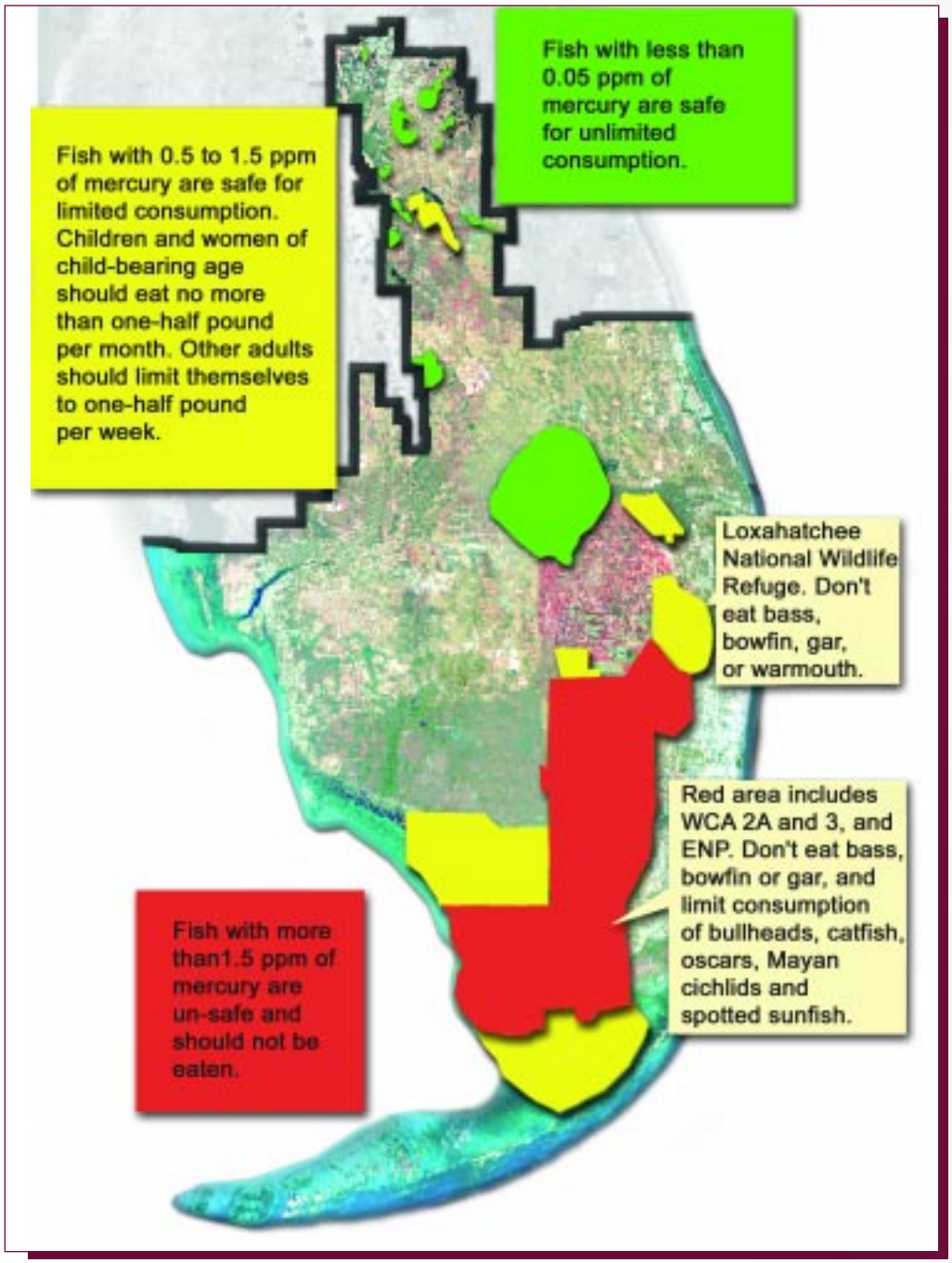
Although methylmercury production is strongly linked to the supply of atmospheric mercury, production is influenced by many factors associated with water quality, such as eutrophication, sulfate, temperature and light levels. Marsh fires and dry periods increase the production of methylmercury and can worsen the mercury problem, at least locally over the short term. Also, lower sulfur concentrations tend to promote methylmercury production, while higher sulfur levels tend to inhibit production. The Central and Southern Everglades both exhibit strong methylmercury production and bioaccumulation and, therefore, high mercury levels in fish and wildlife. These levels are high enough to pose a risk of chronic toxicity.

Technical Analyses May Provide Management Options

Environmental mercury models have been developed for the Everglades that incorporate the latest findings from atmospheric and aquatic research. Results substantiate a strong relationship between atmospheric mercury load to the Everglades and mercury in top predator fish. Modeling analyses also indicate that response times of the Everglades to changes in atmospheric load are relatively short. Significant benefits could be expected within a decade of load reductions, with ultimate benefits occurring within about 30 years.

A better understanding of the role played by sulfur in mercury methylation at sites with different levels of nutrient enrichment is being pursued through continued monitoring and research. Improved predictability of the role of sulfur will permit agencies to evaluate the potential for minimizing the mercury problem through the management of water and its constituents.

Fish Consumption Advisories For Mercury in Florida



Chapter 3: Performance and Optimization Research on Agricultural Best Management Practices

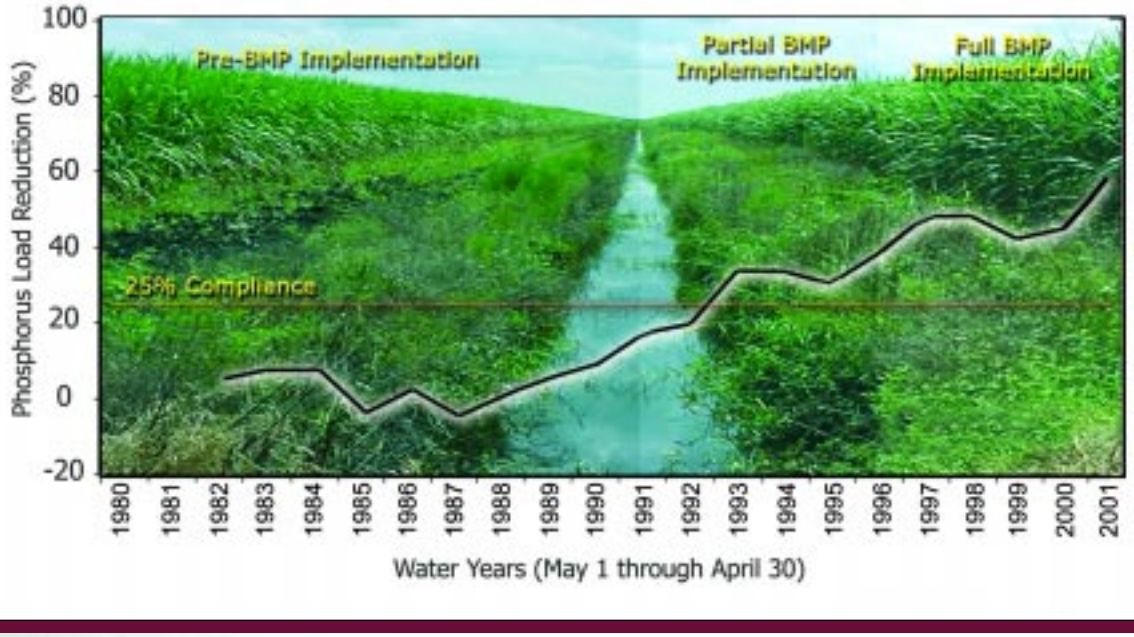
Nutrient-rich discharges from the Everglades Agricultural Area have been identified as contributors to Everglades enrichment and are the primary focus of the Everglades Regulatory Program and the Everglades Construction Project. Best Management Practices (BMPs) implemented by the Everglades Regulatory Program, research projects and educational activities in the Everglades Agricultural Area Basin have all been directed at reducing phosphorus loading from the Everglades Agricultural Area. This year's *Report* provides an update to information on Best Management Practices published previously and supports similar recommendations and conclusions.

Agricultural Research Shows the Effectiveness of Best Management Practices

In addition to the Everglades Regulatory Program, Everglades Agricultural Area landowners sponsor research, testing and implementation to identify appropriate Best Management Practices. The University of Florida farm-scale study continues to demonstrate that Best Management Practices are highly effective in reducing phosphorus loads. The study has recently been expanded to include the development of practices to control sediment and particulate phosphorus transport, shown to be important in earlier research. In addition, the District sponsored two research projects to develop new management practices. One investigated the application of silicon soil amendments to control phosphorus release from organic soils. The other aimed to identify sugarcane varieties with differing abilities to retain phosphorus. Findings from this research could help reduce phosphorus losses from sugarcane production at no additional cost to growers. Overall, effectiveness of agricultural Best Management Practices is clearly demonstrated by ongoing research in the Everglades Agricultural Area.

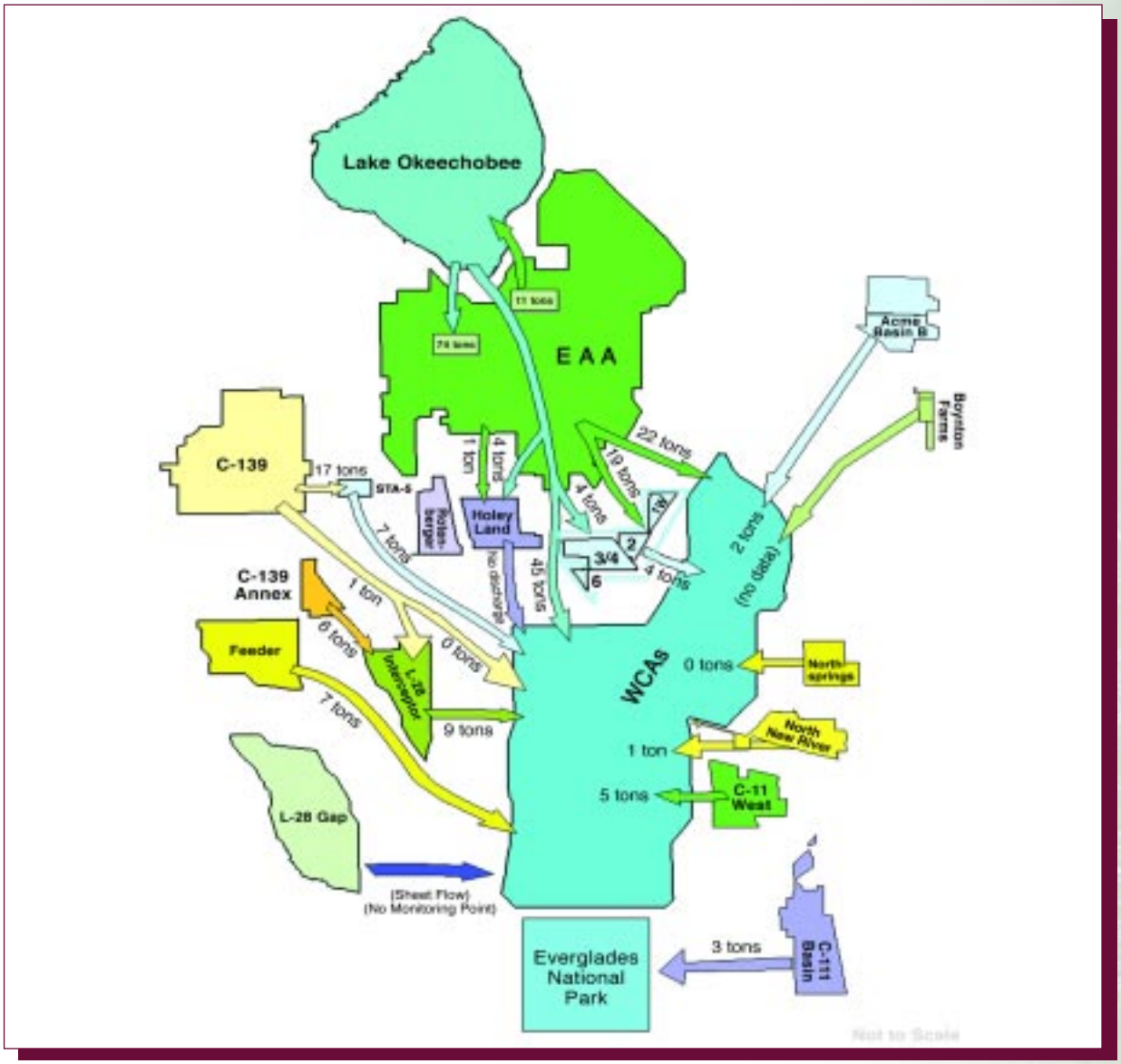
Phosphorus Loads from the Everglades Agricultural Area Have Been Consistently Reduced

The combined efforts of the Everglades Regulatory Program and the cooperative program of research, implementation and testing of Best Management Practices are responsible for appreciable reductions in the load and concentrations of phosphorus attributable to the Everglades Agricultural Area Basin and conveyed to the Everglades. The map on the following page provides a perspective on the relative phosphorus loading from the Everglades Agricultural Area as



Compliance conditions became effective in 1996 when Best Management Practices were fully implemented. During this period, the Everglades Agricultural Area has met the 25 percent total phosphorus reduction criteria, as required by Rule 40E-63.

