SOUTH FLORIDA WATER MANAGEMENT DISTRICT

LOWER EAST COAST WATER SUPPLY PLAN UPDATE

Planning Document

2018

Acknowledgments

The South Florida Water Management District (SFWMD) recognizes and thanks the Regional Water Supply Workshop participants for their contributions, comments, advice, information, and assistance throughout the development of this *2018 Lower East Coast Water Supply Plan Update.*

Furthermore, the SFWMD expresses appreciation to all staff who contributed to the development and production of this plan update.

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Executive Summary

The South Florida Water Management District's (SFWMD's) strategic goal for its water supply plans is to identify sufficient water supply sources and projects to meet existing and future reasonable-beneficial uses during 1-in-10 year drought conditions while sustaining water resources and related natural systems. This *2018 Lower East Coast Water Supply Plan Update* (2018 LEC Plan Update) is the third update to the *2000 Lower East Coast Water Supply Plan* (2000 LEC Plan), which previously was updated in 2006 and 2013. This plan update is consistent with the water supply planning requirements of Chapter 373, Florida Statutes (F.S.), and presents population and water demand projections through 2040, a review of water supply issues and evaluations, and a list of water source options. It also examines local and regional water supply efforts completed since the 2013 plan update and describes water resource and water supply development projects for 2016 to 2040.

This 2018 LEC Plan Update was developed in an open, public forum. Multiple meetings and workshops were held with water users, local governments, utilities, as well as agriculture, industry, and environmental representatives to solicit input, provide information about planning results, and receive comments on draft sections of the plan update.

The LEC Planning Area covers more than 6,500 square miles of southeastern Florida, including all of Palm Beach, Broward, and Miami-Dade counties, most of Monroe County, and portions of eastern Hendry and Collier counties. The LEC Planning Area includes unique and critical ecosystems such as the Everglades, Lake Okeechobee, Florida Bay, Biscayne Bay, and the Loxahatchee River. These ecosystems coexist with large agricultural areas around Lake Okeechobee and in southern Miami-Dade County, and with expansive urban areas housing 30 percent of the state's population.

Typically, the LEC Planning Area receives abundant rainfall seasonally, with volumes exceeding human and natural system needs during wet periods. Annual precipitation averages 57 inches, with three-quarters of rainfall occurring between May and October. Water availability varies annually with periodic drought years. There is an extensive network of canals and waterworks used for water supply and flood control in the LEC Planning Area. The regional water management system plays a critical role in capturing wet season stormwater for use during dry times, moving water between natural systems, delivering water to agricultural areas and urban coastal communities, and moving excess water to tide to provide flood protection. Fresh groundwater from the surficial aquifer system and surface water from Lake Okeechobee are the primary water sources for urban, agricultural, and industrial uses in the LEC Planning Area.

Climate change and sea level rise are issues of concern, especially in coastal regions such as South Florida. South Florida is particularly vulnerable to potential changes in climate and sea level because of its location, regional variability in climate, hydrology, geology, low topography, natural resources, and dense population in coastal areas. To plan and prepare for regional climate change and sea level rise, the SFWMD is conducting research and computer modeling to better predict and reduce uncertainties, analyzing vulnerabilities in the current water management system, and developing effective adaptation strategies for the future. Coordination with other resource management entities and governments is vital to ensuring a common approach and shared information moving forward.

DEMAND ESTIMATES AND PROJECTIONS

As described in **Chapter 2**, the LEC Planning Area has one of the fastest growing populations in the country. The region is home to approximately 6 million people and supports a large seasonal population, tourism and golf, and a substantial agricultural industry. The area's permanent population is projected to reach approximately 7.5 million people by 2040, a 25 percent increase from the 2016 estimate.

Current and future water demands are heavily influenced by the existing and projected population. Population growth will lead to increases in water demands for public water supply, landscape irrigation, power generation, and mining operations in the region. Irrigated agricultural acres are projected to decrease due to conversion from farmland to residential development and environmental restoration.

Total water demands under average rainfall conditions (**Table ES-1**) for all water use categories are projected to increase 14 percent, from a total water use of approximately 1,757 million gallons per day (mgd) in 2016 to 2,007 mgd in 2040. Projected demands under 1-in-10 year drought conditions are 322 mgd (16 percent) higher than the average demands in 2040. Public water supply (PWS) is projected to continue to be the largest use category in the LEC Planning Area, and accounts for 54 percent of the total projected demand in 2040. Agricultural irrigation (AGR) represents the second largest water use in the region, accounting for 31 percent of the total projected demand in 2040. Recreational/landscape irrigation (REC) is the third largest use category in the LEC Planning Area, representing 8 percent of the total 2040 projected demand.

Table ES-1. Estimated and projected gross water demands under average rainfall conditions in the LEC Planning Area for 2016 and 2040.

Water Use Category	2016 Estimated[1] Use (mgd)	2040 Projected Demand (mgd)	Percent Change	Percent of Projected 2040 Total
PWS	864.15	1,089.34	26%	54%
DSS	11.85	15.76	33%	1%
AGR	653.48	625.27	-4%	31%
REC	136.14	156.46	15%	8%
ICI	51.93	66.96	29%	3%
PWR	39.75	52.75	33%	3%
Total	**1,757.30**	**2,006.54**	**14%**	**100%**

AGR = Agricultural Irrigation; DSS = Domestic and Small Public Supply; ICI = Industrial/Commercial/Institutional; mgd = million gallons per day; PWR = Power Generation; PWS = Public Water Supply; REC = Recreational/Landscape Irrigation.

[1] Water use is estimated as reporting is not required for all users.

DEMAND MANAGEMENT: WATER CONSERVATION

Water conservation by all water use categories continues to be a priority to meet future water needs. Conservation programs, described in **Chapter 3**, often are among the lowest-cost solutions to meet future demands and can reduce costs over the long term if properly planned and implemented. Conservation efforts in the LEC Planning Area have effectively lowered the net (finished) water per capita use rate for PWS over the past decade, from 176 gallons per capita per day in 2000 to approximately 138 gallons per capita per day in 2016. Analysis suggests that Palm Beach, Broward, Miami-Dade, Hendry, and Monroe counties collectively can save an additional 103 mgd by 2040 if various urban and agricultural conservation options are implemented.

NATURAL SYSTEMS AND RESOURCE PROTECTION

The LEC Planning Area encompasses extensive natural systems, including Lake Okeechobee, the Everglades, the Loxahatchee River, Lake Worth Lagoon, Florida Bay, Biscayne Bay, and the Florida Keys (**Chapter 5**). The region has two national parks and five national wildlife refuges. The water supply needs for these natural systems are protected and addressed through regulatory mechanisms, restoration efforts, and water resource development projects.

Regulatory mechanisms for water resource protection include Minimum Flows and Minimum Water Levels (MFLs), Water Reservations, Restricted Allocation Areas (**Chapter 4**), and Water Shortage Plans. In the LEC Planning Area, MFLs with recovery strategies have been adopted for Lake Okeechobee, the Everglades, and the Northwest Fork of the Loxahatchee River. MFLs with prevention strategies have been adopted for Florida Bay, the Biscayne aquifer, and the Lower West Coast aquifers. A re-evaluation of the adopted MFL criteria for Florida Bay was completed in 2014. A Water Reservation was established for Nearshore Central Biscayne Bay in 2013. Restricted Allocation Area rules have been established for the L-1, L-2, and L-3 Canal System (1981); the North Palm Beach County/Loxahatchee River Watershed Waterbodies (2007); the LEC Everglades Waterbodies (2007); and Lake Okeechobee and the Lake Okeechobee Service Area (2008). Water shortages are declared by the SFWMD Governing Board when available groundwater or surface water is not sufficient to meet users' needs or when conditions require temporary reduction in total use.

There are numerous ecosystem restoration projects under way in the LEC Planning Area (**Table ES-2**; **Chapter 6**). Ecosystem restoration projects are vital to maintaining the health of the region's water resources, including elements identified in MFL recovery and prevention strategies. The Comprehensive Everglades Restoration Plan (CERP), a partnership between the United States Army Corps of Engineers (USACE) and the SFWMD, is a critical and extensive restoration effort in the LEC Planning Area. CERP includes capital projects needed to protect and restore natural systems and was developed on a parallel track with the 2000 LEC Plan as a critical component of water supply planning in the LEC Planning Area. An Integrated Delivery Schedule organizes the implementation of capital projects.

Water resource development projects (**Chapter 6**) serve various purposes in support of managing, protecting, and restoring water resources. In addition to the ecosystem restoration projects, water resource development projects include hydrologic investigations, groundwater monitoring and modeling, water conservation and alternative water supply programs, and resource protection rule activities.

Table ES-2. Primary ecosystem restoration projects in the LEC Planning Area.

Region	Project	Status
Lake Okeechobee	CERP Lake Okeechobee Watershed Restoration Project	Planning
	Herbert Hoover Dike Rehabilitation	Construction
Everglades	Restoration Strategies Regional Water Quality Plan	Construction/Operational
	Modified Water Deliveries to Everglades National Park	Operational
	WCA-3A Decompartmentalization Physical Model	Testing
	CERP Central Everglades Planning Project	Construction
	C-111 South Dade Project	Construction complete
	CERP C-111 Spreader Canal Western Project	Construction complete
	South Dade Study and Florida Bay Plan	Construction
Western Basins	C-139 Annex Restoration	Construction
	CERP Western Everglades Restoration Project	Planning
Lower East Coast Service Areas	CERP Loxahatchee River Watershed Restoration Project	Planning
	CERP Environmental Preserve at the Marjory Stoneman Douglas Habitat	Operational
	CERP Fran Reich Preserve Reservoir – Phase 1	Construction complete
	CERP Hillsboro Aquifer Storage and Recovery Pilot Project	Operational
	CERP Broward County Water Preserve Areas	Planning/Construction
	CERP Biscayne Bay Coastal Wetlands Project – Phase 1	Construction

CERP = Comprehensive Everglades Restoration Plan; WCA = water conservation area.
Note: Due to the scale and complexity of the projects, some project features may be under construction while planning continues for others.

WATER SUPPLY SOURCE OPTIONS

Current water supply source options in the LEC Planning Area include surface water, groundwater (fresh and brackish), reclaimed water, and seawater (**Chapter 7**). Surface water from canals, lakes, and water conservation areas, and fresh groundwater from the surficial aquifer system (SAS) are considered traditional water sources. Alternative water sources include brackish groundwater from the Floridan aquifer system (FAS), seawater, reclaimed water, and excess surface water and groundwater captured and stored in aquifer storage and recovery (ASR) wells, reservoirs, and other storage features. Use of alternative water supplies is an integral part of the current and future water supply strategy in the LEC Planning Area.

PWS utilities within the LEC Planning Area primarily rely on fresh groundwater from the SAS, with limited use of the FAS and one utility using surface water. Groundwater sources can meet 2040 PWS demands; however, increases in fresh groundwater allocations are limited to comply with resource protection criteria. Of the 54 PWS utilities in the LEC Planning Area, 9 will need to construct new projects to meet their projected 2040 demands, and 6 of those will need additional permit allocations. These new projects include expanded use of the FAS and use of the C-51 Reservoir, both of which are alternative water sources, or interconnections for bulk water from nearby utilities.

Approximately three-quarters of the total agricultural acreage in the LEC Planning Area is in the Everglades Agricultural Area, which relies exclusively on surface water. There are two other agricultural areas in the LEC Planning Area that rely on fresh groundwater: southern Miami-Dade County and the eastern portion of Hendry County. In those areas, groundwater sources can meet 2040 AGR demands; however, increases in fresh groundwater allocations are limited by resource protection criteria.

REC users, including golf courses, rely on surface water, fresh groundwater, and reclaimed water in nearly equal measure. In addition, eight REC users meet their demands with treated brackish groundwater from the FAS. Increases in landscape irrigation demands are expected to be met primarily through the expansion of reclaimed water systems in Palm Beach and Broward counties and with fresh groundwater in Miami-Dade County.

For industrial/commercial/institutional (ICI) users, the 2016 demands for the LEC Planning Area were distributed evenly between surface water, fresh groundwater, and reclaimed water. Increases in the ICI category through 2040 are expected to be met by fresh groundwater and surface water. There are 13 major power generation facilities within the LEC Planning area and 6 of them have demands met from groundwater or reclaimed water. **Table ES-3** summarizes the variety of water source options that typically are used by the water use categories in South Florida.

Table ES-3. Typical water source options for the six water use categories.

Water Use Category	Fresh Surface Water	Fresh Groundwater	Brackish Groundwater	Reclaimed Water
Public Water Supply	✓	✓	✓	
Domestic and Small Public Supply		✓		
Agricultural Irrigation	✓	✓		
Recreational/Landscape Irrigation	✓	✓	✓	✓
Industrial/Commercial/Institutional	✓	✓		✓
Power Generation		✓	✓	✓

Surface Water

Surface water supply sources for the LEC Planning Area include Lake Okeechobee, water conservation areas, Central and Southern Florida Flood Control Project (C&SF Project) canals, county and water control district canals, reservoirs, and on-site ponds. Water availability from Lake Okeechobee and connected surface water bodies is limited due to concerns regarding rehabilitation of the Herbert Hoover Dike, protection of existing legal users, limited storage, and environmental needs. Specific surface water volumes in eastern Hendry County are identified for the Seminole Tribe of Florida Big Cypress Reservation in addition to a secondary irrigation supply from Lake Okeechobee. As discussed earlier, use of some surface water bodies is limited by Restricted Allocation Area rules and MFLs. The City of West Palm Beach is the only PWS utility using surface water as its primary water supply. Future surface water demands are expected to decrease for AGR and increase only slightly for PWS, REC, and ICI. Additional water storage features and tailwater recovery systems could enhance water availability.

For surface water users in the Lake Okeechobee Service Area (LOSA), studies and analyses supporting the USACE's 2008 Lake Okeechobee Regulation Schedule (2008 LORS) projected a decline in the physical level of certainty of agriculture users reliant on lake water supplies, from a 1-in-10 year to a 1-in-6 year drought return frequency. State funding has been provided to assist the USACE in expediting the Herbert Hoover Dike rehabilitation schedule. The current Integrated Delivery Schedule indicates completion of the rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected

to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives. For increases in surface water use other than within LOSA, water availability would have to be determined based on local conditions.

Fresh Groundwater

The SAS, including the Biscayne and Lower Tamiami aquifers, is the primary source of fresh groundwater in the LEC Planning Area and is used by all six water use categories. Development of the SAS is limited by potential impacts on the regional system, wetlands, pollution, and existing legal users as well as the potential for saltwater intrusion or upconing of relict seawater. Specifically, use of the SAS in coastal areas is restricted 1) by the Biscayne Aquifer MFL prevention strategy, which specifies no further inland movement of salt water, and 2) near C&SF Project canals by the LEC Regional Water Availability criteria, which prohibits increased allocations that induce seepage from the canals.

Available water supplies for allocation in eastern Hendry County from the Lower Tamiami aquifer are constrained by the presence of isolated wetlands and the Lower West Coast Aquifers MFL. AGR water demands in the portion of Hendry County within the LEC Planning Area are expected to increase over the planning horizon; water levels will require close monitoring where they are approaching the Maximum Developable Limit. Water availability from the SAS will be determined locally in these areas, considering the quantities required, local resource conditions, existing legal users, and viability of other supply options.

In 2016, the SAS accounted for approximately 90 percent of PWS use and 100 percent of DSS use in the LEC Planning Area. SAS use for PWS is projected to increase from 738 mgd in 2016 to 947 mgd by 2040, as utilities maximize their permitted allocations from this source. Most PWS utilities in the LEC Planning Area have been proactive in permitting and constructing water supply systems that anticipate demand increases and have proposed projects to meet future growth (**Chapter 8**).

For SAS water users, the most recent mapping of saltwater intrusion in Palm Beach, Broward, and Miami-Dade counties indicates the saltwater interface has remained relatively stable, but some inland movement has occurred. Surface water canals and salinity control structures are operated to maintain water levels that minimize inland saltwater movement, and no regional declines in water levels have been observed. However, sea level rise could accelerate the inland movement of the saltwater interface.

Brackish Groundwater

Brackish groundwater from the FAS is utilized by 15 PWS utilities, 8 golf courses, and 2 power generation facilities. Additionally, five utilities have permit allocations for proposed FAS wellfields, and two utilities are proposing to use the FAS in the future to meet their 2040 projected demands. The 15 operating water treatment plants use reverse osmosis (RO) treatment and have a combined RO capacity of approximately 77 mgd. In 2016, the FAS and associated RO water treatment plants supplied water to meet 6 percent of PWS demand and are expected to meet 10 percent by 2040. Current and future FAS demands were simulated using a regional groundwater model to assess the potential impacts of withdrawals on water quality and the viability of the source through the planning horizon. Modeling results for this 2018 LEC Plan Update are provided in **Appendix D**. Review of historical chloride data and model results indicates properly managed FAS wellfields can meet projected demands through 2040.

Current groundwater level and quality data for the FAS are discussed in **Appendix D**. Review and analysis of FAS water level and quality data indicate there have not been substantial regional changes; however, some local changes in water quality have been observed, which may be the result of localized pumping stresses or hydrologic conditions. FAS users may need to spread out withdrawal facilities or reduce individual well pumping rates to mitigate water quality changes. These areas should continue to be monitored through a coordinated effort with utilities and other FAS stakeholders.

Reclaimed Water

Use of reclaimed water is an integral part of water supply in the LEC Planning Area. In 2016, 24 of the 46 wastewater treatment facilities provided at least a portion of the treated wastewater for reuse in other areas. Including supplemental water sources, 15 percent (100 mgd) of the region's treated wastewater was reused for golf course and landscape irrigation, industrial uses, power generation facility cooling purposes, wetland hydration, and groundwater recharge. Four utilities used supplemental water (e.g., groundwater, water treatment plant concentrate, potable water) to expand their water reuse. The volume of reclaimed water used for irrigation is projected to more than double by 2040 as a result of population growth and compliance with the Ocean Outfall Law [Section 403.086, F.S.] requirements.

Water Storage

Capturing surface water and groundwater during wet conditions for use during dry conditions increases the amount of available water. In the LEC Planning Area, water storage options include ASR and reservoirs, which are considered alternative water supplies. As of 2018, the SFWMD and nine municipalities in the LEC Planning Area have built and tested ASR systems. Three ASR systems were in use or being tested in 2016, with two more planning to resume testing for activation in the near future.

Regional reservoirs (e.g., flow equalization basins) and proposed reservoirs (e.g., A-2, C-51, and C-18W reservoirs) are used for stormwater attenuation, water quality treatment in conjunction with stormwater treatment areas, and storage of seasonally available water. Local agricultural reservoirs store recycled irrigation water or collect stormwater runoff. In

January 2017, the SFWMD designated the C-51 Reservoir Phase 1 Project as a pilot alternative water supply development project, pursuant to Section 373.037, F.S. The reservoir is expected to provide up to 35 mgd for PWS.

Seawater

There are two RO seawater desalination treatment plants in the LEC Planning Area. Both plants are in the lower Florida Keys and operated for emergencies. The Stock Island plant—the first desalination plant built in Florida—can produce up to 2 mgd of potable water, and the Marathon plant can produce another 1 mgd. Also, three power generation facilities in the LEC Planning Area use seawater for cooling purposes.

FUTURE DIRECTION

Chapter 9 of this 2018 LEC Plan Update contains guidance to help focus future efforts in the region to meet projected water needs. Some of the key suggestions to regional stakeholders, including the SFWMD, utilities, other government agencies, agricultural interests, and environmental groups, are as follows:

- Continue implementation of robust water conservation programs throughout the LEC Planning Area to increase water use efficiency and reduce the amount of water needed to meet future demands.
- Continue implementation of MFL recovery and prevention strategies, and review and update these strategies, as appropriate, in conjunction with future water supply plan updates.
- Complete repairs to the Herbert Hoover Dike and reassess the 2008 LORS pursuant to the Integrated Delivery Schedule.
- Continue development of alternative water supplies, including maximizing the use of reclaimed water.
- Design new FAS wellfields to maximize withdrawals while minimizing water level and quality changes. This likely will require a combination of additional wells with greater spacing between wells, lower-capacity wells, and continued refinement of wellfield operational plans.
- Develop regional and local reservoirs and other storage systems, where possible, to increase surface water availability for environmental, agricultural, and urban water supply needs.
- Continue supporting ecosystem restoration efforts, including the Restoration Strategies Regional Water Quality Plan and CERP.
- Identify wells critical to long-term monitoring and modeling to ensure they are constructed, maintained, or replaced, as necessary.
- Continue to characterize, monitor, and design adaptation solutions in response to climate change and sea level rise impacts to water supply, and continue participating in the Southeast Florida Regional Climate Change Compact.

CONCLUSIONS

Building on the findings and conclusions of previous LEC water supply plan updates, this 2018 LEC Plan Update assesses water supply demand and available sources for the LEC Planning Area through 2040. This 2018 LEC Plan Update concludes that future water needs of the region during 1-in-10 year drought conditions can be met through the 2040 planning horizon with appropriate management, conservation, and implementation of projects identified herein. Currently, the 1-in-10 year level of certainty is reduced to 1-in-6 year drought conditions for water users (primarily agriculture) that rely solely on surface water from Lake Okeechobee or its tributaries located within the LOSA portion of the LEC Planning Area.

Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives.

Meeting future water needs through 2040 in the LEC Planning Area depends on the following:

- Construction of potable water supply development projects by PWS utilities;
- Implementation of CERP and other projects identified in MFL prevention and recovery strategies; and
- Completion of repairs to the Herbert Hoover Dike by the USACE and subsequent implementation of a new Lake Okeechobee Regulation Schedule.

Successful implementation of this 2018 LEC Plan Update requires close collaboration with agricultural interests, local governments, utilities, and other stakeholders. Coordination efforts should ensure that water resources in the LEC Planning Area continue to be prudently managed and available to meet future demands while also protecting the environment.

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Acronyms and Abbreviations

2008 LORS	2008 Lake Okeechobee Regulation Schedule
AFSIRS	Agricultural Field Scale Irrigation Requirements Simulation
AGR	Agricultural Irrigation
APPZ	Avon Park Permeable Zone
ASR	aquifer storage and recovery
AWE	Alliance for Water Efficiency
AWS	alternative water supply
BBCW	Biscayne Bay Coastal Wetlands
BEBR	Bureau of Economic and Business Research
bls	below land surface
BMP	best management practice
C&SF Project	Central and Southern Florida Flood Control Project
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
CFP	Cooperative Funding Program
Compact	Southeast Florida Regional Climate Change Compact
District	South Florida Water Management District
DSS	Domestic and Small Public Supply
EAA	Everglades Agricultural Area
ECFM	East Coast Floridan Model
EQIP	Environmental Quality Incentives Program
F.A.C.	Florida Administrative Code
F.S.	Florida Statutes
FAS	Floridan aquifer system
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FEB	flow equalization basin
FKAA	Florida Keys Aqueduct Authority
FPL	Florida Power & Light
FSAID	Florida Statewide Agricultural Irrigation Demand
FWC	Florida Fish and Wildlife Conservation Commission

FY	Fiscal Year
gpm	gallons per minute
IAS	intermediate aquifer system
ICI	Industrial/Commercial/Institutional
LEC	Lower East Coast
LFA	Lower Floridan aquifer
LOSA	Lake Okeechobee Service Area
LOWRP	Lake Okeechobee Watershed Restoration Project
MDL	Maximum Developable Limit
MDWASD	Miami-Dade Water and Sewer Department
MFL	Minimum Flow and Minimum Water Level
mg/L	milligrams per liter
mgd	million gallons per day
MIL	mobile irrigation lab
ModWaters	Modified Water Deliveries to Everglades National Park
MSL	mean sea level
NGVD29	National Geodetic Vertical Datum of 1929
PCUR	per capita use rate
PWR	Power Generation
PWS	Public Water Supply
RAA	Restricted Allocation Area
REC	Recreational/Landscape Irrigation
RFGW	Regional Floridan Groundwater (monitoring program)
RO	reverse osmosis
SAS	surficial aquifer system
SFER	South Florida Environmental Report
SFWMD	South Florida Water Management District
STA	stormwater treatment area
TDS	total dissolved solids
UFA	Upper Floridan aquifer
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
Water CHAMP	Water Conservation Hotel and Motel Program
WaterSIP	Water Savings Incentive Program

WCA	Water Conservation Area
WERP	Western Everglades Restoration Project
Work Plan	Water Supply Facilities Work Plan
WTP	water treatment plant
WUD	Water Utilities Department
WWS	Water and Wastewater Services
WWTF	wastewater treatment facility

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Introduction

TOPICS

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The South Florida Water Management District (SFWMD or District) develops and updates regional water supply plans to assess current and future water needs while sustaining central and southern Florida's water resources. Florida Statute requires the plans be based on 20-year planning periods and updated every 5 years. This *2018 Lower East Coast Water Supply Plan Update* (2018 LEC Plan Update) assesses existing and projected water needs as well as water sources to meet those needs through 2040.

The LEC Planning Area encompasses Palm Beach, Broward, and Miami-Dade counties, most of Monroe County, and the eastern portions of Hendry and Collier counties (**Figure 1-1**). Palm Beach, Broward, and Miami-Dade counties are among Florida's most populated counties, representing 30 percent of the state's population. The LEC Planning Area includes the populated portion of Monroe County, while the Collier County portion is in the Big Cypress National Preserve and has no permanent residents.

The boundaries of the LEC Planning Area follow the north-to-south sheetflow pattern of the historical Everglades, draining to Florida Bay at the southern tip of the peninsula, and encompassing the Florida Keys island chain. As shown in **Figure 1-2**, the LEC Planning Area encompasses the LEC Service Areas and most of the Lake Okeechobee Service Area (LOSA). The LEC Service Areas include major metropolitan areas from West Palm Beach to Miami. Portions of Palm Beach, Martin, Okeechobee, Hendry, Glades, and Lee counties in LOSA as well as the Seminole Tribe of Florida's Brighton and Big Cypress reservations (outside the LOSA boundary) depend on surface water from Lake Okeechobee and its connected conveyance canals for supplemental water supply. The Everglades Agricultural Area (EAA), which covers a large portion of LOSA, is within the LEC Planning Area. More information on these areas is provided in **Chapter 5**.

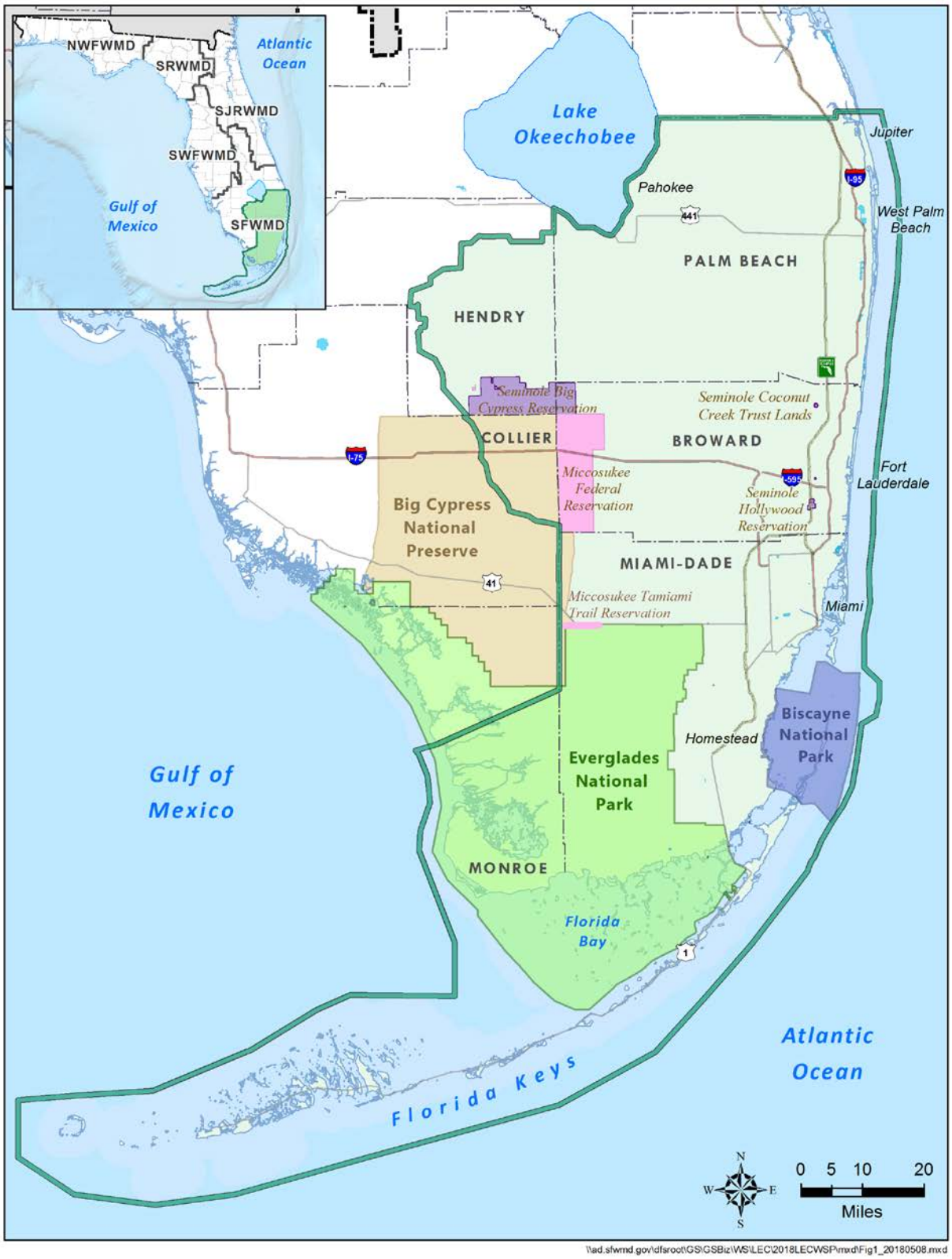

Figure 1-1. LEC water supply planning area.

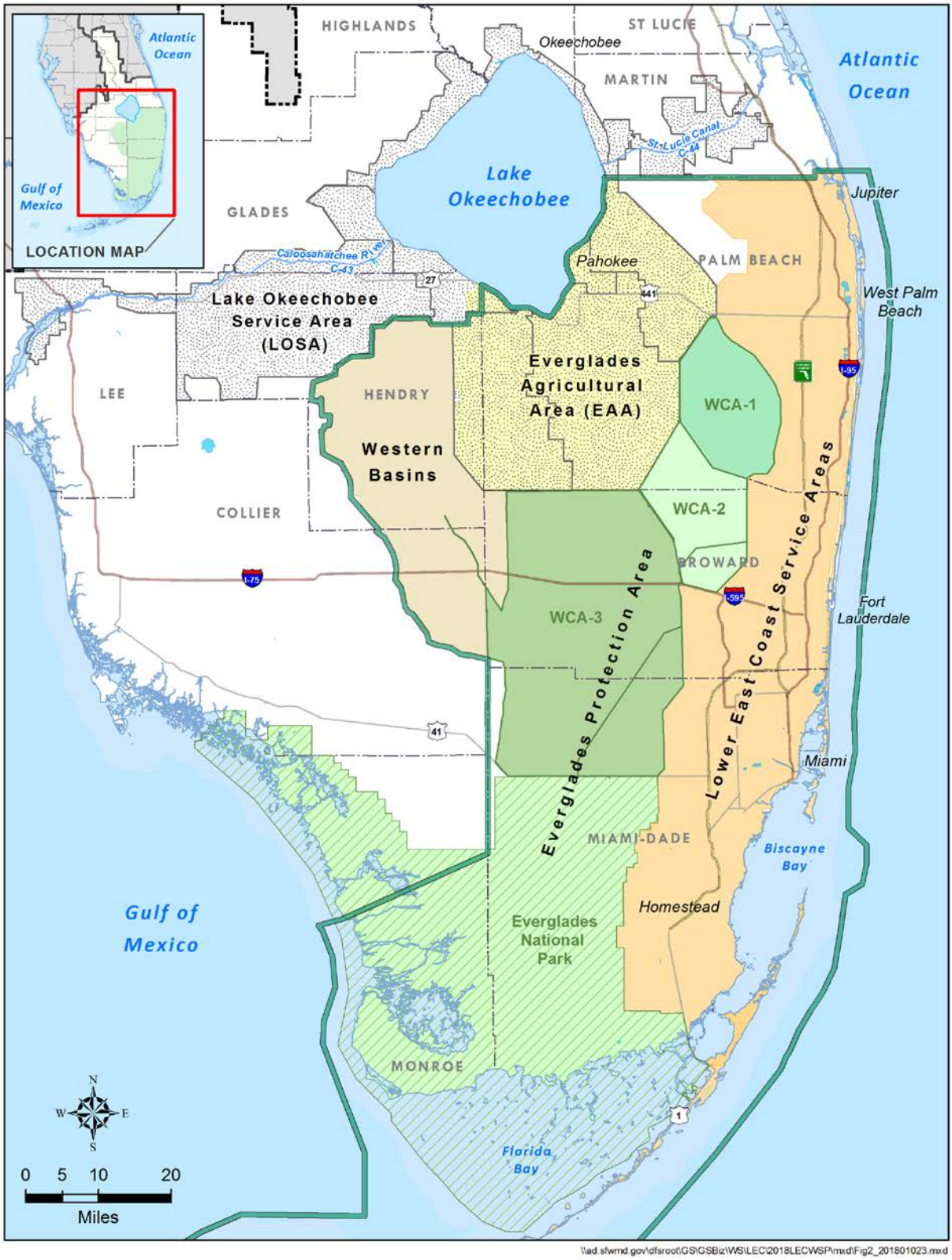

Figure 1-2. Location of major water resource areas and regulatory basins within the LEC Planning Area.

Unique and critical ecosystems such as the Everglades, Lake Okeechobee, Florida Bay, Biscayne Bay, and the Loxahatchee River are located in the LEC Planning Area. Two national parks (Everglades and Biscayne), a federally designated Wild and Scenic River (Northwest Fork of the Loxahatchee River), and five national wildlife refuges are also within the LEC Planning Area boundaries. Because the LEC Planning Area depends on surface water from Lake Okeechobee and the Everglades—especially the Water Conservation Areas (WCAs)—for a portion of its water supply, the LEC planning efforts are tightly linked with restoration efforts and management decisions concerning those water resources. Most restoration projects are part of the Comprehensive Everglades Restoration Plan (CERP), a joint effort between the SFWMD and the United States Army Corps of Engineers (USACE). In addition to important natural areas, the LEC Planning Area includes an extensive agricultural industry, several major urban communities, and the Seminole Tribe of Florida and Miccosukee Tribe of Indians reservations.

2018 LEC PLAN UPDATE

The 2018 LEC Plan Update reflects the changes experienced in the LEC Planning Area since late 2013, when the plan was last updated, and the effects of those changes on water use and projected water demands. The 2018 LEC Plan Update consists of three documents: the planning document, the associated appendices, and the *2016 Water Supply Plan Support Document* (SFWMD 2016a). The planning document and appendices focus on the LEC Planning Area. The Support Document addresses aspects common to all five SFWMD regional planning areas and contains background material such as recent, relevant legislation and rules, water conservation programs, and information on water resource technologies.

GOAL AND OBJECTIVES

The goal of the 2018 LEC Plan Update is to identify sufficient water supply sources and future projects to meet existing and future reasonable-beneficial uses during 1-in-10 year drought conditions through 2040 while sustaining water resources and related natural systems. The 2013 LEC Plan Update (SFWMD 2013) objectives were reviewed and modified for this 2018 LEC Plan Update:

1. **Water Supply** – Identify sufficient sources of water and water supply projects to meet reasonable-beneficial consumptive uses projected through 2040 under 1-in-10 year drought conditions without causing harm to natural resources.

2. **Water Conservation and Alternative Source Development –** Increase the efficiency of water use through water conservation actions, and encourage the development of alternative water supply sources to meet projected demands, including:

    - **Floridan aquifer system (FAS) –** Monitor the FAS to better understand the relationships among water use, water levels, and water quality.
    - **Reuse –** Promote projects that increase use of reclaimed water.
    - **Storage –** Develop water storage options, including aquifer storage and recovery (ASR) and reservoirs.

3. **Natural Systems** – Protect and enhance natural systems and water resources, including the Everglades, estuarine and riverine systems, and other federal, state, and local natural resource areas.

4. **Linkage with Local Governments** – Support local government coordination by providing information for updates to the required Water Supply Facilities Work Plans (Work Plans).

5. **Compatibility and Linkage with Other Efforts –** Achieve compatibility and integration with related activities within the region, including the following:

    - CERP and other environmental restoration projects;
    - Modifications to operating schedules for the regional system, including Lake Okeechobee;
    - Regulatory actions such as the water use permitting process and Minimum Flow and Minimum Water Level (MFL) and Water Reservation development; and
    - Other regional and local water resource planning efforts.

LEGAL AUTHORITY AND REQUIREMENTS

The legal authority and requirements for water supply planning are included in Chapters 373, 403, 187, and 163, Florida Statutes (F.S.). In accordance with Florida's Water Protection and Sustainability Program, regional water supply plans and local government Comprehensive Plans must ensure that adequate potable water facilities are constructed and concurrently available to meet the demands of existing and proposed development. The water supply planning region identified in this plan shall be considered a Water Resource Caution Area under Section 403.064, F.S., and affected parties may challenge the designation pursuant to Section 120.569, F.S.

LAW/CODE

Section 373.709(1), F.S.

The governing board of each water management district shall conduct water supply planning for a water supply planning region within the district identified in the appropriate district water supply plan under Section 373.036, F.S., where it determines that existing sources of water are not adequate to supply water for all existing and future reasonable-beneficial uses and to sustain the water resources and related natural systems for the planning period.

This is the third update of the *2000 Lower East Coast Regional Water Supply Plan* (SFWMD 2000). Since the 2013 LEC Plan Update, there have been changes to Section 373.709, F.S., regarding regional water supply planning. These changes include considering agricultural projections provided by the Florida Department of Agriculture and Consumer Services (FDACS) and a required annual report on the status of water resource development and water supply development projects.

In addition to water supply planning, the SFWMD is required, by statute, to provide updates for a variety of resource development, restoration, and monitoring programs implemented within the District's boundaries. Such updates are provided in the annual publication of the *South Florida Environmental Report*, which is referenced as needed in this plan update.

Implementation of the Florida Department of Environmental Protection (FDEP 2012) guidance memorandum addressing coordination between water management districts' water supply planning and permitting staff regarding projects included in water supply plans has resulted in close collaboration throughout the plan development process.

REGIONAL AND LOCAL PLANNING LINKAGE

The regional water supply planning process is closely coordinated and linked to the local water supply planning of city/county governments and utilities. Substantial coordination and collaboration among all water supply planning entities is needed throughout the regional water supply plan development and approval process. This coordination is crucial for developing future sustainable water sources and optimizing the use of existing resources.

Since 2013, the SFWMD has worked with regional public water supply (PWS) utilities to evaluate the need for water supply development projects for this 2018 LEC Plan Update. Although Comprehensive Plans, Work Plans, and water use permits are prepared at different times, each uses the latest and best available data. **Appendix A** provides information and statutory requirements relevant to local government Comprehensive Plans. The regional and local water supply planning process is described below and illustrated in **Figure 1-3**.

PROCESS

Regional and Local Water Supply Planning Process

On an annual basis, the SFWMD receives input from PWS utilities identifying water supply projects needed to meet projected future demands. The SFWMD also considers water supply projects in local government Work Plans and adopted Sector Plans, which are required to identify needed water supplies and available water sources [Section 163.3245(3)(a)2, F.S.].

The SFWMD is required to notify each PWS utility of the water supply projects that have been included in the water supply plan update for the utility's consideration. Utilities then must respond to the SFWMD about their intentions to develop and implement the identified projects or provide a list of other projects (or methods) to meet projected demands [Section 373.709(8)(a), F.S.].

By November 15 of every year, all PWS utilities are required to submit a progress report to the SFWMD regarding the status of their water supply projects (e.g., completed, under way, planned for implementation).

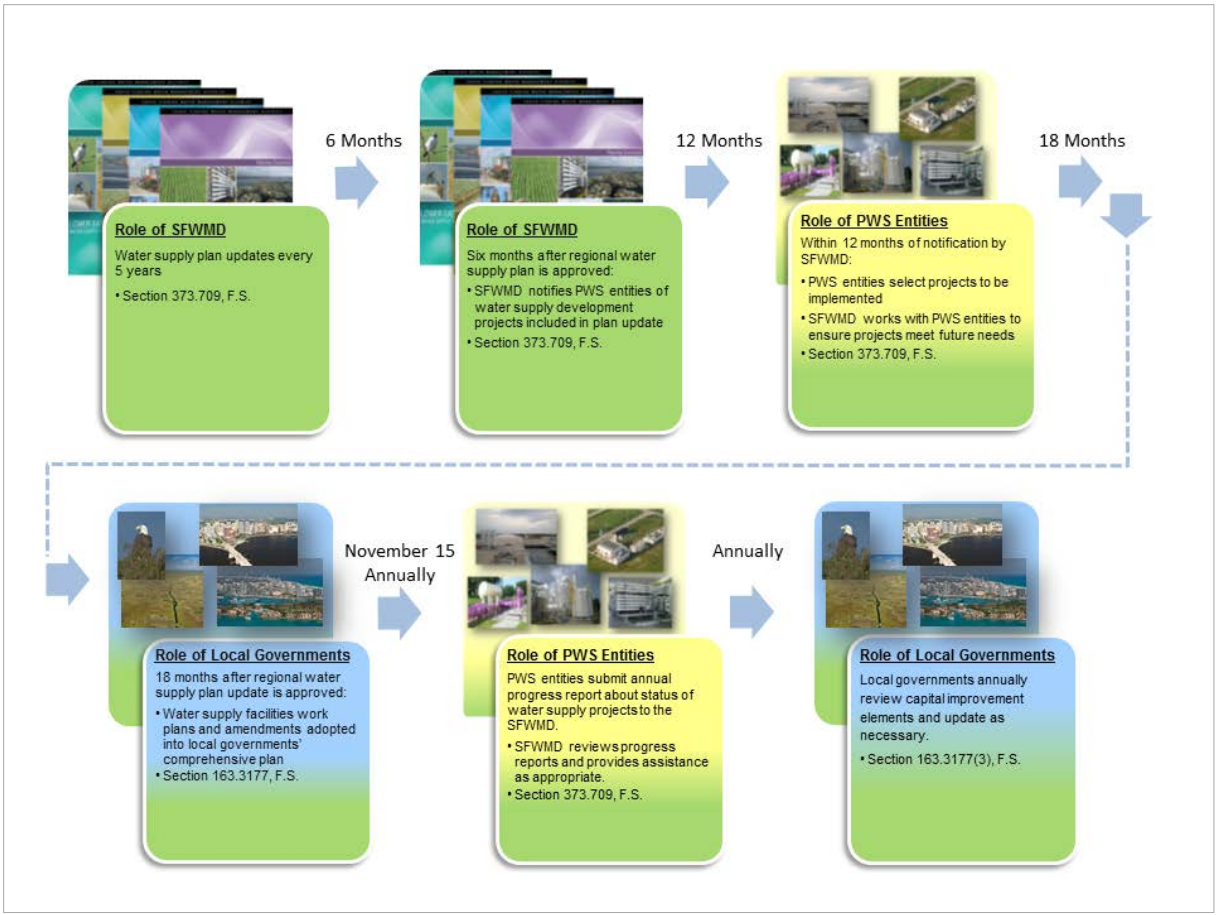

Figure 1-3. Linking regional water supply planning with local government comprehensive planning.

PLAN DEVELOPMENT PROCESS

This 2018 LEC Plan Update describes how anticipated water supply needs will be met in the LEC Planning Area through 2040. The planning process used to develop this plan update is outlined below.

Public Participation

Public participation is a key component of the water supply plan development process to ensure the plan addresses the issues and concerns of stakeholders and that the future direction and projects are appropriate for future water needs. The SFWMD held four local workshops within the LEC Planning Area during the water supply plan update process. Stakeholders representing a variety of interests in the region—agriculture, industry, environmental protection, utilities, local government planning departments, and state and federal agencies as well as the general public—were invited to attend the workshops. During the workshops, participants reviewed and commented on projected demands, water supply issues, the condition of regional water resources, water source options, and other key aspects of the water supply plan update.

Individual meetings also were held throughout the planning process with local government planning departments, utilities, other planning agencies, and agricultural representatives to discuss water demand projections and coordinate planning processes. A draft of this plan update was made available for public review, and comments were considered in finalization of the plan update. Additionally, presentations regarding the plan update were made to the District Governing Board.

PLAN DEVELOPMENT PROCESS

1	2	3	4
Planning and Assessment	**Data Collection, Analysis, and Issue Identification**	**Evaluation of Water Resources and Water Supply Source Options**	**Identification of Water Resource and Water Supply Development Projects**
The process incorporated extensive public participation and coordination with local stakeholders, utilities, agricultural representatives, nongovernmental environmental groups, local governments, the FDEP, FDACS, and other state and federal agencies. A review of previous planning efforts in the region and documentation of activities since the approval of the 2013 LEC Plan Update were key starting points.	Using the 2013 LEC Plan Update as a foundation, developing this plan involved collecting the latest information on population, water demands (**Chapter 2**; **Appendix B**), water conservation (**Chapter 3**), water resource protections (**Chapter 4**; **Appendix C**), water supply source options (**Chapter 5**), and water resource issues and evaluations (**Chapter 6**).	The next phase of the planning process involved reviewing existing solutions or developing new solutions to address the identified issues. In areas where projected demand exceeds available supplies, solutions included alternative water supplies and water conservation.	In areas where water resource conditions warranted, water resource development projects were identified (**Chapter 7**). Water supply development projects intended to meet water needs over the planning horizon were identified, compiled, and evaluated by the SFWMD with input from stakeholders, the public, and other agencies. Additionally, the projects were screened for permitting feasibility (**Chapter 8**).

PLANNING AREA PHYSIOGRAPHY

The LEC Planning Area encompasses approximately 6,500 square miles (4.16 million acres) of southeastern Florida. The region has an average estimated annual rainfall of 57 inches, and nearly 75 percent of rainfall occurs during the wet season (May through October). Major features in the LEC Planning Area include Lake Okeechobee and hydraulically connected surface water bodies, the Loxahatchee River and Estuary, Lake Worth Lagoon, the EAA, WCAs, portions of Everglades National Park, Biscayne National Park, Biscayne Bay, and Florida Bay.

Elevation differences in the LEC Planning Area are slight. The highest elevations are along the Atlantic Coastal Ridge that runs along the eastern coast, with some parts higher than 25 feet above mean sea level (MSL). The lowest elevations are along the southern coastline, where mangroves and coastal glades are at or below sea level and often are flooded by tides or freshwater runoff. The bottom of Lake Okeechobee is approximately at MSL, and the land immediately surrounding Lake Okeechobee ranges from 20 to 25 feet above MSL.

Physiographic regions in the LEC Planning Area include the Eastern Valley, Atlantic Coastal Ridge, Everglades, Immokalee Rise, Big Cypress Spur, Reticulate Coastal Swamps, and Florida Bay Mangrove Islands (**Figure 1-4**). The Eastern Valley consists of wetland communities, including tidal and floodplain swamp and forest. Prior to development and canal construction, the valley slowly drained through multiple sloughs to the Loxahatchee River and the Everglades.

The Atlantic Coastal Ridge, composed of relict beach ridges and sand bars, is mostly underlain by thin sand and Miami Limestone, which are highly permeable and moderately to well drained. The Atlantic Coastal Ridge covers 12,300 acres of scrub, pine flatwoods and hammocks, and forested sloughs. Elevations range from 25 to 50 feet above MSL in Palm Beach County, declining to a maximum of 29 feet above MSL in Broward County.

West of the Atlantic Coastal Ridge, the Everglades extends southward from Lake Okeechobee to the mouth of Shark River Slough at Florida Bay. Prior to development, the Everglades was seasonally inundated, and water drained slowly to the south. Much of the Everglades covers peat and muck soils overlaying interbedded sand, shell, and limestone. Bedrock in the Everglades is almost entirely limestone.

The Immokalee Rise is composed predominantly of sandy soils and ranges in elevation from 25 to 42 feet above MSL. The Big Cypress Spur is a sloping, transitional area between the Immokalee Rise to the north, the Everglades to the east, and the Southwestern Slope to the west. This area receives runoff from the Immokalee Rise and drains to the Everglades and the Southwestern Slope, with elevations around 25 feet above MSL.

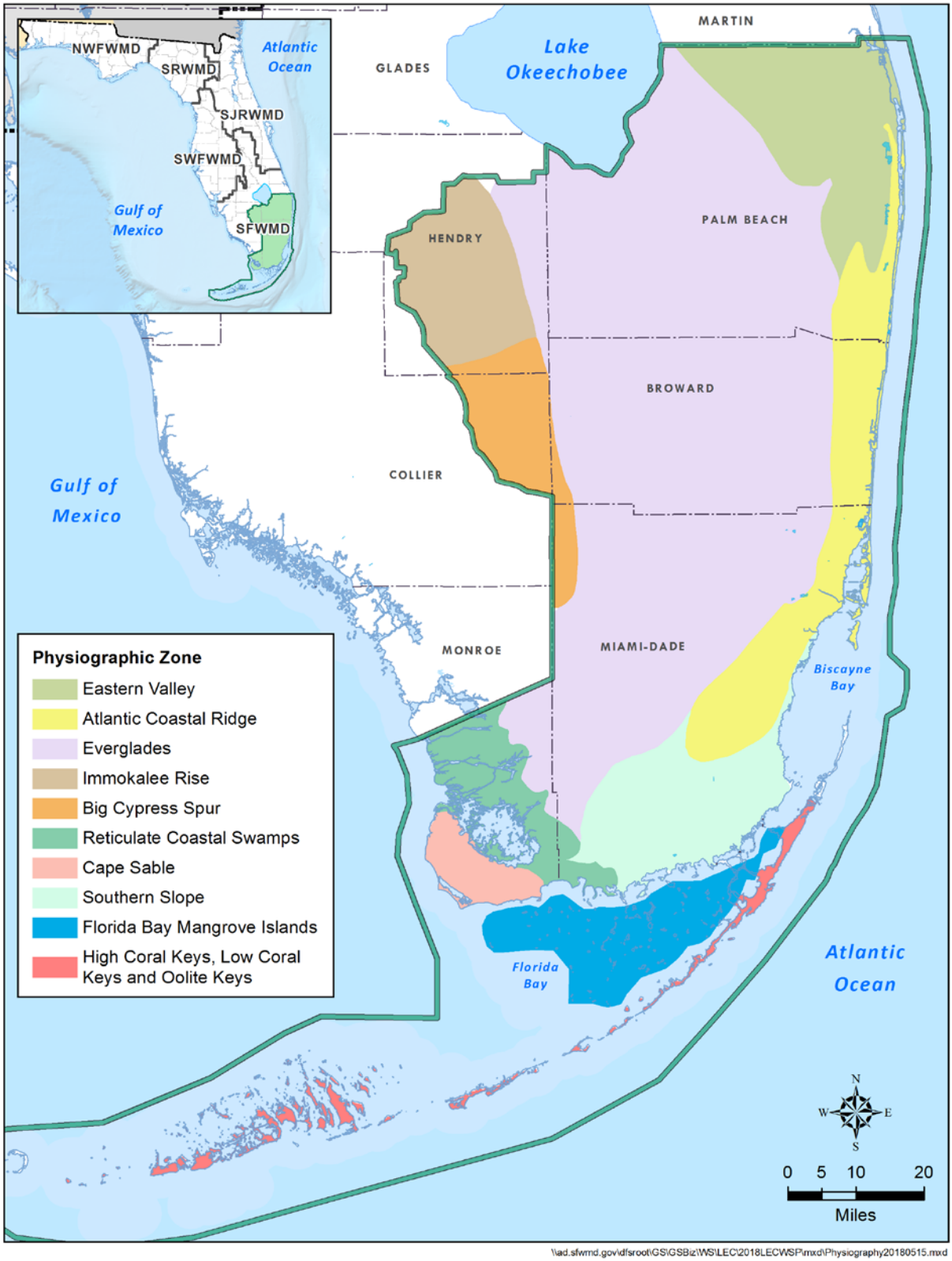

Figure 1-4. Physiography of the LEC Planning Area.

Mangrove swamps occupy a zone between the open waters at the coast and the uplands and freshwater wetlands of the Everglades. Small, densely packed mangrove islands and shoreline jungles form the Reticulate Coastal Swamps of northern Florida Bay, which is an important habitat for many species. Along the southern shores of Everglades National Park, Florida Bay is underlain by Miami Limestone, has an average water depth of approximately 3 feet, and consists of shallow, interconnected basins. The bay experiences rapid salinity changes due to mainland Everglades runoff and regional droughts. Sand shoals and ancient corals underlie mangrove islands throughout the bay.

The Florida Keys consist of highly permeable Key Largo Limestone in the Upper Keys and less permeable Miami Limestone in the Lower Keys. The average elevation is 3 to 4 feet above MSL, with the highest land elevation at 18 feet above MSL in Key West.

WATER RESOURCES OVERVIEW

Surface Water Resources

Freshwater Systems

The Central and Southern Florida Flood Control Project (C&SF Project) canals link Lake Okeechobee and the Everglades with agricultural and urban areas as well as other major ecosystems. The C&SF Project divided the remaining Everglades south of Lake Okeechobee and north of U.S. Highway 41 in Palm Beach, Broward, and Miami-Dade counties into three hydrologic units known as the WCAs. South of U.S. Highway 41 is Everglades National Park. Notable freshwater systems within the LEC Planning Area include the following:

- **Lake Okeechobee** is a key component of the South Florida hydrologic system. It serves multiple purposes, including flood protection; urban, agricultural, and environmental water supply; navigation; commercial and recreational fisheries; and fish and wildlife habitat. The lake is critical for flood control during wet seasons and water supply during dry seasons. Agricultural operations in LOSA are the dominant water users withdrawing from the lake and its tributaries. The Okeechobee Utility Authority (in the Lower Kissimmee Basin Planning Area) is the only remaining PWS utility using water directly from Lake Okeechobee.
- **WCAs** are the remaining portions of the northern and central Everglades that were diked as part of the C&SF Project. The WCAs are operated and maintained for flood control, while providing water supply to the LEC Service Areas and environmental habitats. Stormwater treatment areas (STAs) reduce nutrient levels in runoff from the EAA and in regulatory discharges from Lake Okeechobee before water is conveyed to the WCAs. The WCAs serve as the first source of supplemental water to the coastal canals that recharge the Biscayne aquifer. WCA-1 is owned by the SFWMD and managed by the United States Fish and Wildlife Service as the Arthur R. Marshall Loxahatchee National Wildlife Refuge. Portions of the Seminole Tribe of Florida Big Cypress Reservation and the Miccosukee Federal Reservation (also known as the Miccosukee Alligator Alley Reservation) are within WCA-3A.

- **C&SF Project Canals** move water from Lake Okeechobee and the WCAs to maintain coastal canal levels, augment water supplies during dry times, and prevent saltwater intrusion. The canals also are a crucial component of the region's flood control system, discharging stormwater to the ocean.
- **Everglades National Park** is home to a wide variety of endangered species and has several international preserve designations. Water from the WCAs enters Everglades National Park and flows through Taylor and Shark River sloughs to Whitewater and Florida bays and the Ten Thousand Islands area.
- The **Western Basins** comprise the C-139, Feeder Canal, L-28, and L-28 Gap basins, which are tributary basins to the Everglades Protection Area. The Seminole Tribe of Florida Big Cypress Reservation and a portion of the Miccosukee Federal Reservation are within the Western Basins area.
- **Water Control (298) Districts** are private or public, independent special districts established under Chapter 298, F.S., that maintain and operate local (secondary) canal systems.
- **Wetlands** extend across approximately 2 million acres of the LEC Planning Area (United States Fish and Wildlife Service 2010), mostly composed of the remnant Everglades. In addition to the WCAs and Everglades National Park, key wetlands in the LEC Planning Area include Holey Land and Rotenberger wildlife management areas, Pennsuco wetlands, Grassy Waters Preserve, Loxahatchee Slough, Corbett Wildlife Area, and other wetlands in the Loxahatchee River watershed. The LEC Planning Area also has extensive constructed wetlands within the EAA that serve as STAs as well as wetland mitigation banks and isolated wetlands in coastal portions of the LEC Planning Area.

Coastal Ecosystems

Notable coastal ecosystems in the LEC Planning Area include the following:

- The **Northwest Fork of the Loxahatchee River** is a federally designated Wild and Scenic River. The Loxahatchee River and estuary extend across approximately 128,000 acres in southern Martin and northern Palm Beach counties. A system of inland wetlands (i.e., Grassy Waters Preserve and the Loxahatchee and Hungryland sloughs) forms the headwaters of the watershed. The three branches of the Loxahatchee River—the Northwest Fork, North Fork, and Southwest Fork—discharge to the central embayment area, which flows through Jupiter Inlet to the Atlantic Ocean.
- **Lake Worth Lagoon** is an estuarine system in eastern Palm Beach County, extending approximately 22 miles adjacent to heavily urbanized areas. The lagoon is connected to the Atlantic Ocean by the Lake Worth (Palm Beach) and South Lake Worth (Boynton) inlets.
- **Biscayne Bay** covers approximately 274,000 acres off the southeastern coast of Miami-Dade County. The bay is an aquatic preserve and is designated as an Outstanding Florida Water. The southern half of the bay is within Biscayne National Park, which supports diverse flora and fauna, including many endangered species.

- **Florida Bay** is a large, shallow marine/estuarine lagoon between the Everglades and the Florida Keys. The bay covers 544,000 acres, of which approximately 80 percent is within Everglades National Park.
- The **Florida Keys** are a chain of islands starting at the southeastern tip of the state and extending south and west. Because of the unique marine ecosystems surrounding the Florida Keys, the area is protected as the Florida Keys National Marine Sanctuary. The area contains three national parks (Everglades, Biscayne, and Dry Tortugas) and several state parks.

Florida Bay

Groundwater Resources

Three aquifer systems underlie the LEC Planning Area: the surficial aquifer system (SAS), intermediate aquifer system (IAS), and Floridan aquifer system (FAS). Because hydraulic properties (i.e., ability to yield water to wells) and water quality may vary vertically and horizontally within each aquifer system, the potential for groundwater supply varies throughout the planning area. **Table 1-1** lists the aquifer systems, hydrogeologic units, and general aquifer yields in the LEC Planning Area. Note that the IAS is absent or has low yield in the LEC Planning Area and therefore is not discussed. Groundwater use is minimal within the LEC Planning Area portions of Collier and Monroe counties; therefore, they are not listed in **Table 1-1**. More detailed descriptions of the aquifers are provided in **Chapter 7**.

Table 1-1. Groundwater systems in the LEC Planning Area (Adapted from: SFWMD 2014).

Aquifer System	Hydrogeologic Unit	Aquifer Yield by County			
		Miami-Dade	Broward	Palm Beach	Hendry*
Surficial	Biscayne aquifer	H	H	M	A
	Undifferentiated surficial aquifer system	M	M	L-M	L-M
	Lower Tamiami aquifer/Gray Limestone	L-M	L-M	A	M-H
Intermediate	Sandstone aquifer	A	A	A	L
	Mid-Hawthorn aquifer	A	A	A	L
Floridan	Upper Floridan aquifer	M	M	M-H	M
	Avon Park Permeable Zone	L	L-M	M-H	L-H
	Lower Floridan aquifer	M-H	M-H	M-H	M

A= absent; L = low; M = moderate; H = high.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

Surficial Aquifer System

The SAS—including the Water Table, Biscayne, and Lower Tamiami aquifers—is shallow, predominately unconfined, and generally extends from land surface to 200 feet deep. Rainfall and seepage from canals, lakes, the Everglades, and other wetlands recharge the SAS. The Biscayne aquifer is among the most productive aquifers in the world, and on average, provides more than one billion gallons of water per day for potable and irrigation needs in Palm Beach, Broward, and Miami-Dade counties combined. The Lower Tamiami aquifer provides groundwater for agricultural operations in Hendry County. In 2016, fresh groundwater accounted for 90 percent of potable water produced by PWS utilities in the LEC Planning Area.

Floridan Aquifer System

The FAS is a thick, multi-layered sequence of predominantly carbonate rocks that underlies Florida and parts of Alabama, Georgia, and South Carolina. The Upper Floridan aquifer, at the top of the FAS, is 800 to 1,100 feet below land surface in the LEC Planning Area. Wells in the FAS flow naturally because potentiometric water levels reach 40 to 55 feet above MSL. The Avon Park Permeable Zone is a deeper water-bearing portion of the Upper Floridan aquifer (1,400 to 1,600 feet below land surface). While the FAS is the primary source of fresh water for much of northern and central Florida, it contains brackish water in the LEC, Lower West Coast, and Upper East Coast planning areas.

Historically, the FAS was not widely developed as a water source in the LEC Planning Area due, in part, to the extensive availability of fresh groundwater in the SAS. However, use of the FAS has nearly doubled in the past 5 years as freshwater availability declines. With reverse osmosis treatment, the Upper Floridan aquifer is used as an alternative source of potable water, for irrigating some landscape and golf courses, and for process water at power generation facilities. The Lower Floridan aquifer contains a highly transmissive layer known as the Boulder Zone (3,000 feet below land surface), which is a primary repository for residual brines from reverse osmosis treatment and disposal of secondary effluent from wastewater treatment facilities.

Surface Water and Groundwater Relationships

In many ways, surface water and groundwater resources are interdependent. Although surface water management systems are a major source of water supply, in terms of interaction with groundwater, the systems within the LEC Planning Area function primarily as aquifer drains during the dry season. Surface water management systems also affect aquifer recharge by diverting rainfall runoff before it percolates down to the water table. Once diverted, this water may contribute to aquifer recharge elsewhere in the system, supply a downstream consumptive use, be lost to evapotranspiration, or be discharged to the ocean.

The groundwater hydrology of the LEC Planning Area has been permanently altered by C&SF Project construction as well as urban and agricultural development. Historically, canals locally drained the upper portion of the SAS, which resulted in a decline in inland groundwater levels and groundwater flow towards the ocean, allowing saltwater intrusion in some coastal areas. Subsequent installation of coastal canal water control structures has helped stabilize the saltwater interface, but there is evidence of inland migration in some

areas of coastal Broward and Miami-Dade counties (**Appendix D**). A few coastal PWS wellfields located seaward of salinity control structures are no longer operating due to saltwater intrusion. The diversion of water into water control (298) districts, west of the water control structures, substantially recharges groundwater sources, reduces impacts of irrigation and PWS withdrawals from aquifers, and helps slow saltwater intrusion.

CLIMATE CHANGE AND SEA LEVEL RISE

Climate change and sea level rise are issues of concern globally and especially in coastal regions such as South Florida. Because of its location, variability in climate, hydrology, geology, topography, natural resources, and dense coastal populations, South Florida is particularly vulnerable to the effects of future changes in climate and sea level rise. The nature and rate of change are highly uncertain, particularly at regional scales, but effects of sea level rise are being experienced already within the LEC Planning Area.

Sea level rise affects flood control operations at coastal structures and contributes to inland movement of salt water into aquifers. Increased air temperatures and changes in precipitation regimes and storm frequency associated with climate change could result in greater evaporation, longer drought periods, and higher risk of flooding throughout South Florida. These changes could notably affect regional water resources and planning.

The SFWMD is responsible for managing and protecting water resources of South Florida by balancing and improving flood control, water supply, water quality, and natural systems. Over the last decade, the SFWMD has implemented strategies to adapt its operations to ensure this mission continues to be met under changing climate conditions. The SFWMD's approach centers on staying current with the science of climate change and applying actionable and reliable science to planning and operations. The efforts to address its mission elements require collaboration and cooperation with local governments; other regional, state, and federal agencies; universities; nongovernmental entities; a wide array of stakeholders; and concerned citizens throughout South Florida. Coordination is essential because effective solutions and adaptations require action across multiple agencies and administrative boundaries. In 2010, Palm Beach, Broward, Miami-Dade, and Monroe counties established the Southeast Florida Regional Climate Change Compact (Compact) to inform and coordinate planning efforts and responses to climate change across county lines. Additional participants include numerous local and city governments, utilities, other governmental agencies, and nonprofit organizations. The SFWMD is an active but non-voting member of the Compact and has provided data, workshop support, and technical assistance to develop sea level rise projections. Compact participants recognized the need to 1) protect and address vulnerable water supply and infrastructure, and 2) preserve the region's natural systems and agricultural resources. The Compact has produced the Southeast Florida Regional Climate Action Plan (RCAP 2.0), which recommends advancement of water management strategies and infrastructure improvements needed to mitigate the potential adverse impacts of climate change and sea level rise on water supplies, water and wastewater infrastructure, and water management systems, including regional canal networks, pumps, control structures, and operations (Southeast Florida Regional Climate Change Compact 2017).

Possible Effects

The combination of sea level rise and potential changes in temperature, rainfall patterns, and tropical storm activity likely will alter how the SFWMD achieves its legislatively mandated mission elements—to operate and maintain the regional water management infrastructure, provide flood control and water supply benefits to Florida citizens, and protect and restore natural systems. The agency approach is focused less on the causes of climate change and more on understanding the implications it may have on water resources and future water supply sources as well as determining how to respond and deliver its mission elements through planning, proactive action, and adaptive management.

Air Temperature Rise, Precipitation Regimes, and Storm Frequency

Current predictions, from multiple climate models summarized by the Intergovernmental Panel on Climate Change, indicate global mean surface temperatures likely will increase over the next 20 years, leading to longer and more frequent heat waves over land areas (Southeast Florida Regional Climate Change Compact 2015). This would increase evaporation, resulting in lower surface water levels, increased irrigation demand, and impacts to stormwater runoff, soil moisture, groundwater recharge, and water quality. Additionally, increased air temperatures contribute to sea level rise through thermal expansion of ocean waters and through glacial melt releasing substantial volumes of water into the oceans.

More frequent, intense rainfall events with longer interim dry periods could increase total annual rainfall but decrease effective rainfall (i.e., aquifer recharge) as more water may be lost to runoff, prompting the need for storage alternatives. In addition, longer interim dry periods could increase the need for supplemental irrigation.

Analyses of the results of climate models for Florida suggest a reasonable range for percent change in average annual rainfall is ±5 percent for 2040. Additional studies are under way to determine more precise estimates of future rainfall conditions. The corresponding temperature range for 2040 is +0.5°C to +1.5°C. Several ongoing research studies are focusing on the implications of future temperature changes on evapotranspiration losses. The SFWMD has conducted and commissioned studies on the predictive skills of climate models and has downscaled climate models for Florida. These efforts indicate a need for improvement in the models and identify ongoing efforts to improve regional models. The SFWMD is monitoring the findings of these studies and will incorporate results into planning and operations, as appropriate.

Sea Level Rise

The effects of rising sea levels are most easily observed when water overtops sea walls and floods urban areas during seasonal high tides. Higher sea levels also contribute indirectly to flooding by increasing groundwater levels and decreasing the capacity of the drainage network. As groundwater levels rise, soil storage capacity, which typically helps minimize flooding after rain events, is reduced.

Some salinity control or coastal structures already are experiencing impacts from sea level rise. Canal water levels generally are kept low so they can drain the surrounding areas in response to heavy rains. However, they are kept higher than sea level to prevent salt water

from moving inland through the canals. If they cannot maintain canal water levels higher than sea level, then the salinity control structures are closed to prevent entry of seawater. As sea level rises, the conditions under which the structures are closed become more frequent or of longer duration. Under these conditions, water cannot flow as readily through the canals toward the coast, which increases the risk for flooding and the need for flood control modifications.

Rising seas also can impact South Florida's drinking water supplies. As the rate of sea level rise increases, inland movement of the saltwater interface could accelerate. If sea level continues to rise, saltwater intrusion likely will require some coastal wellfields to relocate farther inland, change treatment processes, or be replaced by alternative water sources.

Global mean sea level rise is caused by thermal expansion and an increase in the volume of water in the oceans from melting glaciers and other sources. The gradual increase in sea level has been observed in sediment, tide gauge, and satellite altimetry records. Tide gauge records show that relative sea level is rising along the Florida coastline (**Figure 1-5**). Since 2006, sea level in Florida has risen at a rate of 0.35 inches per year. The rate of change varies from location to location due to factors such as vertical land movement and ocean currents (Church and White 2011).

INFO

Mean sea level is established by the National Ocean Service using tidal data over a 19-year period, called a tidal datum epoch, which is revised every 20 to 25 years to account for changing sea levels and land elevations.

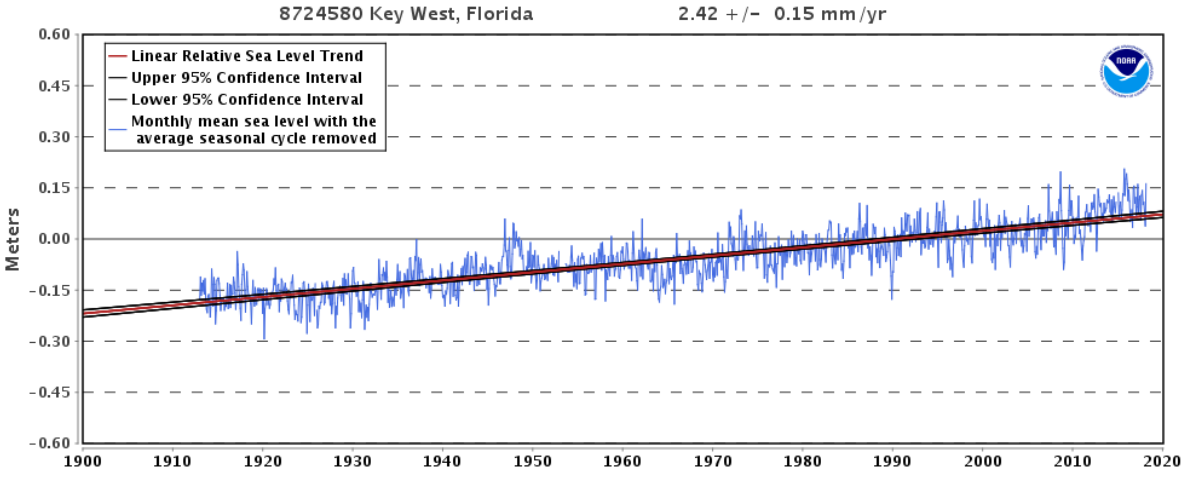

Figure 1-5. Historical sea level measurements from the Key West, Florida tide gauge (From: National Oceanic and Atmospheric Administration 2013).

The current rate of sea level rise is expected to accelerate in the future. The latest projections from the National Climate Assessment (Melillo et al. 2014) suggest sea level may increase 0.66 to 6.6 feet by 2100 (**Figure 1-6**). In 2014, the Compact updated its 2011 sea level rise projections to account for this new information as well as new data published by the Intergovernmental Panel on Climate Change (2013). Based on the Compact's intermediate/low and high projections, sea level is estimated to increase between 2 and 13 inches over the planning horizon of this 2018 LEC Plan Update (2016 to 2040).

The unified sea level rise projection for southeastern Florida is intended to be used for regional planning purposes when considering sea level rise in short- and long-term planning horizons and infrastructure design. The high curve shown in orange in **Figure 1-6** is meant to be used for long-term (50 years or more) and/or high-risk (e.g., nuclear power plants) projects, in which the potential impacts from sea level rise could cause significant damage and/or loss of life. Most regional and local planners are expected to use the projection in the shaded area of **Figure 1-6**, although using the high end of this area will be more conservative and provide an additional level of protection.

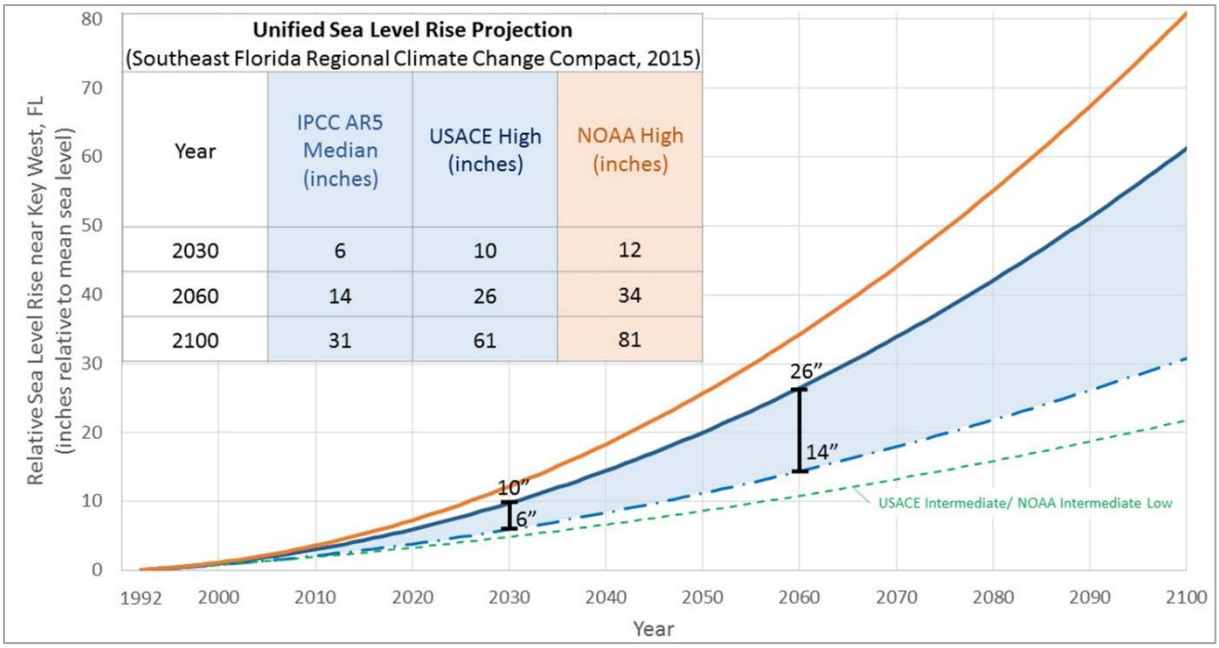

Figure 1-6. Most recent unified southeast Florida sea level rise projection for regional planning purposes (From: Southeast Florida Regional Climate Change Compact 2015).

Sea level rise projections have been incorporated into groundwater models in Miami-Dade and Broward counties. Miami-Dade County contracted with the United States Geological Survey (USGS) to develop a model to evaluate the potential impacts of sea level rise on the interconnected surface water and groundwater systems (Hughes and White 2016). Higher sea levels resulted in landward movement of the saltwater interface, with the largest salinity changes seaward of salinity control structures or where the land was inundated by increased sea level (**Figure 1-7**).

Broward County and the USGS developed a series of groundwater and surface water models that can generate predictive scenarios of saltwater intrusion into the Biscayne aquifer and inundation from sea level rise (Hughes et al. 2016). Model results indicate the saltwater interface will advance progressively inland with increasing rates of sea level rise, preferential movement via canals, and salinities increasing commensurately at wellfields near the existing saltwater interface. Hypothetical repositioning of an existing salinity control structure seaward only had local effects on preventing further movement of the saltwater interface. Injection of fresh water near an existing wellfield had local freshening effects (constrained by land elevations and drainage impacts) but little effect on the saltwater interface or salinity at wellfields. Another scenario relocated wellfield withdrawals to the west. Additionally, the Biscayne aquifer was recharged by the existing primary and secondary canal network with

captured stormwater. This scenario resulted in stabilization of the saltwater front at the existing saltwater boundary, even with the effects predicted by sea level rise. Further information on the Miami-Dade and Broward sea level rise models is provided in **Appendix D**.

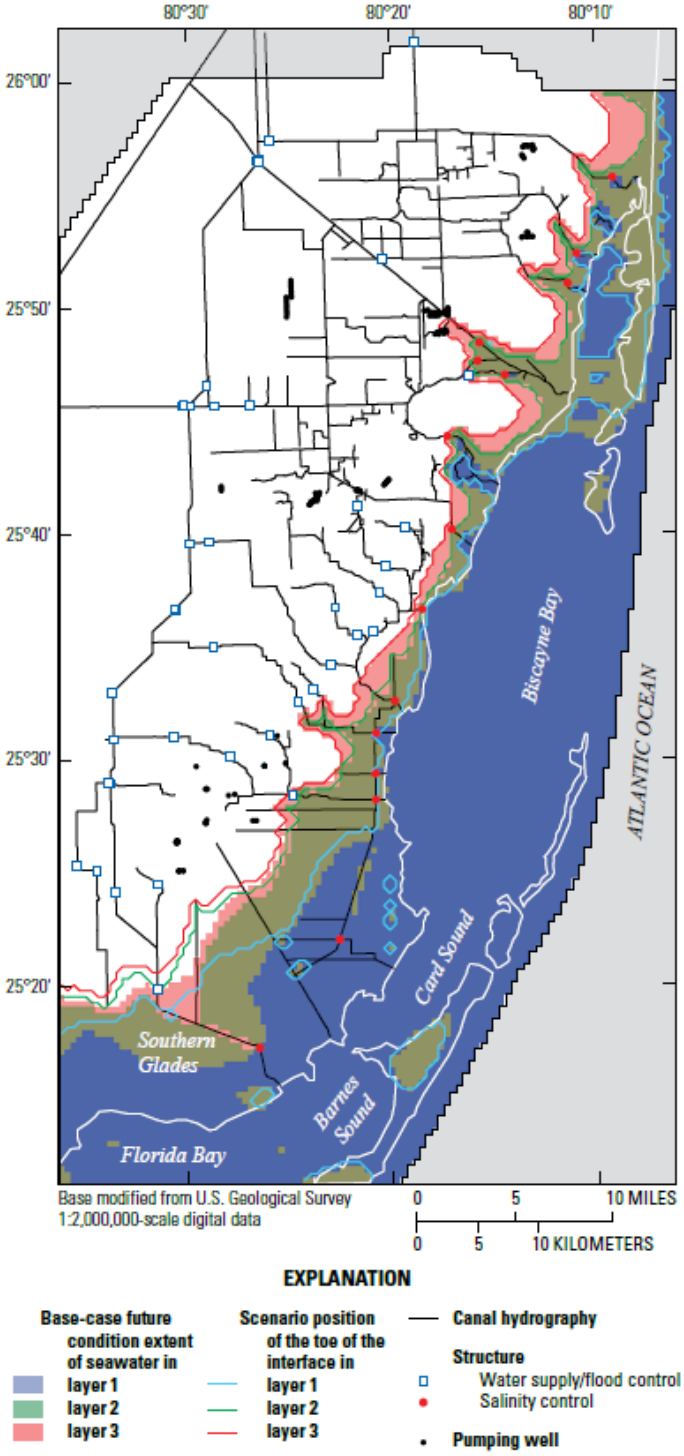

Figure 1-7. Estimated 2040 saline inundation in Miami-Dade County (From: Hughes and White 2016).

Current Management Strategies

The SFWMD has been evaluating climate change and sea level rise since 2008 to determine the best short- and long-term strategies to address water resource management and prepare for related impacts (SFWMD 2009, 2011). Long-established networks of rainfall and surface water flow data, many with real-time electronic reporting, provide continuous data to monitor changes in local hydrology. In addition, an extensive network of coastal and inland surface water and groundwater monitoring sites collect and analyze water level and quality data, including information about saltwater intrusion.

