Chapter 1: Introduction to the *2005 South Florida Environmental Report – Volume I*

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This introductory chapter provides the reader with a basic understanding of the governmental, scientific, and legal context behind the *2005 South Florida Environmental Report* (SFER). The *2005 South Florida Environmental Report* is an expansion of previous Everglades Consolidated Reports (ECRs) published annually between 2000 and 2004. The information presented in the 2005 SFER continues to aid in the implementation of Everglades restoration activities and now will support restoration, management, and protection activities associated with Lake Okeechobee, the Kissimmee River, and South Florida's coastal ecosystems. Overall, this newly established report streamlines and consolidates previous reporting efforts by the South Florida Water Management District (District and SFWMD) and efficiently unifies more than fifty individual reports into a single document. Similar to previous ECRs, this more inclusive report will continue to be used by the District, the Florida Department of Environmental Protection (FDEP), and other agencies to support environmental management decisions.

The *2005 South Florida Environment Report* is comprised of Volumes I and II, and the Executive Summary. Volume I, "The South Florida Environment – Water Year 2004," is a technically based volume organized in a framework of 12 chapters and provides data summaries for all major ecosystems in South Florida in a format similar to the Everglades Consolidated Reports. Chapters 1 through 9 of this volume include all of the topics of the previous ECRs and continue the overall objective to summarize available data and findings relating to the Everglades restoration effort, including aspects of the Comprehensive Everglades Restoration Plan (CERP). Additionally, in order to provide a more integrated perspective for South Florida water management, this year's report has been expanded to include coverage of Lake Okeechobee, the Kissimmee River and Upper Chain of Lakes, and coastal ecosystems in South Florida (presented in Chapters 10, 11, and 12, respectively). The District views the report's expansion as essential to sound, long-term environmental management of the region. It must be recognized that CERP is a regional program and the SFER is targeted at the regional level in the same manner that the earlier ECRs targeted the Everglades Protection Area. Volume I chapters are supported and enhanced by an extensive amount of appended documentation that provides data summaries and detailed analyses for the special-interest reader and complies with various permit requirements.

Volume II, "Annual Plans and Reports," summarizes planning and project status for eight annual reports required under various mandates including the Comprehensive Everglades Restoration Plan Annual Report; Lake Okeechobee Annual Report; Five-Year Water Resource Development Work Program; Alternative Water Supply Annual Report; Everglades Forever Act Annual Financial Report; District Water Management Plan Annual Report; Florida Forever Work Plan, 2005 Annual Update; and Five-Year Capital Improvements Plan. Coverage of the District's land acquisition efforts (Chapter 8C of the 2004 ECR), fiscal resources management (Chapter 8D of the 2004 ECR), and Water Supply Plan status reports (Chapter 8F of the 2004 ECR) have been incorporated into the 2005 SFER – Volume II.

The Executive Summary of the *2005 South Florida Environmental Report* is written for a diverse readership and provides an abstract of the report's key facts and supporting information presented in Volumes I and II. It has been developed to highlight findings of relevance to environmental decision makers, particularly with regard to decisions on the District's projects such as the Everglades and Lake Okeechobee Construction Projects. The Executive Summary also fulfills all of the information needs formerly addressed through the Everglades Annual Report.

This chapter focuses on the content of 2005 SFER – Volume I. A similar introductory chapter to the report's second volume is presented in Chapter 1 of the 2005 SFER – Volume II. The chapter begins with a geographic overview of the entire South Florida environmental resource, giving the reader an appreciation of the diverse challenges facing environmental management in this region. These challenges are discussed from many different vantage points throughout the 2005 SFER.

The chapter next provides a brief section on the history and relationship of the South Florida Water Management District and other agencies overseeing South Florida's water resources. It covers the various components of the South Florida Water Management District's programs, known as the Kissimmee-Okeechobee-Everglades (KOE) and coastal area programs. Collectively, these programs address numerous research and monitoring projects throughout the District. Updates on these projects for the current reporting year, Water Year 2004 (WY2004) (May 1, 2003 through April 30, 2004), are provided throughout the *2005 South Florida Environmental Report*.

Following discussion of the District's programs is an integrative summary of the opportunities and obstacles facing South Florida environmental restoration. This includes an overview of the Everglades restoration strategy, a multifaceted, comprehensive approach that includes interim and long-term plans for achieving water quality goals and for optimizing environmental management. Highlighting the District's comprehensive restoration efforts throughout South Florida, the Kissimmee River, Lake Okeechobee, and coastal ecosystems restoration strategies are also discussed in this chapter.

The objectives of the *2005 South Florida Environmental Report – Volume I* are also described in this chapter, including a discussion of the numerous legal and reporting requirements addressed by this document. Finally, the processes used to create this report, and to provide peer and public review, are summarized. Similar to previous ECRs, the 2005 SFER – Volume I was subjected to an intensive peer-review process, including three days of public workshops with a panel of outside experts.

GEOGRAPHIC FEATURES OF THE SOUTH FLORIDA ENVIRONMENT

AREAS WITHIN THE EVERGLADES PROTECTION AREA

The Everglades is an internationally recognized ecosystem that covers approximately 9,000 square kilometers (3,474 square miles) in South Florida. It represents the largest subtropical wetland in the United States. The historic Everglades extended 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 (ENP or Park), including Florida Bay and the Water Conservation Areas (WCAs) which include WCA-1, WCA-2A/2B, and WCA-3A/3B (**Figure 1-1**). These areas are the primary targets of the Everglades restoration and are described in this section, followed by descriptions of areas adjacent to the EPA. [Note that an overview of Florida Bay is discussed in the *Coastal Ecosystems* section of this chapter.]

Water Conservation Areas 1, 2, and 3

The three Water Conservation Areas (WCA-1, WCA-2, and WCA-3) are major components of the Everglades Protection Area and provide a valued suite of ecological and hydrological functions for the region. WCAs located south of Lake Okeechobee and west of the heavily urbanized Lower East Coast (LEC) comprise an area of about 3,497 square kilometers (1,350 square miles). These remaining Everglades wetlands serve as receiving waters for storm runoff from the surrounding basins, which total about 3,400 square kilometers (1,312 square miles).

These basins include the Everglades Agricultural Area, portions of the LEC, and rural western basins. Regulatory releases from Lake Okeechobee may also be diverted to the WCAs in accordance with the federal operating schedule for the lake. The WCAs are water supply sources for LEC urban areas and agricultural lands, recharging the Biscayne Aquifer and retarding saltwater intrusion into coastal wellfields. The WCAs also serve as critical sources of water for the Park, important habitats for Everglades wildlife, and valued resources for public recreation.

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). The Refuge covers an approximate area of 573 square kilometers (221 square miles), which is slightly larger than WCA-1. WCA-1 covers an approximate area of 566 square kilometers (218 square miles) and receives treated water from Stormwater Treatment Area 1 West (STA-1W). The U.S. Army Corps of Engineers (USACE) is currently completing construction of STA-1 East (STA-1E), which will work in concert with STA-1W to deliver treated water to the Refuge. When operational, these constructed wetlands will capture, treat, and return to the Everglades ecosystem storm water from portions of the EAA and the C-51 West basin that currently is discharged to coastal areas. This WCA has been the subject of extensive monitoring and research, and data and findings from this important resource are summarized primarily in Chapters 2A, 2C, 5, and 6 of the 2005 SFER – Volume I. A discussion of the STAs is presented in Chapter 4 of this volume.

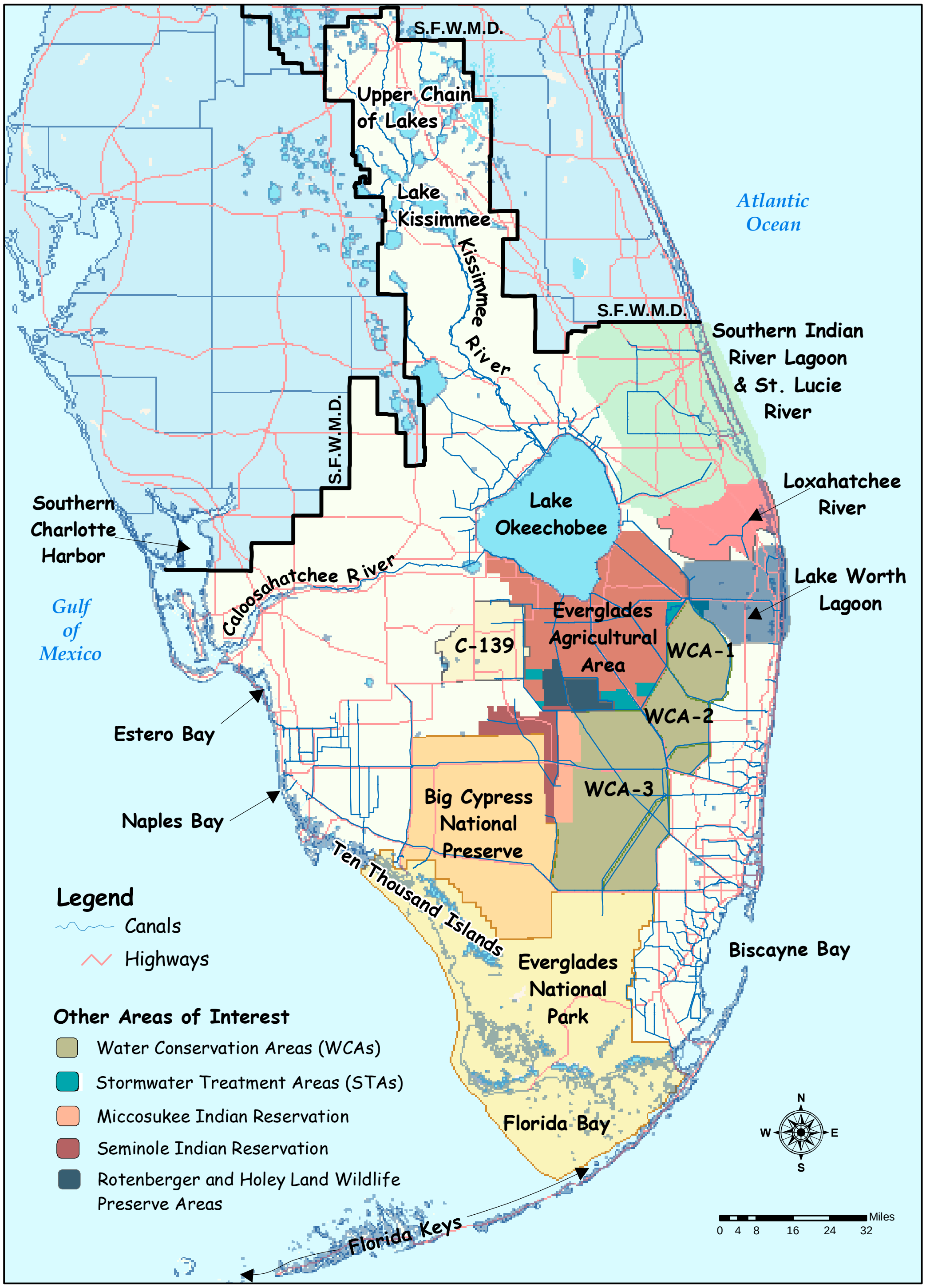

Figure 1-1. Major features of the South Florida environment within the boundaries of the South Florida Water Management District. [Note: See also **Figure 5-50** of this volume for major hydrological features in South Florida.]