PHOSPHORUS LOADS CONVEYED INTO THE EVERGLADES PROTECTION AREA



A schematic of the phosphorus loads conveyed into the Everglades Protection Area during Water Year 2001. Loads are given in metric tons (1000 kg or 2205 lbs), and represent the mass of phosphorus moving into the area during the water year.

compared to other sources of phosphorus into the Everglades Protection Area. The overall effectiveness of Best Management Practices is best demonstrated by the measured phosphorus load reduction in the Everglades Agricultural Area Basin since practices were implemented, as compared to a 10-year, pre-BMP base period. The goal of the Everglades Agricultural Area Everglades Regulatory Program is a 25-percent annual phosphorus reduction from the Everglades Agricultural Area Basin as compared to the base period. As illustrated on the following page, Water Year 2001 represents the sixth year that the basin has been in compliance with the required 25-percent phosphorus load reduction. The Water Year 01-adjusted phosphorus load, assuming that Best Management Practices were not implemented, was 195 tons. The measured phosphorus load was 52 tons, resulting in a 73-percent reduction for the year. The three-year trend equates to a 57-percent reduction of the phosphorus load from the Everglades Agricultural Area Basin.

The trend over several years has shown a significant reduction in phosphorus load with the implementation of agricultural BMPs in the Everglades Agricultural Area. It is recommended that the research, monitoring and education efforts continue in an effort to gain a better understanding of optimization techniques for agricultural Best Management Practices and to apply "lessons learned" to other regions that discharge to the Everglades Protection Area.

Chapter 4: Stormwater Treatment Areas and Advanced Treatment Technologies

The 1994 Everglades Forever Act set into motion an aggressive and comprehensive restoration program of construction, research and regulation projects designed to ensure that all waters discharging into the Everglades Protection Area achieve and maintain compliance with phosphorus and other water quality standards by December 31, 2006. The initial efforts have been focused on implementation of effective Best Management Practices in the Everglades Agricultural Area, and construction and operation of large constructed wetlands, referred to as Stormwater Treatment Areas (STAs). At the time the 1994 act was passed, there was general consensus that the constructed wetlands would reduce phosphorus levels to around 50 parts per billion (ppb), and as such would not be sufficient to achieve the long-term phosphorus standard for the Everglades. The Everglades Forever Act required that the District conduct research to optimize the performance of the Stormwater Treatment Areas and investigate potentially superior technologies, referred to as Advanced Treatment Technologies (ATTs). During Water Year 2001, the District continued to make significant progress in the construction, operation, and optimization of the Stormwater Treatment Areas, and conducted critical research on Advanced Treatment Technologies.

CHAPTER 4A

Stormwater Treatment Area Performance and Compliance

Four of the six Stormwater Treatment Areas are fully operational and are removing phosphorus that otherwise would have gone into the Everglades Protection Area. During Water Year 2001, STA-1 West, STA-5 and STA-6 Section 1 treated over 219 cubic hectometers (177,100 acre feet) of stormwater and Lake Okeechobee discharges and removed over 24 metric tons of phosphorus, for an overall 65-percent removal rate. Drought conditions during Water Year 2001 were responsible for lower-than-anticipated average inflows to the treatment areas. Supplemental water deliveries were required to three of the STAs to maintain minimum water levels to ensure viability of the treatment vegetation. The composition of plant communities in these constructed wetlands can vary among the treatment cells in each project, but is generally dominated by either cattail or Submerged Aquatic Vegetation and periphyton.

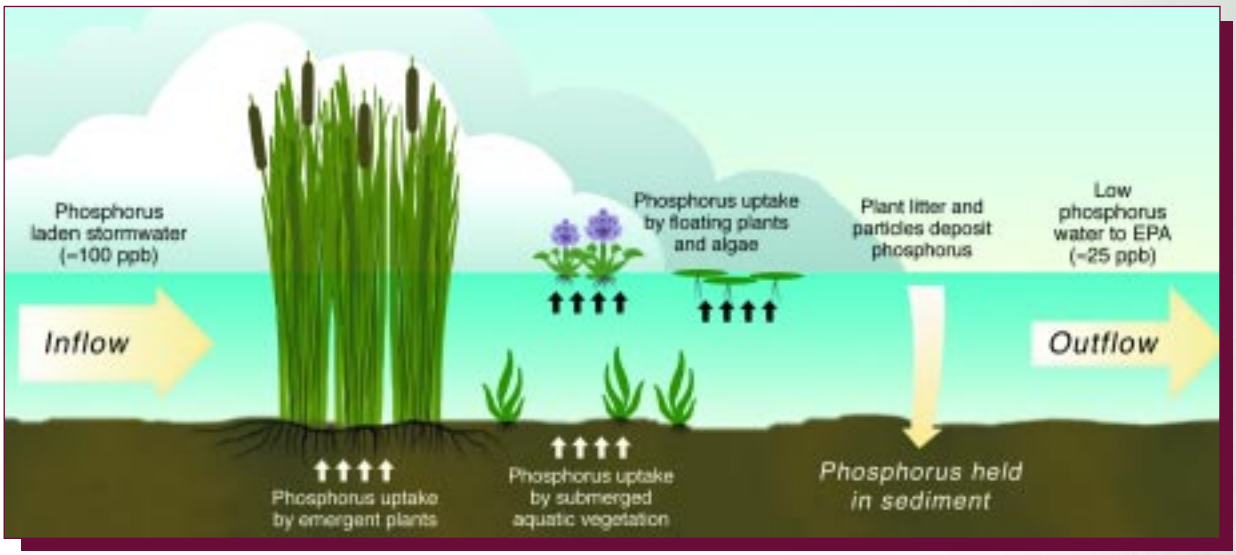
STA Test Cells

Water quality monitoring within and downstream of the Stormwater Treatment Areas demonstrated that the four areas in operation are in full compliance with the state operating permits.

Unfiltered water concentrations of methylmercury and total mercury in the inflows and outflows of Stormwater Treatment Areas 1W, 5 and 6 were highly variable, with occasional periods of net export. Stormwater Treatment Area 6 is in the post-stabilization period of operation and appears to be removing roughly 25 percent of the methylmercury and total mercury present in the inflow on an annual average basis.

While Stormwater Treatment Area 2 Cells 2 and 3 met the net improvement startup criteria in September and November 2000, respectively, Cell 1 still had not at the end of this reporting year due to elevated mercury levels. The District reported anomalously high levels of methylmercury in interior water in STA-2 Cell 1 in October 2000. A followup study detected anomalously high levels of total mercury in mosquitofish, but Cell 1 dried out before sunfish sampling could commence. Nevertheless, the District inferred from the mosquitofish data that these concentrations could possibly represent an unacceptable risk of toxic effects to fish-eating birds preferentially foraging in Cell 1. In August 2001, the District was issued a permit modification to allow Cell 1 to operate in a flow-through mode, which is expected to reduce the methylmercury production and bioaccumulation rates by altering

STA Performance

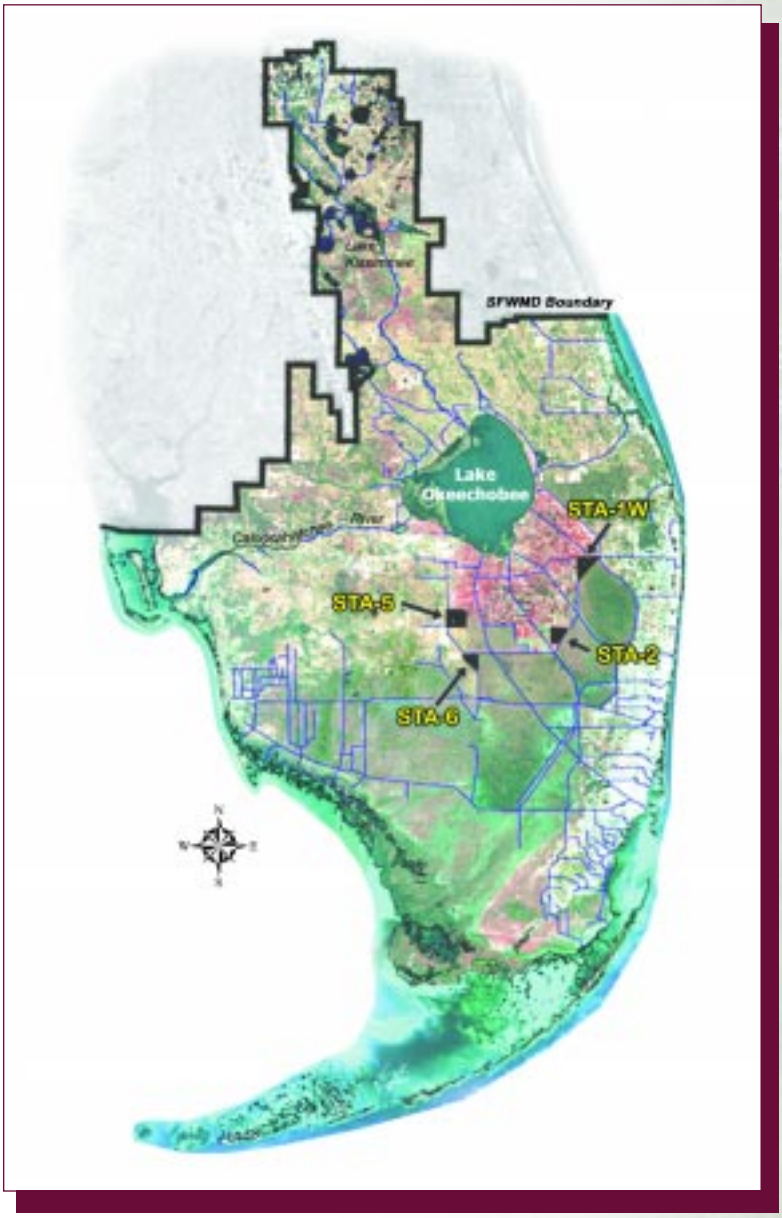


Cell 1 hydrology and surficial soil chemistry. Expanded monitoring will ensure that performance relative to this expectation is properly addressed.

In Stormwater Treatment Area 5, which is still in its stabilization period, total mercury concentrations in mosquitofish, sunfish and largemouth bass were highly variable at all sites and showed differences between treatment trains, but were less than those at the Everglades "hot spot" in Water Conservation Area 3A. Nevertheless, levels of mercury in STA-5 fish remain at or above federal guidance levels developed for the protection of fish-eating wildlife.

Over $200 million of construction is currently underway on Stormwater Treatment Areas 1 East and 3/4. The U.S. Army Corps of Engineers is managing the area 1 East construction, which is scheduled for completion in early 2003. The District is managing the construction of the 17,000-acre Stormwater Treatment Area 3/4, scheduled for completion in October 2003.