Future water supply and stormwater management analyses require the use of rainfall pattern estimates. Currently, this area of climate science is lagging in Florida, and there is no reliable information on how future rainfall patterns may change in South Florida. The SFWMD, in coordination with partners in the private sector and academia, is developing future rainfall intensity-duration-frequency scenarios, rainfall probability analyses, and extreme weather events projections.

Coastal monitor wells are used to track the location and movement of the saltwater interface, which is affected by several factors, including sea level rise and groundwater withdrawals. Every 5 years, the SFWMD uses the monitor data to estimate the location of the saltwater interface. Comparison of 2009 and 2014 saltwater interface maps indicate only a few locations where noticeable inland movement has occurred in Broward and Miami-Dade counties (**Appendix D**). The data will be used to calibrate groundwater models designed to simulate future saltwater movement.

The SFWMD is involved in several studies focused on assessing flood risks associated with sea level rise. One program, the Flood Protection Level of Service Program, is evaluating flood control infrastructure performance at coastal water control structures. The results will be used to 1) determine sea levels at which existing infrastructure can no longer provide sufficient flood protection, 2) identify facilities at risk of impacts from flooding, and 3) support decision-making on prioritizing improvements and adaptation. In 2015, the SFWMD was awarded a grant from the Florida Division of Emergency Management to assess flood protection in portions of northern Miami-Dade County under current and future sea level scenarios and assess mitigation strategies; the analyses are ongoing.

The SFWMD supports local governments in seeking federal grants to address sea level rise in southeastern Florida and provides technical and coordination support. In 2014, the SFWMD established a Memorandum of Agreement with the Ministry of Infrastructure and the Environment of the Netherlands and the Delfland Water Board to share information, expertise, and strategies regarding flood control, water supply, sea level rise, climate adaptation strategies, and saltwater intrusion impacts. There are many similarities in the water management systems of the SFWMD and the Netherlands. In addition, the SFWMD has organized several workshops related to saltwater intrusion and sea level rise.

Future Adaptive Management Strategies

SFWMD staff will actively monitor local and national research projects, interpret the results, and initiate appropriate actions to protect the region's water resources as the effects of climate change become more evident. In addition, the SFWMD is re-evaluating the complex water management system and determining appropriate adaptation measures. Actions by the SFWMD to address climate change and sea level rise effects during the planning period of this update (2016 to 2040) include the following:

- Complete the coastal structure analysis and appropriate modifications.
- Continue to review literature and engage in sea level rise initiatives at the national level.
- Continue to incorporate sea level rise projections in planning associated with infrastructure for flood protection, water supply, and Everglades restoration.
- Deliver data, analysis results, and tools to support decision-making under high uncertainty.
- Continue to monitor and map the position of the saltwater interface.
- Develop surface water and groundwater models that simulate the effects of sea level rise.
- Develop methods and collect data for future rainfall and temperature assumptions.
- Continue to operate salinity control structures to prevent or minimize inland encroachment of seawater.
- Incorporate the effects of climate change and sea level rise, along with other changes in hydrology, into the review process when MFLs and Water Reservations are re-evaluated.

While ongoing SFWMD efforts can provide critical information regarding regional flood protection and saltwater intrusion, local governments, utilities, and private entities are tasked with developing their own adaptive strategies for addressing sea level rise. Community adaptation strategies can be grouped into three generalized approaches:

- **Armament** – Construction of defensive barriers (e.g., berms, seawalls) and pumping systems to protect existing infrastructure.
- **Accommodation** – Improvement of infrastructure (e.g., elevated roads and buildings) to allow coastal inundation to occur.
- **Organized retreat** – Rezoning of property threatened by inundation or transfer to public ownership.

Climate change may affect water supply sources and should be considered when evaluating the ability of water supplies to meet future demand. In addition, climate change could dramatically alter patterns of water demand, thereby becoming an important consideration in demand projections. Changes in water supply and demand would necessitate infrastructure adaptation. As related information is generated, existing and proposed water sources and projects will be evaluated to determine their feasibility and desirability. The SFWMD can provide support during planning and implementation of these approaches as they relate to water supply.

South Florida is particularly vulnerable to potential changes in climate and sea level because of its location, regional variability in climate, hydrology, geology, topography, and natural resources, and dense population in coastal areas. To plan and prepare for regional climate change and sea level rise, the SFWMD is conducting research and computer modeling to better predict and reduce uncertainties, analyzing vulnerabilities in the current water management system, and developing effective adaptation strategies for the future. Coordination with other resource management entities and governments is vital to ensuring a common approach and shared information moving forward.

HISTORY OF PLANNING EFFORTS

The 2000 LEC Plan (SFWMD 2000) concluded timely implementation of CERP projects would meet most of the environmental needs and water supply demands of the region by 2020. When the plan was updated 5 years later, delays to CERP projects changed the basis of that conclusion. The 2000 LEC Plan also recommended water needed for CERP projects be protected from allocation. In response, the SFWMD developed Restricted Allocation Area criteria for the Lower East Coast Everglades Waterbodies and North Palm Beach County/Loxahatchee River Watershed Waterbodies (**Chapter 4**). As a result, the 2005-2006 LEC Plan Update (SFWMD 2007) concluded that PWS would need to depend heavily on water conservation, alternative water sources, and new water treatment plants.

During preparation of the 2005-2006 LEC Plan Update, local governments and water suppliers in the LEC Planning Area worked closely with the SFWMD to identify and develop water supply projects to meet projected water demands. However, water demands were effectively lowered by slower population growth due to the 2006 housing market decline and increased water conservation due to irrigation restrictions and other measures. Additionally, water suppliers maximized their fresh groundwater allocations, as listed in the SFWMD's LEC Regional Water Availability criteria. As a result, local governments and water suppliers postponed many alternative water supply projects proposed in the 2005-2006 LEC Plan Update.

In 2008, the USACE began rehabilitiation of the Herbert Hoover Dike and changed the Lake Okeechobee regulation schedule because of concerns over dike integrity, among others, which reduced the 1-in-10 year water supply level of certainty for Lake Okeechobee users to a 1-in-6 year level of certainty. Also, the SFWMD's water shortage rules were updated [Chapters 40E-21 and 40E-22, Florida Administrative Code] and Lake Okeechobee's MFL status was changed from a prevention strategy to a recovery strategy. With predicted continued slower population growth and lower water demand, the 2013 LEC Plan Update (SFWMD 2013) reported that almost all PWS utilities had sufficient water treatment capacity and permit allocations to meet future demands through 2030. The 2013 LEC Plan Update concluded the 2030 needs of the region could be met with appropriate management, water conservation, and implementation of projects identified in the plan update.

PROGRESS SINCE THE 2013 LEC PLAN UPDATE

Since the 2013 LEC Plan Update, several activities have improved understanding of and enhanced the region's water resources, water supply, and natural systems.

Hydrologic Studies, Monitoring, and Modeling

- **Updated Delineation of the Saltwater Interface** – The SFWMD reviewed 2014 water quality data from Broward and Palm Beach counties and prepared updated maps comparing the 2009 and 2014 extent of saltwater intrusion within the SAS (**Appendix D**). Broward County maintains a regional water monitoring network with the USGS that provides groundwater elevations, chloride concentrations, and induction log observations in 25 wells throughout the county. Miami-Dade County contracts with the USGS to maintain and update its monitoring network, including 35 induction log sites, and its saltwater interface maps. The USGS published the 2011 interface line in 2014 (Prinos et al. 2014) and a 2016 interface map of southern Miami-Dade County in 2017 (Prinos 2017).
- **FAS Monitoring Network** – The SFWMD continues to maintain and update a network of more than 100 FAS monitor wells, 18 of which are within the LEC Planning Area. Water level data from the monitor wells help manage use of the FAS as a water supply source. In addition, water quality sampling and analyses are conducted periodically to observe any trends that might signal overuse of the resource.
- **USGS/SFWMD Cooperative Monitoring** – Water level and water quality monitoring at existing monitor wells provides critical information to develop groundwater models, assess groundwater conditions, and manage groundwater resources. The SFWMD maintains extensive groundwater monitoring networks and partners with the USGS to provide additional support and funding for ongoing monitoring. Well details and monitoring data are provided in various SFWMD technical publications and in the District's corporate environmental database, DBHYDRO. Data from sites monitored by the USGS are archived in a USGS database and published annually.
- **Lower West Coast Hydrogeologic Mapping and Groundwater Modeling** – The SFWMD refined the understanding of the hydrogeology of the SAS and IAS in the Lower West Coast Planning Area by synthesizing data from more than 1,000 wells (Geddes et al. 2015). The maps and aquifer relationships developed from this work are being used to develop an updated regional groundwater model for the area, which is expected to be available in 2019. Preliminary results were reviewed for this plan update to assess the impacts of current withdrawals on groundwater levels within the Hendry County portion of the LEC Planning Area.
- **East Coast Floridan Model** – The SFWMD published documentation of this density-dependent FAS model in October 2014. The model was used in 2015 to evaluate future effects of proposed use of the FAS for the *2016 Upper East Coast Water Supply Plan* (SFWMD 2016b), and the results are available on the SFWMD website (www.sfwmd.gov; Search: East Coast Floridan Model). The model was used in support of this plan update, and further information can be found in **Appendix D**.

- **G-160 and Loxahatchee Slough Groundwater-Surface Water Interaction Study –** The G-160 structure was installed to provide flood protection, increase deliveries to the Loxahatchee River, and improve wetlands in the C-18 Basin, including Loxahatchee Slough. This study assessed surface water and groundwater conditions within and adjacent to the eastern portion of Loxahatchee Slough in northern Palm Beach County since the installation and operation of the G-160 structure on the C-18 Canal, particularly after the structure's headwater stage was increased in June 2009 (Collins et al. 2016). The study analyzed 2005-2013 data from groundwater monitor wells and several local stage and rainfall stations. Based on the analyzed data, the increased operating stage at the G-160 structure has not increased groundwater stages to adverse levels in nearby upstream residential areas.

Loxahatchee Slough (Photo credit: John Math)

- **Monitor Well Installations in Miami-Dade County –** The SFWMD installed monitor wells in Miami-Dade County in support of CERP projects. Monitor wells at the S-356 pump station help evaluate whether the pumps are effectively moving water into Everglades National Park and the potential effects of operating the pumps on the groundwater system. Monitor wells were constructed in the agricultural area east of the L-31W levee in response to concerns that Everglades restoration activities may increase local groundwater levels.
- **CERP ASR Regional Study** – The USACE and SFWMD (2015) published the final Technical Data Report of the CERP ASR Regional Study, documenting more than a decade of scientific and engineering results and serving as a technical guide for considering ASR as part of future Everglades restoration efforts. The study incorporated the results from pilot ASR projects successfully constructed and tested along the Kissimmee River and Hillsboro Canal. The National Research Council (2015) released a peer review of the ASR Regional Study in April 2015, concluding that it "significantly advances understanding of large-scale implementation of ASR in south Florida."
- **C-51 Reservoir Conveyance Analysis** – A 2014 modeling analysis using the Hydrologic Engineering Center River Analysis System (HEC-RAS) and MODFLOW tools simulated conveyance of water from the proposed C-51 Reservoir to the Hillsboro Canal. The model was calibrated with data from a field test of the Lake Worth Drainage District E-1 Canal route.

Regulations and Operations

- **Chapter 40E-2, Florida Administrative Code, Consumptive Use 2014 Rule Update** – Rule updates from the statewide Consumptive Use Permit Consistency effort resulted in revisions to the SFWMD water use permitting criteria, which can be found in the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (SFWMD 2015).
- **Florida Bay MFL Criteria Re-Evaluation** – The Florida Bay MFL criteria were re-evaluated in 2014 based on several years of additional research. Results of the re-evaluation indicated the existing MFL criteria are adequate thresholds of significant harm to Northeastern Florida Bay in terms of the degree of impact that could occur if the MFL criteria were violated.
- **Watershed Initiatives** – The SFWMD has worked with local governments, special districts, and private organizations on projects consistent with the District's mission of flood control, regional water supply, water quality improvement, and ecosystem restoration. Watershed projects include the Loxahatchee River Preservation Initiative, Lake Worth Lagoon Initiative, Palm Beach County Water Resources Task Force, Southeast Florida Regional Climate Change Compact, Broward County Water Resources Task Force, Broward County Climate Change Task Force, Florida Keys Water Quality Steering Committee, and Biscayne Bay Restoration Initiative (in development). Such watershed initiatives complement larger-scale projects, including the Northern Everglades and Estuaries Protection Program and CERP.
- **Operational Testing** – Substantial changes in C&SF Project operations related to CERP include incremental operating elevation modifications to structures along Tamiami Trail and other connections flowing into Taylor Slough, new pumps for Biscayne Bay coastal wetland mitigation, A-1 and L-8 flow equalization basin inflow operations, S-5AS water transfers, and S-190 operational changes.

Water Storage

- **CERP Fran Reich Preserve Phase 1** – Completed in 2016, this phase of the project consists of embankments along the L-40 and S-530 spillways to reduce the amount of seepage loss from the Arthur R. Marshall Loxahatchee National Wildlife Refuge.
- **A-1 Flow Equalization Basin** – Completed in 2015, the shallow impoundment captures, stores, and delivers stormwater runoff to STA-2 and STA-3/4 to improve water quality treatment performance.
- **A-2 Reservoir and STA** – Project authorized in October 2018 under the America's Water Infrastructure Act of 2018.
- **L-8 Flow Equalization Basin and Divide Structure –** Completed in 2017, the L-8 flow equalization basin provides belowground water storage of excess stormwater for release to STA-1E and STA-1W. The divide structure (G-541) allows for higher stages to the south when moving water into and out of the basin.
- **C-51 Reservoir Phase I –** In January 2017, the SFWMD designated the C-51 Reservoir Phase 1 as a pilot alternative water supply development project, pursuant to Section 373.037, F.S. The reservoir is expected to provide up to 35 million gallons per day (mgd) for PWS (**Chapter 7**).

Construction and Restoration Projects

Herbert Hoover Dike

- **Herbert Hoover Dike/Lake Okeechobee** – In 2007, the USACE designated the Herbert Hoover Dike as a Class I risk, the highest risk for dam failure. The completion of the 21.4-mile Reach 1 cutoff wall, on the southeastern portion of Lake Okeechobee from South Bay to the C-44 Canal, satisfies most of the risk reduction goals. Of 32 culverts slated to be replaced, removed, or abandoned by 2018, 1 has been removed, 8 have been replaced, and 18 replacements are in progress. Rehabilitation of additional sections of the dike is ongoing and planned for completion by 2022 (**Chapter 6**).
- **Modified Deliveries to Everglades National Park** – Modifications to the C&SF Project have been completed to improve natural water flows to Shark River Slough in Everglades National Park. Recent activities include structure field testing (operational plans), additional construction on Tamiami Trail bridges, and completion of the S-357N structure in 2018 (**Chapter 6**).
- **C-111 South Dade Project** – Completed in 2018, this project was designed to restore more natural hydrologic conditions in Taylor Slough and Everglades National Park, separate Everglades National Park from agricultural lands to the east, and provide flood control (**Chapter 6**).
- **C-111 Spreader Canal Project** – The goal of this project is to establish more natural flows in Taylor Slough, which will improve the timing, distribution, and quantity of water flowing into Florida Bay. The canal operating range was lowered to capture more seepage, and seasonal variation was added in March 2016. In 2018, the capacities of two pump stations were increased to deliver more water to Taylor Slough (**Chapter 6**).
- **L-31N Canal Seepage Barrier** – Completed in April 2016, this project constructed a 5-mile long, 35-foot deep seepage barrier to reduce groundwater discharge from the Biscayne aquifer in Everglades National Park to the L-31N Canal. Monitor well and flowmeter data indicate the barrier is positively influencing water levels and reducing seepage into the L-31N Canal.
- **Dade-Broward Levee Project** – In 2016, this project finished repairing gaps in the Dade-Broward levee that were causing water level reductions in the Pennsuco wetlands. To further improve hydrology in the wetlands, the western wellfield protection canal control structure was completed in May 2018 and construction of the Pennsuco diversion structure was under way as of 2018.

- **Sam Jones/Abiaki Prairie C-139 Annex Restoration Project** – The goal of this project is to restore historical Everglades hydrologic conditions to 14,437 acres of former citrus grove. In 2016, Phase 1 of the project began restoring 3,300 acres of grove land. In 2017, site leveling was completed and re-vegetation trials began for Phase 1.
- **Biscayne Bay Coastal Wetlands L-31E Flow-way** – This component of CERP is meant to rehydrate coastal wetlands and reduce point source discharges from the C-102, C-103, and Military canals. In 2016, four culverts were constructed and a pump was installed under the L-31E Flow-way Interim Operations Project.
- **Loxahatchee River Dam Renovations** – The Lainhart and Masten dams regulate upstream flow stages in the Northwest Fork of the Loxahatchee River and maintain the hydrology of the riverine floodplain ecosystem. Both dams were in poor condition and renovations were completed in 2017.

Biscayne Bay Coastal Wetlands

Cooperative Funding Program

For nearly two decades, the SFWMD has provided funding to local governments, special districts, utilities, homeowners' associations, and other public and private water users for alternative water supply, water conservation, and stormwater projects that are consistent with the District's core mission. Alternative water supply and water conservation projects are discussed in this plan update as they increase water availability and better manage existing supplies. More information on the Cooperative Funding Program is provided in **Chapter 8**.

- **Alternative Water Supply** – From Fiscal Year (FY) 2013 through FY2018, the SFWMD provided approximately $3.1 million for 11 alternative water supply projects that have been completed or are under construction in the LEC Planning Area, generating 9.25 mgd of additional reclaimed water capacity and 4.19 mgd of additional reclaimed distribution or storage.
- **Water Conservation** – From FY2013 through FY2018, the SFWMD provided approximately $1.2 million for 39 water conservation projects that were completed or are being implemented in the LEC Planning Area. The projects are estimated to save 546.36 million gallons per year (1.50 mgd).

Water Supply Reports

- **Estimated Water Use Report** – Since 2014, the SFWMD has prepared annual reports estimating water use, based primarily on water pumpage records submitted to the District as part of permit requirements.
- **2017 Utility Rate Survey Report** – This report inventoried the water and wastewater utility rates within the District's boundaries. It assessed the pricing of water and the region's use of rate structures that encourage water efficiency.
- **Beneficial Use of Reclaimed Water, Stormwater and Excess Surface Water Report (Senate Bill 536) –** The SFWMD participated in a study that produced recommendations to increase the beneficial use of alternative water sources (FDEP 2015).

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2

Demand Estimates and Projections

This chapter summarizes the water demand estimates and projections for the Lower East Coast (LEC) Planning Area of the South Florida Water Management District (SFWMD or District) through the planning horizon (2016 to 2040). Estimates and projections are presented by water use category and were developed in coordination with various stakeholder groups, including agriculture, utilities, industry, local governments, and other interested groups. A detailed discussion of data collection and analysis methods is provided in **Appendix B**.

TOPICS

- Water Demand
- Water Use Categories
- Population Estimates and Projections
- Public Water Supply
- Domestic and Small Public Supply
- Agricultural Irrigation
- Recreational/Landscape Irrigation
- Industrial/Commercial/ Institutional
- Power Generation
- Summary of Demand Estimates and Projections
- Demand Projections in Perspective

The most recent set of water demand estimates and projections for the LEC Planning Area was published in the *2013 Lower East Coast Water Supply Plan Update* (2013 LEC Plan Update; SFWMD 2013). Since that update, the regional economy has expanded, continuing recovery from the 2008-2012 economic downturn. Real estate markets within the LEC Planning Area are ranked among the most attractive in the United States (Price Waterhouse Coopers and the Urban Land Institute 2017), and the Miami-Fort Lauderdale-West Palm Beach metropolitan area had the nation's seventh largest increase in resident population between 2010 and 2016 (United States Census Bureau 2016). This pace of population growth and economic expansion is projected to continue through 2040, placing greater demands on regional water resources. According to estimates from the University of Florida's Bureau of Economic and Business Research (BEBR), the permanent population in the LEC Planning Area is expected to increase by more than 1.5 million people by 2040 (Rayer and Wang 2017).

Current and future water demands in the LEC Planning Area are heavily influenced by existing and projected population. Population growth will lead to increases in water demands for public water supply, landscape irrigation, power generation, and mining operations in the region. Demands associated with irrigated agriculture in the LEC Planning Area are anticipated to decrease due to conversion of farm land to residential developments and environmental restoration projects.

WATER DEMAND

Water demands can be described and analyzed in two ways: gross demand and net demand. Gross demand is the volume of water withdrawn or diverted from a groundwater or surface water source. This definition serves as the basis for water allocations established through water use permits issued by the SFWMD. Net demand refers to the volume of water delivered to end users after accounting for treatment losses and delivery system inefficiencies. For Public Water Supply (PWS) and Domestic and Small Public Supply (DSS), demands commonly are referred to as raw and finished demands rather than gross and net demands.

This *2018 Lower East Coast Water Supply Plan Update* (2018 LEC Plan Update) presents demands for average rainfall and 1-in-10 year drought conditions (**Appendix B**). Section 373.709, Florida Statutes (F.S.), states the level-of-certainty planning goal associated with identifying water demands contained in water supply plans shall be based on meeting demands during 1-in-10 year drought conditions. Although not quantified in this plan, environmental demands are addressed through resource protection criteria (**Chapter 4**).

INFO

Average Rainfall and 1-in-10 Year Drought

An **average rainfall year** is defined as a year having rainfall with a 50 percent probability of being exceeded in any other year.

A **1-in-10 year drought** is defined as a year in which below normal rainfall occurs with a 90 percent probability of being exceeded in any other year. It has an expected return frequency of once in 10 years.

WATER USE CATEGORIES

Water demands for this 2018 LEC Plan Update are estimated in 5-year increments for the following six water use categories established by the Florida Department of Environmental Protection (FDEP) in coordination with the state's water management districts:

- **Public Water Supply (PWS)** – Potable water supplied by water treatment plants with average gross (raw) pumpage of 0.10 million gallons per day (mgd) or greater.
- **Domestic and Small Public Supply (DSS)** – Potable water used by households served by small utilities (less than 0.10 mgd) or self-supplied by private wells.
- **Agricultural Irrigation (AGR)** – Self-supplied water used for commercial crop irrigation, greenhouses, nurseries, livestock watering, pasture, and aquaculture.
- **Recreational/Landscape Irrigation (REC)** – Self-supplied and reclaimed water used to irrigate golf courses, sports fields, parks, cemeteries, and large common areas such as land managed by homeowners' associations and commercial developments.
- **Industrial/Commercial/Institutional (ICI)** – Self-supplied water associated with the production of goods or provision of services by industrial, commercial, or institutional establishments.
- **Power Generation (PWR)** – Self-supplied and reclaimed water used for cooling, potable, and process water by power generation facilities.

Figure 2-1 compares estimated (2016) and projected (2040) average gross water demands, by category, in the LEC Planning Area. The largest water use category is PWS, followed by AGR. PWS demands reflect the regional population growth over the planning horizon, while AGR demands decrease primarily due to conversion of agricultural land to other uses.

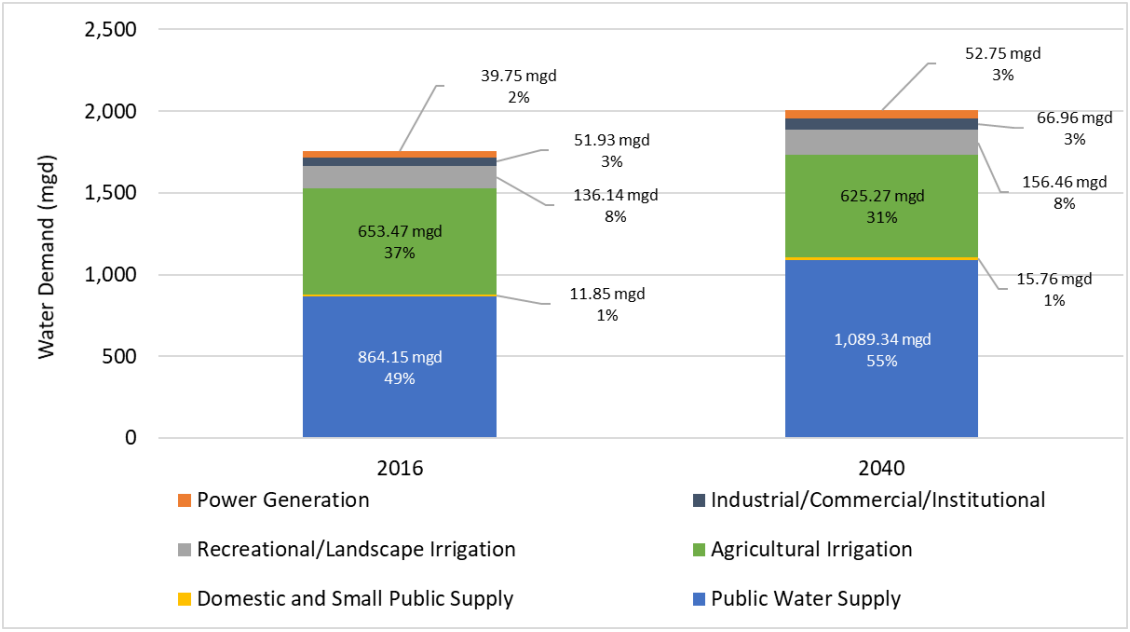

Figure 2-1. Estimated (2016) and projected (2040) gross water demands by use category for the LEC Planning Area.

POPULATION ESTIMATES AND PROJECTIONS

> **NOTE**
>
> All population estimates and projections are for permanent residents, as defined by the United States Census. However, the per capita use rate, which is used to calculate water demands, reflects use by seasonal residents as well.

Population estimates and projections for the LEC Planning Area were used to develop demands for all six water use categories. While BEBR provides population estimates and projections at the county level, water supply planning requires projections at the sub-county level to delineate domestic self-supply and utility service areas for DSS and PWS demands. SFWMD staff determined the current (2016) and likely future (2040) service areas of the PWS utilities in collaboration with utility staff. Detailed sub-county population projections from county planning departments then were assigned to utility service areas and DSS areas. In some cases, modifications were made to service area populations based on information from local land use planning maps and local government Comprehensive Plans (**Appendix A**). Once service area populations were determined, additional adjustments were made so the total county populations for any given year matched the latest set of county population projections from BEBR (Rayer and Wang 2017), in accordance with Section 373.709, F.S. Draft results were provided to PWS utilities to ensure accuracy and obtain agreement with final 2040 population projections for the plan update. **Appendix B** provides further details on the development of population estimates and projections.

Population Estimate and Projection Results

In 2016, the total estimated population within the LEC Planning Area was approximately 6.03 million permanent residents (**Table 2-1**). Medium estimates from BEBR indicate the LEC Planning Area population will increase to approximately 7.57 million permanent residents in 2040. More than half of this growth is expected to occur in Miami-Dade County, the most populous county in Florida. Detailed population projections for PWS utilities and county DSS areas are provided in **Appendix B**.

Table 2-1. Permanent resident population served by PWS and DSS in the LEC Planning Area in 2016 and 2040.

County	2016 Population			2040 Projected Population		
	PWS	DSS	**Total**	PWS	DSS	**Total**
Palm Beach	1,323,103	68,636	**1,391,739**	1,663,936	71,165	**1,735,101**
Broward	1,844,174	10,340	**1,854,514**	2,232,397	5,502	**2,237,899**
Miami-Dade	2,679,429	21,365	**2,700,794**	3,463,865	51,935	**3,515,800**
Monroe	76,047	0	**76,047**	77,100	0	**77,100**
Hendry*	529	3,567	**4,096**	556	3,895	**4,451**
LEC Planning Area Total	**5,923,282**	**103,908**	**6,027,190**	**7,437,854**	**132,497**	**7,570,351**

DSS = Domestic and Small Public Supply; LEC = Lower East Coast; PWS = Public Water Supply.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

PUBLIC WATER SUPPLY

The PWS category includes potable water supplied by water treatment plants with average gross (raw) pumpage of 0.10 mgd or greater. Developing PWS demand projections in the LEC Planning Area was a multistep process that included determining utility service area and DSS populations, calculating per capita use rates, and projecting future water needs.

NOTE

Perceived discrepancies in table totals are due to rounding.

Per Capita Use Rates

A net (finished) water per capita use rate (PCUR) was developed for each PWS utility using 2016 population and finished water data, as reported to the FDEP. The PCUR for each utility is a 5-year (2012 through 2016) average, calculated by dividing annual net (finished) water volumes by the corresponding service area populations for each year. For PWS demand projections, PCURs were assumed to remain constant through 2040. To calculate gross (raw) demands, the treatment efficiency for each utility, based on treatment process type(s) expected in 2040, was applied as a raw-to-finished ratio. Any demand reductions due to historical conservation practices are implicitly factored into the projections by using the 5-year average PCUR. Future water conservation savings were not factored into the demand projections used in this plan update due to water savings uncertainties. Water conservation is discussed in **Chapter 3** as a strategy to reduce demands, and utility-specific water conservation projects completed since the 2013 LEC Plan Update are identified in **Chapter 8**.

PWS service area and water treatment plant maps are provided in **Appendix B**. Utility profiles containing population and finished water use data and projections, permitted allocations, and proposed water supply projects are provided in **Appendix E**.

PWS Demand Estimates and Projections

Tables 2-2 and **2-3** present PWS gross (raw) and net (finished) water demands, respectively, in 5-year increments by county. The results indicate PWS gross (raw) water demands will increase 26 percent, from 864.15 mgd in 2016 to 1,089.34 mgd in 2040 under average rainfall conditions. Calculation of 1-in-10 year demand is based only on the outdoor portion of PWS use, and the methodology is explained in **Appendix B**.

Table 2-2. PWS gross (raw) water demands in the LEC Planning Area, by county.

County	Demand - Average Rainfall Conditions (mgd)						2040 1-in-10 Year Demand
	2016	2020	2025	2030	2035	2040	
Palm Beach	240.03	252.24	265.99	277.09	286.85	295.74	325.31
Broward	234.17	246.19	259.99	271.37	281.00	291.15	320.26
Miami-Dade	371.56	397.52	421.28	442.90	462.17	483.80	517.67
Monroe	18.27	18.31	18.38	18.47	18.55	18.52	19.08
Hendry*	0.13	0.13	0.13	0.13	0.13	0.13	0.14
LEC Planning Area PWS Total	**864.15**	**914.38**	**965.76**	**1,009.96**	**1,048.69**	**1,089.34**	**1,182.45**

LEC = Lower East Coast; mgd = million gallons per day; PWS = Public Water Supply.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

Table 2-3. PWS net (finished) water demands in the LEC Planning Area, by county.

County	Demand - Average Rainfall Conditions (mgd)						2040 1-in-10 Year Demand
	2016	2020	2025	2030	2035	2040	
Palm Beach	214.10	225.08	237.54	247.57	256.40	264.44	290.88
Broward	214.69	225.74	238.40	248.86	257.70	265.40	291.94
Miami-Dade	356.14	381.05	403.83	424.56	443.04	459.88	492.07
Monroe	17.57	17.60	17.67	17.76	17.83	17.81	18.34
Hendry*	0.12	0.12	0.12	0.13	0.13	0.13	0.14
LEC Planning Area PWS Total	**802.62**	**849.59**	**897.57**	**938.88**	**975.10**	**1,007.66**	**1,093.38**

LEC = Lower East Coast; mgd = million gallons per day; PWS = Public Water Supply.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

DOMESTIC AND SMALL PUBLIC SUPPLY

The DSS category includes potable water used by households that are served by small utilities with water withdrawals less than 0.10 mgd or that are self-supplied by private wells. Permanent resident populations within DSS areas were developed simultaneously with the PWS population estimates and projections. All permanent residents outside of PWS utility service area boundaries were considered DSS population. Population projection methodology and results are provided in the previous section and further described in **Appendix B**. County PCURs for DSS were established using the median use rates for PWS

populations within each county. Median PWS PCURs were determined to be more representative of DSS use rates because higher use rates in coastal areas affected by seasonal tourism were removed. Demands associated with current and future DSS populations were calculated by multiplying DSS county PCURs by estimated and projected populations. PCURs were assumed to remain constant over the planning horizon.

Table 2-4 contains the LEC Planning Area's DSS demand estimates and projections under average rainfall conditions. The average gross (raw) demands in 2016 were 11.85 mgd for 103,908 permanent residents (**Table 2-1**). DSS demands are expected to increase 33 percent, to 15.76 mgd in 2040 for 132,497 residents.

Table 2-4. DSS gross (raw) water demands in the LEC Planning Area, by county.

County	Demand - Average Rainfall Conditions (mgd)						2040 1-in-10 Year Demand
	2016	2020	2025	2030	2035	2040	
Palm Beach	7.62	7.76	7.88	7.91	7.92	7.90	8.69
Broward	1.01	0.95	0.85	0.75	0.65	0.54	0.59
Miami-Dade	2.84	3.55	4.43	5.29	6.11	6.91	7.39
Monroe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hendry*	0.38	0.39	0.40	0.40	0.41	0.41	0.44
LEC Planning Area DSS Total	**11.85**	**12.64**	**13.56**	**14.36**	**15.08**	**15.76**	**17.11**

DSS = Domestic and Small Public Supply; LEC = Lower East Coast; mgd = million gallons per day.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

AGRICULTURAL IRRIGATION

The AGR category includes self-supplied water used for commercial crop irrigation, nurseries, greenhouses, livestock watering, pasture, and aquaculture. AGR is the second largest water use category in the LEC Planning Area, accounting for 653.47 mgd (37 percent) of the region's total estimated water demand in 2016. Agricultural production in the LEC Planning Area is of regional and national significance, with more than 580,000 acres under irrigation (**Figure 2-2**). The following statistics further describe the size and importance of the agricultural sector in LEC Planning Area:

- According to the most recent United States Census of Agriculture (United States Department of Agriculture 2014), the value of harvests from Palm Beach, Miami-Dade, and Hendry counties ranked first, second, and third, respectively, in Florida.
- The value of all agricultural commodities produced in the LEC Planning Area was approximately $1.8 billion in 2012 (United States Department of Agriculture 2014).
- Approximately 41 percent of the sugarcane in the United States is grown in the LEC Planning Area (Florida Department of Agriculture and Consumer Services [FDACS] 2017; United States Department of Agriculture – National Agricultural Statistics Service 2017).
- The nursery and ornamental plant industry within the LEC Planning Area is the largest in the state and second largest in the country.

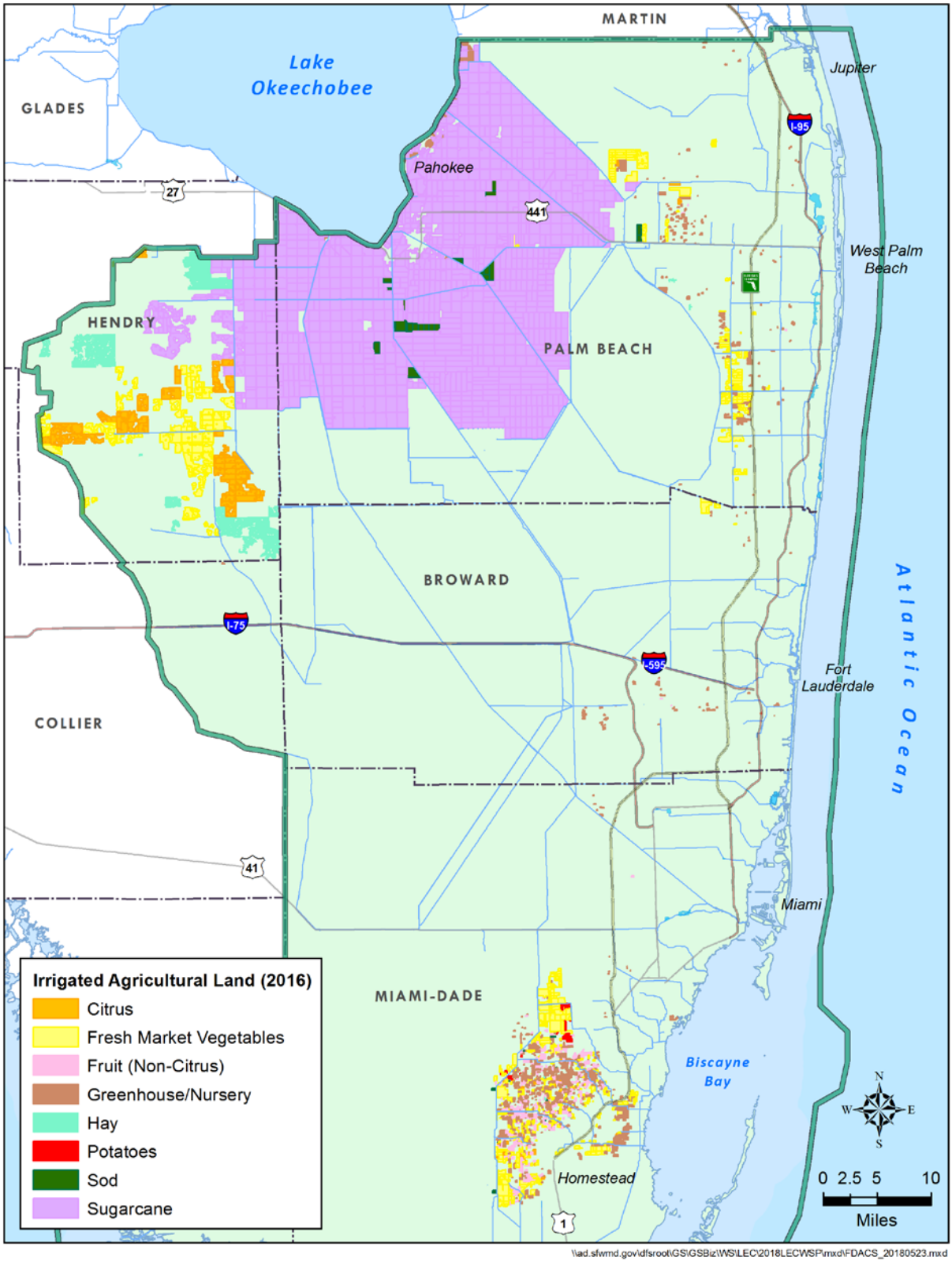

Figure 2-2. Agricultural irrigated land in the LEC Planning Area (Data from: FDACS 2017).

Agricultural acreage data published by FDACS (2017) were used to determine water demands for this 2018 LEC Plan Update. Pursuant to Section 373.709(2)(a), F.S., water management districts are required to consider FDACS water demand projections. Any adjustments or deviations from the projections published by FDACS, "…must be fully described, and the original data must be presented along with the adjusted data." A detailed description of the analyses and adjustments is provided in **Appendix B**.

Agricultural water demand was determined using the Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) model (Smajstrla 1990). The FDACS irrigated crop acres, soil types, growing seasons, and irrigation methods were used as input data for the AFSIRS model. AGR demand estimates and projections are based on the commercially grown crop categories in **Table 2-5**, as generally developed by the FDEP and water management districts for use in water supply plans.

Table 2-5. Agricultural irrigated acres and gross water demands (in mgd) in the LEC Planning Area.

Crop	2016			2040		
	Acres	Average Demand	1-in-10 Year Demand	Acres	Average Demand	1-in-10 Year Demand
Sugarcane	460,260	486.62	671.25	444,362	472.75	651.26
Fresh Market Vegetables	50,804	50.58	60.16	39,798	36.22	43.17
Citrus	21,223	22.29	27.05	22,867	23.90	28.97
Hay/Pasture	20,047	23.85	28.55	20,293	24.07	28.80
Greenhouse/Nursery	16,369	44.20	47.80	11,630	30.44	32.68
Fruit (Non-Citrus)	6,048	14.02	15.51	4,873	11.19	12.37
Sod	5,852	10.09	13.28	5,377	8.96	11.91
Potatoes	867	0.85	1.01	690	0.67	0.79
Field Crops	0	0.00	0.00	190	0.19	0.23
Total	**581,470**	**652.50**	**864.61**	**550,080**	**608.39**	**810.18**

LEC = Lower East Coast; mgd = million gallons per day.

Total irrigated acres in the LEC Planning Area are projected to remain relatively stable, falling approximately 5 percent by 2040, primarily due to the loss of agricultural land in coastal Palm Beach and Miami-Dade counties and to the planned construction of the Everglades Agricultural Area (EAA) Reservoir (**Chapter 6**). The EAA Reservoir project will remove more than 18,500 acres of sugarcane from production, accounting for 15.77 mgd of 2016 demand under average rainfall conditions.

INFO ⓘ

Examples of crop categories used in this report include the following:

Fresh Market Vegetables:
- Tomatoes
- Green beans
- Sweet corn
- Peppers
- Melons

Fruits (Non-Citrus):
- Avocados
- Mangos

Sugarcane currently is the dominant crop in the LEC Planning Area, covering more than 460,000 acres (**Table 2-5**). More than 95 percent of the region's sugarcane acreage and water demands are within the EAA, and the remainder is in Hendry County (**Appendix B**). Demands associated with the production of fresh market vegetables, citrus, greenhouse/nursery stock, and sod are much smaller than sugarcane; however, they account for a substantial amount of the remaining AGR demands and are vital industries in terms of economic impact.

Agricultural Land in Homestead

Relatively little change is anticipated in AGR water demands for nearly all crops within the LEC Planning Area. Mirroring the projected changes in irrigated acreage, AGR demands are projected to decrease in Palm Beach and Miami-Dade counties due to conversion of agricultural land to residential and other land uses. By 2040, AGR demands in Miami-Dade County are projected to decrease by approximately 10 percent. The largest change in demands is expected to occur within the EAA by 2025 due to construction of the planned EAA Reservoir.

Overall, total AGR gross water demands under average rainfall conditions in the LEC Planning Area are estimated to decrease approximately 4 percent, from 653.47 mgd in 2016 to 625.27 mgd in 2040 (**Table 2-6**). These totals include demands from livestock and aquaculture in addition to the demands from crop irrigation shown in **Table 2-5.** Combined, livestock and aquaculture demands totaled 1.22 mgd in 2016. The only notable change to livestock and aquaculture demands over the planning horizon is a planned and permitted aquaculture operation in Miami-Dade County, with a projected water demand of 15.99 mgd by 2025.

Table 2-6. AGR gross water demands in the LEC Planning Area, by county.

Area	Demand – Average Rainfall Conditions (mgd)						2040 1-in-10 Year Demand
	2016	2020	2025	2030	2035	2040	
Palm Beach Coastal	28.29	23.48	18.35	12.36	5.82	1.34	1.45
Palm Beach EAA	444.67	444.67	428.90	428.90	428.90	428.90	591.44
Broward	3.26	3.24	3.19	3.17	3.15	3.08	3.51
Miami-Dade	65.43	67.90	77.63	75.84	73.92	71.89	77.51
Hendry EAA*	33.49	33.49	33.49	33.49	33.49	33.49	48.73
Hendry Western Basins*	78.33	80.47	81.93	83.69	85.77	86.56	104.43
LEC Planning Area Total	**653.47**	**653.25**	**643.51**	**637.45**	**631.06**	**625.27**	**827.06**

AGR = Agricultural Irrigation; EAA = Everglades Agricultural Area; LEC = Lower East Coast; mgd = million gallons per day.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

RECREATIONAL/LANDSCAPE IRRIGATION

REC is the third largest water use category in the LEC Planning Area, encompassing irrigation of golf courses and other landscaped areas such as parks, sports fields, and homeowners' association common areas. Demands are calculated only for REC areas with water use permits issued by the SFWMD. Some permitted areas are irrigated with reclaimed water, and reclaimed water demands are presented with groundwater and surface water demands due to its importance in REC areas. All REC demands are calculated using AFSIRS model results and the reclaimed water quantities reported to the FDEP.

There are three types of irrigated landscaped areas outside of those permitted by the SFWMD that are excluded from the REC demands. The first type includes landscaped areas irrigated with potable water provided by PWS utilities. These demands are accounted for under PWS estimates and projections. The second type is irrigated landscaped areas served by individual residential wells permitted by rule [Rule 40E-2.061, F.A.C.] rather than with an individual water use permit. Demands associated with small residential wells are not quantified as part of this 2018 LEC Plan Update due to the lack of water use and acreage data. The third type of irrigated landscaped areas are those served with reclaimed water that do not require a water use permit. This usually occurs where reclaimed water is used directly from a pressurized pipeline or delivered into a lined lake, where there is no mixing with traditional water sources prior to use. Based on FDEP reported water use, reclaimed water is used to irrigate approximately 15,000 acres not associated with a water use permit. While demands for these acres are not reported here, they are part of the discussion of current and future reclaimed supplies (**Chapter 7**).

There are approximately 190 golf courses, covering 34,157 acres, in the LEC Planning Area (**Table 2-7**). Under average rainfall conditions, this land use required an estimated 51.63 mgd in 2016. Palm Beach County has the most golf courses (112) of any county in the United States. Golf has a long history in South Florida, with the first course established prior to the 20th century. Construction of new courses increased from the 1920s through the 1950s (**Figure 2-3**). Rapid expansion of golf courses in the LEC Planning Area continued up to 2008. Since then, the region, like many others, has experienced a halt in new golf course construction. Many golf courses are struggling financially, and there is increasing pressure to convert golf courses to residential developments. The number of golfers in the United States fell by 7.4 percent between 2011 and 2016 (National Golf Federation 2017). Although there are unique aspects of the golf economy in LEC Planning Area that likely will help maintain the region's status as the "Golf Capital of the World," golf course acreage and associated water demands are projected to remain at their current levels through 2040.

Within the REC category, 55,958 permitted acres of land were attributed to landscape irrigation (**Table 2-7**). These landscaped areas are expected to grow at the same rate as the local population through 2040.

Table 2-7. REC acreage and gross water demands (in mgd) in the LEC Planning Area.

Land Use	2016			2040		
	Acres	Average Demand	1-in-10 Year Demand	Acres	Average Demand	1-in-10 Year Demand
Landscape	55,958	84.51	98.71	69,413	104.83	122.44
Golf	34,157	51.63	60.33	34,157	51.63	60.33
LEC Planning Area REC Total	**90,115**	**136.14**	**159.04**	**103,570**	**156.46**	**182.77**

LEC = Lower East Coast; mgd = million gallons per day; REC = Recreational/Landscape Irrigation.

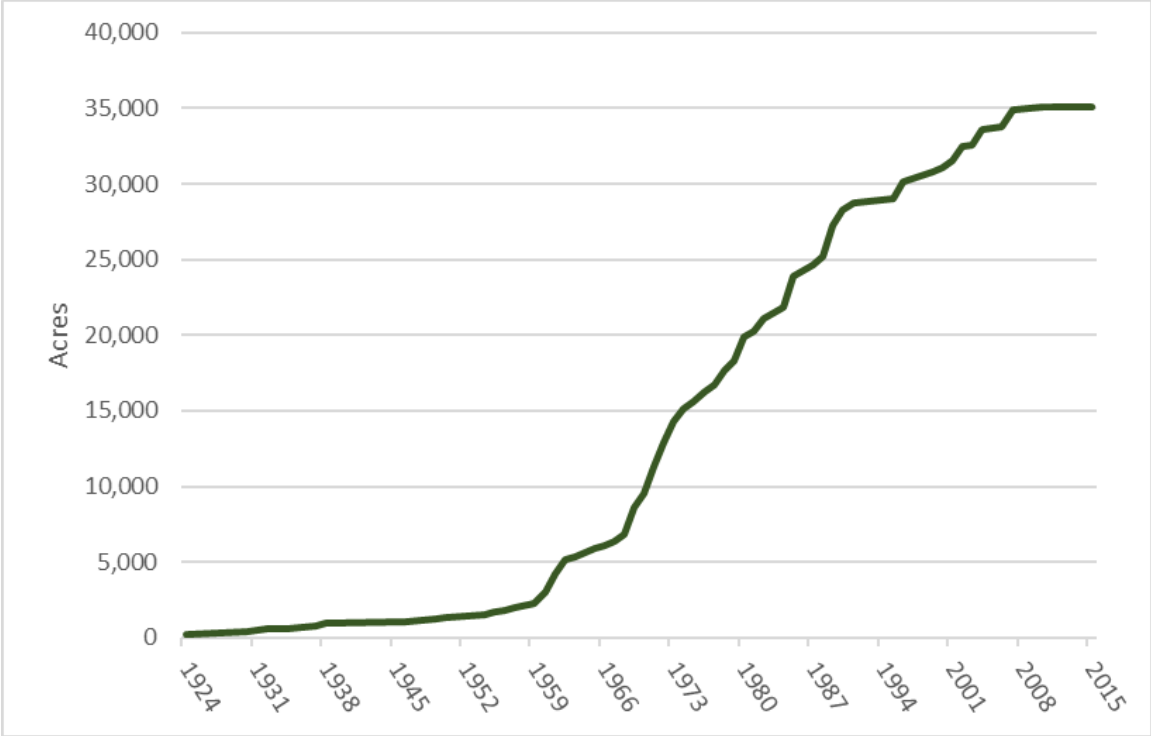

Figure 2-3. Golf course acreage in the LEC Planning Area between 1924 and 2015.

Gross water demands for REC (**Table 2-8**) were calculated by summing demands from the golf sector and the other landscaped areas. Under average rainfall conditions, total estimated REC gross water demands are projected to increase 15 percent, from 136.14 mgd in 2016 to 156.46 mgd in 2040. More than half of REC demands are attributed to Palm Beach County, and the county's majority share is expected to continue through 2040. In 2016, approximately 82 percent (111.77 mgd) of REC demand attributable to golf course irrigation was met with traditional groundwater and surface water sources. The remaining 18 percent (24.37 mgd) was supplied by reclaimed water. The anticipated share of total 2040 REC demands met with reclaimed water (26 percent) is based on the historical relationship between reclaimed supply expansion and population growth in the LEC Planning Area; it does not directly consider the potential impact of Ocean Outfall Law compliance plans. REC demands met with reclaimed water could be much larger if ocean outfall targets are met by 2025 (**Chapter 7**).

Table 2-8. REC gross water demands in the LEC Planning Area by county and source.

County	Source	Demand - Average Rainfall Conditions (mgd)						2040 1-in-10 Year Demand
		2016	2020	2025	2030	2035	2040	
Palm Beach	Groundwater/Surface Water	56.58	55.67	55.31	55.78	56.70	57.93	68.40
	Reclaimed Water	20.79	23.58	26.29	28.17	29.60	30.71	36.27
	Palm Beach County Total	**77.37**	**79.25**	**81.60**	**83.95**	**86.29**	**88.64**	**104.67**
Broward	Groundwater/Surface Water	39.59	39.66	39.42	39.24	39.16	39.17	45.40
	Reclaimed Water	3.35	4.35	5.95	7.48	8.91	10.26	11.89
	Broward County Total	**42.93**	**44.02**	**45.37**	**46.72**	**48.07**	**49.43**	**57.29**
Miami-Dade	Groundwater/Surface Water	15.34	15.77	16.30	16.83	17.37	17.90	20.28
	Reclaimed Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Miami-Dade County Total	**15.34**	**15.77**	**16.30**	**16.83**	**17.37**	**17.90**	**20.28**
Monroe	Groundwater/Surface Water	0.26	0.26	0.26	0.26	0.26	0.26	0.28
	Reclaimed Water	0.23	0.23	0.23	0.23	0.23	0.23	0.25
	Monroe County Total	**0.49**	**0.49**	**0.49**	**0.49**	**0.49**	**0.49**	**0.53**
Hendry*	Groundwater/Surface Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Reclaimed Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hendry County Total	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
LEC Planning Area	**Groundwater/Surface Water**	**111.77**	**111.36**	**111.29**	**112.11**	**113.49**	**115.26**	**134.36**
	Reclaimed Water	**24.37**	**28.16**	**32.47**	**35.88**	**38.74**	**41.20**	**48.41**
	LEC Planning Area Total	**136.14**	**139.53**	**143.76**	**147.99**	**152.23**	**156.46**	**182.77**

LEC = Lower East Coast; mgd = million gallons per day; REC = Recreational/Landscape Irrigation.
* Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL

The ICI water use category includes water demands at industrial and commercial facilities. The largest ICI uses are mining operations and sugar, citrus, and vegetable processing. ICI demands only include self-supplied users and do not include industrial or commercial users that receive water from PWS utilities; those users are included in the PWS category. Recirculated water used in closed-loop geothermal heating and cooling systems is not included in demand calculations. ICI projections assume demands for average rainfall years and 1-in-10 year drought conditions are the same and withdrawal demand is equal to user demand. Therefore, no distinction is made between net and gross water demands.

Estimated ICI demands for 2016 were 51.93 mgd, with modest projected growth resulting in projected ICI demands of 66.96 mgd in 2040 (**Table 2-9**). In the LEC Planning Area, large mining operations account for more than 90 percent of ICI demands. Most mining occurs in the approximately 57,000-acre Lake Belt area of Miami-Dade County, which provides more than half of the limestone resources used in Florida each year (South Florida Regional Planning Council n.d.). Growth within the ICI category is expected to be driven by sand, gravel, and stone mining operations supporting new construction from regional population growth.

Table 2-9. ICI water demands in the LEC Planning Area, by county.

County	Demand - Average Rainfall Conditions (mgd)						2040 1-in-10 Demand
	2016	2020	2025	2030	2035	2040	
Palm Beach	6.59	6.87	7.21	7.56	7.90	8.24	8.24
Broward	2.36	2.44	2.54	2.65	2.75	2.85	2.85
Miami-Dade	42.97	45.12	47.81	50.49	53.18	55.86	55.86
Monroe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hendry*	0.01	0.01	0.01	0.01	0.01	0.01	0.01
LEC Planning Area Total	**51.93**	**54.44**	**57.57**	**60.71**	**63.84**	**66.96**	**66.96**

ICI = Industrial/Commercial/Institutional; LEC = Lower East Coast; mgd = million gallons per day.
* Values listed for Hendry County are only for the areas within the LEC Planning Area boundaries.

POWER GENERATION

Demands under the PWR category include use of groundwater, fresh surface water, or reclaimed water by thermoelectric power generation facilities. PWR demands do not include the use of brackish surface water and cooling water returned to its withdrawal source, or seawater. More information on the development of PWR estimates and projections is provided in **Appendix B**. Demands under average rainfall and 1-in-10 year drought conditions are assumed to be equal for the PWR category, and no distinction is made between net and gross water demands. The reported water use, required as part of each utility's site certification under the Florida Power Plant Siting Act [Sections 403.501 to 403.518, F.S.], was used for baseline PWR demand estimates.

There are 11 thermoelectric power generation facilities with a capacity greater than 60 megawatts currently operating in the LEC Planning Area (**Figure 2-4**). However, only six facilities in Palm Beach and Miami-Dade counties have demands on groundwater, fresh surface water, or reclaimed water sources covered by the PWR category. The FPL Riviera Beach, Port Everglades, and Dania Beach clean energy centers use seawater for cooling purposes. In Palm Beach County, makeup cooling water for Florida Power & Light's (FPL's) West County Energy Center, the Solid Waste Authority's Renewable Energy Park, and the Okeelanta Cogeneration Facility are included in the demand estimates and projections (**Table 2-10**). In Miami-Dade County, FPL's Turkey Point Plant, the Miami-Dade County Resource Recovery Facility, and the G.W. Ivey Power Plant are included in the demand estimates and projections. The total LEC Planning Area PWR demand for 2016 was estimated to be 39.75 mgd.

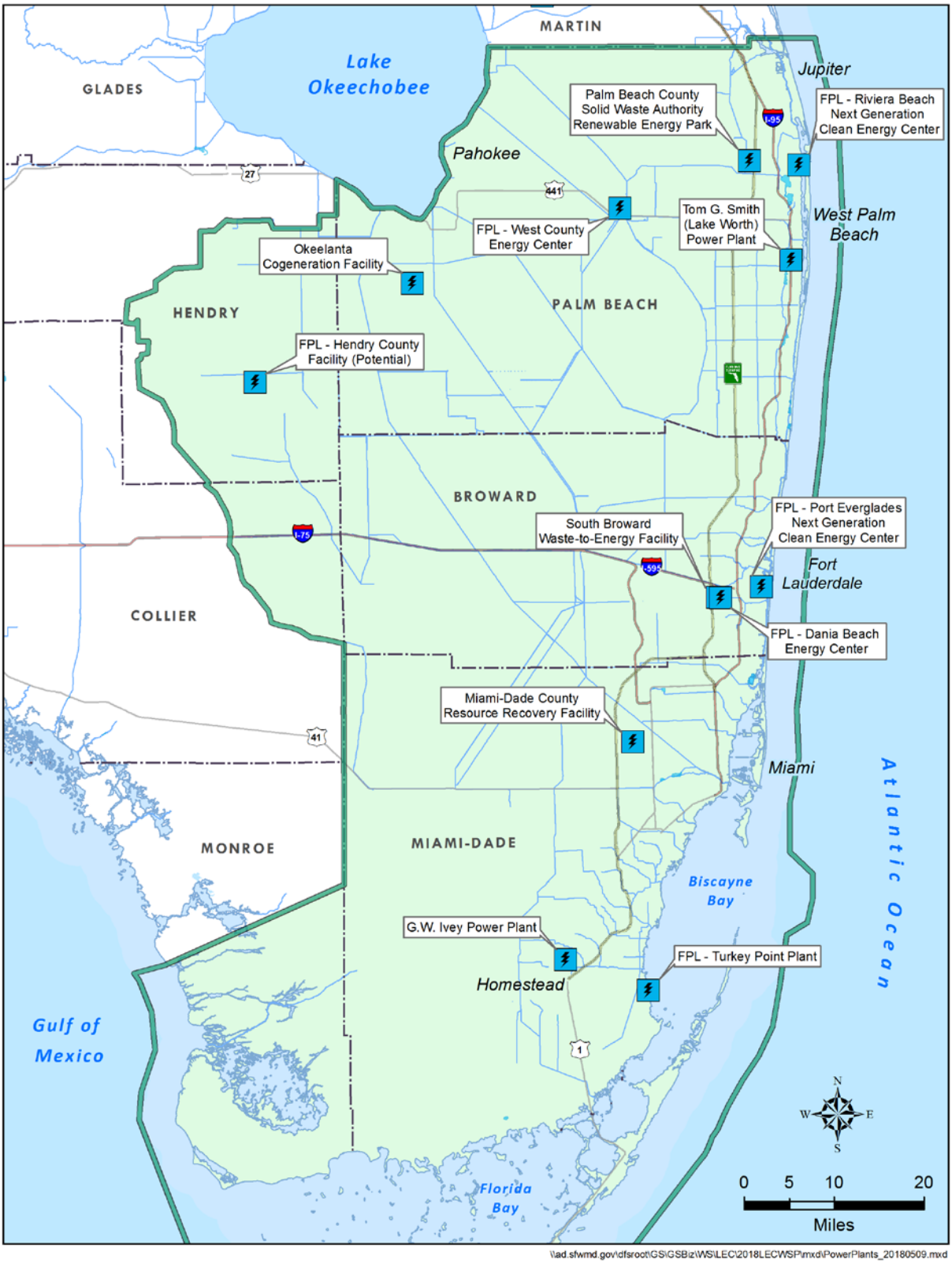

Figure 2-4. Large (60 megawatts or greater) power generation facilities in the LEC Planning Area.

Table 2-10. PWR water demands in the LEC Planning Area, by county and source.

County	Source	Demand - Average Rainfall Conditions (mgd)						2040 1-in-10 Year Demand
		2016	2020	2025	2030	2035	2040	
Palm Beach	Groundwater/Surface Water	2.71	2.71	2.71	2.71	2.71	2.71	2.71
	Reclaimed Water	14.16	14.16	14.16	14.16	14.16	14.16	14.16
	Palm Beach County Total	**16.87**	**16.87**	**16.87**	**16.87**	**16.87**	**16.87**	16.87
Miami-Dade	Groundwater/Surface Water	22.88	22.88	22.88	22.88	22.88	22.88	22.88
	Reclaimed Water[1]	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Miami-Dade County Total	**22.88**	**22.88**	**22.88**	**22.88**	**22.88**	**22.88**	22.88
Hendry[2]	Groundwater/Surface Water	0.00	0.00	0.00	13.00	13.00	13.00	13.00
	Reclaimed Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Hendry County Total	**0.00**	**0.00**	**0.00**	**13.00**	**13.00**	**13.00**	**13.00**
LEC Planning Area	**Groundwater/Surface Water**	**25.59**	**25.59**	**25.59**	**38.59**	**38.59**	**38.59**	38.59
	Reclaimed Water	**14.16**	**14.16**	**14.16**	**14.16**	**14.16**	**14.16**	14.16
	LEC Planning Area Total	**39.75**	**39.75**	**39.75**	**52.75**	**52.75**	**52.75**	**52.75**

PWR = Power Generation; LEC = Lower East Coast; mgd = million gallons per day.

1 Florida Power & Light and Miami-Dade Water and Sewer Department are evaluating future use of reclaimed water at the Turkey Point Plant.

2 Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

The need for additional power supplies is expected to grow as the regional population grows. The PWR demand projections include information from FPL and consider expected load growth and power pool grid contributions within the LEC Planning Area. Additional projected PWR demands are associated with potential development of a large-scale power generation facility in an area of Hendry County currently under agricultural production. The facility could include gas-fired and/or photovoltaic generation as detailed in FPL's (2018) Ten-Year Power Site Plan. Based on information from FPL, 13.00 mgd of process and cooling water are anticipated to be required by 2030 if the gas-fired power generation facility in the northern portion of the proposed site is developed; this likely represents the upper limit of demands for the proposed facility. PWR water demands are projected to increase from 39.75 to 52.75 mgd in 2040.

As noted earlier, the LEC Planning Area's supply of reclaimed water could grow substantially by 2025 due to Ocean Outfall Law compliance targets, which could impact future PWR demands. For example, FPL and Miami-Dade Water and Sewer Department are evaluating the feasibility of building a reclaimed water treatment plant to utilize up to 60 mgd of wastewater for conversion into reclaimed water at the Turkey Point Plant. A previous agreement with FPL for up to 90 mgd of wastewater for conversion into reclaimed water for use as cooling water is under consideration at the time of this plan update. Because these future reclaimed water demands are tentative, they are not reflected in the demand numbers.

SUMMARY OF DEMAND ESTIMATES AND PROJECTIONS

Total gross water demands under average rainfall conditions in the LEC Planning Area are projected to be approximately 2,007 mgd by 2040, a 14 percent increase from 2016 demands (1,757 mgd). **Tables 2-11** and **2-12** provide 5-year incremental summaries of gross demands for all water use categories in the LEC Planning Area under average rainfall and 1-in-10 year drought conditions, respectively. Data for 2015 is included for statewide reporting consistency of water supply plan demands to the FDEP. Average annual estimates are used to demonstrate projected trends, including the following key highlights:

- PWS and DSS average gross (raw) demands are expected to increase to meet the needs of a growing population. More than 7.57 million people are expected to reside in the LEC Planning Area by 2040. PWS demands are projected to increase more than any other water use category by 2040.
- AGR average gross demands are projected to decrease, primarily due to the conversion of more than 31,000 acres of irrigated farm land in Palm Beach and Miami-Dade counties to other uses. AGR will remain the second largest water use category in the LEC Planning Area through 2040.
- REC demands are projected to increase due to expansion of landscaped areas commensurate with population growth. No additional demands from golf course irrigation are expected over the planning horizon.
- ICI demands are projected to grow at a modest rate, reflecting population growth trends.
- PWR demands are projected to increase due to the potential construction of a new FPL thermoelectric power generation facility in Hendry County that would help meet the needs of the region's growing population.

Table 2-11. Summary of gross water demands under average rainfall conditions in the LEC Planning Area, by water use category.

Water Use Category	Demand - Average Rainfall Conditions (mgd)						
	2015	2016	2020	2025	2030	2035	2040
PWS	848.47	864.15	914.38	965.76	1,009.96	1,048.69	1,089.34
DSS	11.72	11.85	12.64	13.56	14.36	15.08	15.76
AGR	653.47	653.47	653.25	643.51	637.45	631.06	625.27
REC	135.11	136.14	139.53	143.76	147.99	152.23	156.46
ICI	51.09	51.93	54.44	57.57	60.71	63.84	66.96
PWR	39.75	39.75	39.75	39.75	52.75	52.75	52.75
Total	**1,739.61**	**1,757.30**	**1,813.99**	**1,863.91**	**1,923.22**	**1,963.65**	**2,006.54**

AGR = Agricultural Irrigation; DSS = Domestic and Small Public Supply; ICI = Industrial/Commercial/Institutional; LEC = Lower East Coast; mgd = million gallons per day; PWR = Power Generation; PWS = Public Water Supply; REC = Recreational/Landscape Irrigation.

Table 2-12. Summary of gross water demands under 1-in-10 year drought conditions in the LEC Planning Area, by water use category.

Water Use Category	Demand - 1-in-10 Year Drought Conditons (mgd)						
	2015	2016	2020	2025	2030	2035	2040
PWS	921.20	938.14	992.61	1,048.41	1,096.37	1,138.40	1,182.45
DSS	12.78	12.94	13.78	14.76	15.62	16.39	17.11
AGR	865.58	865.58	864.70	847.66	840.85	833.67	827.06
REC	157.83	159.04	163.00	167.94	172.88	177.83	182.77
ICI*	51.09	51.93	54.44	57.57	60.71	63.84	66.96
PWR*	39.75	39.75	39.75	39.75	52.75	52.75	52.75
Total	**2,048.23**	**2,067.38**	**2,128.28**	**2,176.09**	**2,239.18**	**2,282.87**	**2,329.11**

AGR = Agricultural Irrigation; DSS = Domestic and Small Public Supply; ICI = Industrial/Commercial/Institutional; LEC = Lower East Coast; mgd = million gallons per day; PWR = Power Generation; PWS = Public Water Supply; REC = Recreational/Landscape Irrigation.

* Demands for PWR and ICI are the same as for average rainfall conditions.

DEMAND PROJECTIONS IN PERSPECTIVE

Demand projections presented in this 2018 LEC Plan Update are based on the best available information. The projections reflect trends, economic circumstances, and industry intentions that will change over time. Like any predictive tool based on past assumptions, there is uncertainty and a margin for error. **Table 2-13** shows the 2030 average gross demands projected in the 2013 LEC Plan Update compared to the 2040 demands projected in this 2018 LEC Plan Update. Although the estimated total demand is for 10 years later, the projection for 2040 in this 2018 LEC Plan Update is only 4 percent more than the estimated 2030 demand projected in the 2013 LEC Plan Update.

Table 2-13. Comparison of gross water demands under average rainfall conditions at the end of the respective planning horizons in the 2013 LEC Plan Update and this 2018 LEC Plan Update.

Water Use Category	2013 LEC Plan Update	2018 LEC Plan Update	Percent Difference
	2030 Demand (mgd)	2040 Demand (mgd)	
PWS	1,007.40	1,089.34	8%
DSS	18.70	15.76	-16%
AGR	663.90	625.27	-6%
REC	152.80	156.46	2%
ICI	56.60	66.96	18%
PWR	33.30	52.75	58%
Total	**1,932.70**	**2,006.54**	**4%**

AGR = Agricultural Irrigation; DSS = Domestic and Small Supply; ICI = Industrial/Commercial/Institutional; LEC = Lower East Coast; mgd = million gallons per day; PWR = Power Generation; PWS = Public Water Supply; REC = Recreational/Landscape Irrigation.

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3

Demand Management: Water Conservation

Demand management is an important aspect of water use and planning, and when used effectively, contributes to the sustainability of water supply resources. A key aspect of successful demand management is strategic planning. This involves understanding the constraints on water use and analyzing how much water is used, when, by whom, for what purpose, and at what level of efficiency. It also includes estimating the potential demand reductions that can occur through improvements to water-using equipment and human behavior as well as developing cost-effective programs. Demand management regularly includes reducing water demands through conservation, but also can involve adjusting the timing of water use (e.g., shifting time of supply to off-peak use through storage, increasing the ability of systems to operate during periods of droughts).

TOPICS

WATER CONSERVATION

Water conservation involves reducing the quantity of water required to meet a demand through efficiency improvements, adjusting the nature of an activity so it can be accomplished with less water, or reducing losses in transmission and distribution. Conservation includes the prevention or reduction of wasteful or unnecessary uses as well as steps to improve the efficiency of necessary uses.

All water sources are finite; therefore, conservation and efficiency measures should be considered, regardless of the source, before more costly development options are implemented. Water conservation can reduce, defer, or eliminate the need for expansion of water supply sources to meet current or future demands, which has the same effect as expanding the existing water supply. Conservation programs often are among the lowest cost solutions to meet future water needs and can reduce costs over the long term if properly planned and implemented.

This chapter describes water conservation opportunities, programs, and strategies available to water users in the Lower East Coast (LEC) Planning Area of the South Florida Water Management District (SFWMD or District). Several of these actions have been implemented by local governments, utilities, and other water users. Existing urban conservation measures and initiatives in the LEC Planning Area include conservation rate structures, indoor fixture replacement programs, outdoor landscaping programs, irrigation ordinances, and public education programs. To estimate potential water savings achievable in the LEC Planning Area by 2040, data were analyzed using conservation best management practices (BMPs) and other methods. Supporting information such as conservation initiatives, measures and programs by user type, and education and outreach materials can be found in the *2016 Water Supply Plan Support Document* (Support Document; SFWMD 2016).

In the LEC Planning Area, urban conservation efforts are reflected in the trends of Public Water Supply (PWS) per capita use rates. The per capita use rate is calculated as PWS finished water demand (in gallons per day) divided by the number of permanent residents in the utility service area. While the per capita use rate is an effective measure of conservation implementation for a single community or utility over time, it is less effective when comparing communities or utilities to each other. Differences between communities, such as the quantity of industrial use, seasonal populations, and other demographic differences, can be substantial and affect the total amount of water used by each community.

Figure 3-1 shows a downward trend in the average PWS per capita use rate in the LEC Planning Area since 2000. This reduction in water use reflects, in part, an emerging water conservation ethic. Utility-driven plumbing retrofit programs, building code standards, public education, and the effects of SFWMD and local government year-round irrigation rules contributed to the reduction in finished water use. External factors that can affect measured per capita use rates and trends include the passive replacement of inefficient water-using devices for efficient ones, declines in the economy, fluctuating population demographics of an area (e.g., persons per household, vacancy rates), local climate, and regional droughts. The SFWMD's objective is to continue this downward trend by working with water users and PWS utilities to achieve long-term water savings.

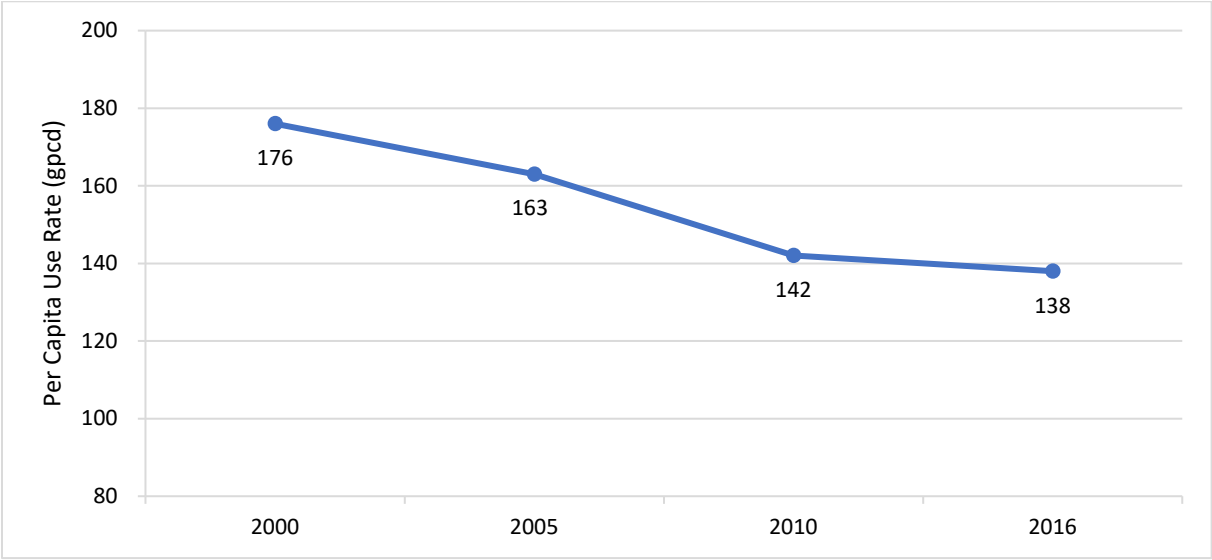

Figure 3-1. Finished Public Water Supply per capita use rate (in gallons per capita per day) in Palm Beach, Broward, Miami-Dade, and Monroe counties within the LEC Planning Area.

COMPREHENSIVE WATER CONSERVATION PROGRAM

In 2008, the SFWMD Governing Board approved the District's Comprehensive Water Conservation Program, which is organized into regulatory, voluntary, and education-based initiatives.

- Regulatory initiatives include establishing a goal-based water conservation plan, adopting local landscape and irrigation ordinances, or requiring utilities to establish rate structures that encourage water conservation. Regulatory tools can lead to substantial water savings by requiring the implementation of conservation practices.
- Voluntary and incentive-based initiatives include financial and technical assistance as well as recognition programs. Rather than relying solely on rules, cooperative partnerships can supplement regulations, build goodwill, leverage investments, and effect wider environmental benefits.
- Education, outreach, and marketing are essential for instilling a lasting conservation ethic throughout the District. Strategies include school-based education programs, public education materials, partnerships with local governments and universities as well as training for local business owners, industry leaders, and elected officials.

Each initiative has its own goals and specific, yet adaptable, implementation strategies. The purpose of the Comprehensive Water Conservation Program is to achieve a measurable reduction in water use by inspiring governments, citizens, and businesses to value and embrace a conservation ethic, and to serve as a model for water conservation. This voluntary program is independent from the consumptive use permitting process. The scope and implementation schedule of the action steps outlined in the program are subject to funding levels and voluntary participation by PWS utilities and other participating water users. The SFWMD's conservation program is more fully described in the *2016 Water Supply Plan Support Document* (SFWMD 2016).

CONSERVATION STRATEGIES

Conservation and water use efficiency programs generally are designed for a specific use or type of user. Fortunately, many conservation initiatives and measures can be implemented by multiple user groups. For example, a computerized irrigation controller can be used to improve irrigation efficiency for residential lawns, agricultural land, and large recreation areas such as public parks and golf courses. It is left to local conservation coordinators to identify target users and decide on the most appropriate initiatives or measures, then craft a program to reach the targeted group.

The following sections contain brief descriptions of conservation opportunities applicable to different water use categories. More information on conservation measures, initiatives, and programs can be found on the SFWMD website (www.sfwmd.gov; Search: Water Conservation).

Public Water Supply

PWS utilities are required to develop and implement an effective water conservation plan to obtain a water use permit from the SFWMD. The regulatory criteria for water conservation plans can be found in Section 2.3.2 of the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (Applicant's Handbook; SFWMD 2015). Water conservation plans can be goal-based plans (composed of water conservation measures selected by the utility) or standard plans (using prescriptive elements found in the Applicant's Handbook). The required elements of a standard plan include a water conservation public education program, outdoor and indoor water use conservation programs, a water conserving rate structure, and a water-loss reduction program (if water losses exceed 10 percent).

PWS conservation professionals have several options available for designing effective PWS demand management (conservation) plans. Many conservation programs feature incentives to replace older, less efficient indoor plumbing fixtures. Programs may also facilitate reducing outdoor water use through irrigation system performance audits or through the dissemination of rain and soil moisture sensors as well as computerized irrigation controllers.

Irrigation System Inspection

The following should be considered when designing an effective PWS water conservation plan:

- Set clear goals for demand management (e.g., reducing peak demand only, overall per capita demand, or both).
- Conduct a full water system audit, including an evaluation of supply sources and existing utility infrastructure.
- Create a demand forecast based on population projections, end-user characteristics, and age of facilities in the service area.
- Identify and select potential water conservation measures that would provide the greatest return on investment.
- Establish an implementation strategy based on available budget, staffing, and desired timeline.

This information will drive the structure of the plan and its components. PWS utilities are strongly encouraged to use a conservation planning tool when creating a water conservation program. Planning tools can help a utility evaluate and compare the costs and benefits of various conservation measures, show projected water savings, and create a goal-based conservation program.

A key component of an effective PWS conservation plan is appropriate water pricing. Water pricing is one of the most effective means by which utilities can influence customer water use behaviors. In the LEC Planning Area, most PWS utilities have implemented an increasing block (also known as "tiered") rate structure, where customers that use more water pay a higher rate (per gallon) than those who use less water. Increasing block rate structures are intended to discourage excessive water use through price controls. By making the water in higher blocks increasingly expensive, residents are encouraged to conserve to avoid buying

water at higher prices. The effectiveness of this type of rate structure depends on how well it is designed. A rate structure that combines reasonable base fees (keeping costs low for the average volume of water required for basic household needs) with substantial increases in volumetric rates for higher use tiers is a valuable tool to motivate customers to conserve. More information about water rates can be found in the SFWMD's *2017 Utility Rate Survey* (SFWMD 2017).

PWS utilities should ensure they have an acceptable method to identify non-revenue water volumes in their water system. Procedures should be put in place to identify and correct apparent water losses (e.g., theft, meter inaccuracies, data handling errors) as well as real water losses (e.g., leaks at mains, storage tanks, or service connections). An active leak detection and repair program is essential to minimize water losses. PWS utilities also should strive to keep raw water treatment losses as low as practical to reduce source water withdrawal volumes.

Domestic and Small Public Supply

All small utilities in the Domestic and Small Public Supply (DSS) category are required to meet the same regulatory conservation requirements described for PWS utilities when applying for water use permits from the SFWMD. All domestic and commercial users must limit landscape irrigation to the hours and days specified in Chapter 40E-24, Florida Administrative Code (F.A.C.; the Mandatory Year-Round Landscape Irrigation Conservation Measures Rule).

Indoor and outdoor water conservation options available to residential PWS users also are applicable to DSS users. Potential strategies include replacing old toilets, fixtures, and water-using appliances with water-efficient models; detecting and repairing household water leaks; and installing smart irrigation devices. Residents also can modify their daily habits to maximize water use efficiency.

Agricultural Irrigation

There are no specific regulatory conservation measures required for Agricultural Irrigation (AGR) users. If supplemental irrigation demands are calculated pursuant to Subsections 2.3.2.A and 2.3.1.C of the Applicant's Handbook (SFWMD 2015), AGR users are presumed to meet water conservation requirements.

The Florida Department of Agriculture and Consumer Services (FDACS) develops and adopts by rule agricultural BMPs to address water quality within the AGR use category. Many of the BMPs also contain an implicit water conservation component. As of December 2017, the LEC Planning Area had a total of 604,065 irrigated and non-irrigated acres enrolled in the FDACS BMP program. Citrus and field crops encompass approximately 83 percent of the enrolled acreage. Cow/calf and equine operations (where water conservation BMPs are less applicable) encompass 14 percent of the enrolled acreage. The remaining 3 percent of acres is used for nursery, fruits/nuts, and mixed-use crops as well as mixed-use BMPs under the Conservation Plan Rule [Chapter 5M-12, F.A.C.]. BMP investment by agricultural operations likely has increased farm and regional efficiency of AGR water use in the LEC Planning Area.

Because the costs associated with moving water affects the profitability of the overall crop, most agricultural operations presumably are as efficient as practical using their existing

irrigation systems and growing methods. Because profit margins may be small and further efficiency changes may be expensive, financial incentives may be necessary to help agricultural operations transition to more efficient systems or methods.

