CHAPTER 1: INTRODUCTION TO THE 2000 EVERGLADES CONSOLIDATED REPORT

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This introduction to the 2000 Everglades Consolidated Report (Report) provides essential background to help the reader understand the legal, scientific and governmental context of the document and supporting efforts in research and planning. An overview of the status of the Everglades and resources at stake is given so that the reader can appreciate the challenges that are faced in the environmental management of South Florida; they are discussed from many different vantage points in the Report. For this Consolidated Report, a section has been added concerning the interim and long-term water quality goals for the Everglades and the many steps that are being taken to reach these goals. This section helps to provide an integrative summary of opportunities and obstacles in the Everglades restoration. Next, the governmental context of the Report is described from the perspective of planning for environmental management over the next two to five decades. The objectives and content of the document are then highlighted, followed by a discussion of the legal and reporting requirements being addressed. The process used to create and review the Report is summarized because it is somewhat unique, particularly in the use of external peer review by the public and a panel of experts. Finally, the Introduction provides a review of constraints on report contents, so that the reader can know what authoritative sources of information were available for authors to discuss and analyze in the Report.

This chapter only provides a general introduction to the issues and content of the Report. The diversity of topics covered precludes a detailed introduction. Individual chapters give specific background needed to interpret information in each subject area. This Report is essentially an anthology of topical reports that describe the status of the Everglades ecosystem; most covered subjects were specified by Florida statute or are known to be important for decision support. Although it has been edited for grammar, format and consistency, the South Florida Water Management District (District) has not attempted to create an integrated volume, such as might be expected for a more narrowly focused book on environmental management of the Everglades ecosystem.

THE GEOGRAPHIC SETTING

MAJOR FEATURES OF THE EVERGLADES PROTECTION AREA AND SURROUNDINGS

The Everglades is an internationally recognized ecosystem that covers approximately 2 million acres in South Florida and represents the largest subtropical wetland in the United States. The historic Everglades extended over an area approximately 40 miles wide by 100 miles long, from the south shore of Lake Okeechobee to the mangrove estuaries of Florida Bay. More than half of the original system has been lost to drainage and development (Davis and Ogden, 1994), including the Everglades Agricultural Area (EAA) located south of Lake Okeechobee. Today's remaining Everglades, which are primarily included within the boundaries of the Everglades Protection Area (EPA), are comprised of Everglades National Park (Park) including Florida Bay and the Water Conservation Areas (WCAs) (WCA-1, WCA-2A, WCA-2B, WCA-3A and WCA-3B) (**Figure 1-1**).

These areas are the primary targets of the Everglades restoration, and are described in the next section of the Report, followed by descriptions of areas adjacent to the EPA.

AREAS WITHIN THE EVERGLADES PROTECTION AREA

Everglades National Park

Everglades National Park (the Park) encompasses 5,569 square kilometers of freshwater sloughs, sawgrass prairies, marl-forming wet prairies, mangrove forests and saline tidal areas at the southern end of the Florida peninsula (**Figure 1-1**). The Park was formally established by Congress in 1934 to preserve the unique ecology of the Everglades. The Park was designated by the United Nations as a World Heritage Site in 1979 and was named as a Federal Wilderness Area, an International Biosphere Reserve, and a Wetland of International Significance. Today, Everglades National Park is the second-largest national park in the United States and is one of the nation's 10 most endangered parks (SFWMD, 1992b).

The Park contains three dominant wetland habitat types—sloughs, marl-forming marshes and mangroves. Sloughs comprise much of the central drainage of the park. Shark River Slough consists of a broad southwesterly arc of continuous wetlands, interspersed with sawgrass stands, open water sloughs, wet prairies and tree islands extending from Tamiami Trial to the mangrove estuaries of Florida Bay. During wet periods, Taylor Slough (also called Taylor River) provides local flow of freshwater from the eastern side of the Park to Florida Bay. Southern marl-forming marshes are characterized by the formation of marl soils (also known as calcitic mud). Marl is formed by the precipitation of calcite by blue-green algae in submerged algal mats (periphyton) under shallow water/short hydroperiod conditions. Marl-forming marshes occur on the eastern and western margins of Shark River Slough, as well as in Taylor Slough and the Rocky Glades. These wetlands occur at a slightly higher elevation than Shark River Slough and exhibit corresponding shallow water depths and shorter hydroperiods. The third major wetland system, mangroves, occupies the southern and western borders of the Park where freshwater ecosystems merge with the brackish estuaries of Florida Bay (SFWMD, 1992b).

WATER CONSERVATION AREAS

The three WCAs are major components of the Everglades Protection Area and an important source of water supply for South Florida (SFWMD, 1992b). The WCAs, located south of Lake Okeechobee and east of the heavily urbanized Lower East Coast, comprise an area of about 3,497 square kilometers (**Figure 1-1**). These remaining Everglades wetlands today serve multiple purposes: a) detention areas for excess water discharged from Lake Okeechobee and flood control discharges from the Everglades Agricultural Area and portions of the lower east coast; b) sources of water supply for lower east coast agricultural lands and urban areas by recharging the Biscayne aquifer and retarding saltwater intrusion in coastal wellfields; c) sources of water supply for Everglades National Park; d) important habitat for Everglades wildlife; and e) areas for public recreation.

Water Conservation Area 1 . Water Conservation Area 1 (WCA-1) is within the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) and is managed by the U.S. Fish and Wildlife Service (USFWS). WCA-1 covers an area of 566 square kilometers (221 square miles) within Palm Beach County. The West Palm Beach Canal discharges agricultural drainage water into the north end of WCA-1 and the Hillsboro canal discharges water into the southwestern portion. The area is enclosed by 93 kilometers (58 miles) of levees and provides storage for excess rainfall and runoff from the Everglades Agricultural Area (SFWMD, 1992b). The Refuge has been the subject of extensive monitoring and some research, and data and findings for this important resource are summarized primarily in Chapters 2, 3 and 4 of this Report.

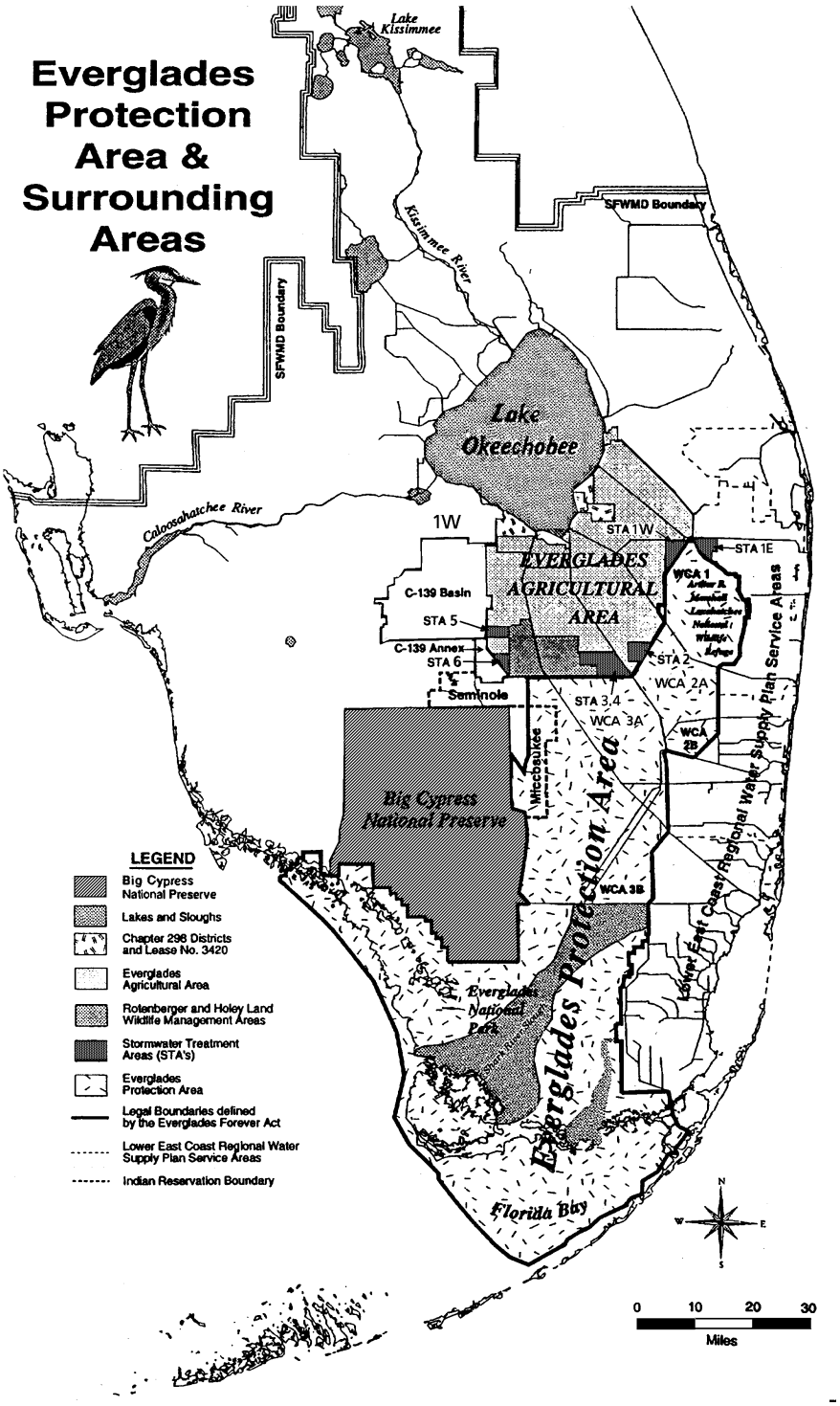

Figure 1-1. Major features of the Everglades Protection Area in South Florida.

WATER CONSERVATION AREAS 2A AND 2B

Water Conservation Area 2 is an extensive sawgrass wetland that encompasses an area of 538 square kilometers (210 square miles). WCA-2 is the smallest of the three Water Conservation Areas and is located within southern Palm Beach and northern Broward counties (**Figure 1-1**). In 1961, a levee (L-35B) was constructed across the southern portion of WCA-2, dividing the area into two smaller units, WCA-2A (442 square kilometers or 173 square miles) and WCA-2B (95 square kilometers or 37 square miles). The area was divided in an effort to reduce water seepage losses to the south and improve the water storage capabilities of WCA-2A. More than half of the inflow water entering WCA-2A originates from the EAA. Canal inflow waters are highly mineralized and contain high concentrations of nitrogen and phosphorus resulting from the oxidation of organic peat soils within the EAA (SFWMD, 1992b). WCA-2A has been the site of intensive ecological research and water quality monitoring; data and findings for this conservation area are summarized in Chapters 2, 3 and 4 of this Report.

Water Conservation Areas 3A and 3B. The largest of the water conservation areas, WCA-3, covers an area of 2,342 square kilometers (915 square miles) and is in western Broward and Dade counties (**Figure 1-1**). The area is predominately a vast sawgrass marsh dotted with tree islands, wet prairies and aquatic sloughs. A cypress forest fringes its western border along the L-28 Gap and extends south to Tamiami Trail. In 1962, WCA-3 was divided into WCA-3A (2,012 square kilometers or 786 square miles) and WCA-3B (327 square kilometers or 128 square miles) by construction of two interior levees so that water losses due to levee seepage could be reduced. WCA-3A is the only water conservation area that is not entirely enclosed by levees. The L-28 Gap allows overland flow to enter WCA-3A from the Big Cypress National Preserve and other western basins (SFWMD, 1992b). Less information is available on this area than WCA-1 or 2, but there is substantial new information (e.g., tree islands, water quality, mercury) being generated and reported in several chapters of this Report.