Locations of Operational STAs



CHAPTER 4B

Stormwater Treatment Area Optimization

Research into optimizing the nutrient-removal performance of the Stormwater Treatment Areas has continued over the past year. The Everglades Forever Act (Section 373.4592, Florida Statutes) requires the District to conduct research and monitoring programs to optimize nutrient-removal performance of these constructed wetlands. Information is derived from practical experience operating the Stormwater Treatment Areas and analyzing performance data. These data come from experiments being conducted in some of the STA-1W test cells, from small-scale mesocosm experiments, from analysis of data available from other wetlands and eventually through simulation of operational scenarios using a dynamic water quality model.

Stormwater Treatment Areas are being studied to hone their performance.

The primary focus of Stormwater Treatment Area optimization research this year has been to assess the performance of the STA-1W treatment cells, conduct controlled experiments in the test cells, perform marsh dryout experiments in mesocosms and improve the hydraulic performance of treatment Cell 4.

Stormwater Treatment Area 1 West has retained approximately 95 metric tons of phosphorus during the period August 1994 through April 2001 that otherwise would have entered untreated into the Everglades. Experiments conducted in the STA-1W test cells indicated that a 50-percent reduction in the phosphorus-loading rate to these cattail-dominated systems did not significantly reduce outflow phosphorus levels. This reduction in phosphorus loading was theoretically equated to doubling the wetland surface area.

Experiments conducted in the STA-1W north test cells found a marked decrease in phosphorus removal when the hydraulic loading (the average volume of water applied to a unit of treatment area) reached 10.4 cm per day, a level four times the average hydraulic loading rate used to design the Stormwater Treatment Areas. However, at the south test cells, which contain lower inflow concentrations than the north test cells, there was no significant correlation between increases in hydraulic-loading rate and outflow phosphorus concentrations.

Experiments were conducted in small-scale mesocosms to investigate the effects of dryout on Stormwater Treatment Area performance. The Marsh Dryout Study found that the muck soils tested always released sediment phosphorus upon reflooding after a dryout. Differences in the magnitude and duration of the phosphorus flux were related to the history of phosphorus loading. Chemical analysis of sediment cores collected from Area 6 (which has a lower organic content than the other STAs) suggested that these soils should not readily release phosphorus into the water column upon rehydration after a dryout and, in fact, may act as a nutrient sink as a result of chemical sorption. Large-scale investigations are underway at each constructed wetland to examine the effects of the 2001 drought on STA performance.

The Dynamic Model for Stormwater Treatment Areas is under development to document in a simulation model our understanding of how biological treatment systems function. This model will be used to evaluate alternative long-term water quality solutions for the Everglades Protection Area and assist in the design and management of the next generation of STAs.

CHAPTER 4C

ADVANCED TREATMENT TECHNOLOGIES

The District is conducting an ambitious research program for testing the feasibility of several Advanced Treatment Technologies for the removal of phosphorus from waters entering Florida's Everglades. The goal of this research program is to identify technologies that will meet the long-term water quality objectives for the Everglades, in accordance with the Everglades Forever Act. The criteria being used to evaluate these treatment technologies are also provided by the EFA: phosphorus load reductions; phosphorus discharge concentration reductions; distribution and timing of water delivery to the Everglades Protection Area; compliance with water quality standards; compatibility of treated water with natural populations of aquatic flora or fauna; cost effectiveness; and schedule for implementation. Other evaluation criteria may include, but not be limited to, technical/scale-up feasibility and possible adverse environmental impacts. The goal of the Advanced Treatment Technology research program is to provide information on phosphorus removal performance, estimated costs and the ability of the technology to meet the Everglades Forever Act requirement that all discharges to the Everglades Protection Area achieve and maintain compliance with all water quality standards.

Based on research to date, it is clear that there are two types of Advanced Treatment Technologies in addition to cattail-dominated STAs that may be used to meet the long-term water quality requirements of the Everglades:

- Biological technologies: Submerged Aquatic Vegetation and Periphyton-based Stormwater Treatment Areas; and
- Chemical treatment technologies: Chemical Treatment/Solids Separation, Microfiltration, Managed Wetlands, and Low Intensity Chemical Dosing.

The findings to date from each Advanced Treatment Technology project are summarized below.

Submerged Aquatic Vegetation

Treatment cells dominated by Submerged Aquatic Vegetation may offer phosphorus removal benefits over cells dominated by cattail. Investigations of SAV systems have been conducted in mesocosms, in test cells and in full-scale treatment cells over the last few years. Field-scale results suggest that these systems should be able to achieve phosphorus levels in the range of 15 to 35 ppb; research is planned in test cells to investigate ways to optimize performance. Limerock or limerock berms provided slightly better phosphorus removal in test cells than systems without these components. Based on promising performance in Cell 4 of Stormwater Treatment Area 1W, treatment cells within STA-1W (Cell 5), STA-2 (Cell 3) and STA-5 (Cell 1B) have been successfully managed to encourage SAV growth. Presently, over 6,000 acres within the Stormwater Treatment Areas are Submerged Aquatic Vegetation treatment cells.

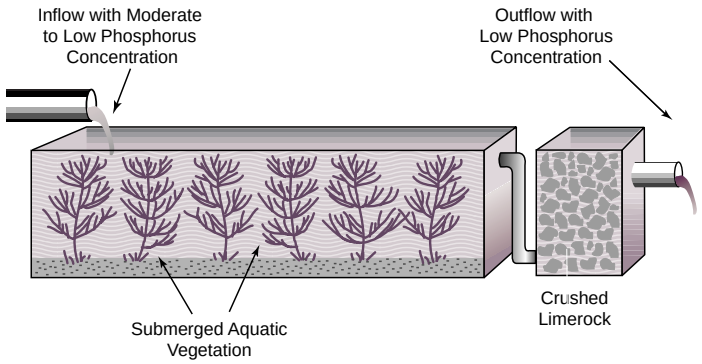
Small-scale research platforms in Stormwater Treatment Area 1-W used to explore the PSTA concept.

Periphyton-based Stormwater Treatment Area

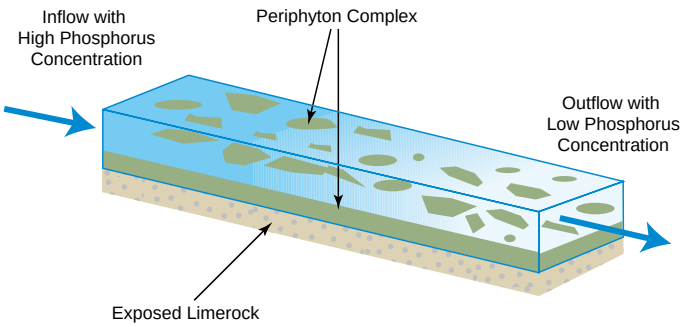
The term "periphyton" refers to various assemblages of algae, bacteria, microscopic animals and other microorganisms found attached to surfaces in aquatic ecosystems. These assemblages rapidly remove phosphorus directly from the water, in contrast to rooted plants that remove phosphorus indirectly through the soil. Periphyton occurs naturally in the Everglades and is found in most of the Stormwater Treatment Areas in association with other aquatic vegetation. Very little was known about the phosphorus-removal characteristics of Periphyton-based Stormwater Treatment Area (PSTA) systems when the District began proof of concept studies. The potential use of PSTA is being investigated as a downstream component of a treatment system, not as the front-end community. Research has progressed through mesocosm, test cell and into field-scale platforms. Test cell research clearly showed that a shellrock-based periphyton system

is more efficient at reducing phosphorus than a peat-based periphyton system. Early results from mesocosm and test cell research indicated that PSTA in a shellrock-based system was able to achieve phosphorus levels below 20 ppb in small-scale systems. Additional research is being conducted in five acre field-scale systems to better understand if these promising results can be achieved at larger scales.

Submerged Aquatic Vegetation and Limerock



Periphyton-based Stormwater Treatment Area (PSTA)



Chemical Treatment/Solids Separation

Chemical treatment followed by solids separation, essentially the addition of metal salts to bond with specific contaminants for easier removal, is a well-known practice in the water and wastewater industry. The use of chemical treatment to remove phosphorus from stormwater entering the Everglades presents certain challenges given the high volumes of storm flow, the high organic carbon content of the inflow water and the unique flora and fauna in the receiving water. While small-scale, short-duration experiments documented the ability of chemical treatment to achieve phosphorus concentrations below 10 ppb, larger-scale investigations are necessary to address the following: optimal dosing levels to minimize the amount of chemicals needed; operational costs and volumes of residuals generated; viable methods of metal salt recovery; alternative means of residuals management; determination of water quality characteristics of nonphosphorus parameters.

A conceptual-level scale-up of a CTSS coupled with a flow equalization basin was prepared to develop conceptual costs associated with this technology. Based on the flow data from the 10-year period of record used for developing the facility conceptual design, the estimated 50-year present-worth total costs for a stand-alone Chemical Treatment/Solid Separation, coupled with a flow equalization basin to achieve 10 ppb, ranged from $343 million for 20 percent hydraulic bypass to $428 million for no hydraulic bypass.

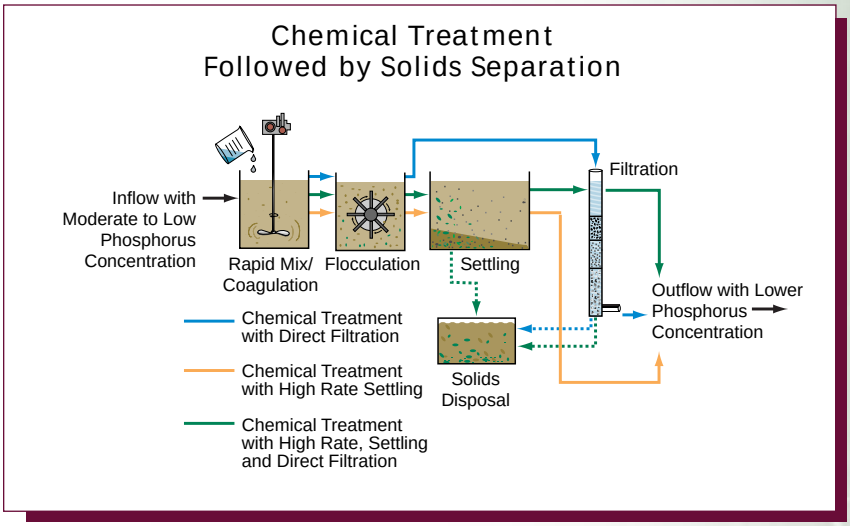
Microfiltration

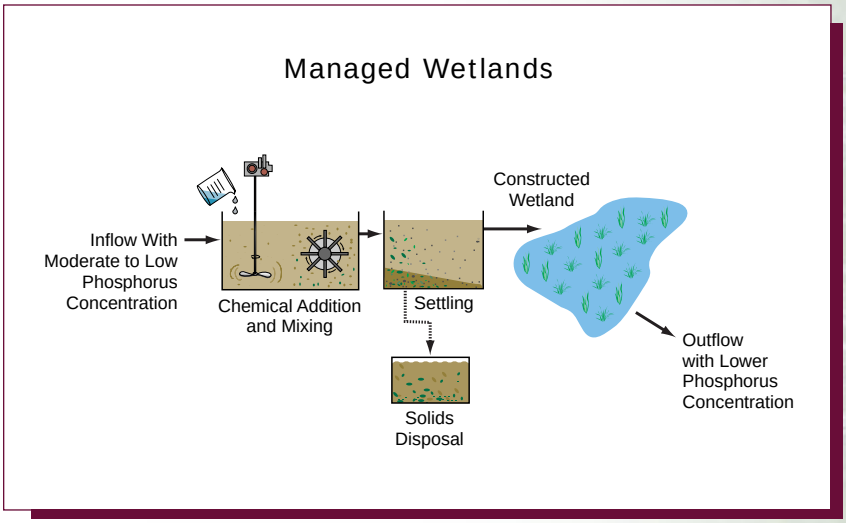
Chemical treatment combined with microfiltration for solids separation was demonstrated to consistently produce outflow phosphorus concentrations of 10 ppb. Microfiltration without chemical addition did not produce outflow phosphorus concentrations of 10 ppb. There has been a steady advancement in configuration, membrane composition, membrane technology, market conditions and availability of membranes that has lowered capital and operational costs of microfiltration over the last decade. However, even with these advancements

the costs for microfiltration were significantly higher than Chemical Treatment/Solids Separation, and therefore no further investigations are planned for this technology.