Recreational/Landscape Irrigation

All Recreational/Landscape Irrigation (REC) users are required to meet the regulatory criteria found in Section 2.3.2 of the Applicant's Handbook (SFWMD 2015) in order to receive a water use permit from the SFWMD. In general, the requirements are to use Florida-Friendly Landscaping™ Program principles where applicable, to install and use rain sensors or other methods to override irrigation systems when adequate rainfall has occurred, and to limit irrigation to the hours and days specified in Chapter 40E-24, F.A.C. (the Mandatory Year-Round Landscape Irrigation Conservation Measures Rule).

INFO ⓘ

Florida-Friendly Landscaping™ means using low-maintenance and drought-tolerant plants and environmentally sustainable landscaping practices to conserve water, reduce pollution and erosion, and create wildlife habitat.

Under the REC use category, demand reduction is possible using Florida-Friendly Landscaping™ Program principles (University of Florida 2014), rain or soil moisture sensors, advanced irrigation technology, proper irrigation system design and scheduling, and maintenance of automatic irrigation systems. While not conservation, the demand on potable or groundwater sources for irrigation use can be reduced or eliminated by switching to other supply sources (e.g., reclaimed water, stormwater captured in cisterns or ponds).

Golf Course Water Audit

Golf courses are highly visible users of water in the REC category, with approximately 190 courses currently within the LEC Planning Area. In 2016, the average gross water demand for golf course irrigation was approximately 52 million gallons per day (mgd), with 22 mgd coming from reclaimed water sources. Because they normally employ professional turf managers and receive almost daily inspections, many golf courses are very efficient in their water use. If they have not done so already, golf courses should consider upgrading to weather and soil moisture-based irrigation control technology. Irrigation uniformity can be improved through careful evaluation of sprinkler head design, nozzle selection, head spacing, pipe size, and pressure selection. Florida-Friendly Landscaping™ Program principles should be applied, where feasible. Additionally, Audubon International has an environmental certification program for golf courses (the Cooperative Sanctuary Program for Golf) that combines water conservation and other environmental measures. There currently are 22 golf courses in the LEC Planning Area certified through this program as utilizing water-conserving irrigation practices.

Potential water savings heavily depend on site-specific conditions and pre-existing equipment. A professional water audit is recommended to estimate savings potential for a golf course or other recreational landscape. More information on REC water demand is provided in **Chapter 2**.

Industrial/Commercial/Institutional

In water supply planning, the Industrial/Commercial/Institutional (ICI) category is for users that are self-supplied (rather than receiving water from a PWS utility). However, in terms of water conservation, the BMPs apply to all ICI users, regardless of the water source. Individual applicants for a commercial or industrial water use must submit a water conservation plan pursuant to Section 2.3.2.D of the Applicant's Handbook (SFWMD 2015) to obtain a water use permit from the SFWMD. In general, the plan must contain the results of a facility water audit, an employee awareness and consumer education program, and procedures and time frames for implementation of the plan. Due to the diverse use of water by industrial entities, the development of efficiency programs can be challenging.

A broad approach by a utility or municipality could seek to increase efficiency in water use areas common to most ICI users such as domestic indoor water uses and heating, ventilation, and air conditioning (HVAC) applications. Other BMPs for improving efficiency may only be applicable to certain operations or facility types. Specific examples include autoclaves in hospitals, food steamers in restaurants, and process water use in metal finishing plants. ICI users should explore ways to accomplish desired tasks using the minimum amount of water necessary to meet performance expectations. A thorough, site-specific water use audit is the first step in understanding how a facility uses water and identifying conservation opportunities that will provide the best return on investment. The Support Document (SFWMD 2016) provides further information on ICI water efficiency and self-conducted water audits.

Power Generation

The water use permit requirements for a conservation plan for Power Generation (PWR) facilities are the same as those described in the ICI section. PWR facilities use large quantities of water for cooling, but most of the water is returned to the source from which it was obtained; as a result, there are minimal efficiency gains to be had in the process. Six of the 11 PWR facilities in the LEC Planning Area derive a portion of their cooling water from reclaimed water, brackish groundwater, or saline surface water sources. While minimal, indoor water use at PWR facilities should be optimized using high-efficiency water-using fixtures and equipment. Additional gains may be available using high-efficiency HVAC equipment.

CONSERVATION PROGRAMS

INFO ⓘ

The basic tools for implementing conservation strategies are measures (e.g., hardware, technology, management practices) and incentives (e.g., educational, financial, regulatory), which can be combined to form conservation programs.

Per capita demand reduction in the LEC Planning Area and within individual PWS utility service areas will occur over time as users implement conservation measures in the absence of incentives. These "passive savings" typically are the result of building codes or ordinances mandating the installation of high-efficiency fixtures (e.g., faucets, showerheads, toilets) in new construction and major renovations; the replacement of older, less efficient water-using fixtures, appliances, and equipment with more efficient ones; and public education. However,

relying on passive savings alone would delay or completely ignore notable conservation savings potential. Therefore, many local governments, utilities, and state agencies sponsor water conservation programs. The SFWMD supports many of these programs through financial sponsorship, collaborative partnerships with other governmental and nongovernmental entities, or direct administration. An overview of some of the available programs is provided in the following subsections.

Education, Outreach, and Marketing

Education, outreach, and marketing are essential to accomplish a measurable reduction in water use and instill a lasting conservation ethic in businesses and communities. Cities and utilities are uniquely positioned between the resource and the end users, and therefore should have robust and comprehensive conservation educational campaigns. In addition to local efforts to reach end users, the SFWMD has supported water providers in their efforts to promote, develop, and implement conservation programs. These programs, when combined with conservation measures and initiatives, have yielded substantial water savings, which can be documented and reproduced by others. Some of the programs and activities are as follows:

- School educational programs
- Media campaigns
- Informative billing
- Training staff and associates at facilities and operations that provide irrigation and landscaping materials, services, and supplies
- Florida-Friendly Landscaping™ demonstration gardens
- Workshops and exhibits
- Landscape design and irrigation education for residents and industry professionals
- Irrigation water audits for residential, commercial, and agricultural users
- Indoor water use audits for residential and commercial users
- Retrofit and rebate programs for replacing inefficient water-using devices with efficient ones

As a condition of receiving a water use permit, PWS utilities are required to have a water conservation public education program. The SFWMD will continue working with utilities implementing voluntary conservation initiatives, assisting with goal-based planning design, and, when requested, the use of analysis tools.

Cost-Share Funding Programs

The SFWMD administers a cost-sharing program, formerly known as the Water Savings Incentive Program (WaterSIP), which supports technology and hardware-based conservation projects. In Fiscal Year (FY) 2016, WaterSIP was combined with the District's alternative water supply development and stormwater management cost-share programs under the name Cooperative Funding Program (CFP). Since 2013, WaterSIP and the CFP have funded 39 water conservation projects in the LEC Planning Area (**Chapter 8**). The CFP is accessible to local governments and utilities, homeowners' associations, commercial entities, and agricultural operations for technology and hardware-based conservation programs. Examples of PWS water conservation projects include toilet and bathroom fixture retrofit programs, irrigation system retrofits, automatic line flushing devices, and analytical data

software to increase customer conservation awareness. Examples of agricultural projects include conversion to more efficient irrigation systems, incorporating the use of technology (e.g., weather or soil moisture sensor-based irrigation controllers), and automated pumping systems. Additional information regarding WaterSIP and the CFP can be found on the SFWMD's website (www.sfwmd.gov; Search: Cooperative Funding Program).

Certification and Recognition Programs

Many cities and utilities support programs that recognize end-user conservation efforts such as the Florida Green Building Coalition, the Florida Green Lodging Program, Leadership in Energy and Environmental Design (LEED), and Green Globes. Some of these programs are driven by a single focus while others are holistic. Holistic programs typically include criteria affecting water use, energy efficiency, climate-adaptive landscaping, sustainable building material, site selection, indoor environmental quality, and greenhouse gas emissions. While holistic programs are more comprehensive in overall environmental impact than single-focus programs, meeting criteria in all areas can be difficult and cost prohibitive. Therefore, in addition to advocating holistic programs, the SFWMD oversees two single-focus water efficiency programs: the Water Conservation Hotel and Motel Program (Water CHAMP) and the Florida Water Star℠ program.

Water CHAMP recognizes water efficiency efforts in the lodging industry and provides participating properties with support materials such as linen and towel reuse cards and faucet aerators. To date, the SFWMD has partnered with 5 municipalities and utilities in the LEC Planning Area (West Palm Beach, Boynton Beach, Florida Keys Aqueduct Authority, Delray Beach, and the Broward Water Partnership) to sponsor Water CHAMP at 66 lodging properties, for a total of 5,107 rooms. Since Water CHAMP launched in 2002, water conservation has become an increasingly standard aspect of hotel and motel operations. A recent study by Cornell University (Bruns-Smith et al. 2015) found 91 percent of hotels and motels have a linen and towel reuse program in place. Because of the successful implementation of efficiency practices in this industry, the SFWMD is shifting from active promotion to a maintenance phase of this program. Water CHAMP materials will continue to be provided upon request, as current supplies allow.

Florida Water Star

The Florida Water Star℠ program certifies buildings and associated outdoor spaces that have been designed or retrofitted to high water-efficiency standards. The program offers training for landscape and irrigation professionals to obtain program accreditation. The Florida Water Star℠ program can be implemented at nearly any property to obtain water savings of approximately 40 percent over traditional construction. The program is functionally linked to the Florida Green Lodging program, making it easier for participants to qualify for one program after receiving certification in the other. Home builders in the LEC Planning Area have yet to voluntarily embrace the Florida Water Star℠ program or build to the program standards. Two private residential homes and one multi-family (community) building have been certified in Miami-Dade County and two commercial buildings have been certified in Palm Beach County. One PWS utility in the District (outside of the LEC Planning Area boundaries) has made meeting Florida Water Star℠ standards for new homes a condition of service, resulting in

approximately 4,000 homes constructed to Florida Water Star℠ standards within their service area. Several utilities and municipalities have taken steps to incentivize new construction projects to meet Florida Water Star℠ standards. Rebate and impact fee reduction programs can be found under "Incentives" on the Florida Water Star℠ webpage (www.floridawaterstar.com). Further information about this program is provided on the SFWMD's website (www.sfwmd.gov; Search: Florida Water Star) and in the Support Document (SFWMD 2016).

The Florida-Friendly Landscaping™ Program is implemented by the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS) and the Florida Department of Environmental Protection. The program promotes low-maintenance and drought-tolerant plants, environmentally sustainable landscaping, and high-efficiency irrigation practices through its nine principles, and it recognizes landscapes that have been designed and managed using environmentally friendly techniques. The program is functionally linked to the Florida Water Star℠ program, making it easier for participants to qualify for one program after receiving certification in the other. The SFWMD website provides further information about these District-sponsored and state-supported programs.

Broward County has certified approximately 4,500 sites through its NatureScape Program, which promotes water conservation and sustainable landscape practices by prioritizing the use of native plants that require less water and fertilizer.

Mobile Irrigation Labs

Urban and agricultural mobile irrigation labs (MILs) evaluate the performance of irrigation systems and encourage adoption of efficient irrigation hardware and management practices. They also make recommendations for improvements and provide a water savings estimate for specific actions in accordance with the MIL Technical Handbook (United States Department of Agriculture, Natural Resources Conservation Service and FDACS 2016). There are two urban MILs currently operating in the LEC Planning Area, one operated by Broward County's Environmental Planning and Community Resilience Division and the other operated by Miami-Dade County through Miami-Dade Water and Sewer Department's Water Use Efficiency Program. These local programs are not affiliated with the FDACS MIL network. The programs aim to increase irrigation water use efficiency in parks, government-owned facilities, commercial properties, and multi- and single-family homes. In FY2017, Broward County's MIL (NatureScape Irrigation Service) program provided assessment services to 51 single-family homes and 134 large properties, resulting in a savings of more than 225,000 gallons of water per day. In 2017, Miami-Dade County's Landscape Irrigation Rebate Program provided assessment services to 84 single-family homes and 37 large properties, resulting in a savings of more than 95,000 gallons of water per day.

Two agricultural MILs serve Miami-Dade and Palm Beach counties, operated by the South Dade and Palm Beach Soil and Water Conservation Districts, respectively. From January 2016 to September 2017, these agricultural MILs conducted 340 initial evaluations on participating agricultural properties, covering a total of 1,674 acres. These MILs estimated a potential water savings of 886 million gallons per year if all recommended irrigation improvements were implemented. During the same reporting period, FDACS performed follow-up evaluations of 62 properties and estimated an actual water savings of 250 million gallons per year for those properties, resulting from improvements that were made to the properties following their initial evaluations.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP), implemented through the Natural Resources Conservation Service of the United States Department of Agriculture, provides a voluntary conservation program for farmers and ranchers. EQIP promotes agricultural production and enhanced environmental quality as compatible national goals. Financial and technical assistance is offered to participants to install structures or implement management practices that address impaired water quality and conservation of water resources on eligible agricultural land.

From FY2012 through FY2016, 91 projects with irrigation efficiency benefits were funded by EQIP in the LEC Planning Area. Eighty-three projects were in Palm Beach and Broward counties and included 243 acres of micro-irrigation installation and 2,252 acres of land leveling and smoothing for sugar cane, vegetables, fruit, and ornamental plants. Improved water control structures were installed for an additional 1,212 acres. The remaining eight projects were in Miami-Dade County and included installation of micro-irrigation systems for 56 acres and solid-set sprinklers for 22 acres. The amount of water savings from these projects was not made available. EQIP is expected to continue, although future funding levels are uncertain.

Conservation Program Resources

The following water conservation programs are recognized by the SFWMD to provide services to conservation professionals and others through standards, information, and other resource materials.

- **Alliance for Water Efficiency** – Provides information on water-efficient products and programs, maintains a web-based water conservation resource library, assists conservation professionals with water conservation efforts, and offers use of its Water Conservation Tracking Tool free to members (www.allianceforwaterefficiency.org).
- **EPA WaterSense** – Certifies water-efficient products and provides information on programs and practices that meet stringent water use performance criteria (www.epa.gov/WaterSense).
- **Consortium for Energy Efficiency** – Provides energy-efficient products and services, with water-efficiency crossover benefits (www.cee1.org).
- **ENERGY STAR** – Provides information on energy-efficient practices and certifies energy-efficient products. Program standards now consider water use efficiency for water-using appliances and equipment (www.energystar.gov).
- **Food Service Technology Center** – Industry leader in commercial kitchen energy and water efficiency and appliance performance (www.fishnick.com).

REGIONAL APPROACH TO WATER CONSERVATION

Smaller utilities or other user groups may find it advantageous to create partnerships among themselves to implement water conservation projects or programs. This type of consortium may capitalize on bulk buying and other economy-of-scale benefits by pooling and sharing resources. One such consortium in the LEC Planning Area is the Broward Water Partnership, an affiliation of local governments, including 18 municipalities and water utilities, who have come together to encourage conservation in their communities. The Partnership was initiated in 2011, with the intent to provide regional programming, including rebates and other incentives, for high-efficiency plumbing fixtures and messaging to residential and commercial water users. The Partnership has saved an estimated 1.9 billion gallons of water since the program began. More information on the Partnership can be found at www.conservationpays.com.

As mentioned earlier, Broward County also runs an MIL program through interlocal agreements with 20 cities and utilities in the county. The NatureScape Irrigation Service is funded by Broward County and its 20 partners, conducting nearly 300 evaluations annually while also engaging in educational and outreach activities targeting professional landscape and irrigation staff as well as the public.

REGULATORY INITIATIVES

Regulatory measures are important tools for an effective water conservation program. Regulations or mandates can be used to shift improved practices or devices into mainstream use. When applied at the regional or state level, regulations can simplify working parameters for contractors operating in broader areas.

Conservation-related ordinances that local governments can adopt include those requiring greater water efficiency in construction, such as the International Green Construction Code and standards derived from the Florida Water Star℠ program and Florida Green Building Coalition. Ordinances and codes can be adopted wholly or partially, depending on pre-existing conditions. Regulations, mandates, or ordinances can be adopted statewide, by statute; by local governments, per ordinance; or by water management districts, by rule. In addition, some PWS utilities may be able to require implementation as a condition of service.

The SFWMD's Year-Round Landscape Irrigation Rule [Chapter 40E-24, F.A.C.] allows up to 3 days per week of irrigation. To minimize water loss due to evaporation, the rule states that landscapes can only be irrigated before 10:00 a.m. or after 4:00 p.m. on the designated watering days. Local governments may adopt more stringent alternative landscape irrigation ordinances based on local water demands, system limitations, or resource availability. Broward and Miami-Dade counties and the Town of Lantana have passed more stringent ordinances allowing irrigation up to 2 days per week. Additional information on watering restrictions is provided in the Support Document (SFWMD 2016).

There are regulatory incentives for water conservation by PWS utilities. If a PWS utility can quantify the amount of water savings attributable to water conservation, a permit extension beyond the original expiration date can be granted through a letter request. Further information regarding this regulatory incentive can be found in Subparagraph 2.3.2.F.1.c of the Applicant's Handbook (SFWMD 2015).

POTENTIAL FOR WATER CONSERVATION SAVINGS

Estimates of water conservation potential were created using conservation initiatives and measures for urban and agricultural water users in the LEC Planning Area. The Alliance for Water Efficiency (AWE) Water Conservation Tracking Tool was used to generate estimates for the urban residential use category, and data from the Florida Department of Revenue were used to generate estimates for the urban industrial water use category. The FDACS Florida Statewide Agricultural Irrigation Demand (FSAID) model generated an estimate of the conservation savings for the agricultural category.

Urban

Estimates of urban water conservation potential were made for the PWS (including DSS) and the ICI water use categories. The AWE Water Conservation Tracking Tool evaluates water savings, costs, and benefits of urban water conservation programs. The AWE tool was used to estimate PWS savings for single family and multi-family residential users in the LEC Planning Area. In general, the tool's default savings assumptions for each conservation measure were used, along with the county populations in **Chapter 2**. Water use was based on finished water monthly operating reports for potable water supply systems, as reported to the Florida Department of Environmental Protection. The portions of Collier and Hendry counties within the LEC Planning Area have no PWS utility permits, and DSS conservation demands are insignificant. Residential conservation (demand reduction) estimates (**Table 3-1**) assume approximately 20 percent of pre-1994 homes would be affected by the following measures by 2040:

LAW/CODE

The U.S. Energy Policy Act of 1992 went into effect in 1994 and set a new standard for water-efficient fixtures in new homes.

- Water use surveys for residential users
- High-efficiency toilets
- High-efficiency showerheads
- Lavatory faucets
- High-efficiency washing machines
- Irrigation controllers (single family only)
- Turf replacement (single family only)
- Efficient irrigation nozzles (single family only)

INFO

If 20% of urban users participated in the measures and practices listed above, potable water demands could be reduced by almost 10 gallons per person per day.

Estimates of water use (in mgd) for PWS-supplied and self-supplied ICI users were calculated using Florida Department of Revenue parcel data for all properties in the LEC Planning Area based on a correlated square footage of building space under climate control to water use (Morales et al. 2009). The volume of water from self-supplied properties (i.e., permitted volumes) was subtracted from the total and a countywide 2016 percentage of ICI to total PWS demands was calculated. To project the 2040 ICI sector demand, the 2040 PWS demands were multiplied by the 2016 countywide ICI percentage. Dziegielewski et al. (2000) showed efficiency improvements in the ICI water use category produced water savings of 15 to 50 percent, with 15 to 35 percent

being typical. For the ICI 2040 savings estimate in **Table 3-1**, the 2040 projected ICI demands were multiplied by a 20 percent participation rate and an average savings of 15 percent. Examples of ICI improvement measures include switching from water-cooled to air-cooled devices, automatic shutoff valves, use of combination ovens, facility water audits, high-efficiency ice-making machines, cooling tower and steam boiler efficiency improvements, and other similar measures. The portion of Collier County within the LEC Planning Area has no ICI self-supplied permits, and the LEC portion of Hendry County has only two, neither of which contribute measurable conservation savings.

Table 3-1. Urban water savings potential (in mgd) by 2040 assuming a participation rate of 20 percent.

Use Sector	Broward	Miami-Dade	Monroe	Palm Beach	**LEC Planning Area Total**
Residential[1]	23.5	29.7	1.4	18.2	**72.8**
ICI[2,3]	1.6	2.6	0.1	1.6	**5.9**
Total	**25.1**	**32.3**	**1.5**	**19.8**	**78.7**

DSS = Domestic and Small Public Supply; ICI = Industrial/Commercial/Institutional; mgd = million gallons per day; PWS = Public Water Supply.

1 Includes all PWS and DSS residential users as well as indoor and outdoor water conservation. Collier and Hendry counties have no PWS utility permits and no measurable DSS conservation demands.

2 Includes estimate of ICI users supplied by PWS utilities with indoor water use savings potential only. Does not include the ICI self-supplied use class of mining, which is presumed to have minimal conservation savings potential.

3 Collier County has no ICI self-supplied permits, and Hendry County only has two, neither of which contribute measurable conservation savings.

Agriculture

Agricultural water use is based on several site-specific parameters, including crop type, acreage, soil type, evapotranspiration, and rainfall. Some parameters cannot be modified easily or at all. Conservation savings can be achieved through controllable parameters (e.g., irrigation method, planting method, irrigation management strategy) to increase irrigation efficiency. Because of costs associated with moving water (which affects the profitability of the overall crop), most farmers are as efficient as practical using existing irrigation systems and growing methods. The selection of new systems and management methods depends on crop type, water source, food safety requirements, and water availability. Generally, these changes are expensive and require logistical and economic planning. Financial incentives may be necessary to help farmers transition to more efficient irrigation systems or growing methods. The volume of water that could be conserved for any individual project varies depending on the number and magnitude of the parameters targeted for change.

According to the FSAID IV report, "improved efficiencies in irrigation technology and management practices have slowed the rate of agricultural water use" (FDACS 2017). The report projects a statewide average conservation savings (through efficiency improvements) of approximately 11 percent of 2016 water use by 2040. The methodology for calculating the amount of potential agricultural water conservation is fully described in Appendix E of the FSAID IV report and generally is based on the United States Department of Agriculture (2014) Farm and Ranch Irrigation Survey. The survey data reflect changes in agricultural use of irrigation water from 1978 to 2013, revealing a downward conservation savings trend for improvements made to irrigation systems, scheduling, and sensor-based automation. The

amount of conservation potential savings within the LEC Planning Area was determined using the FSAID Agricultural Acreage and Water Demand Projections (available at https://fdacs-fsaid.com/). Estimated efficiency improvement (i.e., conservation potential) is one of the parameters calculated annually by the FSAID model in 5-year intervals, and the spatially based data are available for water management district planning areas. Acreage in the Everglades Agricultural Area was not included in the 2040 water savings potential estimate because minimal efficiency improvements are believed to exist due to irrigation, water management, and production practices. The 2040 results for the LEC Planning Area represent the amount of total conservation potential that exists through the entire planning horizon (**Table 3-2**). Water savings potential for acreage that will not exist in 2040 are not part of the calculation. The accuracy of the projected conservation savings for a specific water supply region, using this statewide average approach, depends on the region's similarities to the statewide Farm and Ranch Irrigation Survey data (e.g., crop mix, existing irrigation systems, soil types, economic feasibility, financial incentives).

Table 3-2. Agricultural water savings potential (in mgd) in 2040 by crop type.

Crop	Broward	Collier[a]	Hendry[a,b]	Miami-Dade	Palm Beach[b]	**LEC Planning Area Total**
Citrus	NA	NA	2.876	0.090	NA	**2.966**
Field Crops	NA	NA	0.019	NA	NA	**0.019**
Fresh Market Vegetables	0.203	NA	5.274	3.228	0.0002	**8.706**
Fruit (Non-Citrus)	0.004	NA	NA	1.298	0.002	**1.304**
Greenhouse or Nursery	0.181	0.004	NA	2.978	0.128	**3.290**
Hay	NA	NA	2.259	0.001	NA	**2.260**
Potatoes	NA	NA	NA	0.072	NA	**0.072**
Sod	NA	NA	NA	0.021	NA	**0.021**
Sugarcane	NA	NA	5.107	NA	NA	**5.107**
Total	**0.388**	**0.004**	**15.536**	**7.689**	**0.130**	**23.746**

LEC = Lower East Coast; mgd = million gallons per day; NA = no acreage.

[a] Values listed for Hendry and Collier counties are only for the area within the LEC Planning Area boundaries.

[b] Excludes acreage in the Everglades Agricultural Area.

Note: Monroe County has no agricultural acreage.

SUMMARY OF WATER CONSERVATION

Water supply development projects typically involve costly construction of new treatment plants, wells, reservoirs, or other infrastructure. In contrast, water conservation programs that achieve increased water savings through education, rebates, and new technologies often are much less expensive. Therefore, regardless of source, maximizing conservation should be considered before more costly development options are implemented. Analysis suggests that Broward, Miami-Dade, Palm Beach, Hendry, and Monroe counties collectively can save approximately 102 mgd by 2040 if the urban and agricultural conservation options discussed in this chapter are employed (**Table 3-3**). Greater savings may be possible if additional measures are implemented or if greater participation rates are realized.

Table 3-3. Summary of water savings potential (in mgd) through conservation.

Use Sector	Broward	Miami-Dade	Monroe	Hendry[1]	Palm Beach	**Total by Sector**
Urban[2]	25.1	32.3	1.5	0.0	19.8	**78.7**
Agriculture	0.4	7.7	0.0	15.5	0.1	**23.7**
Total by County	**25.5**	**40.0**	**1.5**	**15.5**	**19.9**	**102.4**

mgd = million gallons per day.

1 Values listed for Hendry County are only for the area within the LEC Planning Area boundaries.

2 Includes Public Water Supply, Domestic and Small Public Supply, and Industrial/Commercial/Institutional water use categories.

Note: Collier County had no urban water savings potential and agricultural savings were limited to 0.004 mgd in the nursery category.

To help meet conservation goals, local governments and utilities are encouraged to 1) review the programs and opportunities discussed herein; 2) review the SFWMD's Comprehensive Water Conservation Program; 3) conduct thorough analyses of their service areas; 4) consider using water conservation planning tools; 5) allocate adequate funding for conservation to assist individual users; and 6) consider using conservation to avoid or delay the need for costlier water supply projects in the future. SFWMD staff are available to assist conservation program developers with technical support, collaborative program implementation, ordinance review, and long-term demand management planning. Irrigation (agricultural, golf course, landscape) and ICI users should consider performing audits to detect leaks and identify areas where water use efficiency can be improved. All users are encouraged to take advantage of the applicable strategies and programs detailed in this chapter.

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4

Water Resource Protection

This chapter provides an overview of protections afforded to water resources in the Lower East Coast (LEC) Planning Area of the South Florida Water Management District (SFWMD or District) through statutory and regulatory criteria. The ability to meet water demands described in **Chapter 2** largely depends on the future availability of water resources. Understanding the relationship between projected water demands, water sources, and limitations imposed on withdrawals is critical to water supply planning.

TOPICS

- Regulatory Protection of Water Resources
- Summary of Water Resource Protection

Past analyses indicated that fresh water from the surficial aquifer system and from surface water in Lake Okeechobee and hydraulically connected canals was insufficient to meet the growing needs of the LEC Planning Area during 1-in-10 year drought conditions. Increased use of these water bodies as water sources is limited in much of the region due to potential impacts on wetlands, the saltwater interface, and other existing uses. Previous water supply plans identified a variety of alternative water supply development projects to minimize water resource impacts, avoid competition between water users, and provide a sustainable supply of water through the targeted planning horizon (SFWMD 2000a, 2006, 2013a). Implementation of these projects is ongoing and includes increased water conservation, use of reclaimed water, surface water storage and management, and use of brackish water as a treated water supply. Active water supply development projects are discussed in **Chapter 8**.

NOTE

The MFL and prevention strategy for Lower West Coast aquifers affect a portion of the LEC Planning Area but are included in the *2017 Lower West Coast Water Supply Plan Update* (SFWMD 2017).

Measures adopted by the SFWMD to further protect water resources in the LEC Planning Area include Minimum Flows and Minimum Water Levels (MFLs), Water Reservations, and Restricted Allocation Areas (RAAs). Between 2001 and 2006, MFLs were adopted for Lake Okeechobee, the Everglades, the Northwest Fork of the Loxahatchee River, Florida Bay, the Biscayne aquifer, and the Lower West Coast aquifers. A Water Reservation for the protection of fish and wildlife was adopted for Nearshore Central Biscayne Bay in 2013. RAAs were established for the L-1, L-2, and L-3 Canal System in 1981; the North Palm Beach County/Loxahatchee River Watershed Waterbodies and LEC Everglades Waterbodies in 2007; and the Lake Okeechobee Service Area (LOSA) in 2008.

The interaction between science, policy, and legal tools as well as water supply regulatory programs helps protect water supplies for natural systems. Water use permit applicants must provide reasonable assurances that the proposed water use 1) is reasonable-beneficial, 2) will not interfere with any existing legal use of water, and 3) is consistent with the public interest. This chapter describes water use permitting criteria, MFL criteria, Water Reservations, RAAs, and water shortage plans designed to protect and manage water resources. Water resource development projects that provide additional water and restore or improve water quality are discussed in **Chapter 6**.

REGULATORY PROTECTION OF WATER RESOURCES

The intent of Chapter 373, Florida Statutes (F.S.), is to promote the availability of sufficient water for all existing and future reasonable-beneficial uses and natural systems [Section 373.016(3)(d), F.S.]. The SFWMD developed water resource protection standards consistent with legislative direction that are implemented in phases to prevent various levels of harm (no harm, harm, significant harm, and serious harm). Each standard plays a role in achieving sustainable water resources. For instance, programs regulating water use permitting must prevent harm to the water resource. **Figure 4-1** represents the conceptual relationship among water resource protection standards, associated conditions, and water shortage severity.

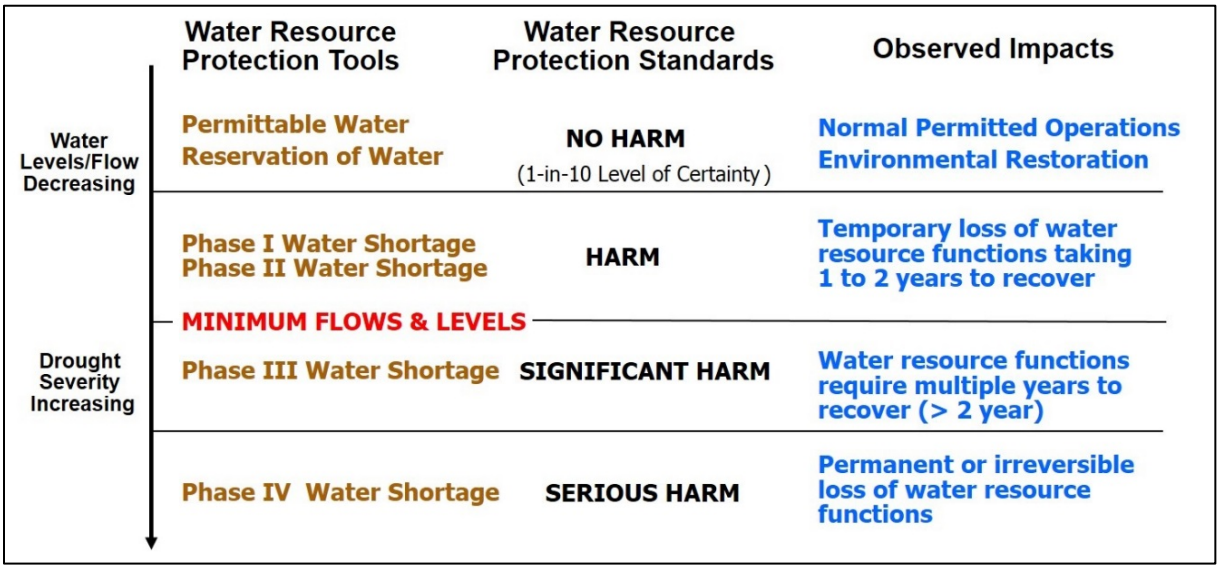

Figure 4-1. Conceptual relationship among water resource protection standards at various levels of water resource harm (Modified from: Rule 40E-8.421, Florida Administrative Code).

Resource Protection Tools	
Water Use Permitting	In most cases, the right to use water is authorized by permit, which allows for the use of water for reasonable-beneficial uses while protecting natural systems from harm. The conditions of permit issuance are more specifically enumerated in Chapter 40E-2, Florida Administrative Code (F.A.C.). To provide reasonable assurances that the conditions of permit issuance are met, applicants must meet the technical criteria in the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (Applicant's Handbook; SFWMD 2015). The following technical criteria are used to evaluate potential impacts from the use and quantity of water proposed in a water use permit application: • Potential for saltwater intrusion • Wetland and other surface water body impacts • Pollution • Impacts to off-site land uses • Interference with existing legal users • Regulatory components of MFLs • Water resource availability
Minimum Flows and Minimum Water Levels (MFLs)	MFL criteria are flows or levels at which the water resources or the ecology of the area would experience significant harm from further withdrawals. If the existing flow or level in a water body is below, or is projected within 20 years to fall below, the applicable MFL established pursuant to Section 373.042, F.S., the SFWMD must expeditiously implement a recovery or prevention strategy [Section 373.0421, F.S.].
Water Reservations	A Water Reservation sets aside a volume of water for the protection of fish and wildlife or public health and safety [Section 373.223, F.S.]. Reserved volumes of water are unavailable for allocation to consumptive uses. Water Reservations can be developed based on existing water availability and/or in consideration of future water supplies made available by water resource development projects. The Water Resources Development Act of 2000 and Section 373.470, F.S., require Comprehensive Everglades Restoration Plan (CERP) projects to have water legally protected by the SFWMD prior to execution of cost-share agreements between the United States Army Corps of Engineers and SFWMD to construct such projects. However, any unreserved volumes of water made available by CERP projects may be certified as available and allocated to consumptive uses.
Water Shortage	Water shortages are declared by the District's Governing Board when available groundwater or surface water is insufficient to meet user needs or when conditions require temporary reductions in total use. The SFWMD's Water Shortage Plans are contained in Chapters 40E-21 and 40E-22, F.A.C. The plans are meant to protect water resources from serious harm; ensure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social, and health related impacts; provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and promote greater security for water use permittees.
Restricted Allocation Areas (RAAs)	RAA criteria are established by rule for specific sources where there are water resource limitations. RAA criteria established for specific sources or areas of the SFWMD are listed in Section 3.2.1 of the Applicant's Handbook (SFWMD 2015), which is incorporated by reference in Rule 40E-2.091, F.A.C.

Changes to Water Use Permitting

The *2000 Lower East Coast Water Supply Plan* (SFWMD 2000a) recommended incorporation of resource protection criteria (i.e., MFLs, Water Reservations, and RAAs), level of certainty, special designations, and permit durations into water use permitting criteria. A series of rulemaking efforts was completed in September 2003, resulting in amendments to various rules, including Chapters 40E-1, 40E-2, 40E-5, 40E-8, and 40E-21, Florida Administrative Code (F.A.C.).

In 2011, the Florida Department of Environmental Protection led a statewide initiative to improve consistency in the water use permitting programs implemented by the state's five water management districts. The initiative resulted in changes to SFWMD water use permitting rules and criteria, which became effective in 2014 and are listed in the Applicant's Handbook (SFWMD 2015). Among the most notable changes were amendments to permit duration, permit renewal, wetland protection, supplemental irrigation requirements, saltwater intrusion, aquifer storage and recovery, and model evaluation criteria.

Additional Protection Afforded Water Resources

The water resource protection criteria contained in the conditions for permit issuance enumerated in Rule 40E-2.301, F.A.C., and the Applicant's Handbook (SFWMD 2015) include three additional mechanisms to protect water supplies: 1) regulatory components of an adopted MFL prevention or recovery strategy, 2) implementation criteria for Water Reservations, and 3) RAA criteria. Water bodies for which these mechanisms have been adopted in the LEC Planning Area are shown in **Figure 4-2**.

In recent years, the SFWMD's priorities have focused on establishing Water Reservation and RAA rules to facilitate construction of Comprehensive Everglades Restoration Plan (CERP) project components. Federal law requires natural system water provided by CERP projects to be reserved or allocated before executing cost-share agreements for project construction. The United States Army Corps of Engineers (USACE) has verified that federal requirements have been met for several CERP projects through SFWMD adoption of Water Reservations and establishment of RAAs. Together, these rules protect water resources across substantial portions of the LEC Planning Area. **Figure 4-3** presents a map of CERP and other restoration projects planned for construction over the next 20 years that provide water supplies supporting MFL, RAA, and Water Reservation water bodies.

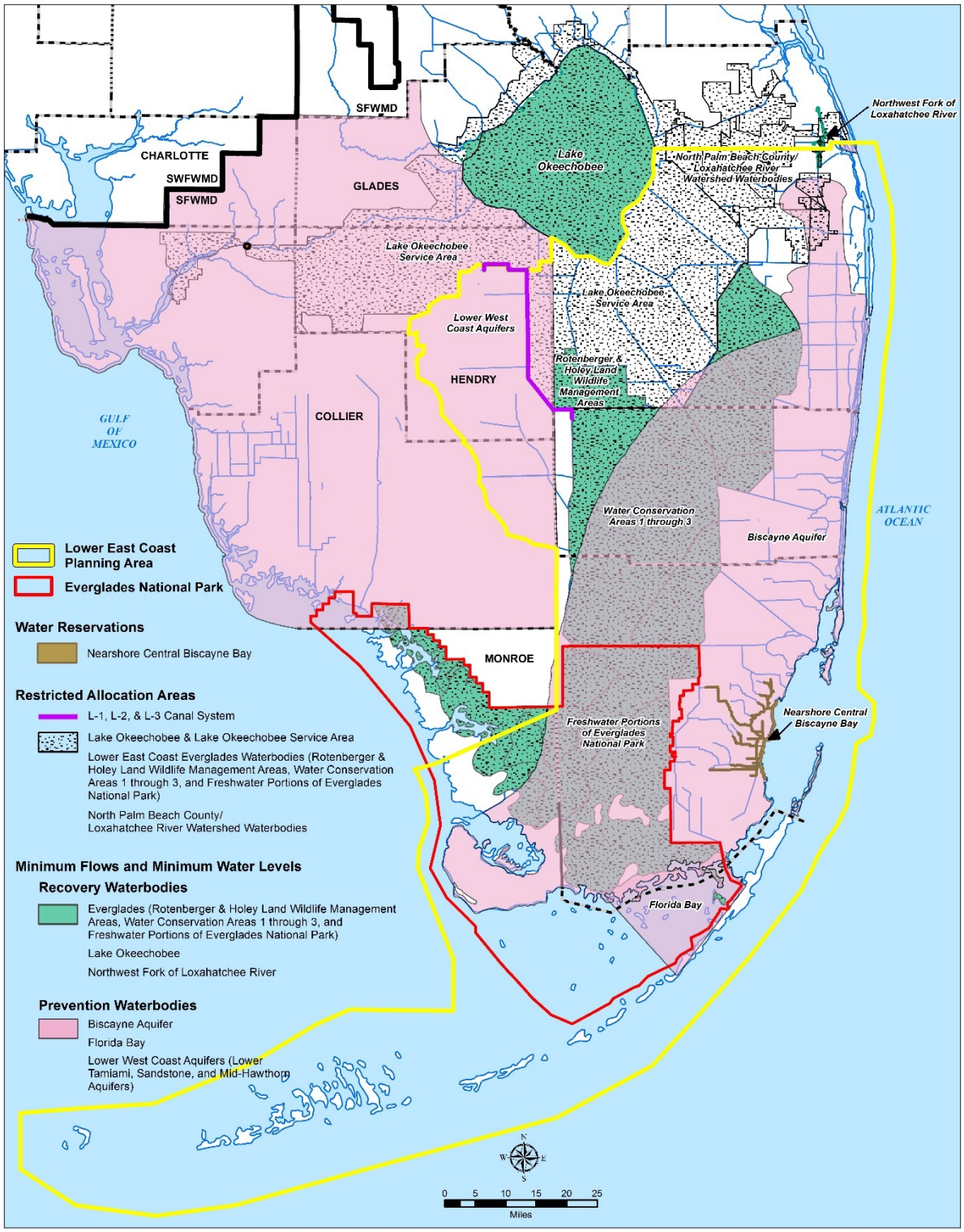

Figure 4-2. Adopted Minimum Flows and Minimum Water Levels, Water Reservations, and Restricted Allocation Areas in the LEC Planning Area.

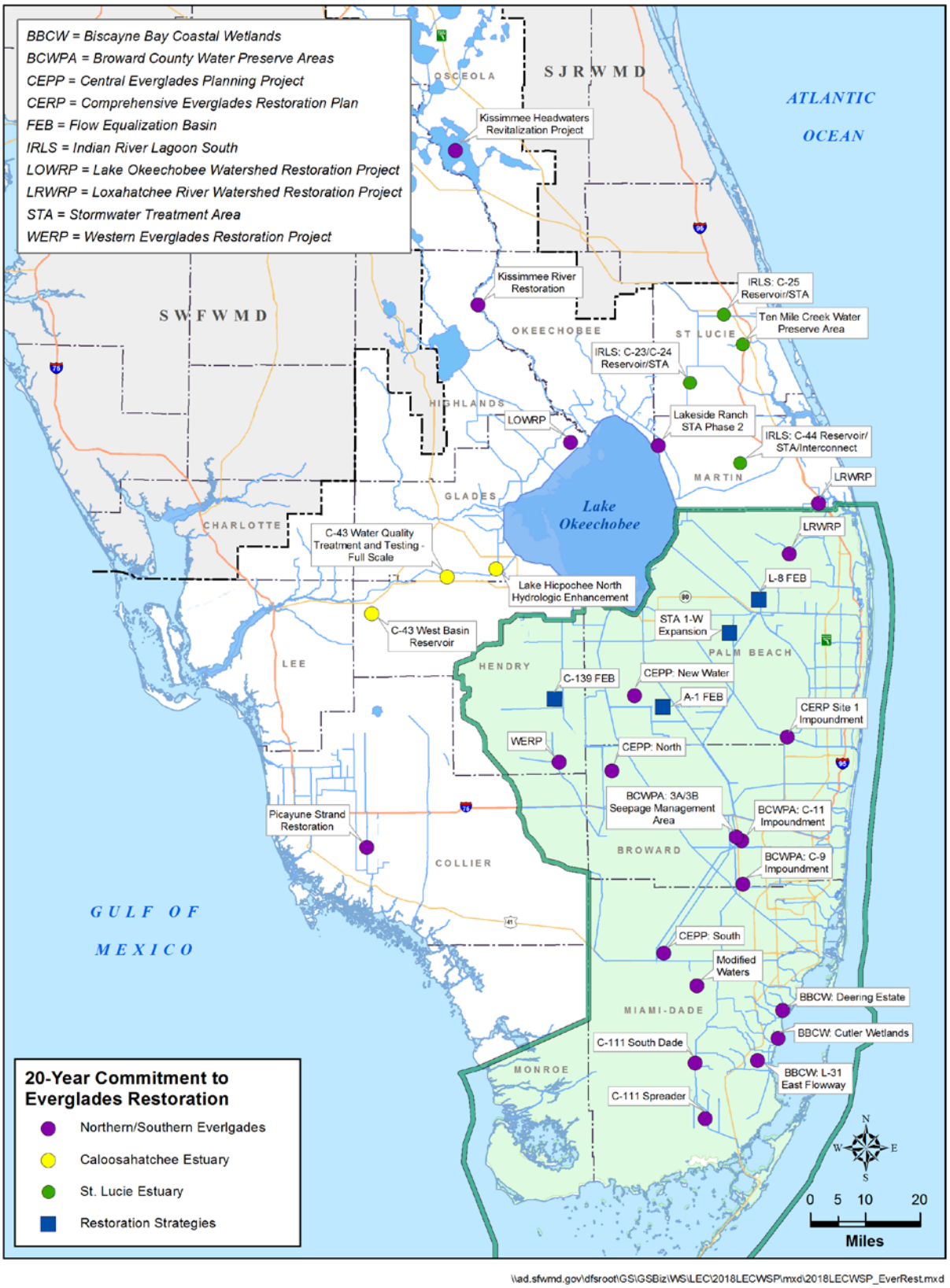

Figure 4-3. Comprehensive Everglades Restoration Plan (CERP) and other restoration projects that support protected water bodies.

Minimum Flows and Minimum Water Levels

MFL criteria are flows or levels at which water resources, or the ecology of the area, would experience significant harm from further withdrawals. Significant harm is defined in Subsection 40E-8.021(31), F.A.C., as the temporary loss of water resource functions, which results from a change in surface water or groundwater hydrology, that takes more than 2 years to recover, but is considered less severe than serious harm. Per Subsection 40E-8.021(17), F.A.C., an MFL exceedance means "to fall below a minimum flow or level… for a duration greater than specified for the MFL water body".

MFL criteria are applied individually to affected water bodies and define the minimum flow or minimum water level for surface water bodies, or minimum water level for groundwater in aquifers. When establishing MFLs, the District Governing Board considers changes and structural alterations to watersheds, surface water bodies, and aquifers as well as the effects such changes or alterations have had and the constraints such changes or alterations have placed on the hydrology of an affected watershed, surface water body, or aquifer [Section 373.0421, F.S.].

The SFWMD continues to fulfill its statutory obligation to identify key water bodies for which MFLs should be developed or re-evaluated. Section 373.042, F.S., requires each water management district to provide an annual priority list and schedule for development of MFLs and Water Reservations to the Florida Department of Environmental Protection. The current priority list and schedule are available in Volume II – Chapter 3 (Edwards 2018) of the *2018 South Florida Environmental Report*. The priority list is based on the importance of the water bodies to the state or region and the existence of, or potential for, significant harm to the water resources or ecology of the state or region and includes water bodies that are experiencing or may reasonably be expected to experience adverse impacts.

Pursuant to Section 373.0421, F.S., recovery strategies [Subsection 40E-8.021(25), F.A.C.] are required to be adopted and implemented for water bodies where MFLs currently are violated. The goal of a recovery strategy is to achieve the established MFL as soon as practicable. Prevention strategies [Subsection 40E-8.021(24), F.A.C.] are required for water bodies where MFLs currently are not violated but are projected to be violated within 20 years of the establishment of the MFL. The goal of a prevention strategy is for the water body to continue to meet the established MFL criteria over the next 20-year planning horizon. The SFWMD also adopts prevention strategies for water bodies that are meeting the MFL at the time of adoption and are expected to meet it in 20 years. The SFWMD develops and adopts recovery or prevention strategies for all priority water bodies simultaneously with MFL rule adoption.

Recovery and prevention strategies must include phasing or a timetable that will allow for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, including development of additional water supplies and implementation of conservation and other efficiency measures consistent with the provisions of Sections 373.0421 and 373.709, F.S. MFL recovery and prevention strategies are implemented in phases with consideration of the SFWMD's missions in managing water resources, including water supply, flood protection, environmental enhancement, and water quality protection, as required by Section 373.016, F.S.

MFLs and recovery and prevention strategies that have been adopted in the LEC Planning Area and included in this plan update are for Lake Okeechobee, the Everglades, the Northwest Fork of the Loxahatchee River, Florida Bay, and the Biscayne aquifer. Recovery strategies have been adopted for Lake Okeechobee, the Everglades, and the Northwest Fork of the Loxahatchee River, and prevention strategies have been adopted for Florida Bay, and the Biscayne aquifer. The Lower West Coast Aquifers MFL and prevention strategy affect a portion of the LEC Planning Area but are discussed in the *2017 Lower West Coast Water Supply Plan Update* (SFWMD 2017).

Lake Okeechobee MFL

Lake Okeechobee is the largest lake in the southeastern United States and a central component of the hydrology and environment of South Florida (**Figure 4-2**; **Appendix C**, Figure C-2). An MFL of 11 feet National Geodetic Vertical Datum of 1929 (NGVD29) was adopted for the lake in 2001 [Subsection 40E-8.221(1), F.A.C.]. A prevention strategy was adopted for the lake simultaneously with MFL adoption, but it was changed in 2008 to a recovery strategy [Subsection 40E-8.421(2), F.A.C.], while maintaining the MFL at 11 feet NGVD29. This change was made in anticipation of lowered lake levels and resulting MFL violations from implementation of the 2008 Lake Okeechobee Regulation Schedule (2008 LORS). The 2008 Amendment to Appendix H of the 2000 LEC Water Supply Plan contains background information on: the regulatory context for Lake Okeechobee's temporary MFL recovery status, the LOSA RAA, and the expectations for the lake's future MFL prevention status (SFWMD 2008).

Everglades MFL

Historically, the Everglades was a system of naturally interconnected sloughs and rivers collectively flowing to the southern coast of Florida. The Everglades has been highly impacted by human-induced alterations in the watershed that have disrupted the natural course of water flow. Extensive efforts are under way as part of CERP to restore more natural flow and movement of water into, within, and from the Everglades and downstream waters. To protect water supplies for the Everglades, an MFL was adopted in 2001 [Subsection 40E-8.221(3), F.A.C.]. The Everglades MFL covers the lands and waters of the water conservation areas (WCAs), Holey Land and Rotenberger wildlife management areas, and freshwater portions of Everglades National Park [Subsection 40E-8.021(7), F.A.C.] (**Figure 4-2**; **Appendix C**, Figure C-2). The MFL criteria for the Everglades are a set of minimum water levels that 1) are based on changes and structural alterations to the pre-drainage conditions of the Everglades that existed at the time of MFL adoption; 2) are specific to the peat- and marl-forming wetlands of the WCAs, Holey Land and Rotenberger wildlife management areas, Shark River Slough, wetlands east and west of Shark River Slough, Rocky Glades, and Taylor Slough; and 3) specify limits on the decline of water levels below ground, under specific conditions and at specific return frequencies, as measured at specific locations in the Everglades (**Appendix C**, Figure C-3). Because the Everglades was not meeting the MFL at the time of adoption, a recovery strategy [Subsection 40E-8.421(2), F.A.C.] was adopted simultaneously with MFL adoption.

Northwest Fork of the Loxahatchee River MFL

Lainhart Dam

The Loxahatchee River is in Martin and Palm Beach counties (**Figure 4-2**; **Appendix C**, Figure C-4), and it flows into the Atlantic Ocean through Jupiter Inlet. The river generally is regarded as the last free-flowing river in southeastern Florida. Approximately 7.6 miles of the river's Northwest Fork were designated as Florida's first Wild and Scenic River in 1985 (United States Fish and Wildlife Service 2018). To protect freshwater flows in the Northwest Fork, an MFL was adopted for it in 2003 [Subsection 40E-8.221(4), F.A.C.]. The MFL criteria are a minimum flow of 35 cubic feet per second over Lainhart Dam and an average daily salinity of less than 2 at river mile 9.2. Because the Northwest Fork was not meeting the MFL at the time of adoption, a recovery strategy [Subsection 40E-8.421(6), F.A.C.] was adopted simultaneously with MFL adoption.

Florida Bay MFL

The Northeast Subregion of Florida Bay ("Florida Bay") [Subsection 40E-021(8), F.A.C.] is at the southern terminus of the state of Florida. It is the southernmost water body in Florida, receiving flow from the Everglades and surface waters farther north (**Figure 4-2**; **Appendix C**, Figure C-2). Wetland and estuarine habitats in Florida Bay support several important species and floral and faunal assemblages. An MFL was adopted in 2006 [Subsection 40E-8.221(5), F.A.C.] for Florida Bay to protect this unique water body and the salinity regimes needed for its flora and fauna. The Florida Bay MFL applies to the bays, basins, and sounds within Taylor Slough and the C-111 Canal basin watersheds, including Long Sound, Little Blackwater Sound, Blackwater Sound, Buttonwood Sound, Joe Bay, Little Madeira Bay, Madeira Bay, Terrapin Bay, Eagle Key Basin, and other open waters of Florida Bay northeast of a boundary line between Terrapin Bay and Plantation Key [Subsection 40E-021(8), F.A.C.] (**Appendix C**, Figure C-6). The MFL is a flow criterion with a salinity performance indicator. It includes a net minimum flow into Florida Bay over a 365-day period of 105,000 acre-feet, which was found through analysis to be needed to maintain a salinity of no greater than 30 at the Taylor River salinity monitoring station. At the time of MFL adoption, Florida Bay was meeting the MFL and no violations were anticipated to occur in the next 20 years. Therefore, a prevention strategy [Subsection 40E-8.421(8), F.A.C.] was adopted for it simultaneously with MFL adoption. The MFL was re-evaluated in 2014 based on several years of additional research. Results of the 2014 re-evaluation indicated the existing MFL criterion was an adequate threshold of significant harm to Florida Bay.

Biscayne Aquifer MFL

The Biscayne aquifer extends beneath Monroe, Miami-Dade, Broward, and Palm Beach counties, over an area of approximately 2.56 million acres (**Appendix C**, Figure C-7). The Biscayne aquifer is composed of limestone, sandstone, and sand. In southern and western Miami-Dade County, the aquifer is primarily limestone and sandstone. However, in northern Miami-Dade County, Broward County, and southern Palm Beach County, the aquifer is primarily sand. Generally, the sand content increases to the north and east (United States Geological Survey 2018). The Biscayne aquifer supplies all, or a large portion, of municipal water supply systems from southern Palm Beach County southward, including the system for the Florida Keys, which is primarily supplied via pipeline from mainland Miami-Dade County.

Due to its widespread use, protecting the Biscayne aquifer from saltwater intrusion is important. An MFL was adopted in 2001 [Subsection 40E-8.231, F.A.C.] for the area shown in **Figure 4-2** and **Appendix C**, Figure C-2, based on analysis of the relationships between groundwater and canal water levels and the potential for saltwater intrusion (SFWMD 2000b). The MFL criterion is the water level in the aquifer that results in movement of the saltwater interface landward to the extent that groundwater quality at an established withdrawal point is insufficient to serve as a water supply source. Maintaining sufficient water levels (stages) in coastal canals is crucial for recharging the aquifer and maintaining the necessary water level in the aquifer to meet the MFL. A prevention strategy [Subsection 40E-8.421(3), F.A.C.] was adopted simultaneously with the MFL adoption. The prevention strategy and the *2000 Lower East Coast Water Supply Plan* (SFWMD 2000a) specify canal stages for meeting the MFL.

More information on the above MFL water bodies is provided in **Appendix C**. Information on all MFLs and recovery and prevention strategies that have been adopted throughout the District can be found in Chapter 40E-8, F.A.C., and on the SFWMD website (www.sfwmd.gov; Search: Minimum Flows and Levels).

Water Reservations

Section 373.709, F.S., requires regional water supply plans to include reservations of water for the planning area, which are defined and adopted by rule. A Water Reservation sets aside a volume of water for the protection of fish and wildlife or public health and safety. Water Reservations can be developed based on existing water availability or in consideration of future water supplies made available by water resource development projects. Reserved volumes of water are unavailable for allocation to consumptive uses [Section 373.223, F.S.]. Water Reservations do not 1) establish operating regimes, 2) drought-proof natural systems, or 3) ensure wildlife proliferation. Additionally, Water Reservations may be used as a recovery or prevention strategy for MFL water bodies.

The Water Resources Development Act of 2000 and Section 373.470, F.S., require that water made available by CERP projects be legally protected by the SFWMD prior to execution of cost-share agreements between the USACE and SFWMD to construct such projects. A Water Reservation is one tool that can be used for this protection. Any water made available by a CERP project in excess of that needed for natural system restoration may be certified as available and allocated to consumptive uses to meet the CERP goal of water made available for other water related uses.

Nearshore Central Biscayne Bay Water Reservation

CERP identifies restoration of Biscayne Bay as an integral step to achieve systemwide benefits in the South Florida ecosystem. Promoting a balanced and healthy salinity regime in Biscayne Bay is essential to maintain the ecological integrity and associated economic benefits of this unique habitat on Florida's southeastern coast. The CERP Biscayne Bay Coastal Wetlands Project – Phase 1 will improve distribution of freshwater flows to southern Biscayne Bay, including Biscayne National Park (**Chapter 6**; SFWMD 2013b). The project will result in healthier coastal wetlands and a more natural overland flow of water that will mimic historical conditions. It also will help re-establish critical low-salinity habitat that is essential for a variety of estuarine plants and animals such as seagrasses, eastern oysters, blue crabs, and spotted sea trout.

The Water Reservation adopted in 2013 for Nearshore Central Biscayne Bay [Subsections 40E-10.061(1) and (2), F.A.C.] protects the water needed for the CERP Biscayne Bay Coastal Wetlands Project – Phase 1. Nearshore Central Biscayne Bay is defined in Subsection 40E-10.021(4), F.A.C., as the area within Biscayne Bay up to 1,640 feet (500 meters) of the shoreline, beginning south of Shoal Point and extending southward to north of Turkey Point (**Figure 4-2**). The Water Reservation reserves from allocation all surface water contained within and flowing into Nearshore Central Biscayne Bay (**Figure 4-4**).

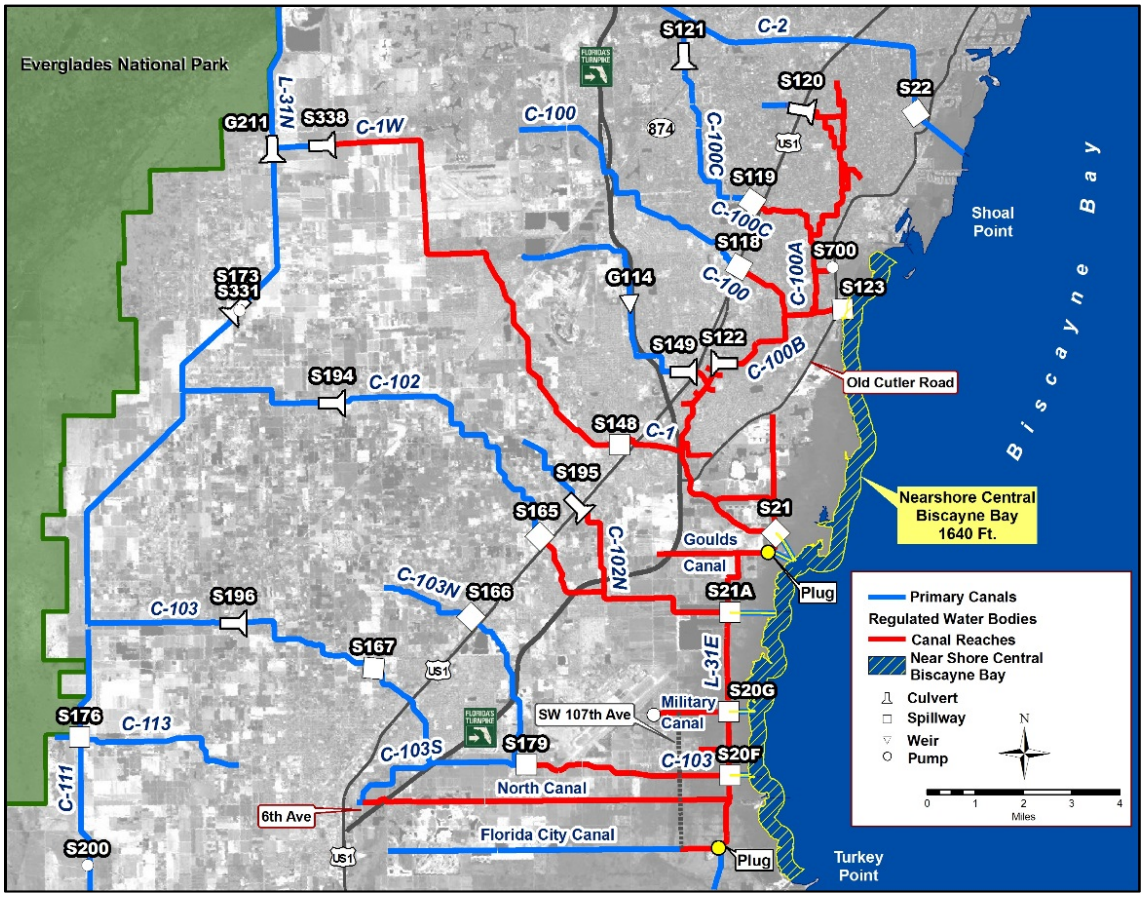

Figure 4-4. Nearshore Central Biscayne Bay reservation water body (includes yellow crosshatching along the coast and red canal reaches extending west).

Long-term success of ecosystem restoration is measured, in part, by the ability of native fish and wildlife to thrive in Biscayne Bay and its coastal habitats. The following key facts were considered during development of the Nearshore Central Biscayne Bay Water Reservation:

- Biscayne Bay is a shallow, subtropical estuary along the coast of Miami-Dade and northeastern Monroe counties. Many rare, threatened, and endangered species live in this ecosystem, including manatees and American crocodiles.
- Major issues affecting Biscayne Bay include altered salinity patterns, reduced water quality, and a lack of freshwater flows to coastal wetlands.
- Phase 1 components of the CERP Biscayne Bay Coastal Wetlands Project include construction of three flow-ways: Deering Estate, Cutler Wetlands, and L-31E (**Chapter 6**).

Further information about the Water Reservations adopted for water bodies in the LEC Planning Area can be found in Chapter 40E-10, F.A.C. and on the SFWMD website (www.sfwmd.gov; Search: Water Reservations).

Restricted Allocation Areas

RAAs are defined geographic areas where water allocations from water resources (e.g., lakes, rivers, wetlands, canals, aquifers) are limited. Additional allocations beyond the established limitation are restricted or prohibited. RAAs are established for a variety of reasons, including 1) where there is a lack of available water to meet the projected needs of a region, 2) to protect water for natural systems and future restoration projects (e.g., CERP), or 3) as part of MFL recovery or prevention strategies. RAA criteria for specific areas of the District are listed in Section 3.2.1 of the Applicant's Handbook (SFWMD 2015), which is incorporated by reference in Rule 40E-2.091, F.A.C. **Figure 4-2** shows the locations of established RAAs wholly or partially within the LEC Planning Area.

North Palm Beach County/Loxahatchee River Watershed Waterbodies RAA

In 2007, an RAA was established for the North Palm Beach County/Loxahatchee River Watershed Waterbodies (Subsection 3.2.1.E of the Applicant's Handbook [SFWMD 2015]; **Figure 4-2**). The RAA includes surface water and groundwater from the Grassy Waters Preserve, Water Catchment Area, Pal Mar property, J.W. Corbett Wildlife Management Area, Loxahatchee Slough, Loxahatchee River, Riverbend Park, Dupuis Reserve, Jonathan Dickinson State Park, Kitching Creek, Moonshine Creek, Cypress Creek, and Hobe Grove Ditch. The RAA also includes the integrated conveyance systems that are hydraulically connected to and receive water from the Waterbodies, such as Central and Southern Florida Flood Control Project (C&SF Project) primary canals and the secondary and tertiary canals that derive water from the primary canals. Net increases in the volume or changes in timing on a monthly basis of direct surface water and indirect groundwater withdrawals from the RAA are prohibited over that resulting from base condition uses permitted as of April 1, 2006. Allocations over the base condition water use are only allowed through sources detailed in Subsection 3.2.1.E.5 of the Applicant's Handbook (SFWMD 2015), such as certified project water, implementation of offsets, alternative water supply, terminated or reduced base condition water use that existed as of April 1, 2006, or available wet season water. The RAA is part of the MFL recovery strategy for the Northwest Fork of the Loxahatchee River.

Lower East Coast Everglades Waterbodies RAA

In 2007, an RAA was established for the Lower East Coast Everglades Waterbodies (Subsection 3.2.1.E of the Applicant's Handbook [SFWMD 2015]; **Figure 4-2**). The RAA covers more than 1.5 million acres and includes WCAs 1, 2A, 2B, 3A, and 3B; the Holey Land and Rotenberger wildlife management areas; and the freshwater portions of Everglades National Park. The RAA also includes the integrated conveyance systems that are hydraulically connected to and receive water from the Waterbodies, such as C&SF Project primary canals and the secondary and tertiary canals that derive water from the primary canals. Net increases in the volume or changes in timing on a monthly basis of direct surface water and indirect groundwater withdrawals from the RAA are prohibited over that resulting from base condition uses permitted as of April 1, 2006. Allocations over the base condition water use are only allowed through sources detailed in Subsection 3.2.1.E.5 of the RAA, such as certified project water, implementation of offsets, alternative water supply, terminated or reduced base condition water use that existed as of April 1, 2006, or available wet season water. The Lower East Coast Everglades Waterbodies RAA is part of the MFL recovery strategy for the Everglades.

Lake Okeechobee Service Area RAA

In October 2008, the District Governing Board adopted RAA criteria for LOSA (Subsection 3.2.1.F of the Applicant's Handbook [SFWMD 2015]; **Figure 4-2**). These criteria limit surface water withdrawals from Lake Okeechobee and all surface water hydraulically connected to the lake. The change in permit criteria was necessitated by the impacts to water supply and increased exceedances of the MFL criteria from implementation of the 2008 LORS, which reduced stages in Lake Okeechobee by approximately 1 foot. The RAA is part of the MFL recovery strategy for Lake Okeechobee, which is described in the 2008 Amendment to Appendix H of the 2000 LEC Water Supply Plan (SFWMD 2008).

The current Integrated Delivery Schedule (USACE 2018) indicates completion of the Herbert Hoover Dike rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019. State funding has been provided to assist the USACE in expediting the rehabilitation schedule. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives. For increases in surface water use other than within LOSA, water availability would have to be determined based on local conditions.

The RAA covers more than 1.8 million acres, including Lake Okeechobee and the integrated conveyance systems that are hydraulically connected to and receive water from Lake Okeechobee such as the C-43 Canal, the C-44 Canal, and secondary canal systems that receive Lake Okeechobee water for water supply purposes via gravity flow or pump. Net increases in the volume of surface water withdrawn from the RAA are prohibited over that resulting from base condition water uses occurring from April 1, 2001 to January 1, 2008. Allocations over the base condition water use are only allowed through sources detailed in Subsection 3.2.1.F.3.c of the Applicant's Handbook (SFWMD 2015), such as certified project water, implementation of offsets, alternative water supply, available and unassigned base condition water use, or base condition water use that was terminated or reduced after January 1, 2008.

L-1, L-2, and L-3 Canal System RAA

In 1981, an RAA was established for the L-1, L-2, and L-3 Canal System (Subsection 3.2.1.C of the Applicant's Handbook [SFWMD 2015]; **Figure 4-2**), which lies along the western boundary of LOSA. This canal system is a limited surface water network that is not connected to Lake Okeechobee. The RAA prohibits increases in surface water pump capacity and additional surface water allocations from the L-1, L-2, and L-3 canals above existing allocations.

Further information about the RAAs established in the LEC Planning Area can be found in the Applicant's Handbook (SFWMD 2015).

Water Shortage Rules

In accordance with Sections 373.175 and 373.246, F.S., water shortages are declared to prevent serious harm from occurring to water resources. Serious harm is defined as the long-term loss of water resource functions resulting from a change in surface water or groundwater hydrology [Subsection 40E-8.021(30), F.A.C.] (**Figure 4-1**).

The water shortage plans laid out in Chapters 40E-21 and 40E-22, F.A.C., are applied to manage water use when insufficient groundwater or surface water is available to meet user needs or when conditions require temporary water use reduction. Chapter 40E-22, F.A.C., contains regional water shortage plans and restrictions related to specific water bodies, including Lake Okeechobee. Further information on water shortage management is available in the *2016 Water Supply Plan Update Support Document* (SFWMD 2016).

SUMMARY OF WATER RESOURCE PROTECTION

- In 2011, the Florida Department of Environmental Protection led a statewide initiative to improve consistency in the water use permitting programs implemented by the state's water management districts. The initiative resulted in changes to SFWMD water use permitting rules and criteria, which became effective in 2014 and are listed in the Applicant's Handbook (SFWMD 2015). Among the most significant changes were amendments to permit duration, terms of permit renewal, wetland protection, supplemental irrigation requirements, saltwater intrusion, aquifer storage and recovery, and model evaluation criteria.
- The MFL criterion and salinity indicator for Florida Bay were re-evaluated in 2014. Results of the re-evaluation indicated the existing MFL criterion is an adequate threshold of significant harm to Florida Bay.
- A Water Reservation rule was adopted in 2013 for Nearshore Central Biscayne Bay. Some aspects of the CERP Biscayne Bay Coastal Wetlands Project – Phase 1, which the Water Reservation supports, have been completed.
- The current Integrated Delivery Schedule (USACE 2018) indicates completion of the Herbert Hoover Dike rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019. State funding has been provided to assist the USACE in expediting the rehabilitation schedule.

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5

Surface Water Resources and Management

TOPICS

- Lake Okeechobee Service Area
- Everglades Protection Area
- Western Basins
- Lower East Coast Service Areas
- Summary of Surface Water Resources and Management

This chapter provides an overview of surface water resources and their management to supply natural systems in the Lower East Coast (LEC) Planning Area, which are integral to water supply planning. In the LEC Planning Area, surface water resources include lakes, rivers, reservoirs, canals, wetlands, and bays. The primary groundwater resources in the region are the surficial and Floridan aquifer systems. Surface water and groundwater resources are interconnected as many surface water bodies recharge aquifers, and both types of resources provide regional water supply. Groundwater and surface water resources in the LEC Planning Area used for urban and agricultural water supply purposes are discussed in **Chapter 7**.

Beyond water supply, surface water and groundwater resources function as flood control and water storage mechanisms and support important cultural and environmental resources. The LEC Planning Area receives approximately three-quarters of its rainfall during the wet season (May through October). Without canals, reservoirs, and aquifer storage and recovery wells to store or discharge excess water, much of South Florida would regularly flood or water would be lost to the ocean. In the LEC Planning Area, the South Florida Water Management District (SFWMD or District) operates a regional network of canals that move water from Lake Okeechobee to the Everglades and ultimately discharge water to bays, lagoons, and estuaries. The SFWMD manages water in the region to maintain water levels for flood protection and water supply, provide sufficient flow to support natural systems, and improve water quality for environmental and human needs.

The Central and Southern Florida Flood Control Project (C&SF Project) was authorized by Congress to provide drainage and flood control, agricultural irrigation, municipal and industrial water supply, fish and wildlife preservation, water supply to and preservation of Everglades National Park, prevention of saltwater intrusion, groundwater recharge, recreation, and navigation. The project was designed and constructed by the United States Army Corps of Engineers (USACE), and the SFWMD serves as the local sponsor. The USACE operates and maintains the St. Lucie (C-44) Canal; C-43 Canal; Herbert Hoover Dike and Lake Okeechobee major spillways; and the main outlets for Water Conservation Areas (WCAs) 1, 2, and 3. The SFWMD operates the remainder of the project in accordance with regulations

prescribed by the USACE. The C&SF Project has evolved over time to address competing water resource objectives and the needs of South Florida water users and the natural environment.

Surface water enters the LEC Planning Area through C&SF Project canals, which are operated under USACE Master Water Control Manuals. At the northern border of the LEC Planning Area, Lake Okeechobee is a central component of the C&SF Project. Through a series of water control structures and canals, water from Lake Okeechobee is transported south through the Everglades Agricultural Area (EAA) and stormwater treatment areas (STAs) to the Everglades Protection Area (WCAs and Everglades National Park). From the WCAs, water enters urbanized coastal basins and flows out of the LEC Planning Area to the ocean through coastal water control structures, many of which were constructed as part of the C&SF Project. For surface water management purposes, the SFWMD divides the LEC Planning Area into four hydrologically related areas (**Figure 5-1**):

INFO

USACE Master Water Control Manuals, including water control plans, guide day-to-day operations of the C&SF Project. There are manuals for three regions in the LEC Planning Area:

- Lake Okeechobee and the EAA
- The WCAs, Everglades National Park, and the Everglades National Park-South Dade Conveyance System
- East Coast Canals

1) Lake Okeechobee Service Area, including the EAA;

2) Everglades Protection Area (encompassing the WCAs) and Everglades National Park, including Florida Bay;

3) Western Basins in eastern Hendry and Collier counties, including the C-139, Feeder Canal, L-28, and L-28 Gap basins; and

4) Lower East Coast Service Areas, spanning the coastal areas of Palm Beach, Broward, and Miami-Dade counties and including the Loxahatchee River and estuary, Lake Worth Lagoon, and Biscayne Bay.

NOTE

Although natural resources such as Florida Bay, Biscayne Bay, and Lake Worth Lagoon are not water supply sources, they are important water bodies to consider because they depend on freshwater inflows to maintain healthy ecosystems.

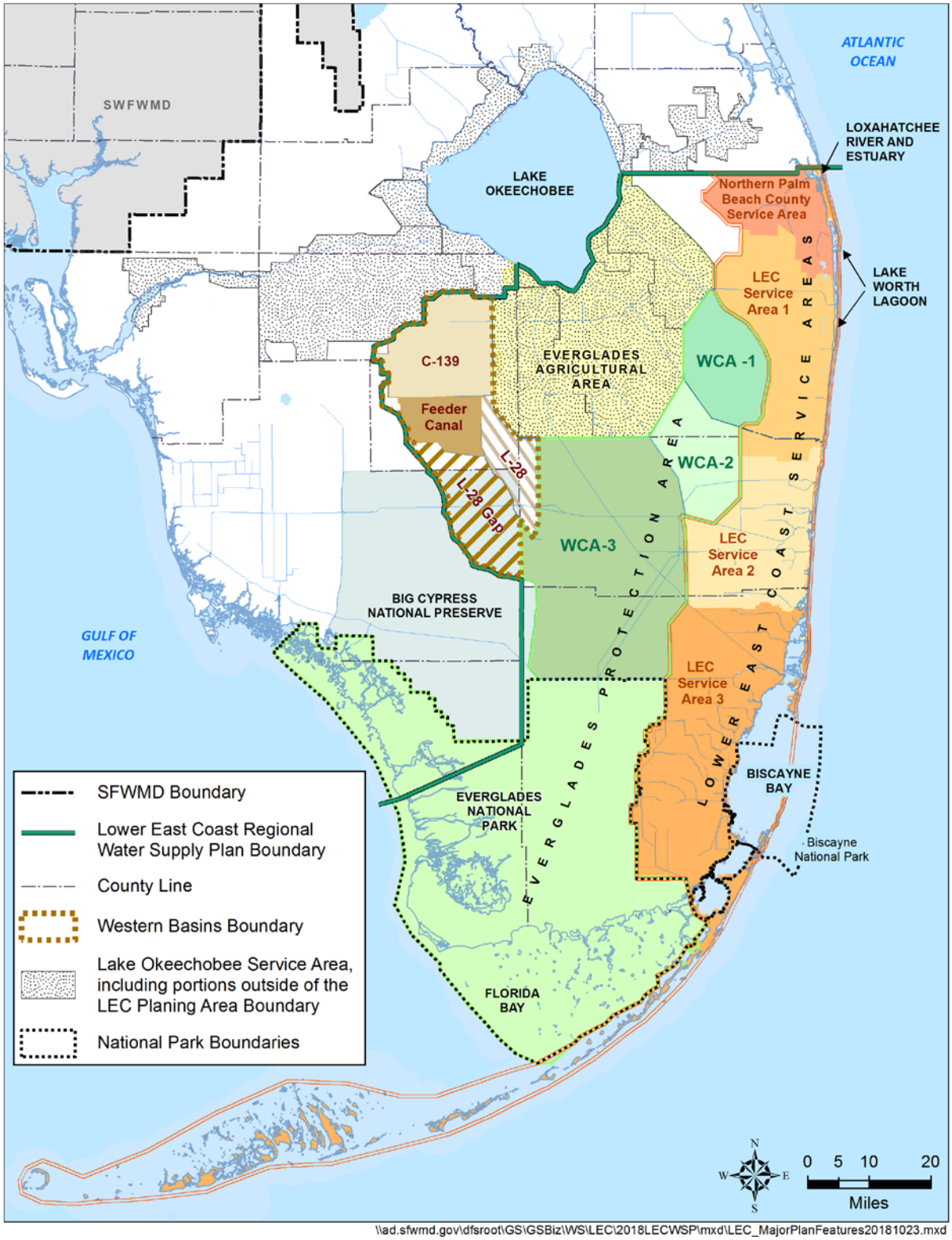


Figure 5-1. Major surface water management regions within the LEC Planning Area.

LAKE OKEECHOBEE SERVICE AREA

Due to its widespread influence throughout the SFWMD, Lake Okeechobee borders four of the District's regional water supply planning areas. However, for water supply planning purposes, Lake Okeechobee is formally included in the LEC water supply plan updates because it supplies much of the region's surface water resources. Lake Okeechobee is the primary source of supplemental irrigation for the EAA and numerous adjacent agricultural basins, which collectively make up the Lake Okeechobee Service Area (LOSA). The LOSA boundaries extend beyond the LEC Planning Area; however, the entire LOSA is considered during the LEC water supply planning process. A Restricted Allocation Area was established for LOSA in 2008 that limits surface water withdrawals from Lake Okeechobee and all surface waters hydraulically connected to the lake.

INFO

The following surface water bodies are part of the LOSA Restricted Allocation Area:

- North, Northeast and Northwest Lake Shore canals
- Southern Indian Prairie canals
- St. Lucie (C-44) Canal
- C-43 Canal and Caloosahatchee River and Estuary
- West Palm Beach Canal
- L-8 Canal
- Nine water control districts' canals
- North New River
- Hillsboro Canal
- Miami Canal

Lake Okeechobee

Lake Okeechobee is a major surface water body for storage and supply in the LEC Planning Area. The lake has multiple inflows from a watershed covering more than 3 million acres, including the Kissimmee River, and several outlets for flood control purposes, including: 1) the C-44 Canal and St. Lucie River to the eastern coast of Florida, 2) the C-43 Canal and Caloosahatchee River to the southwestern coast of Florida, and 3) the EAA canals to the WCAs and southeastern coast of Florida (SFWMD 2011). In addition to water storage, the lake serves multiple functions, including flood control, agricultural and urban water supply, fulfillment of Seminole Tribe of Florida water rights, navigation, recreation, and fish and wildlife preservation and enhancement. Water levels in Lake Okeechobee and in most of the region's canals are operated under regulation schedules for multiple purposes, including water storage and flood protection. The amount of stored water is important to the region's natural ecosystems and developed areas. Management of surface water storage capacity involves balancing two opposing conditions: 1) drought conditions that may occur during periods of deficient rainfall, and 2) flooding that may occur due to excessive rainfall, especially during the wet season. As described in the *2013 Lower East Coast Water Supply Plan Update* (2013 LEC Plan Update; SFWMD 2013) and the 2008 Amendment to Appendix H of the 2005-2006 LEC Plan Update (SFWMD 2008), surface water availability from existing canal and storage networks within LOSA under the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) is not adequate to meet water use demands and environmental needs during 1-in-10 year drought conditions. Past analyses concluded that additional storage would be needed to meet existing legal user and natural system needs in the LEC Planning Area.

Lake Okeechobee is a key ecological component of the Greater Everglades ecosystem (Zhang and Sharfstein 2013). In 2001, Minimum Flow and Minimum Water Level (MFL) criteria and a prevention strategy were adopted for Lake Okeechobee to protect this important resource from significant harm. MFL criteria regarding significant harm were based on the relationship between water levels in the lake and the ability of the lake to 1) protect the coastal aquifer against saltwater intrusion, 2) supply water to Everglades National Park, 3) provide littoral zone habitat for fish and wildlife, and 4) ensure navigational and recreational access (SFWMD 2000). More information on the Lake Okeechobee MFL is provided in **Chapter 4** and **Appendix C**.