Florida Bay

Florida Bay is at the extreme southern tip of mainland Florida and includes the body of water that lies between the mainland peninsula and Florida Keys (SFWMD, 1992b). The Keys form the approximate east and southern boundaries of Florida Bay. The boundary on the west is generally considered to be the 30-foot depth contour line where the Bay adjoins the deeper waters of the Gulf of Mexico. The Bay covers a total area of about 2,200 square kilometers (860 square miles) of which approximately 1,800 square kilometers (700 square miles) lie within Everglades National Park.

Florida Bay is a broad shallow expanse of brackish to salty water that contains numerous small islands, extensive sandbars and grass flats. Florida Bay historically supported important commercial and sport fisheries for invertebrates (lobster, shrimp, sponges) and fishes (snook, redfish, tarpon, seatrout and mullet). In addition, the warm shallow waters provide habitats for major populations of birds and endangered species such as crocodiles and manatees. Much of the productivity of Florida Bay is dependent on mangroves and seagrasses, which provide important sources of primary production and habitat for complex associations of other species. The die-off of seagrasses in the late 1980s was taken as an indication that Florida Bay was seriously threatened by water management practices in upstream basins (SFWMD, 1992b).

There has been great concern that surface water flows to Florida Bay have been reduced due to increasing competition for available fresh water from agriculture and urban development. Also, the available water has been partitioned to meet the needs of other natural areas such as Lake Okeechobee, the Water Conservation Areas, Everglades National Park, Biscayne National Park and

the Big Cypress National Preserve. Another factor of unknown impact has been the reduction in groundwater flow. The effects of long-term variations in rainfall patterns and sea level rise are unknown but may also be significant (Chapter 2; SFWMD, 1992b). Nutrient inputs are also a concern for Florida Bay, both from the Gulf of Mexico and the southern Everglades; the impact of nutrient movement from the Florida Keys is of potential significance to the long-term management of the Florida Bay ecosystem.

AREAS SURROUNDING THE EVERGLADES PROTECTION AREA

Several areas adjacent to the modern Everglades are significant because they were part of the historical system, they provide significant wildlife corridors and habitat, and/or they contribute directly to management problems within the system. These include the Holey Land and Rotenberger Wildlife Management Areas, Everglades Agricultural Area (EAA), the C-139 Basin, Big Cypress National Preserve, and the Seminole and Miccosukee Indian Reservations, and are also illustrated in **Figure 1-1**.

Holey Land and Rotenberger Wildlife Management Areas

The Holey Land Wildlife Management Area is a 140 square kilometers (55 square miles) tract lying in the S-7 and S-8 subbasins. It is wholly state owned and managed by the Florida Fish and Wildlife Conservation Commission (FFWCC). The area is heavily used for hunting of white-tailed deer and hogs. The Rotenberger Wildlife Management Area consists of 96 square kilometers (37 square miles) of state-owned and leased private land (roughly 40 percent of total acreage) that is separated from the Holey Land by the Miami Canal and managed by the FFWCC for deer and hog hunting. In 1983, a Memorandum of Understanding was entered into by the District and other agencies to restore Everglades values associated with the Holey Land/Rotenberger Tract and establish water regulation schedules that will simulate the natural hydroperiod. In June 1990, the District and the FFWCC agreed on operational schedules that improve hydroperiods in both the Holey Land and WCA-3A (SFWMD, 1998). These areas are important for game management, water resource protection and habitat corridors adjacent to the EPA.

Everglades Agricultural Area

The EAA, located south of Lake Okeechobee within eastern Hendry and western Palm Beach counties, encompasses approximately 2,872 square kilometers (1,122 square miles) of highly productive agricultural land comprised of rich organic peat or muck soils. Small portions of EAA muck lands are also found in western Martin County. Approximately 77 percent of the EAA or 2,212 square kilometers (864 square miles) is in agricultural production. The area is considered one of Florida's most important agricultural regions; it extends south from Lake Okeechobee to the northern levee of WCA-3A, from its eastern boundary at the L-8 Canal, to the western boundary along the L-1, L-2 and L-3 levees. Nitrogen-rich organic (peat) soils and a warm subtropical climate permit the year round farming. The major crops in the EAA include sugar cane, vegetables, and sod and smaller amounts of other crops such as rice, and citrus. In 1987, sugar cane production alone accounted for 1,620 square kilometers (633 square miles) of land use within the EAA (Coale, 1987). Nutrient-laden water from the EAA is now recognized as a major contributor to enrichment of the Everglades and is the primary focus of the Everglades Construction Project.

C-139 Basin, Big Cypress National Preserve, and the Seminole and Miccosukee Indian Reservations

Basins located west and northwest of the WCAs discharge into WCA-3A via structures or gaps in the area's western levee. Agriculture is the dominant land use in the C-139, Feeder Canal and L-28 Interceptor basins. The C-139 basin is the

subject of a water quality monitoring program (RAM 9) and development of a regulatory program (REG 4) as part of the Everglades Program. These efforts are to ensure that the C-139 basin does not contribute substantially to nutrient loading in the northern Everglades. The remaining land cover in these three basins is predominately wetlands and forested uplands, while the L-28 Gap basin consists almost entirely of wetlands (98 percent) within the Big Cypress national preserve. Urban land uses occupies 4 percent of the C-139 Basin and less than 1 percent of the remaining Basins.

The areas immediately west of WCA-3 include the Seminole Indian Tribe of Florida and the Miccosukee Tribe of Indians of Florida. These areas include extensive private holdings that traditionally have been used for cattle operations on either native range lands or improved pasture. The basins west of WCA-3A are undergoing rapid intensification of agricultural development. During the 1980s, native range lands, improved and unimproved pastures have been undergoing conversion to citrus, sugar cane or other agricultural use. Tribal lands within the WCA system should be restored and maintained as natural Everglades habitat for the benefit of the Tribes and the Everglades ecosystem.

The 2,280 square kilometers (891 square miles) Big Cypress National Preserve was established by Public Law 93-440 in 1974 to protect natural and recreational values of the Big Cypress watershed, and to allow for continued traditional uses such as hunting, fishing, and oil and gas production. It was also established to provide an ecological buffer zone and protect Everglades National Park's water supply. In 1988, Congress added 584 square kilometers (228 square miles) to the preserve. Excessive drainage and the introduction of water of poor quality into Big Cypress National Preserve via the existing canal system are the most significant water management problems. The canals contributing pollutants into the Preserve are not part of the C&SF Project, but provide local drainage from agricultural lands in the Seminole Indian Reservation, C-139 Basin and C-139 Annex.

GOVERNMENTAL SETTING: THE DISTRICT, OTHER AGENCIES AND THE EVERGLADES PROGRAM

Created originally as the Central and Southern Florida Flood Control District in 1949, the agency was renamed the South Florida Water Management District (District or SFWMD) in response to a broadened mission. The District is now responsible for environmental resources management of approximately 17,000 square miles in South Florida, with an agency mission that includes the following elements: water supply, flood protection, water quality protection and environmental enhancement. The District's fundamental responsibility is to operate and maintain the Central and Southern Florida Project, a multipurpose water resources project first authorized by Congress in 1949.

The District's partner in many of its responsibilities is the Florida Department of Environmental Protection (DEP). Based in statute, the District operates under the general supervisory authority of the DEP and many of the District's programs rely on close cooperation between the agencies. The DEP issues permits to the District for the operation of water control structures. The District and DEP are specifically named as partners in the Everglades Forever Act with shared responsibility for various activities in the Everglades Program; see description below. The DEP is officially a cooperator in the production of this Report (RAM 8; **Table 1-1**). However, this Everglades Consolidated Report is primarily a product of District programs and projects associated with the Everglades Forever Act. Much of the information in this Report is

based on planning, monitoring and research that has been funded or conducted by District staff and has been combined with information available by about July 1, 1999, from peer-reviewed published literature, as well as from other organizations conducting research in the EPA.

The several elements of the Everglades Program (from the Everglades Forever Act) are outlined in **Table 1-1**, along with Research and Monitoring (RAM) Projects that provided most of the information summarized in this Report. **Table 1-1** also provides a summary of the 56 projects of the Everglades Program and ties these activities to chapters in this Report. Descriptions of the projects can be found in the publication titled, "Everglades Program Implementation: Program Management Plan (revision 3)" (SFWMD, 1997). The RAM element encompasses many of the subjects that will be covered in this Consolidated Report, although individual authors may go beyond the original scope of these projects, if required to provide relevant and complete information concerning key topics mentioned in the Act.

The overall Everglades Program includes interpreting the water quality standard for phosphorus (background science in Chapter 3), agricultural best management practices (Chapter 5), the Everglades Construction Project (Chapters 1, 6, 12 and 13), and supplemental technologies for treating stormwater (Chapter 8). A major component of the Everglades Program, the Everglades Stormwater Program (Chapter 11), includes developing the means to assure water quality compliance for structures discharging into, from or within the Everglades Protection Area. The Everglades Stormwater Program moves beyond the Everglades Construction Project (ECP) to assure water quality standards will be met for areas of the EPA that are not directly involved in the ECP. All of these elements of the Everglades Program are integrated in this chapter, Chapter 1, as it highlights successes, linkages and potential setbacks that may occur as these diverse programs are implemented. A general goal of the Everglades Consolidated Report is to improve public understanding of these programs and the science that supports decisions derived from the programs.

The District, other agencies, local governments and private interests, have worked cooperatively to develop a Lower East Coast Water Supply Plan (LEC Plan). The status of this Plan is described in Chapter 9. This Plan, completed in March 1998, is an *interim plan* because it provides for immediate steps within the framework of a larger, longer-term planning process. This regional planning process, the Central and Southern Florida (C&SF) Project Comprehensive Review Study (Restudy) is being led by the U.S. Army Corps of Engineers (Corps) and is the subject of Chapter 10. The Restudy will provide the basis for reconstructing the drainage network within the District so that the regional ecosystem can be managed in a more sustainable manner. The Restudy is linked to the Everglades Construction Project because the Restudy planning process assumes the ECP is completed and functioning fully as a condition of new regional plans. The Everglades Consolidated Report moves beyond the information provided in the 1999 Everglades Interim Report (SFWMD, 1999) with chapters added on land acquisition (12), revenues (13), exotic species control (14) and findings and implications (15). These additions make the Report more complete for decision support on projects relevant to the Everglades Protection Area.

Table 1-1. Seven elements and 56 projects of the Everglades Program as authorized through the 1994 Everglades Forever Act. This Consolidated Report is one of these projects (RAM 8).