Managed Wetlands Treatment System

The concept of the Managed Wetlands Treatment System consists of a chemical treatment plant followed by a cattail-dominated polishing marsh. Flocculent (floc) overflow occurred from the front-end chemical treatment plant, but was controlled by the downstream treatment marsh. However, while managed wetland experiments in the test cells demonstrated a net reduction in phosphorus, further investigations are not planned because average phosphorus outflow concentrations were above 30 ppb.





Low-Intensity Chemical Dosing

The concept of Low Intensity Chemical Dosing entails the addition of small dosages of chemicals directly to the influent to a cattail-dominated marsh treatment system. Results of a study of Low-Intensity Chemical Dosing indicated that this treatment technology was not able to improve upon phosphorus concentration reductions of a passive cattail-marsh wetland. No further investigations of this technology are planned.

Future Research

Research continues to address: (1) the effects of hydrologic pulsing, system dry-out, water depth and antecedent phosphorus soil concentrations on phosphorus removal; (2) constructability; (3) optimal partitioning of vegetation within treatment areas; (4) sustainability of long-term treatment; and (5) treatment effectiveness on urban stormwater. In addition, the District and the Florida Department of Environmental Protection will be working together via a cooperative agreement to address the phosphorus removal performance of sequenced biological treatment trains (Stormwater Treatment Area followed by Submerged Aquatic Vegetation or Periphyton-based Stormwater Treatment Area) and the effects of pulse loading and compartmentalization. These experiments will take place at the 30 test cells located in Stormwater Treatment Area 1-W. For next year's *Everglades Consolidated Report*, the District will have available the data from the Standard of Comparison for Submerged Aquatic Vegetation and Periphyton-based Stormwater Treatment Area.

Funding

No dedicated funding has been identified for implementation of Stormwater Treatment Area optimization measures, nor for the implementation of Advanced Treatment Technologies that may be necessary by December 31, 2006, to meet the long-term water quality standards for waters discharging into the Everglades Protection Area.

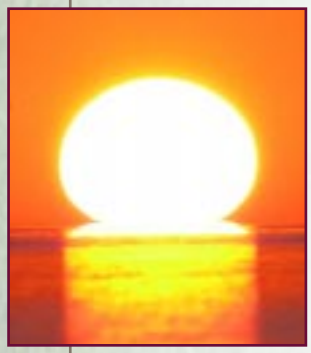
Chapter 5: Development of a Numeric Phosphorus Criterion for the Everglades Protection Area

Nutrient inflows, particularly phosphorus, have been responsible for changes to Everglades ecology. Therefore, reducing this "phosphorus enrichment" is one of the primary goals of Everglades water management. Restoration of the Everglades requires the establishment of a restoration objective, specifically a numeric water quality criterion for phosphorus that prevents an imbalance in Everglades flora or fauna.

The Everglades Forever Act requires the Department and the District to develop a numeric criterion for phosphorus. The current phosphorus criterion is a narrative stating that, "in no case shall nutrient concentrations of a body of water be altered so as to cause an imbalance in natural populations of aquatic flora or fauna." (Rule 62-302.530(48)(b), Fla. Admin. Code). The EFA also specifies that field research conducted by the District and Department needed to establish that a numeric criterion be completed by December 31, 2001. That research is currently being applied by the Department to rulemaking for the phosphorus criterion, which must be initiated by December 31, 2001. If the rule is not adopted by December 31, 2003, the Everglades Forever Act establishes a default numeric phosphorus criterion of 10 parts per billion (ppb) until a criterion is adopted by the Department.

Research in the Refuge and Water Conservation Area 2A Supports a 10-ppb Phosphorus Criterion

The primary research being conducted in the Everglades to support the phosphorus criterion development includes work conducted by the District, the Duke University Wetlands Center and Florida International University, and is discussed at length in previous editions of the *Everglades Consolidated Report.* The researchers have generally used a three-pronged approach to studying the biological responses to phosphorus enrichment. The three facets of the research include: (1) field transect studies along nutrient gradients, (2) dosing experiments in the field, and (3) laboratory experiments.



The Department's analysis of the available research data collected along the gradients in Water Conservation Area 2A and the A.R.M. Loxahatchee National Wildlife Refuge has utilized phosphorus-induced changes in the structure and function of the various biological communities to differentiate minimally impacted reference stations from impacted sites showing significant departures from the natural unaltered ecosystem. The median value for annual geometric means for minimally impacted reference sites in the Refuge is 9.1 ppb, with a similar value of 8.4 ppb determined for the Water Conservation Area 2A reference sites. Based on the results of its analyses of diverse research and monitoring information, the Department concluded that a 10-ppb criterion would be protective of the natural flora in the Refuge and Water Conservation Area 2A without being overly protective or below the natural background levels.

Duke University's research also used gradient and experimental studies. An analysis of the results of experimental dosing studies conducted by the Duke University Wetlands Center researchers supported a phosphorus threshold in the range of 17 to 22 ppb. In last year's *Everglades Consolidated Report,* the Department concluded that the Duke data and analysis may have been biased high, and the analysis was not consistent with requirements of the Everglades Forever Act. Additionally, during recent presentations, Duke University scientists have presented a reanalysis of their data that supports a lower phosphorus threshold depending upon which biological community and response variable was being considered.

Finally, the research of Florida International University has focused on transects and experimental dosing studies to determine water quality impacts in the Refuge and Everglades National Park. Florida International University's data collection and analysis are still ongoing.

Ecological Indicators of Phosphorus Enrichment Include Aquatic Plants

In all cases, the research demonstrates that periphyton is especially sensitive to increased phosphorus concentrations. Periphyton is a community of algae, bacteria and other microorganisms that live attached to the surface of aquatic plants or other submerged substrates. This community of organisms plays an essential role in the Everglades ecosystem and is responsible for production of oxygen, formation of marl soils, cycling of phosphorus, and habitat for macroinvertebrates, such as insects, that are, in turn, consumed by small fish. As a result, the periphyton community forms the base of the Everglades food web. A numeric phosphorus criterion of 10 ppb would be protective of this important community.

Cattail (Typha, on the left) became established over large areas of the Everglades by exploiting conditions created by phosphorus enrichment and water management. Sawgrass (Cladium, on the right) covers large areas of the pristine Everglades landscape. Sawgrass is quite resistant to muck fires and is able to use nutrients efficiently in areas where phosphorus concentrations are naturally low.

Macrophytes in the Everglades also indicate sensitivity to phosphorus enrichment. Historically, the Everglades has consisted of a complex mosaic of tree islands, wet prairies, sawgrass marshes and aquatic sloughs. However, in areas near canal inflows, nutrients have contributed to replacement of desirable species, such as sawgrass, with monotypic stands of cattail. These regions also show depressed levels of dissolved oxygen and the loss of aquatic sloughs. These impacts result in a marked decline in habitat value for other biological communities.

Evidence from Water Conservation Area 3 and Everglades National Park also Supports a 10-ppb Phosphorus Criterion

Recent data regarding the impacts of phosphorus enrichment on flora and fauna in the Everglades have been obtained for Water Conservation Area 3A and Everglades National Park. Both regions show nutrient gradients with phosphorus concentrations near discharges at higher levels than those at interior locations. Although drought conditions in Water Conservation Area 3A limited the amount and utility of the data, results from the transects do indicate natural periphyton communities were found where phosphorus concentrations were 10 ppb or less. By comparison, periphyton communities in Water Conservation Area 3A were significantly different or entirely absent at other locations with phosphorus concentrations above 10 ppb. Research in Everglades National Park was similarly impacted by the drought, but also showed that taxonomic changes in periphyton communities appeared to occur at approximately the same levels of phosphorus enrichment. Although the data remain limited, studies of vegetation in Water Conservation Area 3A, including water lily, bladderwort, spikerush and cattail, also show significant changes as phosphorus concentrations increase above 10 ppb. Additionally, depressed dissolved oxygen levels measured in phosphorus-enriched portions of Water Conservation Area 3A suggest that the structural changes occurring in the biological communities also alter their ecological function in areas with phosphorus concentrations above 10 ppb, as was reported for Water Conservation Area 2A and the Refuge.

The available data also indicate that the periphyton and macrophyte communities in Water Conservation Area 3A and Everglades National Park are very similar to those documented in Water Conservation Area 2A and the Refuge, with nearly all of the taxa identified in Water Conservation Area 3 and the freshwater portions of the Park also being documented in the northern areas. Even though there have been limited data collected for Water Conservation Area 3A and Everglades National Park, analysis of the available data suggests that the biological response is comparable to that documented for Water Conservation Area 2A and the Refuge. Therefore, a phosphorus criterion of 10 ppb based on the exhaustive evaluations conducted for Water Conservation Area 2A and the Refuge would be protective of the flora and fauna throughout other freshwater portions of the Everglades.

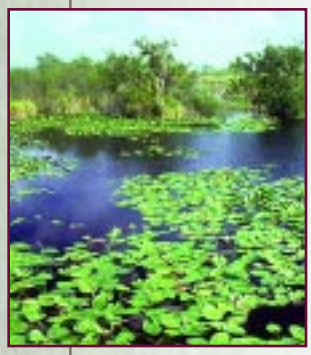
Chapter 6: Hydrological Needs: Effects of Hydrology on the Everglades Protection Area

The 2001 Drought Dominated Recent Everglades Ecology

Monitoring, research and modeling continue using multidisciplinary approaches to better understand and manage the hydrologic patterns of the Everglades Protection Area. Hydrologic trends and ecological assessments this year were dominated by the 2001 drought. Much attention has been given to the lowest-recorded Lake Okeechobee water levels in Florida history, leading to water supply restrictions for urban and agricultural regions. Despite a general reduction in rainfall of 23 percent, and an average reduction of inflows of 45 percent, levels in the Water Conservation Areas were actually 0.4 to 0.7 feet higher than the 32-year average. This apparent disconnect between water levels and rainfall appears to be due to water conservation and active management to hold water in the Water Conservation Areas, but the full impact of the 2001 drought may not be felt until the 2002 dry season. Drought effects were visible in Florida Bay, as a lack of fresh water flows produced increasing salinity in the bay during mid-summer 2001.

Research Provides New Insights into the Creation of Everglades Tree Islands

These hydrologic trends can be expressed as rapid changes to chemical processes in the Everglades or as slow alterations to habitat structure. Tree islands are one of those components of ecological and cultural significance that changes slowly. New information has led to the theory that tree islands form as nutrients released from a small island head (as a function of hydroperiod) leach downstream (as a function of surface and groundwater flows) to form a nutrient-rich substrate for island expansion. These processes are consistent with the tear-drop shape typical of Everglades tree islands. Preliminary data on nitrogen and phosphorus concentrations in surface water and soils pore water tend to support this concept for development of this important Everglades habitat.



Groundwater studies on and around tree islands are a new research effort designed to provide long-term information for adaptive management of the Comprehensive Everglades Restoration Plan, short-term information on the function of groundwater for tree island health, and findings to support the establishment of minimum flows and levels for the Everglades. These studies will examine the idea that the productivity and health of tree islands are linked to groundwater movement and chemistry. The data collected from these efforts will provide baseline hydrologic information prior to the decompartmentalization of Water Conservation Area 3 and, in conjunction with biological indices, will document subsequent changes to hydrologic conditions after decompartmentalization is achieved under the Comprehensive Everglades Restoration Plan.

Fire is a major factor in Everglades ecology.

Ecosystems of the Everglades Protection Area Functioned Quite Well Despite the Stress of the 2001 Drought

Wildlife health and well being continue to be a critical aspect of the Comprehensive Plan, water management in general and the establishment of hydrologic needs. The estimated number of wading bird nests (excluding cattle egrets, which are not dependent on wetlands) in South Florida in 2001 was 38,647. This represents another strong year for White Ibises and Wood Storks, but not for other species. As in 2000, there were differences in the success of birds nesting in different areas of the Everglades Protection Area, but declining water levels in both years during the nesting period tended to support nesting success.

