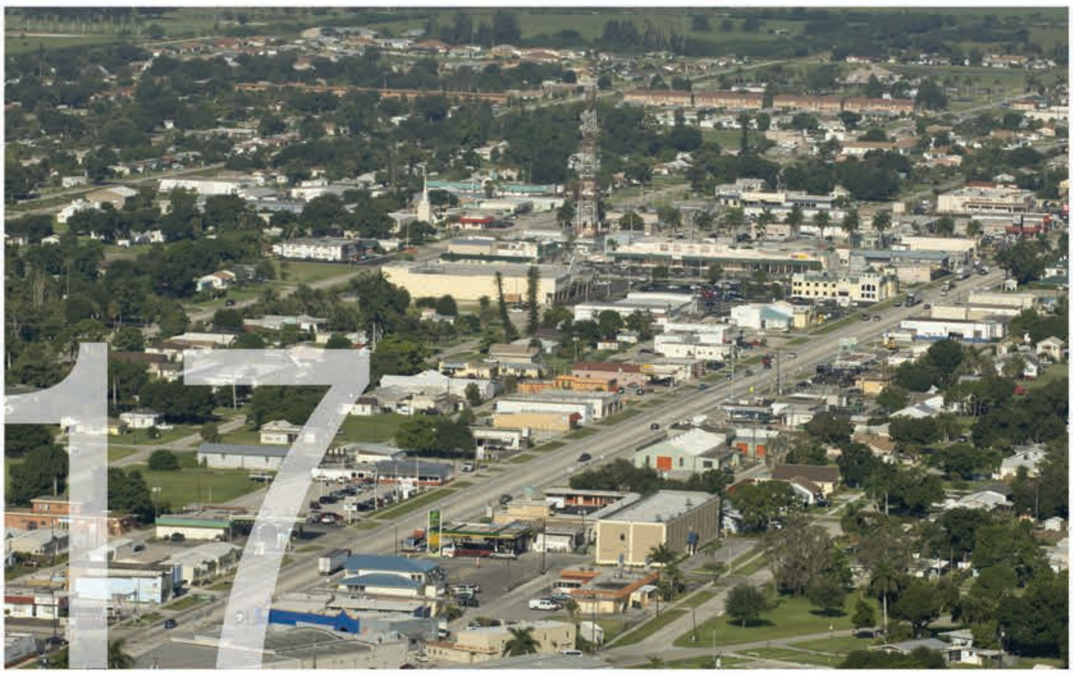
SOUTH FLORIDA WATER MANAGEMENT DISTRICT

LOWER WEST COAST WATER SUPPLY PLAN UPDATE

Planning Document

2017



Acknowledgments

The South Florida Water Management District (SFWMD or District) recognizes and thanks the Water Resources Advisory Commission (WRAC) Regional Water Supply Workshop participants for their contributions, comments, advice, information, and assistance throughout the development of this *2017 Lower West Coast Water Supply Plan Update.*

Furthermore, the SFWMD expresses appreciation to all District 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 future 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 *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update) is the fourth update to the *1994 Lower West Coast Water Supply Plan*, which previously was updated in 2000, 2006, and 2012. This plan update is consistent with the water supply planning requirements of Chapter 373, Florida Statutes, 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 efforts completed since the 2012 plan update and describes water resource and water supply development projects for 2015 to 2040.

This 2017 LWC Plan Update was developed in an open, public forum through the SFWMD's Water Resources Advisory Commission. In addition, multiple meetings and workshops were held with water users, local governments, utilities, agriculture and other industry representatives, and environmental representatives to solicit input, provide information about planning results, and receive comments on draft sections.

The LWC Planning Area covers more than 5,100 square miles, including all of Lee County, most of Collier County, and portions of Charlotte, Glades, Hendry, and Monroe counties. The area generally reflects the watersheds of the Caloosahatchee, Cocohatchee, Estero, and Imperial rivers and the Big Cypress Swamp. While a portion of the Lake Okeechobee Service Area (LOSA) is within the LWC Planning Area, the entire LOSA is addressed in the Lower East Coast water supply plan updates.

Typically, the LWC Planning Area seasonally receives abundant fresh water, with volumes exceeding human and natural system needs during wet periods. Water availability varies annually and includes periodic drought years. Annual precipitation averages 53 inches, with nearly two-thirds of rainfall occurring between May and October. There is an extensive network of canals and waterworks used for water supply and flood control in the LWC Planning Area, including the C-43, Golden Gate, Faka Union, and Henderson Creek canals.

DEMAND ESTIMATES AND PROJECTIONS

As described in **Chapter 2**, the LWC Planning Area has some of the fastest growing job markets in the state. The region is home to approximately 1 million people and supports a large seasonal population, tourism and golf, and a substantial agricultural industry. The permanent population is projected to reach approximately 1.6 million people by 2040, which is approximately 60 percent increase from the 2014 estimate.

Agriculture is a substantial part of the economy. Agricultural irrigated acres are projected to increasing approximately 10 percent from 306,000 acres in 2014 to 340,000 acres in 2040. Citrus is the dominant crop, in terms of acreage, in the LWC Planning Area, covering more than 124,000 acres. However, for the past two decades, the citrus industry has been declining throughout Florida, largely due to citrus greening disease and citrus canker, and statewide harvest estimates continue to set historical lows.

Total water demands by all water use categories are projected to increase from an average total water use of approximately 971 million gallons per day (mgd) in 2014 to 1,211 mgd in 2040 (**Table ES-1**). This projected increase represents a weighted average increase in water use of approximately 25 percent. Although demands are increasing from 2014 levels, the total demand projection for 2040 in this 2017 LWC Plan Update (1,211 mgd) is less than the estimated 2030 demand (1,218 to 1,263 mgd) previously projected in the 2012 LWC Plan Update.

Agricultural Irrigation (AGR) is projected to continue to be the largest use category in the LWC Planning Area, accounting for approximately 56 percent of the total 2040 projected demand. Recreational/Landscape Irrigation (REC) represents the second largest water use in the region at approximately 21 percent of the total 2040 projected demand. Public Water Supply (PWS) is the third largest use category in the LWC Planning Area, representing almost 17 percent of the total 2040 projected demand. Domestic and Small Public Supply (DSS), Industrial/Commercial/Institutional (ICI), and Power Generation (PWR) collectively account for approximately 6 percent of the total 2040 projected demand.

Table ES-1. Estimated and projected average gross water demands (in mgd) in the LWC Planning Area for 2014 and 2040.

Water Use Category	2014 Estimated Use	2040 Projected Demand	Percent Change	Percent of Projected 2040 Total Demand
AGR	615.75	678.83	10.2%	56.1%
REC	177.59	254.32	43.2%	21.0%
PWS	129.33	199.88	54.6%	16.5%
DSS	22.18	33.18	49.6%	2.7%
ICI	25.43	29.07	14.3%	2.4%
PWR	0.40	15.40	3,750.0%	1.3%
Total	**970.68**	**1,210.68**	**24.7%**	**100.0%**

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

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 LWC Planning Area have effectively lowered the net (finished) water per capita use rate for PWS over the past decade, from 175 gallons per capita per day in 2000 to approximately 130 gallons per capita per day in 2014. Analysis suggests that Charlotte, Collier, Glades, Hendry, and Lee counties collectively can save an additional 26 mgd by 2040 if various urban and agricultural conservation options are implemented.

NATURAL SYSTEMS AND RESOURCE PROTECTION

The LWC Planning Area encompasses extensive natural systems, including the Caloosahatchee River Estuary, Lake Okeechobee, Lake Trafford, Corkscrew Regional Ecosystem Watershed, Big Cypress Swamp, Southern Charlotte Harbor, Estero Bay, Naples Bay, Ten Thousand Islands and Rookery Bay, and Fakahatchee Estuary. The water supply needs for natural systems are protected and addressed through a variety of regulatory mechanisms, restoration projects, and water resource development projects.

Minimum Flows and Minimum Water Levels (MFLs) have been adopted in the LWC Planning Area for the Caloosahatchee River, the LWC Aquifers (the Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers), Lake Okeechobee, and the freshwater portions of Everglades National Park (**Chapter 4**). A prevention strategy has been adopted for the LWC Aquifers MFL, and recovery strategies have been adopted for the Caloosahatchee River, Lake Okeechobee, and Everglades National Park MFLs. A re-evaluation of the adopted MFL criteria for the Caloosahatchee River is under way. Water Reservations have been adopted in the LWC Planning Area for Picayune Strand (2009), Fakahatchee Estuary (2009), and the Caloosahatchee River (C-43) West Basin Storage Reservoir (2014). Restricted Allocation Area rules have been established for the LOSA and a small part of the freshwater portions of Everglades National Park.

There are numerous ecosystem restoration projects under way in the LWC Planning Area (**Chapter 7**). 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 and the SFWMD, is a critical component of water supply planning in the LWC Planning Area. CERP includes capital projects needed to protect and restore natural systems and may enhance water availability. The primary CERP project components in the LWC Planning Area are the Caloosahatchee River (C-43) West Basin Storage Reservoir (C-43 Reservoir) and the Picayune Strand Restoration Project. Estimated to be completed by 2022, the C-43 Reservoir will store up to 170,000 acre-feet of water to provide freshwater flows to the Caloosahatchee River Estuary during dry periods. The Picayune Strand Restoration Project in southern Collier County is under way and due to be completed in 2020.

WATER SOURCE OPTIONS

Current water source options (**Chapter 5**) in the LWC Planning Area include surface water, groundwater (fresh and brackish), reclaimed water, and stormwater. Surface water, fresh groundwater (from the surficial and intermediate aquifer systems [SAS and IAS]), and stormwater are considered traditional water sources. Alternative water sources include brackish groundwater (from the Floridan aquifer system [FAS] and portions of the IAS), seawater, reclaimed water, and excess surface water and groundwater captured and stored in aquifer storage and recovery (ASR) wells, reservoirs, and other features. Use of alternative water supplies is an integral part of the current and future water supply strategy in the LWC Planning Area.

AGR users primarily rely on surface water from regional canals and, to a lesser extent, fresh groundwater from the SAS and IAS. The acreage and cumulative volume of water currently allocated for agriculture exceeds the total projected demand for 2040 without additional permit allocation or infrastructure.

PWS utilities within the LWC Planning Area rely on groundwater from the SAS, IAS, and FAS as well as limited amounts of surface water. Groundwater sources generally can meet 2040 PWS demands; however, a few isolated areas of the LWC Planning Area will require additional planning and adaptive management strategies. The cumulative volume of water currently allocated for PWS slightly exceeds the total projected demand for 2040, and most PWS utilities appear able to meet 2040 demands without additional permit allocation or infrastructure. Only 2 of the 22 PWS utilities in the LWC Planning Area need to construct new projects to meet their projected 2040 demands.