Water Conservation Area 2 (WCA-2) is an extensive sawgrass wetland and the smallest of the three WCAs. It was divided into two smaller units, WCA-2A (442 square kilometers, or 171 square miles) and WCA-2B (95 square kilometers, or 37 square miles) to reduce water seepage losses to the south, and to improve the water storage capabilities of WCA-2A. WCA-2 is managed by the District in cooperation with the USACE and the Florida Fish and Wildlife Conservation Commission (FWC). During Water Year 2004 (WY2004) (May 1, 2003 to April 30, 2004), surface inflows to WCA-2A consisted of flows from WCA-1, treated water from STA-2, and storm water from the North New River Canal basin in the EAA. STA-3/4 began initial operations in 2004, and it will subsequently capture and treat runoff from the North New River Canal basin prior to discharge into WCA-2A. WCA-2A has been the site of intensive research and monitoring; data and findings for this conservation area are primarily found in Chapters 2A, 2C, 5, and 6 of the 2005 SFER – Volume I. A discussion of the STAs is presented in Chapter 4 of this volume.

Water Conservation Area 3 (WCA-3) is the largest WCA, with an area of 2,339 square kilometers (903 square miles), and is managed by the District in cooperation with the USACE and the FWC. The area is predominantly 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. Similar to WCA-2, WCA-3 was divided into WCA-3A (2,012 square kilometers, or 777 square miles) and WCA-3B (327 square kilometers, or 126 square miles) by two interior levees so that water losses due to seepage to the urban communities along the eastern coastal areas could be reduced. WCA-3A is the only WCA 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, 1992a). Other surface inflows to WCA-3A during WY2004 consisted of flows from WCA-2A, treated water from STA-5 and STA-6, storm water from the northern and western rural agricultural basins, and water from the highly urbanized C-11W basin along the LEC. STA-3/4 began initial operations in 2004 and it will subsequently capture and treat runoff from the Miami Canal basin prior to discharge into WCA-3A. Less information is available on WCA-3A than on WCA-1 or WCA-2, but there is substantial new information (e.g., on tree islands, water quality, and mercury) that is being generated. This is reported primarily in Chapters 2A, 2B, 2C, 5, and 6 of the 2005 SFER – Volume I. A discussion of the STAs is presented in Chapter 4 of this volume.

Everglades National Park

Everglades National Park encompasses 5,569 square kilometers (2,150 square miles) of freshwater sloughs, sawgrass prairies, marl-forming wet prairies, mangrove forests, and saline tidal areas at the southern end of the Florida peninsula. 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. It has also been named a Federal Wilderness Area, an International Biosphere Reserve, and a Wetland of International Significance. Currently, 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, 1992a).

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 Trail to the mangrove estuaries of Florida Bay. During wet periods, Taylor Slough (also called Taylor River) provides local flow of fresh water 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 and 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. Mangroves, the third major wetland system, occupy the southern and western borders of the Park, where freshwater ecosystems merge with the brackish estuaries of Florida Bay (SFWMD, 1992a). Information on the Park is scattered throughout this report, with specific data and findings included in Chapters 2A, 5, and 6 of the 2005 SFER – Volume I.

AREAS SURROUNDING THE EVERGLADES PROTECTION AREA

Several areas adjacent to the modern Everglades are significant because they were part of the historical system. These areas 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, the C-139 basin, Big Cypress National Preserve, and the Seminole and Miccosukee Indian Reservations (**Figure 1-1**).

Everglades Agricultural Area

The Everglades Agricultural Area (EAA) 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. It incorporates approximately 2,872 square kilometers (1,109 square miles) of highly productive agricultural land containing rich, organic peat or muck soils. Approximately 77 percent of the EAA, or 2,212 square kilometers (854 square miles), is in agricultural production. Nitrogen-rich organic peat soils and a warm subtropical climate permit year-round farming. The major crops in the EAA include sugarcane, vegetables, and sod and smaller amounts of rice and citrus. Nutrient-laden water from the EAA is now recognized as a major contributor to enrichment of the Everglades (refer to the *Everglades Restoration Strategy* section). As a result, nutrient control is the primary focus of programs under the Everglades Forever Act. Information on the EAA is provided primarily in Chapters 2C and 3 of the 2005 SFER – Volume I.

Holey Land and Rotenberger Wildlife Management Areas

The Holey Land Wildlife Management Area (WMA) is a 140 square-kilometer (54 square-mile) tract that is state-owned and managed by the Florida Fish and Wildlife Conservation Commission. The area is heavily used for hunting of white-tailed deer and hogs. The Rotenberger WMA consists of 96 square kilometers (37 square miles) of state-owned land and is also managed by the FWC for deer and hog hunting. Both of these areas lie within the boundaries of the EAA. In 1983, the District and other agencies agreed to restore Everglades values associated with the Holey Land and Rotenberger WMAs and to establish water regulation schedules that will simulate the natural hydroperiod. In June 1990, the District and the FWC agreed on improved operational schedules in both the Holey Land and WCA-3A (SFWMD, 1998). In July 2001, treated water from STA-5 began to be discharged into the Rotenberger Tract to restore a more natural hydroperiod. These areas are important for game management, water resource protection, and providing habitat corridors adjacent to the EPA. Both areas will benefit from water treated by the STAs to restore a more natural hydropattern (see Chapters 4 and 6 of the 2005 SFER – Volume I).

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 and a regulatory program mandated by the Everglades Forever Act (EFA) (see Chapter 3 of the 2005 SFER – Volume I). Chapter 40E-63, Florida Administrative Code (F.A.C.) was amended in January 2002 to include a Best Management Practices (BMP) Regulatory Program in the C-139 basin. The goal of the C-139 Regulatory Program is to maintain phosphorus loads at or below baseline levels for the pre-BMP period (October 1, 1978 through September 30, 1988.). The EFA specifically mandates a method to measure and calculate the annual export of phosphorus in surface water from the C-139 basin. This is determined by comparing measured phosphorus discharges from District structures for each water year (May 1 through April 30) to the pre-BMP baseline period. In order to factor out variability caused by rainfall, the baseline period phosphorus discharges are adjusted for differences in the amount and distribution of rainfall for the current period. The rule requires the District to evaluate the data collected to assess the general trend in TP load leaving the basins and determine whether the basins are in compliance with the TP load reduction requirement.

Discharges from the C-139 basin are treated in STA-5 up to its hydraulic capacity, with some diversion of untreated water directly to the northern WCA-3A. This untreated portion of the C-139 basin will be captured and treated in STA-6 Section 2, scheduled for completion by December 2006. The remaining land cover in the C-139, Feeder Canal, and L-28 Interceptor 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 occupy 4 percent of the C-139 basin and less than 1 percent of the remaining basins.

The areas immediately west of WCA-3 include reservations of 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 native rangelands or for improved pasture. The basins west of WCA-3A are undergoing rapid agricultural development. Tribal lands within the WCA system will be restored and maintained as natural Everglades habitat for the benefit of the tribes and the Everglades ecosystem.

The 2,280 square-kilometer (880 square-mile) Big Cypress National Preserve was established in 1974 to protect natural and recreational values of the Big Cypress Watershed, while allowing continued hunting, fishing, and oil and gas production. Big Cypress National Preserve also provides an ecological buffer zone and water supply for Everglades National Park. 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 provide local drainage from lands in the Seminole Indian Reservation and surrounding private lands.

LAKE OKEECHOBEE

Lake Okeechobee is a large, shallow eutrophic lake located in the southern region of Central Florida (**Figure 1-1**). The lake is the largest body of fresh water in the southeastern United States and covers a surface area of 1,730 square kilometers (668 square miles) with an average depth of 2.7 meters (8.6 feet). The watershed of the lake stretches from just south of Orlando to areas that border the lake on the south, east, and west and covers approximately 3.5 million acres, or 10,400 square kilometers. Lake Okeechobee functions as the central part of a large interconnected aquatic ecosystem in South Florida and is the major surface water body of the Central and Southern Florida Flood Control (C&SF) Project. The lake provides a number of values to society and nature including water supply for agriculture, urban areas and the environment, flood protection, a multi-million dollar sport and commercial fishery, and habitat for wading birds, migratory waterfowl, and the federally endangered Everglades snail kite. These values of the lake have been threatened in recent decades by excessive phosphorus loading, harmful high water levels, and rapid expansion of exotic plants. The Kissimmee River and its watershed are major components of the Lake Okeechobee ecosystem, and restoration of these resources will contribute to the sustainability of the lake. Further information on Lake Okeechobee is presented in Chapter 10 of the 2005 SFER – Volume I.

KISSIMMEE WATERSHED

The Kissimmee watershed is the headwaters to the greater Kissimmee-Okeechobee-Everglades ecosystem (**Figure 1-1**). It encompasses an area of approximately 6,200 square kilometers (2,393 square miles) of southern Central Florida and includes the drainage area of Lake Istokpoga, the Kissimmee River, and the Upper Basin of the Kissimmee watershed. The Upper Basin is an important regional water source with an area of approximately 4,200 square kilometers (1,621 square miles) in the central portion of the Florida peninsula. This area is a diverse natural resource that forms an ecological transition zone between the warm, temperate climate of the north and subtropical areas to the south (Beaver et al., 1981; MacVicar, 1983). The Kissimmee Chain of Lakes (KCOL) consists of 28 prominent lakes in the center of the region that function hydrologically and ecologically as a regional-scale resource. The heart of the chain consists of 18 lakes whose water levels are regulated through a series of 8 major canals and 9 water control structures (USACE, 1956). Collectively, the KCOL resides within 14 sub-watersheds and is fed by more than 30 tributaries throughout the region. The Lower Basin is approximately 2,000 square kilometers (772 square miles) and includes the historic Kissimmee River and its tributary watersheds between Lake Kissimmee, Lake Okeechobee, and the C-38 flood control canal.