This good nesting effort continues to suggest that the Everglades still has the capacity to produce large numbers of the most sensitive species, even if the precise cause of the increased nesting is unknown. Determining causation so that key conditions can be repeated will require both long-term monitoring and shorter-term experiments and modeling.

Water level, muck fire, wading bird habitat and general ecological risk-assessment models were developed to assess current and predicted 2001 drought effects within the Water Conservation Areas, Wildlife Management Areas and Everglades National Park. Such models provide a means for making findings from ecological monitoring and research available in a readily usable form for decision making. Using the U.S. Environmental Protection Agency's environmental monitoring data for South Florida and the District's own Everglades Protection Area monitoring and research data as a basis, formulas were created to predict ecological conditions in the Everglades that may have occurred as a result of the drought. Monthly reports were produced during much of the 2001 drought to allow water managers to respond to ever-changing conditions in the Everglades Protection Area and other associated areas.

Overall, it was a good year for the ecosystems in the Everglades. Several muck fire hazard index marsh sites went beyond the critical water-level threshold. Fortunately, the numerous fires that occurred throughout the Everglades were restricted to healthy surface burns and did not result in damaging muck fires. Wading birds responded to the drought as expected. Herons and egrets had poor nest success, whereas Wood Storks and White Ibises did better than average.

(Middle) The subtle habitat mosaic of Everglades marshes.
(Upper Right) White Ibis
(Lower Left) Endangered Wood Stork

CHAPTER 7: COMPREHENSIVE EVERGLADES RESTORATION PLAN

The Comprehensive Everglades Restoration Plan, known as CERP, was approved by the U.S. Congress and signed by President Clinton in December 2000 in the Water Resources Development Act of 2000. The Comprehensive Plan contains more than 60 components covering a timeframe of four decades and an estimated investment approaching $8 billion. The EFA contains a number of provisions regarding the implementation of the Comprehensive Plan, including a 50/50 cost share between the federal and state governments. Further detailed planning has begun on all six pilot projects, seven construction projects and two new feasibility studies.

The passage of Section 373.470, Florida Statutes (F.S.) requires that a single report be prepared annually, tracking the progress made in the implementation of the Comprehensive Plan. The report must contain detailed financial information, as well as the status of all projects, and is to be issued January 31 of each year. The South Florida Water Management District and the Florida Department of Environmental Protection will work together to prepare the report required by the statute. Accordingly, the *2002 Everglades Consolidated Report* contains a brief status update for pilot projects, feasibility studies and other initial Comprehensive Plan projects. The Report provides a more thorough discussion of Restoration Coordination and Verification (RECOVER) activities.

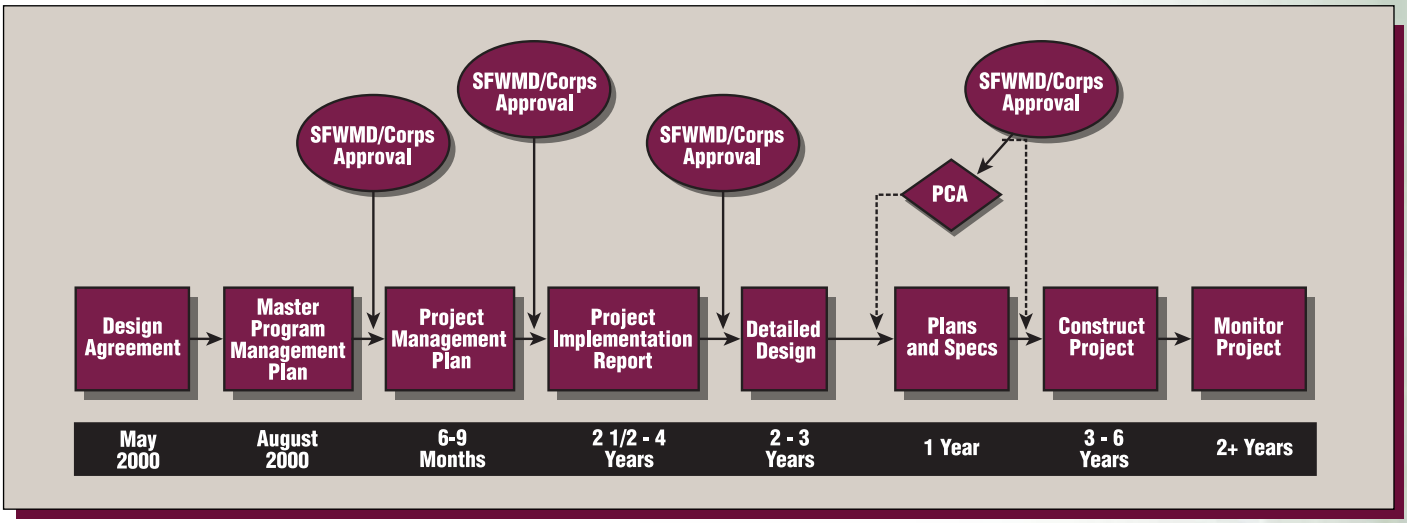
RECOVER Teams will Produce Scientific Information for Adaptive Management of the Comprehensive Plan

RECOVER is a system-wide program of the Comprehensive Everglades Restoration Plan designed to organize and provide the highest-quality scientific and technical support during the implementation of the Plan. The Comprehensive Plan is science-based and it is the role of RECOVER to ensure that the best-available science continues to support and enhance the Plan. The effort is executed through a leadership group and six task teams organized around key themes, such as water quality, adaptive assessment and regional evaluation. RECOVER encourages partnerships among federal, state and local agencies, and tribal governments with regard to research, monitoring and resource management in South Florida. RECOVER affords such entities the opportunity to participate in an ongoing process of adaptive assessment and refinement of the Comprehensive Plan. Additionally, RECOVER invites stakeholders to participate in the review of agency products. RECOVER accomplishments over the past year include the development of the RECOVER management plan, a draft Monitoring and Assessment Plan, several protocol papers and an interagency Memorandum of Understanding (MOU).

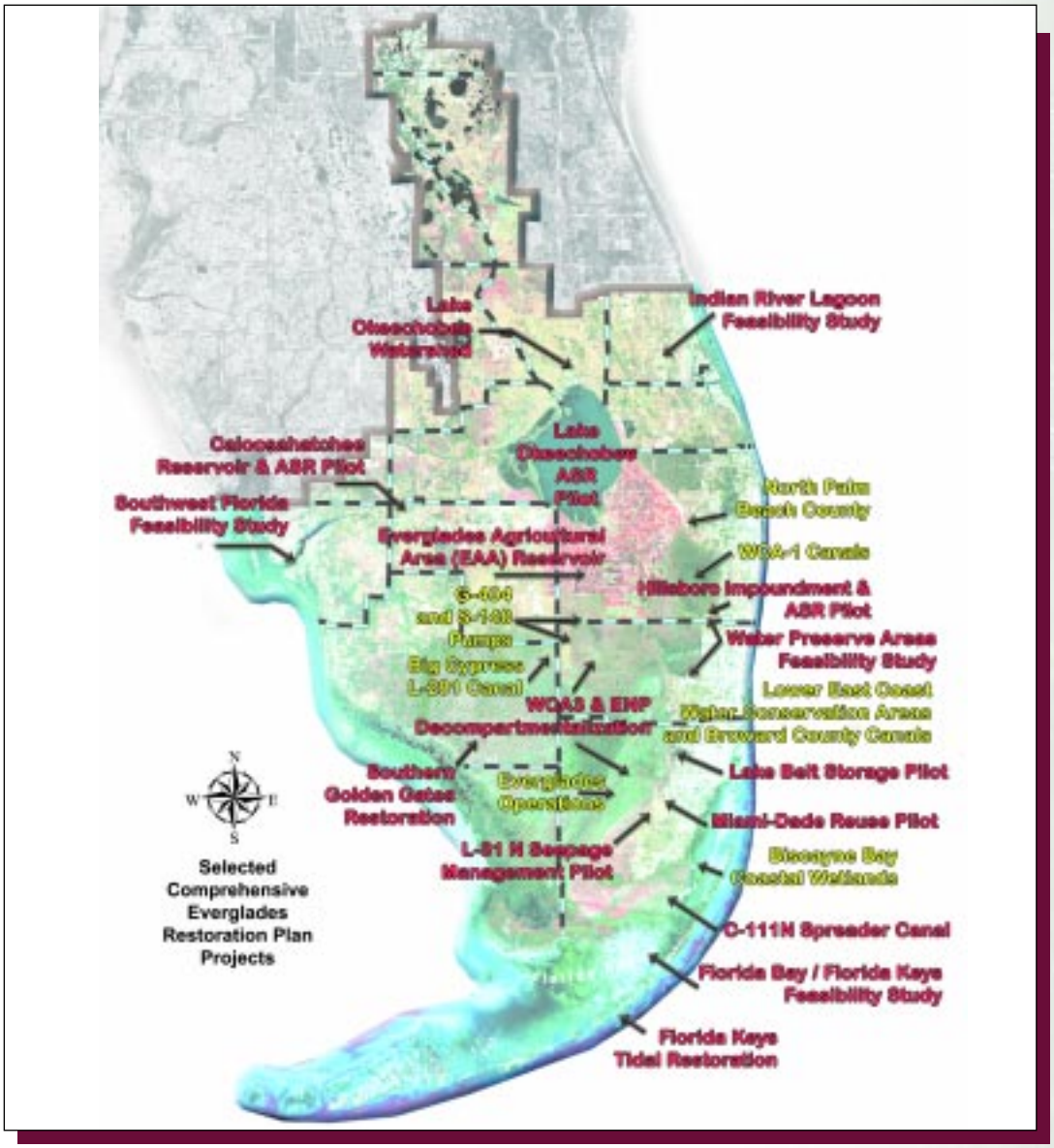
RECOVER OBJECTIVES

- *Evaluate and assess, through modeling and monitoring, Comprehensive Plan performance*
- *Provide options for refinements and improvements in the design and operations of the Plan during advanced plan formulation, design, construction and monitoring phases of implementation*
- *Review effects that other projects may have on the performance of the Comprehensive Plan*
- *Ensure that a system-wide perspective is maintained throughout the restoration process*
- *Develop a consensus among South Florida resource agencies and affected interests regarding scientific and technical aspects of the Comprehensive Plan*

Project Approval Process for the Comprehensive Everglades Restoration Plan



CERP Selected Projects



CERP projects updated in the 2002 Report are highlighted in red.