2008 LORS and Adaptive Protocols

Lake Okeechobee is surrounded by the 143-mile long Herbert Hoover Dike to protect neighboring communities from flooding. However, in 2006, a technical review panel indicated the dike needed major rehabilitation (Bromwell et al. 2006). In 2007, the USACE designated the dike as a Class I risk, the highest risk for failure. To reduce the risk of dike failure, the USACE adopted the 2008 LORS, which is to remain in effect until the dike is rehabilitated (USACE 2007). The 2008 LORS includes operating guidelines designed to maintain Lake Okeechobee high-end water levels approximately 1 foot lower than the previous schedule (varying seasonally between 15.50 and 17.25 feet National Geodetic Vertical Datum of 1929 [NGVD29]), resulting in an average loss of approximately 430,000 acre-feet of water storage. State funding has been provided to assist the USACE in expediting the Herbert Hoover Dike rehabilitation schedule. The current Integrated Delivery Schedule (USACE 2018) indicates completion of the rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019.

Water availability from Lake Okeechobee and its hydraulically connected water bodies is limited due to implementation of the 2008 LORS as well as SFWMD water use permit criteria. As a result of the lowered lake regulation schedule, Restricted Allocation Area rules have been adopted (**Chapter 4**), limiting increases in withdrawals from Lake Okeechobee and all surface waters hydraulically connected to the lake. In addition, the analysis associated with the lowered regulation schedule indicated the level of certainty for LOSA users has been reduced from 1-in-10 years to 1-in-6 years.

Adaptive operational protocols (SFWMD 2010) were revised for the 2008 LORS, identifying lake release volumes that are most beneficial when the regulation schedule does not specify release amounts. The protocols are meant to improve water supply, flood protection, and ecosystem benefits within the constraints of the 2008 LORS and the C&SF Project Water Control Plan (USACE 2008). Adaptive protocols provide guidance to water managers regarding discretionary releases for ecosystem benefits to Lake Okeechobee, the Caloosahatchee and St. Lucie estuaries, STAs, Everglades Protection Area, and Florida Bay.

Everglades Agricultural Area

In 1948, the C&SF Project designated approximately 700,000 acres of the northern Everglades as the EAA, which today includes agricultural land, STAs, and the Rotenberger and Holey Land wildlife management areas. The EAA is south of Lake Okeechobee (**Figure 5-2**) and mostly contains sugarcane crops. Crop and water use information is provided in **Appendix B**. Surface water resources in the EAA are managed for flood control, regional groundwater control, and water supply for agricultural irrigation and industry. Agricultural best management practices and STAs reduce excess phosphorus from stormwater runoff. STAs use vegetation to uptake phosphorous and supply treated water to the wildlife management areas (and the Everglades Protection Area), which provide essential habitat for many plant and wildlife species. STAs are a critical step in supplying fresh water from Lake Okeechobee to the Everglades Protection Area.

EVERGLADES PROTECTION AREA

The Everglades Protection Area is defined by the Everglades Forever Act [Section 373.4592, Florida Statutes] and encompasses the WCAs and Everglades National Park (**Figure 5-2**). The area is managed for flood control, water supply, regional groundwater control (including prevention of saltwater intrusion), recreation, and enhancement of fish and wildlife, including endangered and threatened species (Abtew et al. 2013). As a natural ecosystem, the Everglades Protection Area contains marl marshes, coastal mangrove forests, tree islands, and the globally rare ridge-and-slough patterned peatlands that are important habitat for subtropical and tropical plant and animal species, including fish and other aquatic species, reptiles, amphibians, wading birds, and migratory birds. Because of its ecological importance, the Everglades system is the focus of one of the largest ecological restoration projects in the world, the South Florida Ecosystem Restoration Program, which includes the Comprehensive Everglades Restoration Plan (CERP) and the Central Everglades Planning Project. Further information on this restoration effort can be found at www.evergladesrestoration.gov.

Green Heron in Everglades National Park

The landscape pattern of the Everglades Protection Area is oriented parallel to water flow. Prior to human development, water flowed unimpeded out of Lake Okeechobee through what is now the EAA, bounded by the coastal ridge to the east and the higher lands west of what is now WCA-3A and Big Cypress National Preserve (McVoy et al. 2011). Historically, water discharged to the Gulf of Mexico, Biscayne Bay, and Florida Bay (**Figure 5-3**). Under natural flows, water levels across the landscape generally were of uniform depth. However, the C&SF Project divided the Everglades into shallow, diked marshes that changed wetland depths and altered the historical ridge-and-slough landscape.

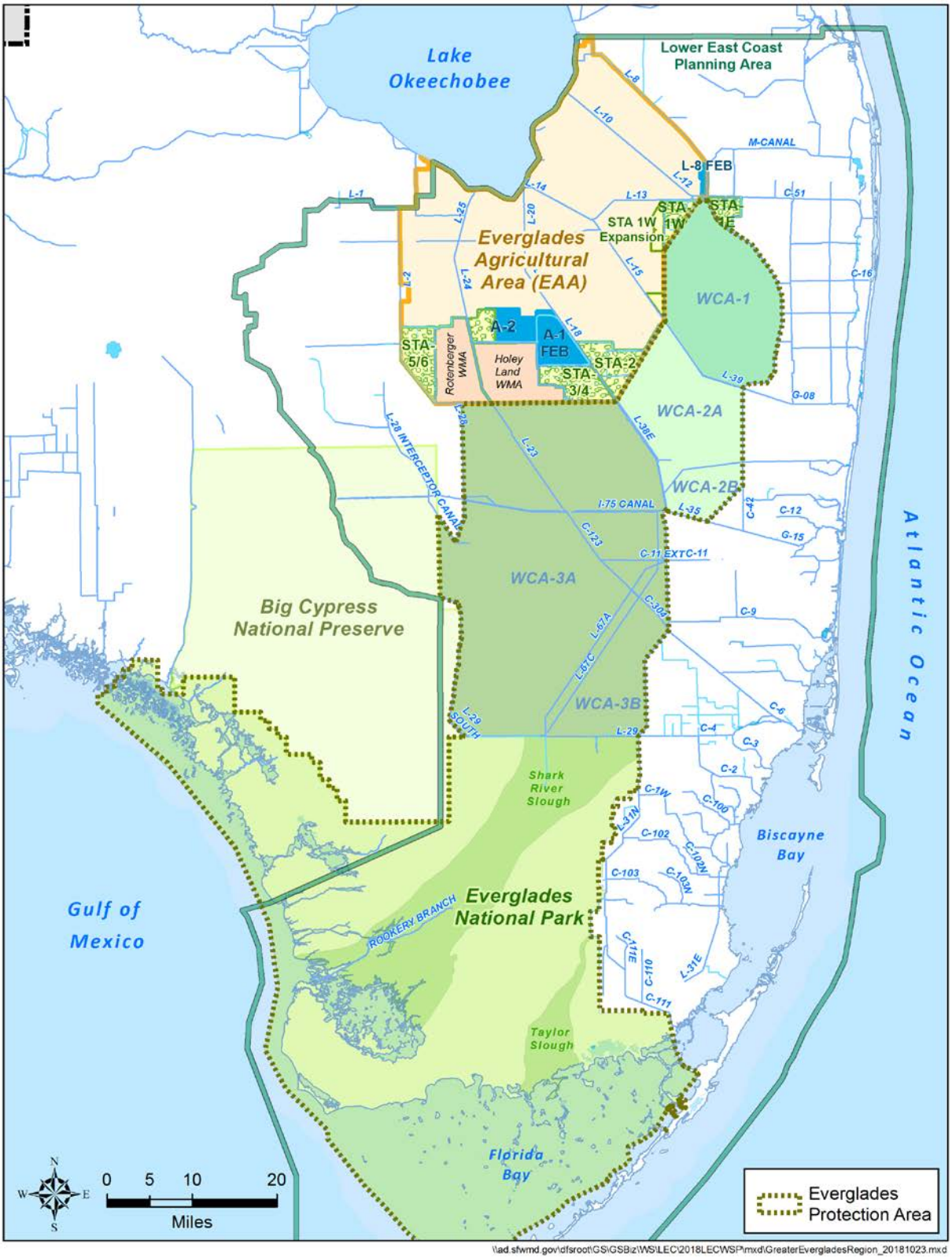


Figure 5-2. Map of the Everglades Agricultural Area and greater Everglades region. (Note: WMA – Wildlife Management Area; FEB – Flow Equalization Basin.)

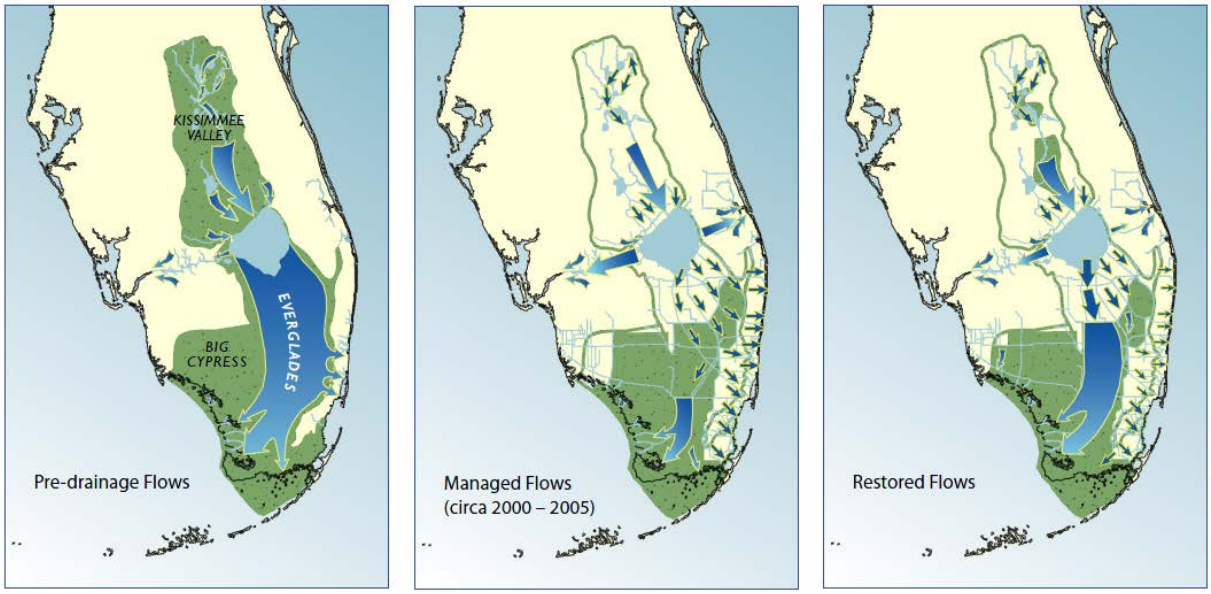


Figure 5-3. Generalized water flow patterns through the Everglades over time.

Water Control Plan for the WCAs, Everglades National Park, and the South Dade Conveyance System

Water flow through the Everglades Protection Area is managed through a USACE Water Control Plan, which contains operating criteria for water control structures within the WCAs, Everglades National Park, and the Everglades National Park-South Dade Conveyance System (USACE 2012). Since 1983, the SFWMD has experimented with water release operations based on rainfall and evaporation in the Everglades, resulting in a near continuous series of modifications to the operation of the C&SF Project. In 2012, the updated Water Control Plan incorporated the Everglades Restoration Transition Plan, modified the WCA-3A regulation schedule, and governed operations within the Modified Water Deliveries project area (USACE 2012). The Everglades Restoration Transition Plan (USACE 2011) provides guidance to improve habitat conditions for critical and protected bird species (e.g., Everglades Snail Kite, Wood Stork, Cape Sable Seaside Sparrow) in the Everglades Protection Area. These incremental changes in operating criteria are interim steps towards full implementation of a Combined Operational Plan.

The USACE is developing the Combined Operational Plan, which combines the Water Control Plan with an environmental impact statement, to define water management operations for completed portions of the Modified Water Deliveries to Everglades National Park and C-111 South Dade projects. The Combined Operational Plan will help achieve restoration and operational benefits for the southern Everglades ecosystem and will be implemented once all necessary infrastructure is in place. Implementation of the Combined Operational Plan is expected to increase the availability of water deliveries from WCA-3A to Everglades National Park through Northeast Shark River Slough and improve hydrologic conditions in Taylor Slough, the Rocky Glades, and the eastern panhandle of Everglades National Park.

Water Conservation Areas

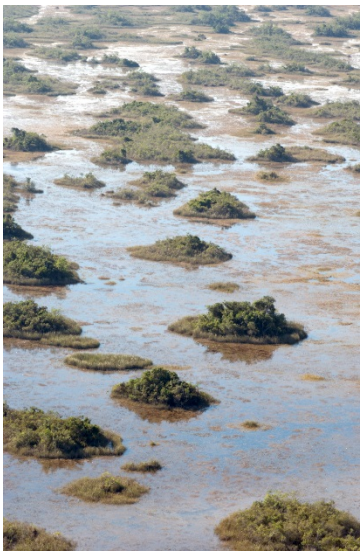
Beginning in the 1950s and 1960s, the C&SF Project compartmentalized approximately half of the original Everglades sawgrass marsh, wet prairies, and hardwood swamps into three shallow, diked hydrologic units known as the WCAs (**Figure 5-2**). The WCAs 1) store excess water; 2) supply water for Everglades National Park, agricultural lands in the LEC Planning Area, and use during the dry season; 3) provide flood control during the wet season; and 4) recharge the Biscayne aquifer.

Water inflow and outflow from the WCAs primarily is through rainfall and evapotranspiration, respectively (Abtew et al. 2013). Water levels in most of the WCAs are managed using water control structures operating under a set of regulation schedules established by the USACE (2012). The regulation schedules allow water levels to vary under different conditions (e.g., wet season, dry season), balancing the needs of the natural system and other water users. WCA-2B and WCA-3B are not operated under regulation schedules because of high seepage rates to the surficial aquifer system.

Current regulation schedules and daily water levels are available at http://www.saj.usace.army.mil. More information about the WCAs can be found in Chapter 2 of the *South Florida Environmental Report – Volume I*, available at http://www.sfwmd.gov/sfer.

WCA-1

WCA-1, also known as the Arthur R. Marshall National Wildlife Refuge, encompasses 140,000 acres in south-central Palm Beach County and is enclosed by 58 miles of canals and levees. The WCA-1 regulation schedule varies from high stages in late fall and winter to low stages in spring (the beginning of the wet season). Surface water inflows to WCA-1 include discharges from STA-1W and STA-1E (**Figure 5-2**). Outflows from WCA-1 are received by WCA-2A through the S-10 structures, the Hillsboro Canal, and a canal system monitored and controlled by the Lake Worth Drainage District.



Water Conservation Area 1

WCA-2A and WCA-2B

WCA-2A and WCA-2B cover approximately 133,000 acres of southwestern Palm Beach and northwestern Broward counties (**Figure 5-2**). WCA-2A is a shallow impoundment and the larger of the two areas, covering 110,000 acres. These WCAs provide wellfield recharge and water supply for urban areas of Broward County. Inflows to WCA-2A primarily come from WCA-1, STA-2, and STA-3/4. Outflows from WCA-2A generally enter WCA-3A through the S-11 structures.

WCA-3A and WCA-3B

Together, WCA-3A and WCA-3B are the largest of the three WCAs, spanning 585,000 acres in western Broward and northwestern Miami-Dade counties (**Figure 5-2**). Water stored in WCA-3A and WCA-3B is used to meet water supply and salinity control requirements for Miami-Dade County; agricultural irrigation requirements in the LEC Planning Area; and environmental water supply needs for Everglades National Park. The Miami Canal traverses WCA-3A from northwest to southeast, and receives most of its water from rainfall, WCA-3A, STA-5, STA-3/4, and regulatory releases from Lake Okeechobee (on a case-by-case basis). WCA-3A also receives excess runoff from Big Cypress National Preserve and flood control discharges from the S-9 and S-9A pump stations in western Broward County. Flows from WCA-3A enter the northern boundaries of Everglades National Park through the S-21 and S-333 water management structures, the 1-mile bridge on Tamiami Trail (U.S. Highway 41), and the culverts located under Tamiami Trail. WCA-3B inflows are through the S-151 and S-152 structures, and outflows are limited to evaporation and seepage along the L-30 Canal.

Water Conservation Area 3

South Dade Conveyance System

Constructed between 1974 and 1983, the South Dade Conveyance System was designed to transfer water from WCA-3A to Everglades National Park for natural resource benefits (**Figure 5-4**). The system, including SFWMD canals (e.g., C-6, C-4, C-102, C-103, C-111, L-31N, L-31W), also provides water to wellfields and canals to minimize saltwater intrusion in southern Miami-Dade County.

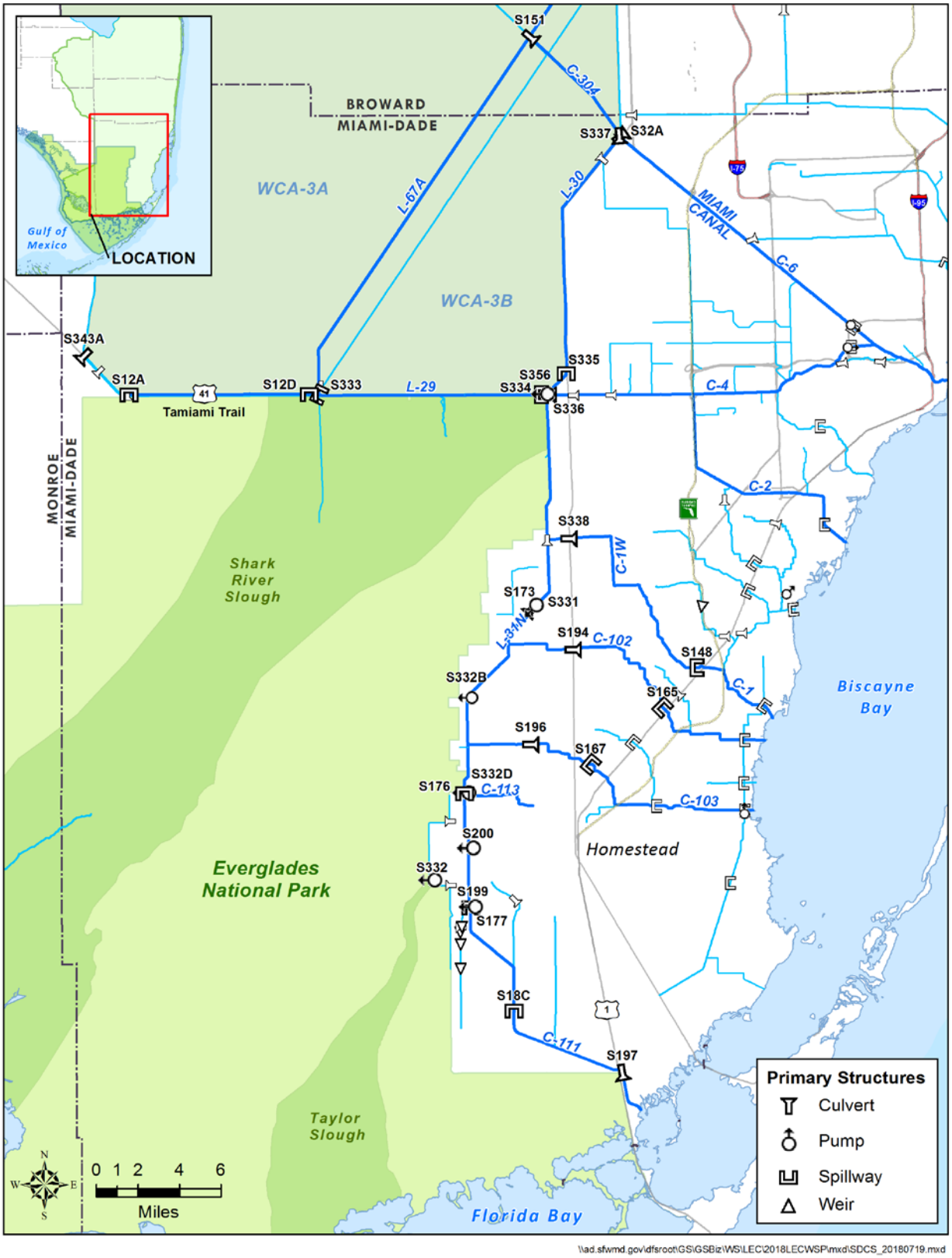


Figure 5-4. South Dade Conveyance System canals and water management structures.

Everglades National Park

Established in 1947 and expanded in 1989, Everglades National Park is the tenth largest national park in the United States, covering more than 1.5 million acres. The park is home to a wide variety of species, including threatened and endangered species protected under the Endangered Species Act.

Everglades National Park

Most water enters Everglades National Park from the WCAs and flows southwest through Shark River Slough to Whitewater Bay, the Ten Thousand Islands area, and Florida Bay. Additional water enters the park through water control structures, pump stations, and Taylor Slough. Taylor Slough is an important tributary to northeastern Florida Bay, and a series of pumped seepage management features located east of the park's eastern boundary, collectively known as the C-111 South Dade Project (described in **Chapter 6**), are designed to keep water in the slough. Water flows out of Everglades National Park through numerous tidal creeks and coastal wetlands, including mangrove and buttonwood forests, salt marshes, and coastal prairies.

Florida Bay

Covering a triangular area of 544,000 acres, Florida Bay is a shallow (average 3.3 feet deep) estuarine system between the Everglades and the Florida Keys (**Figure 5-5**). Approximately 80 percent of the bay is within Everglades National Park. A major premise of Everglades restoration efforts is that freshwater flow from the Everglades to Florida Bay has decreased, causing salinity increases and detrimental ecological changes (e.g., seagrass and sponge die-offs, algal blooms, declines in fish species abundance) in the bay (Rudnick et al. 2005).

While Florida Bay is not a water supply source and not managed by the SFWMD, it is an important natural resource affected by and considered when making water management decisions. The SFWMD has monitoring, research, and modeling programs in place for Florida Bay to better 1) understand the importance of water management as a driver of ecological changes, 2) forecast the impacts of changing water management strategies, and 3) operate water control structures for the protection and restoration of the ecosystem. Results from major monitoring, research, and modeling projects and from the Florida Bay MFL and CERP can be found in Volume I – Chapter 6 of the *2018 South Florida Environmental Report* (McDonald 2018). In addition, the SFWMD re-evaluated the Florida Bay MFL and prevention strategy in 2014, using several years of new information and monitoring data compiled since the 2006 MFL adoption. **Chapter 4** and **Appendix C** provide further information about the MFL, prevention strategy, and re-evaluation.

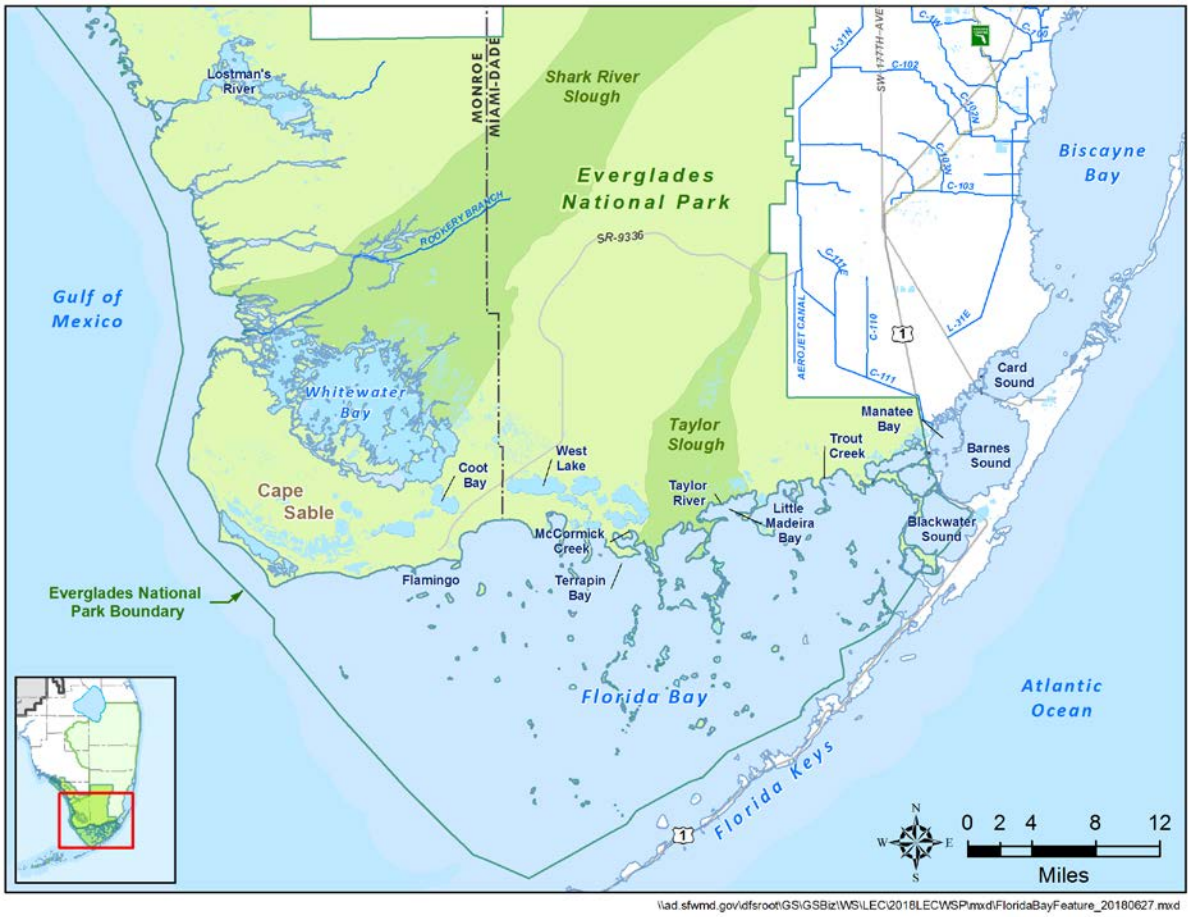


Figure 5-5. Major features of Florida Bay.

WESTERN BASINS

Encompassing approximately 440,000 acres, the C-139, Feeder Canal, L-28, and L-28 Gap drainage basins along the western edge of the Everglades are collectively known as the Western Basins (**Figure 5-6**). The Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida have reservations in the Western Basins, with water supply needs for residents, agriculture, and wetlands. Water supply and water quality of stormwater runoff are challenges to development of the Western Basins.

The Seminole Tribe of Florida has ongoing concerns in the Western Basins regarding adequate water supply for the environment and tribal water rights entitlement (**Chapter 7**) as well as water quality issues. The Miccosukee Tribe of Indians of Florida also is concerned about water supply and water quality issues. Federal and state agencies and tribal entities have convened to discuss these issues and other specific concerns raised by the tribes. In addition, the tribes have been participating in the CERP Western Everglades Restoration Project planning process, which is incorporating tribal concerns in the analysis of restoration alternatives (**Chapter 6**).

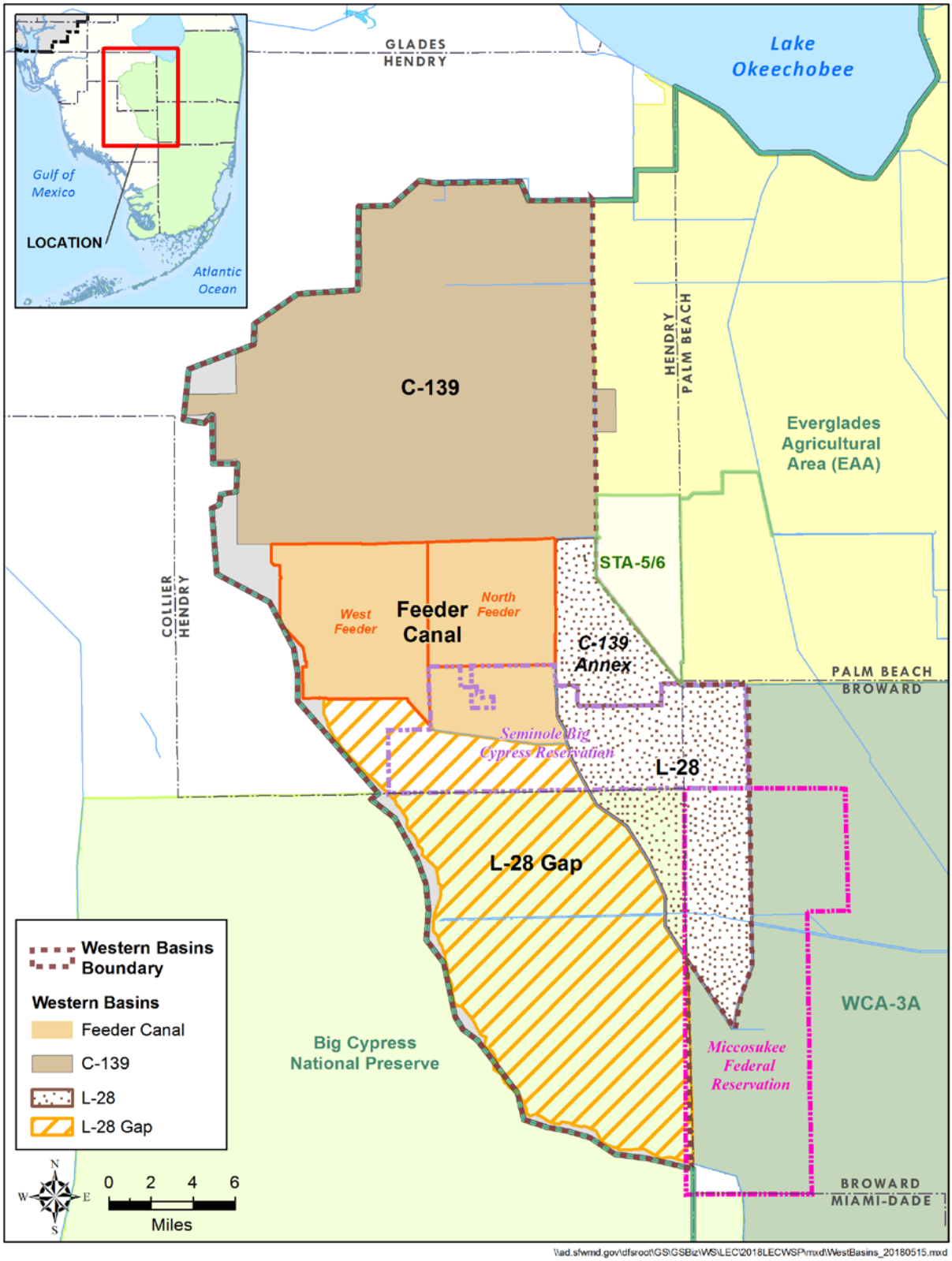


Figure 5-6. The four Western Basins and the surrounding areas.

C-139 Basin

The 170,000-acre C-139 Basin is an agricultural area in Hendry County and the second largest discharging tributary, by volume, to the Everglades Protection Area, behind the EAA. Under the 1994 Everglades Forever Act [Section 373.4592, Florida Statutes], landowners within the C-139 Basin must implement water quality best management practices and collectively not exceed average annual total phosphorus loads, adjusted for rainfall, to protect water quality in the Everglades Protection Area. Stormwater runoff from the C-139 Basin enters WCA-3A via STA-5/6. Agricultural uses in the basin mostly depend on groundwater from the Lower Tamiami aquifer for water supply (**Chapter 7**) with some permitted uses from the L-1 and L-2 canals.

Feeder Canal Basin

The Feeder Canal Basin is the third largest discharging tributary to the Everglades Protection Area and is divided into three major areas: 1) the West Feeder Sub-basin (31,900 acres); 2) the North Feeder Sub-basin (23,150 acres); and 3) a portion of the Seminole Tribe of Florida Big Cypress Reservation (13,850 acres). The two major canals in this basin are the North and West Feeder canals, which merge in the southeastern corner of the basin and discharge south to the L-28 Interceptor Canal and WCA-3A. Agricultural uses in this basin depend on groundwater from the Lower Tamiami aquifer for water supply (**Chapter 7**).

L-28 Basin

The L-28 Basin includes the C-139 Annex and portions of the Seminole Tribe of Florida Big Cypress Reservation, the Miccosukee Federal Reservation (in WCA-3A), and Big Cypress National Preserve. The C-139 Annex is 17,275 acres of land south of Lake Okeechobee purchased by the SFWMD from the United States Sugar Corporation. The SFWMD plans to use the annex for water storage, water quality improvement, and wetland restoration projects. Restoration activities will improve the quality, timing, and distribution of water flowing into the Everglades Protection Area. Flows from the C-139 Annex are diverted to STA-5/6 with mandatory best management practices to reduce total phosphorus loads. Agricultural uses (citrus operations) in the annex depend on groundwater from the Lower Tamiami aquifer for water supply (**Chapter 7**).

L-28 Gap Basin

The L-28 Gap Basin consists of natural and undisturbed wetland marsh and slough systems within Big Cypress National Preserve and a portion of the Seminole Tribe of Florida Big Cypress Reservation south of the Feeder Canal Basin. Runoff from the L-28 Gap Basin flows southeast and drains into WCA-3A. The region is low-lying and nearly level, resulting in poorly drained soils.

LOWER EAST COAST SERVICE AREAS

Flood control works that are now part of the C&SF Project were constructed in the early 20th century and have altered historical freshwater flows to the coastal ecosystems of the LEC Planning Area, including the Loxahatchee River, Lake Worth Lagoon, and Biscayne Bay. These canals and water control structures are operated and maintained by the SFWMD per the USACE (1995) Master Water Control Manual for East Coast Canals. Although the canals have altered historical flows, they also provide many benefits, including flood, regional groundwater level, and salinity control; enhancement of fish and wildlife; and water supply for agricultural irrigation, municipalities, and industry.

For purposes of water supply planning, operations, and water shortage, the SFWMD divides the coastal, urban portion of the LEC Planning Area into four service areas that generally reflect the historical sources of water delivered from the regional system (**Figure 5-7**).

- **Northern Palm Beach** – The coastal and inland portions of northern Palm Beach County that historically have received water from Lake Okeechobee and include the Southern L-8 Basin and M-Canal/Water Catchment Area basins. Natural areas within the North Palm Beach Service Area include DuPuis Reserve, J.W. Corbett Water Management Area, Grassy Waters Preserve, Loxahatchee Slough, Loxahatchee River and Estuary (including the federally designated Wild and Scenic Northwest Fork), and Pal Mar.

Grassy Waters Preserve

- **LEC Service Area 1** – This portion of Palm Beach and northern Broward counties includes the C-51 Canal and Hillsboro Canal basins and receives water from WCA-1.
- **LEC Service Area 2** – The portion of Broward County that includes the C-9, C-11, C-13, and C-14 basins and receives water from WCA-2A and WCA-2B.
- **LEC Service Area 3** – The portion of Miami-Dade County that receives water from WCA-3A and WCA-3B. This service area also includes the Florida Keys because the primary source of drinking water for those users is a wellfield near Florida City.

This section describes the natural coastal ecosystems that depend on surface water supplies from the LEC Service Areas. Groundwater resources in the LEC Service Areas are described in **Chapter 7**.

As discussed in **Chapter 4**, Restricted Allocation Area rules have been adopted for the North Palm Beach County/Loxahatchee River Watershed and LEC Everglades Waterbodies. These rules prohibit net increases in the volume, or a change in timing on a monthly basis, of direct surface and indirect groundwater withdrawals from these areas over that resulting from the base condition water uses permitted as of April 1, 2006. These two Restricted Allocation Areas limit new water allocations from water resources in the LEC Service Areas.

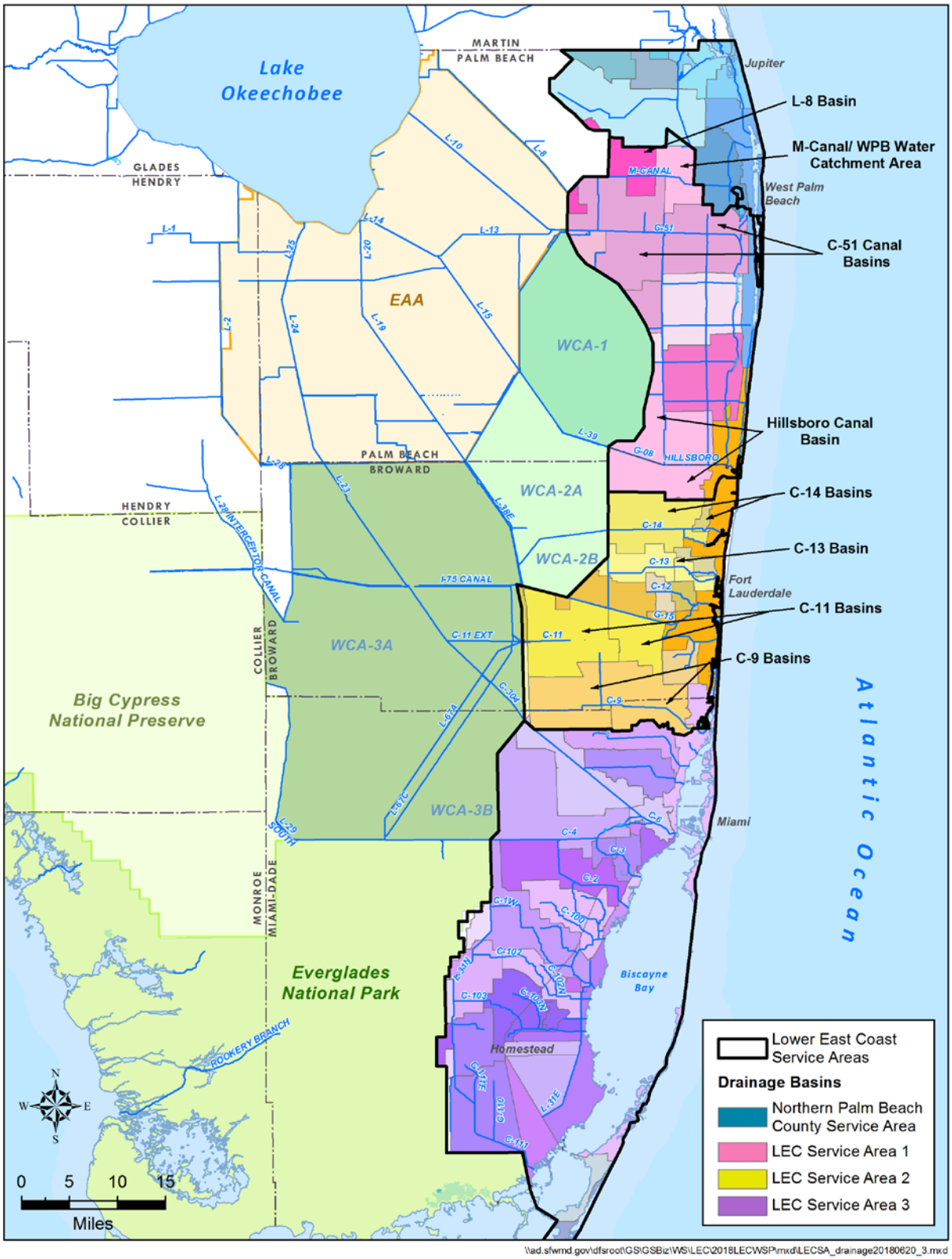


Figure 5-7. Drainage basins in the LEC Service Areas.

Loxahatchee River and Estuary

Stretching across the Martin-Palm Beach county line, the Loxahatchee River and Estuary system is one of the last vestiges of native cypress river swamp in southeastern Florida (**Figure 5-8**). In 1985, 7.6 miles of the Northwest Fork of the river was federally designated as Florida's first National Wild and Scenic River. Grassy Waters Preserve and the Loxahatchee and Hungryland sloughs form the headwaters of the Loxahatchee watershed and drain into the Northwest Fork of the river.

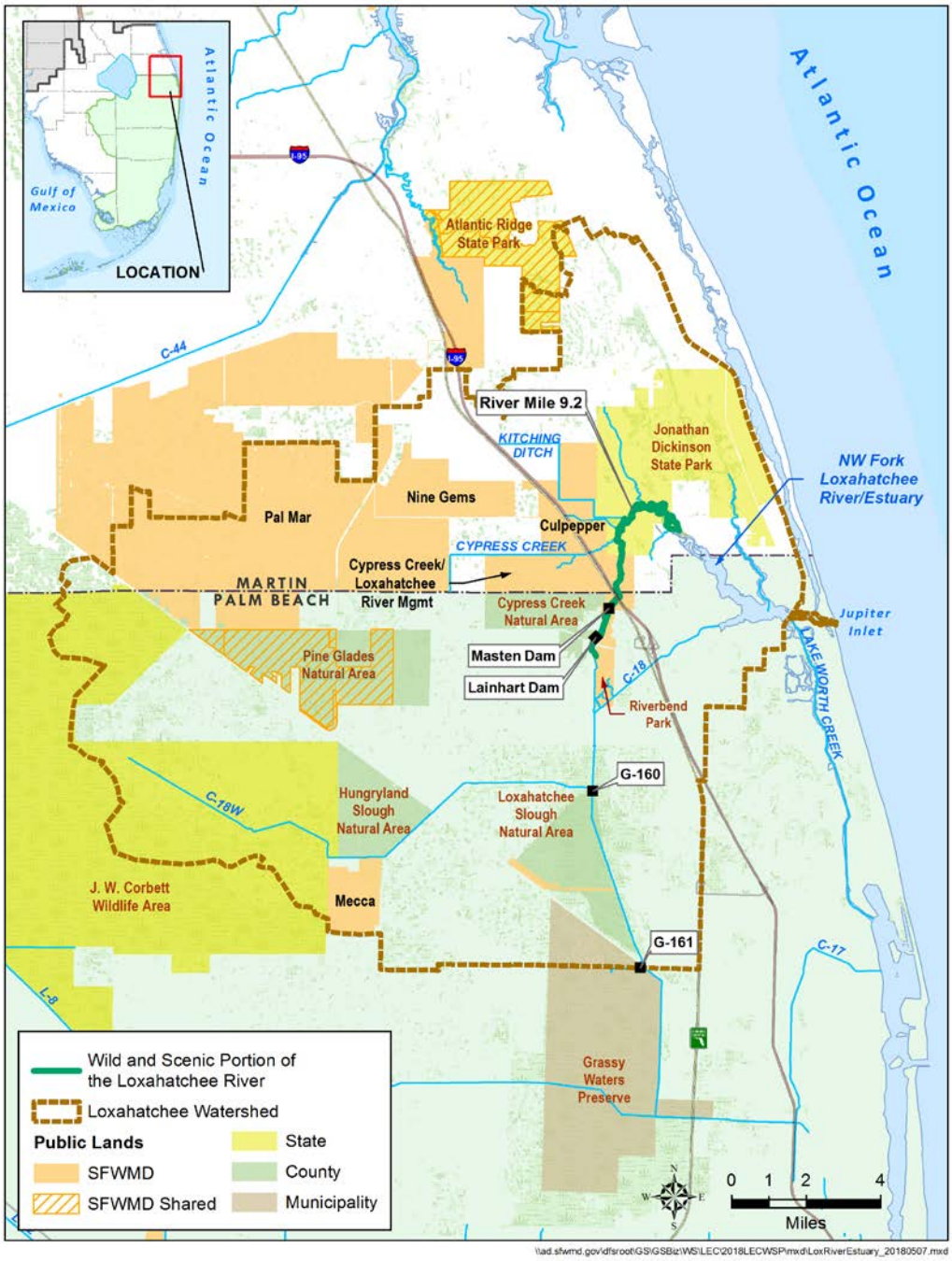


Figure 5-8. Major features of the Loxahatchee River and Estuary.

Floodplain plant communities, soils, and salinity regimes characterize three distinct reaches within the Loxahatchee River and Estuary: riverine (790 acres), which generally is unaffected by salinity; upper tidal (59 acres), which experiences some saltwater intrusion during the dry season; and lower tidal (111 acres), which is highly influenced by tides and salinity (SFWMD 2006). However, increased saltwater intrusion from the opening of the Jupiter Inlet in 1947 and decreased freshwater inflow due to drainage canals have impacted the riverine and upper tidal ecosystems. To address these issues and as part of the Wild and Scenic designation, the Florida Department of Environmental Protection and SFWMD (2010) were required to jointly develop, administer, and implement a Wild and Scenic River Management Plan.

The SFWMD and Florida Department of Environmental Protection committed to develop a practical Restoration Plan and goal (SFWMD et al. 2006) for the Northwest Fork of the Loxahatchee River as part of the MFL recovery strategy. As part of the Restoration Plan, salinity concentrations and freshwater flows are monitored to better understand seasonal flow patterns and to implement water management strategies that ecologically benefit the freshwater portions of the river and estuary. Based on seasonal data, the Restoration Plan established a variable dry season flow between 50 and 110 cubic feet per second, with an average monthly flow of 69 cubic feet per second over Lainhart Dam, while providing 30 cubic feet per second of additional water from downstream tributaries (e.g., Cypress Creek, Kitching Creek, Hobe Grove ditch) when needed. An addendum to the Restoration Plan documented 5 years of additional research and monitoring (SFWMD et al. 2012). The MFL recovery strategy adopted for the Northwest Fork of the Loxahatchee River is discussed in **Chapter 4** and **Appendix C**. Information on current projects related to the Loxahatchee River is provided in **Chapter 6**.

Lake Worth Lagoon

Lake Worth Lagoon is a 22-mile long, 6- to 10-foot deep estuary between mainland Palm Beach County and offshore barrier islands (**Figure 5-9**). While Lake Worth Lagoon is not a water supply source and not managed by the SFWMD, it is an important natural resource affected by and considered when making water management decisions. The lagoon is managed by the county under the Lake Worth Lagoon Management Plan (Palm Beach County Department of Environmental Resource Management 2008), in cooperation with other agencies such as the SFWMD. Management plan performance measures target freshwater discharges and resulting salinities during the wet season to provide optimal conditions for key species (e.g., oysters, seagrass).

The Lake Worth Lagoon watershed encompasses approximately 288,000 acres of predominantly urbanized land in Palm Beach County. The watershed receives fresh water from the C-17 Canal (Earman River), West Palm Beach (C-51) Canal, and Boynton (C-16) Canal. Freshwater runoff from the watershed drains to canals and is discharged to the lagoon. Excessive fresh water discharged into the lagoon reduces salinity and increases turbidity, which can negatively affect the estuarine ecosystem. Tidal exchange with the Atlantic Ocean occurs at the Palm Beach and Boynton inlets. Harmful discharges to Lake Worth Lagoon can be reduced by diverting watershed runoff to the CERP Environmental Preserve at the Marjorie Stoneman Douglas Habitat, to STA-1E for nutrient reduction before discharge to WCA-1, and to the planned C-51 Reservoir.

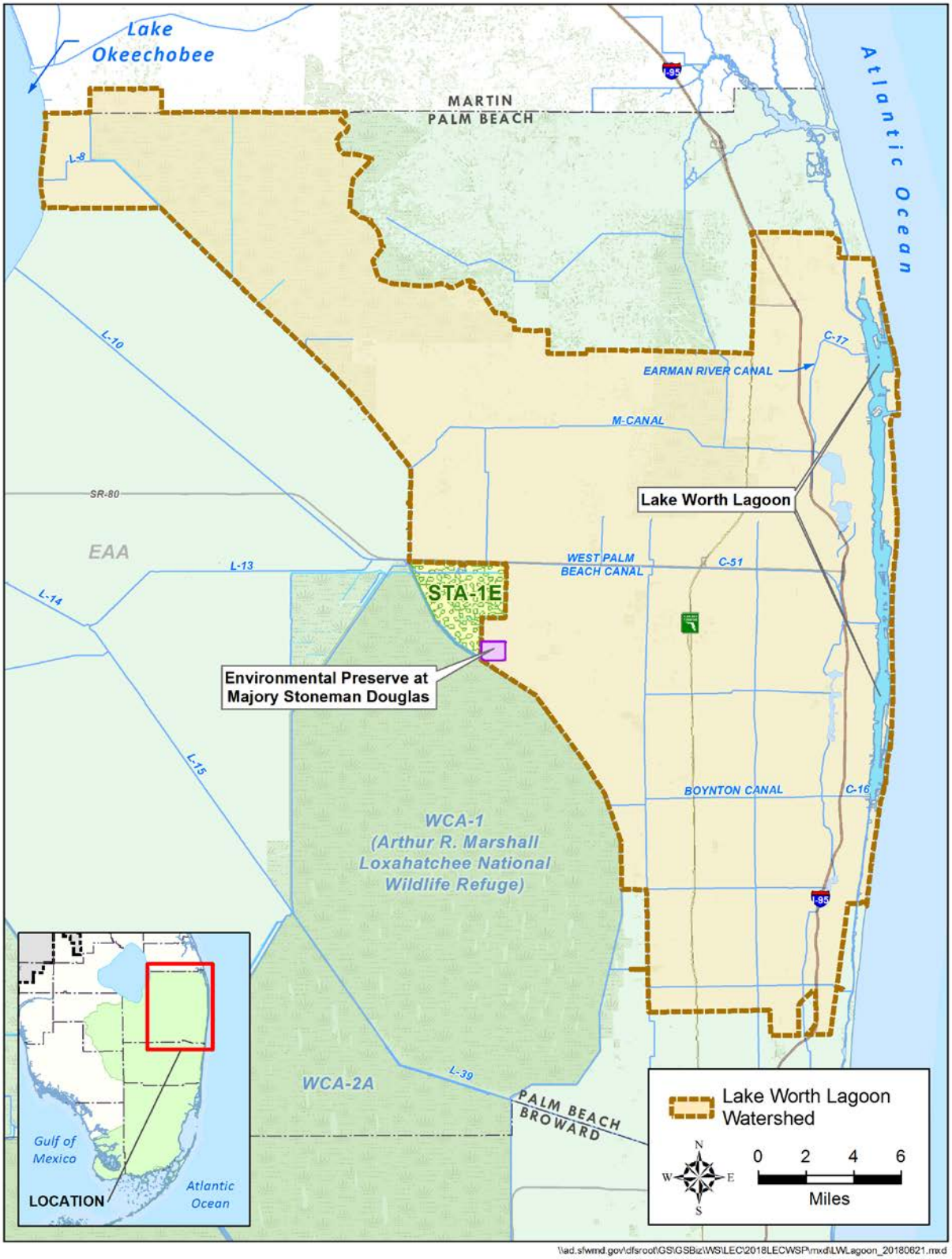


Figure 5-9. Major features of the Lake Worth Lagoon watershed.

Biscayne Bay

Located along the southeastern coast of Florida, Biscayne Bay is a 274,000-acre, shallow, subtropical estuary, with 173,000 acres of the bay in Biscayne National Park (**Figure 5-10**). While Biscayne Bay is not a water supply source and not managed by the SFWMD, it is an important natural resource affected by and considered when making water management decisions. The Biscayne Bay watershed encompasses approximately 600,000 acres of urban and agricultural land in Miami-Dade County. Water levels within the watershed are managed for flood control and water supply, and there are 16 drainage outfalls into Biscayne Bay. Drainage of the watershed has altered the location and timing of freshwater inputs to the bay while construction of artificial inlets and channels has allowed seawater to move farther into the bay. These two factors have contributed heavily to the bay's transition from a freshwater estuary to a more saline environment. Other factors that may be contributing to the bay's increased salinity include reduced rainfall from historical levels and sea level rise. Information on projects related to Biscayne Bay is provided in **Chapter 6**.

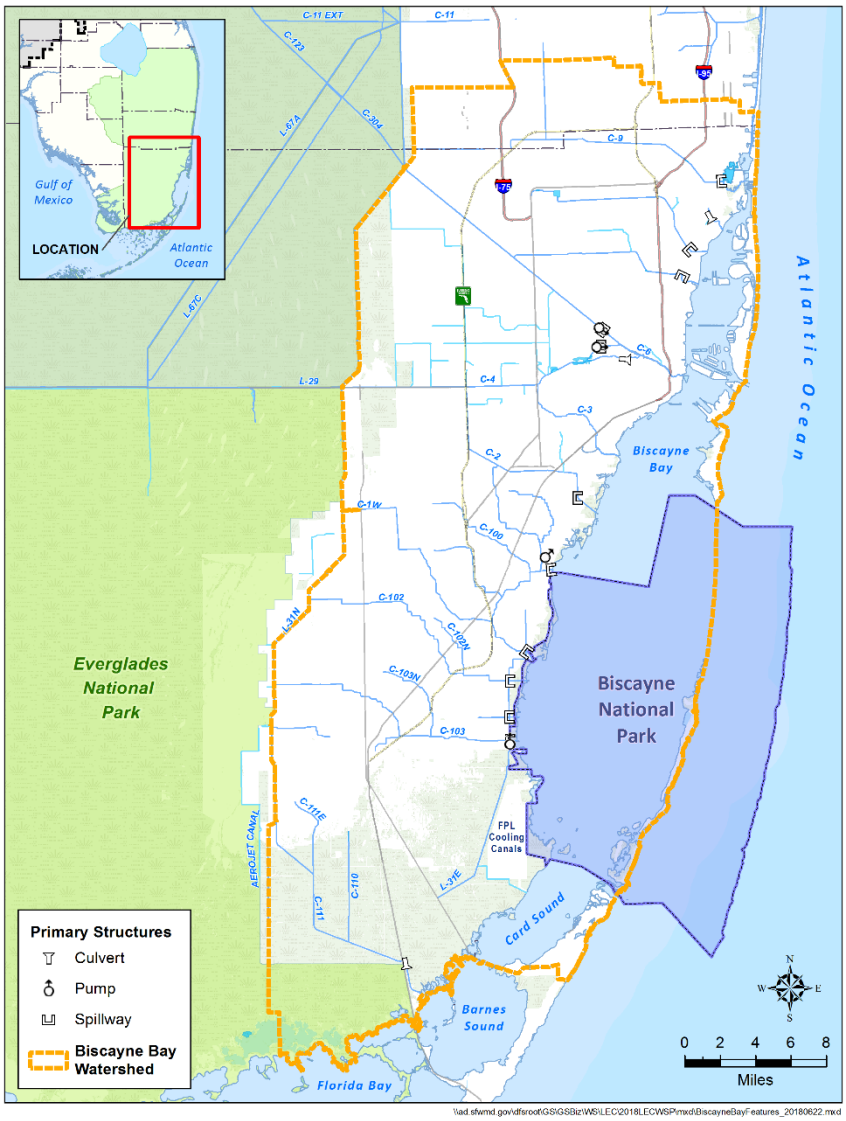


Figure 5-10. Major features of Biscayne Bay and its watershed.

South Miami-Dade Operations

In southeastern Miami-Dade County, agriculture (primarily winter vegetables and ornamental nursery stock) has been a key economic component since the early 1900s. Agricultural operations in the region benefit from moderate temperatures during winter months, but are challenged by the low-lying topography, which often results in thin, unsaturated soil thicknesses and a high risk of crop loss due to flooding during moderate rainfall events. To prevent flooding, canals (e.g., C-102, C-103), pumps, and structures (e.g., S-21A, S-179, S-20F) were constructed by agricultural interests and later incorporated into the C&SF Project (**Figure 5-11**). The SFWMD operates these structures under flexible operational ranges to respond to field conditions and agricultural needs and to reduce inland saltwater intrusion.

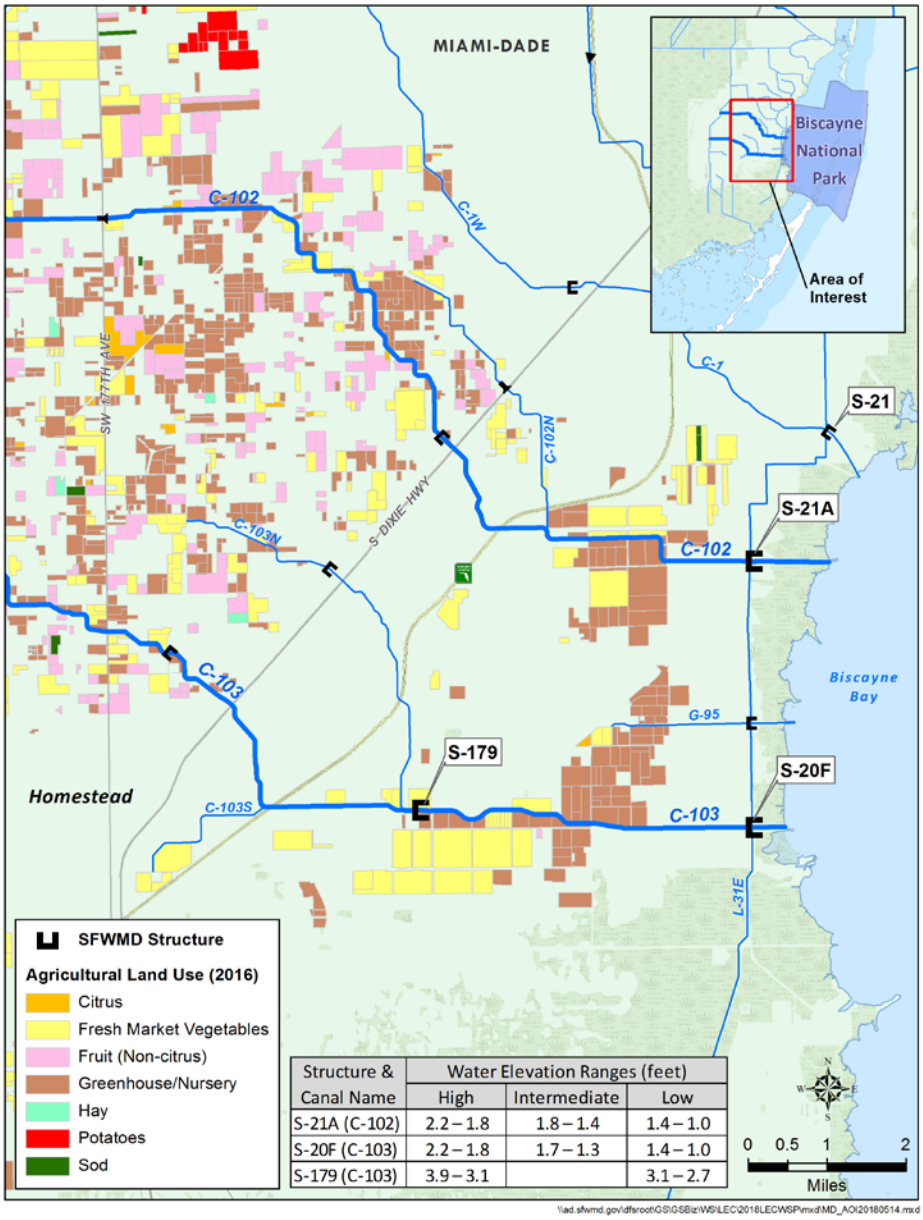


Figure 5-11. South Miami-Dade agricultural operations and related water supply works.

Environmental concerns were raised that the lower operational range used from October to April drained regional groundwater that otherwise may be available late in the dry season (March to May) to moderate nearshore salinity levels in Biscayne Bay. The SFWMD initiated the South Miami-Dade Water Issues Coordination Initiative to identify feasible water management options that would support agriculture while also improving dry season salinity conditions in the bay (Smith 2010). While delaying initiation of the lower operational range would substantially impact winter vegetable crop marketability, the National Park Service suggested that relatively small releases of fresh water from the S-20F, S-21A, and/or S-21 during the dry season would effectively moderate high-salinity events in the nearshore areas of Biscayne Bay while maintaining drainage for farming activities. In addition, operation of available CERP Biscayne Bay Coastal Wetlands Project components (**Chapter 6**), including the L-31E culverts and the Deering Estate S-700 pump station, proved beneficial in distributing fresh water through coastal wetlands.

SUMMARY OF SURFACE WATER RESOURCES AND MANAGEMENT

In 1948, Congress authorized construction of the C&SF Project to provide flood protection and water management throughout South Florida. The C&SF Project canals move water from Lake Okeechobee and the Everglades to coastal counties to recharge the shallow aquifers during the dry season. Although regional development and related water management efforts altered the local movement and balance of water, the interdependence of subregions and overall north to south movement of water still exist.

Lake Okeechobee is a central component of the hydrology and environment of South Florida. The lake is regulated in accordance with the federally adopted 2008 LORS, which limits water availability from Lake Okeechobee and its hydraulically connected water bodies while the Herbert Hoover Dike is under repair. Lake water can be delivered south through the EAA, east to the St. Lucie River (C-44 Canal), and west to the Caloosahatchee River (C-43 Canal) to provide water supply for urban, agricultural, and natural resource needs.

Widespread development and increased urbanization have fundamentally altered the spatial extent, hydrology, water quality, and ecology of the region's ecosystems, including the Everglades. Once extending from the Kissimmee Chain of Lakes to Florida Bay, the Everglades subtropical wetlands supported a rich diversity of plants, fish, and wildlife. CERP is a framework and guide to restore, protect, and preserve much of the water resources of central and southern Florida. Important coastal ecosystems in the LEC Planning Area with ongoing water resource restoration efforts include the Northwest Fork of the Loxahatchee River, Lake Worth Lagoon, Biscayne Bay, and Florida Bay.

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6

Water Resource Development Projects

This chapter provides summaries of water resource development projects in the Lower East Coast (LEC) Planning Area and addresses the roles of the South Florida Water Management District (SFWMD or District) and other parties in implementing these projects. The summaries are organized into four regions where project benefits are expected to occur: Lake Okeechobee, the Everglades, the Western Basins, and the LEC Service Areas. This chapter was created using the Fiscal Year (FY) 2018 Districtwide water resource budget and includes schedules and costs for FY2018 to FY2022. Further information on the current status of these projects can be found in Volume II – Chapter 5A (Demonstranti 2018) of the *2018 South Florida Environmental Report* (SFER), which is updated annually.

TOPICS

- Regional Water Resource Development Projects
- Districtwide Water Resource Development Projects
- Summary of Water Resource Development Projects

Florida water law identifies two types of projects to meet water needs: water resource development projects (subject of this chapter) and water supply development projects (**Chapter 8**). Water resource development is defined in Section 373.019(24), Florida Statutes (F.S.), as:

> *…the formulation and implementation of regional water resource management strategies, including the collection and evaluation of surface water and groundwater data; structural and non-structural programs to protect and manage water resources; development of regional water resource implementation programs; construction, operation, and maintenance of major public works facilities to provide for flood, surface, and underground water storage and groundwater recharge augmentation; and related technical assistance to local governments and to government-owned and privately-owned water utilities.*

Most water resource development activities support and enhance water supply development but do not directly yield specific quantities of water. Instead, these projects are intended to assess the availability of a water supply for existing and future uses, including maintaining the functions of natural systems. For example, project-related hydrologic investigations as well as groundwater monitoring and modeling provide important information about aquifer characteristics (e.g., hydraulic properties, water quality), which is necessary for appropriate facility design, identifying safe aquifer yields, and evaluating the economic viability of projects, but these activities do not increase water availability.

Water supply development projects (**Chapter 8**) generally are the responsibility of water users, such as utilities, and involve the water source options described in **Chapter 7** to meet projected demands. These projects typically include construction of wellfields, water treatment plants, distribution lines, reclaimed water facilities, and storage systems.

Water resource development in the LEC Planning Area is strongly influenced by the Comprehensive Everglades Restoration Plan (CERP), which is a component of the South Florida Ecosystem Restoration Program. Authorized by the United States Congress in 2000, CERP builds on and complements other state and federal initiatives to revitalize South Florida's ecosystems. These restoration efforts have multiple implementation phases organized by the Integrated Delivery Schedule of the South Florida Ecosystem Restoration Program (United States Army Corps of Engineers [USACE] 2018) and supported by water resource development activities such as modeling, land acquisition, project controls, and technical services. The multi-purpose water supply aspects of CERP projects result in new water beneficiaries, including northern and southern estuaries, headwaters, the Everglades and Big Cypress natural areas, and in some cases urban and agricultural users. CERP projects (listed in **Table 6-1**) are described in this chapter and in the annual SFER updates. CERP efforts also form some of the capital projects of the Minimum Flow and Minimum Water Level (MFL) recovery strategies discussed in **Appendix C**.

INFO ⓘ

Integrated Delivery Schedule of the South Florida Ecosystem Restoration Program

The Integrated Delivery Schedule provides the sequencing strategy for planning, designing, and constructing federal Everglades restoration projects cost-shared with local sponsors as part of the Central and Southern Florida Flood Control Project, based on ecosystem needs, benefits, costs, and available funding. The schedule is required as part of the CERP programmatic regulations.

The Integrated Delivery Schedule is updated as needed to reflect progress and/or program changes and provides guidance to decision-makers for scheduling, staffing, and budgeting. The schedule synchronizes program and project priorities with the State of Florida and is needed to request required funding to plan and build South Florida Ecosystem Restoration Program projects (USACE 2018).

Table 6-1. Water resource development projects within the LEC Planning Area, by region.

Region	Project
Lake Okeechobee	CERP Lake Okeechobee Watershed Restoration Project
	Taylor Creek, Nubbin Slough, and Lakeside Ranch STAs
	USACE Herbert Hoover Dike Major Rehabilitation
	Lake Okeechobee Habitat Enhancements
Everglades	Restoration Strategies Regional Water Quality Plan
	Modified Water Deliveries to Everglades National Park
	CERP Water Conservation Area 3A Decompartmentalization Physical Model
	CERP Central Everglades Planning Project
	Wading Bird Monitoring Report
	Tree Island Mapping
	C-111 South Dade Project
	S-197 Structure Replacement Project and Automation
	CERP C-111 Spreader Canal Western Project
	South Dade Study and Florida Bay Plan
Western Basins	CERP Western Everglades Restoration Project
	C-139 Annex Restoration
	Dispersed Water Management Program
	Wetland Reserve Easements Program
LEC Service Areas	Restoration Plan for the Northwest Fork of the Loxahatchee River
	CERP Loxahatchee River Watershed Restoration Project
	Storage for Loxahatchee River
	CERP Environmental Preserve at the Marjorie Stoneman Douglas Everglades Habitat
	CERP Fran Reich Preserve Reservoir
	CERP Hillsboro Aquifer Storage and Recovery Pilot Project
	CERP Broward County Water Preserve Areas
	CERP Biscayne Bay Coastal Wetlands Project

CERP = Comprehensive Everglades Restoration Plan; LEC = Lower East Coast; STA = stormwater treatment area; USACE = United States Army Corps of Engineers.

REGIONAL WATER RESOURCE DEVELOPMENT PROJECTS

Lake Okeechobee

Although they are outside of the LEC Planning Area, the following water resource development projects are within or have an effect on the Lake Okeechobee region and are discussed in this section (**Figure 6-1**):

- CERP Lake Okeechobee Watershed Restoration Project
- Northern Everglades and Estuaries Protection Program
  - Taylor Creek Stormwater Treatment Area (STA) Pilot Project
  - Nubbin Slough STA Pilot Project
  - Lakeside Ranch STA Project
- USACE Herbert Hoover Dike major rehabilitation
- Lake Okeechobee habitat enhancements

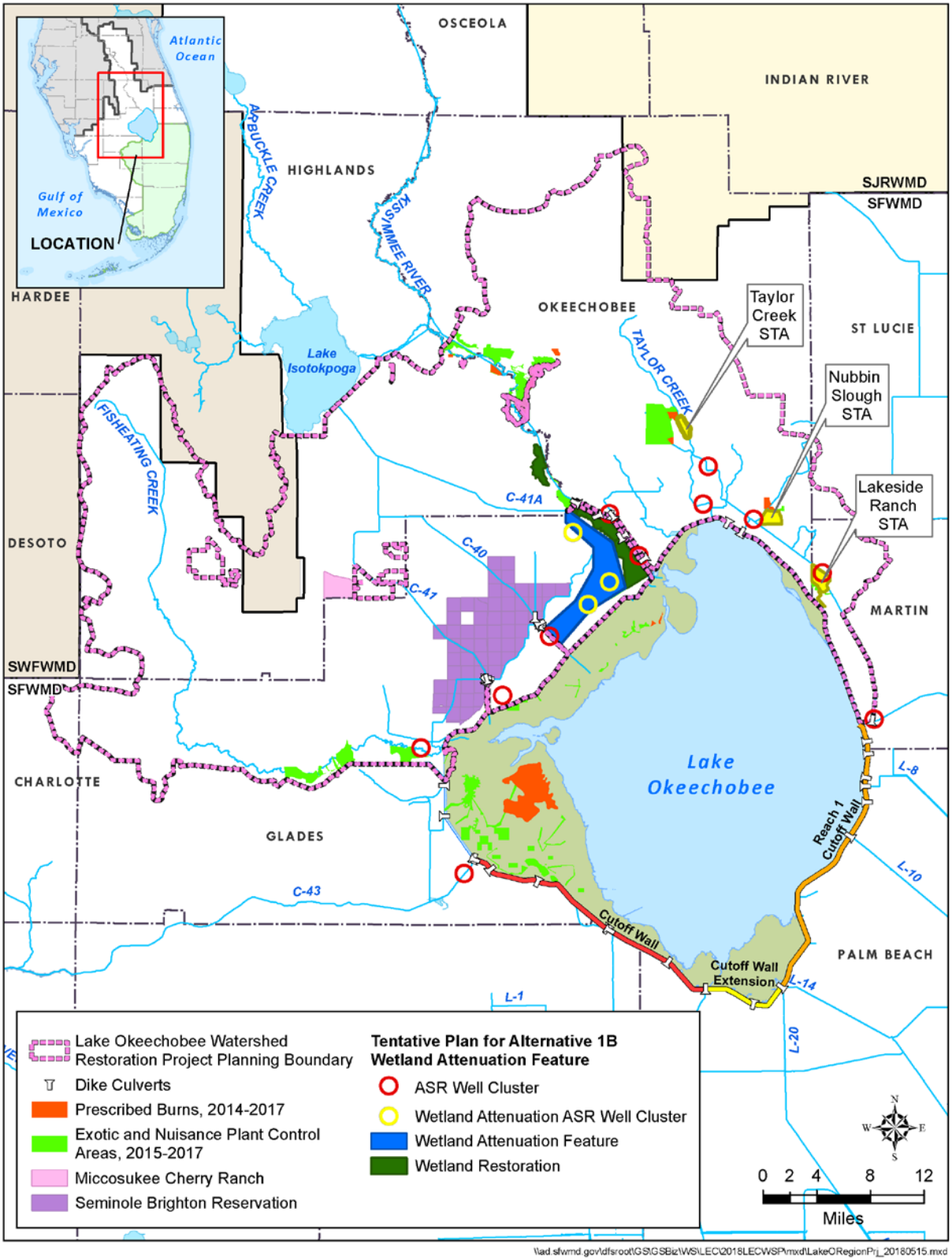

Figure 6-1. Water resource development projects in the Lake Okeechobee region.

CERP Lake Okeechobee Watershed Restoration Project

The CERP Lake Okeechobee Watershed Restoration Project (LOWRP) area (**Figure 6-1**) covers approximately 920,000 acres, including the four major drainage basins that supply water to Lake Okeechobee: Fisheating Creek, Indian Prairie, Taylor Creek/Nubbin Slough, and Lower Kissimmee (S-65D and S-65E). In 2016, the USACE and SFWMD began planning efforts for the LOWRP, with the following goals and objectives:

- Improve the quantity, timing, and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stages more often;
- Improve the quantity and timing of discharges to the St. Lucie and Caloosahatchee estuaries;
- Increase the extent and functionality of aquatic and wildlife habitat within Lake Okeechobee and the surrounding watershed; and
- Increase the availability of water supply to existing legal water users of Lake Okeechobee.

To achieve these project goals and objectives, the LOWRP team is evaluating various management measures such as water storage features (e.g., aboveground reservoirs, aquifer storage and recovery [ASR] wells) and wetland restoration components. By creating additional water storage north of Lake Okeechobee, the LOWRP can improve flexibility in the timing and distribution of water in the lake, to the estuaries, and throughout the watershed. Water can be stored during wet times to reduce damaging high lake levels and be released into the lake during dry times to reduce adverse impacts of low lake levels. Wetland restoration components of the LOWRP are designed to improve the functionality and habitat value of degraded wetlands. After evaluating various project options, the LOWRP team identified a Tentatively Selected Plan in 2018, which will undergo further review and analysis prior to formal submittal for a USACE agency decision.

Northern Everglades and Estuaries Protection Program

The goals and objectives of CERP and the Northern Everglades and Estuaries Protection Program overlap considerably, and the projects often complement one another. Numerous efforts have been conducted as part of Northern Everglades and Estuaries Protection Program, including completion of two pilot-scale STAs in Taylor Creek and Nubbin Slough as well as Phase I and II construction of the Lakeside Ranch STA.

Taylor Creek STA Pilot Project

Under Phase 1 of the Lake Okeechobee Watershed Construction Project, now a component of the Northern Everglades and Estuaries Protection Program, the Taylor Creek STA Pilot Project was constructed by the USACE in central Okeechobee County in 2006 and is included in the Lake Okeechobee Basin Management Action Plan. The 142-acre STA has an effective treatment area of 118 acres. Initial operations began in 2008, were subsequently suspended for repairs, and resumed in September 2010. The USACE and SFWMD co-sponsor the project and have a 50-50 cost share agreement. The SFWMD is responsible for the operation, monitoring, and maintenance of the facility under a Florida Department of Environmental Protection (FDEP) permit (as of May 2011).

The Taylor Creek STA Pilot Project was expected to treat approximately 10 percent of the water flow in Taylor Creek and remove an estimated 2 metric tons (38 percent) of total phosphorus per year (Goforth 2005). However, actual conditions since the STA went into operation have been lower than anticipated, and the STA, on average, has been removing approximately 1 metric ton of total phosphorus per year. The lack of consistency in STA performance led to investigations of the potential causes and recommendations for management measures to improve performance (Villapando 2016).

Nubbin Slough STA Pilot Project

Under Phase 1 of the Lake Okeechobee Watershed Construction Project, the Nubbin Slough STA Pilot Project was constructed by the USACE in 2006. Located approximately 7 miles southeast of the City of Okeechobee, this 809-acre STA has two cells, with a total effective treatment area of 773 acres. The project began operations in 2012, then underwent repairs through December 2014. The SFWMD is the project's local sponsor and has operated the facility under an FDEP operation and maintenance permit since March 2015.

The Nubbin Slough STA Pilot Project was expected to remove approximately 5 metric tons (85 percent) of total phosphorus per year. However, the project has encountered several operational problems since it was constructed. Recent inspections have revealed the need for repairs to the western levee of Cell 2, which has limited the operating water level of the STA until a repair plan can be prepared and funding secured for implementation. Operations are suspended; however, water quality monitoring continues, as required by the FDEP permit, to capture intermittent flow activity and monitor mercury levels.

Lakeside Ranch STA Project

The Lakeside Ranch STA Project is a key component of the Northern Everglades and Estuaries Protection Program and is featured in the *Lake Okeechobee Watershed Construction Project Phase II Technical Plan* (SFWMD et al. 2008), which was authorized by the Northern Everglades and Estuaries Protection Act [Section 373.4595(3)(b)(2), F.S.].

Lakeside Ranch STA Project

Located along the northeastern edge of Lake Okeechobee in Martin County, the Lakeside Ranch STA Project was designed in two phases. Phase I was completed in May 2012 and included a northern STA with an effective treatment area of 919 acres, canal improvements along the L-63 and L-64 levees, and installation of the S-650 pump station. Phase II was completed in August 2018 and includes a southern STA with an effective treatment area of 788 acres, a discharge canal, and a new pump station at S-191. Combined, the two STAs are expected to reduce total phosphorus loads to Lake Okeechobee by up to 19 metric tons (82 percent) per year and may provide additional phosphorus removal by recirculating water from the lake.

USACE Herbert Hoover Dike Major Rehabilitation

Herbert Hoover Dike Rehabilitation Construction

The USACE is rehabilitating the Herbert Hoover Dike, a 143-mile series of levees and structures surrounding Lake Okeechobee, to address structural integrity concerns. The Herbert Hoover Dike was authorized in 1930 and constructed by hydraulic dredge and fill methods. In 2006, the USACE assigned the Herbert Hoover Dike a Safety Action Classification (DSAC Level 1), representing the highest risk of failure and requiring remedial action.

The USACE (2000) divided the dike into eight segments, called reaches, with the initial focus on Reach 1. This reach-by-reach approach was replaced in 2016 with the systemwide risk reduction approach the USACE utilizes for safety modifications to dams. The remediation measures address the highest points of potential failure in the system and reduce the overall risks to tolerable levels.

Implementation of the 21.4-mile cutoff wall component in Reach 1 was completed in 2013, and gap closures at existing structures are anticipated to be completed in 2019. This will complete risk reduction to the embankment within Reach 1. In addition, 32 water control structures (culverts) operated by the USACE are being replaced, removed, or abandoned. The first construction contracts were awarded in 2011, with scheduled completion for all culverts by 2022. To date, 1 culvert has been removed, 8 culverts have been replaced, and 18 culvert replacements are in progress. The final 2 replacements and 3 abandonments are planned to be awarded construction contracts in 2018 and 2019.

The Major Rehabilitation Report Supplement (USACE 2015) was approved in 2015 to support the 6.8-mile Reach 1 Cutoff Wall Extension, and a contract was awarded in March 2018 with anticipated completion in 2021. Due to the dike's Safety Action Classification Level 1 rating, the Florida Legislature appropriated $50 million in 2017 and 2018 for acceleration of the dike rehabilitation. The State funding will pay for a portion of the Reach 1 Cutoff Wall Extension contract, and the total of $100 million in contributed funding will allow the USACE to shorten the schedule of the project by several years.

In 2016, the USACE completed a comprehensive, systemwide Dam Safety Modification Study identifying risks and recommending measures to reduce risks to tolerable levels (USACE 2016). The study identified inundation zones around Lake Okeechobee if the dike should fail. According to the recommended plan, implementation of the following projects around the southern half of the Herbert Hoover Dike and limited areas along the northwestern side would provide sufficient risk reduction with no further remedial efforts needed around the remainder of the lake:

- The existing culvert replacement program;
- 28.6 miles of additional cutoff wall;
- Minor embankment raising and floodwalls at structures S-71 and S-72; and
- Armoring of the State Road 78 bridge over the Harney Pond Canal.

The current Integrated Delivery Schedule (USACE 2018) indicates completion of the Herbert Hoover Dike rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019. State funding has been provided to assist the USACE in expediting the rehabilitation schedule. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives.

Lake Okeechobee Habitat Enhancements

In 2015 and 2016, the Florida Fish and Wildlife Conservation Commission (FWC) and the SFWMD partnered to enhance Moonshine Bay habitats that had converted to dense monocultures of cattail (*Typha* spp.). Herbicides and prescribed burns were used to remove dead vegetation the following year. These activities were extremely effective at providing a mix of open-water foraging and nesting habitat for wading birds and the endangered Everglades snail kite (*Rostrhamus sociabilis* var. *plumbeus*). The 2016 snail kite breeding season was a record high for Lake Okeechobee, with most activity concentrated in the managed areas. In 2017, the FWC and SFWMD sprayed 2,400 acres of exotic torpedograss (*Panicum repens*) and 1,600 acres of cattail in Lake Okeechobee. In early 2018, portions of those areas were being used by wading birds and snail kites. The Florida Forest Service is partnering with the FWC and SFWMD to more effectively burn the managed areas of the lake at regular intervals. In early 2018, the three agencies jointly conducted a prescribed burn of approximately 1,500 acres along the Indian Prairie marsh.