REC users, including golf courses, rely on a combination of fresh groundwater from the SAS and IAS, limited brackish water from the IAS and FAS, stormwater, surface water, and reclaimed water. Increases in landscape irrigation are expected to be met primarily through expanded use of reclaimed water, stormwater, and fresh groundwater. **Table ES-2** summarizes the variety of water source options that typically are used by the water use categories in South Florida.

Table ES-2. Typical water source options for the six water use categories.

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

Surface Water

Surface water supply sources in the LWC Planning Area include Lake Okeechobee, the C-43 Canal, and connected secondary canal systems located in the LOSA as well as regional canals in Collier County (e.g., Golden Gate and Henderson Creek canals). Water availability from these systems are limited due to existing legal users, limited storage, and environmental needs. Additional water storage features could enhance water availability. Surface water is used by AGR, and to a much lesser extent PWS and REC.

For surface water users in LOSA, the level of certainty currently is reduced to a 1-in-6 year drought condition. Meeting the 1-in-10 year level of certainty (consistent with that provided to other permittees) for LOSA is not likely within the next 5 years due to the interrelationship of the federal and state projects outlined in this plan update and the current operations under the 2008 Lake Okeechobee Regulation Schedule. The SFWMD anticipates that any additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule could return the lake to an MFL prevention strategy, increase the level of certainty (from 1-in-6 years back to 1-in-10 years) for existing permitted users, and support other 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

Fresh groundwater sources in the LWC Planning Area are the SAS and IAS, which are used by AGR, PWS, DSS, REC, and ICI. Development of the SAS and IAS has been maximized in many portions of the LWC Planning Area, especially in coastal areas. Water availability from the SAS and IAS will be determined locally in these areas, considering the quantities required, local resource conditions, existing legal users, and viability of other supply options. The SFWMD is developing a regional groundwater model to simulate current and future conditions within the SAS and IAS, and build on previous modeling efforts.

In 2014, the SAS and IAS collectively accounted for approximately 60 percent of PWS and DSS use in the LWC Planning Area. SAS and IAS use for PWS is projected to increase very little, if at all, as the use of alternative water sources such as brackish water from the FAS increases. Most PWS utilities in the LWC 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**).

Current groundwater conditions within the SAS and IAS are discussed in **Chapter 6**. For SAS and IAS water users, recent mapping of saltwater intrusion in Collier and Lee counties indicates that the saltwater interface has remained relatively stable over the past 5 years.

Brackish Groundwater

Brackish groundwater from the IAS and FAS is utilized by many PWS utilities as well as some golf courses (under REC). There are 14 water treatment plants currently treating brackish IAS and FAS water in the LWC Planning Area. These facilities use reverse osmosis (RO) treatment, and have a combined RO capacity of approximately 125 mgd, with an additional 5 mgd under construction. In 2014, RO water treatment plants supplied water to meet 40 percent of PWS demand. The SFWMD is updating the regional groundwater model to simulate current and future conditions within the FAS, and build on previous modeling efforts.

Current groundwater level and quality data for the FAS are discussed in **Chapter 6**. Review of FAS water level and quality data indicates there have not been substantial regional changes; however, some local changes 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, other FAS stakeholders, and the Southwest Florida Water Management District.

Reclaimed Water

Use of reclaimed water is an integral part of water supply in the LWC Planning Area. Including supplemental water sources, 100 percent of the region's treated wastewater (77 mgd) is reused for golf course and landscape irrigation, industrial uses, and groundwater recharge. This volume of reclaimed water and reuse is projected to increase as population grows.

FUTURE DIRECTION

Chapter 9 of this 2017 LWC Plan Update contains guidance to help focus future efforts to meet projected water demands. Some of the key suggestions are as follows:

- Continue implementation of robust water conservation programs throughout the LWC Planning Area to reduce future water demands by all water use categories.
- Continue development of alternative water supplies, where needed, including maximizing the use of reclaimed water. Where appropriate, blending multiple alternative water sources to achieve acceptable water quality is a prudent approach to water supply.
- The design of FAS wells, wellfield locations and configurations, and pumping regimes should 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.
- Where appropriate, water users are encouraged to store excess surface water for water supply purposes.
- Reservoirs and other storage systems should be developed, where possible, to increase surface water availability for environmental, agricultural, and urban water supply needs.
- Complete re-evaluation of the Caloosahatchee River MFL and codify subsequent changes, if any, to the adopted MFL rule.
- The monitoring networks used for saltwater intrusion, aquifer assessment, and groundwater modeling currently are a hybrid of regional programs and monitoring required or performed by water use permittees. Efforts should be made to identify wells considered critical to long-term monitoring and modeling to ensure the wells are constructed, maintained, or replaced as necessary.
- SAS and IAS wellfield operating plans should be reviewed and revised, as needed, to maximize withdrawals while avoiding harm to natural systems and potential impacts from saltwater intrusion.

CONCLUSIONS

Building on the findings and conclusions of previous LWC water supply plan updates, this 2017 LWC Plan Update assesses water supply demand and available sources for the LWC Planning Area through 2040. With construction of the identified projects, sufficient water appears to be available for most users to meet 2040 projected water demands during 1-in-10 year drought conditions. Currently, this 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 planning area.

Demands were developed based on the best available information. There is uncertainty in agricultural projections due to citrus acreage decline resulting from disease, and fallow citrus land may be temporarily converted to other crops. The SFWMD anticipates that when the

LWC Water Supply Plan is updated in 5 years, the trend in agricultural water use will be clearer, reducing uncertainty in agricultural demand projections.

This plan update concludes that future water needs of the region can be met through the 2040 planning horizon with appropriate management, conservation, and implementation of projects identified herein. The SFWMD anticipates any additional water from Lake Okeechobee resulting from revision of the lake regulation schedule could return the lake to an MFL prevention strategy, return the 1-in-10 year drought condition level of certainty to existing permitted users, and support other environmental objectives. Meeting future water needs depends on the following:

- Construction of potable water supply development projects by 2 PWS utilities;
- Implementation of the C-43 Reservoir and other projects identified in MFL prevention and recovery strategies; and
- Utilization of the flexibility within the 2008 Lake Okeechobee Regulation Schedule as incremental dam safety improvements are completed; and in the longer term, completion of the seepage berm construction or equivalent repairs to the Herbert Hoover Dike for Reaches 1, 2, and 3 by the United States Army Corps of Engineers and implementation of a revised Lake Okeechobee Regulation Schedule.

Successful implementation of this 2017 LWC Plan Update requires close collaboration with agricultural interests, local governments, utility water supply planning entities, and other stakeholders. Coordination efforts should ensure that water resources in the LWC Planning Area continue to be prudently managed and available to meet future demands while still 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
ASR	aquifer storage and recovery
AWE	Alliance for Water Efficiency
AWS	alternative water supply
BEBR	Bureau of Economic and Business Research
BMAP	Basin Management Action Plan
BMP	best management practice
C-43 Reservoir	Caloosahatchee River (C-43) West Basin Storage Reservoir
C&SF Project	Central and Southern Florida Project
CERP	Comprehensive Everglades Restoration Plan
CFP	Cooperative Funding Program
CRE	Caloosahatchee River Estuary
CREW	Corkscrew Regional Ecosystem Watershed
District	South Florida Water Management District
DSS	Domestic and Small Public Supply
ENP	Everglades National Park
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
FGS	Florida Geological Survey
FPL	Florida Power & Light
FY	Fiscal Year
gpd	gallons per day
HVAC	heating, ventilation, and air conditioning
IAS	intermediate aquifer system
ICI	Industrial/Commercial/Institutional

LFA	Lower Floridan aquifer
LOSA	Lake Okeechobee Service Area
LWC	Lower West Coast
MDL	Maximum Developable Limit
MF	multi-family
MFL	Minimum Flow and Minimum Water Level
mg/L	milligrams per liter
mgd	million gallons per day
MIL	mobile irrigation lab
MSL	mean sea level
MW	megawatt
NEEPP	Northern Everglades and Estuaries Protection Program
NGVD29	National Geodetic Vertical Datum of 1929
NRC	National Research Council
NWR	National Wildlife Refuge
PCUR	per capita use rate
PES	Payment for Environmental Services
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
SF	single family
SFER	South Florida Environmental Report
SFWMD	South Florida Water Management District
TMDL	total maximum daily load
UFA	Upper Floridan aquifer
USACE	United States Army Corps of Engineers
USDA-NASS	United States Department of Agriculture – National Agricultural Statistics Service
USDOI	United States Department of the Interior
USGS	United States Geological Survey

Water CHAMP	Water Conservation Hotel and Motel Program
WaterSIP	Water Savings Incentive Program
WFPP	water farm pilot project
Work Plan	Water Supply Facilities Work Plan
WRAC	Water Resources Advisory Commission
WTP	water treatment plant
WWTF	wastewater treatment facility

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Introduction

TOPICS

- 2017 LWC Plan Update
- Goal and Objectives
- Legal Authority and Requirements
- Regional and Local Planning Linkage
- Plan Development Process
- Planning Area Background
- Water Resources Overview
- Progress Since the 2012 LWC Plan Update
- Outlook on Climate Change

The South Florida Water Management District (SFWMD or District) develops and updates regional water supply plans to provide for current and future water needs while protecting Central and South Florida's water resources. This *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update) assesses existing and projected water needs as well as water sources to meet those needs through 2040.

Of the six counties in the LWC Planning Area, only Lee County is contained completely within the planning area boundaries (**Figure 1-1**). Most of Collier County is within the LWC Planning Area; the small part in the Lower East Coast Planning Area is in the Big Cypress National Preserve and has no permanent residents. Northern Glades County is in the Lower Kissimmee Basin Planning Area, and eastern Hendry County is in the Lower East Coast Planning Area. A small part of Monroe County is in the LWC Planning Area, but it has no permanent residents. Most of Charlotte County falls under the jurisdiction of the Southwest Florida Water Management District.

The boundaries of the LWC Planning Area generally reflect the drainage patterns of the Caloosahatchee River Basin to the north and Big Cypress National Preserve to the south. The northern area of the basin also is the general jurisdictional boundary between the SFWMD and the Southwest Florida Water Management District in Charlotte County. The eastern boundary of the LWC Planning Area is along the western edge of the historic Everglades watershed, dividing the Big Cypress and Lake Okeechobee drainage basins. At the southern end of the region, the LWC Planning Area encompasses a coastal portion of Everglades National Park (ENP) and ends just north of Shark River Slough.