CHAPTER 8: OTHER EVERGLADES PROGRAMS

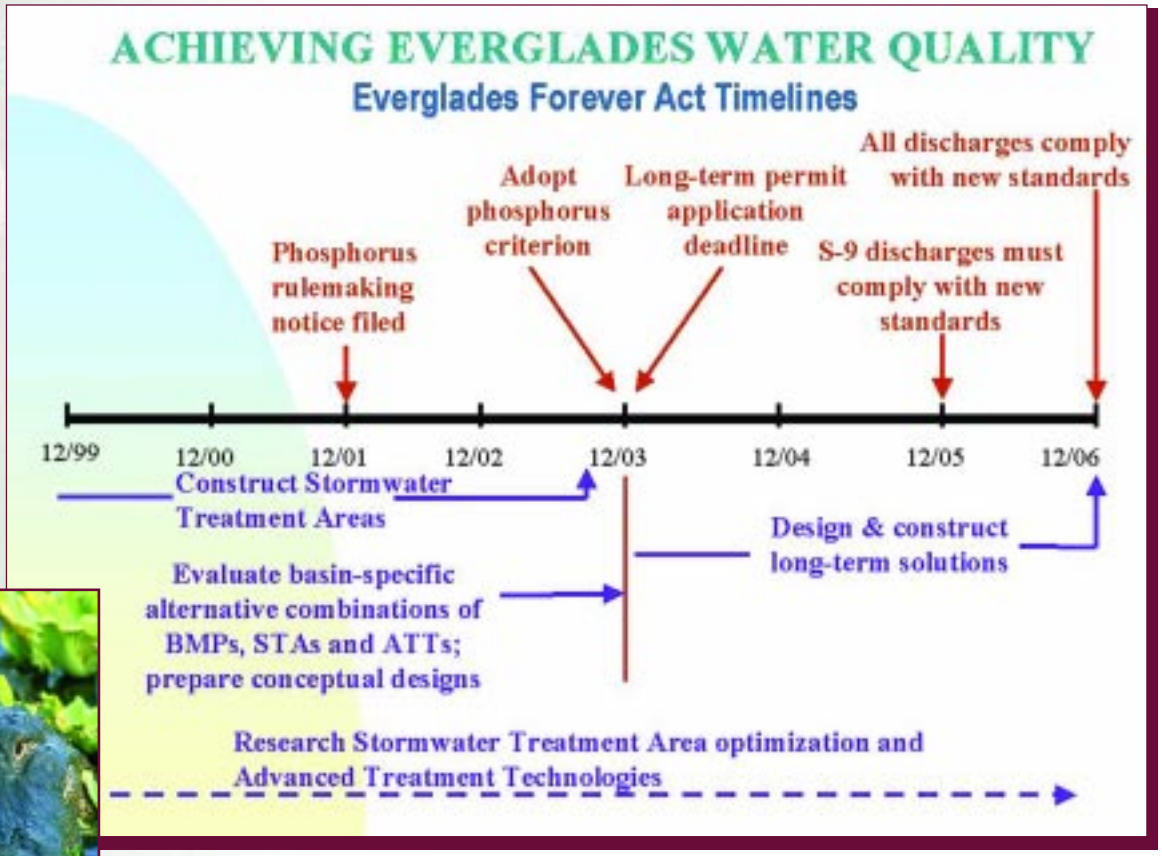
CHAPTER 8A

ACHIEVING LONG-TERM WATER QUALITY GOALS

Everglades Forever Act Programs are Progressing to Reduce Phosphorus Inputs, Although Challenges Remain.

The South Florida Water Management District, Florida Department of Environmental Protection and other parties are aggressively pursuing the interim and long-term Everglades water quality goals. Interim mandates to reduce phosphorus levels include Everglades Agricultural Area landowner Best Management Practices and construction and operation of Stormwater Treatment Areas. The long-term Everglades water quality goal is for all waters discharged to the Everglades Protection Area to achieve compliance with state water quality standards by December 31, 2006.

The sequence of key activities related to water quality compliance is highlighted in the illustration below. Despite the District's best efforts, the 2006 timeframe for compliance with all water quality standards, as established by the Everglades Forever Act, is ambitious considering the number and complexity of the many inter-related activities that must be completed. Delays in the timely completion of these activities, many of which are outside the District's control, may result in unintended delays in achieving compliance with state water quality standards. n an attempt to meet the 2006 deadline, the District may be required to make recommendations for long-term solutions based on incomplete science and engineering information, which carries associated environmental and economic risks. The *2002 Everglades Consolidated Report* describes the integration of research, planning, construction and other activities designed to achieve this long-term goal and identifies the remaining key uncertainties and other outstanding challenges.

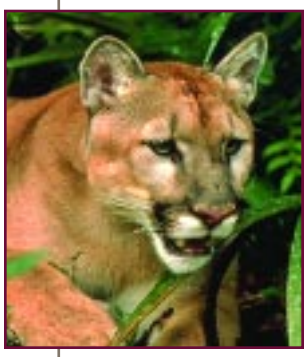


CHAPTER 8B

THE EVERGLADES STORMWATER PROGRAM

Comprehensive Planning will Guide Water Quality Improvement in Eight Basins Flowing into the Everglades Protection Area

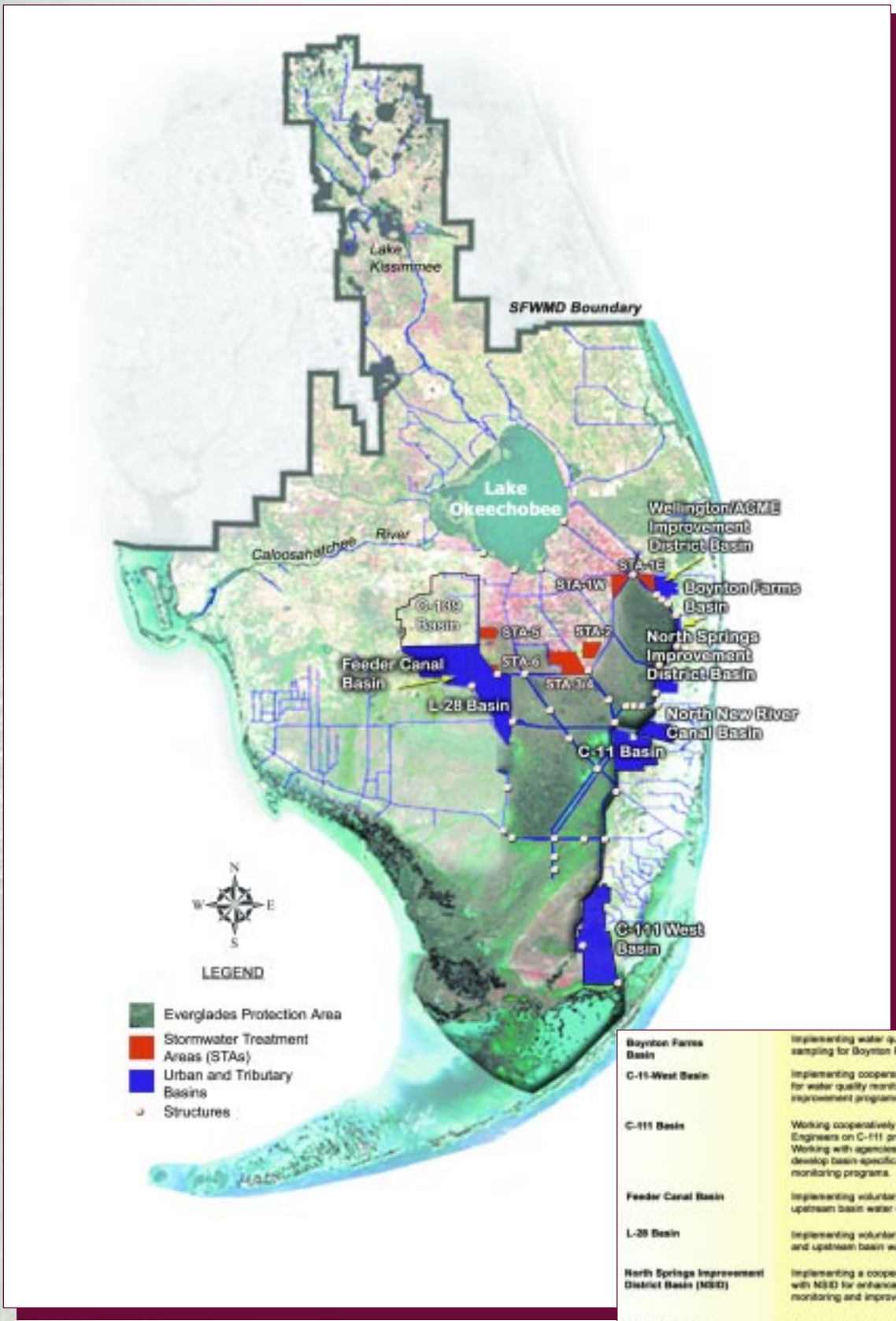
The Everglades Stormwater Program is charged with administering the Non-Everglades Construction Project permit and developing and implementing strategies for achieving compliance with state water quality standards at structures that discharge into the Everglades Protection Area, but are not part of the Everglades Construction Project. Tributary basins within the Everglades Stormwater Program are illustrated on the following page. The District's water quality monitoring program indicates that the quality of water discharging into the Everglades Protection Area is generally acceptable, with the exception of phosphorus concentrations.



The District continues to foster communication with local governments, special districts, the Miccosukee and Seminole Indian Tribes and other state and federal agencies to achieve the goals of the Everglades Forever Act, the Non-Everglades Construction Project permit and a future Long-Term Compliance permit. Improved monitoring programs upstream of structures which discharge into the area have been implemented to identify "hot spots," or areas of water quality concern. Several cooperative cost-sharing agreements have been executed with local governments to implement water quality improvement plans consisting of monitoring, Best Management Practices and operational modifications. Public outreach initiatives have expanded to include public education and development of educational tools, such as turfgrass and landscaping practices and an urban Best Management Practice development manual for Southern Florida. A feasibility study has been initiated in conjunction with the Everglades Construction Project program to evaluate alternative combinations of private works and public works, including integration with the Comprehensive Everglades Restoration Plan, to achieve compliance with the long-term water quality standards for the Everglades Protection Area. These and other accomplishments, as well as updates to ongoing activities, are described in more detail in this *2002 Report.*

The Everglades Stormwater Program will guide water quality improvement in diverse South Florida locations.

Everglades Stormwater Program Locations



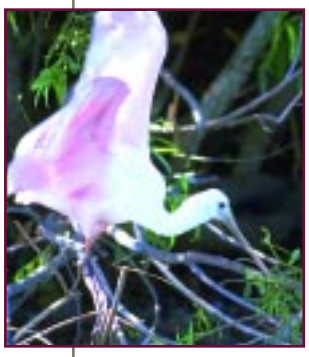
Boynton Farms Basin	Implementing water quality sampling for Boynton Farms.
C-11-West Basin	Implementing cooperative agreements for water quality monitoring and improvement programs.
C-111 Basin	Working cooperatively with the Corps of Engineers on C-111 project modifications. Working with agencies and growers to develop basin-specific BMPs and pesticide monitoring programs.
Feeder Canal Basin	Implementing voluntary BMP strategies and upstream basin water quality sampling.
L-28 Basin	Implementing voluntary BMP strategies and upstream basin water quality sampling.
North Springs Improvement District Basin (NSID)	Implementing a cooperative agreement with NSID for enhanced water quality monitoring and improvement measures.
North New River Canal Basin	Implementing cooperative agreements for water quality monitoring and improvement programs.
Wellington / ACME Improvement District Basin	Implementing agreements for water quality improvements and assisting in the development of BMP ordinance.

CHAPTER 8C

Land Acquisition in Support of Projects in the Everglades Region

Acquiring land for water resources management is a critical component of the District's mission and projects for the Everglades region, notably the Everglades Construction Project and the Comprehensive Everglades Restoration Plan. From May 1, 2000 through April 30, 2001 (Water Year 2001), the District completed hundreds of transactions to acquire lands to be used for reservoirs and Stormwater Treatment Areas and to improve the region's flood control system, drainage and water supply. Land transactions during the period are summarized and described in the table below.

Lands totaling over 1,020 acres were acquired for the Water Preserve Areas to serve as a buffer between natural and urban areas, collecting and storing excess water that would otherwise be discharged to tide. In partnership with Miami-Dade County, the District continued to purchase lands in Model Lands that will be used to maintain the saltwater barrier line, preventing further saltwater intrusion into the South Miami-Dade Region. For Water Year 2001, the District acquired slightly over 127 acres, and Miami-Dade County acquired 581 acres in Model Lands. Furthermore, the District has nearly completed Stormwater Treatment Area acquisitions for the Everglades Construction Project totaling 47,032 acres, almost all the lands required for these projects. Stormwater Treatment Areas are wetlands used to remove harmful nutrients in runoff before it enters the Everglades Protection Area.



The U.S. Army Corps of Engineers has approved the Recommended Plan for the 8.5 Square Mile Area and defined the land acquisition boundary for the Federal Project. In the 8.5 Square Mile Area, the District acquired slightly over 45 acres within Water Year 2001, the majority of which are located within the Federal Project boundary. The U.S. Army Corps of Engineers will assume responsibility for acquiring all remaining land required for this federal project. Future land acquisitions by the District in the 8.5 Square Mile Area outside the Federal Project boundary will be made on a strictly voluntary, willing-seller basis, provided funds are available. Other land acquisitions this year included 20 acres in the Water Conservation Areas, and real estate interests in oil, gas and mineral rights within the Stormwater Treatment Areas.