Historically, the Kissimmee River meandered approximately 103 miles from Lake Kissimmee to Lake Okeechobee, through a one- to two-mile-wide floodplain. The river and surrounding floodplain comprised a mosaic of wetland plant communities and supported a diverse group of waterfowl, wading birds, fish, and other wildlife. As part of early flood control efforts, the river was channelized and two-thirds of the historical floodplain was drained between 1962 and 1971 in order to prevent catastrophic flooding. These modifications resulted in unintentional impacts including drastic declines in wintering waterfowl, wading bird, and game fish populations as well as loss of ecosystem functions. Subsequently, the Kissimmee River Restoration was authorized by the U.S. Congress in the Water Resources Development Act of 1992. The primary goal of this restoration project, led jointly by the District and the USACE, is to reestablish an estimated 104 square kilometers (40 square miles) of the river/floodplain ecosystem, including 43 miles of meandering river channel and 27,000 acres of wetlands. The restoration includes a comprehensive restoration evaluation program to track benefits to more than 320 fish and wildlife species, including the endangered wood stork, snail kite, and bald eagle. Land acquisition, advanced research, and on-going monitoring efforts associated with this project are of potential significance to the long-term restoration of the Kissimmee River ecosystem. Further information on the Kissimmee River and the KCOL is presented in Chapter 11 of the 2005 SFER – Volume I.

COASTAL ECOSYSTEMS

The coastal hydrography of South Florida consists of the near ocean shelf, coastal lagoons or semi-enclosed embayments, estuaries, marshes, sloughs and tidal creeks, and freshwater rivers and canals that emanate from the watershed. South Florida's coastal ecosystems are primarily tropical and subtropical ecosystems and are known for their high species diversity and wide variety of aquatic and upland habitats. These ecosystems support spiny lobster, penaeid shrimp, blue crab, oyster, spotted sea trout, stone crab, and many other species of marine and freshwater species of commercial and recreational interest. The productivity and sustainability of South Florida coastal ecosystems are strongly influenced by the dynamics of the physical environment. Tidal cycles, sea level, meteorological activity, hydrologic conditions, as well as temporal and spatial variability of physical and chemical parameters (e.g., residence time, depths, temperature, water column currents, salinity, turbidity, and nutrient deposition) directly impact coastal resources. In addition to direct impacts from within their watersheds, coastal ecosystems can be impacted by hydrological and meteorological conditions that occur in other areas of the greater Everglades system due to a network of water conveyance facilities. Coastal ecosystems are also especially vulnerable because they attract intense human development, making these areas especially prone to habitat loss and alteration.

South Florida's coastal ecosystems are comprised of several major ecosystems within the South Florida Water Management District. These ecosystems are the Southern Indian River Lagoon, including St. Lucie River and Estuary; Loxahatchee River and Estuary; Lake Worth Lagoon; Biscayne Bay; Florida Bay and Florida Keys; Naples Bay; Estero Bay; Caloosahatchee River and Estuary; and Southern Charlotte Harbor (**Figure 1-1**). Currently, the District conducts scientific research and monitoring for most of these ecosystems, which have been identified as priority coastal water bodies. The key areas of coastal ecosystem management and restoration efforts of the District are highlighted in this section, and more detailed information is presented in Chapter 12 of the 2005 SFER – Volume I.

Southern Indian River Lagoon

The Indian River Lagoon (IRL) is a series of three distinct, but interconnected, estuarine systems, which extend 156 miles from Ponce Inlet to Jupiter Inlet on Florida's east coast. The northern portion of the lagoon is within the St. Johns River Water Management District. The lagoon's southern section is located within the South Florida Water Management District in St. Lucie, Martin, and northern Palm Beach counties. The IRL has been designated for special study, protection, and restoration as part of the regional National Estuary Programs. The estuary is characterized by the greatest species diversity of any estuary in North America including manatees, dolphins, and sea turtles. Approximately 2,200 species have been identified in the lagoon system, with 35 of these species listed as threatened or endangered. The lagoon supports multi-million dollar fishing, clamming, ecotourism, agricultural, and recreational industries. However, there has been great concern for severe impacts on the lagoon's water, sediment, and habitat quality resulting from high nutrient input, sedimentation, and turbidity as well as disturbance of large areas of mangroves and seagrasses. The combined impacts of waste and stormwater runoff, drainage, navigation, loss of essential marshland, and agricultural and urban development are of potential significance to the long-term management of the IRL ecosystem.

St. Lucie River and Estuary

The St. Lucie River and Estuary watershed are located in Martin and St. Lucie counties on the central east coast of Florida. The watershed covers approximately 2,020 square kilometers (780 square miles), while the estuary covers about 24 square kilometers (9 square miles). The river's headwaters lie between the lands west of Ft. Pierce in St. Lucie County to near the north boundary of Jonathan Dickinson State Park in Martin County. The natural watershed is drained by several creeks and canals that flow into either the North Fork or South Fork of the St. Lucie River before entering the Indian River Lagoon near the St. Lucie Inlet. The St. Lucie River, part of the Indian River Lagoon estuary system, provides habitat for thousands of plant and animal species including manatees, dolphins, and sea turtles. The river also attracts a variety of commercial, recreational, and educational activities such as fishing, recreational boating, and ecotourism.

The St. Lucie Estuary (SLE) ecosystem is threatened by increasing residential and commercial development, industry and agriculture, and anthropogenic impacts. The construction of extensive agricultural and urban drainage projects has substantially expanded the watershed of the St. Lucie Estuary. The effects of these man-made changes have caused significant alterations in the timing (excess wet season flows, insufficient dry-season flows), distribution, quality, and volume of fresh water entering the estuary. The estuarine environment is sensitive to freshwater releases, and these alterations have placed severe stress on the entire ecosystem. Extreme salinity fluctuations and ever-increasing inflows have contributed to major changes in the structure of the communities within the estuary, as seen by seagrass and oyster losses.

Loxahatchee River and Estuary

The Loxahatchee River, Florida's first federally designated National Wild and Scenic River, is located in northern Palm Beach County and southern Martin County and encompasses more than 518 square kilometers (200 square miles) that drain to the Jupiter Inlet. The Loxahatchee River watershed includes the communities of Hobe Sound, Tequesta, Jupiter, Jupiter Inlet Colony, Jupiter Farms, Juno Beach, and Palm Beach Gardens. This watershed contains large tracts of undisturbed land such as the Atlantic Coastal Ridge and West Jupiter Wetlands (formerly Pal-Mar) as well as protected parcels such as the J.W. Corbett Wildlife Management Area, Jonathan Dickinson State Park, Loxahatchee Slough Preserve, and the Jupiter Ridge Natural Area. Along the river, and within Jonathan Dickinson State Park, is coastal sand pine scrub, a biological community so rare that it is designated as "globally imperiled." Other habitat types found within the watershed include pinelands, xeric oak scrub, hardwood hammock, freshwater marsh, wet prairie, cypress swamps, mangrove swamps, seagrass beds, tidal flats, oyster beds, and coastal dunes. These areas support diverse biological communities including many endangered species such as the manatee and the four-petal pawpaw, a tree that is found only in Martin and Palm Beach counties. This watershed also contains managed agricultural lands and areas impacted by urban and suburban development, including industrial sites.

Lake Worth Lagoon

The Lake Worth Lagoon (LWL) extends for approximately 20 miles in central Palm Beach County. Lake Worth Creek, Little Lake Worth, Lake Worth Cove, and Mangrove Lagoon (i.e., the John D. MacArthur Beach State Recreation Area) border the northern end of the lagoon in North Palm Beach. The southern end of the LWL drastically narrows at Boynton Beach and Ocean Ridge. The Atlantic Intracoastal Waterway channel runs the entire length of the LWL. The lagoon's watershed is highly urbanized and encompasses more than 1,166 square kilometers (450 square miles) that ultimately drain to the North Lake Worth (Palm Beach) Inlet and South Lake Worth (Boynton) Inlet. The lagoon was historically a freshwater lake with occasional brackish conditions caused by temporary inlets created by storms or high-water conditions. However, due to the opening of permanent inlets, it was rapidly converted to a marine environment by the early 1900s.

Similar to many of South Florida's heavily urbanized coastal areas, the LWL has been negatively impacted by anthropogenic changes. Significant loss of wetlands, shoreline vegetation, seagrasses, and substrate habitat coupled with increased watershed imperviousness, redirection of historical runoff, and significant increases in stormwater discharges, have all contributed to deteriorated habitat and impaired ecosystem function. Currently, the lagoon receives too much runoff in the wet season and fewer freshwater discharges during the dry season, and is subjected to extreme salinity fluctuations and high levels of turbidity and sedimentation. Accumulation of muck deposits have contributed to sediment up to several feet thick in some areas, creating an unnatural anaerobic substrate devoid of invertebrates and seagrasses. In addition, there is a continuing concern over the levels of nutrients, toxic substances, and pathogenic bacteria.

Biscayne Bay

Located along the coast of Miami-Dade and northeastern Monroe County, Biscayne Bay comprises a marine ecosystem of about 1,100 square kilometers (425 square miles), and a watershed area of about 2,430 square kilometers (938 square miles). This subtropical estuary is designated as an aquatic preserve and "Outstanding Florida Water." The bay is comprised of three general areas including north, central, and south Biscayne Bay. The northern area extends from Dumfoundling Bay south to the Rickenbacker Causeway and retains the most estuarine habitat found in the bay. The central area, extending from Rickenbacker Causeway south to Black Point, is more of a marine system that is heavily influenced by daily tidal flushing. The southern area extends from Black Point to Jewfish Creek and includes Biscayne National Park, a sanctuary for the Florida spiny lobster.

Biscayne Bay contains a coral reef system, which is the world's third longest and the only one in the world located in close proximity to a large highly urbanized coastal area, Miami-Dade County. This coral reef is home to more than 200 species of fish and numerous other marine plants and animals, some of which are listed species as well as important for fisheries. Historically, its clear water and its diverse and productive communities of seagrasses, corals, and sponges characterized Biscayne Bay. However, Biscayne Bay presently shows increasing signs of distress, declines in fisheries, increased pollution, and dramatic changes in nearshore vegetation. Intensive development of the watershed has altered the natural cycle of fresh water inflows into the bay. The opening of inlets and further channelization has contributed to the bay's transition from a freshwater estuary to a marine lagoon. Restoration and preservation of Biscayne Bay and Biscayne National Park are dependent on a comprehensive understanding of the relationship between the hydrologic system and the bay ecosystem and of the natural versus human-induced variability of the ecosystem. The goal for Biscayne Bay is to maintain and improve water quality to protect and restore natural ecosystems and human uses of the bay while protecting its environmental resources.

Florida Bay and Florida Keys

The Florida Keys watershed consists of a limestone island archipelago of about 800 islands extending southwest for over 320 kilometers (200 miles), from the southern tip of the Florida mainland to the Dry Tortugas, within both Miami-Dade and Monroe counties. Florida Bay begins at the extreme southern tip of mainland Florida and includes the body of water that lies between the mainland peninsula and the Florida Keys (SFWMD, 1992a). Florida Bay covers a total area of about 2,200 square kilometers (849 square miles), of which approximately 1,800 square kilometers (695 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, and sponges) and fishes (snook, redfish, tarpon, sea trout, and mullet). In addition, the warm, shallow waters provide habitat for major populations of birds and for endangered species such as the American crocodile and West Indian manatee. Much of the productivity and diversity of Florida Bay is dependent on mangroves and seagrasses, and the die-off of seagrasses in the late 1980s was an indication that Florida Bay was seriously threatened by water management practices in upstream basins (SFWMD, 1992a).