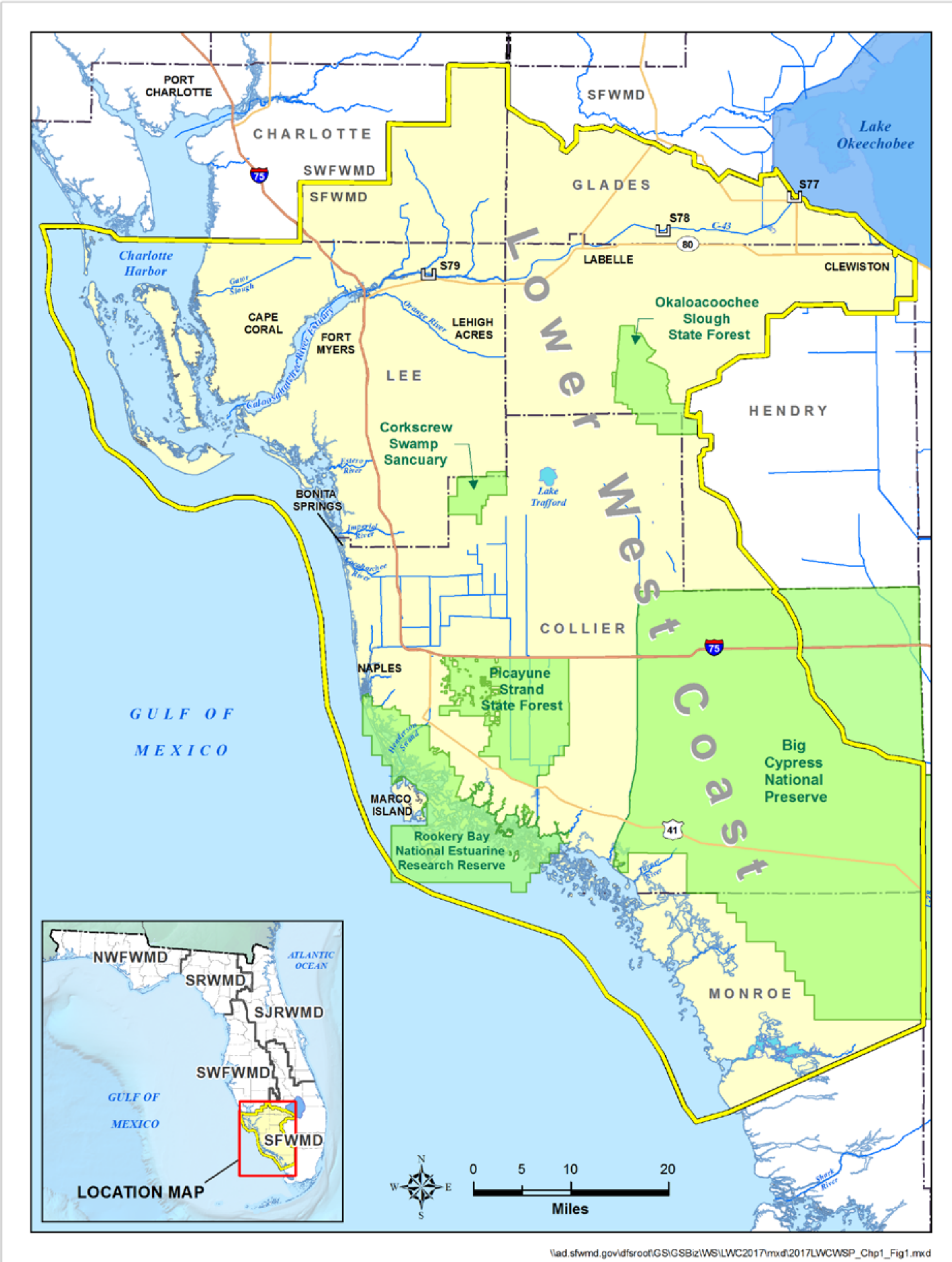


Figure 1-1. Lower West Coast Water Supply Planning Area.

2017 LWC PLAN UPDATE

The 2017 LWC Plan Update reflects the changes experienced in the LWC Planning Area since early 2012 and the effects of those changes on water use and projected demands. The 2017 LWC Plan Update consists of three documents: the planning document, the associated appendices, and the *2016 Water Supply Plan Support Document* (SFWMD 2016). The planning document and appendices focus on the LWC Planning Area. The Support Document addresses aspects common to all five SFWMD regional planning areas and contains background material such as effects of recent, relevant legislation and information on water resource technologies.

GOAL AND OBJECTIVES

The goal of the 2017 LWC 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 objectives of the 2012 LWC Plan Update (SFWMD 2012) were reviewed and modified to develop the following seven objectives for this 2017 LWC 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. **Natural Systems** – Protect natural systems and water resources from harm due to water use, including declining water levels and the harmful movement of saline water.

3. **Estuarine and Riverine Systems** – Protect and enhance estuarine and riverine systems through effective management of water resources.

4. **Conservation and Alternative Source Development** – Encourage water conservation measures to improve water use efficiency, and support and promote the development of alternative diversified sources of water.

5. **Linkage with Local Governments** – Provide information to support local government coordination through updates to the required Water Supply Facilities Work Plans (Work Plans).

6. **Compatibility and Linkage with Other Efforts** – Achieve compatibility with related planning activities within the region and with adjacent water management districts.

7. **Floridan Aquifer System** – Continue to encourage development of the Floridan aquifer system (FAS) as an alternative water source, and monitor the aquifers to enhance understanding of the relationships among water use, water levels, and water quality.

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.). Most of the LWC Planning Area has been designated as a Water Resource Caution Area under Chapter 62-40, F.A.C., which requires reuse when determined feasible by wastewater facilities.

Since the 2012 LWC 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 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 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.

Since 2012, the SFWMD has worked with regional Public Water Supply (PWS) utilities to evaluate the need for water supply development projects for this 2017 LWC 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 1-2**.

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 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 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).

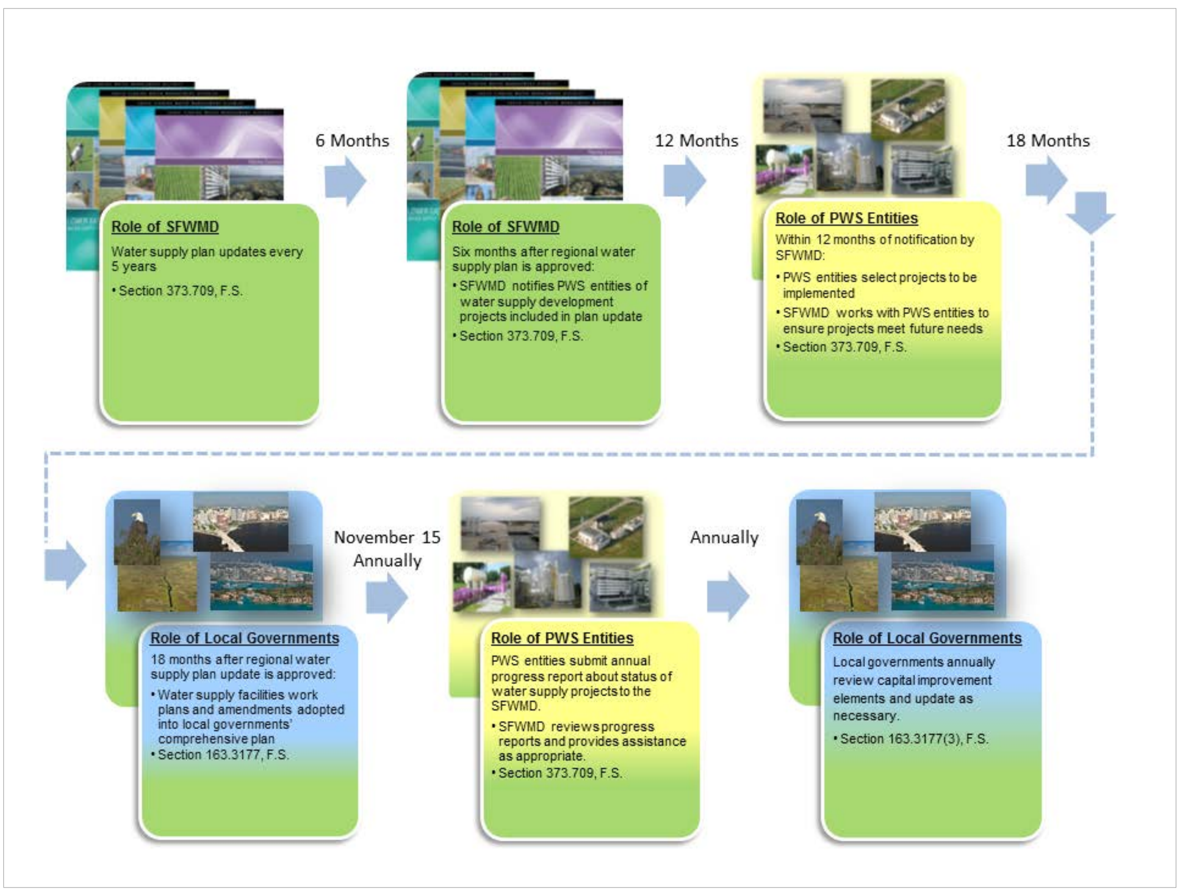


Figure 1-2. Linking regional water supply planning with local government comprehensive planning.

PLAN DEVELOPMENT PROCESS

This 2017 LWC Plan Update describes how anticipated water supply needs will be met in the LWC Planning Area through 2040. The planning process used to develop this plan update is outlined below.

PLAN DEVELOPMENT PROCESS			
1	2	3	4
Planning and Assessment	**Data Collection, Analysis, and Issue Identification**	**Evaluation of Water Resources and Water Source Options**	**Identify 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 Florida Department of Environmental Protection (FDEP), the Florida Department of Agriculture and Consumer Services, and other appropriate state and federal agencies. A review of previous planning efforts in the region and documentation of activities since the approval of the 2012 LWC Plan Update were key starting points.	Using the 2012 LWC Plan Update as a foundation, developing this plan involved collecting the latest information on population, water demands (**Chapter 2**), conservation (**Chapter 3**), water resource protections (**Chapter 4**), water 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**).

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. Public participation for this 2017 LWC Plan Update was conducted through the SFWMD Water Resources Advisory Commission (WRAC). WRAC serves as an advisory body to the District Governing Board and is the primary forum for conducting public workshops, presenting information, and receiving public input on water resource issues affecting Central and South Florida. WRAC members represent environmental, urban, and agricultural interests from each of the District's water supply planning areas.

The SFWMD held three local WRAC Issue Workshops during the water supply planning process. Stakeholders representing a variety of interests in the region—agriculture, industry, environmental protection, utilities, local government planning departments, and state and federal agencies—were invited to attend the workshops. During the workshops, participants reviewed and commented on projected demands and other key elements compiled by the SFWMD.

Individual meetings also were held throughout the planning process with local government planning departments, utilities, other planning agencies, and agricultural industry representatives to discuss water demand projections and coordinate planning processes. Participants reviewed and provided input on water supply issues, the condition of regional water resources, water source options, and other key aspects of the water supply plan update.