Element Titles (7) Project abbreviations and titles (56)		Completion Dates	Chapter Coverage in the Everglades Consolidated Report
1. Everglades Construction			
Everglades Construction contains 18 projects including 5 Stormwater Treatment Areas and 3 hydropattern restorations.		All projects completed by 12/3l06	Construction projects are not discussed specifically in the Consolidated Report, but the ECP is mentioned in Chapters 1, 2, 4, 5, 6, 7, 8, 11, 12, 13, and 15.
2. Hydropattern Restoration			
Of the seven projects in this element, four are complete as of 12/31/98.		Most projects by 12/31/99, all by 10/01/03	Chapter 2 hydropattern issues, Chapter 9 LEC Water Supply Plan and Chapter 10 hydropattern restoration in the Restudy.
3. Research and Monitoring (RAM)			
RAM - 1	Describe Water Quality in EPA and Tributary Waters	01/31/96	Chapter 4 covers water quality in detail.
RAM - 2	Evaluate Best Management Practices Effectiveness	12/31/01	Chapter 5 is devoted to the EAA BMP implementation.
RAM - 3	Evaluate Existing Water Quality Standards for the EPA	12/31/01	Chapter 4 covers water quality in detail.
RAM - 4	Evaluate WQ Standards and Classifications of EAA Canals	12/31/01	Chapters 1 and 4, canal evaluations not completed to date.
RAM - 5	Optimize Stormwater Treatment Area Operation	12/31/06	Chapter 6 with annual updates through 2006.
RAM - 6	Interpret Class III Phosphorus Criterion Research	12/31/02	Chapter 3 with discussion of scheduling in Chapter 1.
RAM - 7	Peer-Review Interim Report	01/01/99	Product of RAM 7 is the 1999 Everglades Interim Report.
RAM - 8	Peer-Review Annual Report	01/01/00 and yearly to 2006	RAM 8 will provide updates; currently, 2000 Everglades Consolidated Report
RAM - 9	Monitor C-139 Basin Water Quality	05/01/95, in progress	Covered in Chapter 4 of this report.
RAM - 10	Hydrological Needs of the Ecosystem	12/31/01	Covered in detail in Chapter 2 and mentioned throughout the Report.
RAM - 11	Mercury Monitoring and Research	12/31/01	Covered in detail in Chapter 7.
RAM - 12	Identify Supplemental Technologies (Advanced Treatment Technologies)	01/01/01	Covered in detail in Chapter 8 and mentioned in Chapters 1 and 11.
RAM - 13	Best Management Practice Strategies for other Water Quality Parameters	12/31/06	Not covered directly in Report; relevant information is in Chapters 5, 6, 8 and 11
4. Regulation Projects			
This element includes 10 projects; three are now completed.		All projects 12/ 31/06	Projects are mentioned in Chapters 1, 5, 9, 11 and 15.
5. Exotic Species Control		Ongoing	Covered in Chapter 14 and mentioned in Chapters 2, 3 and others.
6. Funding Projects		Ongoing	Covered in Chapter 13 and mentioned in 9, 10, 11, 12, and 15.
7. Everglades Annual Reports		Ongoing	This Consolidated Everglades Report attempts to encompass as many annual reporting requirements as possible.

REGIONAL ENVIRONMENTAL ISSUES

As mentioned above, the EPA includes the Water Conservation Areas, the Arthur R. Marshall Loxahatchee National Wildlife Refuge and Everglades National Park, and encompasses what remains of a once larger Everglades ecosystem. This larger system extended from the south shore of Lake Okeechobee to the mangrove estuaries of Florida Bay and covered more than 10,000 square kilometers (Davis, 1987; Light and Dineen, 1994). Urban and agricultural development during this century have reduced the present-day Everglades to 50 percent of its original size (Mitsch and Gosselink, 1993), of which 3,400 square kilometers have been impounded within the WCAs (SFWMD, 1992a; Chapter 2). The remaining wetland still contains a variety of habitats (e.g., tree islands, wet prairies and aquatic sloughs) that support unique biotic communities, and is widely recognized as an ecosystem of immense regional and international importance (SFWMD, 1992a; Lodge, 1994; Maltby and Dugan, 1994; Chapters 2, 3 and 4). Everglades National Park was designated an International Biosphere Reserve in 1976, an Outstanding Florida Water in 1978 and United Nations World Heritage Site in 1979.

There is concern in the regulatory, scientific and environmental communities that the biotic integrity of the remaining Everglades is endangered. This position is based, in part, on undesirable changes observed in water quality, flora and fauna in portions of the EPA during the last several decades. These changes include: establishment of pronounced nutrient gradients in the WCAs downstream of major discharge structures; replacement of large areas once dominated by sawgrass and periphyton with cattail; decline in wading bird populations; and species changes in periphyton and macroinvertebrate communities (Belanger et al., 1989; Davis, 1987, 1991, 1994; Grimshaw et al., 1993; Nearhoof, 1992; Ogden, 1994; Rutchey and Vilchek, 1994; SFWMD, 1992a, 1992b; Swift and Nicholas, 1987; Walker, 1991). These environmental impacts have been attributed to urban and agricultural development, a disruption of the system's natural hydroperiod and an introduction of nutrient-rich runoff to the EPA from the 2,800-square-kilometer-Everglades Agricultural Area (EAA) (see SFWMD 1992a, 1992b, 1992c; Chapters 1, 2, 3, 4, 7, 9, 10 and 15).

The Florida Legislature has stated the following:

> "...the Everglades ecological system not only contributes to South Florida's water supply, flood control, and recreation, but serves as the habitat for diverse species of wildlife and plant life. The system is unique in the world and one of Florida's great treasures. The Everglades ecological system is endangered as a result of adverse changes... and, therefore, must be restored and protected." (Everglades Forever Act [Act; Section 373.4592, F.S. as amended])

Phosphorus has been identified as the nutrient most responsible for changes in periphyton and plant communities within the EPA (Koch and Reddy, 1992; McCormick and O'Dell, 1996; McCormick et al., 1998; Chapter 3). Reducing P loading to the EPA is central to the District's strategy for restoring and preserving the Everglades (SFWMD, 1992a). Agricultural Best Management Practices (Chapter 5) and the application of constructed wetlands for phosphorus assimilation (Chapter 6) are the two fundamental approaches being used to reverse enrichment of Everglades marshes. Best management practices have been installed in the Everglades Agricultural Area and have proven successful at reducing P loading from that basin. Wetlands for stormwater treatment are being constructed as the second line of nutrient cleansing for the Everglades Protection Area.

STORMWATER TREATMENT AREAS

Concern over environmental conditions in the Everglades prompted the Florida Legislature to enact the Everglades Protection Act in 1991 (Section 373.4592, F.S.). This Act was intended to help resolve long-standing litigation related to Everglades restoration, require the District to adopt a Surface Water Improvement and Management Plan for the Everglades that included programs and projects for stormwater management systems, and bring all facilities into compliance with applicable water quality standards. The resulting plan (SFWMD, 1992a) proposed the construction of three large treatment wetlands encompassing approximately 16,000 hectares (about 40,000 acres). These constructed wetlands are now referred to as Stormwater Treatment Areas (STAs) and are designed to serve as biological traps to reduce the P concentration in agricultural runoff entering the EPA. The treatment areas are sometimes called "filter marshes" by the media. We urge that this label not be used because STAs do not filter the water. STAs treat by promoting natural uptake or chemical binding of nutrients, and gradual settling and accumulation of nutrients in the sediments.

The basis of design for the STAs is provided in conceptual design documents by Burns and McDonnell (1992), Kadlec and Newman (1992), and Walker (1995). The Everglades Forever Act (**Act**) was enacted by the Florida Legislature in 1994 and established the funding mechanisms and construction timetable for a more comprehensive program of five STAs, as well as other restoration projects (see **Figure 1-1** for location of STAs). In mandating the Everglades Program, the Legislature opted for action to restore the ecosystem; a no action alternative was not considered viable in the wake of Everglades Protection Act and subsequent negotiations. Furthermore, the Act requires the District to initiate research and monitoring programs that, among other things, will seek to optimize the operation of the STAs to achieve optimum water quality for the benefit of the Everglades. The research and monitoring program described primarily in Chapter 6 of this Report is intended to provide the District with the information necessary to achieve this mandate, particularly with regard to the need to construct the largest unit, STA-3/4. However, the scientific concepts underlying the effectiveness of STAs are also examined in Chapters 2, 3, 4, 5, 7 and 8. The research and monitoring projects within the Everglades Program are summarized in**Table 1-1**.

INTERIM AND LONG-TERM WATER QUALITY GOALS FOR THE EVERGLADES

The following four sections summarize numerous research, regulatory, engineering and construction activities concerning water quality goals for the Everglades, an integrated approach to achieving goals, risks associated with decision-making and conclusions on achieving water quality goals. These sections were contributed by a team of District staff who attempted to integrate and bridge multiple components of the Everglades restoration through this narrative. Contributing authors include Gary Goforth, Susan Gray, Tom Fontaine, Keith Rizzardi, Sharon Trost and Tom Teets.

The South Florida Water Management District (District), in partnership with other agencies and private landowners, is aggressively and successfully achieving interim milestones toward restoration of the Everglades ecosystem. Concurrent with the construction of more than 42,000 acres of treatment wetlands, the District and other groups are conducting water quality research, ecosystem-wide planning and regulatory programs to ensure a sound foundation for science-based decision-making. Florida's 1994 Everglades Forever Act establishes both interim and long-term water quality goals to ultimately achieve restoration and protection of the Everglades Protection Area. The Act recognizes that additional measures may be required to achieve compliance with long-term water quality standards. The interim program encompasses those activities underway to reduce phosphorus (P) concentrations to a long-term average of 50 parts per billion (ppb), and includes the Everglades Construction Project and the Everglades Agricultural Area best management practices (BMPs). The long-term goal is to combine point-source, basin-level and regional solutions in a system-wide approach to ensure that all waters discharged to the EPA are achieving water quality goals by December 31, 2006. With respect to nutrients, the long-term goal is to reduce nutrient discharges to levels that do not cause an imbalance in natural populations of aquatic flora or fauna.

Successful implementation of the long-term water quality strategies will require integration of numerous research, planning, regulatory and construction activities, as represented in **Figure 1-2.** The interrelationships among these activities and their anticipated time frames are diagrammed in more detail in **Figure 1-3**. This section describes how these activities will be synchronized to ensure that implementation decisions incorporate the best available information: true adaptive management in practice. Individual project management plans have been developed for each of these activities (Everglades Program Management Plan, District and DEP 1997). This section, and the others referenced herein, also fulfill the requirement of Special Condition 5 of the U.S. Army Corps of Engineers Section 404 permit for a draft strategy to ensure that water discharged from the STAs (except STA 1 East) meet applicable water quality standards by December 31, 2006. As a draft, this document recognizes that many scientific, engineering, regulatory and other uncertainties remain that will significantly influence the development of a final strategy. Presently, the magnitude and complexity of these uncertainties preclude the finalization of the District's strategy. However, an immediate benefit of this document is that it establishes the foundation upon which the final strategy will be based. Complete descriptions of alternative water quality measures presently being considered are presented, along with descriptions of the proposed rationale for selection of the recommended alternatives, and considerations of flexibility to adjust to potential ranges of phosphorus criteria. Investigations of basin-specific solutions will result in schedules for implementation of the strategy and descriptions of the implementation of operational plans. Revisions/updates to predictive models such as those in the Programmatic Environmental

Impact Statement for cattail response, periphyton response and hydropattern changes are not available now, but will be submitted in the final strategy on January 1, 2001.

Considering the number and complexity of the many activities required to achieve the long-term water quality goals, the 2006 time frame established by the Act is ambitious. Delays in the timely completion of these activities, many of which are outside the control of the District, may result in unintended delays. Acceleration of necessary research before the December 31, 2001, deadline may be difficult because biological research inherently requires one or more growing seasons to evaluate performance. In order 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. Future annual updates to this peer-reviewed Report and Draft Strategy will provide greater detail on the potential obstacles and other constraints for achieving long-term water quality goals, as well as identify potential remedies.