Several acquisitions made during Water Year 2001 directly address land requirements identified for the Comprehensive Everglades Restoration Plan. Acres acquired for the Water Preserve Areas increased District ownership of lands required for the Agricultural Reservoir and Aquifer Storage and Recovery projects, and the Bird Drive Recharge, Pennsuco Area, North Lake Belt Storage and Central Lake Belt Storage components. The 374 acres acquired for Stormwater Treatment Areas increased District land holdings suitable for the Acme Basin B component. In addition, the Berry Groves acquisition of over 9,000 acres provided a cornerstone for the C-43 Basin Storage Reservoir Project.

Through continued partnerships, with the assistance of federal and local governments and state and federal agencies and in cooperation with the public, the District made significant strides in meeting the land requirements in support of projects in the Everglades Region from May 1, 2000 through April 30, 2001.

Closings May 1, 2000 through April 30, 2001

Geographic Region or Project	Purpose or Comments	Land Area-Acres
Water Preserve Areas	Marshes, reservoirs and groundwater recharge areas that abut East Coast Protective Levee	1,023
Model Lands	Recharge area for maintenance of saltwater intrusion	127
Stormwater Treatment Areas	Wetland treatment marshes that will naturally remove nutrients from stormwater runoff	374
8.5 Square Mile Area	East Everglades in low-lying area of Miami-Dade County	45
Water Conservation Areas	Part of the original Central and Southern Florida Flood Control Project	20
Comprehensive Everglades Restoration Plan	Other parts of the Comprehensive Everglades Restoration Plan	9,018

CHAPTER 8D

MANAGING FISCAL RESOURCES

The 1997 Everglades Oversight Act requires the District to provide annually a comparison of actual versus projected revenues, and a projection of costs and revenues over the succeeding five-year period, as shown in the chart on the following page.

The Everglades Construction Project is the first major step in Everglades Restoration. The Everglades Forever Act, passed by the Florida Legislature in 1994, established requirements essential to restoring significant portions of the Everglades. The program represents the District's efforts to implement the Everglades Construction Project, which is a specific element of the Everglades Forever Act. The EFA directs the District to acquire land, design, permit and construct a series of Stormwater Treatment Areas to reduce phosphorus levels from stormwater runoff and other sources before they enter the Everglades Protection Area.

An overview of Stormwater Treatment Area 6, a component of the Everglades Construction Project. This fully operational system removed 83 percent of inflowing phosphorus for Water Year 2001.

The overall restoration and cleanup effort described in the EFA is known as the Everglades Program. It is composed of seven elements:

- The Everglades Construction Project
- Hydropattern Restoration
- Research and Monitoring
- Regulation (Everglades regulatory rules, construction and operating permits for the Everglades Construction Project)
- Exotic Species Control
- Funding
- Annual Progress Reporting.

The Everglades Construction Project is one of several program elements within the Everglades Program Plan.

Funding Sources

A dedicated funding source is essential to carrying out Everglades and Florida Bay restoration programs. As the major component of achieving interim water quality goals, the Everglades Construction Project is estimated to cost approximately $867 million over 20 years. At this time, sources of funding to implement long-term water quality goals are unknown.

An Everglades Trust Fund was created to account for all money used for the Everglades Construction Project. The District provides quarterly reports on the fund to the governor and legislature. For Fiscal Year 2001, actual net tax revenues (unaudited) for the Everglades Construction Project were approximately $44.5 million. Listed below is the Fiscal Year 2001 (October 1, 2000 through September 30, 2001) breakdown by tax revenue source:

- Ad Valorem (1/10 mil) Taxes: $32.0 million
- EAA Agricultural Privilege Taxes: $11.9 million
- C-139 Basin Agricultural Privilege Taxes: $626,074.

The Everglades Forever Act designated other funding sources for the Everglades Construction Project, including excess revenues from Alligator Alley tolls, state land funds, federal funds, other environmental mitigation funds and any additional funds that become available for this purpose. The Alligator Alley toll revenues could provide up to $63 million for the Everglades and Florida Bay restoration projects through Fiscal Year 2016 (toll revenues must be split equally between the Everglades Construction Project and Florida Bay restoration).

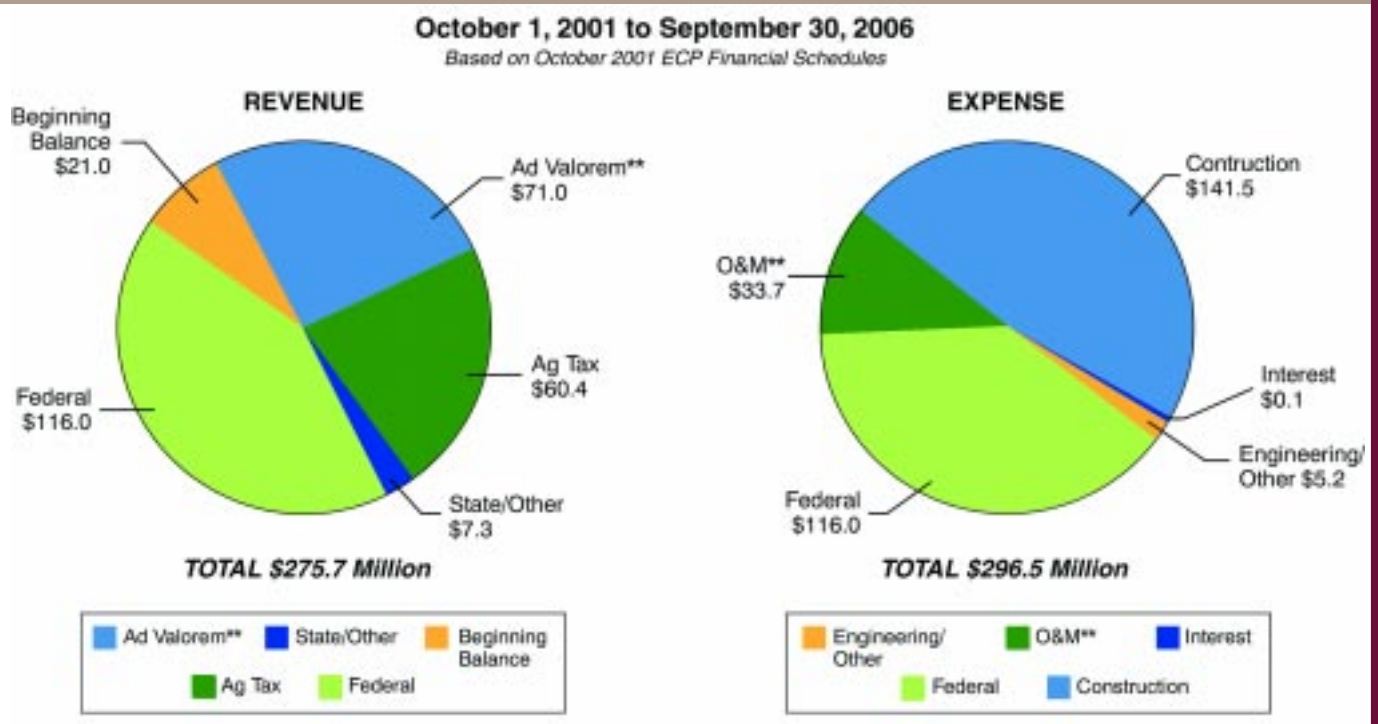
Project estimates and cash flow underwent further review, validation and update in Fiscal Year 2001. Current cash flow estimates reflect projected cash deficits for Fiscal Years 2002 through 2006 at the conclusion of the construction period. Funds borrowed to make up these deficits could be paid back from projected cash balances generated during the operations and maintenance period, beginning in Fiscal Year 2007 through 2014.

Stormwater Treatment Area 1 East/C-51 West is the only Everglades Construction Project element that is federally funded. The federal government is providing about 92 percent of the total estimated cost of $252.5 million, which is approximately $231.7 million. The remaining $20.8 million will be funded by the District.

Funding for the estimated $7.8 billion Comprehensive Everglades Restoration Plan (CERP) will be shared equally between the federal government and the local/state agencies. For more information, please refer to the Comprehensive Everglades Restoration Plan Website at http://www.evergladesplan.org.

In addition to the interim and long-term solutions, the Everglades Forever Act has other significant unfunded mandates totaling approximately $78 million through 2014. The District expects to recalculate the total for these unfunded mandates during Fiscal Year 2002 and provide the updated financial data in next year's *Everglades Consolidated Report*. They include research, regulatory program development and implementation, exotic species control and other related activities. Since the Everglades Forever Act did not designate funding sources beyond the Everglades Construction Project, the District will rely almost exclusively on ad valorem funds to cover these mandates.

Everglades Construction Project Five-Year Project Estimates



CHAPTER 8E

Comprehensive Review of Exotic Species in the Everglades Protection Area

Invasive exotic species have become one of the most serious global environmental problems of our day. In Florida, exotic invasive plants and animals have taken an aggressive hold and are continuing to spread at an alarming rate. Currently, more than 31 percent of the plants found in Florida are non-native, as are over 26 percent of all animals. The Everglades Forever Act of 1994 calls for the District to coordinate and monitor invasive species programs in the Everglades Protection Area. The District has a well-established program to deal with exotic invasive plants. Currently, the District does not have dedicated staff or funding to control exotic invasive animals within the Everglades Protection Area.

Old World climbing fern is emerging as a major invasive threat to the Everglades.

Control of exotic invasive species is a far-reaching issue. The significance for the Everglades Protection Area is demonstrated by the great number of plans, reports, statements and papers on the subject that have been written by various committees, agencies, universities, state and federal task forces, and other organizations. The general consensus is that control and management of all nonindigenous taxa is a critical component of ecosystem restoration in South Florida. This consensus is shared by the South Florida Ecosystem Restoration Task Force, which established the Noxious and Exotic Weeds Task Team in 1997 to focus on nonindigenous plants, and an *ad hoc* interagency team in 1998 to focus on South Florida's nonindigenous animals. As of July 2001, the Task Force has completed the assessment of invasive plants in Florida and is in the process of finalizing the Strategic Plan for management of invasive exotic species. Efforts to focus on nonindigenous animals are still in the assessment phase. A report by the South Florida Ecosystem Working Group, published in 2000, evaluated the status of exotic animals in all habitats, described current control efforts and identified agency needs and conflicts.

The District, as well as other agencies, uses many different techniques to control exotic invasive plants within the Everglades Protection Area. Biological controls, herbicides, manual and mechanical controls, and cultural practices, such as prescribed burning and water level manipulation, are used separately or in conjunction to slow the spread of exotics. While the different methods each have their strengths and weaknesses, biological control may offer the most cost-effective, long-term management approach for control of widespread invasive weeds. Biological control has a proven safety record; none of the approximately 300 insect species imported specifically for this purpose has ever become pests. Biological control has also been effective in controlling almost 50 species of weeds. Because no one method is the final answer, the control techniques need to be better integrated. In the case of biological control, this integration will require a commitment from the United States Department of Agriculture – Animal and Plant Health Inspection Service to continue to work on nonagricultural weeds.

In 1996, under the direction of the Everglades Forever Act, the District and several other state and federal agencies compiled a list of invasive exotic plant species that were the greatest threat to the Everglades. A brief highlight of two of these species, melaleuca and Old World climbing fern, demonstrates the level of success that can be expected with (or without) coordinated agency efforts. In 1993, approximately 197,487 hectares

of melaleuca were reported in South Florida, while 1999 monitoring revealed just 145,283 hectares. This dramatic drop is a direct result of both aggressive management on public lands and continuous funding. Conversely, in 1993 approximately 10,117 hectares of Old World climbing fern were reported within the same area. In 1999, 43,302 acres were reported, and it is clear that Old World climbing fern now represents the single greatest exotic threat to the greater Everglades ecosystem. Successful control of Old World climbing fern will require the same intensity of control and interagency coordination as was given to controlling melaleuca.

The task of controlling nonindigenous species, both animal and plant, is not one to be taken lightly. It cannot be dealt with through one method, by one discipline, regulated by one agency or controlled by one resource manager. The attack on invasive exotic species must be swift and it must be coordinated if we hope to get maintenance control in the State of Florida. Control of these species is a necessary component of all aspects of water resource management, be it for flood control, water supply, water quality or natural resources. The large public investment being allocated to the Comprehensive Everglades Restoration Plan is jeopardized by exotic species, and expanded control efforts are vital to the ultimate performance of the restoration.