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 and from other natural areas. The effects of long-term variations in rainfall patterns and sea-level rise are unknown, but they may be significant (Chapter 6 of 2005 SFER – Volume I; SFWMD, 1992a). Inputs of both nitrogen and phosphorus are also a concern for Florida Bay (Rudnick et al., 1999). Nutrient sources include the atmosphere, the Gulf of Mexico, the Florida Keys, and the southern Everglades. The impact of nutrient movement from the Florida Keys and from hydrological changes associated with Everglades restoration is of potential significance to the long-term management of the Florida Bay ecosystem.

Naples Bay

Naples Bay is the receiving water body of a subtropical watershed of approximately 310 square kilometers (120 square miles) in western Collier County. It is a relatively narrow and shallow estuarine water body ranging in width from 100 to 1,500 feet, and in depth from 1 to 23 feet. Both the primary water inlets (Gordon River, Rock Creek, and Haldeman Creek) and the historic flow-ways to Naples Bay have been altered by road and drainage development over the last 40 years. Large freshwater discharges through a network of man-made canals and stormwater outlets cause large fluctuations in the salinity levels and current patterns. This creates enormous shocks to the aquatic biota of the bay, often resulting in too little fresh water input to the surrounding saline areas. The rapid decline in salinity to near freshwater levels has caused prolonged salinity stresses and eliminated or displaced a high proportion of the benthic, mid-water, and fish plankton communities in the bay. Overall, the impacts of eliminated seagrass beds, significantly reduced shellfish harvest levels, increased stormwater runoff, and decreased salinity levels are of potential significance to the long-term management of the Naples Bay ecosystem.

Estero Bay

Estero Bay is a long, narrow, and very shallow body of water, with its northwestern border beginning at Bowditch Point on Estero Island and reaching as far as Bonita Beach on the south. Estero Island, Black Island, Long Key, Lover's Key, and Big Hickory Island are the barrier islands that separate the bay from the Gulf of Mexico. The watershed of the bay includes central and southern Lee County and parts of northern Collier and western Hendry counties. The principal freshwater inflows come from the Imperial River, Hendry Creek, Mullock Creek, Estero River, and Spring Creek. Four outlets provide access to the Gulf of Mexico including Matanzas Pass, Big Carlos Pass, New Pass, and Big Hickory Pass. The total surface water area for Estero Bay is approximately 39 square kilometers (15 square miles).

The flora and fauna of the bay and its watershed include several state and federally listed species such as the West Indian manatee, loggerhead sea turtle, Florida panther, bald eagle, big cypress fox squirrel, red-cockaded woodpecker, and snowy plover. There are five rookery and roosting islands in the bay utilized by thousands of birds, such as brown pelicans, frigate birds, herons, egrets, cormorants, and ibis. Population growth in the Estero Bay watershed has been rapid, and increasing concern regarding potential threats to sensitive natural resources in the bay and watershed as a result of the growth is widespread. The impacts of reduced seagrass beds, low dissolved oxygen levels, and increased nutrient levels are of potential significance to the long-term management of the Estero Bay ecosystem.

Caloosahatchee River and Estuary

The Caloosahatchee River is a large estuarine system where the waters of the Gulf of Mexico mix with the freshwater inflows from the river, sloughs, and overland sheetflows in the basin. The river extends about 70 miles from Lake Okeechobee to San Carlos Bay on Florida's southwest coast. This watershed includes the East, West, and Tidal Caloosahatchee drainage basins as well as the North Coastal, Telegraph Swamp, C-21, and S-236 drainage basins. The freshwater portion of the river has been reconfigured as a canal (C-43) and extends 45 miles from the Moore Haven Lock and Dam (S-77) to Franklin Lock and Dam (S-79) to better convey floodwater to the Gulf of Mexico. The lower reaches of this estuary are characterized by a shallow bay, extensive seagrass beds, and sand flats. Extensive mangrove forests dominate undeveloped areas of the shoreline. Southwest Florida estuaries are habitat to more than 40 percent of Florida's rare, endangered, and threatened species. Significant natural system resources within the Caloosahatchee River watershed include Pine Island Sound, Matlacha Pass, Charlotte Harbor aquatic preserves, and Telegraph Swamp. The major issues affecting the Caloosahatchee River watershed are water supply availability, salinity variations, and nutrient levels. Water quality within the Caloosahatchee River basin is threatened by altered freshwater inputs, nutrient loads from agricultural activities, trace elements as well as overall urban growth and development within the watershed. The overall goal for the Caloosahatchee River watershed is to protect and enhance the estuaries that receive freshwater regulatory releases from Lake Okeechobee through the Caloosahatchee River.

Southern Charlotte Harbor

Charlotte Harbor is Florida's second-largest open water estuary and one of the state's major environmental features. It is bordered by Lee, Charlotte, and Sarasota counties, and its watershed stretches from the headwaters of the Peace River in Polk County to the southern end of Estero Bay in Lee County over a distance of more than 160 kilometers (100 miles). Similar to the IRL, the Charlotte Harbor Estuary has been designated for special study, protection, and restoration as part of the regional National Estuary Programs. This semi-enclosed body of water opens to the Gulf of Mexico and receives marine water as well as fresh water from three major rivers; several smaller streams create a regime varying from 0 to 100 percent seawater. This estuary has a broad barrier island chain and a largely intact mangrove shoreline with significant parts in public ownership and management. Importantly, this area contains three national wildlife refuges and four aquatic preserves. As a result of the rapid development occurring over the past four decades throughout Southwest Florida, there has been increased concern regarding existing and potential impacts to these areas resulting from hydrologic alterations and the degradation of water quality. In general, the need for restoration activities has been shown to be greatest for the more northern estuarine systems, where the impacts associated with surrounding development have been both more intense and extended back to prior to the implementation of many of the current environmental regulations and management practices.

THE SOUTH FLORIDA WATER MANAGEMENT DISTRICT, OTHER GOVERNMENTAL AGENCIES, AND THE DISTRICT'S PROGRAMS

The Central and Southern Florida Flood Control District was created in 1949 to serve as local sponsor for the Central and Southern Florida Project, a multipurpose water resources project authorized by Congress. In 1973, the agency was renamed the South Florida Water Management District in response to a broadened mission. The District is now responsible for environmental resources management of approximately 44,030 square kilometers (17,000 square miles) in South Florida, with an agency mission that includes water supply, flood protection, water quality protection, and environmental enhancement. One of the District's key goals is to successfully manage and implement its Kissimmee-Okeechobee-Everglades and coastal area programs. These District programs are further discussed in the section below.

EVERGLADES PROGRAM

The South Florida Water Management District's partner in many of its responsibilities is the Florida Department of Environmental Protection. Based on statute, the District operates under the general supervisory authority of the FDEP, and many of the District's programs rely on close cooperation between the agencies. The FDEP issues permits to the District for the operation of water control structures. The District and the FDEP are specifically named as partners in the recently amended Everglades Forever Act (2003), with shared responsibility for various activities in the Everglades Program, including the production of the *2005 South Florida Environmental Report – Volume I*. The FDEP has taken the lead in developing several chapters in this volume including Chapters 2A and 2C on water quality and Chapter 2B on mercury studies. Additionally, the FDEP has provided input on many other sections in this volume.

Particularly important components of the Everglades Program are presented in Volume I, including the Everglades Construction Project (ECP) and Stormwater Treatment Areas (STAs) discussed in Chapters 4 and 8; and agricultural Best Management Practices (BMPs), covered in Chapter 3. Another major component of the Everglades Program, the Everglades Stormwater Program (ESP), covered in Chapter 3, includes developing the means to ensure water quality compliance for structures discharging into, from, or within the EPA. The Everglades Stormwater Program moves beyond the Everglades Construction Project to ensure that water quality standards will be met for areas of the EPA not directly involved in the ECP. Information from the results of the various projects of the Everglades Program was applied in the development of the Conceptual Plan for Achieving Long-Term Water Quality Goals in the Everglades Protection Area (known as the Long-Term Plan) (Chapter 8). The hydrological status of the South Florida environment is the subject of Chapter 5. Chapter 6 updates information on the effects of altered hydrology in the EPA.

LAKE OKEECHOBEE PROTECTION PROGRAM

The Lake Okeechobee Protection Act [LOPA, Section 373.4595, Florida Statutes (F.S.)] was passed by the Florida legislature in May 2000. This legislation provides for the implementation of the Lake Okeechobee Protection Program with the goal of rehabilitating the lake and enhancing lake's ecosystem. This will be accomplished by achieving and maintaining compliance with water quality standards in Lake Okeechobee and its tributary waters through a watershed-based, phased, comprehensive, and innovative protection program designed to reduce phosphorus loads and implement long-term solutions based on the lake's Total Maximum Daily Load (TMDL). The Lake Okeechobee Protection Program sets forth a series of activities and deliverables for the South Florida Water Management District in cooperation with the Florida Department of Environmental Protection and the Florida Department of Agriculture and Consumer Services. This program is focused on addressing excessive nutrient loading, extreme high and low water levels, and exotic species associated with the lake and its watershed.

In order to satisfy this year's legislative requirements for the 2005 Lake Okeechobee Annual Report, important components of the Lake Okeechobee Protection Program are presented. These components include the water quality status and habitat conditions of the lake and its watershed, research and management efforts, and the Lake Okeechobee Construction Project (ECP), covered in Chapter 10 of this volume. This chapter also addresses information required as part of the Lake Okeechobee Protection Plan (LOPP), which identifies areas requiring further legislative support to successfully implement the program to protect and restore this resource.

KISSIMMEE RIVER RESTORATION PROGRAM

In 1994, the South Florida Water Management District and the U.S. Army Corps of Engineers entered into a Project Cooperative Agreement (PCA) that authorized a 50/50 cost share partnership for the Kissimmee River Restoration Program (KRRP). In this joint program, the District is primarily responsible for land acquisition, restoration evaluation, and small-scale construction. To complement the District's role, the USACE is primarily responsible for the engineering design and major construction. Overall, the KRRP is a collective of 31 project components that extend over most of the watershed. To date, 14 projects have been completed, 7 projects are currently in the planning phase, 6 projects are currently in the design phase, and 4 projects are in the construction phase. The projected project completion date is August 2012. The comprehensive restoration evaluation program is expected to be completed several years after project construction has been completed.