INTEGRATED APPROACH TO ACHIEVE LONG-TERM WATER QUALITY GOALS

The long-term water quality goal of the Act is to implement the optimal combination of enhanced BMPs, STAs, advanced treatment technologies and/or regulatory programs to ensure that waters discharged to the EPA achieve water quality standards no later than December 31, 2006. The Act intended "to provide a sufficient period of time for construction, testing, and research so that the benefits of the ECP will be determined and maximized prior to requiring additional measures." (373.4592(1)(g), F.S.). If the ECP and other discharges to the EPA are not in compliance with state water quality standards, the Act requires that the District submit an integrated water quality plan by December 31, 2003, to achieve compliance with state standards by December 31, 2006. If discharges to the EPA are in compliance with state water quality standards, the Act requires that the District submit an integrated plan by December 31, 2003, to maintain compliance with standards. The Corp's construction permit ("404 permit") for the ECP requires the transmittal of a water quality strategy almost three years earlier (January 1, 2001) to ensure that discharges from the STAs (except STA 1E) to the EPA are in compliance with long-term water quality standards by December 31, 2006. A preliminary draft of this strategy was submitted January 1999 and this section, and others referenced herein, are submitted as a revised draft. Both the integrated water quality plan required by the Act and the water quality strategy required by the USACE permit will incorporate the best available information from the on-going research, rule-making and/or other regulatory programs.

As shown in **Figure 1-3**, a tremendous amount of research, data analyses, rule-making, planning and basin-specific evaluations must be completed and integrated in a short time in order to develop the integrated water quality plans and long-term permit applications by December 31, 2003. At least 18 steps, some in parallel, some in sequence, must be completed in order to determine, fund and implement the optimal combination of enhanced BMPs, STAs, advanced treatment technologies and/or additional regulatory programs. The interrelationship between these steps and the anticipated time frames for each are summarized below.

Long-term Everglades phosphorus research must be completed no later than December 31, 2001. Concurrent efforts are underway by researchers supported by the District, federal agencies and the agricultural industry to provide data for the DEP to establish a Class III numeric water quality criterion for P in the EPA. The objective of

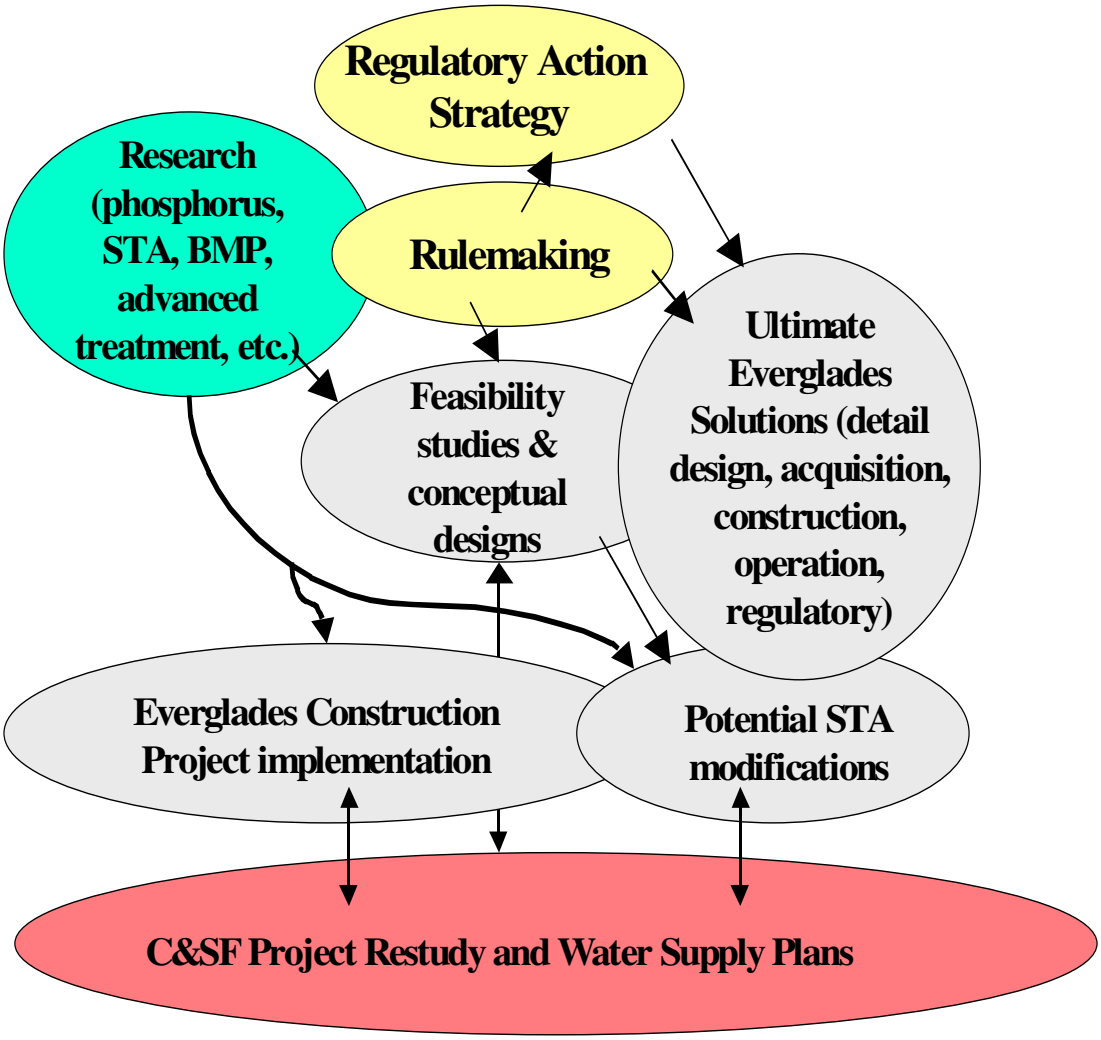

Figure 1-2. Schematic of research, planning, regulatory and construction activities underway to achieve the long-term water quality goals of the Everglades.

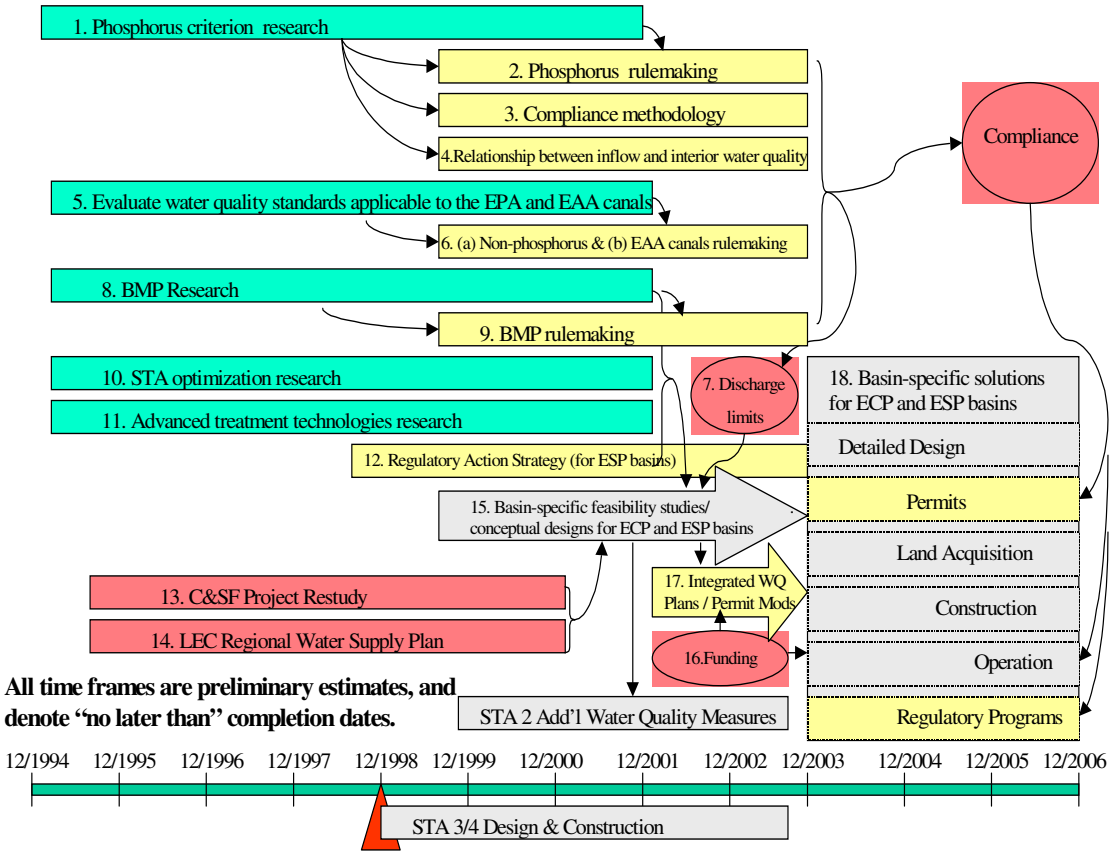

Figure 1-3. Time frames for critical activities to meet the water quality goals identified in the Everglades Forever Act.

this research is to quantify the specific threshold levels of P above which undesirable changes occur to the native Everglades populations of aquatic flora or fauna. While this work continues to focus principally on open-water (wet prairie, slough) habitats, available information indicates that these ecologically critical areas are especially sensitive to P enrichment. Therefore, numeric P standards that are protective of these habitats should be protective of the entire marsh. The DEP established the Everglades Technical Advisory Committee and conducts QA/QC reviews of the data and peer-reviews of the research effort to ensure that regulatory decisions are based on a strong scientific foundation. While the comprehensive research effort will be finished no later than December 31, 2001, research in discrete areas will be completed sooner. Specifically, research in WCA-2A is substantially complete, and District research in the A.R.M. Loxahatchee National Wildlife Refuge (Refuge) should be completed by April 2000. Research in WCA-3A and Taylor Slough of the Everglades National Park should be complete in August 2000. Additional information on the Everglades phosphorus research is found in Chapter 3 of this report.

This phosphorus research will provide the foundation for rule-making to establish a numeric phosphorus criterion for the Everglades, to be completed no later than December 31, 2003. The DEP's current schedule calls for initiating rule-making by December 2000, a full year ahead of the statutory deadline. If rule-making is not completed by December 31, 2003, the Act establishes a default P criterion of 10 ppb. The P criterion, whenever adopted, shall supersede the 10 ppb default otherwise established by the Act, but shall not be lower than the natural conditions of the EPA and shall take into account spatial and temporal variability. In a related action, in May 1999, the USEPA approved the 10 ppb water-column quality standard adopted by the Miccosukee Tribe of Indians of Florida for their tribal lands. Citing peer-reviewed publications and technical reports, the USEPA determined that the 10 ppb standard was a "scientifically defensible value which is not overly protective." Additional information is found in Chapter 3 of this report.

The DEP must finalize the method for determining compliance with the phosphorus criterion and the location of representative receiving water sampling stations. Concurrent with rule-making, the method for determining compliance with these criteria will be finalized in accordance with the framework described in the Act (Section 373.4592(4)(e)3, F.S.):

> Compliance with the phosphorus criterion shall be based upon a long-term geometric mean of concentration levels to be measured at sampling stations recognized from the research to be reasonably representative of receiving waters in the Everglades Protection Area, and so located so as to assure that the Everglades Protection Area is not altered so as to cause an imbalance in natural populations of aquatic flora and fauna and to assure a net improvement in the areas already impacted.

The DEP must develop the relationships between waters entering the Everglades with the resulting water quality in the Everglades. In order to accelerate this process, work was initiated during 1999 and is to be completed no later than December 31, 2003. These relationships will be used to establish phosphorus discharge limits for waters entering the EPA. These upstream discharge limits will serve as the targets for long-term water quality solutions. In advance of these determinations, the District is using a planning-level estimate of 10 ppb for discharge limits for all tributaries to the EPA. Additional details on the nutrient threshold research are provided in Chapter 3 of this report.