PLANNING AREA BACKGROUND

Physical Features

The LWC Planning Area encompasses approximately 5,130 square miles across southwestern Florida, and its elevation ranges from sea level to approximately 65 feet and averages approximately 16 feet above mean sea level. Elevation differences in the region generally are subtle, with low coastal ridges and sloughs being the most common topographic features (**Figure 1-3**). Because of these low-relief elements, water typically flows from north to south and east to west within the LWC Planning Area, with excess surface water runoff ultimately discharging to the coast.

The LWC Planning Area contains nearly 1.8 million acres of wetlands (United States Fish and Wildlife Service 2010). Major features of interest in the LWC Planning Area include the C-43 Canal and Caloosahatchee River Estuary, Lake Okeechobee, Lake Trafford, Corkscrew Regional Ecosystem Watershed (CREW), Big Cypress Swamp, southern Charlotte Harbor, Estero Bay, Naples Bay, Ten Thousand Islands and Rookery Bay, and the Fakahatchee Estuary.

Big Cypress National Preserve

Prior to development, most of the LWC Planning Area was characterized by nearly level, poorly drained lands subject to frequent flooding. With this type of flat terrain, a few vertical feet may have a profound effect on surface water drainage, vegetation, and urbanization settlement patterns. The current landscape is a mosaic of the natural system and human alterations. Most of the coastal portions of Lee and Collier counties have become dominated by urban and suburban land use, as shown in **Figure 1-4**. Much of Charlotte, Glades, and northern Hendry counties are a mix of forested and agricultural land use. Large portions of southeastern Collier and western Monroe counties remain largely undeveloped, and are a mix of wetlands, forests, and upland unforested land.

Much of the surface water system was altered to make the land suitable for agriculture and urban settlement, and to provide flood protection. With an average annual precipitation of 53 inches and nearly 60 percent of the rainfall occurring from May through October, the region depends on the Central and Southern Florida Project (C&SF Project) for flood control and other purposes.

The C&SF Project is a complete system of canals, storage areas, and water control structures spanning from Lake Okeechobee to the east and west coasts of Florida, and from Orlando south to the Everglades. The project was designed and constructed during the 1950s and 1960s by the United States Army Corps of Engineers (USACE) to provide flood control and to improve navigation and recreation. Most of the water bodies within the C&SF Project have specific regulation schedules that are federally mandated by the USACE. In its capacity as the local sponsor, the SFWMD operates and maintains the C&SF Project. Operation of the project includes moving water out of certain water bodies to provide flood protection when stages are above the regulation schedule.

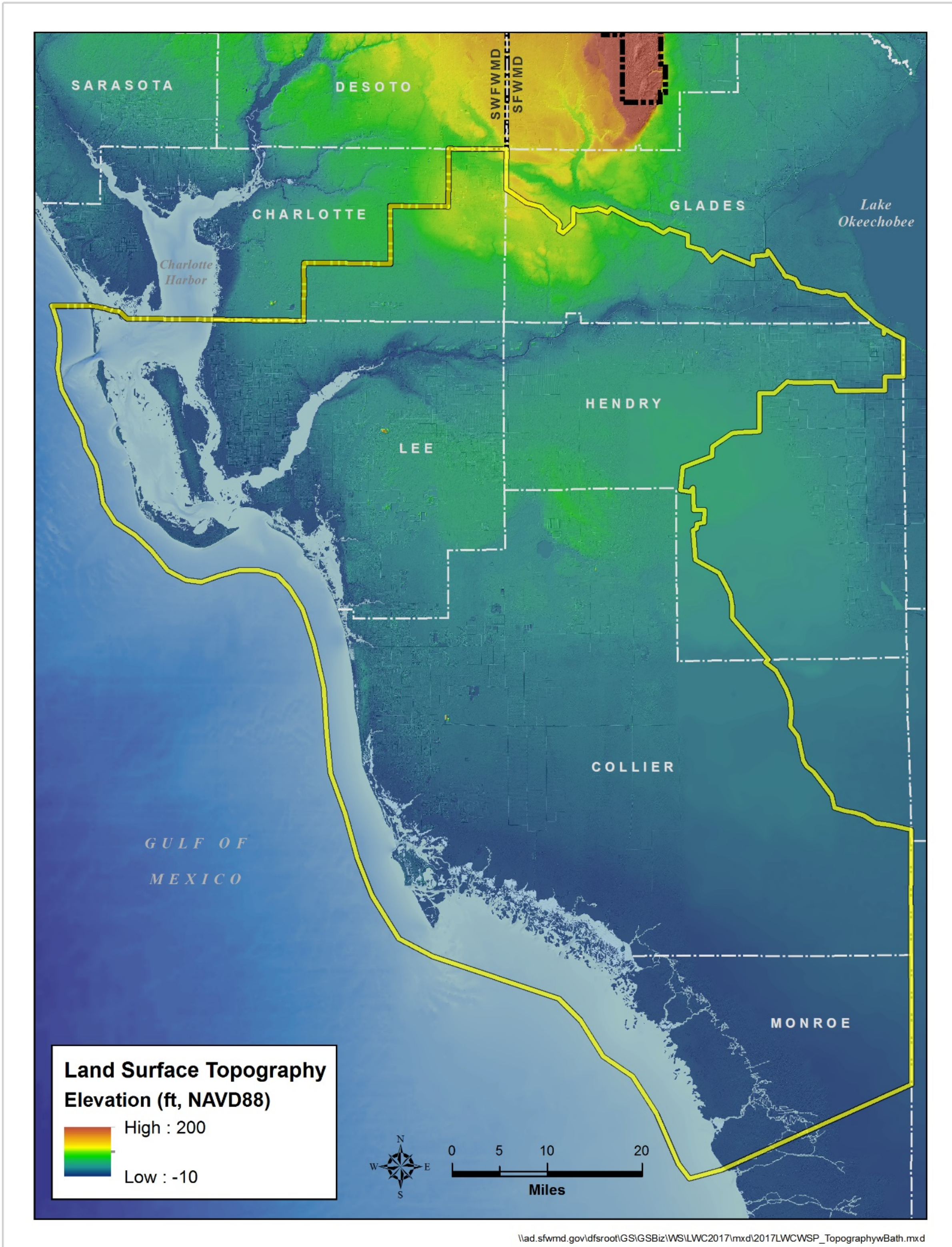


Figure 1-3. Topography of the Lower West Coast Planning Area.

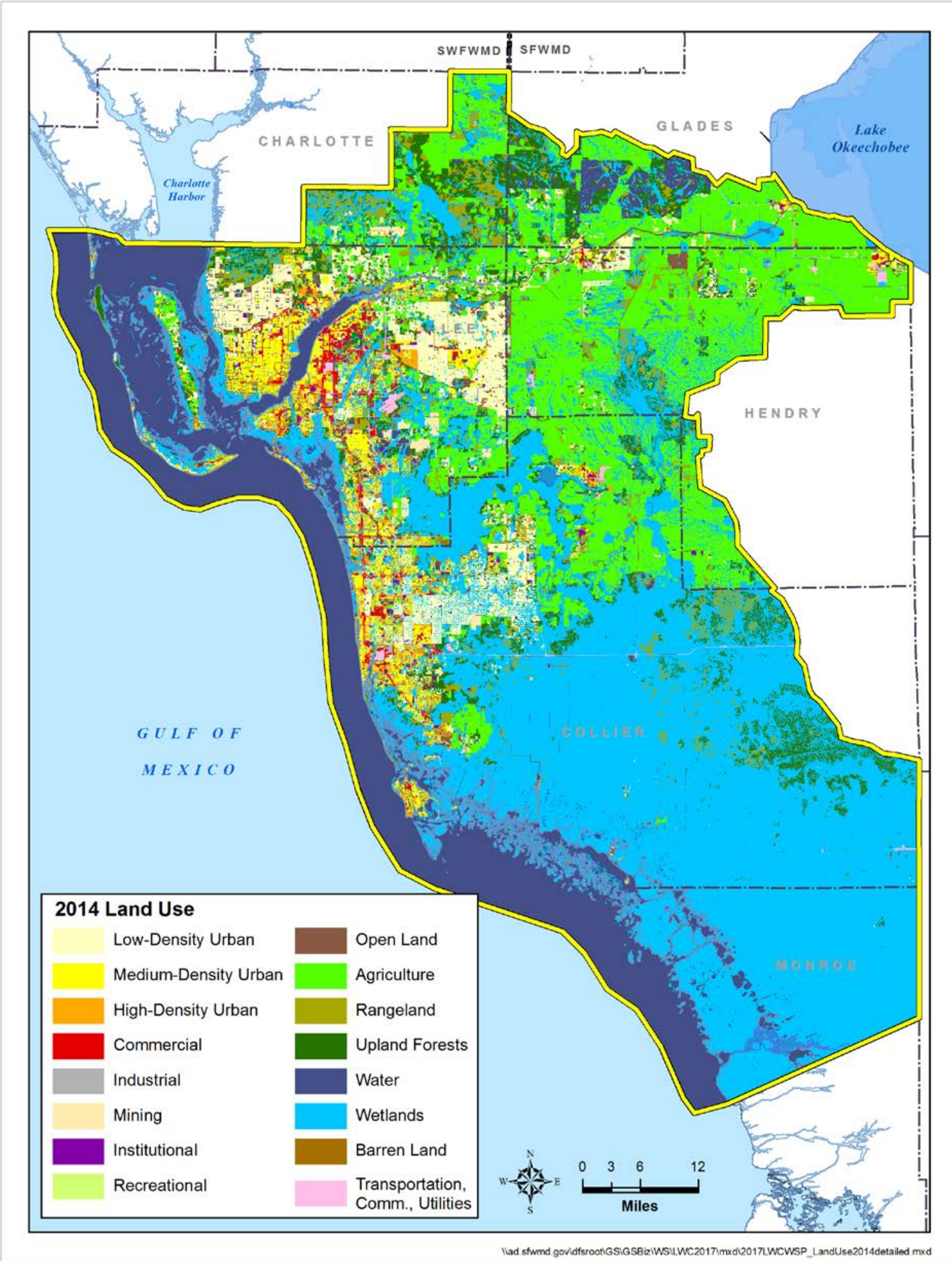


Figure 1-4. Land use in the Lower West Coast Planning Area.

Water Bodies and Landscapes

Lake Okeechobee is one of the largest freshwater lakes in the country, and it provides the majority of surface water storage in South Florida. The lake is east of the LWC Planning Area, but discharges to the Gulf of Mexico via the C-43 Canal and Caloosahatchee River Estuary.

> **NOTE**
>
> The C-43 Canal is defined as the waterway between the S-77 and S-79 water control structures. Waters downstream of the S-79 structure are collectively called the Caloosahatchee River Estuary or Caloosahatchee River.