Currently, research on the Kissimmee Upper Basin (KUB)/Kissimmee River system is being implemented to support the project's comprehensive restoration evaluation program. The primary purpose of this ecological evaluation program is to evaluate the success of the restoration projects in reestablishing the ecological integrity of the Kissimmee River ecosystem. This will be achieved through massive reconstruction of the system by eliminating the flood control canal, water control structures, and levees and reestablishing natural water levels and flow in the Kissimmee watershed. Restoration evaluation studies are also being conducted as an important component of this program in order to evaluate the impacts of the reestablished flow through the river channel and reinundation of the floodplain on the restoration of historic habitat characteristics. A list of key indicators for evaluating the Kissimmee River restoration has been established based on a prioritization process that (1) favored components of the ecosystem, (2) are expected to show reliable short and long-term responses, (3) are efficient to monitor, and (4) will provide useful information for managing the recovering and restored system. The highest priority components are species of recreational, economic, and natural heritage value such as game fish (largemouth bass, black crappie, and bluegill), wading birds, waterfowl, and threatened and endangered species. Additional details on the Kissimmee River restoration and Upper Basin initiatives are presented in Chapter 11 of this volume.

COASTAL WATERSHEDS PROGRAM

Coastal communities throughout the South Florida Water Management District are faced with impressive challenges in balancing water resource needs and functions between an increasing human population and the natural environment that is biologically unique and serves as the backbone of the South Florida economy. The Coastal Watersheds Program involves developing and implementing projects and flood management planning activities that improve the quality, quantity, timing, and distribution of flows to coastal water bodies from their tributary watersheds. Scientific focus is primarily on salinity, seagrass, and other biological indicators and the information gathered from these efforts contributes to enhanced operational decisions regarding the release of fresh water to estuaries. This program includes efforts to understand the effects of changing flows of fresh water to estuaries from both a water quantity and quality perspective and to identify the existing legal sources of water that are beneficial to fish and wildlife.

The Coastal Watersheds Program provides scientific and technical support to the South Florida Water Management District's priority projects, such as CERP project planning, development and evaluation of Minimum Flows and Levels (MFLs), and formulation of water reservations. In addition, ongoing efforts by the District are focused on developing water quality targets that may lead to Pollutant Load Reduction Goals (PLRGs) or TMDLs. Local initiatives, such as stormwater improvement projects and environmental restoration projects, are implemented under this program through the District's nine Service Centers and external partners including the FDEP and USACE. Additional details on the Coastal Watersheds Program are presented in Chapter 12 of this volume.

ENVIRONMENTAL ALTERATION AND RESTORATION OF THE SOUTH FLORIDA ENVIRONMENT

ENVIRONMENTAL PROBLEMS FACING SOUTH FLORIDA

Landscape development is changing ecosystems dramatically around the world. Hydrological alterations are recognized as a major threat to public lands and other ecosystems (Pringle, 2000; Rosenberg et al., 2000). Dams and other changes to flowing waters associated with development have resulted in huge modifications to the hydrology and chemistry of large aquatic ecosystems (Dynesius and Nilsson, 1994; Chao, 1995). Unfortunately, the South Florida environment is no exception to these trends. The Kissimmee-Okeechobee-Everglades and coastal ecosystems have been altered fundamentally by changes in spatial extent, hydrology, and water quality.

The Everglades system once extended from the south shore of Lake Okeechobee to the mangrove estuaries of Florida Bay and covered more than 10,000 square kilometers. Urban and agricultural development during the twentieth century has reduced the present-day Everglades to 50 percent of its original size (Mitsch and Gosselink, 2000). The loss of spatial extent has been accompanied by altered flow regimes and water quality resulting in undesirable changes observed in water quality, flora, and fauna in portions of the Everglades during the past several decades (Davis and Ogden, 1994; Sklar et al., 2002). Development of the water management system of South Florida also resulted in a loss of surface flow. This alteration may be a major factor in changing landscape patterns including the loss of ridge and slough habitat (Science Coordination Team, 2003). 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 (SFWMD 1992a, b, c; Chapters 2 and 3 in the 2000 and 2001 Everglades Consolidated Reports). Exotic plant species also pose a serious problem in South Florida (covered in Chapter 9 of this volume). In addition, mercury in the Everglades remains a concern, although recent regulatory actions have been effective in reducing emissions to the atmosphere covered in Chapter 2B of this volume.

Such impacts from agricultural drainage are not unique to the Everglades (Lemly et al., 2000). Agricultural land use in the watershed of Lake Okeechobee and a massive perimeter levee have also led to severe alteration and enrichment of this large and important lake (Aumen, 1995). As a result, the lake has experienced severe algal blooms, high turbidity, and loss of aquatic plant communities. The Kissimmee River, a major tributary to the lake, was channelized in the 1970s causing a catastrophic loss of riverine, wetland, and wildlife habitat in the river and its floodplain (Koebel, 1995). Water management in the Upper Chain of Lakes has also altered these unique environments and helped to create problems with water quality and expansion of aquatic plant communities. Efforts are under way to improve the sustainability of the Kissimmee River and the Upper Chain of Lakes, and these efforts will, in turn, contribute to a major restoration effort under way in the Lake Okeechobee watershed.

The coastal ecosystems of South Florida have also been impacted greatly by changes in the quantity, quality, timing and distribution of fresh water in the region. All of these valued ecosystems suffer from wide swings in salinity, excessive nutrient inputs, altered light penetration, and invasion by exotic species. These stressors are threatening marine habitats and fisheries resources throughout South Florida and must be addressed as the South Florida restoration strategy is implemented.

THE SOUTH FLORIDA RESTORATION STRATEGY

The environmental management and restoration of South Florida is a massive undertaking, unique in regional scale and complex inter-relationships. Moving forward on many fronts, management actions build on a philosophy of environmental management that addresses the manifestations of excess nutrient inputs (Carpenter et al., 1998; Smith et al., 1999). The restoration strategies described below and throughout this entire report are guided by prior successes in reversing problems associated with nutrient enrichment in aquatic ecosystems around the world. Classic restoration case histories include Lago Maggiore, Italy (de Bernardi et al., 1996); Lake Washington, U.S.A. (Edmondson, 1991); the Chesapeake Bay, U.S.A. (Malone et al., 1996); and the Thames River and Estuary, England (Gameson and Wheeler, 1977). South Florida restoration will require an unparalleled effort to improve both the flow regimes to constituent ecosystems and the overall quality of their tributary waters.

Everglades Management and Restoration

The Everglades Protection Area (EPA) includes Water Conservation Areas 2 and 3, the Arthur R. Marshall Loxahatchee National Wildlife Refuge, and the Everglades National Park, encompassing most of the remaining Everglades wetlands. The remaining Everglades contains a variety of habitats that support unique biotic communities and is still widely recognized as an ecosystem of immense regional and international importance (SFWMD, 1992a; Lodge, 1994; Maltby and Dugan, 1994).

The altered flow regimes and water quality have caused pronounced nutrient gradients in the WCAs downstream of major discharge structures; cattail replacement in large areas that were once dominated by open-water sloughs, sawgrass, and periphyton; decline in wading bird populations; and species changes in periphyton and macroinvertebrate communities (Davis and Ogden, 1994; McCormick et al., 2002).

Phosphorus has been identified as the nutrient most responsible for changing the Everglades environment, and reducing phosphorus loading to the EPA is central to the state of Florida's strategy for restoring and preserving the Everglades, as described in the following section of this chapter. The undesirable changes in the biotic communities of the Everglades are also associated with alterations in the hydropatterns of the ecosystem. Research on the hydrological needs of the EPA and data and findings on current hydrological status are summarized in Chapter 6 of the 2005 SFER – Volume I. In addition, mercury, a heavy metal, is a potential challenge to Everglades restoration. A long-term, multiagency program has contributed greatly to our understanding of this toxic metal in South Florida, and the findings from research and monitoring on mercury are detailed in Chapter 2B and its appendices of this volume.

Restoration of the Everglades ecosystem is a national, even international, imperative. The Florida legislature stated the mandate succinctly in the Everglades Forever Act:

> ...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. (Section 373.4592, F.S.)

Florida's Everglades Forever Act establishes long-term water quality goals to ultimately achieve restoration and protection of the Everglades Protection Area. The program encompasses those activities currently under way to reduce phosphorus concentrations in waters entering the EPA sufficiently to achieve the recently adopted phosphorus rule including a criterion of 10 parts per billion (ppb) within the EPA (see Chapter 2C of this volume). The program also includes the EAA's Best Management Practices (BMPs) and the Everglades Construction Project (ECP) (see Chapters 3 and 4 of this volume, respectively). The long-term goal is to combine point-source, basin-level, and regional solutions in a systemwide approach to ensure that all waters discharged to the EPA are achieving water quality standards (see Chapter 8 of this volume). The Long-Term Plan for Achieving Water Quality in the Everglades Protection Area has recently been incorporated into the amended Everglades Forever Act and is presently being implemented. Achieving the proposed long-term water quality goals will require integration of numerous research, planning, regulatory, and construction activities, as outlined in Chapter 8 and as detailed in the Long-Term Plan on the District's Website at http://www.sfwmd.gov/org/erd/longtermplan/index.shtml.

- **Best Management Practices:** Best Management Practices have been implemented in the Everglades Agricultural Area and have proven successful at reducing phosphorus loading from those basins. An EAA-wide target of 25-percent load reduction, compared to the May 1979 through April 1988 pre-BMP period, was established by District rulemaking. Over the last several years, these BMPs have reduced phosphorus loads by approximately 50 percent, with an associated reduction of more 1,300 metric tons of phosphorus that would have otherwise entered the Everglades. The phosphorus concentrations have also been reduced significantly from the pre-BMP period. Additional details on the BMP programs are provided in Chapter 3 of this volume.

- **Stormwater Treatment Areas:** While BMPs have proven effective, additional phosphorus reduction is necessary to achieve the goal of 50 ppb required by the EFA and move beyond this goal through implementation of the Long-Term Plan. Large constructed wetlands are the primary regional treatment component in the phosphorus control program for the Everglades, codified in the EFA and included in the federal Settlement Agreement (i.e., Settlement Agreement dated July 26, 1991, entered in Case No. 88-1886-Civ-Hoeveler, U.S. District Court for the Southern District of Florida, as modified by the Omnibus Order entered in the case on April 27, 2001). These constructed wetlands, referred to as Stormwater Treatment Areas (STAs), sequester phosphorus in the soils and biomass through naturally occurring biological phenomena and are designed to reduce the phosphorus concentration and load entering the EPA. To date, five of the six STAs, totaling about 35,000 acres, are operational; four of these are performing better than expected. To date, the STAs have removed 427 metric tons of total phosphorus that would otherwise have entered the Everglades. **Figure 1-1** shows the locations of the STAs and details on STA performance and optimization are provided in Chapter 4 of this volume. Steps being taken to enhance their performance are provided in the Long-Term Plan, as discussed in Chapter 8.

- **Phosphorus Research and Rulemaking:** The FDEP summarized available information on nutrient effects in the 2000–2003 Everglades Consolidated Reports. This research was used as the foundation for rulemaking to establish a numeric phosphorus criterion and water quality standard for the Everglades, as required by the EFA. On July 18, 2003, the Environmental Regulation Commission adopted a 10-ppb, numeric water quality criterion for phosphorus in the Everglades Protection Area (codified as 62-302.530-540, F.A.C.). The rule also includes a compliance methodology and moderating provisions, which set forth the parameters for issuing permits to structures that discharge into the Everglades. In June 2004, this rule was formally upheld ending an administrative challenge to rule development. The rule is currently being reviewed by the U.S. Environmental Protection Agency as a change in water quality standards.