The DEP and the District must complete all research required to evaluate all water quality standards other than phosphorus applicable to the EPA and EAA canals by December 31, 2001. The Everglades Forever Act requires the District and DEP to address not only P concerns in the Everglades, but to evaluate other water quality standards applicable

to the EPA and the EAA canals. Paragraph 4(e) of the Act requires that DEP's evaluation include the state's anti-degradation standards and EAA canal classification, and directs DEP to recognize by rule-making existing beneficial uses of the EAA conveyance canals. Should the evaluation indicate that revised standards are necessary, additional rule-making would be required to revise the standards. Although the Act does not set a specific deadline for this rule-making, the requirement for the District to submit an integrated plan by December 31, 2003, to address all water quality parameters suggests that all related rule-making should also be completed by that time. As shown in **Figure 1-3**, completion of this additional rule-making is in the critical path for determining and implementing long-term solutions by December 31, 2006. Additional details on these water quality data evaluations are provided in Chapters 2 and 7 of this Report.

The DEP must complete rule-making to revise water quality standards for the EPA and EAA canals, recognizing the existing beneficial uses of the EAA canals. Although the Act does not set a specific deadline for this rule-making, it is assumed that it will be completed by December 31, 2003.

A key use of the relationships developed in Step 4 above and the rule-making in Step 6 above will be for the DEP to establish discharge limits or levels for waters entering the Everglades Protection Area. It is these upstream discharge limits or levels that will serve as the targets for long-term water quality solutions. This activity is planned to get underway by December 31, 2001, and should be completed by December 31, 2003.

To determine the most cost-effective combination of enhanced BMPs, STAs and advanced treatment technologies, the research from these three efforts will be completed no later than December 31, 2001. The reduction of P discharged from farms, towns and other land uses within this area has been approached through BMPs. An EAA-wide target of 25 percent load reduction compared to the May 1979 - April 1988 pre-BMP period was established by District rule-making. Over the last four years, cumulative P loads from the EAA farms, towns and other land uses have been reduced by 54 percent as compared to the calculated load that would have occurred during the pre-BMP period (adjusted for hydrologic variability). P concentrations have also been reduced significantly from the pre-BMP period to approximately 100 ppb, and while this is a positive improvement, additional P reduction downstream in the regional STAs is necessary in order to achieve the Act's interim goal of 50 ppb. The agricultural industry, with support from state and federal agencies, is continually investigating additional measures to enhance the existing BMP programs. The District's BMP rule (40E-63) has been amended to implement a comprehensive program of research, testing and implementation of BMPs that addresses all water quality standards that are not being significantly improved by the STAs and the current levels of BMPs. If proven cost-effective, additional BMPs could be implemented to reduce the overall costs and scale of the long-term water quality solutions. Additional details on the BMP programs are provided in Chapter 5 of this report.

During each five-year term of EAA BMP permits, the District shall amend Rule 40E-63, FAC as needed to implement a comprehensive program of research, testing and implementation of BMPs that will address all water quality standards within the EPA and EAA.

STA Optimization. Virtually all of the STA designs have been refined according to standard engineering practice to incorporate new information that was not available during the earlier design phase. This adaptive management will continue throughout implementation of the ECP. The period of time between commencement of operations for the interim program and commencement of operation for the long-term solutions varies from 9 years for STA 6 Section 1 to just over three years for STA-3/4. A combination of field research, evaluation of available data for similar systems, and application of appropriate wetland water quality

models is being used to identify ways to optimize the nutrient removal performance of the STAs.

Research has been underway in the large treatment cells of the Everglades Nutrient Removal (ENR) project since 1994. In addition, activities are underway in the smaller ENR test cells where greater water control and statistical replication are available. The results will include recommendations for enhancing the nutrient-removal performance of STAs through refining system operations (e.g., water depths and hydraulic retention times). This optimization research will be completed no later than December 31, 2001, however, results will be incorporated into STA operations as soon as sufficient information becomes available. Also, as the early STAs come on-line, their operations will be continuously evaluated, with valuable feedback incorporated into other STA operations. Based on the review of ENR Cell 4 (polishing cell) data and results from the SAV/Limerock mesocosm research, the District is moving forward with managing STA 1 West (Cell 5), STA 2 (Cell 3) and STA 5 (Cell 1b) as submerged aquatic vegetation treatment cells rather than cattails. In **Figure 1-3**, completion of STA optimization research is in the critical path for determining and implementing long-term solutions by December 31, 2006. Completion of the STA optimization research before the December 31, 2001 deadline may be difficult because biological research inherently requires one or more growing seasons to evaluate performance. Additional details on STA performance and STA optimization research are provided in Chapter 6.

Advanced Treatment Technologies Research. Since the early 1980s, alternative on-farm and regional water quality measures have been evaluated to reduce nutrient levels discharged into the Everglades. In 1996, the District completed a comprehensive evaluation of promising P reduction technologies, ranging from low-intensity management of constructed wetlands to full-scale chemical treatment (PEER Consultants, P.C./ Brown and Caldwell, 1996). Various combinations of the highest ranked technologies were evaluated on the basis of nutrient removal performance, implementation costs and environmental criteria. This evaluation confirmed that STAs are indeed the best interim step towards achieving the long-term water quality and hydropattern restoration goals of the Everglades. In addition, the most promising P removal technologies were identified, and the remaining technological uncertainties were documented to guide future research.

The U. S. Army Corps of Engineers included a condition in their construction permit for the STAs to expand the list of potential advanced treatment treatment technologies to be investigated. The DEP, District and other interests are conducting research efforts on these advanced treatment technologies to further determine critical design criteria such as performance efficacy, hydrologic operating characteristics, land requirements, initial and annual costs, and identification of potential environmental impacts. Many of these have potential for both on-farm treatment of hot spots and regional application. In order to ensure that comparable information is obtained from each advanced treatment technology study, the District developed a Standard of Comparison for use during each research project. The Standard of Comparison standardizes data collection and analyses, as well as defines common methodology for evaluating the individual technologies. As shown in **Figure 1-3**, completion of advanced treatment technology research is in the critical path for determining and implementing long-term solutions by December 31, 2006. Completion of this research before the December 31, 2001, deadline may be difficult because biological research inherently requires one or more growing seasons to evaluate performance. Additional details on the advanced treatment technology research and the Standard of Comparison are provided in Chapter 8.

Everglades Stormwater Program. For all basins that discharge into the Everglades Protection Area that are not covered by the Everglades Construction Project, the District developed and is implementing a Regulatory Action Strategy to develop a basin-specific regulatory program to ensure compliance with all water quality standards

no later than December 31, 2006. The Everglades Construction Project covers seven of the 16 major basins that discharge into the Everglades Protection Area. The water quality strategies for the remaining seven basins and the interior waters of the Everglades were identified in the permit issued in April 1998, which is referred to as the "non-ECP" permit. These schedules and strategies are being implemented through the District's Everglades Stormwater Program. The Everglades Stormwater Program includes a combination of regulatory analyses, water quality monitoring and evaluation, and other water quality improvement measures. Other components of the program include intergovernmental cooperative projects, an education campaign, and development of a method for reimbursement of expenditures through a special assessment. The Everglades Stormwater Program is described more fully in Chapter 11 of this report.

Comprehensive Review Study of the Central and Southern Florida (C&SF) Flood Control Project (Restudy). It is anticipated that the Restudy analyses will yield long-term hydropattern design targets for the long-term solutions and potential EAA reservoirs. Pursuant to federal legislation, the Corps and the District completed a comprehensive review study in 1999 to evaluate the feasibility of making structural and operational modifications to the C&SF Project. The objectives of the feasibility study are to restore the ecological integrity of the South Florida ecosystem while continuing to provide flood protection, agricultural and urban water supply and other project purposes. Evaluation of alternatives was conducted with significant input from an interagency Restudy Team, as well as input from stakeholders and the general public. A draft comprehensive report was completed in the fall of 1998, and the final report was submitted to Congress in July 1999. The final product consisted of a comprehensive feasibility report with a programmatic environmental impact statement. It is anticipated that the C&SF Restudy will (1) determine the total water storage capacity required to achieve the hydropattern restoration goals for the Everglades, and (2) define requirements for temporal and spatial distribution of flows to the Everglades. Interim and final results from the Restudy will be integrated into long-term implementation activities subject to funding and timing constraints. Additional details on the Restudy are provided in Chapter 10 of this report.

Lower East Coast (LEC) Regional Water Supply Plan. Completion of the final Lower East Coast Regional Water Supply Plan (scheduled for April 2000) will further define the hydrologic environment for the long-term solutions including discharge locations, timing of deliveries and overall quantities). Assisted by an Advisory Committee of urban, environmental and agricultural stakeholders, the District completed an interim plan for water supply for the area south and east of Lake Okeechobee in the spring of 1998. There is explicit linkage between the LEC Plan and the implementation of Everglades restoration activities, particularly in the quantity, timing and distribution of flows through the system. The Final LEC Plan, to be consistent with the 1997 Water Resources legislation and to incorporate findings of the Restudy, is anticipated to be complete by April 2000. Additional information on the LEC Plan is provided in Chapter 9 of this report.

As soon as sufficient information is obtained from the BMP, STA optimization, advanced treatment technology research and the Everglades Stormwater Program regulatory action strategy, basin-specific feasibility studies and conceptual designs must be completed to determine the optimal combination of water quality measures required to achieve the long-term water quality goals. For planning purposes, an end-of-pipe discharge limit of 10 ppb will be assumed. If the final discharge limits are significantly different from 10 ppb, the optimal long-term solutions may be altered, with significant cost differences and other implications.

The basin-specific feasibility studies and conceptual engineering designs will be completed on an individual basis between December 31, 2002, and December 31, 2003. It is anticipated that there

will be seven steps in the development of the basin-specific feasibility studies and conceptual designs:

- Characterize basin-specific baseline flows and loads
- Summarize basin-specific outflow water quality and quantity targets for discharges into the EPA
- Determine the treatment required to achieve the targets
- Determine alternative combinations of solutions (BMPs, STA Optimization, advanced treatment technologies, etc.)
- Evaluate alternatives (technical, environmental, economic, financial, etc.)
- Recommend optimal combination for each basin
- Develop basin-specific conceptual designs
- Feasibility studies and conceptual designs will be developed for each of the following Everglades Protection Area tributary basins shown in **Table 1-2**

Table 1-2. Everglades Protection Area Tributary Basins included in Statement of Work

Basin	Canal	STA	Receiving Water
S-5A (EAA)	West Palm Beach Canal	STA 1W, STA 1E	A.R.M Loxahatchee National Wildlife Refuge (WCA 1)
S-6 (EAA)	Hillsboro Canal	STA 2	Water Conservation Area 2A
S-7 (EAA)	North New River Canal	STA-3/4	WCA 3A
S-8 (EAA)	Miami Canal	STA-3/4	WCA 3A
L-8	L-8	STA 1W (interim)	A.R.M Loxahatchee National Wildlife Refuge (WCA 1)
C-51 West	C-51 West	STA 1 E, STA 1W	A.R.M Loxahatchee National Wildlife Refuge (WCA 1)
C-139 (including the Annex)	L-3 Canal	STA 5, STA 6	WCA 3A
North Springs Improvement District	N/A	N/A	WCA 2A
North New River	North New River	N/A	WCA 3A
C-11 West	C-11 West	N/A	WCA 3A
Feeder Canal	L-28 Interceptor Canal	N/A	WCA 3A
L-28	L-28	N/A	WCA 3A

Funds need to be appropriated for implementation of long-term solutions. The Act allocated several state sources for funding the implementation of the ECP, including agricultural privilege taxes, *ad valorem* taxes, Alligator Alley toll revenues, Preservation 2000 funds and Surface Water Improvement and Management funds. In addition, federal funds have been appropriated for STA-1 East. However, funding for implementation of long-term solutions has not been appropriated, though research designed to support these decisions is already underway. The costs of the long-term solutions will be dependent on the basin-specific optimal combination of enhanced BMPs, STAs, advanced treatment technologies and/or additional regulatory programs required to achieve the long-term water quality goals of Everglades restoration. While it is possible to estimate research costs to support long-term decisions, it is impossible at this time to develop a firm estimate of the total costs until additional research and basin-specific studies and conceptual designs are completed. In addition, the Florida Legislature may consider the public/private mix of funding in concert with the recent "polluter pays" amendment to the Florida constitution. This funding picture may be further complicated due to competition for public funds from projects stemming from the C&SF Restudy.