The Caloosahatchee River is the most important surface water source in the LWC Planning Area. The freshwater portion of the river (C-43 Canal) extends from Lake Okeechobee to the S-79 water control structure (Franklin Lock and Dam). Downstream of the S-79 structure, the river mixes with estuarine water (becoming the Caloosahatchee River Estuary) in San Carlos Bay, forming an important tidal estuary. In addition to inflows from Lake Okeechobee, the Caloosahatchee River Estuary receives runoff from within its own watershed and groundwater inflows. Modifications to the Caloosahatchee River allowed development in the watershed, resulting in a network of local secondary and tertiary canals. This network provides conveyance for drainage, flood control, and irrigation to accommodate agricultural and urban needs.

Lake Trafford is the largest lake south of Lake Okeechobee. The lake is in the central portion of the LWC Planning Area and forms the inland headwaters of the Corkscrew Swamp and Imperial and Cocohatchee river watersheds that drain into the Ten Thousand Islands and Estero Bay estuary systems.

Picayune Strand State Forest is located in the heart of the greater Big Cypress Basin. The forest encompasses two major tracts of land, Belle Meade and Southern Golden Gate Estates.

Big Cypress National Preserve spans approximately 1,125 square miles (720,000 acres). Its fresh waters are essential to the health of the Everglades, support the estuaries along Florida's southwest coast, and flow into the Ten Thousand Islands.

Drainage Basins

The LWC Planning Area is divided into nine major drainage basins according to their respective hydrologic characteristics (**Figure 1-5**):

- North Coastal Basin
- Tidal Caloosahatchee Basin
- Telegraph Swamp Basin
- West and East Caloosahatchee Basins
- Estero Bay Basin
- West Collier Basin
- East Collier Basin
- Everglades Basin

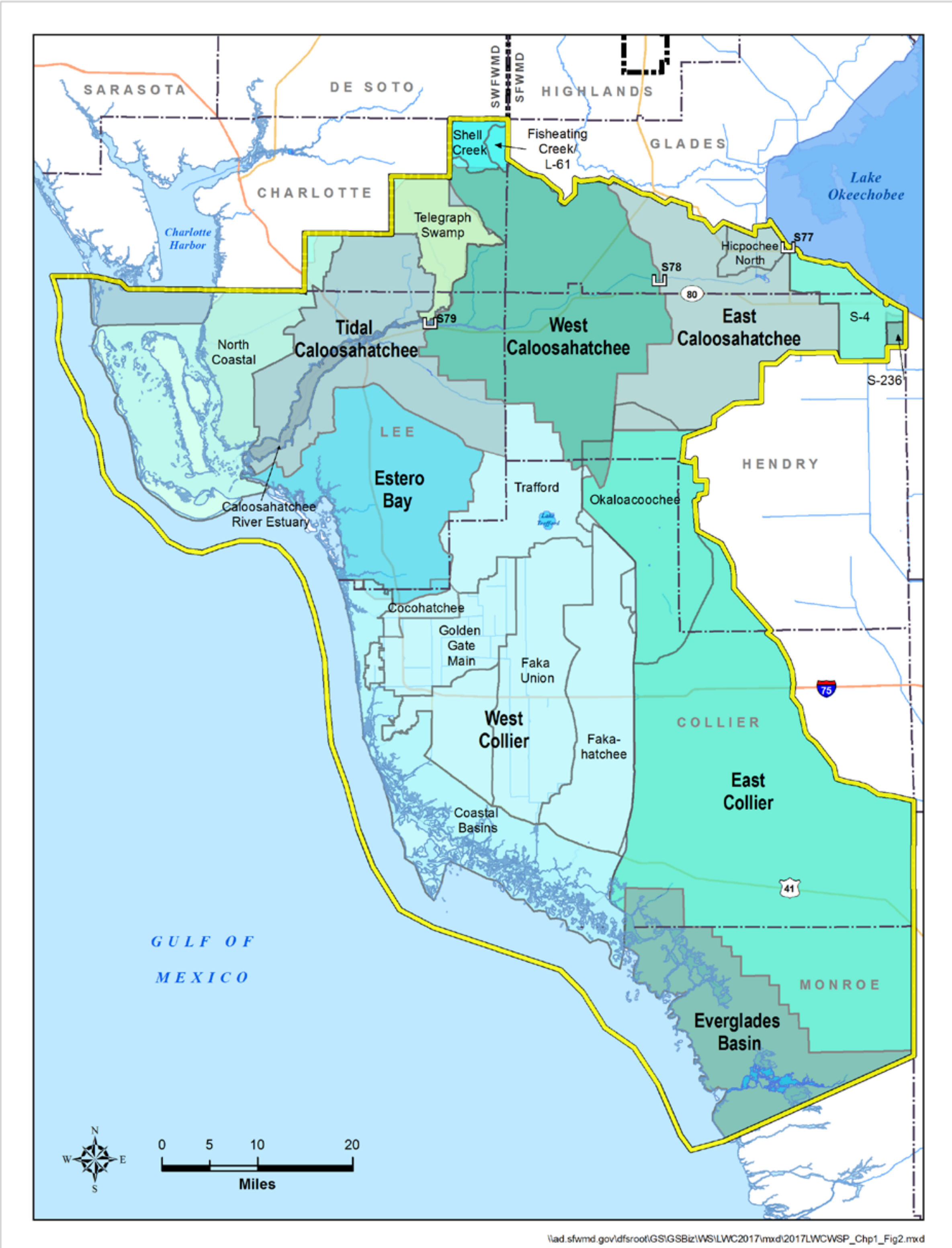


Figure 1-5. Lower West Coast Planning Area drainage basins.

Coastal Ecosystems

Coastal areas of the LWC Planning Area are dominated by large estuarine systems where saline water from the Gulf of Mexico mixes with freshwater inflows from numerous river systems, sloughs, and overland sheetflow. These estuarine areas are characterized by shallow bays, extensive seagrass beds, and sand flats. Undeveloped coastal areas subject to tidal inundation support extensive mangrove forests and salt marsh areas. These brackish water communities were once commonly distributed along the entire southwestern Florida coastline, but now are found in greatest abundance in western Monroe County, southwestern Collier County, and southern Lee County.


Mouth of Caloosahatchee River and San Carlos Bay

WATER RESOURCES OVERVIEW

In the LWC Planning Area, traditional water sources include fresh groundwater from the surficial aquifer system (SAS) and portions of the intermediate aquifer system (IAS) as well as surface water, primarily from the C-43 Canal and connected canals. Alternative water source options include brackish groundwater from portions of the IAS and the FAS, reclaimed water, seawater, and water stored in aquifer storage and recovery (ASR) wells and reservoirs.

Surface Water Resources

Surface water bodies in the LWC Planning Area include rivers and canals that provide storage and conveyance of surface water. The C-43 Canal and Caloosahatchee River Estuary, the region's most important surface water source, extend across three drainage basins in the LWC Planning Area (**Figure 1-5**). The remaining rivers and canals in the LWC Planning Area drain into Estero Bay, the Caloosahatchee River, or the Gulf of Mexico.

Groundwater Resources

Three major aquifer systems—the SAS, IAS, and FAS—lie beneath southwestern Florida and are utilized for water supply. Because hydraulic properties (i.e., ability to yield water to wells) and water quality may vary vertically and horizontally within each aquifer, groundwater supply potential is variable throughout the planning area. **Table 1-1** lists the aquifer systems, hydrogeologic units, and aquifer yields in the LWC Planning Area.

Table 1-1. Groundwater systems in the Lower West Coast Planning Area (From: SFWMD 2014).

Aquifer System	Hydrogeologic Unit	Aquifer Yield				
		Charlotte	Glades	Lee	Hendry	Collier
Surficial	Water Table aquifer	L	L-M	L-M	L-M	M-H
	Lower Tamiami aquifer	A	A-L-M	A-M	A-M-H	H
Intermediate	Sandstone aquifer	A-L	A-L-M	A-L-M	A-L-M	A-L
	Mid-Hawthorn aquifer	L	A-L	L	L	M
Floridan	Upper Floridan aquifer	H	H	H	M-H	M-H
	Avon Park Permeable Zone middle confining unit	L	L	L	L	L
	Lower Floridan aquifer	H	H	M	M	M

A= absent; L = low; M = moderate; H = high.

Surficial Aquifer System

In the LWC Planning Area, the SAS consists of the Water Table aquifer, confining beds, and the Lower Tamiami aquifer. The thickness of the SAS ranges from approximately 200 feet in southwestern Collier County to less than 25 feet in northern Lee County (Reese 2000). The SAS is recharged by precipitation, seepage from canals and other surface water bodies, and upward leakance from the IAS.

Intermediate Aquifer System

The IAS consists of three relatively impermeable confining units as well as the Sandstone and Mid-Hawthorn aquifers underlying the SAS and overlying and confining the FAS. Recharge to the IAS occurs through upward leakance from the FAS and downward leakance from the SAS (Bush and Johnston 1988). In Lee and Hendry counties, the IAS is a source of fresh water. In Collier County, the IAS is brackish and requires desalination to meet drinking water standards.

Floridan Aquifer System

In southwestern Florida, the FAS contains several thin, highly permeable, water-bearing zones, producing brackish water throughout most of the LWC Planning Area. Salinity in the FAS increases from north to south and vertically with depth.

With reverse osmosis (RO) treatment, the Upper Floridan aquifer (UFA) is a principal source of potable water in the region. The UFA also supplies water for some agricultural users, and irrigation water (blended with freshwater sources) for landscape and golf courses in the region.

The lower portion of the Lower Floridan aquifer (LFA) contains a highly transmissive layer known as the Boulder Zone, which is a primary repository for residual brines from RO treatment and for disposal of secondary effluent from wastewater treatment facilities.

Surface Water and Groundwater Relationships

Construction and operation of surface water management systems affect the quantity and distribution of recharge to the SAS. Surface water management systems within the LWC Planning Area function primarily as SAS drains because ambient groundwater levels generally exceed surface water elevations within the region. The Caloosahatchee River Estuary and the Gulf of Mexico act as regional groundwater discharge points. Groundwater seepage represents part of the inflow to the Caloosahatchee River (C-43 Canal). After a rain event, some recharge to the SAS may occur from drainage canals, small lakes and stormwater ponds, Lake Trafford, and low-lying areas.

Surface water management systems also affect aquifer recharge by diverting rainfall from an area before it has time to percolate down to the Water Table aquifer. Once diverted, this water may contribute to aquifer recharge elsewhere in the system, supply downstream users, be lost to evapotranspiration, or be discharged to tide.

PROGRESS SINCE THE 2012 LWC PLAN UPDATE

Since the 2012 LWC Plan Update, the following activities and programs have been enhancing the understanding of the region's water resources, water supply, and natural systems.