Everglades

The following water resource development projects are within, have an effect on, or are affected by the Everglades region and are discussed in this section (**Figure 6-2**):

- Everglades Forever Act projects, including the Restoration Strategies Regional Water Quality Plan
- Modified Water Deliveries to Everglades National Park (ModWaters)
- CERP Water Conservation Area (WCA) 3A Decompartmentalization Physical Model
- CERP Central Everglades Planning Project (CEPP)
- Wading bird monitoring report
- Tree island mapping
- Florida Bay projects
  - C-111 South Dade Project
  - S-197 Structure Replacement Project and Automation
  - CERP C-111 Spreader Canal Western Project
  - South Dade Study and Florida Bay Plan

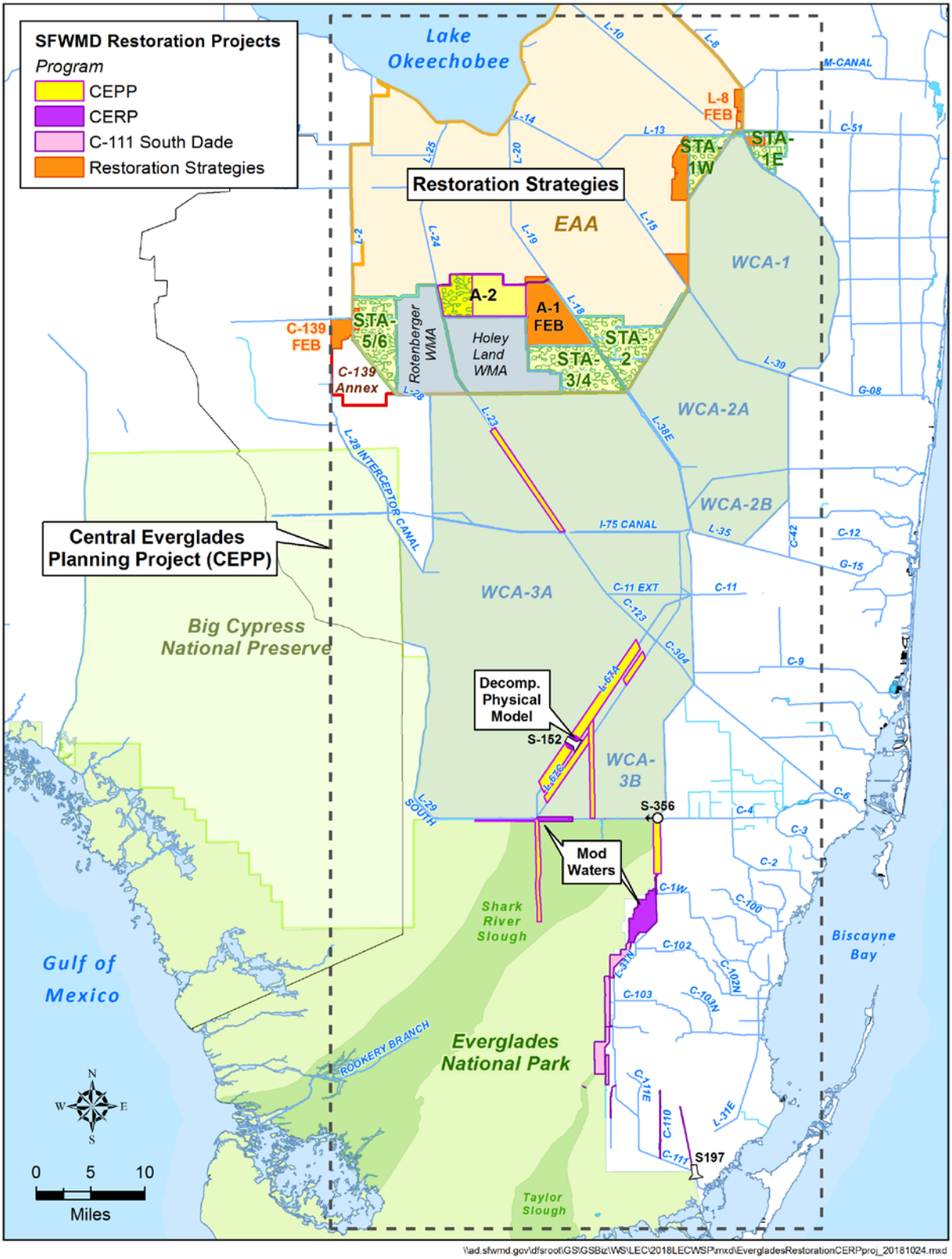

Figure 6-2. Water resource development projects in the Everglades region of the LEC Planning Area. (Note: Florida Bay projects are shown in greater detail in **Figure 6-6**).

Everglades Forever Act Projects

The Everglades Forever Act was passed in 1994 [Section 373.4592, F.S.] to ensure all water discharged to the Everglades Protection Area meets stringent water quality (phosphorus) standards. The status of the impacted areas, construction progress, best management practice implementation, and exotic species removal is updated annually in the SFER.

In 2012, the FDEP and SFWMD, in coordination with the United States Environmental Protection Agency, reached consensus on new restoration strategies to expand water quality improvement projects and achieve the water quality (phosphorus) standard established for the Everglades Protection Area. Under these strategies, the SFWMD implemented the Restoration Strategies Regional Water Quality Plan to complete and operate multiple water treatment and storage projects. The projects primarily consist of flow equalization basins (FEBs), STA expansions, and associated infrastructure and conveyance improvements, though some projects address pollution reduction at the source in the Everglades Agricultural Area.

INFO

Flow equalization basins are constructed storage features used to capture peak stormwater flows in order to provide a steadier flow of water to stormwater treatment areas, helping to maintain water levels needed to achieve optimal water quality treatment performance.

As part of the Restoration Strategies Regional Water Quality Plan, the SFWMD implemented the Science Plan in 2013 and updated it in 2018 (SFWMD 2018a). The plan investigates the factors that influence performance of the Everglades STAs. By 2018, three of the nine initial Science Plan studies had been completed, the other six are nearing completion, and two new studies have been initiated. More than 6,500 acres of new STAs and 116,000 acre-feet of additional water storage will be created by the Restoration Strategies projects (**Figure 6-3**). The projects will be designed and constructed through 2025 at a total cost of approximately $880 million (**Table 6-4**).

In 2007, the SFWMD purchased the L-8 Reservoir (now the L-8 FEB), a belowground impoundment created by rock mining operations in central Palm Beach County. The L-8 Reservoir was expected to provide water storage as a CERP component but was repurposed in 2012 to serve as an FEB under the Restoration Strategies Regional Water Quality Plan. The L-8 FEB, which provides approximately 45,000 acre-feet of storage, attenuates peak stormwater flows, temporarily stores stormwater runoff, improves delivery rates to STA-1E and STA-1W, expands water storage south of Lake Okeechobee, supports interim Loxahatchee River restoration efforts, and offers additional flexibility related to flood protection and water supply operations. Construction activities at the L-8 FEB, including the L-8 divide structure, were completed in June 2017.

Located in southwestern Palm Beach County, the A-1 FEB is a 15,000-acre shallow impoundment designed to store approximately 60,000 acre-feet of water. The impoundment includes numerous water control structures, perimeter and internal embankments, and seepage management features. The A-1 FEB attenuates peak stormwater flows, temporarily stores stormwater runoff, improves delivery rates to STA-2 and STA-3/4, expands water storage south of Lake Okeechobee, and offers additional flexibility related to flood protection and water supply operations. The A-1 FEB became operational in August 2015 and cost approximately $62 million to construct.

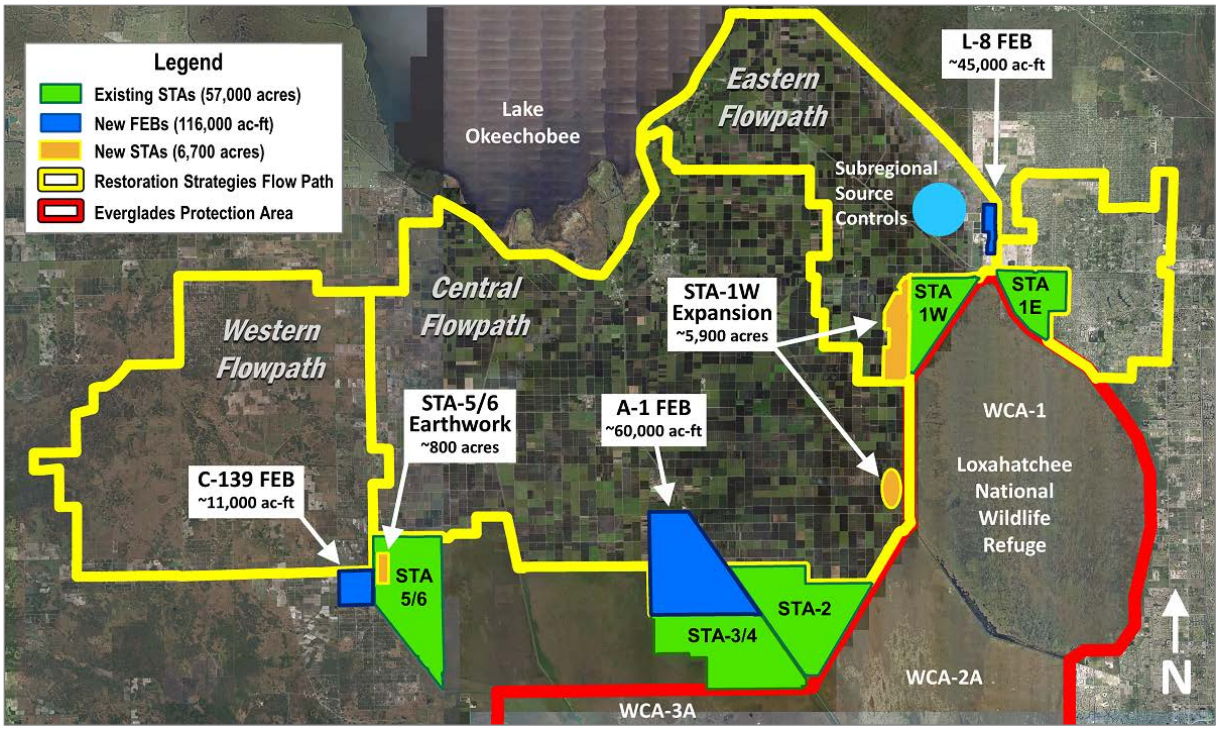

Figure 6-3. Key elements of the Restoration Strategies Regional Water Quality Plan.

Modified Water Deliveries to Everglades National Park

The United States Department of the Interior and USACE co-sponsored ModWaters, a foundation project for CERP completed in 2018 that was the first major restoration effort for Everglades National Park. The goal of ModWaters was to 1) restore natural flow into eastern Everglades National Park, which was altered by construction of roads, levees, and canals; and 2) control seepage eastward into urban areas. ModWaters was essential to provide the flow capacity necessary for future CERP projects and Everglades MFL recovery. ModWaters had five major components:

- **Taylor Slough Bridge –** A replacement bridge was constructed in 2007 to increase the flow capacity under the main park road.
- **8.5-Square Mile Area Protection Features –** A levee, seepage collection canal, and detention area were completed in 2008, and the S-357 pump station became operational in 2014. These structures maintain existing levels of flood protection to the 8.5-Square Mile Area under the higher stages expected with increased flow to northeastern Shark River Slough.
- **Tamiami Trail Modifications** – The L-29 levee and Tamiami Trail Highway impede water flow from WCA-3B to northeastern Shark River Slough in Everglades National Park. Two new water control structures were installed to allow flow through the L-29 levee, Tamiami Trail was raised, and bridge segments on Tamiami Trail were installed to address the water flow issue. Construction of a 1-mile bridge was completed in 2013. The United States Department of the Interior initiated a separate project to build a 2.6-mile bridge, and construction began in late 2016, with anticipated completion in December 2018.

- **S-356 Pump Station –** Operational since 2015, this pump station collects water that seeps out of WCA-3B and northeastern Shark River Slough into the L-30 and L-31 canals and pumps it into the L-29 Canal, thereby returning water to northeastern Shark River Slough. This component provides restoration benefits to Everglades National Park and avoids impacts on flood protection to the east. The FDEP issued an operational permit to the SFWMD in July 2017. The USACE has conducted a series of incremental field tests over the last 4 years to raise the stage in the L-29 Canal as part of developing a Combined Operational Plan, which will modify the USACE's Water Control Plan for the WCAs and Everglades National Park.
- **L-67A Conveyance Features –** New water control structures would allow water to flow from WCA-3A to WCA-3B. These features were removed from the ModWaters project due to budgetary constraints.

CERP WCA-3A Decompartmentalization Physical Model

The CERP WCA-3A Decompartmentalization and Sheetflow Enhancement Project was designed to re-establish sheetflow in the Everglades by hydrologically reconnecting WCA-3A, WCA-3B, and northeastern Shark River Slough (**Figure 6-4**). Part of this project, the CERP WCA-3A Decompartmentalization Physical Model, is a field-scale test assessing the effects of pulsed flows on hydrology, sediment transport, vegetation, and wildlife as well as the ecological effects of backfilling canals and modifying levees. This project will help determine the water supplies needed to meet the Everglades MFL recovery strategy.

Figure 6-4. CERP WCA-3A Decompartmentalization Physical Model (From: USACE 2017).

Installation of the CERP WCA-3A Decompartmentalization Physical Model was completed in October 2013. Project components included 10 culverts in the L-67A levee (S-152) and a 3,000-foot gap in the L-67C levee with three backfill treatments (no backfill, partial backfill, and complete backfill). The S-152 structure allows for pulsed releases toward the various backfill treatments in the L-67C gap. Four operational testing periods have occurred between October and January in 2013, 2014, 2015, and 2016. Additional year-round testing is tentatively planned through 2021.

CERP Central Everglades Planning Project

Authorized by Congress in 2016, CEPP combines a series of CERP components into one project implementation report. The purpose of CEPP is to improve the quantity, quality, timing, and distribution of water flows to the northern estuaries, central Everglades (WCA-3A, WCA-3B, and Everglades National Park), and Florida Bay while increasing water supply for municipal, industrial, and agricultural users. In July 2014, the USACE and SFWMD (2014a) completed the *Central Everglades Planning Project Implementation Report and Environmental Impact Statement*, which describes the project purpose and need, location, evaluation of alternatives, and recommended plan. CEPP was authorized by Congress in 2016.

In 2017, the SFWMD prepared a Post Authorization Change Report (SFWMD 2018b) to CEPP under the authority provided by Section 203 of the Water Resources Development Act of 1986, as amended. The change increases the amount of water storage and treatment authorized in CEPP to reduce damaging discharges from Lake Okeechobee to the northern estuaries and allow more water to move to the central Everglades. The modifications to CEPP are: 1) change the A-2 FEB to a 240,000-acre-foot reservoir with multipurpose operational flexibility and a 6,500-acre STA, and 2) increase conveyance in the Miami and North New River canals. The changes were authorized by America's Water Infrastructure Act of 2018 in October 2018. The following CEPP components for storage and treatment, distribution and conveyance, and seepage management are included in the recommended plan (**Figure 6-5**).

Storage and Treatment

- Construction of an STA and reservoir on the A-2 parcel (also known as EAA Storage Reservoir) and integrated operations with the Restoration Strategies Regional Water Quality Plan A-1 FEB operations.
- Diversion of L-6 Canal flows and L-5 Canal improvements.
- Removal of approximately 3 miles of the western portion of the L-4 levee and modification of the S-8 pump station.
- Miami Canal backfill and spoil mound removal (beginning 1.5 miles south of the S-8 structure and ending at Interstate 75).

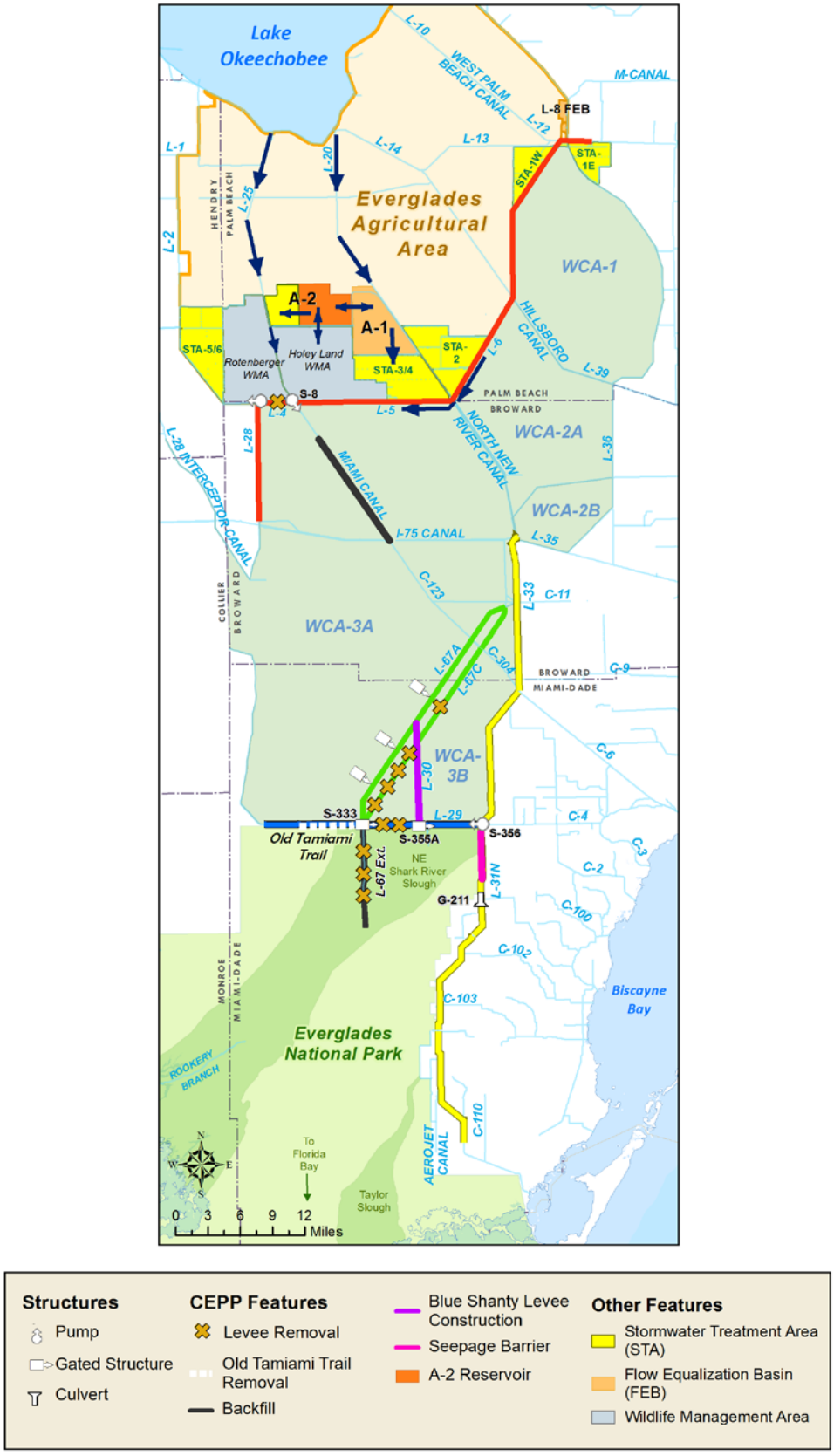

Figure 6-5. Central Everglades Planning Project features.

Distribution and Conveyance (Southern WCA-3A/3B)

- Modification of the S-333 structure.
- Construction of three structures and spoil removal west of the L-67A Canal north and south of the structures, with two of the structures at the beginning of the flow-way from WCA-3A through WCA-3B to Everglades National Park.
- Construction of a levee in WCA-3B connecting the L-67A and L-29 levees along with removal of the L-67C (no canal backfill) and L-29 levees, creating a flow-way from WCA-3A through WCA-3B to Everglades National Park.
- Construction of a gated structure along the L-67A levee and a 6,000-foot gap in the L-67C levee.
- Removal of the L-67 extension levee and backfill of the L-67 extension canal.
- Removal of Old Tamiami Trail from the L-67 extension levee to Everglades National Park's Tram Road.

Seepage Management

- Increase in the capacity of the S-356 pump station.
- Construction of a partial depth seepage barrier south of Tamiami Trail (along the L-31N levee).
- Systemwide operations refinements.

To provide early project benefits and help alleviate high-water events in WCA-3A and WCA-3B, the SFWMD is expediting two components of CEPP to be completed by 2020: the removal of Old Tamiami Trail and the modification of the S-333 structure.

Wading Bird Monitoring Report

Each year, SFWMD staff prepare the Wading Bird Monitoring Report addressing wading bird breeding colonies in South Florida. Wading birds are indicators of environmental health, and the collection of data and analysis of trends help to track changes in the environment. The 2017 report documents improved nesting effort and success for Wood Storks (*Mycteria americana*) but continued declines in the nesting activity of other wading bird species, highlighting the need for Everglades restoration and development of regional water resource development projects (Cook and Baranski 2018).

Tree Island Mapping

Everglades tree islands are critical habitat areas and centers of biodiversity. In 2011, the SFWMD mapped tree islands within Everglades National Park using stereoscopic analyses of aerial photographs from 1952 through 2004. Previous mapping efforts found tree island degradation or loss in 90 percent of WCA-2A and 60 percent of WCA-3A since the 1940s due to hydrologic alterations. Everglades National Park staff are mapping the different vegetation types that characterize the park and Big Cypress National Preserve. These mapping studies incorporate the status of tree islands in Everglades National Park and highlight the need for regional water resource development projects that restore hydrologic conditions in the WCAs to sustain tree islands.

Florida Bay

The following water resource development projects affect Florida Bay and are discussed in this section (**Figure 6-6**):

- C-111 South Dade Project
- SFWMD S-197 Structure Replacement Project and Automation
- CERP C-111 Spreader Canal Western Project
- South Dade Study and Florida Bay Plan

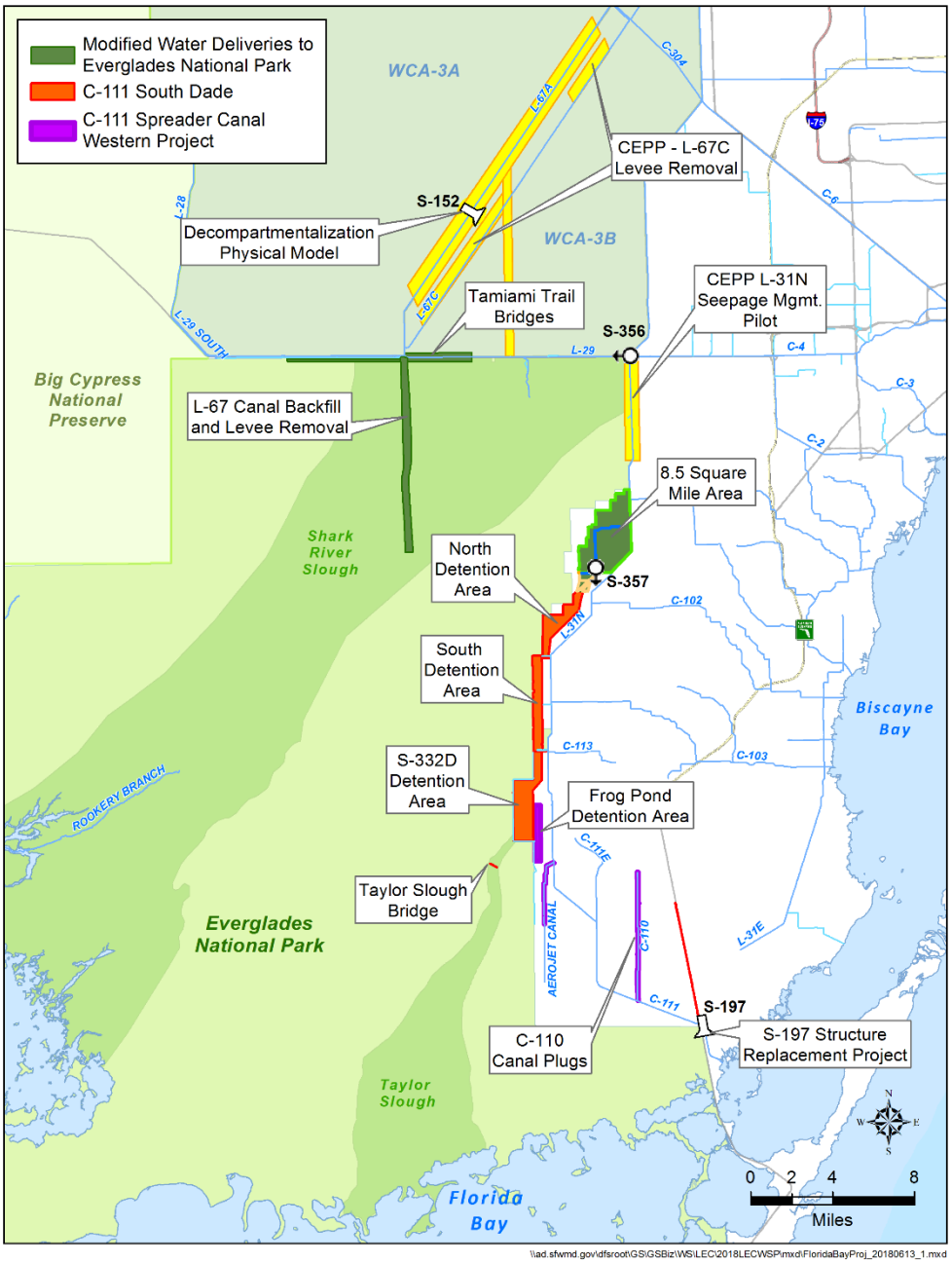

Figure 6-6. Water resource development projects in the Florida Bay region that support Everglades restoration.

C-111 South Dade Project

In 1995, the USACE and SFWMD executed a cost-share agreement to jointly implement the C-111 South Dade Project, a foundation project completed in 2018, that CERP builds upon to deliver essential restoration benefits to the Everglades. The objective of the C-111 South Dade project is to restore natural hydrologic conditions in Taylor Slough and the eastern panhandle of Everglades National Park while also preserving the current level of flood protection for agricultural lands in southern Miami-Dade County. The project works with the infrastructure constructed for ModWaters and created a hydraulic ridge to prevent groundwater from seeping out of Everglades National Park and to allow additional water flow into Florida Bay. This project provides water supplies identified in the Florida Bay MFL prevention strategy.

The C-111 South Dade Project, composed of 12 contracts, began in 1994, with construction commencing in 1996. As of 2013, 7 of the 12 contracts had been executed, and 3 contracts were deferred. In 2014, the cost-share agreement between the USACE and SFWMD was amended to enable the USACE and SFWMD to continue construction and complete the remaining features. The following work was completed:

- Two interim pump stations and one permanent pump station were constructed between 1997 and 2002.
- 4.75 miles of spoil mounds along the lower C-111 Canal were removed in 1997.
- Taylor Slough Bridge was replaced in 1999.
- Partial retention/detention zones were completed in 2000 and 2002.
- The S-331 Command and Control Center was constructed in 2009.
- The South Detention Area, linking previously separated pump station detention areas, was constructed in 2009.
- Construction of 10 plugs in the L-31W Canal as well as re-building of the L-31W levee and the Taylor Slough integrated weir was completed in early 2018.
- Construction of the North Detention Area was completed in 2018.
- The L-359 and South detention areas were modified to create an eastern flow-way between the S-357 and S-332C pump stations (approximately 8 miles) in 2018.

The next step is to replace the interim pumps at the S-332B and S-332C pump stations with permanent ones. The USACE and the SFWMD entered a cost-share agreement in 2018 to complete a Post-Authorization Change Report seeking Congressional authorization for construction of the permanent pump stations.

S-197 Structure Replacement Project and Automation

Located in southern Miami-Dade County near Manatee Bay, the S-197 structure is an important flood control component that also provides environmental benefits and water resource protection by preventing saltwater intrusion into coastal fresh waters. In 2013, the SFWMD replaced the S-197 structure using the same operation criteria, location, and discharge capacity to ensure it continues to be an effective component of flood control operations in the C-111 Canal. The SFWMD initiated a project to automate operation of the S-197 structure, allowing remote operation from SFWMD control centers. Automation is expected to be completed in 2019.

CERP C-111 Spreader Canal Western Project

The CERP C-111 Spreader Canal Western Project (**Figure 6-7**) involves structural and operational changes to improve 1) the quantity, timing, and distribution of water delivered to Florida Bay via Taylor Slough; and 2) hydroperiods within the wetlands of the Southern Glades and Model lands. The project provides more natural sheetflow to Florida Bay and decreases damaging discharges to Manatee Bay and Barnes Sound without adversely impacting existing levels of flood protection to adjacent agricultural and urban lands. The project provides water supplies identified in the Florida Bay MFL prevention strategy.

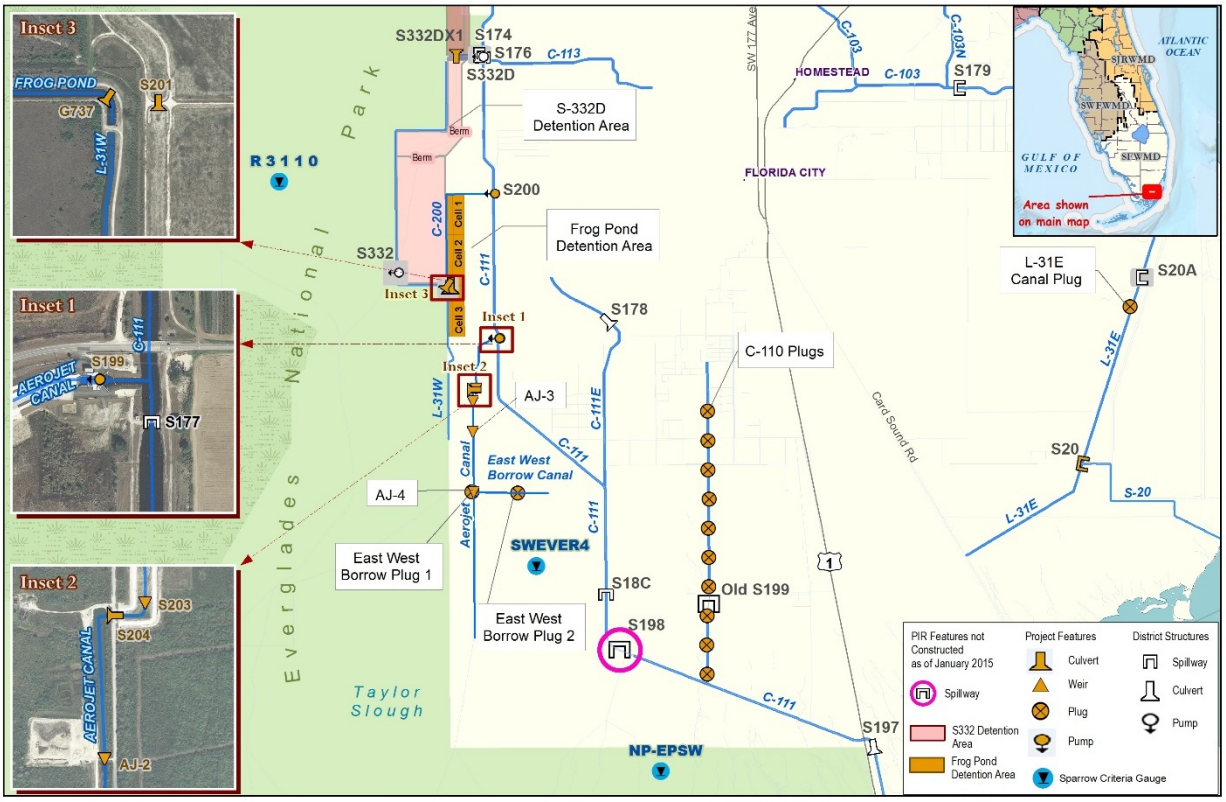

Figure 6-7. C-111 Spreader Canal Project – Phase 1.

The SFWMD completed construction of the CERP C-111 Spreader Canal Western Project in 2012 using State funds to create a 6-mile hydraulic ridge adjacent to Everglades National Park, which keeps more natural rainfall and water flows within Taylor Slough. Congress authorized the CERP C-111 Spreader Canal Western Project in 2016.

In 2015, the SFWMD sought to improve flows to Taylor Slough by expanding the capacity of the S-200 and S-199 pump stations to 300 cubic feet per second to move water from the C-111 Canal to the Frog Pond Detention Area and Aerojet Canal. The USACE and FDEP issued permits and construction of both features will be complete in 2018. The SFWMD also added culverts (G-737) in 2017 to connect the S-200 pump station to the L-31W Canal to deliver water to Taylor Slough.

Important changes in the hydrology and ecology of the southern Everglades wetlands, the mangrove ecotone, and Florida Bay are expected to occur as a result of the CERP

C-111 Spreader Canal Western Project. The ecological effects of the project are being assessed by comparing baseline and post-implementation monitoring data. Previous monitoring efforts developed baseline data for operational and restoration planning, performance measures and targets, and simulation models. Post-implementation monitoring is ongoing and includes the following:

- Monitoring changes in nutrient and organic matter transport and transformations in water flowing from canals and through the wetlands of the southern Everglades to Florida Bay;
- Documenting changes in salinity patterns within coastal wetlands and estuaries; and
- Synthesizing the findings from a large wetland monitoring network with complementary monitoring and research efforts in the region to assess status, trends, and causes of change.

According to the most recent Restoration Coordination and Verification (RECOVER) Program system status report (USACE and SFWMD 2014b), monitoring results were not yet conclusive and could not indicate how well the project is performing. However, preliminary results indicate the project features are adjusting flows in the water management system, as designed. The next status report is scheduled for 2019.

The SFWMD is conducting additional long-term monitoring, including 1) freshwater macrophyte species composition; 2) sawgrass (*Cladium jamaicense*) biomass, productivity, and tissue nutrient content; 3) soil characteristics, geochemical parameters, porewater salinity, and nutrients in several transects across the salinity gradient; 4) water levels and hydroperiod within the study area; 5) nutrient concentrations in the wetland and in creek inputs to Florida Bay; and 6) periphyton biomass and nutrient ratios at selected sites. The project will provide water quality and ecological data necessary for the CERP C-111 Spreader Canal Western Project as well as the following:

- Restoration Coordination and Verification (RECOVER) Program system status reports (available at www.evergladesrestoration.gov, Search: System Status Report);
- Assessment of the southern Everglades and Florida Bay portions of the Everglades Protection Area pertaining to the Everglades Forever Act; and
- Assessment of ongoing operational plans and effects.

South Dade Study and Florida Bay Plan

In July 2016, the District Governing Board implemented a plan to expedite additional operational and structural projects that would deliver fresh water to Florida Bay to help reduce salinity levels in the bay and promote the recovery of seagrasses following a severe drought in 2015. The plan for Florida Bay was developed out of the work of the South Dade Study. The SFWMD initiated the 6-month South Dade Study in September 2015 to examine water resource management in southern Miami-Dade County and its effects on Taylor Slough restoration, critical habitats of the Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*) in Everglades National Park, and active agricultural operations and urban areas. Water management in this area also affects the eastern panhandle of Everglades National Park, Biscayne Bay, and wetlands in southeastern Miami-Dade County. The study identified projects to reduce flood risks in urban and agricultural areas of Miami-Dade County while providing water to natural areas.

Based on direction from the District Governing Board in February 2016, selected operational and structural projects were incorporated into ongoing and upcoming efforts in C-111 projects. Additional operational and structural projects were expedited by the SFWMD in July 2016 to deliver more freshwater to Taylor Slough, which connects to Florida Bay. **Figure 6-8** depicts the operational and structural changes implemented by the SFWMD between 2016 and 2018.

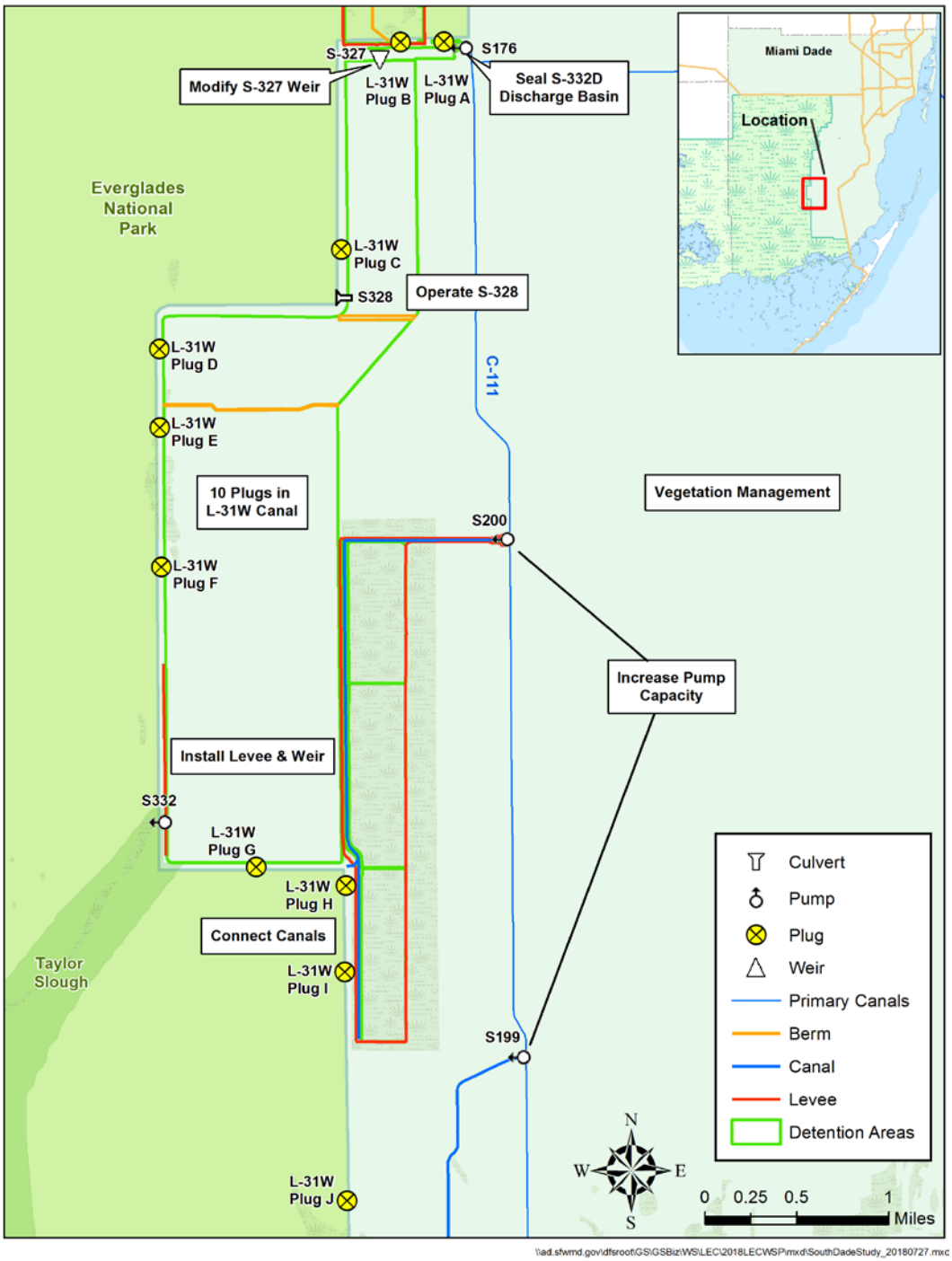

Figure 6-8. South Dade Study and Florida Bay Plan features and operational changes since 2016.

Western Basins

The following water resource development projects are within the Western Basins and are discussed in this section (**Figures 6-9** and **6-10**):

- CERP Western Everglades Restoration Project
- C-139 Annex Restoration
- Dispersed Water Management Program
- Wetland Reserve Easements Program

CERP Western Everglades Restoration Project

The CERP Western Everglades Restoration Project (WERP) area encompasses approximately 772,700 acres west of the Everglades Agricultural Area and WCA-3A. Within the LEC Planning Area, WERP includes the Western Basins (the C-139, Feeder Canal, L-28, and L-28 Gap), Big Cypress National Preserve, western WCA-3A, Seminole Tribe of Florida Big Cypress Reservation, and Miccosukee Federal Reservation (**Figure 6-9**). Through the use of water management and water quality features as well as canal and levee alterations, WERP is designed to achieve the following goals:

Big Cypress National Preserve

- Re-establish sheetflow across the Seminole Tribe of Florida Big Cypress Reservation and into Big Cypress National Preserve;
- Maintain existing levels of flood protection;
- Restore oligotrophic (low-nutrient) conditions to re-establish and sustain native flora and fauna;
- Re-establish ecological connectivity of wetland and upland habitats in the western Everglades with restored freshwater flow paths, flow volumes and timing, seasonal hydroperiods, and historical distributions of sheetflow; and
- Reduce wildfires that damage the underlying geomorphic condition of the western Everglades.
- Promote systemwide resilience considering future change (e.g., climate change, sea level rise).

Based on the results of the project, the USACE is expected to identify a Tentatively Selected Plan in 2019.

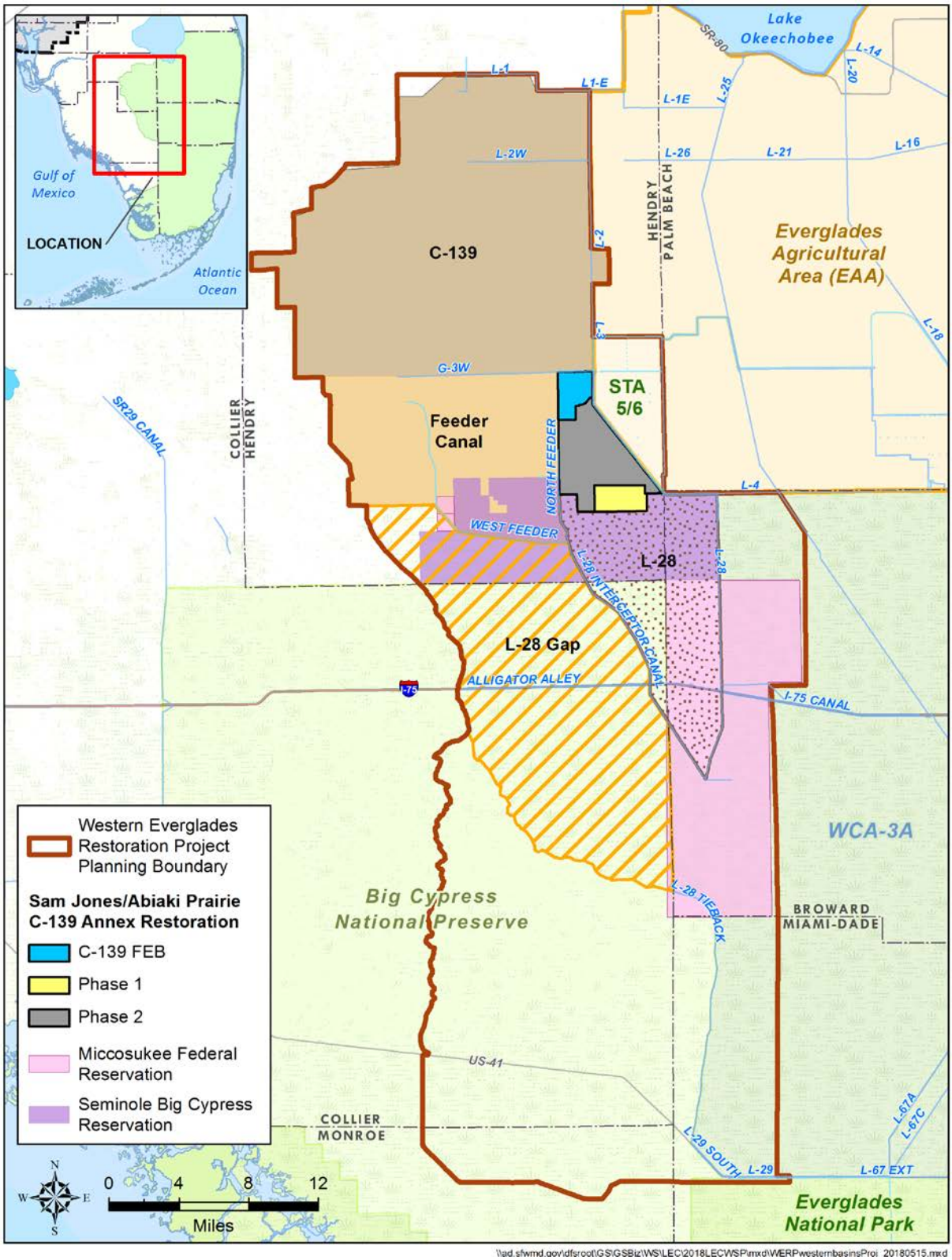

Figure 6-9. Western Everglades Restoration Project area and C-139 Annex restoration.

C-139 Annex Restoration

The goal of the C-139 Annex (Sam Jones/Abiaki Prairie) restoration project is to restore the historical functions of the wet and dry prairies, sloughs, depression marshes, and tree islands in the Everglades as much as possible. The restoration is occurring in two phases; upon completion, the smaller first phase will supply the native plant material needed for the much larger second phase. The project is being implemented with mitigation funds from limestone mining activities in the Miami-Dade County Lake Belt region.

The restoration project will restore Everglades hydrologic conditions to 6,700 acres of former citrus groves and 1,000 acres of existing wetlands (**Figure 6-9**). Restoration will progress as mitigation funds allow and is expected to be complete by 2025. The project consists of the following elements:

- Removing buildings and structures;
- Removing exotic vegetation;
- Clearing citrus trees and leveling plant beds;
- Removing old irrigation systems and abandoning unused wells;
- Backfilling canals and leveling roads and levees; and
- Replanting native vegetation and microtopographic contouring.

Within the C-139 Annex, the C-139 FEB (a future Restoration Strategies project) will attenuate peak stormwater flows from the C-139 Basin to STA-5/6. FEB design is expected to begin in 2019 with project completion by 2025.

The SFWMD and FDEP initiated the Western Basins Water Resources Evaluation Study in 2015 to evaluate data, fill in data gaps, and identify potential hydrologic and water quality improvements in the Feeder Canal Basin and C-139 Annex. The study was completed in January 2017.

Dispersed Water Management Program

Dispersed Water Management

The SFWMD participates in the multi-agency Dispersed Water Management Program, working cooperatively with public, private, and tribal landowners to retain stormwater on the landscape rather than discharging it downstream when such discharges may be harmful. Without substantial alteration, shallow water is distributed and retained on land using relatively simple structures or operational changes. To date, through a combination of public and private projects, the program has more than 144,000 acre-feet of storage in operation and an additional 234,000 acre-feet in construction, design, permitting, or planned throughout the Everglades system, including the Caloosahatchee River Estuary and St. Lucie Estuary watersheds, and sites north and south of

Lake Okeechobee. The program is implemented through independent and combined efforts among multiple local, state, and federal agencies.

The focus of the Dispersed Water Management Program is to retain runoff during the rainy season for the benefit of local waterways, wetlands, and coastal estuaries. Locally, there are some water supply benefits into the early dry season because of retention and a higher water table. However, because this is shallow storage, the volume of water is insufficient to be considered a water source during the dry season.

There is one approved dispersed water management project in the LEC Planning Area: Alico Ranch Water Management Area (**Table 6-2**; **Figure 6-10**). This 35,192-acre project is anticipated to store 91,944 acre-feet of water per year and began the design and permitting stage in 2017.

Wetland Reserve Easements Program

The United States Department of Agriculture's Natural Resources Conservation Service manages the Agricultural Conservation Easement Program, which provides financial and technical assistance to help conserve agricultural lands and wetlands. The Wetland Reserve Easements component of the program works with private landowners and Indian tribes to restore, protect, and enhance wetland areas that had been converted to agriculture, paying 75 to 100 percent of the wetland restoration costs. Once the wetland area is restored, agricultural operations and irrigation withdrawals cease, and the formerly allocated water supply becomes available for other uses. **Table 6-2** and **Figure 6-10** provide location, ownership, and acreage information for the wetland reserve easements in the LEC Planning Area.

Table 6-2. Wetland reserve easements and dispersed water management projects in the LEC Planning Area.

Figure 6-10 Map ID	Owner Name	Acres
Wetland Reserve Easements		
1	Alico, Inc.	11,594
2	Devil's Garden Golden Ox, LLC	982
3	Finca Vigia, LLC	645
4	Solon Crews Mills Jr.	4,260
5	Aspring Inc.	1,130
6	Solon Crews Mills Jr.	1,901
7	Triple A Enterprises, L.L.C.	944
8	Sunrise Sod, Inc.	318
9	RDZ, Inc.	455
10	Ganesha 302, LLC	3,483
11	Zipperer Farms, L.L.C.	6,188
12	JSW Davis & Sons Ranch LLC / J.J.W.B. Ranch, LLC	730
13	Garcia Family Farm, LLC	1,144
Dispersed Water Management		
--	Alico, Inc.	35,192

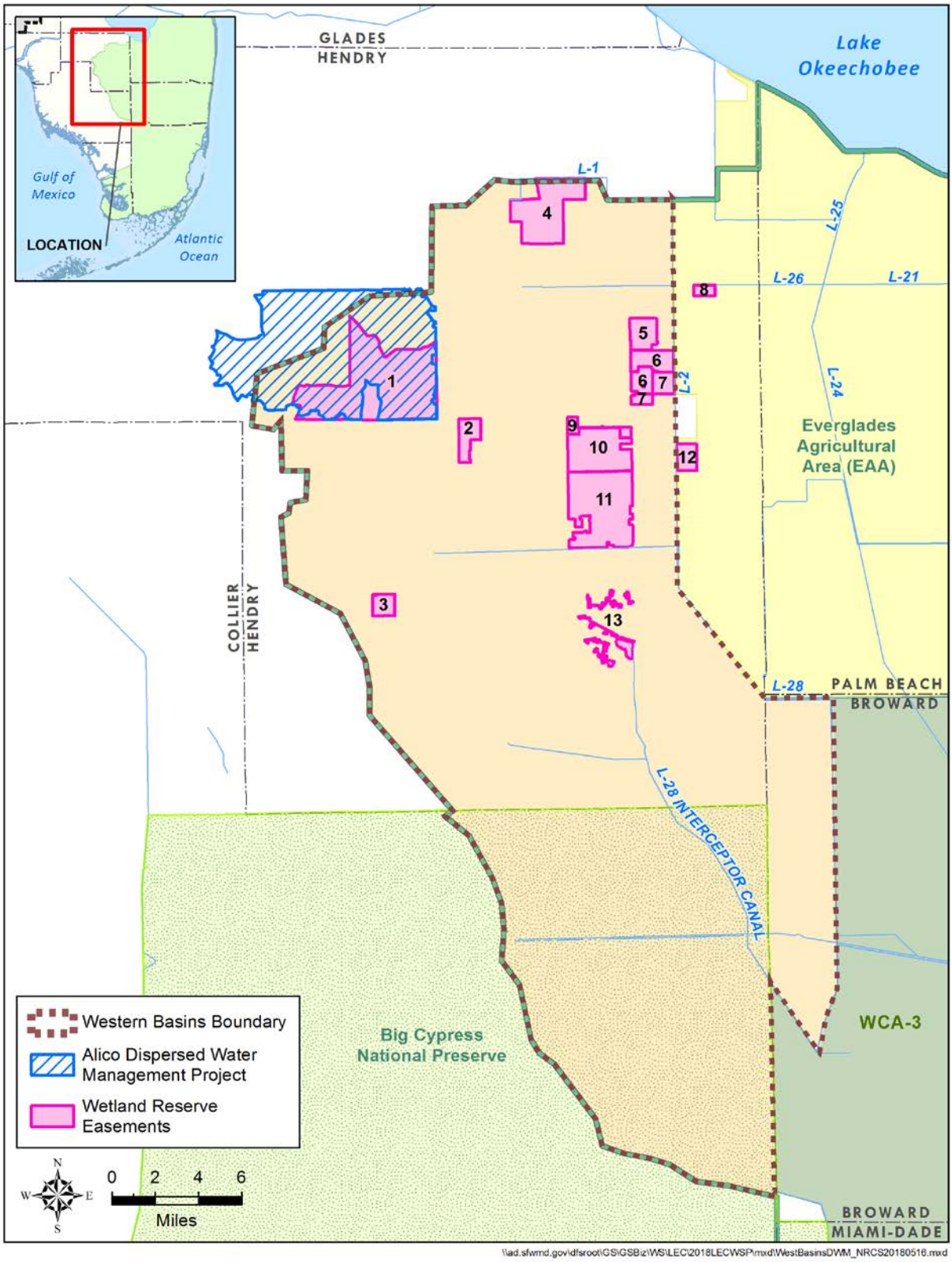

Figure 6-10. Wetland reserve easements and dispersed water management projects in the LEC Planning Area. **Table 6-2** provides details of these projects.

Lower East Coast Service Areas

The following water resource development projects are within the LEC Service Areas and are discussed in this section (**Figure 6-11**):

- Loxahatchee River projects
  - Restoration Plan for the Northwest Fork of the Loxahatchee River
  - CERP Loxahatchee River Watershed Restoration Project
  - Storage for Loxahatchee River
- CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat (formerly Acme Basin B Discharge Project)
- CERP Fran Reich Preserve Reservoir (formerly Site 1 Reservoir)
- CERP Hillsboro ASR Pilot Project
- CERP Broward County Water Preserve Areas
- CERP Biscayne Bay Coastal Wetlands Project

Loxahatchee River

The following water resource development projects affect the Loxahatchee River and are discussed in this section:

- Restoration Plan for the Northwest Fork of the Loxahatchee River
- CERP Loxahatchee River Watershed Restoration Project
- Storage for the Loxahatchee River

A description of the Loxahatchee River and Estuary is provided in **Chapter 5**, and features described here are shown in **Figure 5-8**.

Restoration Plan for the Northwest Fork of the Loxahatchee River

Loxahatchee River

In April 2003, an MFL and recovery strategy were adopted for the Northwest Fork of the Loxahatchee River. The recovery strategy included continued partnership with the FDEP and other partners to establish a practical restoration goal and plan (SFWMD et al. 2006) for the Loxahatchee River watershed and restore flows to the Northwest Fork of the river. The restoration plan was updated in 2011 (SFWMD et al. 2012) to provide information on the latest vegetation monitoring, soil salinity, and groundwater well monitoring studies conducted by staff from the SFWMD, FDEP, Florida Park Service, and Loxahatchee River District. Initial modeling that established restoration flow targets for the Northwest Fork were re-examined using new flow, salinity, and biological data and found to be valid. The flow targets are being used in the most recent CERP effort.

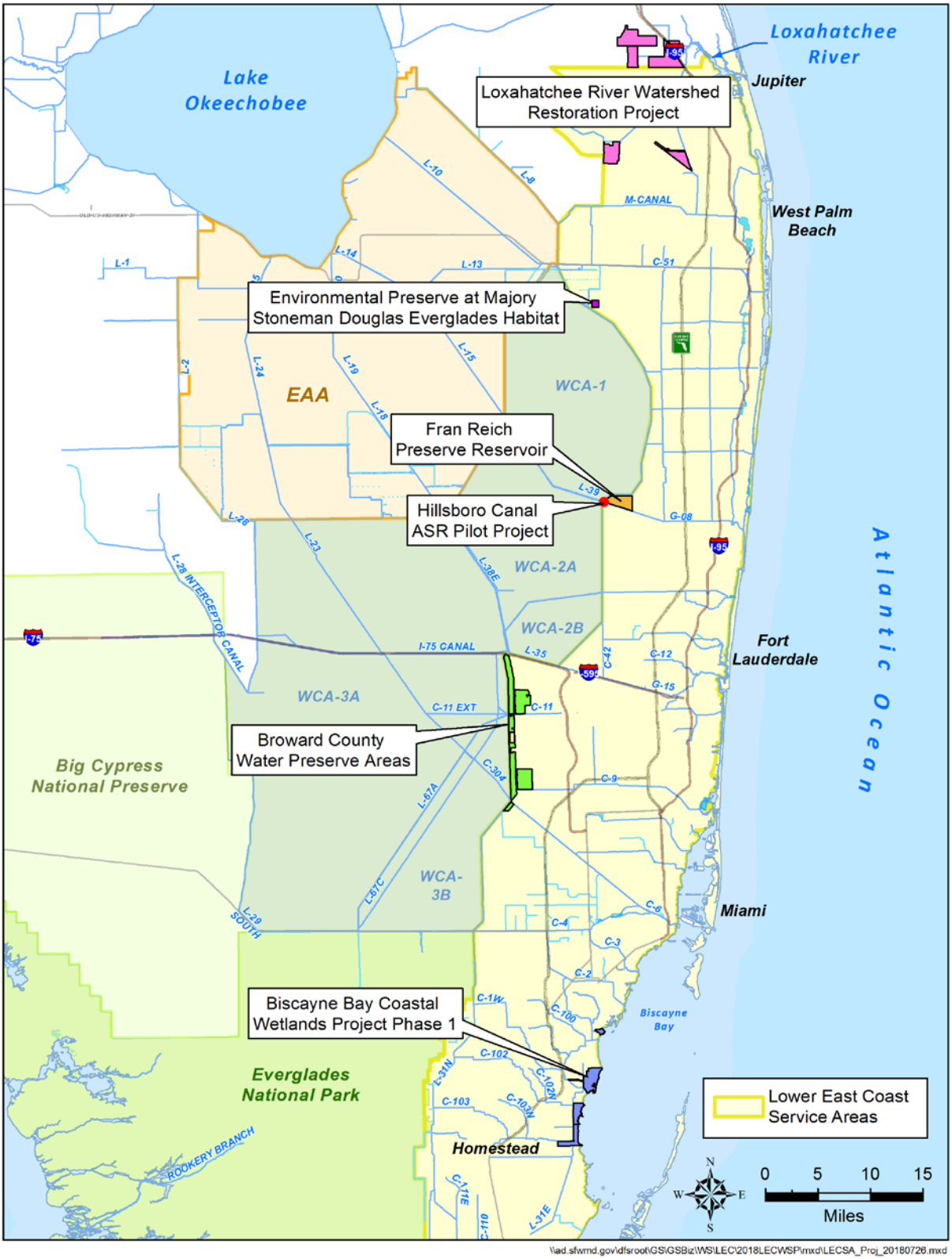

Figure 6-11. Water resource development projects in the LEC Service Areas.

The SFWMD acquired the following parcels of land in support of Northwest Fork of the Loxahatchee River restoration (**Figure 5-8**):

- Culpepper (1,282 acres)
- Cypress Creek (3,398 acres)
- Pal Mar East – Nine Gems (2,895 acres)
- Loxahatchee Slough (592 acres)
- Mecca Farms and associated easements (1,850 acres)

The following projects benefitting the Loxahatchee River have been constructed by the SFWMD or with SFWMD support:

- Installation of the G-160 (2004) and G-161 (2007) structures
- Widening of the M-Canal – initial section completed in 2007
- Nine Gems Restoration – initial activities completed in 2010
- C-18 Project culvert replacements – completed in 2011
- Culpepper hydrologic restoration – initial activities completed in 2011
- Lainhart and Masten Dam refurbishments – completed in 2017
- Loxahatchee Slough Natural Area Hydrological Restoration Project – ongoing

The Lainhart and Masten dams, first built in the 1930s, regulate upstream flow stages in the Northwest Fork of the Loxahatchee River and maintain the hydrology of the riverine floodplain ecosystem. Without the dams, upstream water levels would be approximately 1.5 feet lower, draining the freshwater swamp and facilitating saltwater intrusion. Repairs were made to decayed areas of the dams where water was no longer being held back, and soil under and around the dams was stabilized to reduce seepage. Dam restoration work cost $2.5 million and was completed in 2017.

The Loxahatchee Slough encompasses almost 13,000 acres and, along with Hungryland Slough and Grassy Waters Preserve, forms the headwaters for the Loxahatchee River. Palm Beach County owns and manages the slough, with a small portion leased from the SFWMD. Extensive restoration activities have been conducted to restore areas impacted by over-drainage, agricultural uses, and invasion of non-native plant species.

CERP Loxahatchee River Watershed Restoration Project

The CERP Loxahatchee River Watershed Restoration Project (formerly known as the North Palm Beach County Project – Part 1) encompasses 481,000 acres between the C-44 and C-51 canals, from Lake Okeechobee to the Atlantic coast. The project area includes extensive urban areas, limited agricultural areas, and large natural areas such as J.W. Corbett Wildlife Management Area, DuPuis Reserve, Jonathan Dickinson State Park, Grassy Waters Preserve, and Loxahatchee Slough and River (**Figure 5-8**). The project objectives are as follows:

- Restore wet and dry season flows to the Northwest Fork of the Loxahatchee River;
- Restore or maintain estuarine communities (e.g., oysters, fish, seagrass);
- Increase natural areal extent of wetlands;
- Restore connections between natural areas; and
- Restore native plant and animal species abundance and diversity.

Management measures (e.g., storage impoundments, wetland restoration, reconnecting historical flow paths) to meet planning objectives were incorporated into a draft tentatively selected plan, which was identified in July 2018 (**Figure 6-12**; **Table 6-3**).

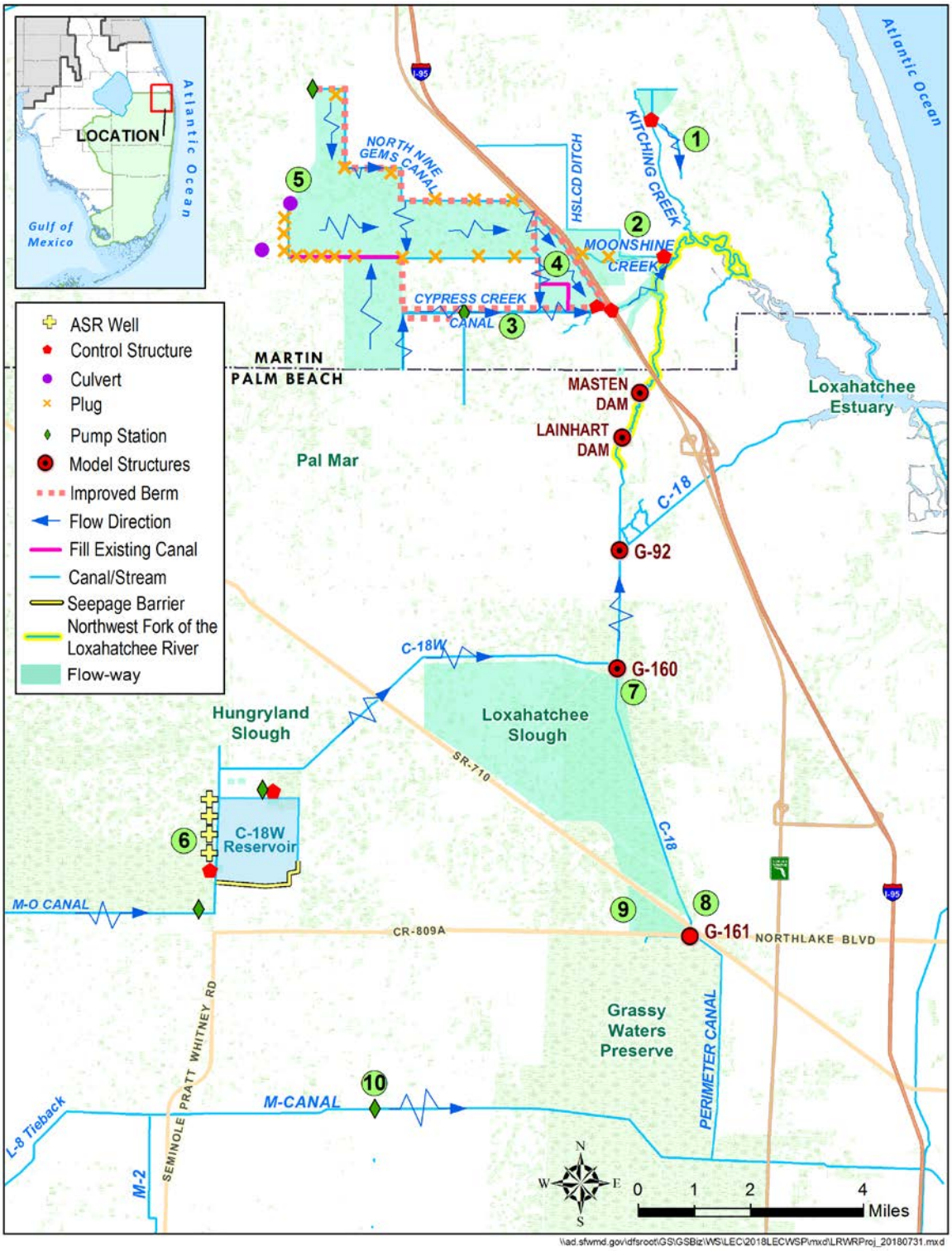

Figure 6-12. Loxahatchee River Watershed Restoration Project draft tentatively selected plan components. **Table 6-3** provides details of these projects.

Table 6-3. Loxahatchee River Watershed Restoration Project draft tentatively selected plan components.

Figure 6-12 Map ID	Name	Description
1	Kitching Creek	Improve hydration with spreader canal and Jenkins ditch weir/plug.
2	Moonshine Creek and Gulfstream East	Restore flow by connecting Hobe St. Lucie Conservancy District ditch to Moonshine Creek, install weir in Hobe Grove ditch, and regrade area to historical topography.
3	Cypress Creek Canal	Reduce over-drainage with new raised Cypress Creek Canal weir and drainage improvements, and regrade southern forks of canal.
4	Gulfstream West	Reduce over-drainage with Hobe St. Lucie Conservancy District Canal re-alignment. Restore flow with pump and flow through marsh.
5	Pal Mar East	Restore flow and connection with berm improvements, pumps, and drainage re-direction.
6	C-18W Reservoir	Provide storage with 9,500-acre-foot aboveground reservoir and 4 aquifer storage and recovery wells. Connect to M-O Canal and install pump.
7	G-160 Structure	Reduce over-drainage to improve hydroperiod in Loxahatchee Slough.
8	G-161 Structure	Connect Grassy Waters Preserve to Loxahatchee Slough and the Northwest Fork of the Loxahatchee River via the C-18 Canal.
9	Grassy Waters Preserve Triangle	Connect Grassy Waters Preserve to Loxahatchee Slough and the Northwest Fork of the Loxahatchee River via the C-18 Canal.
10	M-1 Pump Station	Convey lower M-1 Basin water to M-Canal, Grassy Waters Preserve, and G-161 structure.

The L-8 Reservoir originally was acquired to provide water storage as a component of the CERP North Palm Beach County-Part 1 Project. In 2012, the Restoration Strategies Regional Water Quality Plan incorporated the L-8 Reservoir as one of its features, and it now is being used as an FEB to increase the water quality improvement capabilities of STA-1E and STA-1W (**Figure 6-2**).

In 2013, the SFWMD acquired approximately 1,850 acres in the western C-18 Basin (referred to as Mecca Farms). This property was identified under the Restoration Strategies program as a potential replacement facility for the L-8 Reservoir to store and deliver water to the Northwest Fork of the Loxahatchee River. The C-18W Reservoir (Mecca Farms) is included in the Loxahatchee River Watershed Restoration Project's tentatively selected plan, along with adjacent ASR wells (**Figure 6-12**).

CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat

The Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat (formerly called the Acme Basin B Discharge Project) was the first CERP project completed in Palm Beach County and is meant to provide water quality and flood mitigation benefits. The project improves water quality by diverting urban runoff to STA-1E for additional nutrient reduction before it enters WCA-1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge).

Marjory Stoneman Douglas Everglades Habitat
Adjacent to the Village of Wellington

Beginning in 2007, 2 pump stations and a 365-acre water storage area were constructed to impound flood waters and provide a buffer between natural and developed areas. This project provides water supplies identified in the Everglades MFL recovery strategy. Project construction was completed in 2010. The SFWMD and the Village of Wellington invested approximately $35 million in the project.

CERP Fran Reich Preserve Reservoir

Located in Palm Beach County, the Fran Reich Preserve Reservoir (formerly called the Site 1 Reservoir) is a proposed 1,660-acre, 8-foot deep, aboveground impoundment to capture and store excess surface water from the Hillsboro Basin and WCA-1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge). With the reservoir in place, dry season water withdrawals from the refuge to meet water demands would be reduced, allowing more natural and consistent water levels within the refuge. In addition, benefits to the downstream estuaries and reduced groundwater seepage from the refuge are expected. This project provides water supplies identified in the Everglades MFL recovery strategy.

In order to utilize funding from the American Recovery and Reinvestment Act of 2009, Phase I of the Fran Reich Preserve Reservoir, a standalone and usable portion of the project, was identified for construction. Phase I includes the embankment (L-40 modifications) and the S-530 spillway, which reduce seepage loss from the adjacent wildlife refuge. Phase I construction was completed in December 2016.

Phase II includes additional site preparation, earthwork, construction of pump stations, canal improvements, embankment, placement of geocells on the embankment exterior, and placement of soil cement on the embankment interior. Phase II requires congressional authorization due to increased project cost.

CERP Hillsboro ASR Pilot Project

The CERP Hillsboro ASR Pilot Project is located on the Fran Reich Preserve Reservoir site, where multiple ASR wells are planned. The project was implemented to evaluate and reduce the technical and regulatory uncertainties of a full-scale ASR project, as planned for in several CERP projects. The ASR system was installed in late 2008 and underwent initial testing between 2010 and 2012, with a focus on recovery efficiency and water quality (i.e., arsenic concentrations). Although some arsenic was observed in water recovered during the first test cycle, concentrations declined to below regulatory concern during subsequent cycles. Recovery efficiencies increased from approximately 21 percent during the first cycle to more than 40 percent by the third cycle. The USACE and SFWMD (2013) summarized the pilot project, and the results were integrated into a regional analysis of ASR implementation for CERP (USACE and SFWMD 2015).

In response to unusually wet conditions in 2017, the Hillsboro ASR system was tested again. Recovery using only artesian pressure resulted in an increased recovery efficiency of 60 percent. Future use of the Hillsboro ASR system for water management operation is under evaluation.

CERP Broward County Water Preserve Areas

The CERP Broward County Water Preserve Areas project was designed to perform three primary functions:

- Reduce seepage loss from WCA-3A/3B to developed areas (i.e., the C-11 and C-9 basins).
- Capture, store, and distribute surface water runoff from the western C-11 Basin.
- Restore wetlands, recharge groundwater, improve hydroperiods in WCA-3A/3B, and maintain flood protection.

The following major infrastructure features will be constructed as part of the project:

- **C-11 Impoundment** – A 1,168-acre impoundment to capture and store runoff from the C-11 Basin, reduce pumping of surface water into the WCAs, and provide releases for other regional uses.
- **WCA-3A/3B Seepage Management Area** – A 4,353-acre seepage management area that would establish a buffer to reduce seepage from WCA-3A/3B, connect the C-11 and C-9 impoundments via conveyance canal, and maintain flood protection.
- **C-9 Impoundment** – A 1,641-acre impoundment to capture and store surface runoff from the C-9 Basin, store C-11 Impoundment overflow, manage seepage, and provide releases for regional benefit.

These infrastructure features will provide various functions such as reducing seepage from WCA-3A, reducing phosphorus loading to WCA-3A, capturing stormwater otherwise lost to tide, and providing conveyance features for urban and natural system water deliveries. The preserve areas will benefit federally listed threatened and endangered species and many wading birds. This project provides water supplies identified in the Everglades MFL recovery strategy. The project received congressional authorization in 2014. Design efforts are under way for the C-11 Impoundment, and construction began in October 2017 on a portion of the mitigation area. Construction of the C-11 Impoundment is expected to be completed in 2027. The WCA-3A/3B Seepage Management Area is anticipated to begin construction in 2027. Construction of the C-9 Impoundment is expected to begin in 2030.

CERP Biscayne Bay Coastal Wetlands Project

Development of surface water drainage systems and groundwater withdrawals altered the quantity, quality, timing, and distribution of freshwater flows to Biscayne Bay. Water quality in the bay suffered due to rapid runoff from surface water drainage systems. Development shifted the overall balance of freshwater inflows to Biscayne Bay, which altered the bay's salinity. The Water Quality Data Analysis (Migliaccio 2008) and Storm Event Sampling in the Biscayne Bay Watershed (Migliaccio 2009) projects were designed to further understand these impacts. The links between development, freshwater inflows, and the bay's ecology are complex. The Biscayne Bay Seepage Study (Langevin 2001) and Characterization of Nearshore Epifauna Study (Browder et al. 2011) were part of the effort to clarify these relationships.

The CERP Biscayne Bay Coastal Wetlands (BBCW) Project is essential to the restoration of tidal wetlands and nearshore habitats within Biscayne Bay, including Biscayne National Park. The project will divert runoff that currently discharges directly to the bay through regional canals and will redistribute the fresh water through a spreader canal system into the coastal wetlands adjoining Biscayne Bay to provide more natural overland flow. The slower, more natural delivery of fresh water over a broad area is expected to provide more stable salinity conditions and re-establish appropriate estuarine salinities for fish and shellfish nursery habitat in tidal wetlands and the nearshore bay.

Phase 1 of the CERP BBCW Project is composed of three flow-ways: Deering Estate, Cutler Wetlands, and L-31 East (**Figure 6-13**). In advance of congressional authorization and appropriations, the SFWMD constructed the Deering Estates Flow-way and a portion of the L-31E Flow-way.

- **Deering Estate Flow-way –** This flow-way redistributes excess freshwater runoff, directing it away from existing canal discharges and spreading it out as sheetflow prior to discharging into Biscayne Bay. The SFWMD completed construction of the flow-way in April 2012. The project became operational in November 2012.

Deering Estate Flow-Way Pump Station (S-700)

- **Cutler Wetlands Flow-way –** This component includes construction of a pump station on the C-1 Canal, a lined conveyance canal, a spreader canal system, and box culverts under roadways, in addition to plugging mosquito control ditches. The pump station will deliver water to the spreader canal in the saltwater wetlands via a lined conveyance canal. The project is under permit review, and a design update is scheduled for 2019. The SFWMD is expected to complete construction of the Cutler Wetlands Flow-way in 2022.

- **L-31 East Flow-way –** This flow-way is designed to partially re-establish historical sheetflow and wetland hydroperiods downstream of the project area by redirecting flow through a series of new culverts. The flow-way may provide the additional benefit of mitigating impacts from freshwater discharges via existing canals. By 2013, the SFWMD had constructed four of the ten culverts planned for the L-31 East Flow-way, and the USACE constructed two additional culverts in 2017. The SFWMD will construct the final four culverts in 2018. The USACE will construct the remaining features of the L-31 East Flow-way (five pump stations and an inverted siphon) with anticipated completion by 2022. In 2017, the SFWMD initiated interim pump operations at the S-709 structure. A temporary pump was installed to divert available fresh water from the C-103 Canal through project culverts and into the L-31E Canal. Interim operations will provide early benefits to the coastal wetlands and nearshore Biscayne Bay prior to the USACE constructing the permanent S-709 pump station.

The USACE and SFWMD (2012) completed the final report for Phase 1 of the BBCW Project, which describes the project purpose and need, location, evaluation of alternatives, and recommended plan. The project was authorized by Congress in 2014.

Staff from Miami-Dade County, Biscayne Bay National Park, Deering Estate Park, the National Oceanic and Atmospheric Administration, Fairchild Tropical Botanic Garden, and Florida International University contributed to project efforts. Routine compliance monitoring is conducted for water quality, including salinity, and ecological parameters for the BBCW Project. At one monitoring site, an increased abundance of bird species, amphibians, invertebrates, and fish was observed as well as a decrease in invasive exotic plant species. The SFWMD also tracks performance of the constructed components of the BBCW Project, including freshwater flow volumes to the wetlands. Updated BBCW Project monitoring data and analyses are reported annually in the South Florida Environmental Report.

Biscayne Bay

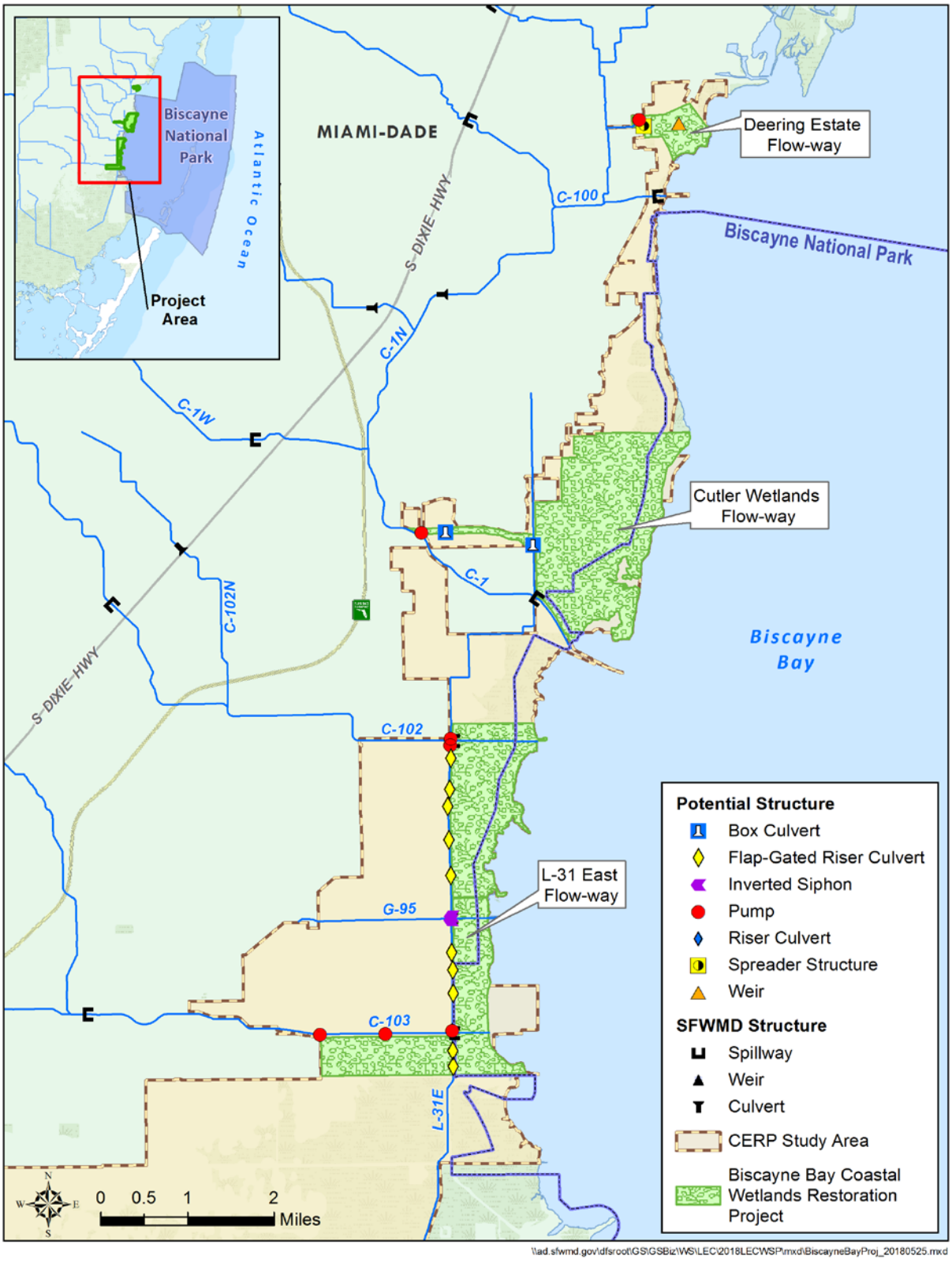

Figure 6-13. Biscayne Bay Coastal Wetlands Project – Phase 1.