By December 31, 2003, the District must submit to the DEP permit modifications and/or applications for the long-term water quality measures, as needed. These will include the integrated water quality plans required by the Everglades Forever Act and will be refined from the water quality strategy submitted to the Corps by January 1, 2001. In addition to the information developed in the basin-specific feasibility studies, the integrated water quality plans will include proposed funding mechanisms and implementation schedules.

Ultimately, if all the preceding steps are completed on time, and if the integrated water quality plans are authorized by all appropriate State and federal agencies, the District must design, acquire necessary lands, establish necessary regulatory programs and otherwise implement the long-term solutions by December 31, 2006.

ACCELERATING IMPLEMENTATION OF LONG-TERM SOLUTIONS

In February 1999, Governor Bush directed that the Everglades program be accelerated to implement advanced treatment technologies as soon as possible. Responding to Governor Bush's direction, the DEP took the lead to bring the SFWMD, Miccosukee Tribe of Indians, agricultural representatives, and Everglades researchers together to evaluate means of accelerating restoration and restore a more natural hydropattern to the Everglades. Department of Interior consultants participated as technical advisors. The basic principles of the DEP's technical work group were: 1) Everglades water quality should be restored and water quality standards achieved by December 2006; 2) Long-term water quality treatment should be based on environmentally sound and biologically based technologies; 3) Long-term water quality solutions should be implemented as soon as possible by retrofitting existing STAs to achieve the greatest reductions in phosphorus concentrations; 4) an accelerated program of research and monitoring should be devised to establish design criteria for achieving water quality standards by December 2006; 5) the ongoing design of STA 3/4 should be modified and the STA constructed to take advantage of advances in water quality treatment technology; and 6) whenever possible, make additional efforts toward correcting hydropattern deficiencies caused by construction of the Central & Southern Florida Flood Control Project.

This technical work group reviewed data from the Everglades Nutrient Removal project and results of ongoing research on advanced treatment

technologies and determined that there are significant steps that can now be taken to incorporate research findings into the existing Everglades Construction Project. The work group developed a draft accelerated technical plan that included structural and operational modifications to the STAs, additional water quality/flow monitoring, and accelerated research. (**NOTE: The draft accelerated technical plan had not been completed by DEP at the time of this publication.**)

The phosphorus goal of the draft accelerated technical plan was to achieve average outflow phosphorus concentrations of less than 25 ppb, and best professional judgement suggests that concentrations in the range of 15-35 ppb are achievable. The current state of knowledge does not identify a way to meet 10 ppb or less using natural technologies within the existing footprint or on prior agricultural lands. With additional research, it may be possible to develop such a design, however, if this does not prove possible the State of Florida remains committed to evaluate other means to achieve this goal. To achieve compliance with water quality standards in the Everglades by December 2006, it will be necessary to continue refining structural and operational modifications to the STAs, based on critical research, monitoring and improved forecast modeling, through the continued involvement of an interdisciplinary technical review team.

RISKS ASSOCIATED WITH PREMATURE SELECTION OF LONG-TERM WATER QUALITY SOLUTIONS

Florida's Everglades Forever Act establishes an orderly process of research and rule-making to develop a science-based foundation for making long-term water quality decisions. This process was described above and remains the ideal strategy for achieving long-term compliance with all water quality goals. This approach accomplishes the Legislature's intent to allow a sufficient time for construction, testing and research, so that the benefits of the Everglades Construction Project and the EAA BMPs will be determined and maximized prior to requiring additional measures. If the interim program alone cannot achieve the long-term goals, this orderly approach will enable sound science-based decisions for the selection of additional water quality treatment options.

If critical decisions on long-term water quality solutions were made prematurely, i.e., without sufficient time to assess the current program, establish appropriate discharge limits and investigate alternative measures, they would carry associated environmental and economic risks.

Examples of potential environmental risks include the following:

1. The possibility that the solutions selected early may not achieve the long-term phosphorus target;
2. The possibility that the solutions selected early may not achieve the long-term water quality goals for parameters other than phosphorus;
3. The possibility that the solutions selected early may cause or contribute to unintended adverse impacts to the Everglades.
4. The possibility that the solutions selected early may cause potential sludge or other by-products disposal problems.

Examples of potential economic risks include the following:

1. The possibility that the solutions selected early may incur additional capital as well as annual operation and maintenance costs.

2. The possibility that the solutions selected early may incur acquisition of additional lands.
3. The possibility that the solutions selected early may result in legal challenges to the sufficiency of science and engineering information used in the decision process.

The orderly process of research and rule-making described above was designed to provide sufficient science and engineering information, and to reduce the uncertainty in associated factors, thereby satisfying both the intent of the Everglades Forever Act and minimizing the environmental and economic risks associated with the long-term water quality solutions.

CONCLUSIONS AND FINDINGS ON AN INTEGRATED PLAN TO ACHIEVE WATER QUALITY GOALS

Concurrent with the implementation of the interim projects, the District and other groups are conducting water quality research, ecosystem-wide planning, and regulatory programs to ensure a sound foundation for science-based decision-making for long-term water quality solutions. However, in order to meet the ambitious time frames in the Everglades Forever Act, the District may be required to make recommendations for the long-term solutions based on incomplete science, engineering and regulatory information, which carries associated environmental and economic risks. The key gaps in the information base for the long-term decisions, described throughout this section, are summarized below:

1. The Class III numeric phosphorus criterion for the Everglades Protection Area.
2. The methodology to be used to determine compliance with the Class III numeric phosphorus criterion for the Everglades Protection Area.
3. The relationship between waters entering the Everglades and the resulting water quality in the Everglades.
4. Revised water quality standards for parameters other than phosphorus applicable to the Everglades Protection Area and EAA canals.
5. Basin-specific discharge limits for waters entering the Everglades Protection Area.
6. Technical efficacy and cost effectiveness of enhanced BMPs.
7. Means to optimize the phosphorus treatment performance of STAs.
8. Technical efficacy of advanced treatment technologies, along with examination of costs and benefits of phosphorus reduction alternatives, and implementation schedules.
9. Water quality evaluation for tributaries other than those treated by the ECP.
10. Modifications to the flows and phosphorus loads resulting from C&SF Restudy components, along with implementation schedules.
11. Hydrologic regimes from the LEC Plan, along with implementation schedules.
12. Funding constraints for long-term solutions and time frames, including Amendment 5 issues.
13. Basin-specific combinations of BMPs, STAs, advanced treatment technologies as needed and/or additional regulatory programs.

Considering the number and complexity of the many activities required to achieve the long-term water quality goals, the 2006 time frame established by the Act is very ambitious. Delays in the timely completion of these activities, many of which are outside the control of the District, may result in unintended delays, despite the best efforts

of the District. Acceleration of necessary research before the December 31, 2001, deadline may be difficult because biological research inherently requires one or more growing seasons to evaluate performance. Future annual updates to this peer-reviewed Report will provide greater details on the potential obstacles and other constraints for achieving the long-term water quality goals, as well as identify potential remedies.

OBJECTIVES AND CONTENT OF THE EVERGLADES CONSOLIDATED REPORT

The first and foremost objective of this Report is to summarize available data and findings relating to the Everglades restoration effort. Information from this Report will be used by the District and DEP for making decisions affecting implementation of the Everglades Construction Project (ECP) and other restoration and management activities. It is important to recognize that the Report does not conclude any planning or public input process. Rather, the Report is part of an ongoing process to provide information for decisions and updates on important programs. In addition, the Report satisfies the reporting requirements and specifications of multiple permits, including: the U.S. Army Corps of Engineers (Corps) Section 404 permit for the ECP; DEP permits for the ECP; the Non- ECP permit issued by DEP; and the DEP Long-Term Compliance Permit, which the District will apply for in December 2003. It is also the intent of District authors to provide information needed for resource management whether there is a specific requirement for reporting or not.

This Everglades Consolidated Report has been produced pursuant to section 373.4592(4)(d) 6 F.S., which requires the District to submit an annual peer-reviewed report to state officials; this requirement is RAM 8 of the Everglades Program (**Table 1-1**). The scientific workshop and the public hearing are part of the peer review process and were held in September 1999. Through that review process, numerous other agencies or organizations contributed information and focus to this report. However, unlike the 1999 Everglades Interim Report, peer review is not required to include a public hearing with public access to the review panel. The District's Executive Council voted to hold a public hearing and to conduct an open panel review for this Report because the issues being communicated are very important to local resource agencies and the public, and the issues deserve open deliberation before a panel of objective experts. The concept is that everyone benefits from peer review in the sunshine and the District is able to generate a more credible and responsive product through constructive public criticism.

The contents of this 2000 Everglades Consolidated Report expand upon those of the 1999 Everglades Interim Report (SFWMD, 1999). The data and findings will be used for decisions regarding the implementation of the ECP and other restoration programs, and are set forth in the Act (Section 373.4592(4)(d)5. F.S.) as follows:

> The interim report shall summarize all data and findings available as of July 1, 1998, on the effectiveness of STAs and BMPs in improving water quality. The interim report shall also include a summary of the then-available data and findings related to the following: the Lower East Coast Water Supply Plan of the district, the United States Environmental Protection Agency Everglades Mercury Study, the United States Army Corps of Engineers South Florida Ecosystem Restoration Study, the results of research and monitoring of water quality and quantity in the Everglades region, the degree of phosphorus discharge reductions achieved by BMPs and agricultural operations in the region, the current information on the ecological and hydrological needs of the Ever-

glades, and the costs and benefits of phosphorus reduction alternatives.

For purposes of this Report, "available data and findings" and "then-available data and findings" are interpreted as data that were subjected to quality control and complete technical interpretation by about July 1, 1999. It is important to note that samples collected in the field take several months to analyze and process through quality assurance. Where ever possible, authors summarize data based upon "water years" defined as the period from May 1 through April 30 of each year. This period is convenient for South Florida since it generally follows the overall wet/dry cycles of this subtropical environment and is consistent with calculations done in the Everglades Regulatory Program described in Chapter 5 of this Report. Although existing data sets are extensive for many locations in South Florida, they yield an incomplete picture for virtually all the issues in the Everglades. The time frame for acquiring information specified in the Act and available to authors varies with each program, and most information is being derived from ongoing projects. The status of monitoring and research in each area and the time period used for analyses are discussed within each chapter.