Hydrologic Studies and Modeling

- **Hydrogeologic Unit Mapping Update for the LWC Water Supply Planning Area** – The SFWMD updated and refined the understanding of the hydrogeology of the SAS and IAS in the LWC Planning Area by incorporating and synthesizing data from more than 1,000 wells in addition to recent reports and investigations (Geddes et al. 2015). The maps and relationships developed from this work are being used to develop an updated regional groundwater model for the area.
- **Sandstone Aquifer at Lehigh Acres Maximum Developable Limits** – The SFWMD constructed and tested two boreholes to more accurately determine the elevation of the top of the Sandstone aquifer within the Lehigh Acres area to better define the Maximum Developable Limits (McMillan and Anderson 2015).
- **Updated Delineation of the Saltwater Interface in Lee and Collier Counties** – The SFWMD reviewed recent water quality data from Lee and Collier counties, and prepared updated maps of the extent of saltwater intrusion within the SAS and IAS in 2014.
- **Lower West Coast Surficial and Intermediate Aquifer Systems Model –** The SFWMD is developing a peer-reviewed regional MODFLOW model to simulate groundwater conditions in the SAS and IAS. The model is expected to be available by 2018-2019 and will assist in forecasting the impacts of withdrawals on groundwater levels within the LWC Planning Area.
- **West Coast Floridan Model** – The SFWMD is developing a density-dependent groundwater flow and transport model of the FAS covering the west coast of the District. The model will be used to evaluate potential changes to regional conditions of the FAS. The model is anticipated to be available for simulations by 2018-2019.

- **CERP ASR Regional Study** – In 2015, 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".

Regulatory Protection and Water Quality Efforts

- **Chapter 40E-2, F.A.C., Consumptive Use 2013 Rule Update** – A statutory update to establish lower permitting thresholds for the Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers.
- **Chapter 40E-10, F.A.C., Water Reservations 2014 Rule Update** – A statutory update to add the Caloosahatchee River (C-43) West Basin Storage Reservoir to the Water Reservation rule.
- **Caloosahatchee Estuary Basin Management Action Plan (BMAP)** – The Caloosahatchee Estuary BMAP was adopted in December 2012 (Caloosahatchee Estuary Basin Technical Stakeholders and FDEP 2012). The first 5-year iteration (2012 to 2017) is expected to reach approximately 40 percent of the required reductions for total nitrogen based on projects submitted by stakeholders.
- **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 have included the Charlotte Harbor Flatwoods Initiative, the Lehigh Headwaters Initiative, the North Six Mile Cypress Initiative, and the Caloosahatchee Corridor Project. Such watershed initiatives complement larger-scale projects, including the Northern Everglades and Estuaries Protection Program and the Comprehensive Everglades Restoration Plan (CERP).

Water Storage, Construction, and Restoration Projects

- **Herbert Hoover Dike/Lake Okeechobee** – The USACE designated the Herbert Hoover Dike as a Class I risk, the highest risk for dam failure. Construction of a portion of the cutoff wall was completed in 2012. Water control structures (culverts) operated by the USACE are being replaced, removed, or abandoned, with scheduled completion in 2019. Rehabilitation of additional sections of the dike is ongoing and planned for completion by 2025.

Herbert Hoover Dike

- **Picayune Strand** – The Picayune Strand Restoration Project will reestablish natural sheetflow to enhance wetlands and provide more natural freshwater inflow to the Ten Thousand Islands National Wildlife Refuge and Fakahatchee Estuary. Within the past 5 years, construction has been completed on the Merritt Canal and Faka Union pump stations, and Merritt Canal has been plugged. A manatee mitigation feature was constructed in 2016 to provide a warm water location for manatees to congregate during cold weather periods.
- **CERP Caloosahatchee River (C-43) West Basin Storage Reservoir** – Several important milestones for the Caloosahatchee River (C-43) West Basin Storage Reservoir have occurred in the past 5 years, including federal authorization of the project under the 2014 Water Resources Reform and Development Act. Construction of the project began in 2016 and is expected to be completed in 2022.
- **C-43 Water Quality Treatment Feature** – The SFWMD currently is conducting a bioassay study for use in larger-scale mesocosms designed to reduce nitrogen within the Caloosahatchee River Estuary. Pending confirmation of additional funding, the design, construction, and operation of mesocosms are planned to occur through 2018.
- **Lake Trafford Restoration** – This project removed muck build-up from the lake bottom and nearshore areas in 2010. In 2014 and 2015, submerged aquatic vegetation mapping and plantings were performed by the SFWMD. An accurate watershed boundary and delineation of the flow network for Lake Trafford are under development, which will be used to create a watershed management plan.
- **Southern CREW** – The State of Florida and SFWMD have partnered with other government agencies and conservation organizations to acquire 45,000 acres of the vast CREW. The Southern CREW project will improve or restore the hydrology and ecology of approximately 2,280 acres of wetlands, with resulting benefits to upstream and downstream lands. The final project design and permitting was completed in 2013; construction began in 2016 and is expected to be completed by 2018.
- **Lake Hicpochee Hydrologic Enhancement Project** – In 2014, the SFWMD acquired approximately 715 acres of land for a shallow storage feature north of Lake Hicpochee to store and deliver water to the lakebed. The project will capture surface water from the C-19 Canal, then store the water before distributing it (via spreader canal) to the northwestern area of Lake Hicpochee. Construction of the project began in 2016 and is anticipated to be complete by 2019.

Cooperative Funding Program

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 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 contribute to water supply planning. More information on the Cooperative Funding Program can be found in **Chapter 8**.

- **Alternative Water Supply** – From Fiscal Year (FY) 2012 through FY2017, the SFWMD provided alternative water supply project funding for 19 projects that were completed or are under construction in the LWC Planning Area, generating 18.3 million gallons per day (mgd) of additional water capacity.

- **Water Conservation** – From FY2012 through FY2017, the SFWMD provided funding for seven water conservation projects that were completed or are being implemented in the LWC Planning Area. The projects are estimated to save 67.9 million gallons per year.

Big Cypress Basin Initiatives

The Big Cypress Basin Board operates and maintains a network of 153 miles of primary canals, 45 water control structures, and 3 dry season recharge pumps in Collier County (**Figure 1-6**). Big Cypress Basin facilities are operated in coordination with local governments.

Paramount to protection and restoration efforts is the implementation of the Collier County Watershed Management Plan, completed in 2011. Developed in cooperation with local municipalities, the plan sets the framework for enhancement of freshwater and coastal systems through the implementation of stormwater, flood control, and habitat restoration projects. Key elements of the plan include the Northern Golden Gate Estates Flow-way, North Belle Meade Rehydration, and Henderson Creek Diversion projects, which will improve the quality, quantity, timing, and distribution of water delivered to Naples Bay and Rookery Bay. Protection of Naples Bay has been a collective priority of all regional stakeholders.

The recently completed restoration of Lake Trafford was authorized as a Critical Restoration Project under the Water Resources Development Act of 1996. The Big Cypress Basin Board funded the project as the local sponsor with support from the State of Florida and Collier County.

Within the past 5 years, the Big Cypress Basin Board has provided more than $5 million to PWS utilities to improve and expand alternative water supplies throughout Collier County. Projects have included construction of ASR systems for Collier County and the City of Naples, reclaimed water system expansion at Marco Island, improvements at the Everglades City water treatment plant, and an RO system expansion at Collier County Water-Sewer District.

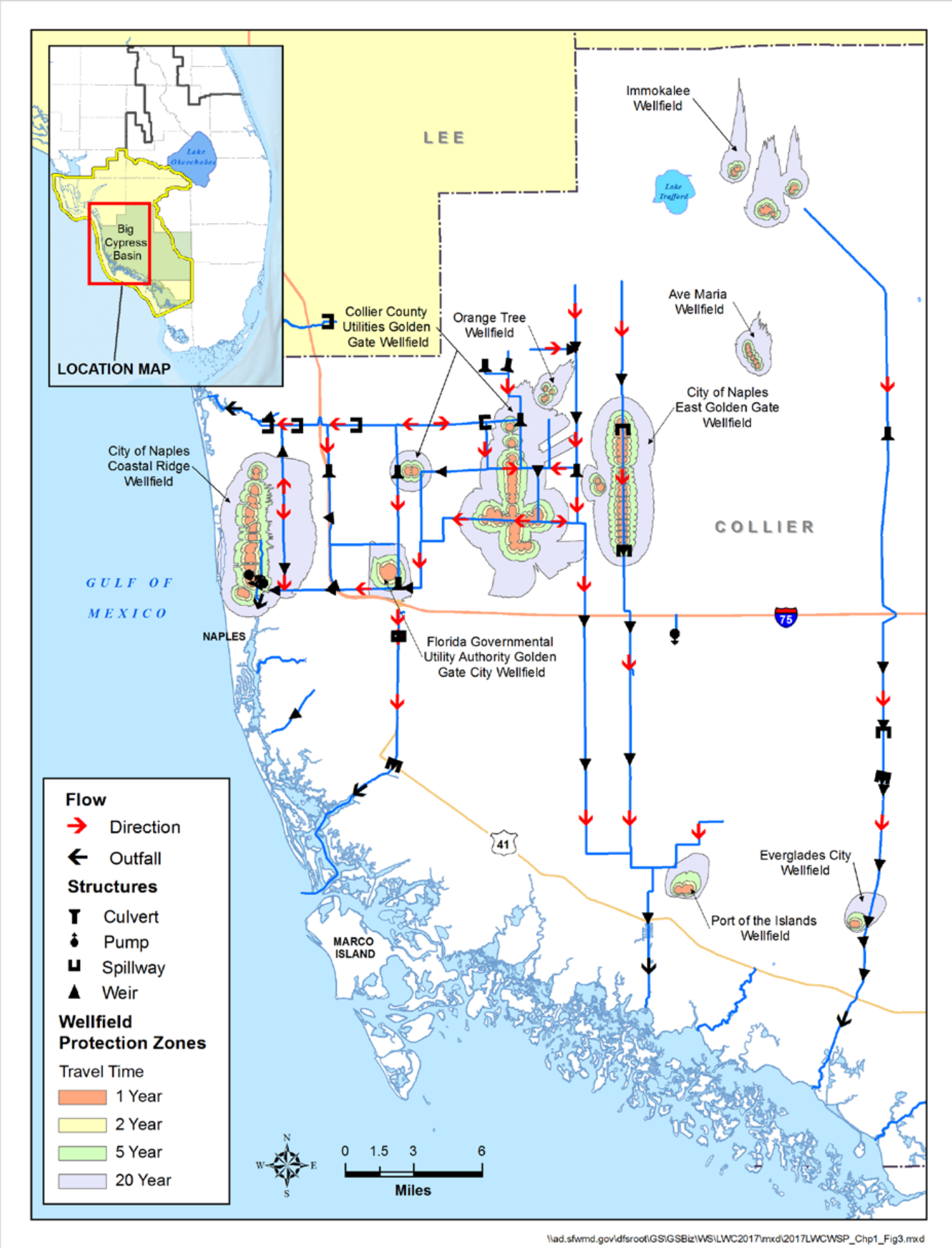


Figure 1-6. Big Cypress Basin canals, water control structures, and surficial aquifer system wellfields.