- **Comprehensive Everglades Restoration Plan:** The goal of the Comprehensive Everglades Restoration Plan is to restore, preserve, and protect South Florida's ecosystem while providing for other water-related needs of the region, including water supply and flood protection [Water Resources Development Act 2000, Title VI, Paragraph 601(h)(1)]. CERP will restore the ecological integrity of the South Florida ecosystem, while continuing to provide flood protection, agricultural and urban water supply, and other project purposes. Information on the Restoration Coordination and Verification (RECOVER) monitoring and assessment activities for CERP is provided in Chapter 7. The status of projects being implemented through CERP is discussed in the 2005 SFER – Volume II.

- **Everglades Stormwater Program:** The Everglades Construction Project covers seven of the 15 major basins that discharge into the Everglades Protection Area. The EFA also requires water quality strategies for the remaining eight 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 (ESP). This program includes a combination of regulatory analyses, water quality evaluations, water quality improvement measures, and source controls. The Everglades Stormwater Program is described more fully in Chapter 3 of this volume.
- **The Long-Term Plan for Achieving Water Quality Goals:** For the past several years, the District and other parties have been researching ways to reduce phosphorus inflows to the Everglades. Based on extensive basin-specific feasibility studies (see Chapter 8 of the *2003 Everglades Consolidated Report*), a Long-Term Plan for Achieving Water Quality Goals in the EPA was developed for all discharges to achieve water quality standards by December 2006. The plan's strategy combines controlling phosphorus at the source, enhancing the performance of the STAs, and integration with CERP projects to avoid unnecessary and duplicative costs. The plan identifies specific enhancements to the existing STAs and requires them to be implemented by December 2006. In addition to STA optimization, the Long-Term Plan also recommends that additional source control measures be implemented in all the tributary basins to minimize phosphorus-laden runoff. Additionally, the Long-Term Plan includes activities designed to accelerate the recovery of areas within the EPA that are already impacted. Complete details about the Long-Term Plan are provided in Chapter 8 of this volume.

Long-term simulations of the pre-2006 STA enhancements for the ECP basins predict future discharge concentrations in the range of 10 to 14 ppb (geometric mean), well below the 50 ppb level considered by the EFA and the federal Settlement Agreement. Significantly, under the Long-Term Plan, phosphorus removal will also be coordinated with the $8 billion, federal-state Comprehensive Everglades Restoration Plan. For example, a cost savings of more than $100 million is possible by integrating the C-11 West basin CERP impoundment and diversion projects with other water quality improvement measures mandated under the EFA. Thus, when CERP projects are completed in the non-ECP basins, inflows are predicted to decrease to below near 10 to 15 ppb (geometric mean).

The Long-Term Plan, which is estimated to cost approximately $451 million to implement also includes additional research to find new ways to achieve the planning goal and objective of achieving the phosphorus criterion in the EPA. The plan then requires additional capital improvements to implement the newly discovered measures, if the pre-2006 measures do not achieve the criterion in the EPA.

Lake Okeechobee Management and Restoration

Lake Okeechobee is currently experiencing (1) excessive phosphorus loads, (2) unnaturally high and low water levels, and (3) rapid spread of exotic and nuisance plants in the littoral zone.

Currently, the District is working with the FDEP, USACE, and other agencies to address these interconnected issues to rehabilitate the lake and enhance the ecosystem services that it provides.

The excessive phosphorus loads originate from agricultural and urban activities and currently average 528 metric tons per year based on a five-year rolling average from 2000–2004. This is almost four times higher than a recently established TMDL of 140 metric tons per year, which is considered necessary achieve the target 40 ppb in-lake phosphorus concentration. The Florida legislature passed the Lake Okeechobee Protection Act (LOPA) in 2000, mandating that the TMDL be met by 2015 through an aggressive program to address excessive phosphorus loads and exotic species. In addition, the SFWMD and USACE are implementing CERP components that will partially address the phosphorus issue and provide alternative storage locations so that water levels in the lake can be regulated in a more environmentally friendly manner.

The Lake Okeechobee Protection Plan, which lays out the major projects that will address the issues identified in the LOPA, was submitted to the Florida legislature in January 2004. The plan includes optimization of existing regulatory and best management programs (BMPs), development and implementation of new BMPs, improvement and restoration of hydrologic functions in natural and managed systems in the watershed, and use of alternative technologies for nutrient reduction. The Lake Okeechobee Watershed Project of CERP, which will provide substantial amounts of water storage and 38.5 percent of the phosphorus load reduction needed to meet the TMDL, is moving forward on schedule and cooperating agencies have been able to implement a large number of phosphorus reduction projects ahead of schedule.

Water levels in the lake have been favorable for development of a diverse community of submerged aquatic vegetation in the lake's shoreline areas, where plants were almost completely eliminated by high water in the late 1990s. Along with a resurgence of plants, key species of fish (e.g., largemouth bass) are presently displaying successful recruitment. Until there are large alternative storage projects (projected to be completed by CERP about 2010 to 2015), sustainable management of lake stage is difficult with inputs from such a large watershed combined with the demands for irrigation water in droughts and with Lake Okeechobee's major outlet releases causing impacts to estuarine systems. In addition to the long-term programs, projects are occurring in the lake to restore natural habitats. Presently, the focus is on three large islands at the south end of the lake, where former agricultural ditches and levees are being degraded in order to reestablish a more natural hydrologic connection with the lake. Additionally, work is being conducted to remove organic tussocks that have accumulated along the western shoreline during years of high water.

A critical component of the Lake Okeechobee Protection Program is a comprehensive program of water quality monitoring in the lake and watershed and ecological monitoring in the lake. There is also ongoing research and model development aimed at providing the predictive understanding necessary to effectively manage this water resource. Like the CERP, the Lake Okeechobee Protection Program is an adaptive program, meaning that, if responses are not occurring as expected, or if research and demonstration elucidates important new information, restoration programs can be modified accordingly to optimize their effectiveness. Further details about the Lake Okeechobee watershed management, including the LOPP, are covered in Chapter 10 of the 2005 SFER – Volume I.

Kissimmee River Management and Restoration

The Kissimmee River Restoration Project is the world's largest riverine ecosystem initiative. The project was authorized by the 1992 Water Resources Development Act (Public Law

102-580). The goal of the restoration project is to restore ecological integrity to the river-floodplain ecosystem. This goal is defined as the "reestablishment of a river-floodplain ecosystem that is capable of supporting and maintaining a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region." The project will restore ecological integrity to 104 square kilometers of the river-floodplain system by acquiring more than 37,000 hectares (ha) of historic floodplain, filling more than 35 kilometers of C-38, removing two dam and navigation lock structures, reconnecting 74 kilometers of historic river channel, and reestablishing historic hydrologic processes.

Successful restoration of the Kissimmee River is largely dependent on restoring continuous, variable in-flow characteristics from the Upper Kissimmee Basin resulting in floodplain inundation frequencies and recession rates similar to prechannelization periods. In order to accomplish this goal, a Headwaters Revitalization Project has been initiated and includes both structural and non-structural modifications to achieve this goal. Structural modifications include maintenance dredging of C-35, widening canals C-36 and C-37, and increasing discharge capacity at structure S-65 by installing two additional flood control gates. Non-structural components consist of modifying the S-65 regulation schedule and increasing the storage capacities of Lakes Kissimmee, Hatchineha, Cypress, and Tiger. Greater storage capacity will be achieved by purchasing approximately 19,500 ha of land surrounding the lakes and increasing maximum lake stages from 15.9 to 16.4 meters (m) National Geodetic Vertical Datum (NGVD). Raising lake stages will increase storage by 12,340 ha-m and reestablish approximately 14,200 ha of wetlands around the lakes. Further details about the projects associated with the Kissimmee River restoration efforts are covered in Chapter 11 of the 2005 SFER – Volume I.

Coastal Management and Restoration

An improved understanding of the way coastal ecosystems function, coupled with an ability to predict responses of ecosystems to natural and anthropogenic stressors, is fundamental to the District's strategy for coastal watersheds. Coastal ecosystems are complex, and therefore the scientific community must conduct interdisciplinary research to produce a broad range of data, information, and tools to assist in the management and restoration of sustainable ecosystems. An integrated program of monitoring, research, modeling, assessments, and peer review provides the scientific basis for measures designed to maintain and enhance these ecosystems.

The District's Coastal Watersheds Program provides scientific information to assist decision makers in meeting the challenges of managing coastal resources. Its goal is to create near-term and continuous improvements in environmental decisions affecting the coastal resources of South Florida. The program targets critical issues in priority watersheds and communicates its findings to District decision makers and resource managers, external agencies, lawmakers, the public, and other stakeholders. Within the Coastal Watersheds Program, the Coastal Ecosystems Division (CED) is responsible for the development and application of science-based information and tools, as well as the design and implementation of projects that reduce scientific uncertainty and provide enhanced predictive capability for management of coastal ecosystems. Key coastal ecosystem management and restoration efforts include (1) environmental monitoring and assessment of status and trends focused largely on salinity, seagrass, and other biological indicators; (2) high-quality applied science and tool development for analysis and prediction of habitat response to PLRGs, MFLs, TMDLs, and other technical criteria; and (3) implementation of restoration projects for coastal watersheds and estuaries through collaborative partnerships and local initiatives. Further details about the coastal management and restoration strategies of the District are covered in Chapter 12 of the 2005 SFER – Volume I.

CONTENT OF THE 2005 SOUTH FLORIDA ENVIRONMENTAL REPORT – VOLUME I

REPORT OBJECTIVES

The *2005 South Florida Environmental Report* represents a comprehensive, District-wide report consolidation effort. The report consists of two volumes and was undertaken by the South Florida Water Management District as part of a short-term pilot project authorized by the Florida legislature in May 2004 in Chapter 2004-53, Laws of Florida. The primary objective of the 2005 SFER – Volume I is to update and summarize available data and findings relating to the District's programs, specifically the Kissimmee-Okeechobee-Everglades and coastal ecosystems restoration efforts. Volume I of the SFER is part of an ongoing process that was initiated under previous Everglades Consolidation Reports to provide information for decisions and updates on important programs of the District. Information provided in this volume will be used by the South Florida Water Management District and the Florida Department of Environmental Protection for making decisions affecting implementation of the Everglades Construction Project (ECP), the Lake Okeechobee Construction Project (LOCP), and other restoration and management activities in South Florida. This year's edition of the report builds on and updates information from the 2000–2004 Everglades Consolidated Reports along with supplemental data and findings from the Lake Okeechobee, Kissimmee River and Upper Chain of Lakes, and coastal ecosystem programs to provide a more comprehensive view of the South Florida environment.