Aggressive management efforts have reduced the extent of melaleuca stands, which has been a major threat to the Everglades.

Efforts to control melaleuca, the paper-bark tree, continue as a major interagency effort in South Florida.

CHAPTER 8F

The Lower East Coast Regional Water Supply Plan

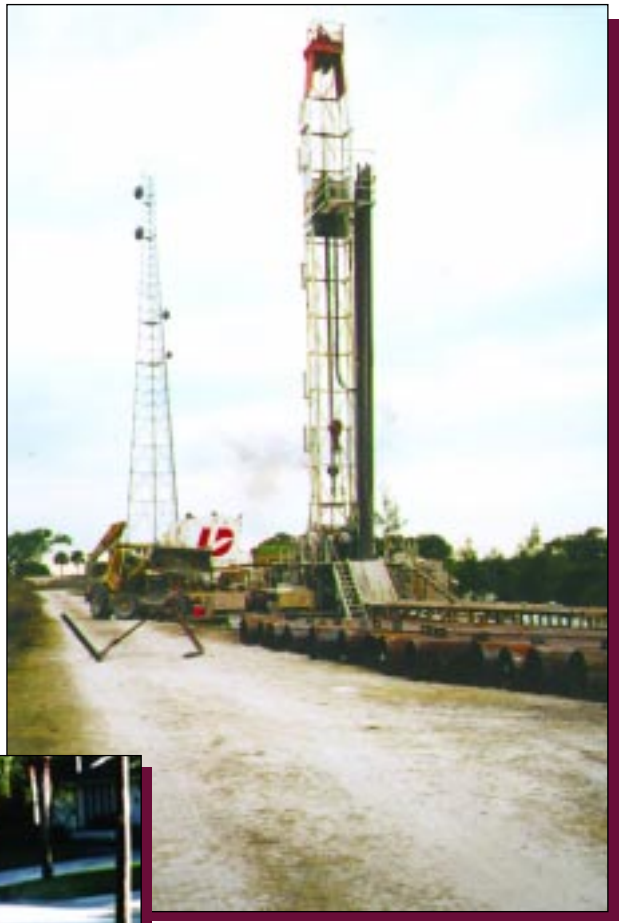
The Lower East Coast Regional Water Supply Plan (LEC Plan) provides a blueprint to help meet the water resource needs of South Florida through the year 2020. Future population growth and the need for significant increases in water supply deliveries to the natural system of South Florida led to the development of the LEC Plan over an eight-year study period.

In May 2000, the Governing Board of the South Florida Water Management District formally adopted the plan. In 2001, the District began the implementation of several LEC Plan projects of benefit to future populations and to the Everglades as part of the Comprehensive Everglades Restoration Plan (CERP).

Many of the recommendations developed in the LEC planning process were incorporated into the final Comprehensive Plan document. The LEC Plan also identifies additional water supply projects that may be needed to help meet the region's future needs.

Of particular importance are projects that will bring additional water from reservoirs and other storage facilities to address environmental needs. For example, the Northern Palm Beach County Comprehensive Water Management Plan, which was folded into the LEC Plan, uses this water to address minimum flows and levels in the Northwest Fork of the Loxahatchee River and restoration of the Loxahatchee Slough.

There are several other LEC Plan highlights in 2001. The South Florida Water Management District completed construction of a pilot project for Aquifer Storage and Recovery (ASR) along the Hillsboro Canal. Testing also began in 2001. The technical analysis will help in the success of similar Aquifer Storage and Recovery projects to be implemented in the Comprehensive Plan. Funding from the South Florida Water Management District in 2001 enabled Mobile Irrigation Labs to evaluate 500 irrigation systems in seven counties, resulting in a savings of nearly one billion gallons of water. Finally, a feasibility analysis and master plan for a regional reuse irrigation system began in 2001 along the state's population-dense Lower East Coast.



ASR pilot project along the Hillsboro Canal.

Reuse irrigation system in the Lower East Coast.

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Authors: This *Report* could not exist without the diligent effort of its many authors. Their excellent analyses of complex information form the substance of this Report, and its quality and value are a reflection of the authors' competence, commitment and willingness to respond fully to peer review and public comment. The professionalism and dedication of these individuals are gratefully acknowledged.

2002 Everglades Consolidated Report

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Glossary

Advanced Treatment Technologies (ATTs) - Biological and chemical treatment technologies to remove phosphorus from stormwater to low concentrations.

Aquifer – An underground layer of porous rock, sand or gravel where large amounts of water can be stored.

Best Management Practices (BMPs) - Land, industrial and waste management techniques that reduce pollutant loading from an industry or land use.

Bioaccumulation - An increase in concentration of certain chemicals (such as pesticides and metals) by organisms over that to which they are exposed in their environment.

Comprehensive Everglades Restoration Plan (CERP) – A long-term series of regional projects designed to restore the health, integrity and beauty of the South Florida environment. The Plan was authorized as Title VI of the 2000 Water Resources Development Act and will vastly increase storage and water supply for the natural system, as well as for urban and agricultural needs, while maintaining current Central and Southern Florida Project purposes.

Eutrophication - The enrichment of an aquatic environment with plant nutrients, such as phosphorus, leading to ecological changes and high plant growth rates.

Everglades Stormwater Program - A District program to ensure compliance with water quality standards for tributary basins not included in the Everglades Construction Project.

Excursion of a water quality constituent – A constituent concentration that is of potential concern as an apparent exceedance of an applicable water quality criterion.

Exotic Species – Species of plants or animals that are not found naturally in a region (nonindigenous), and can sometimes invade habitats aggressively and cause multiple ecological changes, including the displacement of native species.

Fauna - All animal life associated with a given habitat.

Flora - All plant life associated with a given habitat.

Flow - Rate of movement of water expressed as volume discharged from a source in a given time period.

Flow Weighted Mean Concentration - The average concentration of a substance in water corrected for the volume of water flow at the time of sampling. Samples taken when flow is high are given greater weight in the average, and flow-weighted concentrations can be used to calculate mass loading at a particular location.

Loading (Mass loading) - The mass of a material entering an area per unit time (e.g., phosphorus loading into Water Conservation Area 2A as metric tons per year).

Macrophyte – Visibly large plants found in aquatic environments; sawgrass, cattails, sedges and water lilies are examples of macrophytes.

Median – The middle value in a set of ordered data. The median is used often to express the typical (average) value of a group water quality data because it is less influenced by rare and extreme values seen routinely in such data than is the arithmetic average.

Methylmercury – An organic form of the heavy metal, mercury, that is readily accumulated by living organisms. Inorganic mercury is converted to methylmercury by sulfate-reducing bacteria in aquatic sediments, such as those that are present in Everglades marshes.

Parts per billion (ppb) – Concentration equivalent to one microgram per liter.

Periphyton - Community of algae, tiny animals and microbes attached to surfaces that takes up the phosphorus from the water and often serves as the base for aquatic food webs in wetlands.

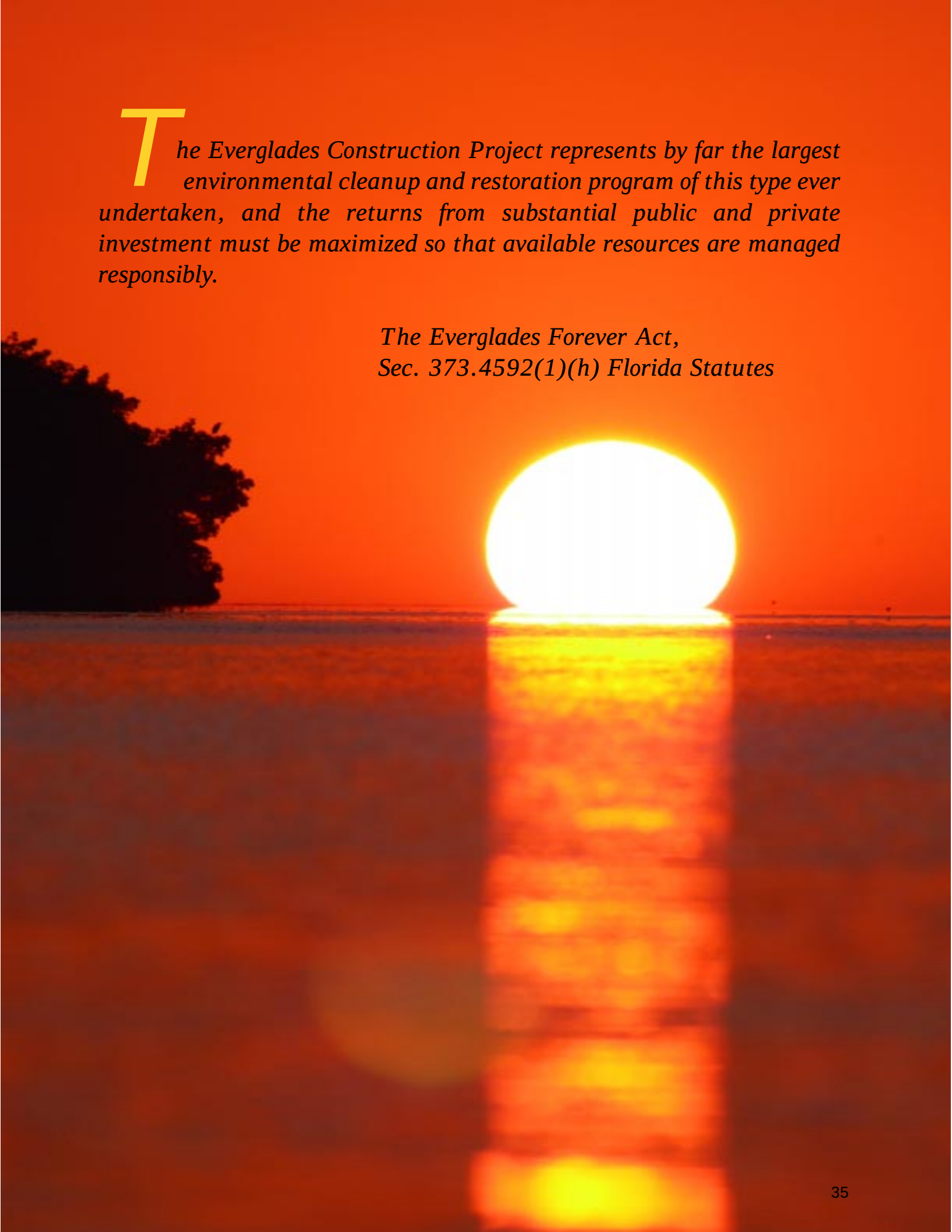
Stormwater Treatment Area (STA) - Large, constructed wetland designed to remove pollutants from stormwater runoff.

Phosphorus (P) - Element that is essential to life and often promotes the growth of algae in water. Total phosphorus includes organic and inorganic forms and is measured in unfiltered water samples after the oxidation of all organic matter.

Water Quality Criteria - Constituent concentrations based on scientific data and judgements on the relationship between pollutant concentrations and environmental and human health effects. Criteria apply to specified beneficial uses of a water resource and can be revised to reflect the latest scientific knowledge.

Water Quality Standard – State water quality standards are composed of the beneficial use classification, numerical criteria applicable to that classification, the Florida anti-degradation policy and several provisions in other rules. Standards often take the form of plans for pollution prevention and abatement in relation to a designated use.

Water Year 2001 - The period from May 1, 2000 - April 30, 2001 during which water samples are collected to provide data for the 2002 Everglades Consolidated Report.



The Everglades Construction Project represents by far the largest environmental cleanup and restoration program of this type ever undertaken, and the returns from substantial public and private investment must be maximized so that available resources are managed responsibly.

The Everglades Forever Act,
Sec. 373.4592(1)(h) Florida Statutes

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www.sfwmd.gov/org/ema/everglades

On the cover: Southern Florida Red-Shouldered Hawk.
Photo by Patrick Lynch, SFWMD

A dwarf cypress tree –
unique to the Everglades landscape

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