OUTLOOK ON CLIMATE CHANGE

Numerous peer-reviewed articles suggest future changes in climate patterns and associated effects such as accelerating sea level rise and increasing temperature. South Florida is particularly vulnerable to the effects of 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. Understanding the implications of such a dynamic environment on water resources is critical to water supply planning and management. The SFWMD's current approach is not to investigate causes of potential changes in climate, but rather investigate how to respond if climate change is occurring or expected in the future.

The SFWMD has investigated the potential implications of climate change and sea level rise on its mission elements, including water supply (www.sfwmd.gov; Search: Climate Change). Sea level rise may push saltwater farther inland within the SAS and threaten the water quality of coastal wellfields. While water availability from the SAS is limited in the LWC Planning Area, it is an important source for many PWS utilities. Projected increases of warmer air temperatures could cause elevated rates of evapotranspiration, escalating irrigation demands by agricultural and urban users. Climate models suggest that the magnitude of future changes in rainfall patterns are more difficult to determine. However, any reduction in average rainfall may have water supply implications. Changes in effective rainfall may create a need for new or expanded water storage projects to meet seasonal demands.

Future analyses of climate change implications for water supply generally will be performed in the context of flood control, environmental protection and restoration, and water quality using the best available science at the time.

REFERENCES

Bush, P.W. and R.H. Johnston. 1988. *Ground water hydraulics, regional flow, and ground water development of the Floridan aquifer system in Florida and in parts of Georgia, South Carolina, and Alabama*. Professional Paper 1403-C. U.S. Geological Survey, Tallahassee, FL.

Caloosahatchee Estuary Basin Technical Stakeholders and FDEP. 2012. *Final Basin Management Action Plan for the Implementation of Total Maximum Daily Loads for Nutrients in the Caloosahatchee Estuary Basin*. Adopted by the Florida Department of Environmental Protection, Tallahassee, FL. December 2012.

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.

Geddes, E., E. Richardson, and A. Dodd. 2015. *Hydrogeologic Unit Mapping Update for the Lower West Coast Water Supply Planning Area*. Technical Publication WS-35. South Florida Water Management District, West Palm Beach, FL.

McMillan, C. and S. Anderson. 2015. *Sandstone Aquifer at Lehigh Acres Maximum Developable Limits*. Technical Publication WS-38. South Florida Water Management District, West Palm Beach, FL.

National Research Council. 2015. Review of the Everglades Aquifer Storage and Recovery Regional Study. National Research Council of the National Academies. The National Academy Press. Washington, D.C.

Reese, R.S. 2000. *Hydrogeology and the distribution of salinity in the Floridan aquifer system, southwestern Florida*. Water Resources Investigations Report 98-4253. U.S. Geological Survey, Tallahassee, FL.

SFWMD. 2012. *2012 Lower West Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2014. *2011-2014 Water Supply Plan Support Document*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2016. *2016 Water Supply Plan Support Document*. South Florida Water Management District, West Palm Beach, FL.

United States Fish and Wildlife Service. 2010. *National Wetlands Inventory*. National Wetlands Inventory Program, Branch of Resource and Mapping Support, United States Fish and Wildlife Service, Washington, D.C.

USACE and SFWMD. 2015. *Central and Southern Florida Project Comprehensive Everglades Restoration Plan Final Technical Data Report of the Aquifer Storage and Recover Regional Study*. United States Army Corps of Engineers, Jacksonville, FL and South Florida Water Management District, West Palm Beach, FL. May 2015.

2

Demand Estimates and Projections

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

This chapter summarizes the water demand estimates and projections for the South Florida Water Management District (SFWMD or District) Lower West Coast (LWC) Planning Area. Estimates and projections are presented by water use category for the planning period of 2014 through 2040. Water demand projections were developed through coordination with stakeholders from agriculture, utilities, industry, local governments, and other interested groups. A detailed discussion of data collection and analysis methods can be found in **Appendix B**.

The most recent set of estimates and projections for the LWC Planning Area were published in the *2012 Lower West Coast Water Supply Plan Update* (SFWMD 2012). Since then, the region has been recovering from the 2008-2012 economic downturn. The job markets in Lee and Collier counties are some of the fastest growing in the country (Badenhausen 2016). The regional population has increased as well, with Collier and Lee counties among the top 10 fastest growing counties in the United States (United States Census Bureau 2016). Development patterns include the expansion of residential and commercial areas, little to no golf course construction projects, rising property values, and increasing pressure on undeveloped areas as a result of eastern housing expansion from the Gulf Coast. This pace of population growth and economic expansion is projected to continue through 2040, placing greater demands on water resources. In Hendry County, the approved Rodina and Southwest Hendry County Sector Plans allow for development of more than 43,000 residential units within the next 50 years (Sector Plans are discussed further in **Appendix A**).

Water demands in the LWC Planning Area are driven by population and agriculture. Over the last two decades, the region's population continues to increase while the per capita use rate continues to decline; these have broad impacts on water demand. Total irrigated agriculture in the LWC Planning Area is anticipated to increase slightly due to expansion of fresh market vegetable acreage. There is uncertainty in agricultural projections due to citrus acreage decline resulting from disease. In general, fallow citrus land is still used for agriculture.

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.

Demands under Average Rainfall and 1-in-10 Year Drought Conditions

Projections are based on demand under average annual rainfall conditions through 2040. In addition, because water use is impacted by weather, particularly rainfall, Section 373.709, Florida Statutes (F.S.), states that the level-of-certainty planning goal associated with identifying water demands shall be based on meeting demands during 1-in-10 year drought conditions. Therefore, this *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update) presents demands during average rainfall and 1-in-10 year drought conditions (see **Appendix B**) through the 2040 planning horizon. Although not quantified in this chapter, environmental demands are addressed through resource protection criteria (**Chapter 4**).

> NOTE
>
> **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 over a 12-month period.
>
> A **1-in-10 year drought** is a drought of such intensity that it is expected to have a return frequency of once in 10 years.

WATER USE CATEGORIES

Water demands for this 2017 LWC Plan Update are estimated in 5-year increments for the following six water use categories established by the Florida Department of Environmental Protection:

- **Public Water Supply (PWS)** – Potable water supplied by water treatment plants with projected average pumpage of 0.1 million gallons per day (mgd) or greater.
- **Domestic and Small Public Supply (DSS)** – Potable water used by households served by small utilities (less than 0.1 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 water used for irrigation of 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 water used by power generation facilities, excluding the use of seawater.

Figure 2-1 compares estimated (2014) and projected (2040) average gross water use, by category, in the LWC Planning Area. The largest water use category is AGR, followed by REC and PWS. The demand estimates and projections reflect a rapidly growing regional population and a moderately increasing agricultural sector, primarily due to expansion of fresh market vegetable production.

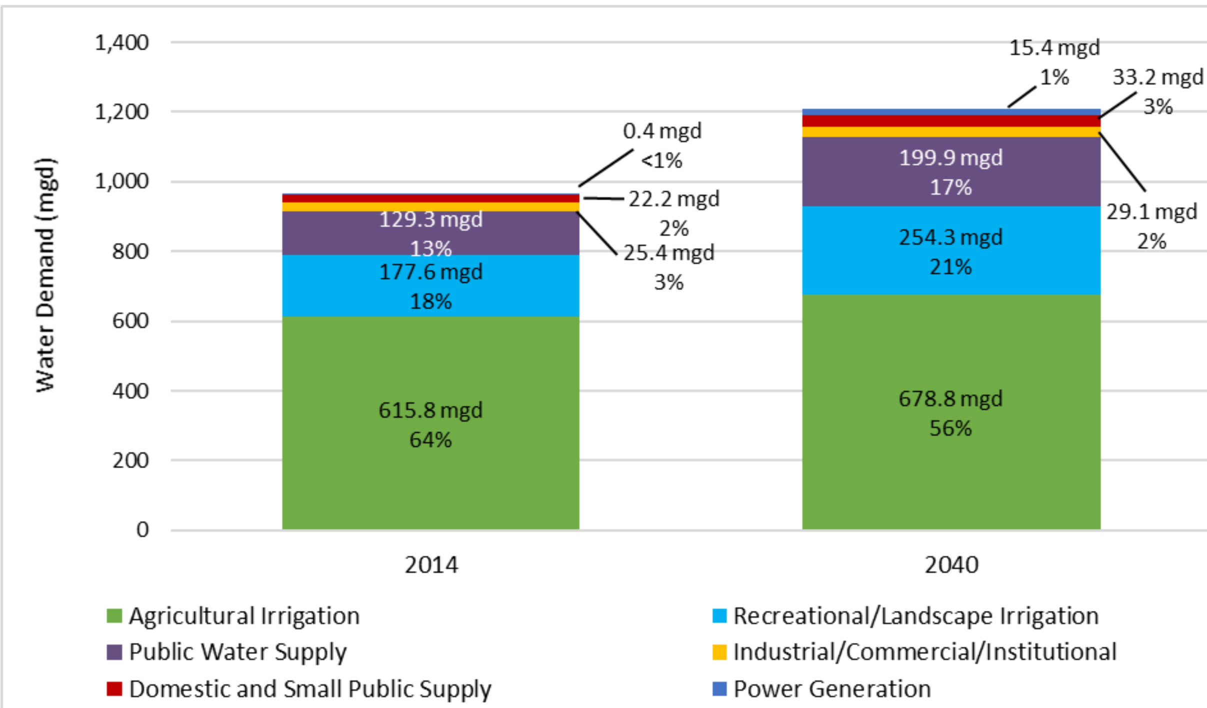


Figure 2-1. Estimated (2014) and projected (2040) gross water demands and relative percent of total demands for the Lower West Coast Planning Area.

PUBLIC WATER SUPPLY AND DOMESTIC AND SMALL PUBLIC SUPPLY

The PWS category includes potable water supplied by water treatment plants with projected average pumpage greater than 0.1 mgd, while the DSS category includes potable water used by households served by small utilities (less than 0.1 mgd) or self-supplied by private wells. Developing PWS and DSS water demand projections in the LWC Planning Area was a multistep process, which is summarized here; further details can be found in **Appendix B**. The first step was determining the current (2014) and future (2040) service areas of the region's PWS utilities through coordination between SFWMD and utility staff. The next step was determining and applying population data from the 2010 United States Census (United States Census Bureau 2012) and University of Florida's Bureau of Economic and Business Research (BEBR) 2014 estimates (Rayer and Wang 2015) to each utility service area. Projections from the 2014 population were made using additional data, including BEBR county-level population projections and 2040 projections published by local metropolitan planning organizations.