In addition, this report satisfies, or partially satisfies, the reporting requirements and specifications of multiple permits, including the USACE Section 404 permit for the ECP; FDEP permits for the ECP; and the non-ECP permit issued by the FDEP. In the various chapters and appendices, District authors also provide information needed for resource management, even if a specific requirement for reporting is not required. For 2005, the SFER will not address the Lake Okeechobee operating permit data due to the timing requirements. With the issuance of a new permit in 2005, it is anticipated that permit reporting for the lake will be included in the *2006 South Florida Environmental Report.*

The *2005 South Florida Environmental Report – Volume I* has been produced pursuant to the Everglades Forever Act, Subparagraph 373.4592(4)(d)5, F.S., which requires the District to submit an annual peer-reviewed report to state officials summarizing data and findings on a variety of programs concerning the Everglades Protection Area. The scientific workshops and public hearing are part of the peer-review process and were held September 21 through 23, 2004. Through that review process, numerous other agencies or organizations contributed information and focus to this report. However, peer review is not required to include a public hearing with public access to the review panel. The District and the FDEP elect 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 to the public. Furthermore, the issues deserve open deliberation before a panel of objective experts. This review process is described later in this introductory chapter.

The topics covered in each chapter of the 2005 SFER – Volume I are highlighted as follows. The contents of Chapters 1 through 9 in this volume are primarily the same as those of earlier ECRs and are specifically related to the Everglades Program, as set forth in the EFA, Subparagraph 373.4592(4)(d)5, F.S. Water quality status and trends for standard Class III parameters in the EPA are the subjects of Chapters 2A, 2B, and 2C. Chapter 2B specifically covers issues concerning mercury and includes an update on research and monitoring in support of risk analysis for mercury contamination in South Florida. A history and summary of actions taken under the Everglades Regulatory Program, a BMP program in the Everglades Agricultural Area, and a summary of the Everglades Stormwater Program, are provided in Chapter 3. Chapter 4 provides a detailed account of information gathered on the compliance and performance of the STAs and on STA optimization research. The hydrological and ecological status of South Florida is summarized in Chapters 5 and 6, respectively. Chapter 7 summarizes the ongoing activities associated with RECOVER monitoring and implementation for CERP. Chapter 8 describes the strategy for achieving long-term water quality goals through the Conceptual Plan for Achieving Water Quality Goals in the EPA. Chapter 8 has been modified in content from previous ECRs and most of the remaining topics (e.g., land acquisition, fiscal resources, and water supply plans) are now addressed in the 2005 SFER – Volume II. Chapter 9 presents a comprehensive view of both plant and animal invasive exotic species in the South Florida environment, expanding coverage from the 2004 ECR.

With the addition of three newly established chapters (Chapters 10–12), the 2005 SFER – Volume I provides a more comprehensive perspective on the entire South Florida environment encompassing both the Kissimmee-Okeechobee-Everglades and coastal ecosystems. Chapter 10 introduces the Lake Okeechobee programs and updates findings from monitoring, research, and regulatory activities associated with the lake and its watershed. Chapter 11 summarizes the background and accomplishments of the Kissimmee River restoration and Upper Basin initiatives, including the design and implementation of its restoration program. Chapter 12 presents diverse information on South Florida's coastal resources and highlights various activities associated with estuarine and freshwater environments within the District.

The data used in the 2005 SFER – Volume I were subjected to quality assurance/quality control (QA/QC) and complete technical interpretation by or about July 1, 2004. In most cases, by this date, authors had access to all data from Water Year 2004 (WY2004) (May 1, 2003 through April 30, 2004). Most data summaries in this volume use the WY2004 period. This period is especially appropriate for addressing environmental issues in South Florida, because it generally follows the overall wet/dry cycles of South Florida's subtropical environment, and it is consistent with calculations done in the Everglades Regulatory Program described in Chapter 3 of this volume.

LEGAL AND REPORTING REQUIREMENTS

The *2005 South Florida Environmental Report* is the product of a major consolidation process authorized by the Florida legislature in Chapter 2004-53, Laws of Florida, effective as of May 12, 2004 (http://election.dos.state.fl.us/laws/04laws/convframe.html). This newly established legislation directs the South Florida Water Management District to undertake a pilot project to consolidate mandated plans and reports to the Florida legislature and governor. Other non-mandated plans and reports are also addressed in order to improve coordination, efficiency, and effectiveness as part of this consolidation effort. A new temporary deadline of February 15, 2005 has been implemented in lieu of statutory deadlines for the submission of certain plans and reports of the District, including the Everglades Consolidated Report and the Lake Okeechobee Protection Program.

The District's restoration efforts under the Everglades and Lake Okeechobee programs entail numerous reporting mandates covered in the 2005 SFER – Volume I of the 2005 SFER. These legal requirements include the following:

- An Everglades Forever Act Annual Report, required by Subsection 373.4592(13), F.S., submitted to the FDEP, the Florida governor's office, and the leaders of the Florida legislature. This 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 Subparagraph 373.4592(4)(d)5, F.S., also submitted to the FDEP, the Florida governor, and legislative leaders regarding the research and monitoring program that summarizes all data and findings as an update on most topics included in the *1999 Everglades Interim Report*, required by Subparagraph 373.4592(4)(d)5, F.S.
- A Non-Everglades Construction Project permit annual report, required by Paragraphs 373.4592(9)(k) and (l), F.S., and by FDEP Permit No. 06, 502590709, to be submitted to the FDEP and to address water quality at structures associated with the Everglades Protection Area that are not included in the Everglades Construction Project. This report also addresses schedules and strategies to improve that water quality.
- A 404 permit report(s), required by Permit No. 199404532, submitted to the USACE and addressing the District's strategy for achieving water quality standards and updating the USACE on the activities authorized or otherwise regulated by the permit.
- A series of reports on the STAs from National Pollutant Discharge Elimination System (NPDES) permits and Everglades Forever Act permits and to be submitted to the FDEP and the USACE. These permits require information on the quality of water discharged from the treatment systems as well as on the progress of the treatment systems at improving water quality.
- A Lake Okeechobee Protection Program Annual Report, required by Paragraph 373.4595(3)(g), F.S., submitted to the FDEP, the Florida governor's office, and the leaders of the Florida legislature. This report must include a summary of the water quality and habitat conditions in Lake Okeechobee and its watershed and the status of implementation activities including the Lake Okeechobee Construction Project.

Volume I of the 2005 SFER is submitted in compliance with the reporting requirements noted above. The Kissimmee River and coastal ecosystems programs are also included in this volume as supplemental information to these mandated reports and to improve communication on the status and findings of the restoration efforts. By consolidating all the requirements into a single document, the District ensures that its evaluation of annual data is both comprehensive and cost-effective. Furthermore, by incorporating the information presented in Volumes I and II, this 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 District's programs, projects, and plans for use in decision making. However, the reader should recognize that the report is not a formal part of any legal or administrative process. Interpretation of wording in this report must be done from a technical, not a legal, perspective.

PEER REVIEW OF THE 2005 SOUTH FLORIDA ENVIRONMENTAL REPORT – VOLUME I

The *2005 South Florida Environmental Report – Volume I* was developed through a two-step review and revision process described previously. Following internal review and revision during July and August 2004, an updated and revised draft of this report was distributed for external public review on the District's Website at http://www.sfwmd.gov. A scientific review panel also received this report during September 2004 (see below). The requirement for peer review is specified by narrative from the EFA (373.4592(4)(d)5:

> 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 report shall identify water quality parameters, in addition to phosphorus, which exceed state water quality standards or are causing or contributing to adverse impacts in the Everglades Protection Area.

The District organized the external review of this report in accordance with (1) typical scientific review practices, (2) the independent panel review process required by Florida Statute for evaluating Minimum Flows and Levels [Section 373.042 (4), F.S.], and (3) "government in the sunshine" provisions of Florida statutes. In the context of this review process, "independent" means the 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 this report, as such objectivity is the cornerstone of a bonafide review process. The panel reviewed this report independently, and then interacted with each other and the public over a WebBoard and through public hearings conducted on September 21–23, 2004. The panel collaborated in providing recommendations in draft and final reports to the District. The breadth of the 2005 SFER and the need for interaction with reviewers require that this report be reviewed by such a group of experts, as described below.

A general Statement of Work was developed for the review process and was modified to fit the specific role of each panelist. Panelists were given a Purchase Order and Statement of Work by the District to provide the following review services on the 2005 SFER:

- **Read selected chapters of earlier Everglades Consolidated Reports as background**. Each panelist was asked to focus attention on assigned chapters closest to their areas of expertise; a matrix attached to the Statement of Work provided assignments. Broad reading of the *2004 Everglades Consolidated Report* was encouraged as general background for the *2005 South Florida Environmental Report* and associated public hearings. Earlier Everglades Consolidated Reports as well as other District reports related to new content (i.e., Kissimmee River, Lake Okeechobee, and coastal ecosystems) were available through the District's Website at http://www.sfwmd.gov and were read, as needed, on specific issues during the review.
- **Read assigned chapters of the *2005 South Florida Environmental Report***. Prior to the public hearing, panelists reviewed assigned chapters of the *2005 South Florida Environmental Report* and prepared a preliminary written review, including questions to be addressed by District staff. All communications between the panelists were done "in the sunshine" through the WebBoard linked to the District's Website at http://www.sfwmd.gov.

- **Participate in the public hearings as a panelist from September 21 through 23, 2004 in West Palm Beach, Florida**. The 2005 panel participated in public workshops on Volume I, noticed as public meetings in accordance with "government in the sunshine" statutes. They interacted with report authors, interested parties, and each other during the three-day public workshop near District headquarters. The first workshop day addressed water quality, BMPs, stormwater treatment technologies, hydrological conditions, and Everglades ecological research. The second workshop day covered the Long-Term Plan, exotic species in South Florida, implementation of CERP RECOVER, the Lake Okeechobee Protection Plan, Kissimmee River Restoration, and the status of coastal ecosystems. The panel site visit ended with a working session on September 23, 2004.
- **Develop a draft report with conclusions and recommendations**. During a working session on **September 23, 2004**, following the public workshops, the panel developed their draft conclusions and recommendations on the *2005 South Florida Environmental Report*.
- **Collaborate with the other panelists in writing the final report**. The panel's final report summarized conclusions and recommendations and included a narrative with details to the extent the panel deemed appropriate for each chapter. Public comments contributed before and during the hearings were considered by the panel. The final report was delivered to the District on **October 13, 2004** and is provided in Appendix 1-1 of this volume.
- **Panel Chairperson, additional responsibilities**. Additional duties of the Chairperson included: communicating with the panelists as needed to ensure consistent interpretation of the Statement of Work; assisting panelists, as necessary, in the use of the Website for posting reviews and ensuring that panelists used this site for all communication; while in West Palm Beach, conducting organizational meetings, as needed, to keep the review process well focused; chairing the workshops and working session, September 21 through 23, 2004; organizing the panel's preparation of draft and final reports to the District; and ensuring that the final report was well edited and delivered to the District on schedule.