DISTRICTWIDE WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects encompassing more than one planning area are considered Districtwide projects. The SFWMD is the implementing agency for the projects described in this section. **Table 6-4** at the end of this section summarizes the estimated costs and time frames of the Districtwide projects discussed herein. Aspects relevant to the LEC Planning Area are identified within the context of these Districtwide projects. **Table 6-4** does not include other programs with water resources development components, such as CERP, which are primarily budgeted as ecosystem restoration projects; however, these were discussed earlier in the chapter.

The following ongoing and future projects are discussed in this section:

- MFL, Water Reservation, and Restricted Allocation Areas rule activities
- Comprehensive Water Conservation Program
- Alternative water supply
- Drilling and testing
- Groundwater assessment – saltwater interface mapping
- Groundwater, surface water, and wetland monitoring
- Hydrologic modeling

MFL, Water Reservation, and Restricted Allocation Area Rule Activities

MFLs, Water Reservations, Restricted Allocation Areas (RAAs), and other resource protection measures have been developed to ensure the sustainability of water resources within the District. **Chapter 4** and **Appendix C** provide further information on MFLs, Water Reservations, and RAAs.

Comprehensive Water Conservation Program

The SFWMD's long-standing conservation goal is to prevent and reduce wasteful or unreasonable uses of water resources. This goal is addressed through planning; regulation; use of alternative sources, including reclaimed water; public education; and demand reduction through conservation technology, best management practices, and water-saving programs.

The Comprehensive Water Conservation Program combines a series of implementation strategies designed to create an enduring conservation ethic and permanent reduction in water use. The program was developed in conjunction with stakeholders, and the program's planning document was approved by the District Governing Board in 2008. The program is organized into regulatory, voluntary and incentive-based, and educational and marketing initiatives. More detailed information about the Comprehensive Water Conservation Program is provided in **Chapter 3**. Additional supporting information can be found in the *2016 Water Supply Plan Support Document* (SFWMD 2016a).

Alternative Water Supply

Source diversification utilizing alternative water supply projects to supplement traditional water sources is critical to meet current and future water needs. The SFWMD's Alternative Water Supply Funding Program, now part of the Cooperative Funding Program, has helped water users develop reclaimed water projects, water reclamation facilities, brackish water wellfields, reverse osmosis treatment facilities, stormwater capture systems, and ASR well systems. From FY2013 to FY2018, the SFWMD provided more than $3 million in alternative water supply funding for 11 projects in the LEC Planning Area. Funded projects created 9.25 million gallons per day (mgd) of new reclaimed water capacity and 4.19 mgd of additional reclaimed water distribution or storage in the LEC Planning Area. A full description of alternative water supply projects and associated funding is provided in the SFWMD's Alternative Water Supply Annual Reports, prepared pursuant to Section 373.707(7), F.S., and in annual updates of the SFER. Information on alternative water supply projects funded by the Cooperative Funding Program is provided in **Chapter 8**. The costs included in **Table 6-4** are for contracts and staff time.

The following water reuse/alternative water supply studies have been completed in the LEC Planning Area and are further described in the 2013 LEC Plan Update (SFWMD 2013):

- Gun Club Road Satellite Reuse Facility Feasibility Study and Pilot Project;
- Groundwater Replenishment via Canal Recharge Augmentation Study;
- Alternative Water Sources Subregional Feasibility Study; and
- Water Desalination Concentrate Management and Piloting Study.

Drilling and Testing

The SFWMD installs and continually tests groundwater monitor wells of various depths throughout the District to track aquifer water levels and water quality. Data from these wells enhance the SFWMD's knowledge of South Florida hydrogeology, improve the accuracy of regional groundwater models, and support decision-making regarding approval of water use permits. The costs included in **Table 6-4** are for contract and staff time for items such as drilling and well construction, geophysical logging, aquifer tests, sediment analysis, and lithological descriptions.

Installation of Monitor Wells in Miami-Dade County

The SFWMD has installed monitor wells throughout Miami-Dade County in support of CERP projects. A four-well monitor cluster was installed in 2015 at the S-356 pump station to evaluate 1) the effectiveness of the pumps moving water into Everglades National Park, and 2) the impacts of operating the pumps on the groundwater system (Smith 2018a). The wells were installed in three producing zones within the Biscayne aquifer, and one in the top of the Tamiami formation. Water level data loggers and telemetry provide real-time data.

Shallow groundwater monitor wells equipped with telemetry were constructed in the agricultural area east of the L-31W levee in Miami-Dade County in response to concerns that Everglades restoration activities may increase local groundwater levels (Smith 2018b). The SFWMD can use telemetry data from these wells to make real-time operational adjustments to the regional water management system. In addition, the data will be used to enhance groundwater and surface water models of the area. Three of the wells have been added to a groundwater quality monitoring network operated by Miami-Dade County.

Groundwater Assessment

Groundwater assessment includes items such as local hydrogeologic research and saltwater interface map development. The costs included in **Table 6-4** are for staff time.

G-160 and Loxahatchee Slough Groundwater-Surface Water Interaction Study

This study assessed surface water and groundwater conditions within and adjacent to the eastern portion of Loxahatchee Slough in northern Palm Beach County since the installation and operation of the G-160 structure on the C-18 Canal, particularly after the structure's headwater stage was increased in June 2009 (Collins et al. 2016). The study analyzed 2005 to 2013 data from groundwater monitor wells and several local stage and rainfall stations. Based on the analyzed data, the increased operating stage at the G-160 structure has not substantially impacted groundwater levels or resulted in adverse conditions.

Saltwater Interface Mapping

The SFWMD periodically develops maps documenting the inland extent of saltwater intrusion to understand the potential effects on wellfields and coastal aquifers (**Appendix D**). Salinity data from monitor wells were compiled from multiple sources (e.g., United States Geological Survey [USGS], SFWMD, water use permittees) to estimate the farthest inland extent of the saltwater interface, as defined by the 250 milligrams per liter (mg/L) chloride concentration in groundwater. The SFWMD has developed two series of maps for Palm Beach and Broward counties, 2009 and 2014, with plans to update the maps every 5 years (SFWMD 2014a,b). This approach tracks the saltwater interface position over time, can be used to identify areas of concern that may require additional monitoring, and may suggest the need for changes in wellfield operations. In a separate effort, Miami-Dade County contracts with the USGS to develop saltwater intrusion maps, as defined by the 1,000 mg/L chloride concentration. An interactive salinity analysis map viewer managed by the USGS is available at https://fl.water.usgs.gov/mapper and includes the SFWMD 2014 and USGS 2011 saltwater interface positions.

The saltwater interface is regionally dynamic, with inland movement in some areas and seaward movement in other areas. Local-scale investigation of the interface position could be warranted in some areas, depending on the network of monitor wells available, the proximity of saltwater sources to wellfield locations, and withdrawal rates.

Groundwater, Surface Water, and Wetland Monitoring

Information regarding groundwater and surface water levels is essential to manage and protect South Florida's water resources. Real-time data combined with historical information about water levels, weather, rainfall, and water quality changes inform water resource decisions. The costs included in **Table 6-4** are for contracts (e.g., USGS contracts) and staff time.

Water level and water quality monitoring at existing wells provide critical information to develop groundwater models, assess groundwater conditions, and manage groundwater resources. The SFWMD maintains extensive groundwater monitoring networks and partners with the USGS to provide additional support for ongoing monitoring. Data are archived in DBHYDRO—the SFWMD's corporate environmental database—which contains hydrologic, meteorologic, hydrogeologic, and water quality data. Data are available through www.sfwmd.gov/dbhydro. The USGS monitors, archives, and publishes data annually. **Appendix D** provides maps of the groundwater well network in the LEC Planning Area.

Districtwide monitoring activities related to the LEC Planning Area include the following:

- **USGS water level monitoring** – The USGS has been collecting water level monitoring data in the surficial aquifer system (SAS) for more than 60 years. The initiative includes well and recorder maintenance as well as data archiving in the USGS database.
- **SFWMD water level monitoring** – An ongoing effort to monitor groundwater levels throughout the District in the surficial, intermediate, and Floridan aquifer systems (SAS, IAS, and FAS). As of 2018, there are 760 groundwater stations monitored within the District's boundaries. Data are collected, analyzed, validated, and archived in DBHYDRO.
- **SAS water quality sampling and analysis** – The SFWMD analyzes salinity and other basic water quality parameters from a network of SAS wells within the LEC Planning Area on a 5-year rotation to provide long-term water quality data. The data are stored and made available to the public through DBHYDRO.
- **Water use permitting water level and water quality monitoring** – Some SFWMD water use permittees submit water level and/or water quality data from selected SAS and FAS monitor and production wells to the SFWMD. The data are available for each permit on the SFWMD website.
- **FAS well installation, testing, and maintenance** – The SFWMD monitors water levels at 104 FAS wells within its Districtwide groundwater monitoring network. Well maintenance is conducted as needed. Data are collected, analyzed, validated, and archived in DBHYDRO.
- **Florida Geological Survey potentiometric surface mapping support** – The SFWMD extracts and compiles water level data from the Upper Floridan aquifer in the LEC Planning Area and provides the data to the Florida Geological Survey for construction of annual statewide potentiometric surface maps, which are available to the public.

- **Hydrogeologic database improvements** – SFWMD staff are uploading backlogged data and conducting miscellaneous database corrections. In addition to continued uploading of geophysical data and documents to DBHYDRO, borehole video logs for many FAS monitor, injection, and ASR wells are available in each well station's multimedia.
- **Surface water monitoring** – The SFWMD monitors the water levels and water quality of several surface water bodies (e.g., L-8 Reservoir; Loxahatchee River; Lake Worth Lagoon; Nearshore Central Biscayne Bay; Florida Bay; A-1 Reservoir; WCAs 1, 2A, 2B, 3A, and 3B; L-3 Canal system).
- **MFL-required monitoring** – In support of adopted MFL recovery and prevention strategies, the SFWMD monitors changes in surface water and groundwater levels, flows, and specific MFL-related constituents; the location of the saltwater interface; and the floral and faunal populations.

Hydrologic Modeling

Regional surface water and groundwater flow models simulate the rate and direction of water movement through the SFWMD's water resources system and subsurface. The models include the major components of the hydrologic cycle and are used to understand the effects of current and future water management operations and water supply use under varied climactic and hydrologic conditions. The costs included in **Table 6-4** are for contracts (e.g., peer review) and staff time for groundwater models only.

Regional Simulation Model

Using South Florida's climate records and technical details on regional canals, water control structures, local topography, and storage reservoirs, the Regional Simulation Model (RSM) addresses the region's complex hydrology. The model has been applied to several Everglades restoration projects, including CEPP, WERP, the WCA-3 Decompartmentalization Physical Model, the C-111 Spreader Canal Western Project, and the BBCW Project.

Application of the Regional Simulation Model to the Kissimmee-Okeechobee-Everglades and adjacent Big Cypress pre-drainage watersheds is referred to as the Natural Systems Regional Simulation Model (NSRSM). This model allows for meaningful comparisons between managed and natural systems under identical climactic conditions. A peer-review panel indicated the most useful application of the Natural Systems Regional Simulation Model is to help guide management experiments aimed at restoring hydrologic regimes and ecological function.

East Coast Floridan Model

The SFWMD developed an FAS groundwater model to improve management of this alternative water supply source given projected limits on traditional sources to meet future water demands. Development of the East Coast Floridan Aquifer System Model began in 2007 and was completed in October 2008 (Golder Associates 2008). Modifications were made to the model based on peer-review recommendations and the final transient, density-dependent model—the East Coast Floridan Model—was completed in 2013 (**Figure 6-14**). Model simulations were conducted in 2015 for the *2016 Upper East Coast Water Supply Plan Update* (SFWMD 2016b) and in 2018 for this LEC Plan Update. Model results are discussed in **Appendix D**.

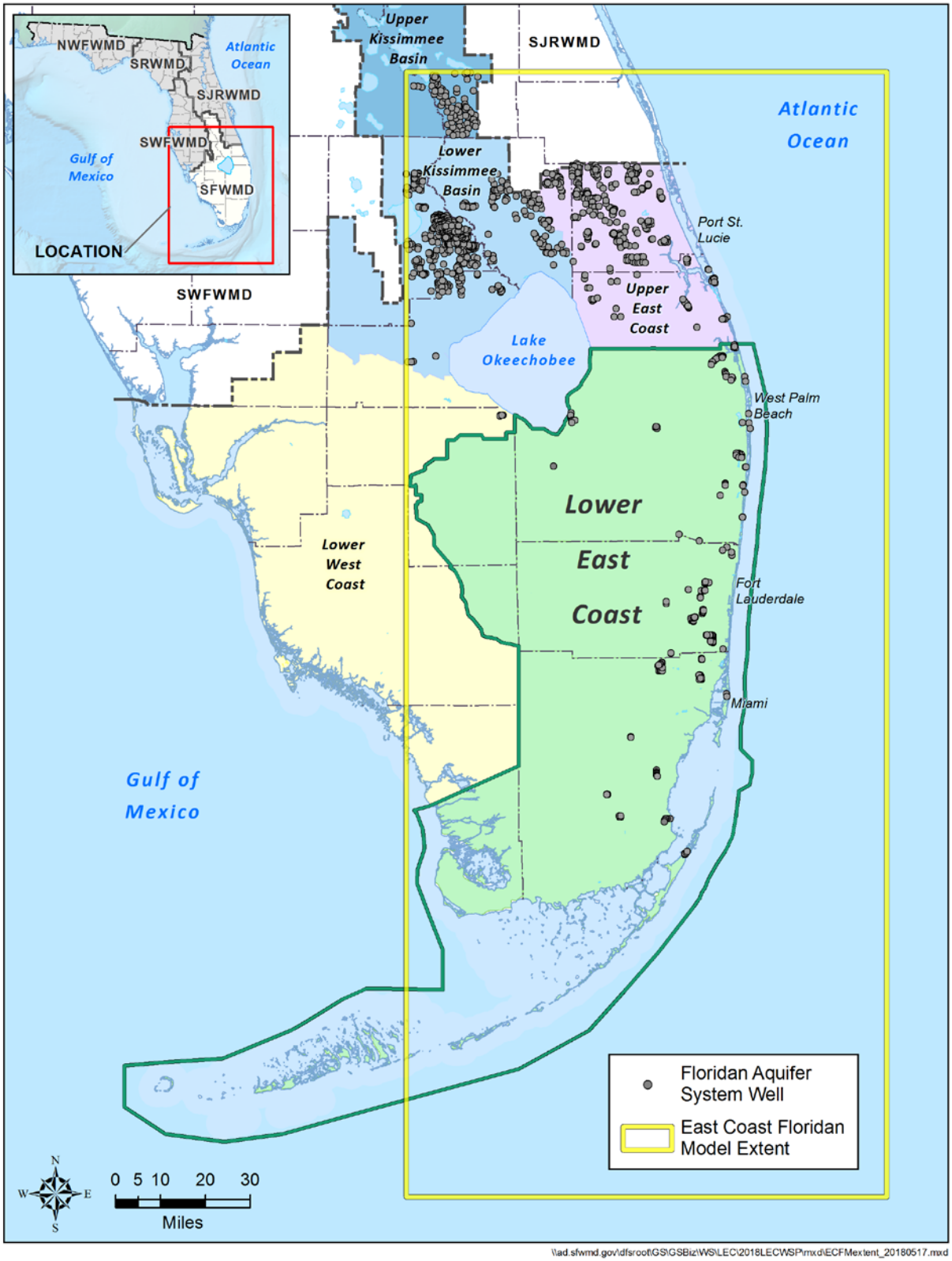

Figure 6-14. East Coast Floridan Model boundary and Floridan aquifer system wells.

Lower West Coast Surficial and Intermediate Aquifer Systems Model

The Lower West Coast Surficial and Intermediate Aquifer Systems Model (**Figure 6-15**) is currently being updated, incorporating new hydrostratigraphic, water level, water use, and saltwater interface data. A hydrostratigraphic re-interpretation report was completed in 2015 (Geddes et al. 2015), and the calibrated model is undergoing peer review. Once the peer review is complete, model simulations will be used to evaluate regional water resources for future water supply plan updates. Model results are expected to be available in 2019.

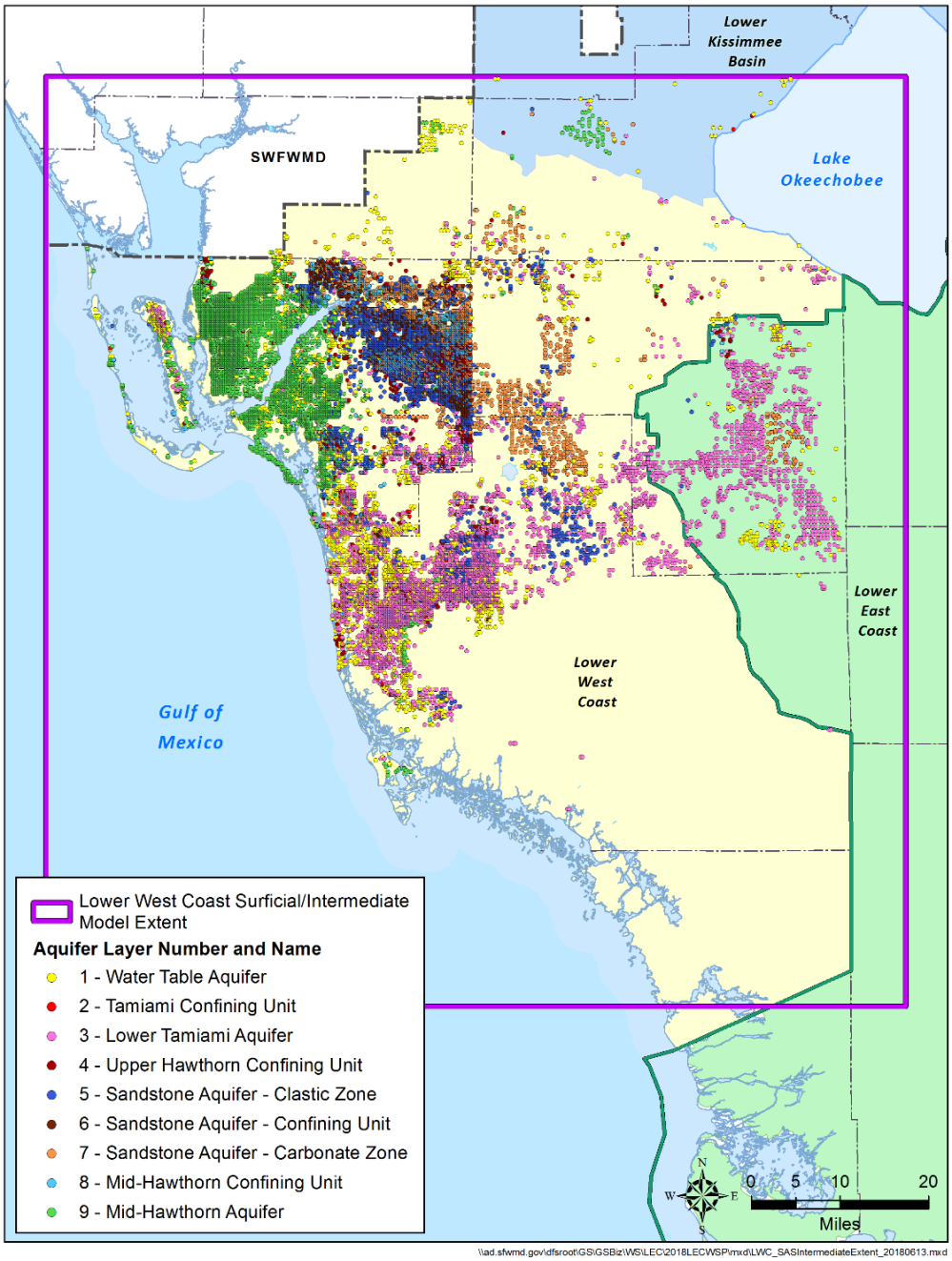

Figure 6-15. Lower West Coast Surficial and Intermediate Aquifer Systems Model boundary and permitted wells simulated in the model.

Table 6-4. Fiscal Year 2017-2018 through Fiscal Year 2021-2022 implementation schedule and projected expenditures (including salaries, benefits, and operating expenses) for water resource development activities. All activities are ongoing unless noted otherwise. (Modified from: Demonstranti 2018).

Districtwide Water Activities	Plan Implementation Costs ($ thousands)					Total
	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	
MFL, Water Reservation, and RAA Activities	369	380	380	380	380	**1,889**
Comprehensive Water Conservation Program	351[a]	351	351	351	351	**1,755**
Cooperative Funding Program	64[a]	64	64	0	0	**192**
Groundwater Monitoring	1,324	1,450	1,450	1,450	1,450	**7,124**
Groundwater Modeling	657	775	775	775	775	**3,757**
Estimated portion of C&SF Project Operation & Maintenance budget allocated to Water Supply[b]	107,868	107,868	107,868	107,868	107,868	**539,340**
Total	**110,633**	**110,888**	**110,888**	**110,824**	**110,824**	**554,057**

C&SF Project = Central and Southern Florida Flood Control Project; MFL = Minimum Flow and Minimum Water Level; RAA = Restricted Allocation Area.

[a] Funds identified in the District's Fiscal Year 2017-2018 preliminary budget for water conservation ($1.0 million) and alternative water supply ($3.5 million) Cooperative Funding Program have been pooled with other funds in the budget for potential use in response to Hurricane Irma impacts. A determination of what funds, if any, will be allocated for cooperative funding projects will be made by the District Governing Board during the fiscal year, dependent on needs for hurricane response.

[b] Approximated based on 50 percent of the Fiscal Year 2017-2018 Operation & Maintenance budget.

SUMMARY OF WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects serve various purposes in support of managing, protecting, and restoring water resources. Benefits of the water resource development projects discussed in this chapter include the following:

- Restoration of natural resources and prevention of further loss.
- Support for MFL recovery or prevention strategies.
- Protection of existing water supplies through better resource management and continued implementation of regional resource monitoring.
- Water conservation as a demand management tool to expand current water supplies.
- Improved understanding of the hydrogeologic system that provides traditional and alternative water supplies for the LEC Planning Area.
- Increased future supply availability.

Table 6-5 provides the status of the projects discussed in this chapter.

Table 6-5. Status of regional and Districtwide water resource projects in the LEC Planning Area, by region.

Project	Completed Project Elements	Status of Ongoing/Uncompleted Elements
Lake Okeechobee Region		
CERP Lake Okeechobee Watershed Restoration Project	Planning efforts were implemented in 2016. A tentatively selected plan was identified in 2018.	Planning is ongoing.
Taylor Creek, Nubbin Slough, and Lakeside Ranch STAs	The Taylor Creek STA Pilot Project became operational in 2008. Initial construction of the Nubbin Slough Pilot Project Phase 1 was completed in 2006 and intermittently operated from 2012 to 2014. Lakeside Ranch STA Pilot Project Phase I became operational in 2012. Phase II was completed in August 2018.	The Nubbin Slough STA Project is non-operational until repaired.
USACE Herbert Hoover Dike Major Rehabilitation	The USACE completed assessment of Hebert Hoover Dike and classified it a dam safety action classification of Class 1. The 21.4-mile cutoff wall component in Reach 1 was installed between 2007 and 2013. A contract was awarded in 2018 for the Reach 1 cutoff wall extension. Three culverts have been abandoned, one has been removed, and eight have been replaced. The Dam Safety Modification Report was completed in 2016.	The Reach 1 cutoff wall gap closures are expected to be completed by December 2018. The Reach 1 cutoff wall extension (6.8 miles) is expected to be completed by 2021. The Reach 2 cutoff wall (28.6 miles) and other components will be completed between 2019 and 2025. Replacement, removal, or abandonment of all 32 culverts is expected to be completed by 2022.
Lake Okeechobee Habitat Enhancements	Muck and tire removal was conducted in 2007 and 2008. Tree plantings and native aquatic plant enhancements were conducted between 2007 and 2011. Prescribed burns and/or herbicide applications to remove vegetation were conducted between 2015 and 2017.	Spraying and burning for exotic and nuisance plant control is ongoing.
Everglades Region		
Everglades Forever Act Projects (Restoration Strategies Regional Water Quality Plan)	A-1 FEB construction was completed in July 2015, and the FEB is operational. S-5A structure modifications were completed in May 2016, and the structure is operational. L-8 divide structure (G-541) construction was completed in July 2016, and the structure is operational. L-8 FEB construction was completed in June 2017, and the FEB is operational. S-375 structure expansion (G-716) construction was completed in April 2017, and the structure is operational.	STA-1 West Expansion #1 construction is ongoing and expected to be completed by December 2018. STA-1 West Expansion #2 design activities will start in 2018; construction is expected to begin by November 2020. G-341 related conveyance improvements are ongoing and expected to be completed by December 2024. Design of the C-139 FEB and STA-5/6 internal improvements are expected to begin in 2018. Completion of all projects is expected by 2025.

Project	Completed Project Elements	Status of Ongoing/Uncompleted Elements
Modified Water Deliveries to Everglades National Park	Taylor Slough Bridge was completed in 2007. 8.5-Square Mile Area protection features were completed in 2008. A 1-mile bridge on Tamiami Trail was completed in 2013. Four of the 9 miles of the L-67 extension canal and levee have been degraded. S-356 pump station construction is complete, and an operating permit was issued in 2017.	Construction of the 2.6-mile bridge on Tamiami Trail by the United States Department of the Interior began in 2016 and is scheduled for completion in 2018.
CERP WCA-3A Decompartmentalization Physical Model	The final permit for model construction and interim operations was received in 2012. A construction contract was awarded in May 2012. Model construction was completed in 2013. Operational testing was completed between 2013 and 2016.	Additional testing is tentatively planned through 2021.
CERP Central Everglades Planning Project (CEPP)	The project implementation report was approved in 2014. CEPP was authorized in December 2016. CEPP modifications for the A-2 Reservoir were authorized in October 2018.	CERP and CEPP planning on other projects is ongoing.
Wading Bird Monitoring Report	Most recent (2017) report was published in February 2018.	Reports completed annually to identify breeding colonies.
Tree Island Mapping	The SFWMD completed mapping in 2011.	Additional mapping by Everglades National Park is ongoing.
C-111 South Dade Project	An amendment to the cost-share agreement (Project Cooperation Agreement) was executed in 2014. Ten plugs in the L-31W Canal were completed in 2018. The L-31W levee was completed in 2018. A weir at Taylor Slough headwaters was completed in 2018. Construction of the North Detention Area and modification of the L-359 and South detention areas was completed in 2018.	Replace the interim pumps at the S-332B and S-332C pump stations with permanent ones, which requires Congressional approval of a post-authorization change report for the C-111 South Dade Project.
S-197 Structure Replacement Project and Automation	The S-197 structure was replaced in 2013 and is fully operational.	Automation of the S-197 structure will be completed in 2019.
CERP C-111 Spreader Canal Western Project	Construction of major elements was completed in 2012. Congress authorized the project in 2014.	S-199 and S-200 pump capacity increases and conveyance improvements will be completed in 2018.
South Dade Study and Florida Bay Plan	The South Dade Study was completed in February 2016. C-111 South Dade projects were completed in September 2018. Operational changes started in March 2017, with additional changes in February 2018.	Seepage barrier along L-31N/C-111 canals and lower C-111 seepage collection canal and pump not yet initiated. Further operational changes anticipated in April 2020.

Project	Completed Project Elements	Status of Ongoing/Uncompleted Elements
Western Basins		
CERP Western Everglades Restoration Project	Planning efforts began in 2016.	Planning is ongoing. Identification of a tentatively selected plan is anticipated in 2019.
C-139 Annex Restoration	The Lake Belt Mitigation Committee approved the C-139 Annex for wetlands mitigation in 2012. Phase 1 construction began in 2016.	Abiaki Prairie restoration will progress as mitigation funds allow and is expected to be completed by 2025. C-139 FEB design will begin in 2019.
Lower East Coast Service Areas		
Restoration Plan for the Northwest Fork of the Loxahatchee River	The SFWMD has acquired more than 20,000 acres of land in river corridor and tributary watersheds for Loxahatchee River restoration since 1985. The G-160 structure was completed in 2004 and is operational. The G-161 structure was completed in 2007 and is operational. M-Canal widening was completed in 2007. Nine Gems restoration was completed in 2010. Initial Culpepper hydrologic restoration activities were completed in 2011. C-18 Project culvert replacements were completed in 2011. Update to the Restoration Plan was completed in 2011. Cypress Creek weir installation was completed in 2012. The Lainhart and Masten dams were repaired in 2017.	Construction of Cypress Creek berm/water control structures is ongoing. Loxahatchee Slough restoration is ongoing. Additional restoration activities are expected to occur at Culpepper and Nine Gems sites.
CERP Loxahatchee River Watershed Restoration Project	Planning efforts began in 2005. In 2013, the SFWMD acquired 1,850 acres of land (Mecca Farms) for water storage. A draft tentatively selected plan was chosen in July 2018.	Planning is ongoing.
CERP Environmental Preserve at the Marjory Stoneman Douglas Everglades Habitat	The preserve was completed in 2010 and is operational.	
CERP Fran Reich Preserve Reservoir	Phase 1 L-40 modification and S-530 spillway construction were completed in 2016.	Additional authorization from Congress needed for Phase 2.
CERP Hillsboro Aquifer Storage and Recovery Pilot Project	Testing was conducted between 2010 and 2012. The first technical data report was published in 2013. An updated report was published in 2018.	Future use under evaluation.

Project	Completed Project Elements	Status of Ongoing/Uncompleted Elements
CERP Broward County Water Preserve Areas	The project received Congressional approval in 2014. The Project Implementation Report and Chief of Engineers' report were completed in 2012. Broward County Water Preserve Area projects are included in the Integrated Delivery Schedule.	Projects are ongoing. The C-11 Impoundment Mitigation Area A Berm is under construction and anticipated to be completed in 2019. The C-11 impoundment will be completed in 2027. The C-9 Impoundment construction expected to begin in 2030. WCA-3A/3B Seepage Management Area construction anticipated to begin in 2027.
CERP Biscayne Bay Coastal Wetlands Project	The Project Implementation Report and Chief of Engineers' report were completed in 2012. Deering Estate Flow-way construction was completed in 2012, and the flow-way is operational. Authorized by Congress in 2014 under the Water Resources Development Act. Ten culverts were completed in the L-31 East Flow-way by 2018.	Cutler Wetlands (to be constructed by the SFWMD) is anticipated to be completed by 2022. Remaining features of L-31 East Flow-way (to be constructed by the USACE) are anticipated to be completed by 2022.
Districtwide Water Resource Development Projects		
MFL, Water Reservation, and Restricted Allocation Area Rule Activities	Six MFLs and four Restricted Allocation Areas were established prior to 2013 in the LEC Planning Area. The Nearshore Central Biscayne Bay Water Reservation was adopted in June 2013.	Continued implementation of MFL recovery and prevention strategies.
Comprehensive Water Conservation Program	The program was approved in 2008. The year-round irrigation rule was adopted in 2010. From FY2013 through FY2018, 39 water conservation projects were funded, partially through the Cooperative Funding Program.	Continued operation of recognition and certification programs, regulatory initiatives, education, and outreach.
Alternative Water Supply	From FY2013 through FY2018, 11 alternative water supply projects were funded, partially through the Cooperative Funding Program.	Continued support through the Cooperative Funding Program.
Drilling and Testing	Monitor wells were installed at S-356 and east of the L-31W levee.	Installation of monitor wells and subsurface testing as needed.
Groundwater Assessment	The Loxahatchee Slough Study was completed in 2014. Saltwater interface maps were updated in 2014.	Saltwater interface maps will be updated in 2019.
Groundwater, Surface Water, and Wetland Monitoring	Hydrogeologic mapping update of the Lower West Coast aquifers was completed in 2015. Hydrogeologic data archiving of Floridan aquifer system borehole video logs was completed in 2017.	Ongoing monitoring of 760 groundwater and numerous surface water stations Districtwide.
Hydrologic Modeling	The East Coast Floridan Model was completed in 2014 and used for the 2016 Upper East Coast Plan and 2018 Lower East Coast Plan updates.	The Lower West Coast Surficial and Intermediate Aquifers Transient Model is undergoing peer review and resource analysis.

CEPP = Central Everglades Planning Project; CERP = Comprehensive Everglades Restoration Plan; FEB = flow equalization basin; FY = Fiscal Year; LEC = Lower East Coast; MFL = Minimum Flow and Minimum Water Level; SFWMD = South Florida Water Management District; STA = stormwater treatment area; USACE = United States Army Corp of Engineers; WCA = water conservation area.

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7

Water Supply Source Options

TOPICS

- Surface Water
- Groundwater
- Reclaimed Water
- Water Storage
- Seawater
- Summary of Water Supply Source Options

This chapter presents water supply source options expected to be available through 2040 to accommodate urban and agricultural growth in the Lower East Coast (LEC) Planning Area while addressing the needs of natural systems. To meet water supply needs, the LEC Planning Area primarily relies on traditional freshwater sources, including fresh groundwater from the surficial aquifer system (SAS) and surface water from canals, lakes, and water conservation areas (WCAs) (**Figure 7-1**). However, as population and water demands increase, so does the need for the development of alternative water supply (AWS) options, including brackish groundwater from the Floridan aquifer system (FAS), reclaimed water, seawater, and excess water stored in reservoirs or aquifer storage and recovery (ASR) systems. Current water use data, listed by source, were obtained from the SFWMD annual estimated water use report (SFWMD 2017a).

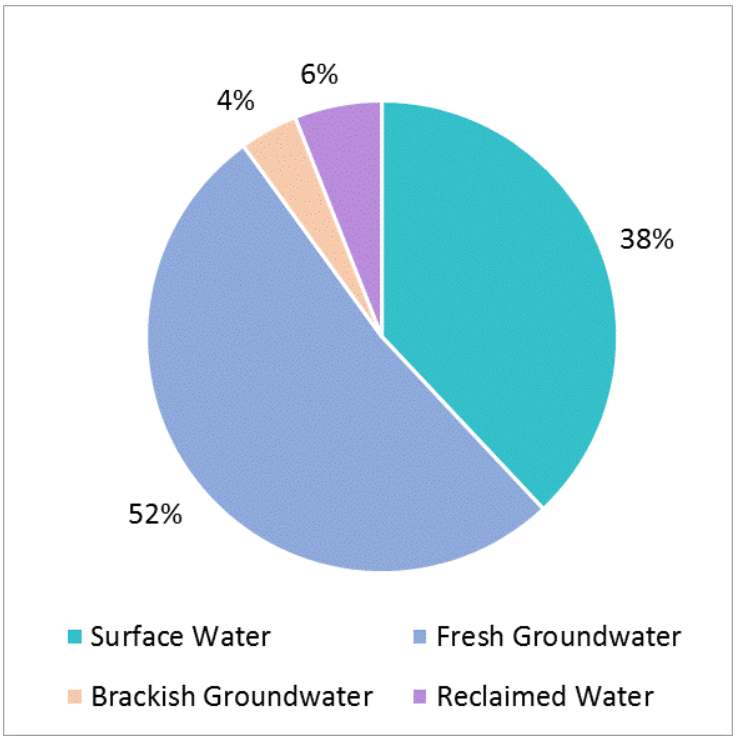

Figure 7-1. Water use in the LEC Planning Area in 2016, by source.

This chapter includes descriptions of water source options, current and projected uses, current condition of resources, and factors that affect availability for water supply purposes (e.g., source protections, water quality requirements, cost). More detailed information about water treatment technologies and their related costs is provided in the South Florida Water Management District (SFWMD or District) *2016 Water Supply Plan Support Document* (Support Document; SFWMD 2016).

Surface water and fresh groundwater currently supply 94 percent of Public Water Supply (PWS) and 100 percent of Agricultural Irrigation (AGR) needs in the LEC Planning Area (**Figure 7-2**). Of the 54 PWS utilities in the LEC Planning Area, 51 utilities use fresh groundwater from the SAS to supply the majority of the potable water demand, and 15 utilities use brackish groundwater for a portion of or all their needs. Agricultural operations in the Everglades Agricultural Area (EAA) rely on surface water, while growers in eastern Palm Beach and Miami-Dade counties and in the LEC Planning Area portion of Hendry County use a combination of fresh groundwater and surface water. Existing allocations and infrastructure can meet a substantial portion of the 2040 water needs for PWS and AGR. New withdrawals from traditional groundwater sources that induce seepage from regional surface water sources are limited by Restricted Allocation Area (RAA) criteria (**Chapter 4**).

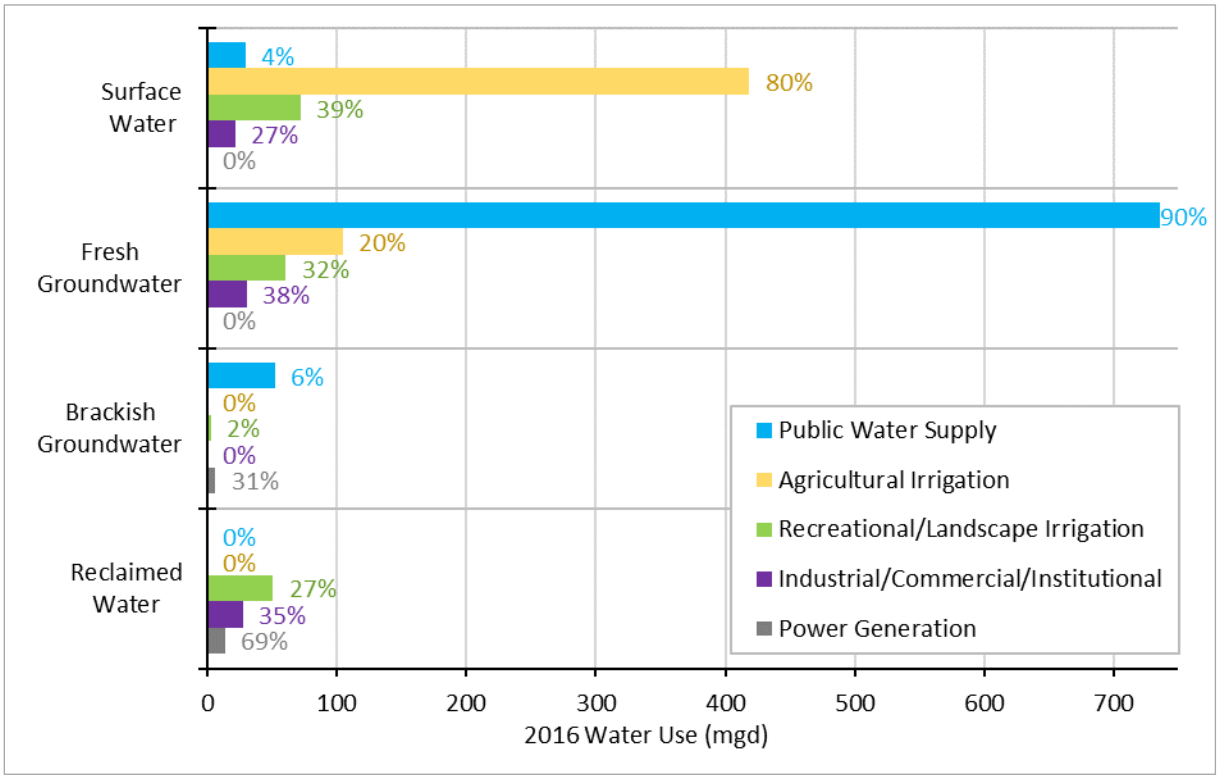

Figure 7-2. Water use in the LEC Planning Area in 2016, by source and use type. (Note: Fresh groundwater supplies 100 percent of Domestic and Small Public Supply.)

SURFACE WATER

Surface water is a major source of water supply in the LEC Planning Area. Surface water sources, primarily used for agricultural and urban irrigation supply, include Lake Okeechobee and the WCAs, regional and local canals and lakes, and reservoirs. **Chapter 5** provides more information about the region's surface water resources.

Lake Okeechobee and Water Conservation Areas

Lake Okeechobee, its connected conveyance system, and the WCAs are the most important surface water sources for the LEC Planning Area. These sources supply surface water to the regional system via canals and recharge the SAS. Lake Okeechobee serves multiple purposes, including flood control during the wet season and water supply during the dry season. AGR is the predominant user of surface water from Lake Okeechobee, which serves as a supplemental water supply source when rainfall is insufficient to meet demands. At lower lake levels, the SFWMD can deploy portable pumps to meet water supply needs in the EAA and the Seminole Tribe of Florida Big Cypress Reservation. Water from the lake can be used as a backup source for urban users in the LEC Service Areas during dry times, and depending on availability, may provide pass-through water to the WCAs in accordance with their regulation schedules. Implementation of the 2008 Lake Okeechobee Regulation Schedule (2008 LORS) resulted in an average reduction of approximately 430,000 acre-feet of water storage for all uses. Canals connected to the lake will continue to provide fresh surface water for supplemental agricultural and urban irrigation in the future, consistent with water use permits.

Local Surface Water Sources

- **Central and Southern Florida Flood Control Project (C&SF Project) Canals** – These primary regional canals move water from Lake Okeechobee to coastal areas to recharge the SAS during the dry season (**Figure 7-3**). Water for AGR and Recreational/Landscape Irrigation (REC) is withdrawn directly from the canals or diverted to local canal systems for additional storage and use.
- **Water Control (298) Districts** – There are numerous water control districts, established under Chapter 298, Florida Statutes (F.S.), that are operated for flood control and water supply. Stormwater from the interconnected lakes and canals can be held in the water control district canal systems for irrigation. Some of the water control districts divert water from C&SF Project canals to maintain specific water levels within their boundaries (**Figure 7-4**). In the LEC Service Areas, diversions are for recharging PWS wellfields and managing saltwater intrusion. In the EAA, water control districts provide water supply for AGR.

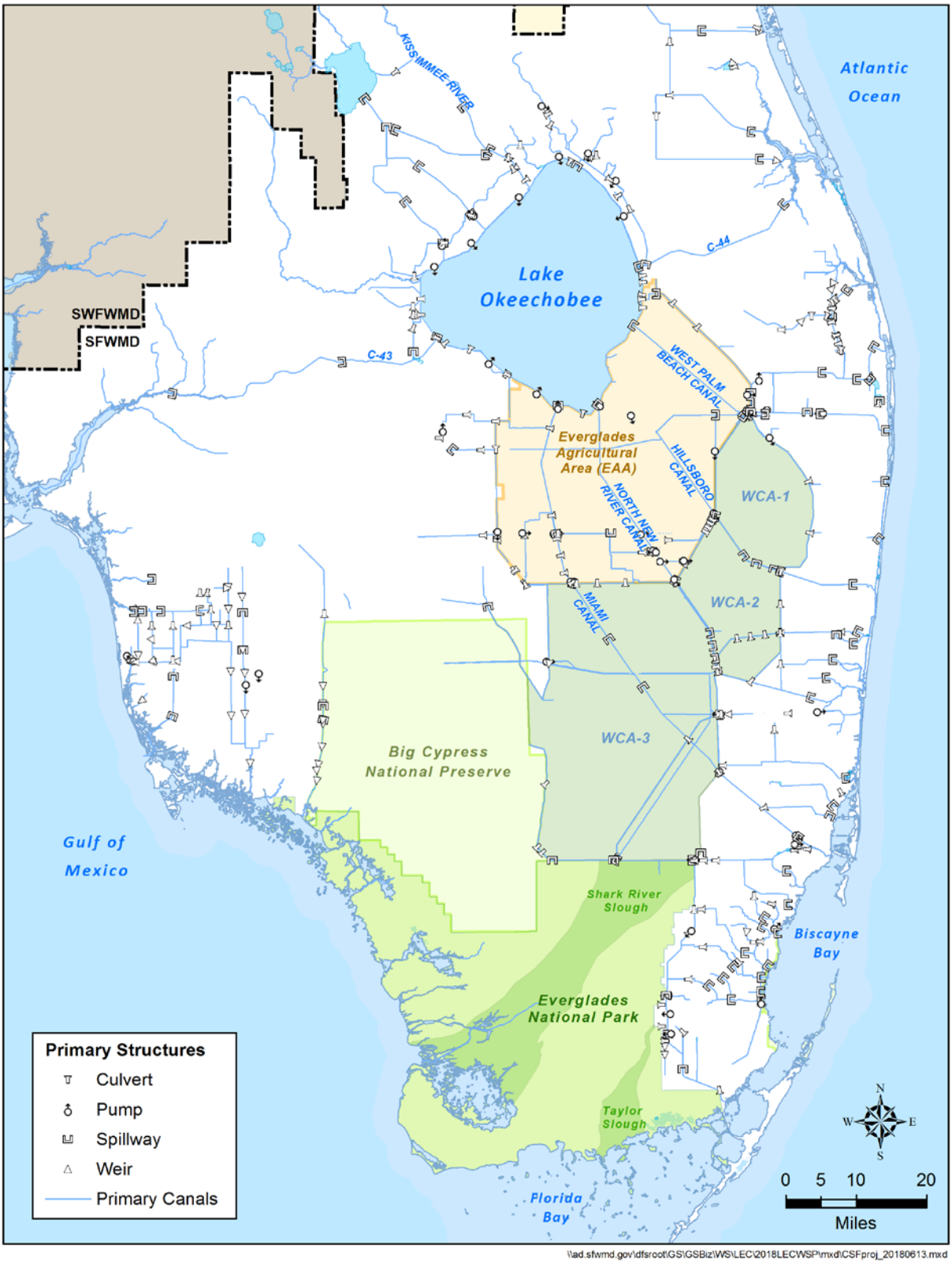

Figure 7-3. Central and Southern Florida Flood Control Project canal system.

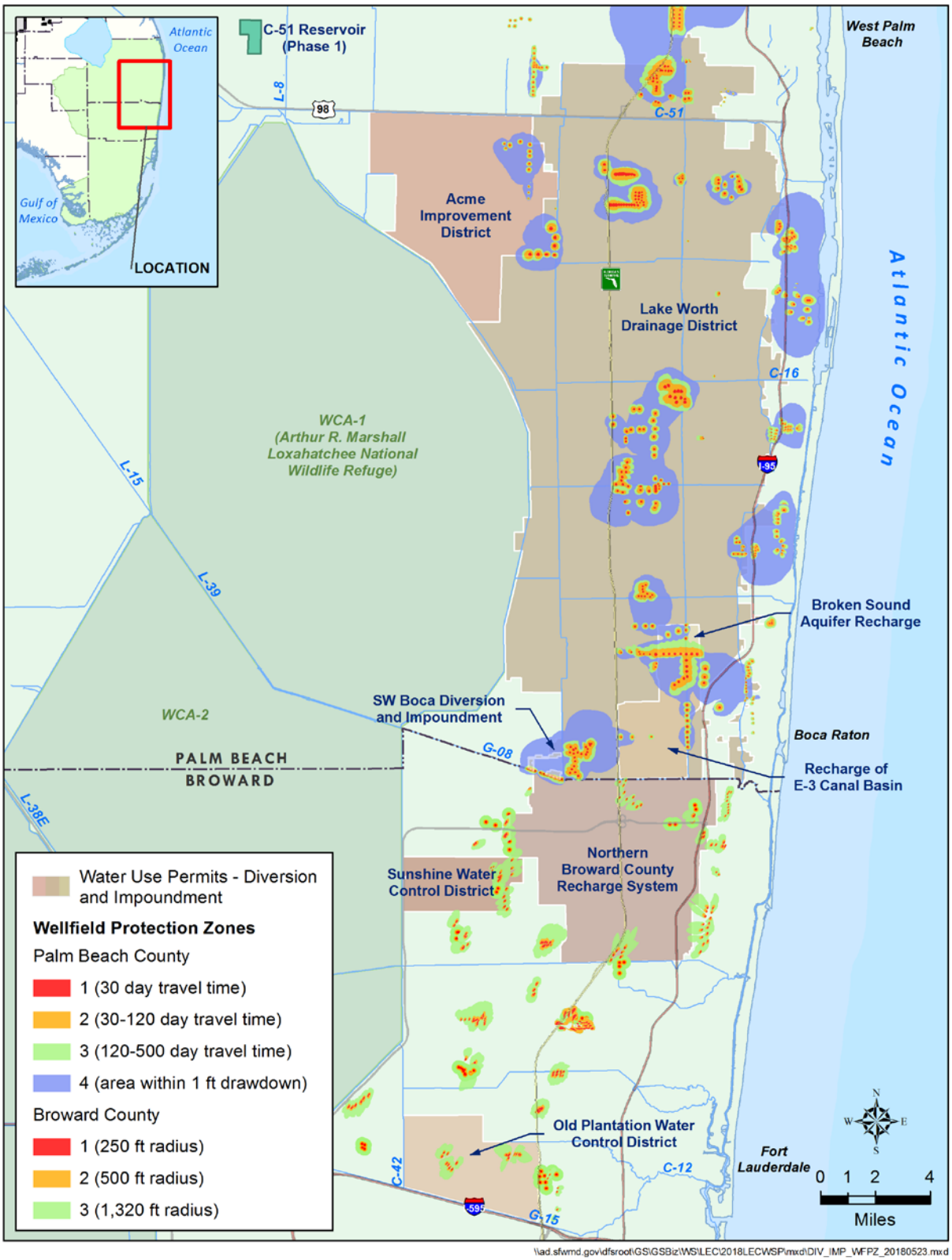

Figure 7-4. Water control districts that divert regional water to recharge Public Water Supply wellfields in the LEC Planning Area.

Existing and Future Use

In 2016, approximately 80 percent of AGR demands in the LEC Planning Area were met with surface water. Most AGR acreage (77 percent) in the LEC Planning Area is in the EAA (**Chapter 2**), and supplemental irrigation is supplied by surface water from canals connected to Lake Okeechobee. AGR users in eastern Palm Beach County also rely on surface water from the regional canal network, WCA-1, and Lake Okeechobee for supplemental irrigation. Some smaller agricultural uses, including nurseries and aquaculture, in Broward and Miami-Dade counties use surface water. Projected water demands for the EAA decline slightly from 2016 to 2040 due to a reduction in irrigated acres as a result of the planned construction of the EAA Reservoir. In 2040, 75 percent of AGR demands are expected to be met with surface water. Permitted AGR surface water withdrawals in the LEC Planning Area are shown in **Figure 7-5**.

Approximately 40 percent of REC demand in the LEC Planning Area, including golf courses, was met with surface water in 2016 (SFWMD 2017a). Withdrawals primarily are from on-site ponds or adjacent local canals. REC use is expected to increase approximately 15 percent by 2040; however, surface water withdrawals may decrease as new demands and some existing demands are met with reclaimed water. Permitted REC surface water withdrawals in the LEC Planning Area are shown in **Figure 7-6**.

In 2016, surface water was used to meet 27 percent of the demands for Industrial/Commercial/Institutional (ICI) uses in the LEC Planning Area. Surface water supplied 74 percent of ICI demand in Palm Beach County, 1 percent in Broward County, and 38 percent in Miami-Dade County. Sand, gravel, and stone mining operations account for most of the ICI water demands. ICI demand will increase slightly by 2040, and the same proportion presumably will be met with surface water.

The City of West Palm Beach is the only PWS utility in the LEC Planning Area that uses surface water as its primary source. The city withdraws water from Clear Lake, which is connected to Lake Okeechobee via tie-back canals (L-8 Canal and M-Canal) and Grassy Waters Preserve, a water impoundment area.

Surface Water Supplies to Seminole Tribe of Florida

The Seminole Tribe of Florida has two reservations in the LEC Planning Area: Hollywood and Big Cypress (**Figure 1-1**). At the Big Cypress Reservation, surface water is delivered via the G-409 structure, at the junction of the L-3 and L-4 canals, and via the North and West Feeder canals (**Figure 7-5**). Lake Okeechobee, via the Miami Canal and the G-404 water control structure, is a secondary supplemental irrigation supply source, with specific volumes of water identified for delivery to the Big Cypress Reservation. The Seminole Tribe of Florida also owns other facilities and land within the LEC Planning Area. Demands, if any, associated with these other properties and the Hollywood Reservation are included within the AGR, REC, and PWS water use categories and are met primarily with groundwater.

The Seminole Tribe of Florida has surface water entitlement rights pursuant to the 1987 Water Rights Compact between the Seminole Tribe of Florida, State of Florida, and SFWMD [Public Law 100-228, 101 Statute 1566, and Chapter 87-292, Laws of Florida, as codified in Section 285.165, F.S.]. The parties executed subsequent documents addressing the compact entitlement provisions. One such document is the 1996 agreement addressing the

SFWMD's mitigation responsibilities regarding impacts to the Seminole Tribe of Florida's ability to obtain surface water supplies at the Brighton (northwest of Lake Okeechobee beyond the LEC Planning Area boundaries) and Big Cypress reservations.

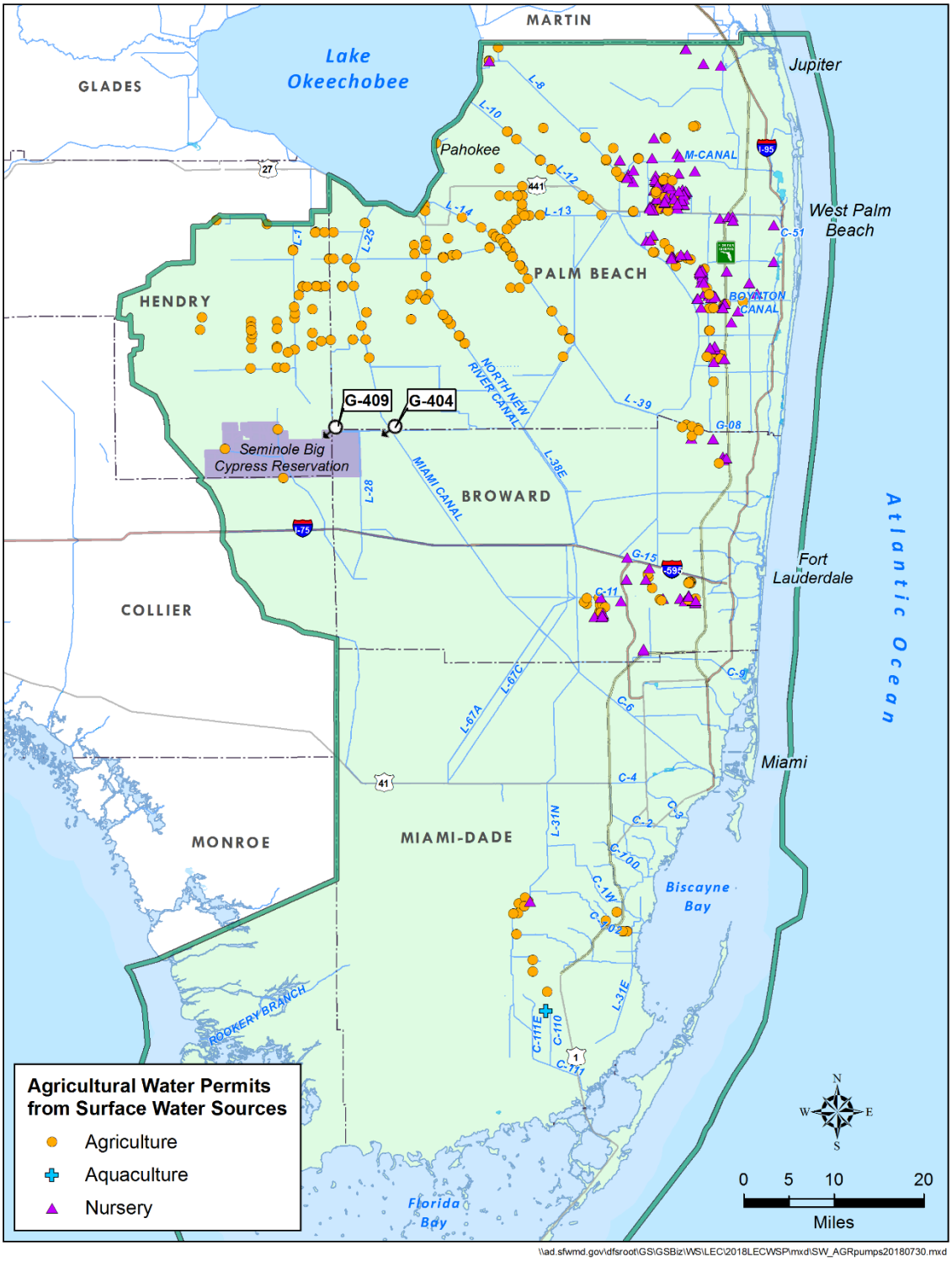

Figure 7-5. Agricultural irrigation water use permit withdrawal locations from surface water within LEC Planning Area.

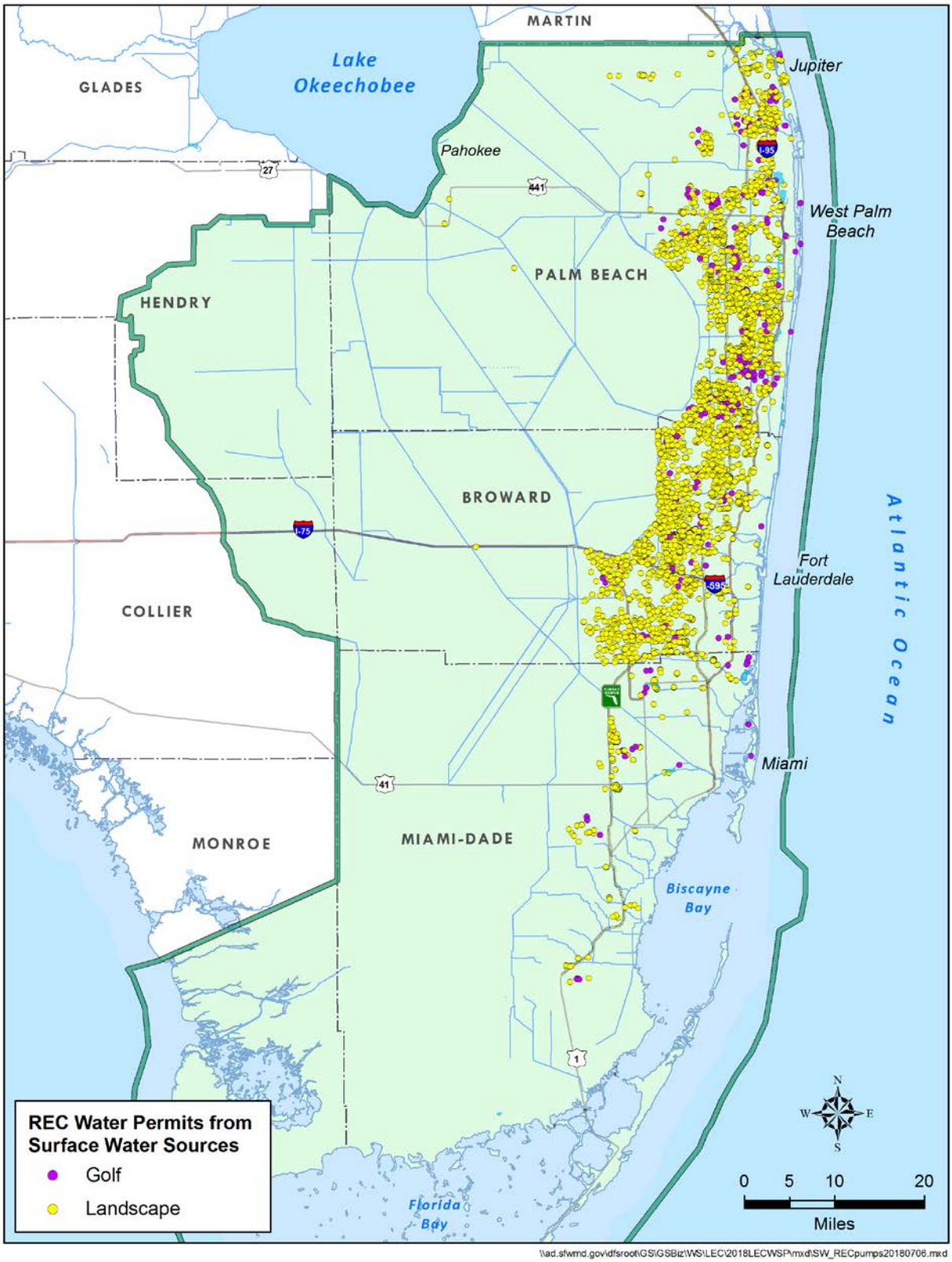

Figure 7-6. Golf and landscape irrigation water use permit withdrawal locations from surface water within LEC Planning Area.

Limits on Availability

As discussed in **Chapter 4**, the SFWMD adopted RAA criteria in 2008 for the Lake Okeechobee Service Area as part of the Minimum Flow and Minimum Water Level (MFL) recovery strategy for Lake Okeechobee. The criteria limit allocations from Lake Okeechobee and integrated conveyance systems that are hydraulically connected to and receive water from the lake, including the C-43 and C-44 canals, to base condition water uses that occurred from April 1, 2001 to January 1, 2008 (Section 3.2.1.F of the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* [Applicant's Handbook; SFWMD 2015]). Following adoption of the RAA, all irrigation users in the Lake Okeechobee Service Area were required to renew their water use permits. The unique water management activities within the EAA result in more efficient use of water (75 percent efficiency) compared to other agricultural areas using similar seepage irrigation systems (50 percent efficiency) and result in lower water needs for the basin. By changing the efficiency applied to water use permit renewals in the EAA, there was a 33 percent decrease in the renewal allocation for the basin.

In 2007, the SFWMD adopted the LEC Regional Water Availability criteria to prohibit increases in surface water and groundwater withdrawn from the North Palm Beach County/Loxahatchee River Watershed Waterbodies and Lower East Coast Everglades Waterbodies above base condition water uses permitted as of April 1, 2006 (Section 3.2.1.E of the Applicant's Handbook [SFWMD 2015]). This also includes canals that are connected to and receive water from these water bodies. New direct surface water withdrawals are prohibited from the Everglades and Loxahatchee River watersheds and from the integrated conveyance systems. These criteria are components of the MFL recovery strategies for the Everglades and the Northwest Fork of the Loxahatchee River (Section 3.2.1.E of the Applicant's Handbook [SFWMD 2015]).

An RAA was adopted for the L-1, L-2, and L-3 canals in eastern Hendry County in 1981. The limited network of surface water drainage canals within this area do not receive water from Lake Okeechobee. The RAA prohibits allocation of additional surface water from the L-1, L-2, and L-3 canals beyond existing allocations, and it also prohibits increases in surface water pump capacity (Section 3.2.1.C of the Applicant's Handbook [SFWMD 2015]). More information about MFLs, associated recovery and prevention strategies, and RAAs is provided in **Chapter 4**, **Appendix C**, and the Applicant's Handbook (SFWMD 2015).

GROUNDWATER

Groundwater is produced from two major aquifer systems in the LEC Planning Area: the SAS and the FAS (**Figure 7-7**). The SAS provides fresh groundwater from the Biscayne aquifer underlying Broward and Miami-Dade counties, undifferentiated surficial aquifers underlying Palm Beach County, and the Lower Tamiami aquifer underlying Hendry County. The FAS provides brackish groundwater from the Upper Floridan aquifer (UFA) throughout the region.

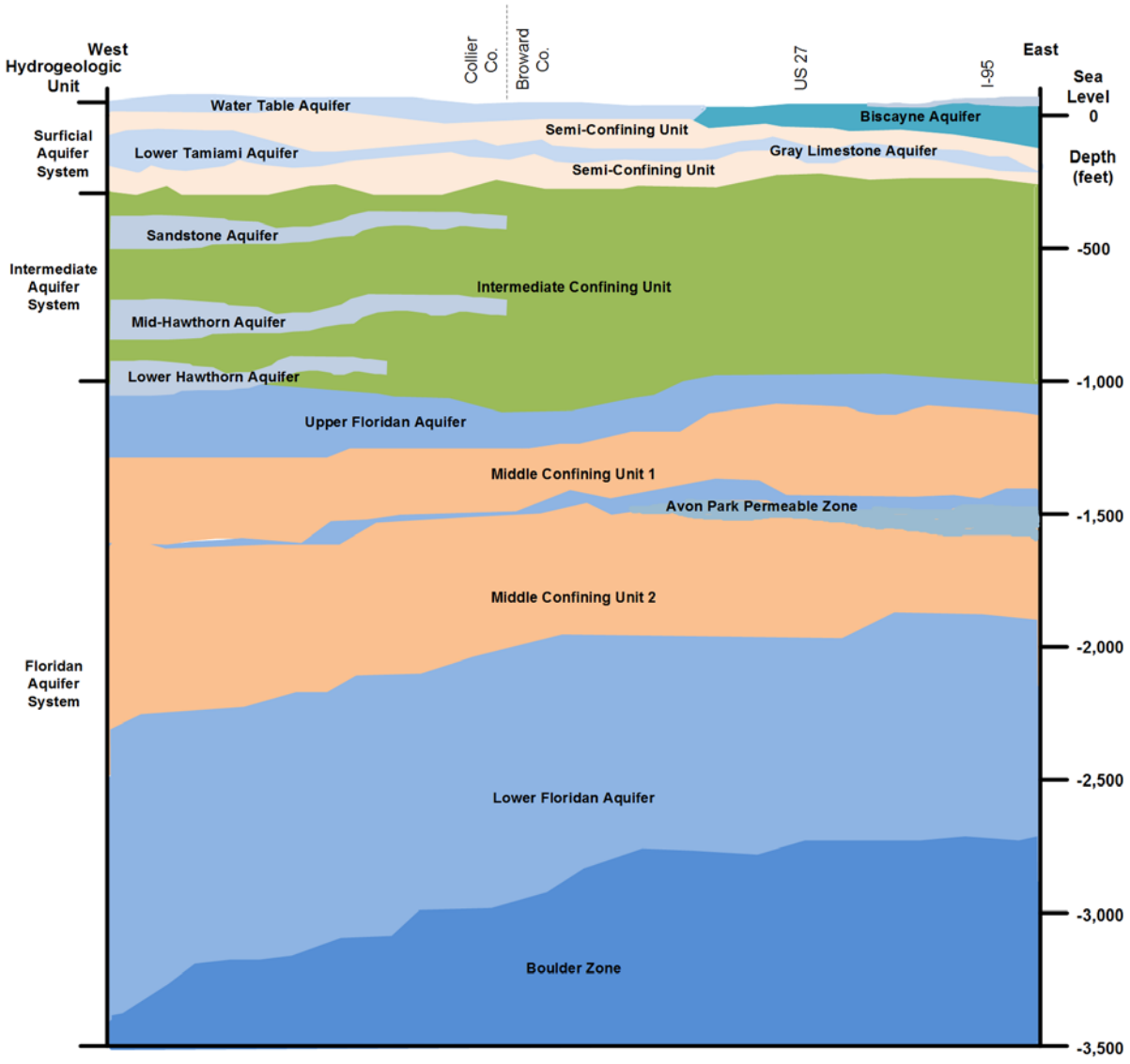

Figure 7-7. Generalized hydrogeologic cross-section of the LEC Planning Area.

Fresh Groundwater – Surficial Aquifer System

Fresh water has a chloride concentration less than 250 milligrams per liter (mg/L), which is a secondary drinking water standard (United States Environmental Protection Agency 2017). Fresh groundwater is the primary source of supply for PWS, AGR, REC, and ICI uses in the LEC Planning Area.

Lower East Coast Service Areas

The SAS is an unconfined to semi-confined aquifer system composed of solutioned limestone, sandstone, sand, shell, and clayey sand. In the LEC Service Areas, the SAS includes the water table, Biscayne, and undifferentiated surficial aquifers, separated by less permeable semi-confining units. The base of the SAS ranges from 150 to almost 300 feet below land surface. The transmissivities in the SAS range from 10,000 feet squared per day in sandy, shelly portions to more than 1 million feet squared per day in open, solutioned cavity portions of the Biscayne aquifer.

INFO ⓘ

Transmissivity is the ability of an aquifer to transmit water, which affects the rate at which groundwater can be pumped and how much that pumpage reduces local water levels.

In Palm Beach County, the SAS is generally referred to as the surficial aquifer. A highly productive portion of the SAS is referred to locally as the Turnpike aquifer (**Figure 7-8**) and is thickest and most productive in the vicinity of the Florida Turnpike (Reese and Wacker 2009).

The Biscayne aquifer extends south from coastal, southern Palm Beach County through most of Broward and Miami-Dade counties into portions of southeastern (mainland) Monroe County (**Figure 7-8**). The Biscayne aquifer is composed of interbedded, unconsolidated sand and shell units with varying thicknesses of consolidated, highly solutioned limestone and sandstone. In general, the Biscayne aquifer contains less sand and more solutioned limestone than most of the SAS and is the most productive aquifer in Florida.

The SAS is recharged by local rainfall, canals, groundwater seepage from the WCAs and Everglades National Park, and surface water deliveries from the WCAs. When sufficient water is available, surface water from Lake Okeechobee also can be routed to the WCAs, then to regional canals and local water control districts to maintain water levels and recharge the SAS. During droughts, lower regional groundwater levels may cause inland movement of the saltwater interface in the SAS. In this case, water shortage restrictions may be declared by the District Governing Board to conserve freshwater supplies and reduce the risk of saltwater intrusion.

The SAS produces high-quality fresh water from relatively shallow wells in most of the LEC Planning Area. In some cases, the ambient water quality meets primary and secondary drinking water quality standards. However, in central and western Palm Beach and Broward counties, high salinities in the SAS are attributed to relict seawater (connate water) in less transmissive portions of the SAS (Fish 1988; Reese and Wacker 2009). This underlying saline water affects some PWS wellfields and irrigation well withdrawals. Higher salinities also are found in EAA canals where portions of the canals are within the SAS.

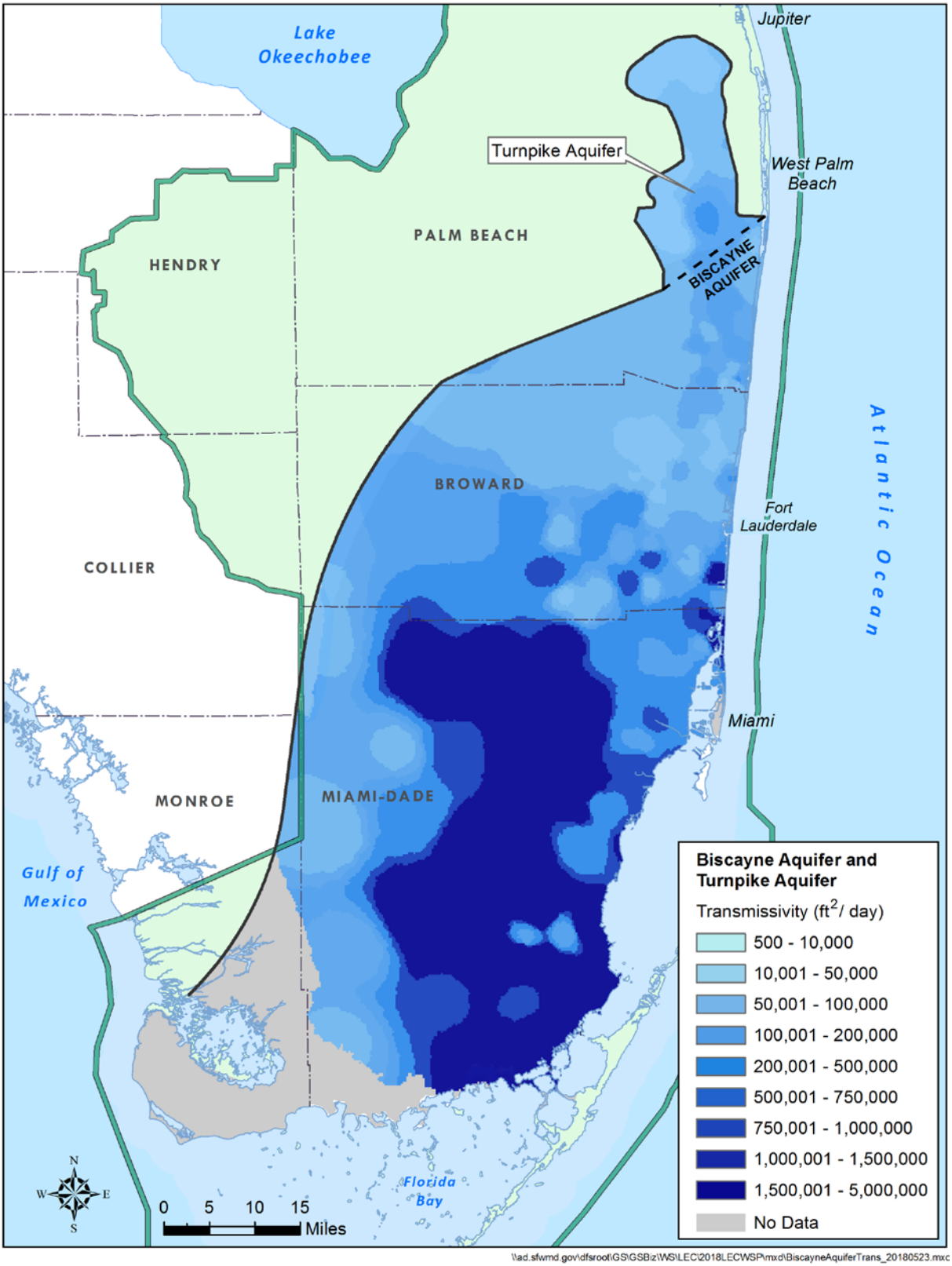

Figure 7-8. Location and transmissivity of the Biscayne and Turnpike aquifers.

Some coastal areas in the LEC Planning Area have chloride concentrations greater than 250 mg/L in the SAS. In Palm Beach County, SAS chloride concentrations have remained stable overall, and in the Lake Worth and Lantana areas, the saltwater interface (250 mg/L isochlor) has moved seaward. Only minor movement of the saltwater interface has occurred in northern and central Broward County; however, steady inland movement has been observed in the SAS around Dania Beach and along the North New River. The North Miami and Homestead areas show the most inland movement of the SAS saltwater interface in Miami-Dade County. A unique condition in southern Miami-Dade County is a hypersaline plume from Florida Power & Light (FPL) Turkey Point cooling canals migrating westward along the bottom of the more permeable zone of the Biscayne aquifer. Appendix D contains saltwater interface maps and chloride concentration data from the SAS.

Existing and Future Use

PWS is the largest user of fresh and brackish groundwater in the LEC Planning Area, with relatively consistent withdrawals for the past 9 years (**Figure 7-9**). The reduction in demands starting in 2009 reflects a combination of water shortage restrictions, new irrigation rules, the economic downturn, and increased water conservation awareness. In 2016, fresh groundwater supplied 90 percent of the region's total PWS demand (**Figure 7-2**). However, existing allocations of fresh groundwater will not meet projected 2040 demands for 9 of the 54 PWS utilities in the LEC Planning Area (**Chapter 8**). By 2040, approximately 87 percent of PWS demand will be met with fresh groundwater from the SAS, and the remainder will be supplied by surface water and the FAS. **Appendix E** contains information about actual and permitted withdrawals from each source as well as wellfield maps by county.

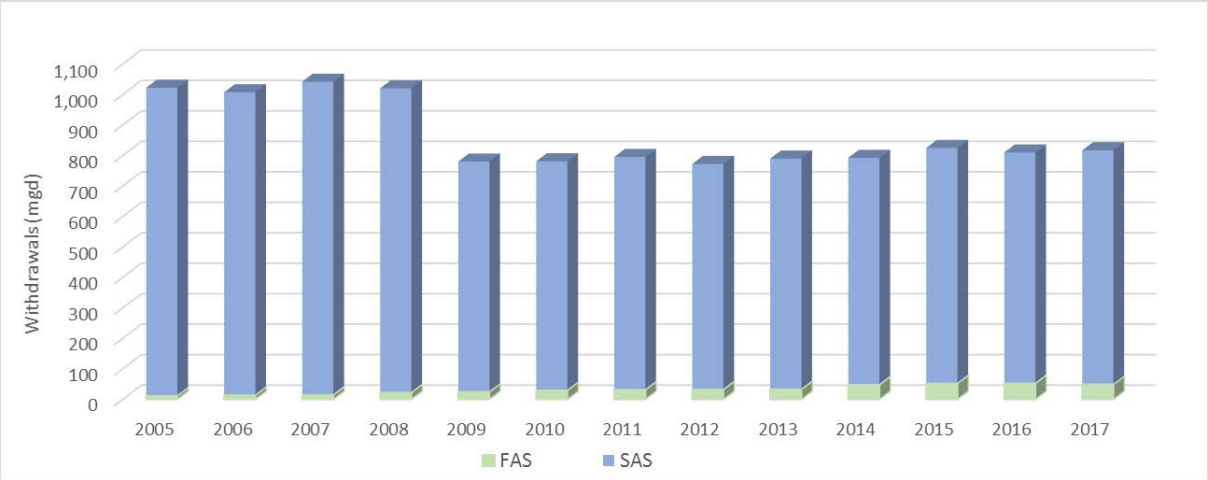

Figure 7-9. Public Water Supply withdrawals from the surficial and Floridan aquifer systems in the LEC Planning Area (2005 to 2017).

In the LEC Planning Area, fresh groundwater supplied 100 percent of the estimated demand (12 million gallons per day [mgd]) for Domestic and Small Public Supply (DSS) users in 2016. By 2040, DSS demand is expected to increase to 16 mgd. Fresh groundwater from the SAS will continue to supply DSS through 2040.

AGR in Broward and Miami-Dade counties, accounting for approximately 7 percent of irrigated agricultural acres in the LEC Planning Area in 2016, primarily depends on withdrawals from the Biscayne aquifer to supply irrigation for crops, livestock, and other purposes. In 2016, approximately 23 mgd of AGR demand in the LEC Service Areas was met using fresh groundwater from the SAS. AGR demand in the LEC Service Areas, and its reliance on the SAS, is expected to substantially decline in Palm Beach County but increase 10 percent in Miami-Dade County over the next 20 years. In the Western Basins, AGR demands on the SAS are expected to increase from 78 mgd in 2016 to 86 mgd in 2040. Permitted AGR groundwater withdrawals in the LEC Planning Area are shown in **Figure 7-10**.

Approximately 32 percent of REC demand in the LEC Planning Area, including golf courses, and 38 percent of the total ICI demand was met with groundwater in 2016 (SFWMD 2017a). The REC and ICI categories are expected to grow approximately 15 percent, based on population growth. Fresh groundwater is expected to meet approximately one-third of the increased demand resulting from this growth, depending on availability at specific locations. For the REC category, some SAS withdrawals may be replaced by reclaimed water, especially in areas with Ocean Outfall Law reuse requirements, discussed later in this chapter. Permitted REC groundwater withdrawals in the LEC Planning Area are shown in **Figure 7-11**.

Fresh groundwater provided 10 percent of the total Power Generation (PWR) demand in the LEC Planning Area in 2016. Replacement of the Dania Beach FPL Energy Center is expected to reduce freshwater use at the plant from 1.70 to 1.00 mgd by 2022. By 2040, a proposed power plant in Hendry County will increase the fresh groundwater contribution to approximately 32 percent of the total PWR demand.