LEGAL AND REPORTING REQUIREMENTS

Recent legislative and regulatory efforts have subjected the District's Everglades restoration efforts to numerous reporting requirements. These legal requirements include the following:

- An Everglades Forever Act Annual Report, required by §373.4592(12), submitted to the Department of Environmental Protection, the Governor's office, and the leaders of the Florida Legislature. That report must include a summary of the water conditions in the Everglades Protection Area, the status of the impacted areas, the status of the construction of the STAs, the implementation of the BMPs, and actions taken to monitor and control exotic species.
- An annual peer-reviewed report, required by §373.4592(4)(d)6., F.S., also submitted to the Department, the Governor, and the legislative leaders, regarding the research and monitoring program that summarizes all data and findings, identifying water quality parameters, in addition to phosphorus, which exceed state water quality standards or are causing or contributing to adverse impacts in the Everglades, and updating information contained in the 1999 Everglades Interim Report, required by §373.4592(4)(d)5., F.S.
- A Joint Legislative Committee on Everglades Oversight (JLCEO) Report, required by §11.80(4), Florida Statute, submitted to the legislative committee, and addressing changes to the Everglades Construction Project, and analyzing costs and revenues.
- A Non-Everglades Construction Project permit annual report, required by §373.4592(9)(k) and (l), F.S., and by DEP Permit No. 06, 502590709, submitted to the Department, and addressing water quality at structures that are operated, maintained and controlled by the District, that discharge into, within, or from the Everglades Protection Area, and that are not included in the Everglades Construction Project; and also addressing schedules and strategies to improve that water quality.
- A 404 permit report(s), required by Permit No. 199404532, submitted to the U.S. Army Corps of Engineers, and addressing the District's strategy for achieving water quality standards and updating the Corps on the activities authorized or otherwise regulated by the permit.

- A series of reports on the Stormwater Treatment Areas, including National Pollutant Discharge Elimination System permits and Everglades Forever Act permits, submitted to the Department and the U.S. Environmental Protection Agency and addressing the quality of water discharged from the treatment systems, as well as the progress of the treatment systems as they shift from the start-up phase, which floods the land and encourages vegetative growth, to the flow-through stages, when the facility is expected to improve water quality.

This 2000 Consolidated Everglades Report is submitted in compliance with all of these reporting requirements. By consolidating all those requirements into a single document, the District ensures that its evaluation of annual data on the Everglades is both comprehensive and cost effective. Furthermore, the Consolidated Report is intended to ease the review process for other agencies, organizations and interested persons, and to provide a single source of information on the Everglades for use in future research and decision-making.

LAYOUT AND FORMAT

This Report consists of a coordinated set of chapters with varying levels of technical detail and synthesis, including an executive summary, the technical report in 14 chapters and a list of major findings and implications as Chapter 15. Most chapters also include appended material and responses to public comment is included as **Appendix 1** to the Report. The executive summary of the Report is written for a diverse readership and provides an abstract of the key facts and supporting information. This section of the Report is intended as a stand-alone document designed to communicate findings to a broad audience and to contain minimal technical discussion and data presentation. It has been developed to highlight findings of relevance to environmental decision-makers, particularly with regard to decisions on the ECP and associated projects. The executive summary fulfills all of the information needs formerly addressed through the Everglades Annual Report.

The 14-chapter technical document conveying data and findings in each topic area is the main product of this reporting effort. This technical document is targeted at individuals who seek detailed information on topics mentioned in the Act, along with technical interpretation and supporting information. The list of major findings and implications highlights major conclusions of the Report for the public and other interested parties with only a brief summary of supporting analyses; this list is included as Chapter 15 of the Report. Another product of the reporting effort is a volume of supporting documentation referred to in the main body of the Report. These appendices are designed to give interested readers pivotal data summaries and detailed analyses of interest as background for the special interest reader. A summary of responses to reviewer comments on the Report is also included in the appendices.

This Consolidated Report presented an opportunity for open communication of progress on technical areas described in the Act and for data sharing on many technical issues. Through the required peer review of the Report, programs, projects and products were evaluated critically by scientists outside of the agencies involved in Everglades information gathering. Subsequently, this input will provide the District with an opportunity to identify strategies for filling information gaps on these important topics.

PROCESS USED TO DEVELOP THE REPORT

This Report was developed through a two-step review and revision process. Authors and project staff associated with the research and monitoring programs required by the Act submitted rough drafts of chapters for internal, technical review in the early spring of 1999. After this initial review, each chapter was revised by the author and submitted to the document assembly team, which formatted chapters into the first working draft of the entire Report. At this point (early September), the draft was sent out for external review by a panel of experts and the interested public. This intensive review resulted in many substantive and helpful comments on the chapters, and guided the authors as they revised the chapters into the final draft, which was submitted to the District's Governing Board for acceptance on November 12, 1999. All comments received during Report development were given directly to chapter authors. Their responses to these comments are summarized in **Appendix 1**.

The technical body of this Report has been developed in a manner often used for scientific volumes compiling information on diverse issues. Chapters were written independently by authors with expertise in the topic being addressed. Chapters reflect the writing style of the authors and the level of detail appropriate to the topic. The order of authors on each chapter indicates their contributions to the Report in accordance with common practice in science and engineering. Technical review and integration was provided by the Report Editors Garth Redfield, Keith Rizzardi and Gary Goforth. The Report was formatted and assembled by Susan Bennett, Kimberly Jacobs, Victor Mullen, Felicia Berger, and Diane Smith. Technical and grammatical editing was done by Marian Heitzman, Susan Bennett and Victor Mullen, and the Report was reviewed extensively by a peer review panel (see below) and other reviewers outside the agency. Kimberly Jacobs (production manager) and Susan Bennett (project manager) also provided leadership for the team producing the Consolidated Report. Production assistance was provided by Hedy Marshall.

CONSTRAINTS ON CHAPTER CONTENT AND INTERPRETATION

There are several important factors that influenced the interpretation of chapters in this Report. First, detailed discussion of methods and quality assurance/quality control (QA/QC) or complex interpretative (statistical) issues cannot be dealt with through the Report, due to time and space limitations and the broad target audience. Many issues covered in the Report are complex and do not lend themselves to simple answers free of caveats. Authors have attempted to summarize the data and findings as definitely as possible, arriving at discrete conclusions whenever possible. Second, for the most part, authors do not repeat technical discussions that have been published in the peer reviewed literature; they are expected to provide readers with appropriate citations to the primary information source. Third, authors can only report information that is readily available as of about July 1, 1999, and included data through the water year ending April 30, 1999. Publications used for the Report must be complete and interpretable by standard scientific norms. In practical terms, this means that information from other agencies must be in the form of formal agency reports or literature publications in order to ensure that authors can include it in their evaluations.

The mid-stream status of most projects required by the Act should also be kept in mind. Each chapter will detail the overview status of research and monitoring activities on the specified topics, but it must be recognized that the vast majority of information-generating projects are still in progress. Thus, to varying extents, all chapters are truly interim in nature. The level of detail varies in accordance with the magnitude of information available and the opinion of the author on what data should be presented to address issues of interest to decision-makers. For example, Chapter 7 on the mercury problem contains dozens of literature citations and findings from research in south Florida, while Chapter 8 on Supplemental Technologies is more focused on project descriptions and current status of ongoing data collection.

The Report is not a formal part of any legal or administrative process, such as setting the criteria and standards for phosphorus in the EPA. Any interpretation of wording in this Report must be done from a technical, not a legal perspective. For example, the official process of setting the standard for surface water quality is primarily the responsibility of the Environmental Regulation Commission, working in concert with DEP. Any use of "imbalance" or other similar terms in this Report is done to describe ecological evidence and must not be considered as any official interpretation of Class III criteria by the District or the DEP.

CHAPTER ORGANIZATION

As stated above, the Report is composed of 14 chapters, a compilation of major findings and implications (Chapter 15), and an executive summary. This chapter, Chapter 1, the Introduction, provides background for the Report, an overview of the process used to develop the Report and an outline of its organization, as well as factors affecting the nature and interpretation of data and findings. It is also an integration of projects and programs described in the Report and explains complementaries in planning and construction activities and overall organization of the Everglades restoration effort. Chapters 2 through 14 each contain a summary, background on the topic, technical discussion of data, findings, strategies for obtaining additional information and references cited in the chapter. The executive summary and the list of findings and implications attempt to summarize information about important issues and guide the reader to sources of additional information in the Report. They are written as an abstract of critical information and conclusions for decision-makers.

The hydrological needs of the Everglades Protection Area and supporting technical information is the subject of Chapter 2. This chapter also provides a unique synthesis of important information on the history and development of water management and resultant ecosystem alterations in south Florida. The ecological needs of the Everglades is discussed in Chapter 3. This detailed account provides up-to-date information on the intricate effects of nutrients and associated factors on Everglades ecology. Water quality status and trends for standard Class III parameters are the subjects of Chapter 4 (although issues concerning mercury in the EPA are covered in Chapter 7). A history and summary of actions taken under the Everglades Regulatory Program, a Best Management Practices Program in the Everglades Agricultural Area, are provided in Chapter 5. Chapter 6 provides a detailed account of information gathered to date on the performance of the Stormwater Treatment Areas, particularly the Everglades Nutrient Removal (ENR) Project and STA optimization research. Chapter 7, as mentioned, discusses mercury issues and analyzes the risk of mercury contamination associated with the Everglades Construction Project.

Chapter 8 describes techniques being investigated as means for removing phosphorus from water down to the planning level of 10 parts per billion, the default concentration specified in the Act. This eighth chapter reflects the fact that the studies of Supplemental Technologies are in midstream as this report is written, and most information on the relative costs and effectiveness of technologies will not be available for several years. Nevertheless, the chapter does provide a preliminary understanding of the relative costs and benefits of each technology. Chapter 9 describes the status of the Lower East Coast Water Supply Plan, as required by the Act, and Chapter 10 summarizes the ongoing planning effort on the Restudy of the Central and South Florida Project. The Restudy has resulted in a preferred alternative plan to restore the greater Everglades ecosystem and is being reviewed for Federal support by the Congress as this report is written. The Everglades Stormwater Program, which is the subject of Chapter 11, is being implemented to assure that water quality standards will be met in areas not encompassed by the Everglades Construction Project, particularly along the lower east coast of Florida. Chapters 12, 13 and 14 concern land acquisition, funding, and exotic species control, respectively, and have been added to the Report to in an effort to fulfill information needs for decision support, while fulfilling reporting requirements on District activities. Chapter 15 contains the findings and implications of the Report.

PEER REVIEW OF THE EVERGLADES CONSOLIDATED REPORT

The Everglades Consolidated Report was developed through a two-step review and revision process, described earlier in this chapter. Following internal review and revision, an updated and revised September 9, 1999, draft of the Report was distributed for external review by the public (via hard copy and the District's internet site) and a scientific review panel. The requirement for peer review is specified by narrative from the Act (373.4592(4)(d) 6):

> Beginning January 1, 2000, the district and the department shall annually issue a peer-reviewed report regarding the research and monitoring program that summarizes all data and findings.

The District organized the review of the Report in accordance with typical scientific review practices, the independent panel review process required by Florida Statute for evaluating Minimum Flows and Levels (Florida Statute 373.042 (4)) and "government in the sunshine" provisions of Florida Statutes. "Independence" in the context of this review process means that panelists should have no substantial personal or professional relationship with the District or any other organization involved in environmental management in South Florida. Maintaining such independence provides reasonable assurance that reviewers will be objective in evaluating materials presented in the Report -- such objectivity is the cornerstone of a bona fide review process. The panel reviewed the Report independently, then interacted with each other and the public at a scientific workshop and public hearing. The panel collaborated in authoring recommendations and a final report to the District. The breadth of this Report and the need for interaction with reviewers require that the Everglades Consolidated Report be reviewed by such a group of experts, as described below.