This intensive public and panel review resulted in extensive written comments and suggestions to the report's authors. Comments from the peer-review panel, as posted on the *2005 South Florida Environmental Report* WebBoard, appear in Appendix 1-1 of this report. Public comments posted to this WebBoard appear in Appendix 1-2, and the authors' responses to all comments are found in Appendix 1-3. Appendix 1-4 contains the final report of the peer-review panel, reproduced verbatim. Each of the authors of the *2005 South Florida Environmental Report* benefited from the thorough and incisive suggestions of the expert panel. Advice from the panel and from other reviewers guided the authors through a major revision of this report during October and November 2004.

PANELISTS REVIEWING THE 2005 SFER – VOLUME I

The selection of panelists for the *2005 South Florida Environmental Report – Volume I* review was primarily based on the success of previous ECR reviews. Report authors and interested parties continue to feel that having panelists serve more than once improves their review comments by allowing more time for deliberation of relevant technical matters and less time in "getting up to speed" on the details of the District's issues. The District and the FDEP received many favorable comments on the panel's performance in 2003 in grappling with difficult Everglades issues and in providing thoughtful and constructive comments to both agencies in their review. Based on these considerations, five panelists from last year's review process reviewed the *2005 South Florida Environmental Report – Volume I*. Given that this year's technical report has been expanded to include Lake Okeechobee, the Kissimmee River, and coastal ecosystems, three new panelists were also selected to review the 2005 SFER in order to provide coverage of all major ecosystems in South Florida.

In accordance with earlier reviews of the Everglades Consolidated Reports and with routine practice in scientific peer review, professional expertise and experience in the major subject areas covered by this report were the primary criteria used for selecting these panelists for the 2005 process. Knowledge of environmental management and decision making was also important for these well-qualified panelists, and they continued to be free of any professional connection to interests or organizations in South Florida, ensuring their independence. Biographical sketches for the panelists are provided below, along with chapter assignments and specific strengths that they brought to the 2005 SFER review process. Experts 1 through 5 are returning panelists from the 2004 ECR and experts 6 through 8 are new for the 2005 SFER.

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

With more than 15 years of post-doctoral experience in agricultural economics and water resource policy, Dr. Jeffrey 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 publications, one book, and several book chapters authored during his productive career with the University of Georgia. Dr. Jordan is well acquainted with general environmental and water quality issues South Florida faces today. He fulfilled all contract requirements very effectively as Panel Chair for the peer review of the 2000–2004 Everglades Consolidated Reports. Earlier, he 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. His background and record of accomplishment proved to be invaluable for dealing effectively with the wide-ranging topics and issues associated with the 2005 SFER review. Together, these qualities made him ideally suited for chairperson of the peer review panel. Also, he specifically reviewed 2005 SFER – Volume I chapters on the Introduction (Chapter 1), hydrological aspects of South Florida (Chapter 5), RECOVER/CERP (Chapter 7), Everglades water quality plans (Chapter 8), Kissimmee River restoration (Chapter 11), and coastal ecosystems (Chapter 12).

Expert 2: Dr. Richard A. Meganck, Rector, United Nations University for Water Science and Education, Delft, the Netherlands

Dr. Richard Meganck is highly experienced in planning for sustainable 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 with the Organization of American States, the United Nations Environment Program, and as a private consultant in environmental management. His resource-planning experience is exceptionally diversified and unique, particularly his extensive work on park management and sustainability. He participated in peer review of the 2000–2004 Everglades Consolidated Reports and proved to be very thoughtful and innovative in his review comments. His expertise was well matched to the needs of the 2005 SFER review panel for Volume I issues dealing with environmental restoration (Chapter 1), BMPs (Chapter 3), CERP/RECOVER (Chapter 7), Everglades water quality programs (Chapter 8), control of exotic species (Chapter 9), and management of Lake Okeechobee (Chapter 10).

Expert 3: Dr. Robert C. Ward, Professor and Director, Colorado Water Resources Research Institute, Colorado State University, Fort Collins, Colorado

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. He is also familiar with South Florida's technical issues and science through his participation in panels that reviewed the phosphorus control program in the Lake Okeechobee watershed and Everglades Consolidated Reports since 1999. In addition, he is experienced in dealing with diverse audiences through his work with students, educational initiatives, and professional societies. His quantitative experience with water quality monitoring data is extensive, and his knowledge of monitoring program design is exceptional. Dr. Ward was well matched to the needs of the 2005 SFER review panel particularly for Volume I issues concerning water quality (Chapters 2A and 2C), agricultural BMPs (Chapter 3), hydrology of South Florida (Chapter 5), and management and restoration of coastal ecosystems (Chapter 12). He also commented on CERP/RECOVER (Chapter 7) and the management and restoration efforts associated with Lake Okeechobee and the Kissimmee River and Upper Chain of Lakes (Chapters 10 and 11, respectively).

Expert 4: Dr. Yuch Ping Hsieh, Wetland Ecology Program, Florida A&M University, Tallahassee, Florida

After receiving a doctorate from Rutgers University in 1976, Dr. Hsieh has held a series of academic positions as a wetland chemist and soil scientist. From 1986 to the present, he has been Professor and Program Leader in the Wetland Ecology Program of Florida A&M University. Dr. Hsieh has been responsible for more than 40 scientific publications concerning carbon and sulfur cycling, nitrogen and phosphorus dynamics, and management practices for sustainable soils. He has served on many advisory and review teams and has attracted over $2.7 million in external support to Florida A&M University. Dr. Hsieh has been involved in water quality issues throughout his career and is extremely well versed in state-of-the-science methods in environmental chemistry, particularly involving isotope techniques and advanced chemical analyses of environmental samples. His input on the 2005 SFER has been particularly important for Volume I chapters on water quality (Chapters 2A and 2C), BMPs (Chapter 3), constructed wetlands (Chapter 4), hydrology of South Florida (Chapter 5), Everglades ecology (Chapter 6), Everglades water quality programs (Chapter 8), and exotic species (Chapter 9). Dr. Hsieh's unique knowledge of sulfur cycling is also particularly valuable to aspects of Volume I dealing with mercury dynamics in the Everglades (Chapter 2B).

Expert 5: Dr. Joanna Burger, Professor, Division of Life Sciences, Rutgers University, Piscataway, New Jersey

Dr. Joanna Burger has a distinguished research and teaching career that spans three decades. She has contributed greatly to our understanding of water-bird ecology and behavior and the effects of metals and other toxic substances on animals. Her research and scholarly activities have been extremely diverse and numerous and have recently included aspects of ecological risk assessment, a subject of emerging importance in South Florida. She is a highly productive research scientist with over 70 books and book chapters and about 400 refereed publications. The unusual depth and breadth of Dr. Burger's experience as a biologist, ecologist, and toxicologist have allowed her to contribute greatly to the review of the 2005 SFER. Her unique understanding of wading bird ecology has also been a valuable asset to this review. Dr. Burger acted as the primary reviewer on the Volume I chapters on mercury in South Florida (Chapter 2B), Everglades ecological studies (Chapter 6), and the Kissimmee River restoration and Upper Basin initiatives (Chapter 11). She also commented on wetland science, hydrology, and exotic species (Chapters 4, 5, and 9, respectively).

Expert 6: Dr. Ellen van Donk, Professor and Department Head for Food Web Studies, NIOO Centre for Limnology, Netherlands Institute of Ecology, the Netherlands

Dr. Ellen van Donk has more than 20 years of experience as an aquatic researcher and Department Head at the Netherlands Institute of Ecology. She has served on a diverse array of editorial boards and peer review panels, including providing review comments on the Lake Okeechobee minimum flow and level determination in 1998. Dr. van Donk has worked with scientists in Europe and the United States on studies concerning basic limnology, planktonic food webs, lake restoration and management, wetland ecology, and ecotoxicology. Her experience with complex interactions involving food webs, nutrients, and plant community structure has been gained through publication of more than 90 papers in the peer-reviewed literature and has been extremely valuable for the 2005 SFER review panel. She is also well versed in the management and restoration of shallow lakes. Dr. van Donk acted as the primary reviewer for the Volume I chapters on Lake Okeechobee and the Kissimmee River restoration and Upper Basin initiatives (Chapters 10 and 11, respectively) and provided detailed comments on Everglades ecological studies (Chapter 6) and exotic species (Chapter 9). In addition, she provided general comments on the Introduction (Chapter 1), water quality (Chapters 2A and 2C), and STAs (Chapter 4).

Expert 7: Dr. David L. Strayer, Institute of Ecosystem Studies, Millbrook, New York

In a career spanning about two decades, Dr. David Strayer has proven to be a highly productive researcher on aquatic invertebrates focusing on conservation biology, impacts of exotic species, and the roles of ecological heterogeneity in lakes, rivers, and estuaries. He has authored over 80 publications in the peer-reviewed literature while serving as a scientist for the Institute of Ecosystem Studies and Adjunct Professor at the State University of New York, Albany. Dr. Strayer's research has been conducted primarily on natural systems that have been altered as a result of anthropogenic impacts, particularly the Hudson River. His understanding of the role of plant communities in aquatic systems is particularly relevant to South Florida, where submerged plants are a key aspect of marine and freshwater management. Dr. Strayer acted as the lead reviewer for the Volume I chapter on coastal ecosystems (Chapter 12) and a detailed reviewer for Lake Okeechobee and the Kissimmee River restoration and Upper Basin initiatives (Chapters 10 and 11, respectively). Additionally, he provided general comments on the Introduction (Chapter 1), Everglades ecological studies (Chapter 6), and exotic species (Chapter 9).

Expert 8: Dr. Neal E. Armstrong, Vice Provost for Faculty Affairs and Zarrow Centennial Professor in Engineering, University of Texas at Austin, Austin, Texas

Through an engineering career spanning more than three decades, Dr. Neal Armstrong has held a suite of positions with increasing responsibility and authority in engineering and science. His experience base is extremely diverse and includes more than 12 academic committees, many assignments from professional societies, many consultancies often related to water quality, and dozens of research projects involving water pollution ecology, eutrophication, and water quality modeling and analysis. His expertise is well suited for dealing with the array of challenges facing South Florida regarding water quality. Dr. Armstong is also highly experienced in peer review for applied science and engineering, serving on the Florida Bay Oversight Panel from 1994 to 1999 and on the panel to review phosphorus control strategies for Lake Okeechobee in 1995. For the 2005 SFER, Dr. Armstrong acted as lead reviewer for Volume I chapters on agricultural BMPs (Chapter 3) and the Long-Term Plan (Chapter 8). Additionally, he will provide detailed comments on the Introduction (Chapter 1), STAs (Chapter 4) and Lake Okeechobee management (Chapter 10), and he will contribute general comments on water quality (Chapters 2A and 2C) and the restoration and management of coastal ecosystems (Chapter 12).

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