Limits on Availability

Use of the SAS in the LEC Service Areas is limited by potential impacts on: the regional system, wetlands, pollution, and existing legal users, and by the potential for saltwater intrusion. The Biscayne aquifer also is an MFL water body, and withdrawals cannot cause further inward movement of the saltwater interface. Potential impacts on the regional system are addressed by the Restricted Allocation Area criteria for withdrawals within the LEC Service Areas and Northern Palm Beach County Service Areas as discussed earlier. Future strategies to address limits on availability are provided in **Chapter 9**.

INFO ⓘ

Due to its regional importance, the Biscayne aquifer is designated as a Sole Source Aquifer by the United States Environmental Protection Agency, under the Safe Drinking Water Act. As such, stringent protection of the Biscayne aquifer is necessary because it is a principal source of drinking water and highly susceptible to contamination and saltwater intrusion due to its high permeability and proximity to land surface in many locations.

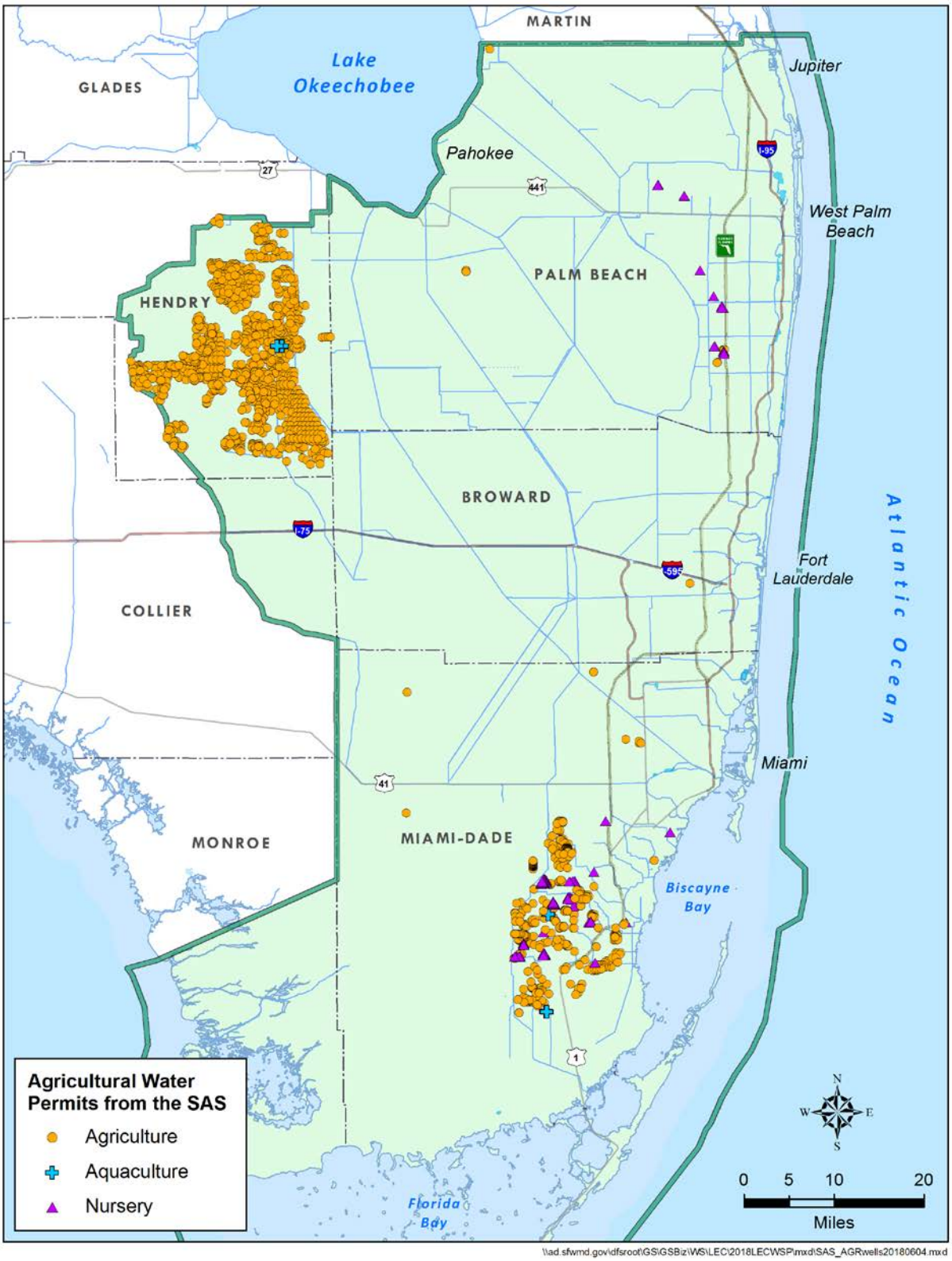

Figure 7-10. Agricultural Irrigation water use permit withdrawal locations from the surficial aquifer system within LEC Planning Area.

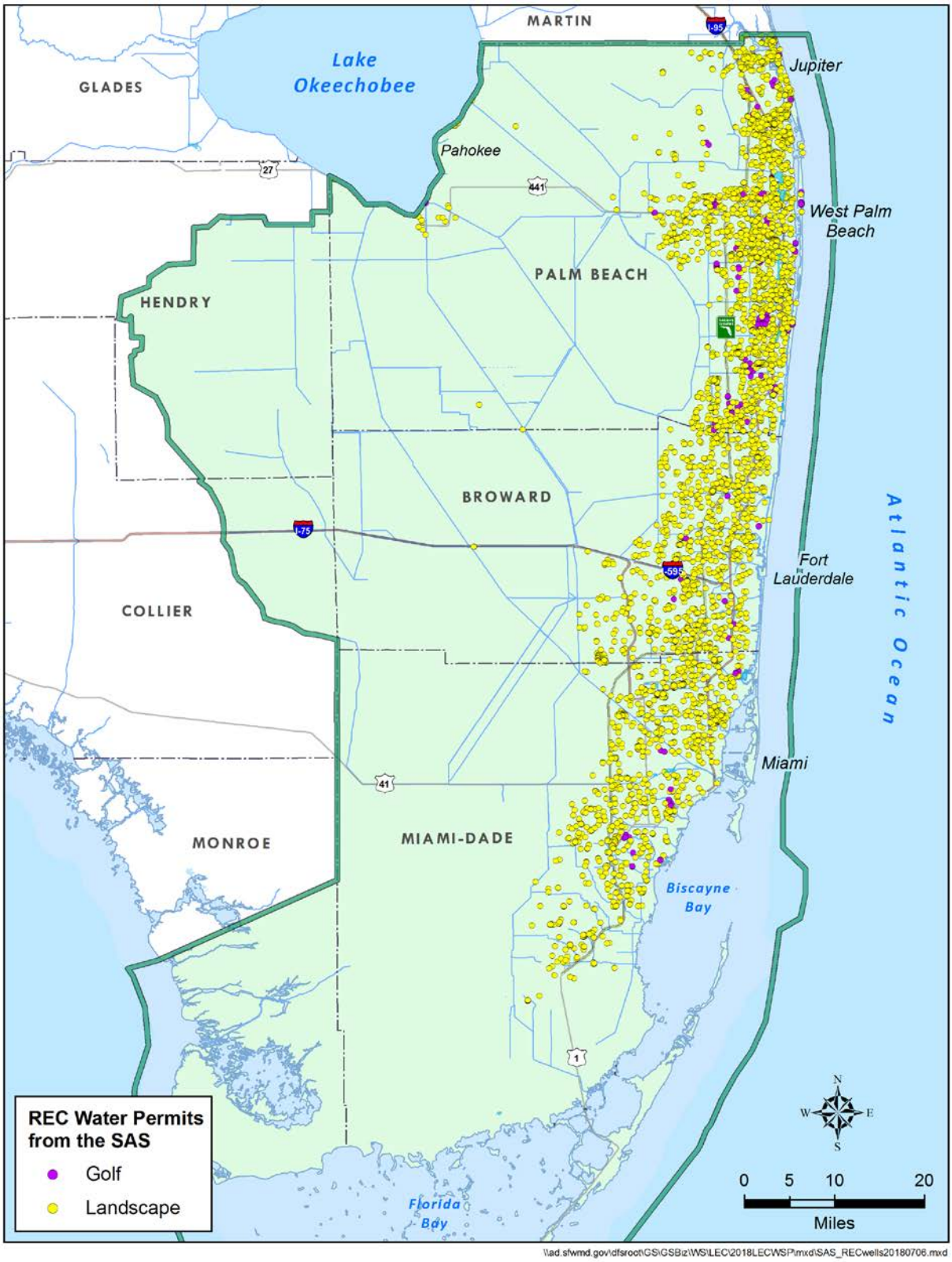

Figure 7-11. Golf and landscape irrigation water use permit withdrawal locations from the surficial aquifer system within LEC Planning Area.

Western Basins – Lower Tamiami Aquifer

The SAS is composed of the water table and Lower Tamiami aquifer in the Western Basins. It is an unconfined to semi-confined aquifer system composed of limestone, sandstone, sand, shell, and clayey sand. The water table generally is 20 feet or less in thickness and does not produce substantial quantities of water. An intermittent clayey layer (leaky confining zone) separates the water table from the underlying Lower Tamiami aquifer. Below the Lower Tamiami aquifer, the Sandstone and Mid-Hawthorn aquifers in the intermediate aquifer system are not productive in the Western Basins.

The Lower Tamiami aquifer is the major source of groundwater in eastern Hendry County and extends east into the LEC Service Areas as the Gray Limestone aquifer (Reese and Cunningham 2000). The aquifer is composed of shelly sand, course-grained sandy limestone, and sandstone 25 to 200 feet below land surface. Transmissivities of the Lower Tamiami aquifer increase from north to south in eastern Hendry County.

The SAS produces high-quality fresh water from relatively shallow wells in the Western Basins. With moderate transmissivities and substantial AGR withdrawals, water levels in the Lower Tamiami aquifer are monitored for potentially harmful declines below the top of the aquifer. Monitor well locations and hydrographs are provided in **Appendix D**.

Existing and Future Use

The Western Basins include four drainage basins in eastern Hendry County (**Figure 5-1**). Generally, land within these basins is classified as agriculture (e.g., vegetable, sugarcane, citrus), cow-calf operations, or wetlands and natural areas. Fresh groundwater from the Lower Tamiami aquifer is the primary source for AGR demands in the Western Basins.

Agriculture in the Western Basins primarily depends on withdrawals from the Lower Tamiami aquifer to supply irrigation for crops, livestock, and other purposes. In 2016, approximately 80 mgd of fresh groundwater was used to meet AGR demand in the Western Basins. This is expected to increase to 86 mgd by 2040. **Figure 7-10** shows the location of agricultural groundwater withdrawals in the Western Basins. The remainder of AGR demand in the Western Basins is supplied by fresh surface water. Potential construction of a new FPL energy facility in southeastern Hendry County, which is designed to have solar and natural gas facilities, could require up to 13 mgd of groundwater by 2030.

The Seminole Tribe of Florida and Miccosukee Tribe of Indians of Florida have reservations in the Western Basins (**Figure 1-1**) and require water for residents, agriculture, and wetlands. The Lower Tamiami aquifer is used for PWS, DSS, and AGR in the Seminole Tribe of Florida Big Cypress Reservation. The SAS provides water for DSS in the Miccosukee Federal Reservation and for PWS in the Miccosukee Tamiami Trail Reservation.

Limits on Availability

SAS allocations in the Western Basins are constrained by the presence of isolated wetlands and the Lower West Coast Aquifers MFL (discussed in **Chapter 4** of this plan update and in more detail in the *2017 Lower West Coast Water Supply Plan Update* [SFWMD 2017b]). AGR demands fluctuate seasonally, with emphasis on the growing seasons, which require optimal water table levels. Per the Maximum Developable Limit criteria, part of the Lower West Coast Aquifers MFL prevention strategy, the potentiometric head within the Lower Tamiami aquifer is not allowed to drop to less than 20 feet above the top of the uppermost geologic stratum of the aquifer at any point during 1-in-10 year drought conditions. Water levels in two of six regional Lower Tamiami aquifer monitor wells in eastern Hendry County periodically have been less than 20 feet above the top of the aquifer during drought periods. The other monitor wells have remained at least 30 feet above the top of the aquifer for the period of record. Water level data for this area are provided in **Appendix D**.

As AGR water use in the Western Basins is expected to increase over the planning horizon, water levels in the Lower Tamiami aquifer will require close monitoring where they are approaching the Maximum Developable Limit, and withdrawal reductions may become necessary. Where the Lower Tamiami aquifer thins or is heavily used, AWS options may be needed to ensure adequate future supply and prevent harm to the aquifer. Additional groundwater allocations may be available on a case-by-case basis. Future strategies to address limits on availability are provided in **Chapter 9**.

Brackish Groundwater – Floridan Aquifer System

Brackish water has a chloride concentration greater than 250 mg/L and less than 19,000 mg/L (seawater). In the LEC Planning Area, water from the FAS typically contains chloride concentrations greater than 1,000 mg/L. Desalination is required before this water supply source is suitable for most uses, including human consumption. Brackish groundwater generally is unsuitable for AGR and requires blending with fresh water to meet acceptable chloride concentrations.

The FAS is a confined aquifer system separated from the SAS by the low-permeability sediments of the Intermediate Confining Unit. Within the LEC Planning Area, the FAS is composed of a carbonate rock (limestones and dolostones) sequence more than 2,700 feet thick. The FAS has several discrete aquifers separated by low-permeability confining units, but typically is divided into two regionally continuous producing zones: the brackish UFA and more saline Lower Floridan aquifer (LFA) (**Figure 7-7**).

In the LEC Planning Area, the top of the FAS (coincident with the top of the UFA) is approximately 800 to 1,100 feet below land surface. The FAS is shallowest in the northwestern corner of Palm Beach County and deepens to the south and east. The UFA is under artesian pressure in the LEC Planning Area, with potentiometric heads ranging from 30 to 50 feet above mean sea level. Although the potentiometric surface of the UFA is above land surface, the Intermediate Confining Unit prevents upward migration of water into shallower aquifers.

The UFA is composed of limestones from the Suwannee, Ocala, and Upper Avon Park formations. Productivity and salinity in the UFA tend to increase from west to east, with the greatest productivity and highest salinities occurring in coastal areas. The UFA can be divided into the upper producing zone at the top of the FAS and the deeper Avon Park Permeable Zone, separated by a confining unit (**Figure 7-7**, middle confining unit 1). Heads in these two zones are similar, but productivity and salinity vary considerably. Generally, salinity within the FAS increases with depth; however, in some coastal regions of the LEC Planning Area, salinity is greater in the shallower portions of the UFA due to relict seawater.

The LFA comprises the limestones and dolostones of the Lower Avon Park, Oldsmar, and Upper Cedar Keys formations. The total dissolved solids concentration (a measure of salinity) within the LFA is greater than 10,000 mg/L, which is the threshold for an underground source of drinking water. Though generally not considered useful as a water supply source in the LEC Planning Area, the LFA also includes the Boulder Zone (approximately 2,700 feet below mean sea level), a cavernous and highly transmissive interval used for disposal of wastewater and concentrate from reverse osmosis (RO) treatment facilities through the use of deep injection wells.

The SFWMD partners with the United States Geological Survey to monitor the FAS through regional networks of monitor wells and through permittees as part of reporting requirements for water use (SFWMD) and injection wells (Florida Department of Environmental Protection [FDEP]). Data from these wells indicate seasonal variations in water levels, but overall, levels have remained stable over the period of record. Nearly all PWS utilities in the LEC Planning Area that use the UFA have had one or more production wells experience degraded water quality. However, regional water quality of the FAS has remained relatively stable. **Appendix D** contains monitor well location information and data for the regional FAS network as well as PWS utility water quality graphs.

Existing and Future Use

In the LEC Planning Area, the UFA provides brackish groundwater for PWS, REC, and PWR demands. Use of the UFA began in the late 1970s, and by 2016, 15 PWS treatment plants had been constructed, with a combined treatment capacity of 102 mgd, in Palm Beach, Broward, and Miami-Dade counties. From 2006 to 2016, PWS withdrawals from the FAS increased from 14 to 53 mgd (**Figure 7-12**) and are expected to increase to 104 mgd by 2040. In the LEC Planning Area, 22 PWS utilities have UFA allocations, totaling 184 mgd. The UFA is not used for PWS in the portions of Monroe, Collier, and Hendry counties within the LEC Planning Area.

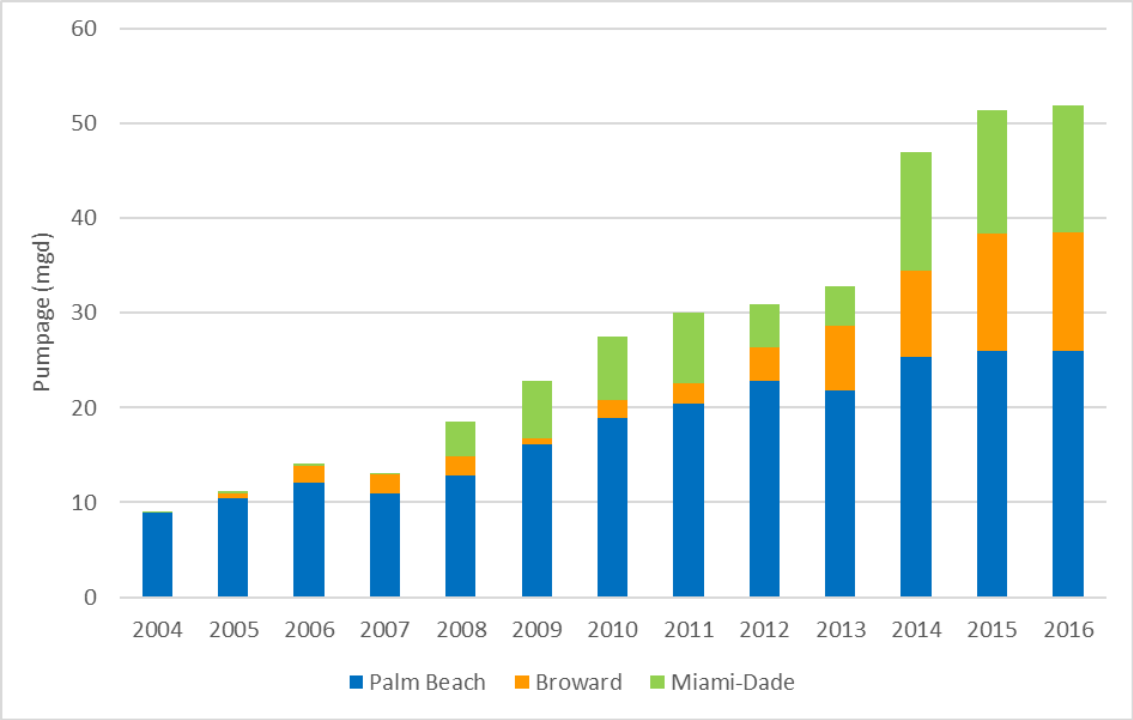

Figure 7-12. Public Water Supply withdrawals from the Floridan aquifer system in the LEC Planning Area (2004 to 2016).

PWS utilities typically use RO processes to remove excess salinity and reach acceptable drinking water quality. The approximate production efficiency or recovery for brackish water RO facilities Districtwide is between 75 and 85 percent, depending on the membrane technology employed and the salinity of the source water (Carollo Engineers, Inc. 2009). Some utilities blend brackish UFA water with fresh groundwater from the SAS and treat the blended product with lime softening or nanofiltration technology to meet drinking water standards.

Additional FAS users in the LEC Planning Area include seven golf courses—Seminole, Lost Tree, Everglades Club, Breakers, Palm Beach Country Club, and Palm Beach Par 3 in Palm Beach County, and North Key Largo (Ocean Reef Club) in Monroe County; Gulfstream Park in Broward County; and three power generation facilities—the FPL Turkey Point Plant in Miami-Dade County, and the FPL West County Energy Center (backup wells) and Okeelanta Cogeneration Facility in Palm Beach County. REC and PWR demands from the FAS are not expected to increase beyond 2016 use. Well locations in the FAS, including ASR wells discussed later in this chapter, are shown in **Figure 7-13**.

The SFWMD used the East Coast Floridan Model (ECFM) to simulate 2016 and 2040 demands from the FAS in the LEC Planning Area. Review of historical chloride data and the ECFM results concluded that properly designed and managed FAS wellfields appear able to meet projected demands through 2040 in the LEC Planning Area. The planning-level ECFM simulations and analyses conducted to support this plan update are considered conservative and provide insight to potential water level and water quality changes that may occur in the FAS over time if no wellfield design or operations plan is implemented to minimize the movement of poor-quality water. The model results identified potential issues that may require further evaluation. The FAS will continue to provide a substantial and increasing portion of the water needed to meet projected 2040 demands. Water quality should remain adequate for all users with RO treatment, as needed. A discussion of the model results, conclusions, and recommendations is provided in **Appendix D**.

Limits on Availability

Several FAS wellfields in the LEC Planning Area have experienced some water quality degradation, but current operations have shown this can be managed by PWS utilities through appropriate wellfield design and operating protocols, including the following activities:

- Increasing well spacing (more than 1,000 feet) to minimize interference effects and to reduce stress on the FAS.
- Rotating the operation of individual wells, thereby reducing overall pumping stress on the well's production zone.
- Plugging and abandoning individual wells experiencing increases in chloride concentration and replacing them with new wells elsewhere within the wellfield area.
- Reducing pumping rates at individual wells to minimize water level declines, which increase the potential for poor-quality water to enter the well's production zone from below.
- Installing monitor wells to provide early warning of the need for changes to wellfield operations to minimize upconing or lateral movement of poor-quality water.

Future strategies to address limits on availability are provided in **Chapter 9**.

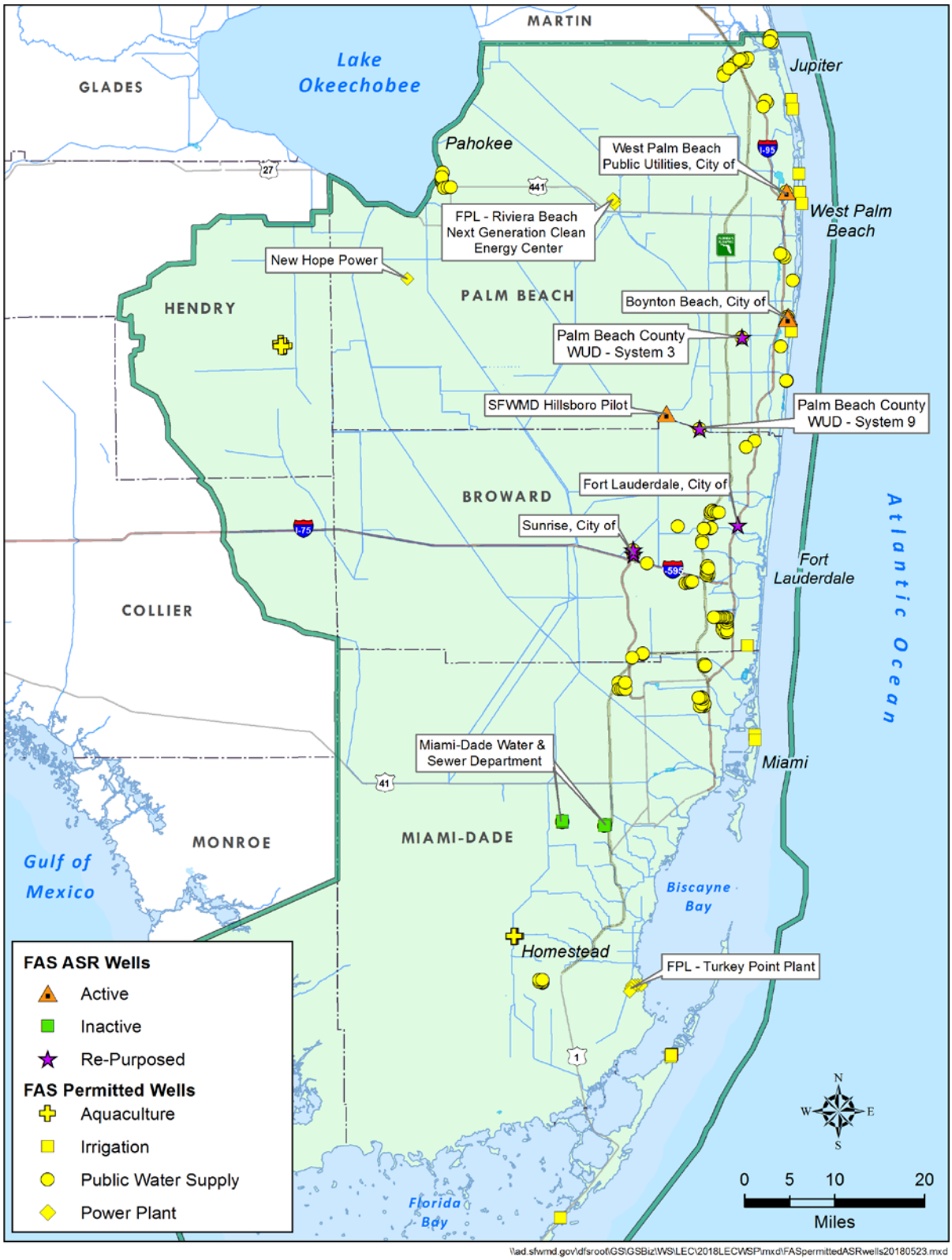

Figure 7-13. Floridan aquifer system wells and aquifer storage and recovery systems within the LEC Planning Area.

RECLAIMED WATER

Reclaimed water is water that receives at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility (WWTF). The State of Florida encourages and promotes the use of reclaimed water as an AWS. Reclaimed water can be used for many purposes, including green space irrigation, industrial cooling and process water, groundwater recharge, saltwater intrusion barriers, environmental enhancement, and other nonpotable uses.

The Water Resource Implementation Rule [Chapter 62-40, Florida Administrative Code] requires the FDEP and water management districts to advocate and direct the use of reclaimed water as an integral part of water management programs, rules, and plans. The SFWMD requires all water use permit applicants proposing to irrigate with more than 0.10 mgd of water and applicants within a mandatory reuse zone, as designated by local governments through ordinance, to use reclaimed water if feasible. In addition, substitution credits and impact offsets, resulting from use of reclaimed water, may be included in a water use permit. A substitution credit is the use of reclaimed water to replace a portion or all of an existing permitted use of a limited surface water or groundwater resource, allowing a different user to initiate or increase withdrawals from the resource. Impact offsets are derived from the use of reclaimed water to reduce or eliminate a harmful impact that has occurred or otherwise would occur as a result of a surface water or groundwater withdrawal.

The use of reclaimed water in the LEC Planning Area helps minimize resource impacts by reducing reliance on traditional freshwater sources. Wastewater reuse also reduces use of traditional wastewater disposal methods such as ocean outfalls and deep well injection, although utilities require backup disposal methods during wet periods when irrigation demand is low.

Existing Reuse in the LEC Planning Area

Wastewater management within the SFWMD boundaries evolved from smaller subregional facilities to a partially integrated system of larger regional facilities and a limited but growing network of pipelines that carry reclaimed water to end users (**Appendix F**). The volume of reclaimed water used in the LEC Planning Area for a beneficial purpose, such as landscape irrigation and cooling water, increased ten-fold from 1994 to 2016, primarily in Palm Beach County (**Figure 7-14**). Annual fluctuations in the volume of reclaimed water used is due to the addition of new users and variable amounts of rainfall.

In 2016, 46 WWTFs in the LEC Planning Area had a permitted treatment capacity of 0.10 mgd or greater. These facilities had a total wastewater treatment capacity of 900 mgd and treated an average of 661 mgd of wastewater in 2016 (FDEP 2017). The Miami-Dade Central District WWTF, operated by the Miami-Dade Water and Sewer Department (MDWASD), is the area's largest WWTF, with a capacity of 143 mgd.

In 2016, approximately 88 percent (579 mgd) of the LEC Planning Area's treated wastewater was disposed of through deep well injection (363 mgd), ocean outfall (213 mgd), and shallow well injection (3 mgd in the Florida Keys).

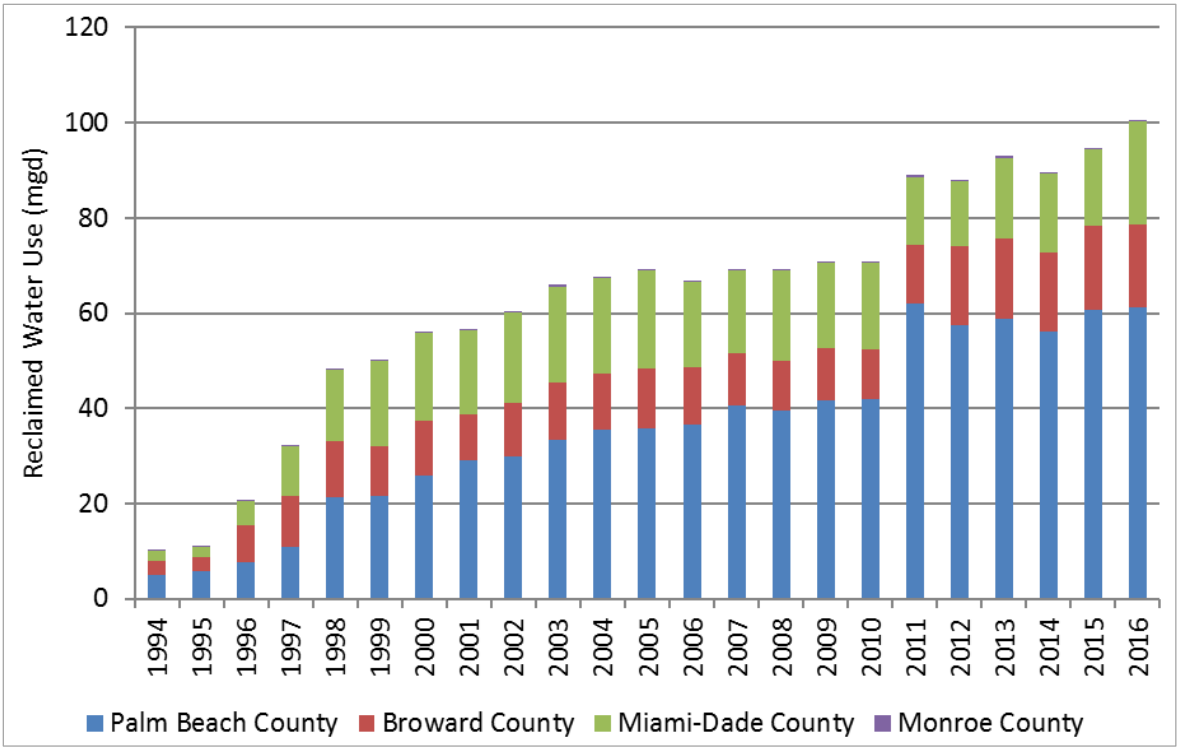

Figure 7-14. Annual average reclaimed water use in the LEC Planning Area from 1994 to 2016.

Of the 46 WWTFs in the LEC Planning Area, 25 facilities reused at least a portion of their wastewater in 2016, for a total reuse amount of 101 mgd. Approximately 51 mgd were used to irrigate landscape for more than 22,000 residences, 63 golf courses, 68 parks, and 22 schools, mostly in Palm Beach County (FDEP 2017). More than 5 mgd of reclaimed water were used for groundwater recharge, mainly by the City of Homestead, through rapid infiltration basins and percolation ponds. The remaining 44 mgd of reclaimed water were used for PWR cooling and various other purposes, including hydration of created wetlands and natural areas in Palm Beach County (Wakodahatchee, Green Cay, and Peaceful Waters) and industrial use at WWTFs. Summaries of wastewater and reclaimed water facilities, including their capacities and locations, are provided in **Appendix F**.

The total amount of water reused in the LEC Planning Area in 2016 (101 mgd) exceeds the difference between wastewater treated (661 mgd) and wastewater disposed (579 mgd). Wastewater disposed cannot be subtracted from wastewater treated to quantify the volume reused because additional water may be introduced to the disposal or reclaimed volumes. For example, a utility may reuse water at the WWTF for process water, then return it to the disposal system. In addition, several utilities have permits to blend groundwater or surface water with reclaimed water. This supplemental water is added into the total water reused without being treated at the WWTF.

Reclaimed water is one of three primary sources of cooling water for PWR, along with tidal water and seawater. Use of reclaimed water for PWR increased in late 2010 when Palm Beach County began providing the FPL West County Energy Center with reclaimed water from the East Central Regional WWTF (note increase in reclaimed water use between 2010 and 2011 in **Figure 7-14**).

Future Reuse in the LEC Planning Area

Wastewater flows are projected to increase from 669 mgd in 2016 to 822 mgd in 2040. In addition, 30 of the 46 utilities operating WWTFs are projected to reuse a portion of their treated wastewater flow. To comply with the Ocean Outfall Law (described in the following section), the responsible utilities need to reuse an additional 153 mgd above their 2016 flows (44 mgd). Use of reclaimed water, including reuse by ocean outfall utilities, is projected to increase from 101 mgd in 2016 to 297 mgd by 2040, primarily a result of the Ocean Outfall Law.

While using reclaimed water for irrigation will continue to be an important part of reuse in the LEC Planning Area, additional options are expected to become available to help meet water demands or offset potential impacts associated with future withdrawals. Additional reclaimed water options include the following:

- As a saltwater intrusion barrier preventing or delaying inland movement of the saltwater interface along the coast. Under this scenario, reclaimed water would be injected into the aquifer between the saltwater source and the PWS wellfield.
- For the benefit of the environment. The application of water reuse for environmental benefit could be accomplished in several ways, including hydration of natural or created wetlands.
- To recharge and replenish the network of canals in Palm Beach, Broward, and Miami-Dade counties and to reduce water deliveries from the regional water management system, especially during the dry season. These canals could act as a distribution network for reclaimed water, provided water quality standards are met.
- For potable reuse. Singapore's NEWater facilities have been producing potable water for over a decade. In the United States, California and other areas in the Southwest are turning to potable reuse, both direct and indirect, for water supply. In 2018, a collaborative partnership, the Potable Reuse Commission, was initiated to create a framework for potable reuse implementation in Florida to augment future water supply and support water quality initiatives.

Irrigation with reclaimed water could result in a decrease in per capita demand to the local utility if replacing potable water. If groundwater or surface water is replaced with reclaimed water, utilities can receive a substitution credit as part of their water use permit. A few PWS utilities (Boca Raton, Miramar, and Boynton Beach) in the LEC Planning Area have substitution credits, or similar, incorporated into their current water use permit. Palm Beach County Utilities (Wakodahatchee and Green Cay wetlands) and Wellington Utilities (Peaceful Waters Sanctuary) have

Wakodahatchee Wetlands

successfully implemented wetlands hydration projects, which benefit the utilities by providing an environmentally friendly means of wastewater disposal in addition to indirectly recharging the SAS.

Canal recharge and saltwater intrusion barriers as reuse options have been studied but are not currently implemented by wastewater utilities in the LEC Planning Area. State and local regulatory constraints would need to be addressed before further progress could be made.

Leah Schad Memorial Ocean Outfall Program

In 2008, the Florida Legislature enacted an ocean outfall statute [Section 403.086(9), F.S.] requiring elimination of the use of six ocean outfalls in southeastern Florida as the primary means for disposal of treated domestic wastewater by 2025. In addition, affected wastewater utilities are required to reuse at least 60 percent of the outfall flows by 2025. The objectives of this statute were to reduce nutrient loadings to the environment and to more efficiently use water to meet demands.

The Leah Schad Memorial Ocean Outfall Program applies to the eight wastewater utilities that have permits to discharge through an ocean outfall, all of which are in the LEC Planning Area. Six WWTFs have ocean outfall discharges:

- South Central Regional WWTF (Delray Beach and Boynton Beach)
- Boca Raton WWTF
- Broward County North Regional WWTF
- Hollywood Southern Regional WWTF
- Miami-Dade North District WWTF (MDWASD)
- Miami-Dade Central District WWTF (MDWASD)

Additionally, Cooper City and the Town of Davie are permitted to discharge effluent through the Hollywood Southern Regional WWTF. Therefore, these two local governments also have obligations to meet the ocean outfall requirements for their portion of wastewater contributions.

The 60 percent of wastewater discharged through ocean outfalls that must be beneficially reused is computed from a baseline discharge flow of each ocean outfall from 2003 through 2007. The current 60 percent reuse requirements, including adjustments by the FDEP, and the total reuse required by 2025 for each utility are presented in **Table 7-1**. The reuse requirements for Miami-Dade County WWTFs may be met countywide because the North, Central, and South District WWTFs are owned and operated by one utility (MDWASD) and are interconnected. Note the South District WWTF does not have an ocean outfall; it uses deep well injection for disposal.

Table 7-1. The 60 percent reuse requirement and total 2025 reuse for the utilities affected by the Ocean Outfall Law (Modified from: FDEP 2015).

Utility	60 Percent Reuse Requirement (mgd)	2025 Total Reuse[a] (mgd)
South Central Regional WWTF (Delray and Boynton)	7.70	13.30
Boca Raton WWTF	6.20	11.80
Broward County North Regional WWTF	21.45[b]	25.95
Hollywood Southern Regional WWTF	10.00[c]	12.30
Cooper City WWTF	0.90	0.90
Davie WWTF	1.10	1.10
Miami-Dade North District WWTF (MDWASD)	48.60	51.60
Miami-Dade Central District WWTF (MDWASD)	68.90	74.80
Miami-Dade South District WWTF (MDWASD)	0.00	5.10
Total	**164.85**	**196.85**

MDWASD = Miami-Dade Water and Sewer Department; mgd = million gallons per day; WWTF = wastewater treatment facility.

[a] The total reuse amount required by 2025 is the sum of the reuse amount existing in 2008 and the additional 60 percent reuse requirement.

[b] Reduced from the original 22.4 mgd.

[c] Reduced from the original 20.4 mgd.

Based on reports submitted to the FDEP, the current status of changes for each ocean outfall utility to meet the Ocean Outfall Law is as follows:

- **South Central Regional WWTF** – A deep injection well was installed for disposal such that the ocean outfall will only be used as an emergency backup. The 60 percent water reuse requirement is expected to be met primarily by increasing public access irrigation in the cities of Boynton Beach and Delray Beach.
- **Boca Raton WWTF** – The City of Boca Raton has increased capacity of its WWTF to provide 100 percent reuse. Reclaimed water will be provided for public access irrigation at additional locations in or near the city.
- **Broward County North Regional WWTF** – Broward County plans to meet the 60 percent reuse requirement by expanding its public access irrigation in northern Broward and southern Palm Beach counties, including expanding reuse systems in the cities of Pompano Beach and Coconut Creek. Additional deep injection wells are being installed for backup disposal and to decrease flows to the ocean outfall.
- **Hollywood Southern Regional WWTF** – The City of Hollywood plans to meet its 60 percent water reuse requirement by increasing public access irrigation near the WWTF and is considering contract reuse in neighboring service areas. Additional deep injection wells are being installed for backup disposal and to decrease flows to the ocean outfall.
- **Cooper City WWTF** – Cooper City has entered into a contract with a neighboring utility to provide reclaimed water and meet the ocean outfall requirements.

- **Davie WWTF** – The Town of Davie has constructed a town-owned water reclamation facility, thereby reducing the amount of wastewater effluent it sends to the Hollywood Southern Regional WWTF. Water from the new reclamation facility will be reused for public access irrigation in the city to meet the ocean outfall requirements.
- **Miami-Dade North, Central, and South District WWTFs** – The MDWASD has updated its water reuse feasibility study. At this time, the most likely use of reclaimed water is for freshening and cooling the canals at the FPL Turkey Point Plant (up to 60 mgd of wastewater and 45 mgd of reclaimed water). Additional deep injection wells are being installed for backup disposal and to decrease flows to the ocean outfalls.

Supplemental Sources to Meet Reuse Demand

In some service areas, the demand for reclaimed water exceeds the volume of wastewater treated by the utility. This can be during specific times of the year or related to anticipated new wastewater sources not yet available. To meet peak demands for reclaimed water, typically during the dry season, supplemental water supplies (e.g., surface water, groundwater, potable water) may be required, enabling a utility to maximize use of reclaimed water. However, during times of drought, traditional supplemental water sources are subject to water shortage restrictions. The availability of these supplies to supplement reclaimed water will be evaluated using SFWMD water use permitting criteria on an application-by-application basis.

Four utilities in the LEC Planning Area used supplemental water to expand their water reuse systems in 2016. The Seacoast Utility Authority used a combination of membrane concentrate (1.51 mgd), groundwater (0.30 mgd), and potable water (0.02 mgd). The Loxahatchee River District (1.90 mgd) and the City of Boca Raton (0.22 mgd) also used membrane concentrate. The Florida Keys Aqueduct Authority – Duck Key (Hawk's Cay) used 0.03 mgd of potable water.

WATER STORAGE

Storage is an essential component of any supply system experiencing fluctuation in supply and demand. Capturing surface water and groundwater during wet conditions for use during dry conditions increases the amount of available water. Approximately three-quarters of South Florida's annual rainfall occurs during the wet season. Without sufficient storage capacity, much of this water discharges to the ocean through surface water management systems and natural drainage. In the LEC Planning Area, potential water storage options include ASR systems and reservoirs, both of which are considered AWS options.

Aquifer Storage and Recovery

ASR involves storing stormwater, surface water, fresh groundwater, drinking water, or reclaimed water in an aquifer that has appropriate attributes (e.g., modest transmissivity, intergranular porosity, overlain by a competent confining unit, low ambient water salinity) and subsequently recovering the water at a later date. In this process, an aquifer acts as an underground reservoir for injected water. The injected water is treated to appropriate

standards, which may vary depending on the water quality of the receiving aquifer, and then pumped into the aquifer through a well (stored). The water is pumped back out (recovered) at a later date and treated for use. The amount of water recovered depends on subsurface conditions, storage time, and water quality. The level of treatment required during recovery depends on the intended use of the water (e.g., public consumption, irrigation, surface water augmentation, wetlands enhancement).

The volume of water made available through ASR depends on several factors, including well yield, water availability, aquifer characteristics, variability in water supply and demand, and use type. There are uncertainties that need to be addressed with the implementation of ASR systems, but this storage option has the potential to retain substantial quantities of water that otherwise would be lost to the ocean, deep well injection, or evaporation.

Most of the ASR systems in the District have been built by PWS utilities to store potable water during periods of low seasonal demand for subsequent recovery during periods of high demand. Of the ASR systems constructed in the LEC Planning Area, three are active (described below), two are idle and available for operation (MDWASD), one was abandoned (Broward County Water and Wastewater Services District 2A), and several others were re-purposed as FAS supply wells (City of Sunrise, City of Fort Lauderdale, and Palm Beach County Water Utilities Department) (**Figure 7-13**).

- **SFWMD Hillsboro Comprehensive Everglades Restoration Plan (CERP) Pilot Project** – The SFWMD constructed and initially tested the Hillsboro ASR pilot project through 2012 using treated surface water from the Hillsboro Canal. The system was inactive until 2016, when it was reactivated to store water during an unusually wet period. The system underwent another test cycle in 2016, and recovery took place using the natural artesian pressure of the FAS, with a recovery efficiency of 60 percent, representing continuous improvement over previous cycles.
- **City of West Palm Beach –** In 1996, the City of West Palm Beach constructed an ASR system at the water treatment plant and tested it through 1998 using partially treated surface water from Clear Lake. The system was inactive until 2012, when the FDEP issued a permit to reactivate operational testing, which began in 2013. In 2015, the FDEP granted a Limited Aquifer Exemption for the ASR system, allowing the City to eliminate the disinfection process. During summer 2016, the ASR system was used for the first time for PWS when the water quality of Clear Lake declined. The City is in the process of renewing its permit to continue operating the well.
- **City of Boynton Beach** – The City of Boynton Beach constructed its first ASR system at the East Water Treatment Plant in 1992 and has since stored treated drinking water in the UFA for recovery to meet peak demands. Given the success of the first ASR system, the City constructed a second ASR well in 2007. The ASR system has incrementally increased its total storage volume, resulting in a surplus of 250 million gallons stored in the UFA.

Boynton Beach ASR System

2013 Federal Guidance on ASR Systems

In 2013, the United States Environmental Protection Agency prepared a correspondence to the FDEP, providing an interpretation of the federal and state rules for permitting ASR wells. The guidance references the use of multiple regulatory and administrative mechanisms that are in rules to provide protection of aquifers and the public during operation of ASR systems. Interpretation of the existing regulations recognizes implementation of monitoring, treatment technology, and administrative or institutional controls that exist in Florida's regulatory framework to allow some flexibility in permitting ASR systems. The guidance recognizes the water resource benefits provided through ASR and provides clarity on the path towards issuance of permits for ASR systems. Several ASR systems throughout Florida are moving forward with operation and permitting under this guidance.

Local and Regional Reservoirs

Surface water reservoirs store water, primarily captured during wet weather conditions, for use in the dry season and are considered an AWS. Water typically is captured and pumped from rivers or canals and stored in aboveground or in-ground reservoirs, which are referred to as off-stream reservoirs. The proposed C-51 Reservoir is an example of an off-stream regional reservoir. Small-scale (local) reservoirs are used by agricultural operations for storage of recycled irrigation water or collection of stormwater runoff. These reservoirs also may provide water quality treatment before off-site discharge. Large-scale (regional) reservoirs are used for stormwater attenuation, water quality treatment in conjunction with stormwater treatment areas, and storage of seasonally available water. Examples include water preserve areas, Grassy Waters Preserve, and the planned C-18W (Mecca Farms) and C-51 reservoirs. Water supply development projects designed to capture, treat, and store water are discussed in **Chapter 8**.

C-51 Reservoir

The C-51 Reservoir project is a public-private partnership being developed by PWS utilities and water supply authorities for use as an AWS source in southeastern Florida. PWS utilities have executed agreements with the property owners to purchase capacity as part of total reservoir storage. The utilities have received or are processing modifications to their water use permits to reflect this AWS source as a means for meeting future demands. The proposed C-51 Reservoir (**Figure 7-15**) is a rock mine owned by Palm Beach Aggregates in central Palm Beach County, north of the C-51 Canal in Palm Beach County and adjacent to the SFWMD's L-8 flow equalization basin (FEB). The C-51 Reservoir project has been divided into two phases.

The mining operation for Phase 1 is complete and designed to store an estimated 14,000 acre-feet of surface water and provide 35 mgd of canal/SAS recharge near PWS withdrawals. The FDEP has issued a diversion and impoundment consumptive use permit and an environmental resource permit for construction and operation of Phase 1. Phase 2 of the project could provide an additional 46,000 acre-feet of storage, most likely for natural systems [Section 373.4598, F.S.]. The FDEP has issued a conceptual environmental resource permit for Phase 2. Over the past decade, the SFWMD, Lake Worth Drainage District, Palm Beach Aggregates, and PWS utilities jointly investigated the feasibility of using the C-51 Reservoir to capture and store excess surface water runoff from the C-51 Basin for beneficial uses; this effort resulted in the current two-phase project. A connection to the adjacent L-8 FEB would be constructed to deliver water to and from the reservoir, and excess

basin runoff would be the source of water for Phase 1. The amount of water available to the reservoir could be supplemented by pumping water from the eastern portion of the C-51 Basin at the S-155A structure to the western portion of the C-51 Basin, if needed for Phase 2. Water that otherwise would be discharged to Lake Worth Lagoon would be diverted into the C-51 Reservoir during wet periods and released into the C-51 Canal during dry periods to meet demands. During dry periods, water from the C-51 Canal would be pumped, or flow by gravity, south through canals of the Lake Worth Drainage District, who has entered into a conveyance system agreement with Palm Beach Aggregates. Additionally, water routed south to the Hillsboro Canal could be redistributed to recharge local canals and drainage districts in Broward County, pursuant to an operations and maintenance agreement between the SFWMD and Palm Beach Aggregates and implemented through an operating plan with the SFWMD (under development) or other local water control districts.

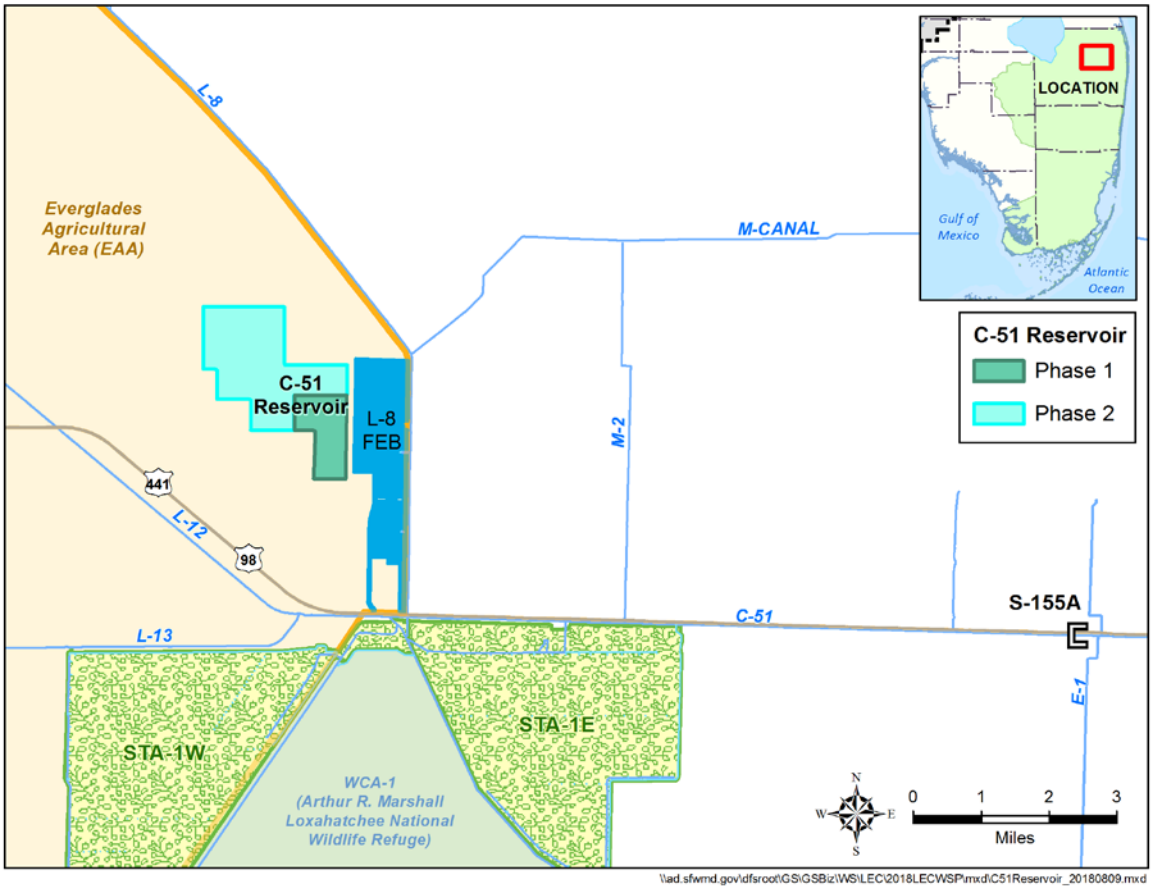

Figure 7-15. Proposed C-51 Reservoir in central Palm Beach County.

This water supply delivery operation is based on modeling conducted for the *C-51 Reservoir – Preliminary Design and Cost Estimate Final Report* (Lake Worth Drainage District et al. 2013). At full construction (Phases 1 and 2 combined), Palm Beach Aggregates expects the reservoir to be capable of producing 155 mgd of water during the dry season under 1-in-10 year drought conditions. As of fall 2018, four PWS utilities (Broward County, Sunrise, Dania Beach, and Hallandale Beach) have entered into capacity allocation agreements for a total of 13 mgd of the available 35 mgd in Phase 1.

Several PWS utilities in the LEC Planning Area are evaluating implementation and funding options for the C-51 Reservoir project. The SFWMD continues to explore its potential operational role and was authorized by the FDEP in Consumptive Use Permit 50-301070-003 to withdraw 4,889 million gallons of water annually from the C-51 Canal to fill the reservoir during wet-weather conditions. Over time, the SFWMD's role may evolve, depending on Governing Board direction. In 2011, a memorandum of understanding between the SFWMD and Palm Beach Aggregates was executed to identify the responsibilities of each entity for design, finance, construction, conveyance, assistance in permitting and, operation of the project. As part of this process, utilities and local governments approved creation of the C-51 Governance and Finance Work Group (2015), which conducted a third-party review of the project. After design and construction of the connection to the L-8 FEB is complete, the C-51 Reservoir could be available to PWS utilities in the LEC Planning Area as an AWS option. To use the reservoir as a water source, utilities would have to revise their water use permits and address applicable regulatory criteria. The first utility to accomplish this task was Broward County for their South Regional wellfield, which received a water use permit modification in March 2018. The C-51 Reservoir was designated as the SFWMD's pilot AWS project pursuant to Section 373.037, F.S.

SEAWATER

The use of desalinated seawater from the Atlantic Ocean is an AWS source option for the LEC Planning Area. The SFWMD does not require water use permits for seawater. Three power plants in the LEC Planning Area use seawater from tidally influenced water bodies for cooling purposes: FPL Riviera Beach Next Generation Clean Energy Center, FPL Port Everglades Next Generation Clean Energy Center, and FPL Dania Beach Energy Center (**Figure 2-4**). The ocean is an abundant source of water; however, desalination is required before seawater can be used for most water supply purposes. Desalination treatment technologies include distillation, RO, and electrodialysis reversal. RO is the most common desalination technology in the LEC Planning Area. There are two RO seawater desalination facilities in the LEC Planning Area. Both plants are in Monroe County (Stock Island and Marathon) and operated by the Florida Keys Aqueduct Authority for emergencies. They have a combined supply capacity of 3 mgd to the lower Florida Keys.

Major advances in seawater desalination treatment and efficiencies have occurred over the past decade. As a result, desalination costs are declining; however, the cost of standalone seawater desalination facilities remains moderately higher than brackish water desalination. Co-locating seawater desalination facilities with coastal power plants results in cost savings, further decreasing the cost difference compared to other AWS options. In December 2006, the SFWMD completed a feasibility study for co-locating seawater desalination facilities with power plants in South Florida (Metcalf & Eddy 2006), identifying FPL facilities in Fort Myers, Fort Lauderdale, and Port Everglades as the best potential sites. Additional information regarding seawater desalination is provided in the Support Document (SFWMD 2016).

SUMMARY OF WATER SUPPLY SOURCE OPTIONS

The LEC Planning Area relies on fresh groundwater and surface water for urban, agricultural, and industrial uses. However, traditional freshwater sources in the LEC Planning Area are not sufficient to meet projected 2040 water demands. Analyses indicate increases in allocations of fresh groundwater from the SAS and surface water from Lake Okeechobee are not available to meet the growing needs of the LEC Planning Area during 1-in-10 year drought conditions. The following water supply issues continue to influence water supply planning efforts in the LEC Planning Area:

- Increased withdrawals from the SAS are limited due to potential impacts on the regional system, wetlands, and existing legal water uses and due to the potential for saltwater intrusion.
- Surface water allocations from Lake Okeechobee and hydraulically connected surface waters are limited by the Lake Okeechobee Service Area RAA criteria.
- While the 2008 LORS is in effect, surface water users in the Lake Okeechobee Service Area have a reduced (1-in-6 year) level of certainty.
- During dry conditions, surface water availability and current storage capacity sometimes is insufficient to meet water demands and environmental needs.
- Additional storage (i.e., ASR systems and reservoirs) is required for the regional system to attenuate damaging peak flow events from Lake Okeechobee.

The current Integrated Delivery Schedule (United States Army Corps of Engineers 2018) indicates completion of the Herbert Hoover Dike rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019. State funding has been provided to assist the United States Army Corps of Engineers in expediting the rehabilitation schedule. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives.

The SAS historically has served as the primary source of water to meet PWS demands in the LEC Planning Area. Large-scale expansion of SAS withdrawals is limited due to resource constraints, impacts to existing users, environmental impacts to natural systems, and water level decreases in the Western Basins.

Surface water bodies and the SAS will remain primary sources for existing agricultural and landscape irrigation uses. Large-scale expansion of surface water and groundwater withdrawals is limited due to resource constraints. As urban growth occurs, some agricultural land is expected to transition to urban community uses. Many existing agricultural areas have water use permits to use fresh groundwater for crop irrigation. While water use permits cannot be directly transferred from one land use type to another, conversion of agricultural lands to another use may result in available fresh groundwater consistent with regulatory criteria.

The following findings could increase the availability of water resources in the LEC Planning Area to meet the projected 2040 water demands:

- The FAS is a brackish water source that requires blending or desalination before use. Some PWS utilities in the LEC Planning Area use the FAS as an AWS source to meet a portion of their demands. The FAS will provide an increasing portion of the water needed to meet 2040 projected demands. East Coast Floridan Model results indicate the FAS will be able to meet demand, in terms of volume and water quality.
- Approximately 88 percent of the LEC Planning Area's treated wastewater supply is disposed of through ocean outfalls, deep well injection, or shallow well injection. Wastewater that is reused is primarily for public access irrigation and PWR cooling processes. Further development of reclaimed water as an AWS option is expected, mostly due to the Ocean Outfall Law requirements.
- Approximately three-quarters of South Florida's annual rainfall occurs during the wet season; however, without sufficient storage capacity, much of this water discharges to tide. In the LEC Planning Area, potential types of needed water storage are under development, including ASR systems and reservoirs.

Water source options depend on location, use type, demand, regulatory requirements, and cost. As competition for limited water resources increases, development of AWS sources also will increase. The findings and conclusions of previous plan updates continue to represent the issues considered to meet the 2040 projected water demands within the LEC Planning Area.

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8

Water Supply Development Projects

This chapter summarizes the proposed water supply development projects, including potable, nonpotable, and conservation projects, intended to help meet anticipated water needs in the Lower East Coast (LEC) Planning Area for the 2016 to 2040 planning horizon. Public Water Supply (PWS) utilities, local governments, and large self-supplied water users, including Industrial/Commercial/Institutional (ICI) and Agricultural Irrigation (AGR), are primarily responsible for water supply development projects. For this *2018 Lower East Coast Water Supply Plan Update* (2018 LEC Plan Update), water supply development projects described in this chapter are only from PWS utilities. For each PWS utility supplying 0.10 million gallons per day (mgd) or more to its service area (**Appendix A**), a utility summary is included in **Appendix E**. Each utility summary includes population and demand projections (**Chapter 2**; **Appendix B**), permitted water allocations, potable water and wastewater permitted treatment capacities, and proposed water supply development projects.

TOPICS

- Link to Water Use Permitting
- Projects Identified for this Plan Update
- Cooperative Funding Program
- Summary of Water Supply Development Projects

LINK TO WATER USE PERMITTING

PWS utilities and local governments are required to use best available data when preparing Comprehensive Plans, Water Supply Facilities Work Plans, and water use permit applications (**Appendix A**). Population projections in such plans and applications should consider data from the most recent regional water supply plan update. Future water supply development projects should be consistent among the plans and permits. Proposed projects also must meet or exceed projected water demands through the planning horizon. However, local economic conditions and population growth may affect when water is needed, which projects are required, and how water use permits need to be modified to accommodate demand.

A Florida Department of Environmental Protection (FDEP) 2012 guidance memorandum addressed internal coordination between the South Florida Water Management District (SFWMD or District) water use permitting and water supply planning staff on projects included in regional water supply plans and updates (FDEP 2012). By increasing internal coordination during the water supply planning process, SFWMD staff are more familiar with a permit applicant's projects and will be able to facilitate the permitting process. The proposed projects considered for this 2018 LEC Plan Update screened by SFWMD water use permitting and water supply planning staff to determine if a proposed project is likely to be permitted by using the following set of questions:

- Does the proposed project use a source of limited availability?
- Is the project located in a Restricted Allocation Area (RAA)?
- Is the proposed source a Minimum Flow and Minimum Water Level (MFL) water body or is it connected, directly or indirectly, to an MFL water body? If yes, is the proposed use consistent with MFL recovery or prevention strategy?
- What other environmental water needs (e.g., Comprehensive Everglades Restoration Plan [CERP] targets, Water Reservations) may be impacted?
- What resource issues have been identified in recent permit applications in the general area for the same source (e.g., wetlands, saltwater intrusion, pollution, MFL)?
- Have existing legal users of the same source had resource-related compliance issues?
- Have any new technical studies been completed related to source availability?

Each proposed use of water must meet the conditions for permit issuance found in Section 373.223, Florida Statutes (F.S.), and the implementing criteria found in Chapter 40E-2, Florida Administrative Code (F.A.C.). Section 373.223, F.S., requires applicants to establish that the proposed use of water 1) is a reasonable-beneficial use as defined in Section 373.019, F.S.; 2) will not interfere with any existing legal use of water; and 3) is consistent with the public interest. Water use permits typically are required for water supply development projects. Permitting requirements (and exceptions) are found in Section 373.219, F.S.; Rule 40E-2.051, F.A.C.; and the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (Applicant's Handbook; SFWMD 2015).

The availability of water from the surficial aquifer system (SAS) in the LEC Planning Area is restricted due to existing water demands, source limitations, and resource issues such as saltwater intrusion, environmental needs, and aquifer protection criteria (**Chapter 4**). New or increased allocations from the SAS will be evaluated on an application-by-application basis to determine if the proposed use meets water use permitting criteria. The permitting of small volumes from the SAS may be feasible given local conditions, reductions in historical water use, and availability of new resources. The following sections discuss the demand and supply conditions for the six major water use categories and if there is a need for water supply development projects.

PROJECTS IDENTIFIED FOR THIS PLAN UPDATE

Projects proposed for inclusion in this plan update were evaluated based on factors discussed in the previous section, level of detail provided by the applicant (e.g., project scope, cost, schedule), and whether the project is expected to contribute to new water supply, possibly increasing permit allocation(s).

Users are not required to select a project included in this 2018 LEC Plan Update. In accordance with Section 373.709(6), F.S., nothing contained in the water supply component of a regional water supply plan should be construed to require local governments, public or privately owned utilities, special districts, self-suppliers, multijurisdictional entities, or other water suppliers to select the identified projects. In addition, an anticipated project may not be implemented or may be deferred if there is insufficient need.

Reverse Osmosis Water Treatment Plant

Public Water Supply

PWS demand includes all potable uses served by public and private utilities with a pumping capacity of 0.10 mgd or greater. As of 2016, PWS demand in the LEC Planning Area was met by fresh groundwater from the SAS (90 percent), brackish groundwater from the Floridan aquifer system (FAS) (6 percent), and surface water (4 percent). The PWS average net (finished) water demand is projected to grow from 802.62 mgd in 2016 to 1007.66 mgd by 2040, a 25 percent increase. A combination of existing and additional capacity created by water supply development projects will be used to meet the increased demand.

In addition to meeting demands, utilities may propose water supply development projects to address specific situations such as accommodating a change in treatment process or source, or optimizing distribution systems to match future demand locations. Although reuse and conservation of water do not produce potable water, they are demand management options to meet nonpotable demand or extend existing potable supplies to meet future demand. Each utility's proposed projects are listed in the utility profiles contained in **Appendix E** and summarized in **Tables 8-1**, **8-4**, and **8-5**.

In this plan update, 17 utilities have proposed 24 new projects to implement system expansions, source diversification, changes in treatment technology, expansion of existing plants, and construction of new production wells. Of the 24 projects proposed, 6 will require a water use permit modification before the project can be implemented due to changes in allocation or source. The minimum amount of additional allocations necessary will be approximately 48.10 mgd.

Several utilities proposed projects that would provide more water than necessary to meet projected demands for 2040. Utilities may replace or remove projects that are not needed or defer projects beyond the 20-year planning horizon of this plan update. If the projects identified in this plan update are not selected and the future demand will be left unmet, the utility must identify alternative methods or project(s) to meet its needs and inform the

SFWMD of the change. The local government then needs to include the project information in its Water Supply Facilities Work Plan.

Nine of the 54 PWS utilities in the LEC Planning Area need to construct projects or establish bulk agreements with nearby utilities to meet projected 2040 demands: Village of Palm Springs, City of Riviera Beach, City of Dania Beach, City of Fort Lauderdale, City of Hallandale Beach, North Springs Improvement District, Florida City Water and Sewer, City of Homestead, and Miami-Dade Water and Sewer Department (MDWASD). The minimum amount of water needed by these utilities to meet their shortfall is 53.40 mgd. In total, the proposed PWS development projects in the SAS and FAS could create new capacity for 72.83 to 80.13 mgd of net (finished) water (**Table 8-1**). Combined with existing capacity (1,496.63 mgd), this will exceed the projected 2040 PWS total net (finished) demand of 1,007.66 mgd.

For the nine utilities that need projects to meet their 2040 demands, the following projects have been proposed:

- The **Village of Palm Springs** plans to construct a recovery basin to add 0.20 mgd of capacity to its water treatment plant (WTP). Based on projected water needs beginning in 2030, the SFWMD suggests purchasing up to 0.30 mgd of bulk water from Palm Beach County Water Utilities Department (WUD), which has the capacity to provide this amount. The Village of Palm Springs can implement this suggestion or determine an alternative source to meet its demands starting in 2030.
- The **City of Riviera Beach** is working to reduce unaccounted-for water and its per capita use rate; however, if necessary, the SFWMD suggests purchasing up to 1.00 mgd of bulk water from the City of West Palm Beach or Palm Beach County WUD, which have the capacities to provide this amount. The City of Riviera Beach can implement this suggestion or determine an alternative source to meet its demands starting in 2030.
- The **City of Dania Beach** currently is unable to provide its own water; until 2023, the Broward County Water and Wastewater Services (WWS) South Regional Wellfield will provide all raw water through a bulk agreement. Beyond 2023, the City must implement projects or determine an alternative source(s) to meet 2023 to 2040 demands. Potential projects include purchasing bulk water from the City of Hollywood and implementing its approved capacity allocation agreement for Phase 1 of the C-51 Reservoir.
- The **City of Fort Lauderdale** plans to expand its WTP and add RO treatment for FAS water, which will provide 6.00 mgd of additional water.
- The **City of Hallandale Beach** plans to install an additional SAS well that will provide up to 3.03 mgd. In addition, the City plans to implement its approved capacity allocation agreement for Phase 1 of the C-51 Reservoir.
- **North Springs Improvement District** plans to install two or three FAS wells and an RO WTP that will provide 2.50 mgd of additional water.

- **Florida City** Water and Sewer Department is working to reduce unaccounted-for water and its per capita use rate; however, if necessary, the SFWMD suggests developing interconnections with the City of Homestead and the Florida Keys Aqueduct Authority (FKAA) and purchasing 1.00 mgd (2020) to 2.50 mgd (2040) of bulk water from either entity. Florida City Water and Sewer Department can implement this suggestion or determine an alternative source to meet its demands starting in 2020.
- The **City of Homestead** is working to reduce unaccounted-for water and its per capita use rate; however, if necessary, the SFWMD suggests purchasing additional bulk water from MDWASD (1.00 mgd starting in 2030 and up to 2.50 mgd in 2040) or determine an alternative source to meet its demands starting in 2030.
- **MDWASD** is planning four projects:
    - A 2.50-mgd expansion of its Hialeah RO WTP;
    - A two-phase project for the South Miami Heights FAS and SAS wellfields with an RO WTP plant that will provide 17.50 mgd of treatment for FAS water and 2.55 mgd for SAS water (which still will be treated via lime softening);
    - A new South Dade Regional SAS wellfield, which will provide 10.00 mgd of additional water; and
    - The proposed SAS Facilities Optimization project to maximize use of wet and dry season non-regional flows throughout Miami-Dade County. The project will incorporate operational flexibility between the utility's WTPs and wellfields.

The following projects have been proposed by utilities that can meet their 2040 demand but want to diversify their water sources or improve their current treatment methods to increase capacity:

- **Seacoast Utility Authority** plans to install two additional FAS wells that will provide a total of 4.00 mgd of additional water.
- **Broward County WWS District 1** has constructed two FAS wells and plans to add RO treatment to its WTP, which will provide a total of 3.00 mgd of additional water.
- **Broward County WWS District 2A/North Regional** plans to add FAS wells and expand its WTP to include RO treatment, or utilize 3 mgd in Phase 1 of the C-51 Reservoir for impact offsets, which will provide a total of 9.00 mgd of additional water.
- The **City of Hollywood** plans to expand its RO treatment plant by 2.00 mgd and install two additional FAS wells, which will provide a total of 4.00 mgd of additional water.
- The **City of Lauderhill** plans to replace an existing SAS well with one that will provide 5.50 mgd water. In addition, the City is planning multi-phase projects to install five FAS wells and construct an RO WTP, which will provide a total of 8.00 mgd of additional water.
- The **City of Pompano Beach** plans to improve the efficiency of its nanofiltration WTP by adding a concentrate recovery system that will yield 0.60 mgd of water.

- The **City of Sunrise** plans to convert two previously drilled FAS wells to aquifer storage and recovery (ASR) wells to store 3.00 mgd of additional potable water from the SAS. The City has approved a capacity allocation agreement for Phase 1 of the C-51 Reservoir for 5.00 mgd of impact offsets.
- The **City of North Miami Beach** is planning a two-phase RO WTP expansion with additional FAS wells that will provide 8.00 mgd of water.

PWS utilities have proposed nonpotable water supply projects using reclaimed water, surface water, and stormwater that could create 223.16 to 268.46 mgd of additional water supply for landscape and golf course irrigation as well as groundwater recharge (**Table 8-1**). The proposed nonpotable water projects include construction and expansion of reclaimed water production facilities, a reclaimed water storage facility, and aquifer recharge projects. Although projects involving new nonpotable water distribution lines and other infrastructure may qualify for the Cooperative Funding Program (described later in this chapter), they are not included as projects within this plan update because they do not generate new water supply capacity. The *2016 FDEP Reuse Inventory Report* (FDEP 2017) indicated 51 percent of wastewater generated in Palm Beach County, 7 percent generated in Broward County, 7 percent generated in Miami-Dade County, and 4 percent generated in Monroe County is reused for irrigation, industrial applications, wetland hydration, and aquifer recharge.

Reclaimed Water Storage and Distribution System

Table 8-1. Proposed potable and nonpotable Public Water Supply development projects in the LEC Planning Area (2016 to 2040).[a]

County	Implementing Agency or Entity	Project Name	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Potable – SAS						
Palm Beach	Palm Springs, Village of	RL Pratt Washwater Recovery Basin	Construct a washwater recovery basin at the RL Pratt WTP to collect filter backwash and recycle.	0.20	1.75	2020
Palm Beach	Palm Springs, Village of	Bulk water purchase from PBCWUD[b]	Based on water needs for 2030-2040, the SFWMD suggests purchasing up to 0.30 mgd of bulk water from PBCWUD.	0.30[b]	ND	2030
Palm Beach	Riviera Beach, City of	Bulk water purchase from PBCWUD or City of West Palm Beach[b]	The City of Riviera Beach must implement the project or determine an alternative source(s) to meet 2030 to 2040 demands.	1.00[b]	ND	2030
Broward	Dania Beach, City of	Bulk water purchase from City of Hollywood[b]	The City of Dania Beach must implement the project or determine an alternative source(s) to meet 2023 to 2040 demands.	1.00[b]	ND	2023
Broward	Hallandale Beach, City of	Well #9	Design, locate, and build western well for future water supply.	3.03[c]	1.80	ND
Broward	Lauderhill, City of	Well #9	New well to replace old/inadequate well, installed on WTP premises, and minimize impact to existing wellfield.	5.50[d]	1.00	2019
Broward	Pompano Beach, City of	Concentrate Treatment	Additional treatment of nanofiltration membrane waste stream to reduce waste from 15%-20% to 10%, yielding a water savings.	0.60	0.10	2021
Broward	Sunrise, City of	SGF-1 ASR Conversion	Conversion of an FAS well to an ASR well and installation of SAS and recharge zone aquifer monitor wells and a recharge and recovery pipeline.	3.00	7.62	2019
Miami-Dade	Florida City Water and Sewer Department	Interconnect and bulk water purchase from City of Homestead or FKAA[b]	Develop interconnections between City of Homestead and FKAA, purchasing 1.00 mgd (2020) to 2.50 mgd (2040) of bulk water from City of Homestead or FKAA.	2.50[b]	ND	2020-2040
Miami-Dade	Homestead, City of	Additional bulk water purchase from MDWASD[b]	Based on water needs for 2030-2040, the SFWMD suggests purchasing up to an additional 2.50 mgd bulk water from MDWASD.	2.50[b]	ND	2030
Miami-Dade	MDWASD	South Miami Heights WTP – Phase 1 (SAS portion)	Phase 1 includes SAS production wells that will provide 2.55 mgd.	2.55	95.00[e]	2021
Miami-Dade	MDWASD	SAS Facilities Optimization	This project will not increase potable water treatment capacity; it will optimize the SAS facility's production to meet 2040 demands.	0.00[f]	ND	2030

County	Implementing Agency or Entity	Project Name	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Potable – FAS						
Palm Beach	Seacoast Utility Authority	FAS Well F-6	Construct FAS water supply well and connecting raw water transmission main.	2.00	4.00	2018
Palm Beach	Seacoast Utility Authority	FAS Well F-9	Construct FAS water supply well and connecting raw water transmission main.	2.00	4.00	2020
Broward	BCWWS (District 1)	District 1 Water Supply Improvement Alternatives	Construct FAS water supply wells and connecting raw water transmission main and RO treatment to the WTP.	3.00	5.60	2025
Broward	BCWWS (District 2A/North Regional Wellfield)	District 2 WTP Expansion	Construct FAS water supply wells and expand treatment capacity of WTP 2A by adding approximately 6 mgd of RO process treatment.	6.00	33.34	2026
Broward	Fort Lauderdale, City of	Dixie FAS Water Supply/Treatment Facility	Expansion of the Peele-Dixie nanofiltration WTP to include RO treatment.	6.00	22.90	2030
Broward	Hollywood, City of	RO Train E	Installation of new RO train.	2.00	2.00	2034
Broward	Hollywood, City of	FAS Wells F14 and F15	Construction of 2 FAS wells.	4.00	3.00	2034
Broward	Lauderhill, City of	FAS Well Drilling Equipping and Testing (Phase 1)	Installation of 3 FAS wells.	3.00	2.50	2021
Broward	Lauderhill, City of	Construction of RO facility (Phase 1)	Phase 1 of construction of an RO WTP.	1.00	2.00	2021
Broward	Lauderhill, City of	FAS Well drilling equipping and testing (Phase 2)	Installation of 2 FAS wells.	2.00	2.50	2024
Broward	Lauderhill, City of	Construction of RO facility (Phase 2)	Phase 2 of construction of an RO WTP.	2.00	3.00	2025
Broward	NSID	FAS Wells and RO WTP	Installation of FAS wells and construction of an RO facility.	2.50	4.00	2031
Miami-Dade	MDWASD	Hialeah Floridan Aquifer RO WTP (Phase 1-b)	Installation of 4 FAS wells.	2.50	4.00	2017
Miami-Dade	MDWASD	South Miami Heights WTP –Phase 1 (FAS portion)	Phase 1 includes installation of FAS production wells and construction of an RO WTP.	12.45	289.95	2021
Miami-Dade	MDWASD	South Miami Heights WTP –Phase 2	Phase 2 of construction of an RO WTP.	5.00	4.00	2031
Miami-Dade	North Miami Beach, City of	FAS Wells, Lines, Mains, and RO WTP (Norwood WTP) Phase I	Phased construction of an 8.00-mgd RO WTP (when all phases complete).	3.00	35.60	2019
Miami-Dade	North Miami Beach, City of	FAS Wells, Lines, Mains, and RO WTP (Norwood WTP) Phase II	Phased construction of an RO WTP, adding 5 mgd of capacity.	5.00	37.50	2030

County	Implementing Agency or Entity	Project Name	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Nonpotable – Reclaimed Water						
Palm Beach	PBCWUD	South County Reclaimed (Phase I)	Construction of a 24-inch diameter reclaimed water transmission pipeline from BCWWS to serve the southern portion of the PBCWUD service area.	10.50	22.00	2021
Palm Beach	Wellington Public Utilities Dept.	Phased Reclaimed System Expansions	Install additional reuse filter equipment as influent flow increases. It will be a phased project: 1.30 mgd by 2020, 2.90 mgd by 2030 and 6.50 mgd by 2040.	6.50	4.00	2040
Broward	Cooper City Utility Dept., City of	Cooper City – Miramar Wastewater Reuse Agreement	Cooper City and Miramar plan to enter into an agreement wherein Miramar will satisfy Cooper City's permit requirement to produce 1.00 mgd of reclaimed water.	1.00	3.50	2017-2025
Broward	Miramar, City of	Reclaimed Water Treatment Expansion (Phase 2)	Expand reclaimed water treatment capacity from 4.00 to 6.00 mgd.	2.00	5.30	2020
Broward	NSID	Water Reuse Plant	Construct a water reuse facility within the newly annexed boundaries of NSID.	4.00	ND	2017
Broward	Sunrise, City of	Sawgrass WWTF High Level Disinfection and Reuse Improvements (Phase I)	Installation of a 4.00-mgd modular deep-bed sand filtration and high-level disinfection treatment process, including storage and pumping facilities.	4.00	17.94	2017
Miami-Dade	MDWASD	Biscayne Coastal Wetlands Rehydration	Diversion of runoff that currently discharges through regional canals and redistribute the water through a spreader canal system.	89.00	1,120.00	2022
Miami-Dade	MDWASD	Reclaimed Water for FPL Turkey Point	FPL will be able to utilize up to 60.00 mgd of treated water from MDWASD for the cooling canal system at the Turkey Point facilities.	60.00	ND	2025
Nonpotable – Storage/ASR						
Palm Beach	WPB Public Utilities, City of	ASR Well Expansion Program	Install up to 3 ASR wells injecting surface water into the FAS (classified as Class V injection wells) and associated FAS and SAS monitor wells at the City's WTP site.	6.00	9.00	ND

County	Implementing Agency or Entity	Project Name	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Nonpotable – Surface Water/Stormwater						
Palm Beach	Jupiter, Town of	Surface Water Recharge System	The final phase of the project includes connecting the regional system to recharge wetlands and recharging the local aquifer.	16.16	1.76	2019
Palm Beach	WPB Public Utilities, City of	C -17 Water Supply Pump Station	Constructed a pump station withdrawing water from the Congress Avenue Canal and pumping it into the City's adjacent M-Canal (Lake Mangonia). Pump station will consist of 1 electric submersible pump housed in a belowground concrete wet well structure.	10.00	1.50	2017
Palm Beach	WPB Public Utilities, City of	Grassy Waters Preserve Water Quality, Diversion & Storage Improvements	Evaluate, design, and construct recommended improvements within the City's surface water supply system to increase the water storage and treatment capacity of the existing Grassy Waters and Apoxee Preserves.	3.00	6.00	ND
Broward	BCWWS (South Regional Wellfield)	C-51 Reservoir Phase 1	BCWWS has entered into an agreement for capacity allocation in Phase 1 of C-51 Reservoir with Palm Beach Aggregates.	3.00	13.80	2020
Broward	BCWWS District 2A/NR Wellfield	C-51 Reservoir Phase 1	BCWWS has entered into an agreement for capacity allocation in Phase 1 of C-51 Reservoir with Palm Beach Aggregates.	3.00	13.80	2026
Broward	Dania Beach, City of	C-51 Reservoir Phase 1	The City of Dania has entered into an agreement for capacity allocation in Phase 1 of C-51 Reservoir with Palm Beach Aggregates.	1.00	4.60	2023
Broward	Hallandale Beach, City of	C-51 Reservoir Phase 1	The City of Hallandale Beach has entered into an agreement for capacity allocation in Phase 1 of C-51 Reservoir with Palm Beach Aggregates.	1.00	4.60	2023
Broward	Sunrise, City of	C-51 Reservoir Phase 1	The City of Sunrise has entered into an agreement for capacity allocation in Phase 1 of C-51 Reservoir with Palm Beach Aggregates.	5.00	23.00	2020

ASR = aquifer storage and recovery; BCWWS = Broward County Water and Wastewater Services; FAS = Floridan aquifer system; FKAA = Florida Keys Aqueduct Authority; FPL = Florida Power & Light; LEC = Lower East Coast; MDWASD = Miami-Dade Water and Sewer Department; mgd = million gallons per day; ND = no data; NR = North Regional; NSID = North Springs Improvement District; PBCWUD = Palm Beach County Water Utilities Department; PWS = Public Water Supply; RO = reverse osmosis; SAS = surficial aquifer system; WPB = West Palm Beach; WTP = water treatment plant; WWTF = wastewater treatment facility.