A Statement of Work was developed for the review process. Each panelist was given Purchase Orders by the District to provide the following review services on the Everglades Consolidated Report:

- **Read the 1999 Everglades Interim Report**. Each panelist was asked to focus attention on chapters closest to their areas of expertise, although broad reading of the Report was

encouraged as general background for the 2000 Consolidated Report.

- **Read draft Everglades Consolidated Report.** Prior to the workshop and public hearing, panelists were asked to review select chapters of the Report and to prepare a preliminary written review, including questions to be addressed by District Staff at the scientific workshop and public hearing. Unlike the review process for the 1999 Interim Report, all review comments from the panel are sent to the lead reviewer assigned to each chapter and a single review is then given to staff. This process simplifies both the review and revision processes and avoids duplication of effort and inconsistency to comments.
- **Post all comments on the Report by Panelists on the World Wide Web on a Web Board.** All public comments were also posted on the Web Board to keep the entire peer review process in the public record. This allowed for instant communication 'in the sunshine' among panelists and between the public and the Panel.
- **Participate in the scientific workshop and public hearing as a panelist September 30, 1999, at District headquarters.** The Panel participated in a public hearing which was held in association with the scientific workshop, September 30, 1999 at District headquarters in West Palm Beach.
- **Develop a draft Panel Report with conclusions and recommendations**. During an executive session following the public workshop on October 1, 1999, the panel developed their draft conclusions and recommendations on the Consolidated Report, and provided these to the District on October 4, 1999, as a rough draft of the report. This step gave the authors information from the review so that revision can begin immediately. After allowing public comments to be submitted to a Web Board until October 22, 1999, the Panel reviewed all available materials and submitted a revised draft report on October 27, 1999; this report is included in **Appendix 1**.
- **Participate in a second public workshop on the Report.** The panel was requested by the District to participate in a second workshop to allow for presentation of Chapter 3 and for additional discussion of other chapters, particularly those subject to significant revision (e.g., Chapters 5 and 7). This workshop was held on November 3, 1999, and most of the presentations and discussion were focussed on Chapters 3 and 7 of the Report; District staff were available to explain their responses to public comment.
- **Collaborate with the other panelists in writing the Final Report**. After the workshop on November 3, the Panel revised their report and delivered it to the District on November 5, 1999. The panel's final report summarized conclusions and recommendations, and included a narrative with details to the extent that the Panel deemed appropriate for each chapter. The Panel Chairperson presented the panel's report to the District's Governing Board on November 9, 1999; the final report was also posted on the Web Board. The draft and final Reports are provided in **Appendix 1** of this Everglades Consolidated Report.

To the extent possible, panelists were selected from the District's Expert Assistance Pool, which contains more than 400 pre-qualified technical experts. Professional expertise and experience in the major areas covered by the Report were the primary criteria for selection. Knowledge of environmental management and decision-making was also considered in potential panelists. Candidate panelists from the pool were screened for any professional connection to interests or organizations in South Florida to ensure independence. Two additional experts were located through professional knowledge and referrals, and included an outstanding wetland scientist and a highly experienced environmental engineer.

Eight expert panelists were selected to conduct an independent scientific peer review of the Everglades Consolidated Report. Their experience and credentials are summarized below:

Expert 1: Dr. Jeffery L. Jordan, Professor, Department of Agricultural and Applied Economics, University of Georgia, Griffin, Ga.

With 15 years of post-doctoral experience in agricultural economics and water resource policy, Prof. Jeffery Jordan is recognized for his work in modeling water demand and allocation, conservation planning, survey design and other aspects of water resource analysis. This diverse experience in water-related economic and policy analyses is demonstrated in more than 35 peer-reviewed articles, 45 miscellaneous publication, one book and several book chapters authored during his productive career with the University of Georgia. He is well acquainted with general environmental and water quality issues being faced in south Florida and has served on the peer review panel for the Lake Okeechobee minimum flow and levels, the Spalding County Water Authority and the Georgia Water Wise Council. This diverse background will prove to be invaluable for dealing effectively with the wide range of topics and issues associated with this review. Together, these qualities make him ideally suited as Chair of the peer review panel for the Everglades Consolidated Report and as a lead reviewer for chapters on water supply planning, the Restudy and revenue aspects of Everglades restoration.

Expert 2: Dr. Richard A. Meganck, Director, Sustainable Development and Environment, Organization of American States, Washington, D.C.

Dr. Richard Meganck is highly experienced in planning for development and natural resource management internationally. Since receiving a doctorate in natural resource management in 1975, he has authored dozens of refereed articles and papers in conference proceedings on park planning, international development, ecological restoration and sustainable development. Dr. Meganck is very experienced in dealing with diverse audiences and interests through his work the Organization of American States, the United Nations Environment Program, and as a private consultant in environmental management. His resource planning experience is exceptionally diverse and unique, particularly his extensive work on park management and sustainability. His expertise is well matched to the needs of the Report review panel for issues dealing with environmental restoration, water supply planning, the Restudy and land management. His participation is highly recommended for material summarized primarily in Chapters 1, 9, 10, 12 and 13.

Expert 3: Dr. Rebecca R. Sharitz, Professor, Department of Botany and Savanna River Ecology Laboratory, University of Georgia, Aiken, S.C.

Dr. Rebecca Sharitz is highly experienced in management-related science of wetlands through her work on southern forests, swamps and marshes. Trained as a botanical ecologist, she has worked on the effects of disturbance and water level on forested wetlands and marsh plant communities, and has researched the interactive effects of many factors on these biological communities. She has mentored two dozen graduate students over her career and has served in a variety of administrative and professional service positions, including many national panels and boards. The ecological principles used throughout this distinguished career are the same suite of scientific concepts underlying issues in the Everglades ecosystem, especially concerning the effects of eutrophication and hydroperiod alterations on south Florida vegetation communities. With over 90 publications in the international scientific literature, and dozens of presentations at scientific meetings, Dr. Sharitz is expected to make a major contribution to the Everglades Consolidated Report review on wetland hydrology (Chapter 2), nutrient issues (Chapter 3), stormwater treatment areas (Chapter 6) and exotic species (Chapter 14).

Expert 4: Dr. Robert C. Ward, Director, Colorado Water Resources Research Institute, Colorado State University, Fort Collins, Co.

Dr. Robert Ward is highly experienced in the science of water quality assessment, including the design of information systems and water quality monitoring networks, application of data to decision-making and communication with the public, and wastewater treatment. Since receiving a doctorate in Agricultural Engineering in 1970, he has authored dozens of refereed articles and papers in conference proceedings. Dr. Ward is well acquainted with peer review having served on many panels and review committees, including a panel that reviewed the phosphorus control program in the Lake Okeechobee watershed and last year's panel on the Everglades Interim Report. In addition, he is very experienced in dealing with diverse audiences through his work with students, educational initiatives and professional societies. His quantitative experience with water quality data is exceptionally diverse and extensive, and his knowledge of monitoring program design is exceptional. Dr. Ward is well matched to the needs of the Report review panel for issues dealing of water quality and interpretation of monitoring data. His participation is highly recommended for aspects related to water quality monitoring and compliance contained primarily in Chapters 1, 4, 11 and 15 of the Report.

Expert 5: Mr. Willie Buchanan, Principal Scientist, Tennessee Valley Authority, Muscle Shoals, Ala.

After receiving a Master of Science in agronomy from Tuskegee University, Mr. Buchanan was involved in research on crop responses to fertilization and agricultural use of industrial wastes and by-products. He then worked on a variety of programs in the Field Programs Department of TVA concerning evaluation of new products, fertilizer and nutrient practices, and related educational programs. Since 1993, he has coordinated projects on best management practices, particularly across agencies and the private sector. With TVA's Land and Water Sciences, Mr. Buchanan has worked extensively on applied research of sustainable agricultural and land use practices, particularly for the control of non-point source pollution. Research activities involved soil nitrates, erosion control, phosphorus use efficiency and nutrient release. He is highly experienced in communicating with diverse audiences, especially in farming areas, and bridging environmental and agricultural interests. Mr. Buchanan's unique career qualifies him to provide valuable prammatic recommendations for chapters 4, 5, 11, and 15 involving water quality and agricultural best management practices.

**Expert 6: Dr. Donald M. Kent, Partner, Wetlands Design Group,
Ipswich, Mass.**

After receiving a doctorate from Boston University, Dr. Donald Kent worked as a wetlands biologist for several years, then joined a consulting firm where he conducted projects on permitting, mitigation and environmental assessments. From 1992 to the present time, he has been a consult to Walt Disney Imagineering Research and Development, Incorporated, conducting research on environmental issues relevant to Disney operations. Beginning in 1996, he has been a partner in Wetlands Design Group, an enterprise providing expertise for monitoring, design and management of wetlands, often for international clients. Dr. Kent is responsible for over 35 scientific publications and is a certified Senior Ecologist and Professional Wetland Scientist. He edited an important text on wetlands entitled "Applied Wetlands Science and Technology", now in its second edition. He has served on many advisory and review teams, and has a diverse portfolio of projects in applied wetlands science. Staff recommends Dr. Kent as a wetland scientist for the Panel and looks forward to his input particularly on Chapters 2, 3, 6 and 12 concerning wetland science and constructed wetlands.

Expert 7: Dr. Judith S. Weis, Professor, Department of Zoology, Rutgers University, Newark, N.J.

Dr. Weis has a research and teaching career that spans over three decades. Trained as a marine zoologist, she has contributed greatly to our understanding of the biological effects of pollutants, particularly metals, in aquatic systems. Her professional and scholarly activities have been extremely diverse and numerous, and have included association with the Congressional Science Office, U.S. Environmental Protection Agency laboratories, and the National Science Foundation. Her research activities have produced several hundred seminars, papers at conferences, and refereed publications. The unusual depth and breadth of her services to professional societies, government agencies and the university provides assurance that she will contribute greatly to the review of the Everglades Consolidated Report. We look forward especially to her comments on the use of constructed wetlands, the Everglades mercury problem, development of supplemental technologies and invasion of exotic species.

Expert 8: Dr. E. Joseph Middlebrooks, Environmental Engineering Consultant, Layfayette, Co.

Dr. Joe Middlebrooks has a track record in science and engineering dating from 1966 and involving a wide range of activities and responsibilities. He has extensive administrative experience at the University of Tulsa, Tennessee Technological University and Utah State University demonstrating an excellent grasp of research and policy directions and needs in environmental engineering. He has been involved in a variety of consulting activities on water quality, wastewater treatment and industrial waste management. Dr. Middlebrooks has been very active in professional societies and has a substantial list of accomplishments and honors as a Professor of engineering. With eleven books, more than 50 sole-authored papers and more than 200 jointly authored papers and reports, he has an outstanding record of contribution to wastewater and environmental engineering. This breadth of experience and accomplishment places Dr. Middlebrooks in a unique position to contribute greatly to the review of the Everglades Consolidated Report, particularly regarding Chapters 1, 4, 6, 7, 8 and 11 on the subjects of water quality, stormwater treatment and environmental regulation.

This intensive public and panel review resulted in extensive written comments and suggestions to the authors of the Report; all written reviews and the panel report are provided *verbatim* in Appendix 1. Although all reviews were helpful to authors, the Report benefited most extensively from the throughout and incisive suggestions of the expert panel. The advice of reviewers and the panel guided the authors through a major revision of the Report during October and November 1999. A summary of the responses of authors to reviewer comments is also given in Appendix 1.

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