[a] Based on planning-level screening, water supply projects are identified in this plan update to meet 2040 projected demands and have a likelihood of being permitted. However, each proposed use of water must meet the conditions for permit issuance found in Section 373.223, F.S., and the implementing criteria found in Chapter 40E-2, F.A.C., and will be reviewed on an application-by-application basis.

[b] These projects are suggested by the SFWMD for the utility to meet its future demands. The utility can implement the suggestion(s) or provide an alternative source to meet its demands. The cost of suggested projects is unknown.

[c] The City of Hallandale is working with SFWMD staff to permit an additional well and modify a permit to increase its SAS allocation. The well will not increase potable water treatment capacity.

[d] Well #9 is a replacement well and will not increase potable water treatment capacity.

[e] There is an SAS treatment plant expansion component of the South Miami-Dade Heights WTP project. To avoid double-counting, the project and cost are counted under FAS projects, but SAS capacity is included for SAS project capacity.

[f] This project will not increase potable water treatment capacity; it will optimize the SAS facility's production to meet 2040 demands. MDWASD and the USGS have developed an extensive, peer-reviewed integrated surface water/groundwater model. In addition, MDWASD has developed optimization tools in conjunction with the model to maximize use of wet and dry season non-regional flows throughout Miami-Dade County. These optimization tools incorporate operational flexibility between the utility's water treatment plants and wellfields. By optimizing pumping and other strategies, MDWASD should be able to maximize the use of water resources to meet demands through 2040.

Domestic and Small Public Supply

Domestic and Small Public Supply (DSS) includes potable water used by households served by small utilities (less than 0.10 mgd) or self-supplied by private wells. DSS average net (finished) demands in the LEC Planning Area are projected to increase from 11.85 mgd in 2016 to 15.76 mgd in 2040. All current and future needs in this use category are expected to be met from private wells using fresh groundwater from the SAS. As such, no water supply development projects have been proposed for this use category.

Agricultural Irrigation

The AGR category includes water used for commercial crop irrigation, greenhouses, nurseries, livestock watering, pasture, and aquaculture. AGR is the second largest water use category in the LEC Planning Area and is projected to remain so over the planning horizon. However, AGR is the only water use category projected to have a lower demand in 2040 than in 2016. Gross AGR water demand is projected to decrease by 4 percent, from 653.47 mgd in 2016 to 625.27 mgd in 2040, and irrigated acreage is projected to decrease by 5 percent (31,390 acres). **Chapter 2** and **Appendix B** provide more information about AGR water use and projected demands.

Fresh surface water and groundwater are the primary water sources for AGR in the LEC Planning Area. However, freshwater sources, including fresh surface water from lakes and canals and fresh groundwater from the SAS, may not be adequate to meet all projected demands under 1-in-10 year drought conditions. As discussed in **Chapter 4,** the Lake Okeechobee Service Area is designated as an RAA. The RAA generally limits surface water withdrawals from Lake Okeechobee and all surface waters hydraulically connected to the lake to base condition water uses occurring from April 1, 2001 to January 1, 2008. The RAA is part of the MFL recovery strategy for Lake Okeechobee. The RAA criteria apply to new projects, existing unpermitted projects, and modifications or renewals to existing projects within the Lake Okeechobee Service Area, and limit surface water allocation increases from these sources (SFWMD 2015).

Development of groundwater and surface water sources may be practicable in some areas; however, permitting new freshwater supplies will depend on local resource conditions, and some source options are not available or, in some cases, compatible for all crop types. New alternative water supply (AWS) opportunities for AGR may be available in the future by

capture and use of water normally lost to a farm's water management system (tailwater recovery), capture and use of stormwater, and blending of brackish groundwater with fresh water. The storage and application of reclaimed water may be used for a limited number of crops when meeting food safety and market standards, but there are no sources of reclaimed water near most agricultural areas in the region. The use of more efficient irrigation systems for various agricultural operations could reduce the amount of water needed to meet future crop demands; however, implementation of such systems can be economically and technically challenging.

Continued use of best management practices (BMPs), including increases in irrigation efficiency, could reduce the amount of water needed to meet crop demands (**Chapter 3**). The Florida Department of Agriculture and Consumer Services (FDACS) develops and adopts by rule agricultural BMPs addressing water quality. Some BMPs contain an implicit water conservation component. Growers who enroll in the FDACS BMP program and implement BMPs demonstrate their commitment to water resource protection, have a presumption of compliance with state water quality standards, and are eligible for technical and financial assistance toward meeting water resource protection goals. No specific water supply development projects for this category have been provided or identified for this plan update.

Recreational/Landscape Irrigation

The Recreational/Landscape Irrigation (REC) category includes self-supplied water used to irrigate golf courses, sports fields, parks, cemeteries, and large common areas (e.g., land managed by homeowners' associations and commercial developments). Irrigation supplies for this category include fresh groundwater, surface water from local canals or stormwater management system ponds, and reclaimed water. In the LEC Planning Area, REC average gross demand is projected to increase from 136.14 mgd in 2016 to 156.46 mgd in 2040.

The increased demand projected for this category is expected to be partially met through currently proposed reclaimed water projects. In the LEC Planning Area, reclaimed water is used to irrigate large landscaped areas such as residential and commercial common areas. Reclaimed capacity increases projected by wastewater treatment utilities indicate substantial volumes of additional reclaimed water will be made available in the future, primarily due to compliance with the Ocean Outfall Law [Section 403.086, F.S.]. More information can be found in **Chapter 7** and **Appendix F**. Reclaimed water projects proposed by PWS utilities are expected to generate 175.00 mgd of reclaimed water by 2040. This additional volume may provide opportunities for current irrigation users to change from fresh water to reclaimed water. Where reclaimed water is not available, users may qualify for limited freshwater withdrawals on a permit-by-permit basis. No specific water supply development projects for this category have been provided or identified for this plan update.

Industrial/Commercial/Institutional

The ICI water use category includes water associated with the production of goods or provision of services by industrial, commercial, and institutional establishments. In the LEC Planning Area, users historically have relied on fresh groundwater and, to a limited extent, fresh surface water for ICI supply. The projected average gross demand for this category is estimated to be 66.96 mgd by 2040, an increase of 15.03 mgd from 2016 demands, primarily associated with rock mining operations.

Although fresh groundwater supplies generally are considered adequate to meet the relatively small new demands projected for this use category, AWS options should be considered based on location and local resource conditions. If reclaimed water is available to meet existing or new ICI water demands, the feasibility of such opportunities will be evaluated through water use permitting. No specific water supply development projects for this category have been provided or identified for this plan update.

Power Generation

Power supply needs are expected to increase as the population grows in the LEC Planning Area and other portions of South Florida. The Power Generation (PWR) water use category, which includes water used for cooling, processing, and potable drinking water at power generation facilities is projected to increase from 39.75 mgd in 2016 to 52.75 mgd in 2040. Future power generation capacity includes potential construction of a new Florida Power & Light (FPL) energy facility in southeastern Hendry County, which is designed to have solar and natural gas facilities. Because of the remote location, AWS options are not available; however, the solar portion of the facility will not require water. Replacement of the Dania Beach FPL Energy Center is expected to reduce freshwater use at the facility from 1.70 to 1.00 mgd by 2022. No specific water supply development projects for this category have been provided or identified for this plan update.

COOPERATIVE FUNDING PROGRAM

Funding for water supply development and water conservation at the local level is the shared responsibility of water suppliers and users. The State of Florida and the water management districts have provided funding to local water users to develop AWS options and to implement water conservation programs. One criterion for funding consideration is that the project must be included in, or consistent with, a regional water supply plan update. Some projects not included in this 2018 LEC Plan Update, but consistent with the plan's goals, may be funded. When the SFWMD deems appropriate, a plan may specifically identify the need for multijurisdictional approaches to projects based on technical, permit, and financial feasibility.

For nearly two decades, the SFWMD has provided funding to local governments, special districts, utilities, homeowners' associations, water users, and other public and private organizations for AWS, water conservation, and stormwater projects consistent with the SFWMD's core mission. Historically, the SFWMD has provided funding for AWS and water conservation projects through its AWS Program and Water Savings Incentive Program (WaterSIP). In Fiscal Year (FY) 2016, these efforts were combined under the Cooperative Funding Program (CFP), which provides financial incentives for local projects that complement ongoing regional restoration, flood control, water quality, and water supply efforts within the District's 16-county jurisdiction.

Boca Raton Membrane Concentrate Recycling

Each fiscal year, the District Governing Board will determine the amount of funding, if any, to allocate to the CFP, the project priorities for that year, and the cost share to be allocated. SFWMD staff will coordinate evaluation of the projects for funding based on criteria and priorities established by the District Governing Board.

Alternative Water Supply

This component of the CFP, formerly known as the AWS Program, provides cost-share funding for AWS projects. From FY2013 through FY2018, the SFWMD provided more than $11 million in AWS funding for 31 projects Districtwide. During this time, 11 AWS projects were funded, completed, or are under construction in the LEC Planning Area, generating 9.25 mgd of additional water capacity and 4.19 mgd of additional distribution or storage from an AWS source (**Table 8-2**). All AWS projects funded from FY2013 to FY2018 in the LEC Planning Area were reclaimed water projects, and no AWS projects were proposed in Miami-Dade or Monroe counties.

Table 8-2. Alternative water supply (reclaimed water) projects in LEC Planning Area supported by the Cooperative Funding Program (FY2013 to FY2018).

Project Name	Entity Name	Fiscal Year	Capacity (mgd)
Palm Beach County			
Reclaimed Water System – Area 12A Phase I	Delray Beach, City of	2013	0.11[a]
Recycling of Membrane Concentrate for Reclaimed Water	Boca Raton, City of	2013	4.25
3.0-mgd Nanofiltration Concentrate Blending Pump Station and Reclaimed Water Main	Seacoast Utility Authority	2013	3.00
Reclaimed Water System - Area 12A Phase II	Delray Beach, City of	2014	0.08[a]
Reclaimed Water System Expansion – Area 12C	Delray Beach, City of	2017-2018	0.16[a]
Broward County			
3.5-mgd Reclaimed Water Facility Phase II-C	Davie, Town of	2013	3.50[b]
Reclaimed Water Distribution System Expansion 2013	Pompano Beach, City of	2013	0.10[a]
Reclaimed Water Main Extension – Wiles Road	Coconut Creek, City of	2017-2018	0.50[a]
Reclaimed Water System Expansion – NE Pompano and Lighthouse Point	Pompano Beach, City of	2017-2018	0.04[a]
Sawgrass Water Reclamation Facility – Phase I	Sunrise, City of	2017-2018	2.00
Reclaimed Water Main Extension – Springtree Drive	Sunrise, City of	2017-2018	0.20[a]
		Total Capacity	**9.25**

CFP = Cooperative Funding Program; FY = Fiscal Year; LEC = Lower East Coast; mgd = million gallons per day.
[a] Project adds to the reclaimed water distribution system but does not increase actual water treatment capacity.
[b] Multi-phased project; water treatment capacity counted in previous phase.

Water Conservation


Rain Sensor

This component of the CFP, formerly known as the WaterSIP, provides cost-share funding for projects that reduce water use. The SFWMD has provided matching funds up to $100,000 or 50 percent, whichever is less, to water providers and users (e.g., cities, utilities, industrial groups, schools, hospitals, homeowners' associations) for implementing water-saving technologies (e.g., low-flow plumbing fixtures, rain sensors, fire hydrant flushing devices). From FY2013 to FY2018, the SFWMD provided more than $1.7 million towards 56 projects Districtwide through WaterSIP and the CFP, with an estimated water savings of 1.08 billion gallons per year, or 2.96 mgd. During this time, 39 of these projects were funded, completed, or being implemented in the LEC Planning Area. The projects are estimated to save 546.36 million gallons per year, or 1.50 mgd (**Table 8-3**). **Chapter 3** provides more information about the CFP.

Table 8-3. Water conservation projects in LEC Planning Area supported by Water Savings Incentive Program and the Cooperative Funding Program (FY2013 to FY2018).

Project Name	Entity Name	Project Type	Fiscal Year	Proposed Water Savings (mgy)
Palm Beach County				
Community Water Conservation Strategies – Phase III (Toilet Replacement)	West Palm Beach, City of	Indoor Plumbing	2013	7.27
ALFDs	Delray Beach, City of	ALFDs	2013	4.36
ALFDs	Delray Beach, City of	ALFDs	2014	4.59
ALFDs	Palm Beach County Utilities	ALFDs	2014	6.24
Community Water Conservation Strategies Phase IV - HET Rebates	West Palm Beach, City of	Indoor Plumbing	2014	5.70
ALFDs	Palm Beach County Utilities	ALFDs	2015	6.24
ALFDs	Lake Worth, City of	ALFDs	2017-2018	11.34
Nursery Overhead Efficiency Project	Palm Beach Soil and Water Conservation District	Irrigation	2017-2018	22.70
Community Water Conservation Strategies, Phase VI – HET	West Palm Beach, City of	Indoor Plumbing	2017-2018	4.80
Water Conservation Software Technology: Phase 2 & 3	West Palm Beach, City of	Software	2017-2018	174.50
Broward County				
Multi-family Toilet Retrofit	Tamarac, City of	Indoor Plumbing	2013	9.20
USEPA WaterSense HET Replacement/Credit Program	Broward County Board of County Commissioners	Indoor Plumbing	2013	6.08
HET Rebate Program	Broward Water Partnership[a]	Indoor Plumbing	2013	7.85
ALFDs	Coral Springs, City of	ALFDs	2013	2.70
USEPA WaterSense HET Replacement/Credit Program	Broward County Board of County Commissioners	Indoor Plumbing	2014	5.35
HET Rebate Program	Broward Water Partnership[a]	Indoor Plumbing	2014	15.73
ALFDs	Coral Springs, City of	ALFDs	2014	5.50
Ramblewood East Residential HET Retrofit	Ramblewood East Condominium Association	Indoor Plumbing	2014	1.47

Project Name	Entity Name	Project Type	Fiscal Year	Proposed Water Savings (mgy)
HET Rebate Program	Broward Water Partnership[b]	Indoor Plumbing	2015	7.87
USEPA WaterSense HET Replacement/Credit Program	Broward County Board of County Commissioners	Indoor Plumbing	2015	3.70
NatureScape Irrigation Services Smart Irrigation Technology Program	Broward Water Partnership[b]	Irrigation	2015	25.69
Conservation Pays HET Rebate Program	Broward Water Partnership[b]	Indoor Plumbing	2017-2018	10.74
NatureScape Irrigation Service Smart Irrigation Technology Retrofit Program	Broward Water Partnership[b]	Irrigation	2017-2018	41.10
USEPA WaterSense HET Replacement/Credit Program	Broward County Water and Wastewater Services	Indoor Plumbing	2017-2018	3.20
Water Conservation Software Technology Projects	Cooper City, City of	Software	2017-2018	32.85
HET Rebate Program	Coral Springs Improvement District	Indoor Plumbing	2017-2018	1.00
Water Savings Irrigation Retrofits	Lauderdale Lakes, City of	Irrigation	2017-2018	5.19
Automatic Flushing Plan Program	North Lauderdale, City of	ALFDs	2017-2018	0.74
Miami-Dade County				
Residential HET Rebate Project 2012-2013	MDWASD	Indoor Plumbing	2013	10.59
Residential HET Rebate Project 2013-2014	MDWASD	Indoor Plumbing	2014	10.59
Residential HET Rebate Project 2014-2015	MDWASD	Indoor Plumbing	2015	5.29
Cistern Project at 2337 5th Ave – Mana Building	Malux Realty, LLC	Rain Harvesting	2017-2018	8.04[c]
Landscape Irrigation Evaluation and Rebate Project 2017-2018	MDWASD	Irrigation	2017-2018	29.51
Residential HET Rebate Project 2017-2018	MDWASD	Indoor Plumbing	2017-2018	15.88
Water Conservation Software Technology Project FY2017 & FY2018	MDWASD	Software	2017-2018	30.57
Monroe County				
HET Retrofit Rebate Program	Florida Keys Aqueduct Authority	Indoor Plumbing	2014	3.00
HET Retrofit Rebate Program	Florida Keys Aqueduct Authority	Indoor Plumbing	2015	1.70
Cisterns in Paradise: Florida Keys Rain Catchment Initiative	Florida Keys Aqueduct Authority	Rain Harvesting	2017-2018	0.52
Palm Beach, Broward, and Miami-Dade Counties				
SF-FY2013 Home Depot Rain Harvest (Miami-Dade, Broward, Palm Beach, Lee, and Okeechobee)	The Home Depot U.S.A., Inc.	Rain Harvesting	2013	5.00
			Estimated Total Water Savings	**546.36**

ALFD = automatic line flushing device; CFP = Cooperative Funding Program; FY = Fiscal Year; HET = high-efficiency toilet; LEC = Lower East Coast; MDWASD = Miami-Dade Water and Sewer Department; mgy = million gallons per year; USEPA = United States Environmental Protection Agency.

[a] This project was completed by the Broward County Natural Resources Planning and Management Division on behalf of the Broward Water Partnership.

[b] This project was completed by the Broward County Environmental Planning and Community Resilience Division on behalf of the Broward Water Partnership.

[c] Project was canceled.

SUMMARY OF WATER SUPPLY DEVELOPMENT PROJECTS

Total gross water demands within the LEC Planning Area are projected to increase approximately 249.25 mgd (14 percent) by 2040. Meeting these demands requires continued demand reduction through water conservation and use of diverse water sources, including brackish groundwater, reclaimed water, seasonally available surface water, and ASR.

During the planning horizon, average gross (raw) PWS demand is projected to increase 225.19 mgd (26 percent). Based on the evaluation for this plan update, groundwater and surface water supplies, coupled with proposed water supply development projects, are believed to be adequate to meet projected PWS demands through 2040.

Nine of the 54 PWS utilities with a capacity of 0.10 mgd or greater in the LEC Planning Area need to construct projects to meet their projected 2040 demands. The proposed water supply development projects could generate 72.83 to 80.13 mgd of new water treatment capacity to meet the 2040 PWS net (finished) demand of 1,007.66 mgd. New treatment capacity consists of 63.45 mgd of water produced by FAS projects and 9.38 to 16.68 mgd of water produced by SAS projects. Summaries of existing and proposed projects and capacities are provided in **Tables 8-4** and **8-5**.

Table 8-4. Number and capacity of potable and nonpotable water supply development projects proposed by utilities for construction/implementation between 2016 and 2040.

Water Source	Number of Projects[a,b]	Capacity (mgd)	Cost ($ million)
Potable Projects			
SAS	6[c] – 11[d]	9.38[c] – 16.68[d]	$32.30[c]
FAS	17	63.45	$508.19
Potable Total	**23 – 28[d]**	**72.83 – 80.13[d]**	**$540.49**
Nonpotable Projects			
Reclaimed	8	175.00 – 220.30[e]	$1,197.70
Water Storage/ASR	1	6.00	$9.00
Surface Water/Stormwater	8	42.16	$69.06
Nonpotable Total	**17**	**223.16 – 268.46[e]**	**$1,275.76**
Total	**40 – 45[d]**	**295.99 – 348.59[e]**	**$1,816.25**

ASR = aquifer storage and recovery; FAS = Floridan aquifer system; mgd = million gallons per day; SAS = surficial aquifer system.

[a] Projects designed to expand distribution of treated water are not included because they do not generate new water.

[b] Many of the projects are multi-phased (e.g., more than one project at the same water treatment plant).

[c] There is an SAS expansion component of the South Miami-Dade Heights water treatment plant project. To avoid double-counting, the project and cost are counted under FAS projects, but SAS capacity is included for SAS project capacity.

[d] Projects are suggested by the SFWMD for the utility to meet its future demands. The utility can implement the suggestion(s) or provide an alternative source to meet its demands. The cost of suggested projects is unknown.

[e] Proposed capacity provided by utility staff, no specific proposed project.

Table 8-5. Existing and proposed potable water supply capacities (in mgd) for Public Water Supply utilities in the LEC Planning Area.

County	PWS Utility	Surface Water/ Stormwater		SAS		FAS		ASR		Reclaimed[a]	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed[b]
Palm Beach	Boca Raton, City of			70.00						17.50	
	Boynton Beach, City of			29.64				4.00		8.00	3.00[c]
	Delray Beach WSD, City of			26.00						5.00	3.00[c]
	Golf, Village of			0.86							
	Highland Beach, Town of					3.00					
	Jupiter, Town of		16.16	16.30		13.70					
	Lake Worth Utilities, City of			12.90		4.50					
	Lantana, Town of			3.84							
	Manalapan, Town of			0.65		1.70					
	Mangonia Park, Town of			1.08							
	Maralago Cay			0.42							
	PBCWUD			103.28						25.00	10.50
	PBCWUD-Western Region					10.00					
	Palm Springs, Village of			10.00	0.20-0.50[d]						
	Riviera Beach, City of			17.50	1.00[d]						
	Seacoast Utility Authority			27.50		3.00	4.00			15.00	
	Tequesta, Village of			2.73		3.60					
	Wellington Public Utilities Dept.			12.80						1.00	6.50
	WPB Public Utilities, City of	66.98	13.00	47.00				8.00	6.00	0.70	
Broward	BCWWS District 1			16.00			3.00				
	BCWWS District 2A/NR Wellfield		3.00	40.00			6.00			10.00	16.00[c]
	BCWWS District 3 SR Wellfield		3.00								
	Cooper City Utility Dept., City of			7.00							1.00
	Coral Springs, City of			16.00							
	CSID			7.40							
	Dania Beach, City of		1.00	5.02	1.00[d]						
	Davie, Town of			4.00		6.00				3.50	
	Deerfield Beach, City of			20.60		3.00					
	Fort Lauderdale, City of			90.00			6.00				
	Hallandale Beach, City of		1.00	16.00	3.03						
	Hillsboro Beach, Town of			2.25							
	Hollywood, City of			55.50		4.00	6.00			3.00	4.80[c]

County	PWS Utility	Surface Water/ Stormwater		SAS		FAS		ASR		Reclaimed[a]	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed[b]
Broward (cont.)	Lauderhill, City of			16.00			8.00				
	Margate, City of			13.50							
	Miramar, City of			15.25		2.50				4.00	2.00-4.00[e]
	North Lauderdale, City of			7.50							
	NSID			6.80			2.50				4.00
	Parkland Utilities, Inc.			0.58							
	Pembroke Pines, City of			18.00							
	Plantation, City of			24.00						0.77	
	Pompano Beach, City of			50.00	0.60					7.50	4.50[e]
	Royal Utility Company			1.00							
	STOF - Hollywood			2.00							
	Sunrise, City of		5.00	50.00	3.00	1.50				0.80	4.00
	Tamarac, City of			16.00							
	Tindall Hammock ISCD			1.00						0.60	
Miami-Dade	Americana Village			0.50							
	Florida City WSD			4.00	2.50[d]						
	Homestead, City of			19.20	2.50[d]					4.50	10.00[e]
	MDWASD			453.93	2.55	7.50	19.95			16.49	149.00
	North Miami, City of			9.30							
	North Miami Beach, City of			25.50		6.50	8.00				
Monroe	FKAA			23.80		6.00				1.28	
Hendry	STOF – Big Cypress Reservation			2.00							
Total		**66.98**	**42.16**	**1,422.13**	**9.38-16.68[d]**	**76.50**	**63.45**	**12.00**	**6.00**	**126.64**	**175.00-220.30[c,e]**

ASR = aquifer storage and recovery; BCWWS = Broward County Water and Wastewater Services; CSID = Coral Springs Improvement District; FAS = Floridan aquifer system; FKAA = Florida Keys Aqueduct Authority; ISCD = Irrigation and Soil Conservation District; LEC = Lower East Coast; MDWASD = Miami-Dade Water and Sewer Department; mgd = million gallons per day; NR = North Regional; NSID = North Springs Improvement District; PBCWUD = Palm Beach County Water Utilities Department; PWS = Public Water Supply; SAS = surficial aquifer system; SR = South Regional; STOF = Seminole Tribe of Florida; WPB = West Palm Beach; WSD = Water and Sewer Department.

[a] Reclaimed water is not a potable water source in the LEC Planning Area; however, it is an alternative water supply used to reduce reliance on traditional water sources.

[b] Includes reclaimed water production as well as storage and nonpotable surface water/stormwater projects. Distribution lines and infrastructure projects that do not generate new nonpotable water are not included.

[c] Proposed capacity provided by utility staff regarding anticipated compliance with Ocean Outfall Law. For the BCWWS District 2A/NR Wellfield, most of the proposed 16.00 mgd will be transmitted to and used in Palm Beach County.

[d] These projects are suggested by the SFWMD for the utility to meet its future demands. The utility can implement the suggestion(s) or provide an alternative source to meet its demands.

[e] Proposed capacity provided by utility staff, no specific proposed project.

There is sufficient water supply allocation to meet AGR demands in the LEC Planning Area during 1-in-10 year drought conditions. However, for agriculture users in Lake Okeechobee Service Area reliant on lake water supplies, the physical level of certainty has been reduced from a 1-in-10 year to a 1-in-6 year drought return frequency. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy and enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty. Because AGR demands are projected to decrease by 2040, traditional sources are expected to be adequate to meet future needs. Water conservation and BMPs can increase irrigation efficiency and reduce the amount of water needed to meet crop demands. No AGR water supply development projects have been proposed in the LEC Planning Area.

In the LEC Planning Area, REC average gross demand is projected to increase from 136.14 mgd in 2016 to 156.46 mgd in 2040. The increased demand is expected to be met partially through expanded wastewater treatment capacity and reclaimed water projects producing 175.00 mgd by 2040. The additional supply will provide opportunities for current irrigation users to shift from traditional groundwater and surface water sources to reclaimed water.

Among the DSS, ICI, and PWR water use categories, no new water supply development projects have been specifically proposed. Future needs of these categories can be met under existing permit allocations and conditions using traditional and alternative sources, and through conservation.

REFERENCES

FDEP. 2012. *Guidance for Improved Linkage between Regional Water Supply Plans and the Consumptive Use Permitting Process*. Office of Water Policy, Florida Department of Environmental Protection, Tallahassee, FL. March 23, 2012.

FDEP. 2017. *2016 Reuse Inventory*. Water Reuse Program, Florida Department of Environmental Protection, Tallahassee, FL.

SFWMD. 2015. *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District*. South Florida Water Management District, West Palm Beach, FL. September 2015.

9

Future Direction

TOPICS

- Demand Summary
- Demand Management: Water Conservation
- Natural Systems and Resource Protection
- Water Supply Source Options
- Coordination
- Climate Change and Sea Level Rise
- Conclusion

This chapter summarizes the future direction for water supply planning in the Lower East Coast (LEC) Planning Area of the South Florida Water Management District (SFWMD or District). This *2018 Lower East Coast Water Supply Plan Update* (2018 LEC Plan Update) assesses the water supply demands (**Chapter 2**) and available water sources (**Chapter 7**) for the region through 2040. Water conservation, which may reduce, defer, or eliminate the need to expand water supply infrastructure, is a key element in meeting future water needs (**Chapter 3**). Water resource protection strategies, including Minimum Flows and Minimum Water Levels (MFLs), Water Reservations, Restricted Allocation Areas (RAAs; **Chapter 4**; **Appendix C**), and Water Shortage Plans, play a critical role in ensuring sufficient water is available for the environment and other uses, and these strategies are reviewed and updated as needed. Management of surface water resources, including the Central and Southern Florida Flood Control Project (C&SF Project) canals, continues to be evaluated and adjusted to optimize supply for natural systems (**Chapter 5**), agriculture, and urban use (**Chapter 7**).

Each 5-year water supply plan update addresses the progress of water resource and water supply development projects in the region (**Chapters 6** and **8**). Many of the projects in this 2018 LEC Plan Update are long term and ongoing. Most Public Water Supply (PWS) utilities have sufficient treatment capacity and permitted allocations to meet their projected 2040 demands, and future projects were identified where needed (**Chapter 8**).

Guidance in this 2018 LEC Plan Update should be considered when developing water supply options to meet future needs. Statutory requirements, existing conditions, resource constraints (including protection tools and criteria), and the needs of all water users are addressed herein, with emphasis on alternative water supply (AWS) development, water conservation, and projects for environmental needs. The SFWMD's future direction for water supply planning involves the following:

- Continued coordination with utilities and other water users;
- Protection of natural resources;
- Diversification of water supply sources; and
- Continued monitoring and modeling of saltwater intrusion and sea level rise.

DEMAND SUMMARY

Average water demands are projected to increase approximately 249 million gallons per day (mgd) from 2016 demands, primarily due to population growth and resulting increases in urban demands (**Chapter 2**). Total projected average annual demands for all water use categories for 2040 are estimated to be 2,007 mgd (**Table 9-1**). Although demands are increasing over the planning horizon, the total demand projection for 2040 in this 2018 LEC Plan Update (2,007 mgd) is only about 4 percent higher than the 2030 demand (1,933 mgd) previously projected in the 2013 LEC Plan Update (SFWMD 2013a).

Table 9-1. Change in water use demands in the LEC Planning Area from 2016 to 2040.

Water Use Category	2016 (mgd)	2040 (mgd)	Change (mgd)
Public Water Supply	864.15	1,089.34	+225.19
Domestic and Small Public Supply	11.85	15.76	+3.91
Agricultural Irrigation	653.48	625.27	-28.21
Recreational/Landscape Irrigation	136.14	156.46	+20.32
Industrial/Commercial/Institutional	51.93	66.96	+15.03
Power Generation	39.75	52.75	+13.00
Total	**1,757.30**	**2,006.54**	**+249.24**

LEC = Lower East Coast; mgd = million gallons per day.

DEMAND MANAGEMENT: WATER CONSERVATION

Implementation of robust water conservation programs throughout the LEC Planning Area could reduce the future amount of water needed to meet water demands. The continuing decline in per capita use rates shows, in part, the effectiveness of ongoing conservation programs. All water users are urged to implement water conservation measures to reduce water supply demands, extend existing allocations, and defer construction of capital-intensive projects. The following conservation-related actions are suggested:

- To the extent feasible, the SFWMD should continue to implement the 2008 Comprehensive Water Conservation Program.
- PWS utilities are encouraged to develop goal-based water conservation plans to implement water-saving measures and programs.
- Local governments should consider developing or enhancing ordinances regarding Florida-Friendly Landscaping™ Program principles [Section 373.185, Florida Statutes].

- Landscape water users are encouraged to use advanced irrigation technology, implement improved landscape design and management practices, and participate in user recognition programs to increase their water use efficiency.


Smart Irrigation Rain Sensor

- Local governments and utilities, in cooperation with the SFWMD, are encouraged to provide water conservation-related educational programs, which instill a year-round water conservation ethic. Local governments are encouraged to partner with adjoining municipalities to leverage resources in public outreach and education (e.g., the Broward Water Partnership).
- Local governments should evaluate the implementation of water conservation measures appropriate for their jurisdiction, such as 2-days-per-week landscape irrigation ordinances, which have been successfully adopted in Broward and Miami-Dade counties.
- Agricultural water users are encouraged to install high-efficiency irrigation systems, where appropriate, for specific crop types.
- Industrial, commercial, and institutional entities are encouraged to utilize the *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities, A Guide for Facility Managers* (SFWMD 2013b) to improve water use efficiency and reduce operating costs.

NATURAL SYSTEMS AND RESOURCE PROTECTION


STA-1 West Cell 3

A wide range of activities related to natural systems can affect future water supplies within the LEC Planning Area. Such activities include the Comprehensive Everglades Restoration Plan (CERP) projects; changes by the USACE to regulation schedules for the Everglades, Lake Okeechobee, and other water bodies; and monitoring and research projects. In addition, regulatory criteria designed to protect water resources, including elements identified in MFL recovery and prevention strategies, can place limitations on water allocations (**Chapters 4** and **5**; **Appendix C**).

Water supply needs for natural systems are addressed by water resource development projects such as CERP (**Chapter 6**). CERP includes regional projects to improve the quality, timing, volume, distribution, and delivery of water to the natural system. Future environmental restoration and water resource protection efforts include the following:

- Continue to make progress towards completion of Restoration Strategies Program and CERP projects, including flow equalization basins/stormwater treatment areas, C-111 Spreader Canal Western project, and Biscayne Bay Coastal Wetlands project.
- Continue to partner with the USACE on planning for future CERP projects in the Lake Okeechobee, Loxahatchee River, and Western Everglades watersheds, and in the Broward County Water Preserve Areas.
- Continue to synchronize CERP priorities with the USACE using the Integrated Delivery Schedule (USACE 2018), a sequencing strategy for planning, designing, and constructing cost-shared projects as part of the South Florida Ecosystem Restoration Program, based on ecosystem needs, benefits, costs, and available funding.
- Continue to refine operations to achieve restoration benefits, including ongoing efforts in the Modified Water Deliveries to Everglades National Park and WCA-3A Decompartmentalization Physical Model projects.
- Continue to monitor and research natural areas, including Biscayne Bay, Florida Bay, the Loxahatchee River, and Lake Okeechobee, and provide annual updates in the South Florida Environmental Report to track the health of the areas and meet regulatory requirements.
- Continue to implement, review, and update MFL recovery and prevention strategies, as appropriate, in conjunction with future water supply plan updates.
- Re-evaluate the Biscayne aquifer monitoring network data on a regular basis to ensure water levels in coastal canals that recharge the aquifer are being maintained at the operation levels needed to meet the Biscayne Aquifer MFL.

WATER SUPPLY SOURCE OPTIONS

The LEC Planning Area relies primarily on fresh groundwater from the surficial aquifer system (SAS) for PWS uses. Due to a decrease in population growth rates and per capita use rates, many PWS utilities have been able to extend their use of currently allocated SAS volumes, delaying expansion of treatment facilities and diversification of supply sources. However, to meet future demands, multiple PWS utilities are expected to begin or expand use of the Floridan aquifer system (FAS) as an AWS source.

Agricultural Irrigation (AGR) users in the LEC Planning Area rely primarily on surface water from Lake Okeechobee, water conservation areas, and regional canals. Based on projected declines in AGR surface water demands, mainly in Palm Beach County and the Everglades Agricultural Area, existing sources should be able to meet future irrigation requirements. In the Western Basins and South Dade Agricultural Area, AGR demand is projected to increase 10 percent and will be met primarily with fresh groundwater. Fresh groundwater and local surface water sources may be available for AGR and Recreational/Landscape Irrigation (REC) demands, but quantities will depend on local conditions, including other uses in the area. Regulatory criteria continue to limit large-scale expansion of fresh surface and groundwater withdrawals.

AWS sources will be needed to meet 2040 water supply demands. Use of reclaimed water, in place of fresh groundwater, is expected to increase substantially over the planning horizon, in part due to the Ocean Outfall Law that requires reuse of 60 percent of the wastewater disposed of through ocean outfalls (**Chapter 7**). Additionally, water storage features such as reservoirs, aquifer storage and recovery (ASR) wells, and impoundments can capture excess stormwater, groundwater, and surface water during wet weather periods and provide supplemental supply for PWS, AGR, and natural systems. Seawater is a potential AWS source as technology costs continue to decline, making it a more feasible option.

The SFWMD offers guidance on water supply source options in the following sections for consideration by local governments, utilities, other water users, and SFWMD water supply managers and staff as a basis for water supply planning in the LEC Planning Area.

Surface Water

Surface water sources in the LEC Planning Area, including Lake Okeechobee, are integrally connected as part of the Kissimmee-Okeechobee-Everglades ecosystem and regional water supply system. Several local water control districts connect with the regional system to divert water for water supply. In addition, many regional surface water bodies are part of current and future environmental restoration projects. Withdrawals from some surface water sources are limited by RAA and Water Reservation rules. Future direction regarding the use of surface water in the LEC Planning Area includes the following:

- The current Integrated Delivery Schedule (USACE 2018) indicates completion of the rehabilitation by 2022 and evaluation of a revision of the 2008 LORS beginning in 2019. State funding has been provided to assist the USACE in expediting the Herbert Hoover Dike rehabilitation schedule. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives.

Herbert Hoover Dike

- Local governments, agricultural operations, and utilities are encouraged to create additional storage capacity for excess surface water to use for water supply purposes, when feasible. Entities also are encouraged to investigate the potential storage capacity in local water control district water bodies.

Groundwater

Fresh groundwater is the primary source of water for potable use and agriculture irrigation in the LEC Planning Area coastal region. Approximately 90 percent of PWS demand in 2016 was met with water from the SAS. Current permit allocations are sufficient to meet most utilities' demands through 2040. Additional allocation of fresh groundwater above currently permitted levels to meet future PWS demand in the LEC Planning Area depends on the location and source limitations. Use of reclaimed water and water conservation measures can extend fresh groundwater supplies. The remaining 2040 PWS demand is expected to be met using the brackish FAS.

Surficial Aquifer System

Withdrawals from the SAS are limited due to MFL criteria, RAA rules, saltwater intrusion concerns, potential impacts on wetlands, pollution, interference with existing legal users and off-site land uses. Potential use of the SAS for new or increased allocations will be evaluated on an application-by-application basis to determine if a project meets water use permitting criteria. Where appropriate, water users are encouraged to diversify water sources to meet future water demands. Future direction to sustain existing permitted uses and identify the potential for limited development of fresh groundwater sources includes the following:

- Utilities should design wellfield locations, configurations, and pumping regimes to avoid saltwater intrusion, pollution, harm to natural systems, or increased dependence on the regional system (as demonstrated through modeling).
- Water users are encouraged to reduce reliance on the SAS by diversifying water sources and developing AWS sources to meet future water demands.
- Utilities should consider implementing groundwater recharge systems using reclaimed or excess surface water as an impact offset or substitution credit (see *Reclaimed Water* section).
- Utilities should continue to expand interconnections with other utilities and assess existing interconnections to confirm they operate as intended.
- The SFWMD, United States Geological Survey, and local governments should continue coordinating saltwater intrusion monitoring efforts to delineate the location and movement of the saltwater interface and identify areas of concern.
- The SFWMD should periodically review existing groundwater monitoring networks and enhance them, as appropriate.
- The SFWMD, in coordination with water users, should identify opportunities to expand water level monitoring in the Lower Tamiami aquifer in Hendry County to ensure regulatory protection criteria are being met and to evaluate water availability from this source.
- The SFWMD will continue to implement, review, and update MFL recovery and prevention strategies, as appropriate, in conjunction with future water supply plan updates.

Floridan Aquifer System

PWS utilities in the LEC Planning Area are proposing substantial increases in FAS development over the planning horizon. Additional FAS withdrawals for salinity remediation and aquaculture also are anticipated in this 2018 LEC Plan Update. The East Coast Floridan Model simulations and analyses conducted for this plan update identified potential issues that may require further evaluation. The following FAS-related actions are suggested:

- Utilities should use an incremental approach to install and test production wells due to geologic variability within the FAS. Wellfields should be designed and monitored to prevent over-stressing production zones and to minimize changes in water quality.
- PWS utilities developing FAS sources are encouraged to share water quality, water level, and hydrologic data to increase understanding of the FAS and improve regional groundwater models.
- The SFWMD should continue to use the East Coast Floridan Model to address regional resource questions. Refinements to and recalibration of the model should be made as new data become available.

Floridan Aquifer System Monitor Well

- FAS users and SFWMD staff should evaluate the effects of water quality degradation and coordinate on related permitting, modeling, and planning strategies to maintain the viability of the FAS as a water supply source.

Reclaimed Water

In the LEC Planning Area, reclaimed water is used for landscape irrigation, groundwater recharge, power generation cooling water, and environmental enhancement. Reclaimed water can supply new uses or replace traditional freshwater sources currently used for irrigation and industrial purposes. It also could reduce regional water deliveries and offset losses to regional canals from water supply withdrawals. Opportunities to expand reclaimed water use include the following:

- Local governments should consider requiring construction of reclaimed water infrastructure in new development projects. Building codes, ordinances, and land development regulations are options to promote reclaimed water use.
- Local governments should consider establishing mandatory reuse zones, where reclaimed water use is required by ordinance. The SFWMD will provide technical assistance to local governments who wish to establish mandatory reuse zones.
- Local governments and utilities should support development of additional reclaimed water lines for green space irrigation (e.g., residential lots, medians, common areas, golf courses) to decrease reliance on traditional freshwater sources.

- The SFWMD encourages utilities to develop creative solutions to beneficially use reclaimed water to comply with Ocean Outfall Law requirements, such as saltwater intrusion barriers, groundwater and canal recharge, environmental enhancement, potable reuse, and impact offsets and substitution credits (**Chapter 7**; **Appendix F**).
- Utilities should consider using substitution credits and impact offsets [Section 373.250, Florida Statutes] to promote increased availability and distribution of reclaimed water and decrease use of traditional water sources.
- Utilities should extend their reclaimed water supply by implementing feasible options such as increased storage, residential customer metering, tiered rate structures, limiting landscape irrigation frequency, and interconnects with other reclaimed water utilities.

Water Reuse

- Reclaimed water providers should consider using supplemental water supplies to meet peak demands. Supplemental water may enable a utility to extend its reclaimed water system over a larger area. However, during times of drought, availability of supplemental water sources such as surface water, groundwater, or stormwater may be limited.
- Utilities are encouraged to develop strategies to isolate wastewater collected in areas affected by saltwater intrusion to maximize reuse of the freshwater portion of the wastewater stream.

New Storage Capacity for Surface Water or Groundwater

In the LEC Planning Area, water storage options include reservoirs, ASR wells, and surface water impoundments. Proposed projects that develop new storage and create additional water supply may be considered AWS sources. Opportunities for new storage capacity include the following:

- Construction of new or retrofitted on-site surface water storage systems and tailwater recovery systems for agricultural operations.
- Construction of surface water storage reservoirs or diversion to water control districts to store excess water currently discharged to the ocean. This supply could be used directly, provide saltwater intrusion abatement benefits, or offset increased well withdrawals, expanding use of the SAS.

West Palm Beach ASR System at Clear Lake

- Utilities are encouraged to evaluate using ASR to capture water in the wet season for use during peak demand periods in the dry season.

COORDINATION

Coordination and collaboration among regional and local governments and utilities are essential for water supply planning. The following coordination activities are provided as guidance:

- The SFWMD will continue to review Water Supply Facilities Work Plans, which are due within 18 months of approval of this 2018 LEC Plan Update. Local governments and utilities need to provide linkages and coordination between the SFWMD's plan update and the water supply-related components of their Comprehensive Plans.
- The SFWMD should continue to work with the Florida Department of Agriculture and Consumer Services and agricultural stakeholders to provide data for further development of the Florida Statewide Agricultural Irrigation Demand simulation for future crop acreage and water demand projections.
- The SFWMD should coordinate with utilities, counties, and the United States Geological Survey to review, recommend improvements, and provide data and analysis for saltwater intrusion monitoring networks.
- Where wellfields are at risk of saltwater intrusion, the SFWMD will work with utility and county staff to identify potential solutions.
- The SFWMD will coordinate with stakeholders on the development and use of regional groundwater and surface water models to evaluate water resource availability.
- The SFWMD will support the development of multi-jurisdictional partnerships, where appropriate, to implement programs or projects that benefit a greater number of people than one entity might benefit by itself, such as the Broward Water Partnership and the C-51 Reservoir Project participants.

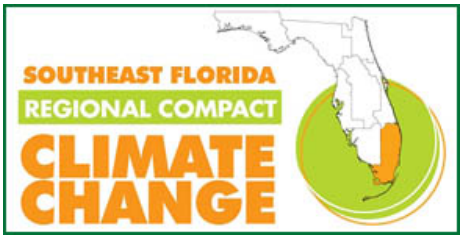
CLIMATE CHANGE AND SEA LEVEL RISE

Long-term data show increasing global temperatures and a corresponding rise in sea level. The rise in sea level will further change the hydrodynamics of coastal estuaries, alter the location and shape of the saltwater interface (increased intrusion) into coastal aquifers, and affect the functionality of coastal water control structures. Analysis is needed to determine the potential impacts of sea level rise on utility wellfields and other users at risk of saltwater intrusion within the District. In addition, continued comprehensive monitoring is needed to accurately characterize and measure aquifer conditions, saltwater movement, and sea level rise. The following guidance is provided regarding climate change and sea level rise:

- The SFWMD should continue to investigate climate change and sea level rise projection models for use in water supply planning and system operations.
- The SFWMD, USACE, and coastal utilities and municipalities should identify methods to evaluate the consequences of climate change and sea level rise and use them to assess the cumulative impacts to existing structures and legal users.

- Local governments and water providers are encouraged to participate in the Southeast Florida Regional Climate Change Compact to support regional planning efforts and initiatives focused on adapting to rising sea levels in the LEC Planning Area.

- The SFWMD should continue to provide technical assistance to local governments as they develop climate change adaptation efforts.



Southeast Florida Regional Climate Change Compact

CONCLUSIONS

This 2018 LEC Plan Update concludes that future water needs of the region can be met through 2040 with appropriate management, conservation, and implementation of projects identified herein. Additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule is expected to return the lake to an MFL prevention strategy, enhance the level of certainty for existing permitted users now receiving less than a 1-in-10 year level of certainty, and support environmental objectives. Meeting future water needs through 2040 depends on the following:

- Construction of potable water supply development projects by nine PWS utilities (**Chapter 8**);
- Implementation of CERP and other projects identified in MFL prevention and recovery strategies; and
- Completion of repairs to the Herbert Hoover Dike by the USACE and subsequent implementation of a new Lake Okeechobee Regulation Schedule.

Successful implementation of this 2018 LEC Plan Update requires close coordination and collaboration with local governments, utilities, agricultural interests, and other stakeholders. This partnering should ensure water resources in the LEC Planning Area are prudently managed and available to meet future demands while also protecting the environment.

REFERENCES

SFWMD. 2013a. *2013 Lower East Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2013b. *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities, A Guide for Facility Managers*. Second Edition. South Florida Water Management District, West Palm Beach, FL. July 2013.

USACE. 2018. *Integrated Delivery Schedule 2018 Update*. United States Army Corps of Engineers, Jacksonville, FL. July 2018.

Glossary

1-in-10 year drought A year in which below normal rainfall occurs with a 90 percent probability of being exceeded in any other year. It has an expected return frequency of once in 10 years.

1-in-10 year level of certainty (see *Level of Certainty*)

Acre-foot, acre-feet The volume of water that covers 1 acre (43,560 square feet) to a depth of 1 foot. The equivalent of 43,560 cubic feet, 1,233.5 cubic meters, or 325,872 gallons.

Agricultural best management practice (Agricultural BMP) A practice or combination of agricultural practices, based on research, field testing, and expert review, determined to be the most effective and practicable means of improving water quality or quantity while maintaining or even enhancing agricultural production.

Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) A water budget model for calculating irrigation demands that estimates demand based on basin-specific data. The AFSIRS model calculates both net and gross irrigation requirements for average and 1-in-10 year drought irrigation requirements. A crop's net irrigation requirement is the amount of water delivered to the root zone of the crop, while the gross irrigation requirement includes both the net irrigation requirement and the losses incurred in the process of delivering irrigation to the crop's root zone.

Agricultural Irrigation (AGR) Self-supplied water used for commercial crop irrigation, greenhouses, nurseries, livestock watering, pasture, and aquaculture.

Alternative water supply Salt water; brackish surface water and groundwater; surface water captured predominately during wet-weather flows; sources made available through the addition of new storage capacity for surface water or groundwater; water that has been reclaimed after one or more public supply, municipal, industrial, commercial, or agricultural uses; the downstream augmentation of water bodies with reclaimed water; stormwater; and, any other water supply source that is designated as nontraditional for a water supply planning region in the applicable regional water supply plan [Section 373.019, Florida Statutes (F.S.)].

Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District **(Applicant's Handbook)** Read in conjunction with Chapter 40E-2, Florida Administrative Code (F.A.C.), the Applicant's Handbook further specifies the general procedures and criteria used by SFWMD staff for review of water use permit applications to ensure water uses permitted by the SFWMD are reasonable-beneficial, do not interfere with existing legal users, and are in the public interest.

Aquifer A geologic formation, group of formations, or part of a formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs.

Aquifer storage and recovery (ASR) The underground storage of potable water, stormwater, surface water, fresh groundwater, or reclaimed water, which is appropriately treated to potable standards and injected into an aquifer through wells. The aquifer (typically the Floridan aquifer system in South Florida) acts as an underground reservoir for the injected water, reducing water loss to evaporation. The water is injected during the wet season or when water is readily available and stored with the intent to recover it for use during future dry periods.

Aquifer system A heterogeneous body of (interbedded or intercalated) permeable and less permeable material that functions regionally as a water-yielding hydraulic unit and may be composed of more than one aquifer separated at least locally by confining units that impede groundwater movement, but do not greatly affect the hydraulic continuity of the system.

Average rainfall year A year having rainfall with a 50 percent probability of being exceeded over a 12-month period.

Base flow Sustained flow of a stream in the absence of direct runoff. It includes natural and human-induced stream flows. Natural base flow is sustained largely by groundwater discharges.

Base condition A specified period of time during which collected data are used for comparison with subsequent data.

Basin There are two types of basins: 1) a groundwater basin is a hydrologic unit consisting of one large aquifer, or several connecting and interconnecting aquifers; and 2) a surface water basin is a tract of land drained by a surface water body or its tributaries.

Below land surface Depth below land surface regardless of land surface elevation.

Biscayne aquifer A portion of the surficial aquifer system, which provides most of the fresh water for Public Water Supply and agriculture within Miami-Dade, Broward, and southeastern Palm Beach counties. It is highly susceptible to contamination due to its high permeability and proximity to the land surface in many locations.

Boulder Zone A highly transmissive, cavernous zone of dolomite within the Lower Floridan aquifer used to dispose of secondary-treated effluent from wastewater treatment facilities and concentrate from membrane water treatment plants via deep injection wells.

Brackish water Water with a chloride concentration greater than 250 milligrams per liter (mg/L) and less than 19,000 mg/L.

Canal A manmade waterway used for draining or irrigating land or for navigation by boat.

Capacity Capacity represents the ability to treat, move, or reuse water. Typically, capacity is expressed in millions of gallons per day (mgd).

Central and Southern Florida Flood Control Project (C&SF Project) A complete system of canals, storage areas, and water control structures spanning the area from Lake Okeechobee to the east and west coasts and from Orlando south to the Everglades. It was designed and constructed during the 1950s by the United States Army Corps of Engineers (USACE) to provide flood control and improve navigation and recreation.

Central Everglades Planning Project (CEPP) CEPP is a planning process for key restoration projects in the Everglades. CEPP combines a series of Comprehensive Everglades Restoration Plan (CERP) components into one project implementation report. Through this effort, projects will be identified and planned on land already in public ownership to allow more water to be directed south to the central Everglades, Everglades National Park, and Florida Bay while protecting coastal estuaries.

Comprehensive Everglades Restoration Plan (CERP) The federal-state partnership framework and guide for the restoration, protection, and preservation of the South Florida ecosystem. CERP also provides for water-related needs of the region, such as water supply and flood protection.

Confined aquifer An aquifer containing groundwater that is confined under pressure and bounded between substantially less permeable materials such that water will rise in a fully penetrating well above the top of the aquifer. In cases where the hydraulic head is greater than the elevation of the overlying land surface, a fully penetrating well will naturally flow at the land surface without means of pumping or lifting.

Confining unit A body of significantly less permeable material than the aquifer, or aquifers, that it stratigraphically separates. The hydraulic conductivity may range from nearly zero to some value significantly lower than that of the adjoining aquifers, and impedes the vertical movement of water.

Conservation (see *Water conservation*)

Consumptive use Any use of water that reduces the supply from which it is withdrawn or diverted**.**

Control structure An artificial structure designed to regulate the level/flow of water in a canal or other water body (e.g., weirs, dams).

Cubic feet per second (cfs) A rate of flow (e.g., in streams and rivers) equal to a volume of water 1 foot high and 1 foot wide flowing a distance of 1 foot in 1 second. One cfs is equal to 7.48 gallons of water flowing each second.

Culvert Conveyance structure that provides a means for water to pass under a road, railroad, dike, levee, or berm.

DBHYDRO The SFWMD's corporate environmental database, storing hydrologic, meteorologic, hydrogeologic, and water quality data.

Demand The quantity of water needed to fulfill a requirement.

Demand management Reducing the demand for water through activities that alter water use practices, improve efficiency in water use, reduce losses of water, reduce waste of water, alter land management practices, and/or alter land uses.

Desalination The process of removing or reducing salts and other chemicals from seawater or other highly mineralized water sources.

Dike An embankment to confine or control water, especially one built along the banks of a river or lake to prevent overflow of lowlands; a levee.

Discharge The rate of water movement past a reference point, measured as volume per unit of time (usually expressed as gallons per minute, cubic feet per second, or cubic meters per second).

Disinfection The process of inactivating microorganisms that cause disease. All potable water requires disinfection as part of the treatment process prior to distribution. Disinfection methods include chlorination, ultraviolet radiation, and ozonation.

Disposal Effluent disposal involves the practice of releasing treated effluent back to the environment using ocean outfalls, surface water discharges, or deep injection wells.

Domestic and Small Public Supply (DSS) Potable water used by households served by small utilities (less than 0.10 mgd) or self-supplied by private wells.

Domestic wastewater Wastewater derived principally from residential dwellings, commercial buildings, and institutions; sanitary wastewater; sewage.

Drainage basin The land area where precipitation ultimately drains to a particular watercourse (e.g., river, stream) or body of water (e.g., lake, reservoir). Drainage basins in South Florida are defined by rule and periodically are redefined to reflect changes in the regional drainage network.

Drawdown 1) The vertical distance between the static water level and the surface of the cone of depression. 2) A lowering of the groundwater surface caused by pumping.

Drought A long period of abnormally low rainfall, especially one that reduces water supply availability.

Ecology The study of the inter-relationships of plants and animals to one another and to their physical and biological environment.

Ecosystem Biological communities together with their environment, functioning as a unit.

Ecosystem restoration The process of reestablishing to as near its natural condition as possible, the structure, function, and composition of an ecosystem.

Effluent Treated water that is not reused after flowing out of any facility or other works used for treating, stabilizing, or holding wastes. Effluent is typically is “disposed” of via ocean outfall or deep well injection.

Elevation The height in feet above mean sea level according to National Geodetic Vertical Datum of 1929 (NGVD29) or North American Vertical Datum of 1988 (NAVD88). May also be expressed in feet above mean sea level as reference datum.

Environmental impact statement An evaluation of the positive and negative environmental effects of a proposed agency action required under United States environmental law by the National Environmental Policy Act for federal government agency actions “significantly affecting the quality of the human environment.”

Estuary A body of water found where a river meets the ocean that is characterized by fresh water mixing with salt water.

Evapotranspiration (ET) The total loss of water to the atmosphere by evaporation from land and water surfaces and by transpiration from plants.

Exceedance The violation of the pollutant levels permitted by environmental protection standards.

Exceedance (MFL) As defined in Rule 40E-8.021(17), F.A.C., to fall below a minimum flow or level, which is established in Parts II and III of Chapter 40E-8, F.A.C, for a duration greater than specified for the MFL water body.

Finished water Water that has undergone a purification or treatment process; water that has passed through all the processes in a water treatment plant and is ready to be delivered to consumers. Contrast with *Raw water*.

Finished water demand (see *Net water demand*)

Fiscal Year (FY) The South Florida Water Management District's fiscal year begins on October 1 and ends on September 30 the following year.

Florida Administrative Code (F.A.C.) The Florida Administrative Code is the official compilation of the administrative rules and regulations of state agencies.

Florida Department of Agriculture and Consumer Services (FDACS) An executive department of the Government of Florida. FDACS supports and promotes Florida agriculture, protects the environment, safeguards consumers, and ensures the safety and wholesomeness of food. The Office of Agricultural Water Policy works with agricultural producers, industry groups, the Florida Department of Environmental Protection, universities, and water management districts to develop and implement agricultural best management practices, addressing water quality and water conservation.

Florida-Friendly landscaping Quality landscapes that conserve water, protect the environment, are adaptable to local conditions, and are drought tolerant. The principles of such landscaping include planting the right plant in the right place, efficient watering, appropriate fertilization, mulching, attraction of wildlife, responsible management of yard pests, recycling yard waste, reduction of stormwater runoff, and waterfront protection. Additional components include practices such as landscape planning and design, soil analysis, the appropriate use of solid waste compost, minimizing the use of irrigation, and proper maintenance.

Florida Statutes (F.S.) The Florida Statutes are a permanent collection of state laws organized by subject area into a code made up of titles, chapters, parts, and sections. The Florida Statutes are updated annually by laws that create, amend, or repeal statutory material.

Floridan aquifer system (FAS) A highly used, deep aquifer system composed of the Upper and Lower Floridan aquifers. It is the principal source of water supply north of Lake Okeechobee and is highly mineralized south of the lake, requiring membrane treatment prior to use.

Flow The actual amount of water flowing by a particular point over some specified time. In the context of water supply, flow represents the amount of water being treated, moved, or reused. Flow is frequently expressed in millions of gallons per day (mgd).

Flow equalization basin (FEB) A constructed storage feature used to capture and store peak stormwater flows. They provide a steadier flow of water to stormwater treatment areas, helping to maintain desired water levels needed to achieve optimal water quality treatment performance.

Fresh water An aqueous solution with a chloride concentration less than or equal to 250 mg/L.

Geologic unit A geologic unit is a volume of rock or ice of identifiable origin and age range that is defined by the distinctive and dominant, easily mapped and recognizable petrographic, lithologic, or paleontologic features that characterize it.

Gross (raw) water demand The amount of water withdrawn from a water resource to meet a particular need of a water user or customer. Gross demand is the amount of water allocated in a water use permit. Gross or raw water demands are nearly always higher than net or user/customer water demands to account for treatment and distribution losses.

Groundwater Water beneath the surface of the ground, whether or not flowing through known and definite channels. Specifically, that part of the subsurface water in the saturated zone, where the water is under pressure greater than the atmosphere.

Groundwater recharge (see *Recharge*)

Harm As defined in Chapter 40E-8, F.A.C., the temporary loss of water resource functions that results from a change in surface or groundwater hydrology and takes a period of one to two years of average rainfall conditions to recover.

Headwater(s) 1) Water that is typically of higher elevation (with respect to tailwater) or on the controlled side of a structure. 2) The waters at the highest upstream point of a natural system that are considered the major source waters of the system.

Hydrogeologic unit Any rock unit or zone that because of its hydraulic properties has a distinct influence on the storage or movement of groundwater.

Hydrogeology The geology of groundwater, with emphasis on the chemistry and movement of water.

Hydrologic condition(s) The state of an area pertaining to the amount and timing of water present.

Hydrologic model A conceptual or physically based procedure for numerically simulating a process or processes that occur in a watershed.

Hydrology The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hypersaline Salinity conditions in excess of typical marine conditions, with chloride concentrations greater than 19,000 mg/L or total dissolved solids concentrations greater than 35,000 mg/L.

Impoundment Any lake, reservoir, or other containment of surface water occupying a depression or bed in the earth's surface and having a discernible shoreline.

Industrial/Commercial/Institutional (ICI) Self-supplied water associated the production of goods or provision of services by industrial, commercial, or institutional establishments.

Infiltration The movement of water through the soil surface into the soil under the forces of gravity and capillarity.

Inflow 1) The act or process of flowing in or into. 2) The measured quantity of water that has moved into a specific location.

Injection well Refers to a well constructed to inject treated wastewater directly into the ground. Wastewater is generally forced (pumped) into the well for dispersal or storage in a designated aquifer. Injection wells are generally drilled below freshwater levels, or into unused aquifers or aquifers that do not contain drinking water.

Intermediate aquifer system (IAS) This aquifer system consists of five zones of alternating confining and producing units. The producing zones include the Sandstone and Mid-Hawthorn aquifers in the Lower West Coast Planning Area.

Irrigation The application of water to crops and other plants by artificial means to supplement rainfall.

Landscape irrigation The outside watering of shrubbery, trees, lawns, grass, ground covers, vines, gardens, and other such flora, not intended for resale, which are planted and are situated in such diverse locations as residential and recreational areas, cemeteries, public, commercial and industrial establishments, and public medians and rights-of-way.

Levee An embankment to prevent flooding or a continuous dike or ridge for confining the irrigation areas of land to be flooded.

Level of certainty A water supply planning goal to assure at least a 90 percent probability during any given year that all the needs of reasonable-beneficial water uses will be met, while sustaining water resources and related natural systems during a 1-in-10 year drought event.

Marsh A frequently or continually inundated unforested wetland characterized by emergent herbaceous vegetation adapted to saturated soil conditions.

Maximum developable limit A maximum limit water use permitting criteria that is utilized to provide reasonable assurances that the proposed water use does not cause harmful drawdowns to semi-confined freshwater aquifers in the Lower West Coast Planning Area. The potentiometric head within the Lower Tamiami aquifer, Sandstone aquifer, and Mid-Hawthorn aquifer shall not be allowed to drop to less than 20 feet above the top of the uppermost geologic strata that comprises the aquifer at any point during a 1-in-10 year drought condition.

Mean Sea Level 1) The level of the surface of the sea between mean high and mean low tide; used as a reference point for measuring elevations. 2) The average height of the sea for all stages of the tide over a 19-year period, usually determined from hourly height observations on an open coast or in adjacent waters having free access to the sea.

Million gallons per day (mgd) A rate of flow of water equal to 133,680.56 cubic feet per day, 1.5472 cubic feet per second, or 3.0689 acre-feet per day. A flow of one million gallons per day for one year equals 1,120 acre-feet (365 million gallons).

Minimum Flow and Minimum Water Level (MFL) A flow or level established by the SFWMD pursuant to Sections 373.042 and 373.0421, F.S., for a given water body, at which further withdrawals would be significantly harmful to the water resources or ecology of the area.

Mobile irrigation lab (MIL) A vehicle furnished with irrigation evaluation equipment that is used to carry out on-site evaluations of irrigation systems and to provide recommendations on improving irrigation efficiency.

Model A computer model is a representation of a system and its operations, and provides a cost-effective way to evaluate future system changes, summarize data, and help understand interactions in complex systems. Hydrologic models are used for evaluating, planning, and simulating the implementation of operations within the SFWMD's water management system under different climatic and hydrologic conditions. Water quality and ecological models are also used to evaluate other processes vital to the health of ecosystems. Groundwater flow models are a numerical representation of water flow and water quality within an aquifer or aquifer system.

Monitor well Any human-made excavation by any method to monitor fluctuations in groundwater levels, quality of underground waters, or the concentration of contaminants in underground waters.

National Geodetic Vertical Datum of 1929 (NGVD29) A geodetic datum derived from a network of information collected in the United States and Canada. It was formerly called the "Sea Level Datum of 1929" or "mean sea level." Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific coasts, it does not necessarily represent local mean sea level at any particular place. As technology has improved and the demand for greater accuracy increased, inherent inaccuracies were uncovered in NGVD29. As a result, NGVD29 has been superseded by the North American Vertical Datum (NAVD) of 1988.

Natural system(s) A self-sustaining living system that supports an interdependent network of aquatic, wetland-dependent, and upland living resources.

Outflow The measured quantity of water that has left an area or water body (through pumping or gravity) during a certain period of time.

Per capita use 1) The average amount of water used per person during a standard time period, generally per day. 2) Total use divided by the total population served.

Permeability The capacity of a porous rock, sediment, or soil for transmitting a fluid.

Piezometer An open-ended pipe, placed in a drilled borehole, with a bottom tip of perforated or slotted screen. The water level in a piezometer reflects the water pressure only at the bottom of the pipe. The difference between a piezometer and a monitor well is that monitor well screens can extend through more than one water-bearing layer and intercept multiple water pressures.

Planning Area The SFWMD is divided into five areas within which planning activities are focused: Upper Kissimmee Basin (part of the Central Florida Water Initiative), Lower Kissimmee Basin, Upper East Coast, Lower West Coast, and Lower East Coast.

Potable water Water that is suitable for drinking, culinary, or domestic purposes.

Potentiometric head The level to which water will rise when a well is placed in a confined aquifer.

Power Generation (PWR) The difference in the amount of water withdrawn by electric power generating facilities for cooling purposes and the water returned to the hydrologic system near the point of withdrawal.

Priority Water Bodies List and Schedule Required in Section 373.042(2), F.S. of the state's five water management districts to provide the Florida Department of Environmental Protection with an annual list and schedule of specific surface waters and groundwaters with minimum flows and levels and water reservation rules that will be adopted to protect them from the effects of consumptive use allocations.

Process water Water used for nonpotable industrial use, e.g., mixing cement.

Public Water Supply (PWS) Water supplied by water treatment facilities for potable use (drinking quality) with projected average pumpages greater than 0.10 million gallons per day.

Public Water Supply (PWS) demand All potable (drinking quality) water supplied by water treatment plants with projected average pumpages of 0.10 million gallons per day or greater to all types of customers, not just residential.

Rapid infiltration basin A disposal method by which treated wastewater is applied in deep and permeable deposits of highly porous soils for percolation.

Raw water 1) Water that is direct from the source—groundwater or surface water—without any treatment. 2) Untreated water, usually that entering the first unit of a water treatment plant. Contrast with *Finished Water*.

Raw water demand The amount of water that must be withdrawn from the groundwater or surface water system to meet a particular need. Withdrawal demands are almost always higher than user/customer demands because of treatment and process losses, and inefficiencies associated with delivering water from the source to the end user.

Reasonable-beneficial use Use of water in such quantity as is needed for economic and efficient use for a purpose, which is both reasonable and consistent with the public interest.

Recharge (groundwater) The natural or intentional infiltration of surface water or reclaimed water into the ground to raise groundwater levels.

Reclaimed water Water that has received at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility [Rule 62-610.200, F.A.C.].

Recovery The rate and extent of return of a natural population or community to some aspect(s) of its previous condition. Because of the dynamic nature of ecological systems, the attributes of a "recovered" system should be carefully defined.

Recreational/Landscape Irrigation (REC) Water used for landscape and golf course irrigation. The landscape subcategory includes water used for parks, cemeteries, and other irrigation applications of 0.10 million gallons per day or greater. The golf course subcategory includes operations not supplied by a Public Water Supply or regional reuse facility.

Regional Simulation Model A regional hydrologic model developed on a sound conceptual and mathematical framework that allows it to be applied generically to a wide range of hydrologic situations. It simulates the coupled movement and distribution of groundwater and surface water throughout the model domain using a hydrologic simulation engine to simulate the natural hydrology and a management simulation engine to provide a wide range of operational capability.

Reservoir An artificial or natural water body used for water storage. Reservoirs can be above or below ground.

Restoration The recovery of a natural system's vitality and biological and hydrological integrity to the extent that the health and ecological functions are self-sustaining over time.

Restricted Allocation Area An area designated within the South Florida Water Management District boundaries for which allocation restrictions are applied regarding the use of specific sources of water. The water resources in these areas are managed in response to specific sources of water in the area for which there is a lack of water availability to meet the projected needs of the region from that specific source of water.

Retrofit 1) Indoor: The replacement of existing water fixtures, appliances, and devices with more efficient fixtures, appliances, and devices for the purpose of water conservation. 2) Outdoor: The replacement or changing out of an existing irrigation system with a more efficient irrigation system, such as a conversion from an overhead sprinkler system to a micro-irrigation system. May also include rain or soil moisture sensors to increase efficiency.

Reuse The deliberate application of reclaimed water for a beneficial purpose. Criteria used to classify projects as "reuse" or "effluent disposal" are contained in Rule 62-610.810, F.A.C. The term "reuse" is synonymous with "water reuse."

Reverse osmosis A treatment process for desalting water using applied pressure to drive the feed water (source water) through a semipermeable membrane.

Rule(s) Of or pertaining to the SFWMD's regulatory programs, which are set forth in various statutes, codes, and criteria.

Runoff That component of rainfall, which is not absorbed by soil, intercepted and stored by surface water bodies, evaporated to the atmosphere, transpired and stored by plants, or infiltrated to groundwater, but which flows to a watercourse as surface water flow.

Salinity Of or relating to chemical salts, usually measured in milligrams per liter (mg/L), or practical salinity units.

Salt water (see *Seawater or Salt water*)

Saltwater interface The hypothetical surface of chloride concentration between fresh water and seawater where the chloride concentration is 250 mg/L at each point on the surface.

Saltwater intrusion The invasion of a body of fresh water by a body of salt water due to its greater density. It can occur either in surface water or groundwater bodies. The term is applied to the flooding of freshwater marshes by seawater, the upward migration of seawater into rivers and navigation channels, and the movement of seawater into freshwater aquifers along coastal regions.

Seawater or **Salt water** Water with a chloride concentration at or above 19,000 mg/L.

Seepage The passage of water or other fluid through a porous medium, such as the passage of water through an earth embankment or masonry wall. Groundwater emerging on the face of a stream bank; the slow movement of water through small cracks, pores, interstices, etc., of a material into or out of a body of surface or subsurface water. The interstitial movement of water that may take place through a dam, its foundation or its abutments. The movement of water by infiltration into the soil from a canal, ditches, laterals, watercourse, reservoir, storage facilities, or other body of water, or from a field. Seepage is generally expressed as flow volume per unit of time.

Serious harm As defined in Chapter 40E-8, F.A.C., the long-term, irreversible, or permanent loss of water resource functions resulting from a change in surface water or groundwater hydrology.

Service area The geographical region in which a water supplier has the ability and the legal right to distribute water for use.

Significant harm As defined in Chapter 40E-8, F.A.C., the temporary loss of water resource functions that results from a change in surface water or groundwater hydrology and takes more than 2 years to recover, but which is considered less severe than serious harm.

Stormwater Water that does not infiltrate but accumulates on land as a result of storm runoff, snowmelt, irrigation, or drainage from impervious surfaces.

Stormwater discharge Precipitation runoff from roadways, parking lots, and roof drains that is collected in gutters and drains. A major source of nonpoint source pollution to water bodies and sewage treatment facilities in municipalities where stormwater is combined with the flow of domestic wastewater (sewage) before entering the wastewater treatment facility.

Stormwater Treatment Area (STA) A system of constructed water quality treatment wetlands that use natural biological processes to reduce levels of nutrients and pollutants from surface water runoff.

Submersed aquatic vegetation Aquatic plants that exist completely below the water surface.

Surface water Water above the soil or substrate surface, whether contained in bounds, created naturally or artificially, or diffused. Water from natural springs is classified as surface water when it exits from the spring onto the earth's surface.

Surficial aquifer system (SAS) Often the principal source of water for urban uses. This aquifer is unconfined, consisting of varying amounts of limestone and sediments that extend from the land surface to the top of an intermediate confining unit.

Treatment facility Any facility or other works used for the purpose of treating, stabilizing, or holding water or wastewater.

Tributary A stream that flows into a larger stream or other body of water.

United States Army Corps of Engineers (USACE) As part of the Department of the Army, the USACE has responsibilities in civil and military areas. In civil works, the USACE has authority for approval of dredge and fill permits in navigable waters and tributaries thereof; the USACE enforces wetlands regulations, and constructs and operates a variety of water resources projects, mostly notably levee, dams, and locks.

United States Geological Survey (USGS) The federal agency chartered in 1879 by Congress to classify public lands, and to examine the geologic structure, mineral resources, and products of the national domain. As part of its mission, the USGS provides information and data on the nation's rivers and streams that are useful for mitigation of hazards associated with floods and droughts. The USGS works with partners to monitor, assess, conduct targeted research, and deliver information on a wide range of water resources and conditions, including streamflow, groundwater, water quality, and water use and availability.

Upconing Upward migration of mineralized or saline water as a result of a pressure variation caused by withdrawals.

Utility Any legal entity responsible for supplying potable water for a defined service area.

Violation (MFL) As defined in Rule 40E-8.021(18), F.A.C., to fall below an adopted minimum flow or level criterion for a duration and frequency greater than specified for the MFL water body. Unless otherwise specified herein, in determining the frequency with which water flows and levels fall below an established MFL for purposes of determining an MFL violation, a "year" means 365 days from the last day of the previous MFL exceedance.

Wastewater The combination of liquid and water-carried pollutants from residences, commercial buildings, industrial plants, and institutions together with any groundwater, surface runoff, or leachate that may be present.

Water conservation The permanent, long-term reduction of daily water use. Permanent water use reduction requires the implementation of water saving technologies and measures that reduce water use while satisfying consumer needs. Water conservation is considered a demand management measure because it reduces the need for future expansion of water supply infrastructure (see *Demand management*).

Water Conservation Area (WCA) Part of the original Everglades ecosystem that is now diked and hydrologically controlled for flood control and water supply purposes. The three WCAs are in the western portions of Miami-Dade, Broward, and Palm Beach counties, and preserve approximately 840,000 acres (50 percent) of the original Everglades.

Water conservation rate structure A water rate structure designed to conserve water. Examples of conservation rate structures include increasing block rates, seasonal rates, and quantity-based surcharges.

Water management The general application of practices to obtain added benefits from precipitation, water or water flow in any of a number of areas, such as irrigation, drainage, wildlife and recreation, navigation, water supply, watershed management, and water storage in soil for crop production. Watershed management is the analysis, protection, development, operation, or maintenance of the land, vegetation, and water resources of a drainage basin for the conservation of all its resources for the benefit of its residents. Watershed management for water production is concerned with the quality, quantity and timing of the water which is produced.

Water quality 1) A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose. 2) The physical, chemical, and biological condition of water as applied to a specific use. Federal and state guidelines set water quality standards based on the water's intended use, whether it is for recreation, fishing, drinking, navigation, shellfish harvesting, or agriculture.

Water Reservation A legal mechanism to set aside water for the protection of fish and wildlife or the public health and safety from consumptive water use. The reservation is composed of a quantification of the water to be protected, which includes a seasonal and a location component.

Water Resources Analysis Coalition (WRAC) The primary forum for conducting workshops, presenting information, and receiving public input on water resource issues affecting Central and South Florida.

Water resource development The formulation and implementation of regional water resource management strategies, including collection and evaluation of surface water and groundwater data; structural and nonstructural programs to protect and manage the water resources; development of regional water resource implementation programs; construction, operation and maintenance of major public works facilities to provide for flood control, surface and groundwater storage, and groundwater recharge augmentation; and related technical assistance to local governments and to government-owned and privately owned water utilities [Section 373.019, F.S.].

Water reuse (see *Reuse*)

Watershed A region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water. Watersheds conform to federal hydrologic unit code standards and can be divided into subwatersheds and further divided into catchments, the smallest water management unit recognized by SFWMD Operations. Unlike drainage basins, which are defined by Rule, watersheds are continuously evolving as the drainage network evolves.

Water Shortage Plan(s) This effort includes provisions in Chapters 40E-21 and 40E-22, F.A.C., and identifies how water supplies are allocated to users during declared water shortages. The plan allows for supply allotments and cutbacks to be identified on a weekly basis based on the water level within Lake Okeechobee, demands, time of year, and rainfall forecasts.

Water supply development The planning, design, construction, operation, and maintenance of public or private facilities for water collection, production, treatment, transmission, or distribution for sale, resale, or end use [Section 373.019, F.S.].

Water Supply Plan Detailed water supply plan developed by the water management districts under Section 373.709, F.S., providing an evaluation of available water supply and projected demands at the regional scale. The planning process projects future demand for at least 20 years and recommends projects to meet identified needs.

Water table The surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere; defined by the level where water within an unconfined aquifer stands in a well.

Water use Any use of water that reduces the supply from which it is withdrawn or diverted.

Water use permitting The issuance of permits by the South Florida Water Management District, under the authority of Chapter 40E-2, F.A.C., allowing a specified quantity of water withdrawal for consumptive use over a specified time period.

Wellfield One or more wells producing water from a groundwater source. A tract of land that contains a number of wells for supplying a large municipality or irrigation district.

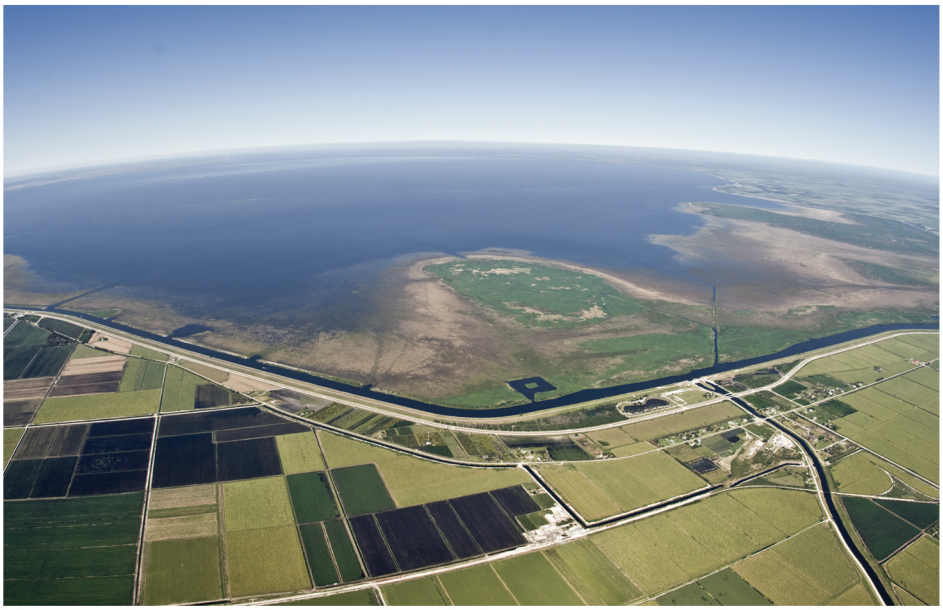
Wetland An area that is inundated or saturated by surface water or groundwater with vegetation adapted for life under those soil conditions (e.g., swamps, bogs, marshes).

Wild and Scenic River A river as designated under the authority of the of Public Law 90-542, the *Wild and Scenic Rivers Act,* as amended, is a means to preserve selected free-flowing rivers in their natural condition and protect the water quality of such rivers. A portion of the North Fork of the Loxahatchee River was federally designated as the first Wild and Scenic River in Florida on May 17, 1985.

Withdrawal Water removed from a groundwater or surface water source for use.

Yield The quantity of water (expressed as rate of flow or total quantity per year) that can be collected for a given use from surface or groundwater sources.

Meeting South Florida's water supply needs
while safeguarding its natural systems requires
innovative solutions, cohesive planning,
and a shared vision.



South Florida Water Management District

Committed to managing and protecting our region's water resources

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