Using the 2014 service area maps and applying medium BEBR county-level 2014 population estimates, 2014 population estimates were developed for each PWS utility. To develop the 2040 population projections, information such as anticipated growth and build outs within each utility service area was collected. Information from local government Comprehensive Plans and Sector Plans (**Appendix A**) was considered as well. Using the 2040 medium BEBR population for each county, the 2014 population estimates for each utility, and the collected growth information, preliminary 2040 population projections were developed for each PWS utility. The projections were discussed with the utilities to ensure accuracy and coordinate final 2040 projections (**Figure 2-2**).

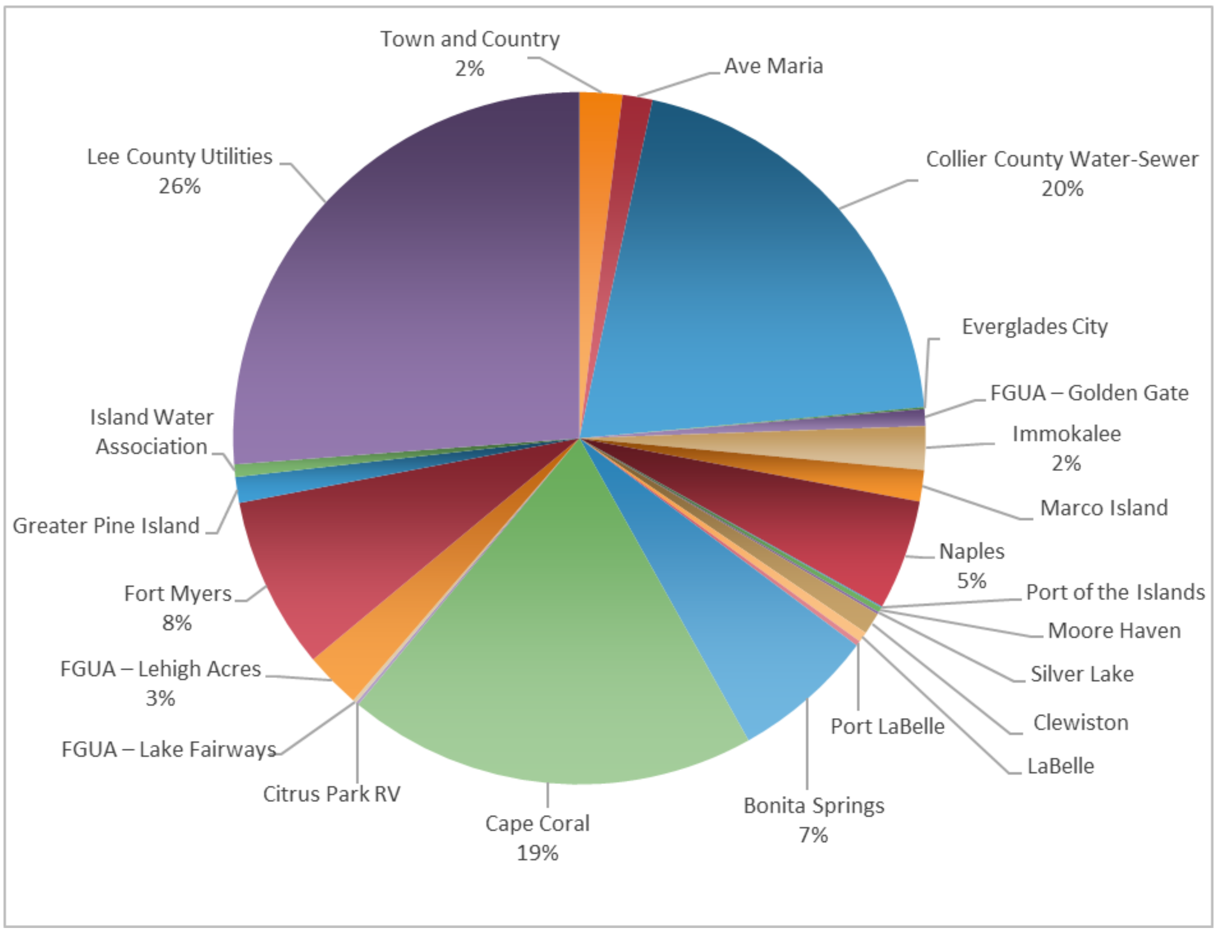


Figure 2-2. Projected (2040) population estimates within each Public Water Supply utility's service area in the Lower West Coast Planning Area. (Note: Utility labels without a percentage are 1 percent or less.)

DSS populations represent the difference between the total county population (within the planning area) and the PWS utility service area population for the same county. In accordance with Section 373.709, F.S., medium BEBR estimates and projections were used for county populations (and the resulting PWS and DSS calculations). All population estimates and projections are for permanent residents. **Appendix B** discusses the effects of seasonal residents on per capita use rates.

In 2014, the total estimated population within the LWC Planning Area was approximately 1 million permanent residents, with more than 96 percent living within Lee and Collier counties (**Table 2-1**). Based on medium BEBR estimates, population growth is expected to continue in Lee and Collier counties. By 2040, Lee County alone is projected to have more than 1 million permanent residents, and the total population within the LWC Planning Area is projected to increase approximately 60 percent, to more than 1.6 million permanent residents.

Table 2-1. Permanent resident population served by PWS and DSS in the LWC Planning Area in 2014 and 2040 (projected).

County	2014 Population			2040 Projected Population		
	PWS	DSS	**Total**	PWS	DSS	**Total**
Charlotte*	72	1,968	**2,040**	26,500	2,152	**28,652**
Collier	289,738	47,045	**336,783**	414,393	72,865	**487,258**
Glades*	4,252	4,610	**8,862**	4,606	6,102	**10,708**
Hendry*	23,297	10,641	**33,938**	23,029	13,028	**36,057**
Lee	512,504	137,797	**650,301**	862,127	207,366	**1,069,493**
Total	**829,863**	**202,061**	**1,031,924**	**1,330,655**	**301,513**	**1,632,168**

DSS = Domestic and Small Public Supply; LWC = Lower West Coast; PWS = Public Water Supply.
* Populations listed for Charlotte, Glades, and Hendry counties are only for the areas within the Lower West Coast Planning Area boundaries.

Net (finished) water per capita use rates (PCURs) were developed for each utility using historic water use information and estimated service area populations. PCURs were assumed to remain constant through 2040. The PCURs were applied to population projections to develop future PWS net (finished) water demands for each utility. To calculate gross (raw) demands, the corresponding treatment efficiency for each utility based on treatment process type(s) were applied as a raw-to-finished ratio to net (finished) demands. The PCURs for DSS were based on countywide weighted average PCURs for PWS. Water conservation measures were not factored into the demand projections used in this plan update; instead, water conservation is discussed as a demand management strategy in **Chapter 3**.

Table 2-2 presents the estimated (2014) and projected (2040) PWS and DSS gross (raw) water demands by county. **Table 2-3** lists the estimated (2014) and projected (2040) PWS and DSS net (finished) water demands by county. Similar to the results for population, Lee and Collier counties account for more than 95 percent of the PWS and DSS gross (raw) and net (finished) water demand through 2040.

Table 2-2. Average gross (raw) water demands (in mgd) for PWS and DSS in the LWC Planning Area between 2014 and 2040.

County	Water Use Category	2014	2020	2025	2030	2035	2040
Charlotte*	PWS	0.01	0.64	1.28	1.91	2.55	3.18
	DSS	0.18	0.17	0.17	0.18	0.18	0.18
Charlotte County Total		**0.18**	**0.81**	**1.45**	**2.09**	**2.73**	**3.36**
Collier	PWS	55.40	61.73	66.21	70.32	74.06	77.70
	DSS	6.07	6.92	7.60	8.23	8.82	9.40
Collier County Total		**61.47**	**68.65**	**73.80**	**78.55**	**82.88**	**87.10**
Glades*	PWS	0.80	0.82	0.84	0.85	0.85	0.86
	DSS	0.49	0.53	0.56	0.59	0.62	0.65
Glades County Total		**1.29**	**1.35**	**1.40**	**1.44**	**1.47**	**1.50**
Hendry*	PWS	3.17	3.19	3.19	3.18	3.16	3.13
	DSS	1.13	1.19	1.25	1.30	1.34	1.38
Hendry County Total		**4.30**	**4.38**	**4.44**	**4.47**	**4.50**	**4.51**
Lee	PWS	69.94	81.17	90.57	99.44	107.52	115.01
	DSS	14.33	16.18	17.71	19.14	20.41	21.57
Lee County Total		**84.27**	**97.35**	**108.28**	**118.57**	**127.92**	**136.58**
LWC Planning Area PWS Total		**129.33**	**147.55**	**162.08**	**175.69**	**188.14**	**199.88**
LWC Planning Area DSS Total		**22.18**	**24.99**	**27.29**	**29.43**	**31.37**	**33.18**
LWC Planning Area Total		**151.51**	**172.55**	**189.37**	**205.12**	**219.50**	**233.06**

DSS = Domestic and Small Public Supply; LWC = Lower West Coast; mgd = million gallons per day; PWS = Public Water Supply.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

Table 2-3. Average net (finished) water demands (in mgd) for PWS and DSS in the LWC Planning Area between 2014 and 2040.

County	Water Use Category	2014	2020	2025	2030	2035	2040
Charlotte*	PWS	0.01	0.54	1.06	1.59	2.12	2.65
	DSS	0.17	0.17	0.17	0.18	0.18	0.18
Charlotte County Total		**0.17**	**0.71**	**1.24**	**1.77**	**2.30**	**2.83**
Collier	PWS	48.14	53.55	57.40	60.92	64.13	67.24
	DSS	6.07	6.92	7.60	8.23	8.82	9.40
Collier County Total		**54.21**	**60.48**	**64.99**	**69.15**	**72.95**	**76.64**
Glades*	PWS	0.60	0.62	0.63	0.63	0.64	0.64
	DSS	0.49	0.53	0.56	0.59	0.62	0.65
Glades County Total		**1.09**	**1.15**	**1.19**	**1.23**	**1.26**	**1.29**
Hendry*	PWS	2.36	2.37	2.37	2.36	2.35	2.33
	DSS	1.13	1.19	1.25	1.30	1.34	1.38
Hendry County Total		**3.49**	**3.56**	**3.62**	**3.66**	**3.69**	**3.71**
Lee	PWS	55.97	64.94	72.44	79.52	85.97	91.96
	DSS	14.33	16.18	17.71	19.14	20.41	21.57
Lee County Total		**70.30**	**81.12**	**90.15**	**98.66**	**106.38**	**113.52**
LWC Planning Area PWS Total		**107.08**	**122.01**	**133.90**	**145.03**	**155.21**	**164.82**
LWC Planning Area DSS Total		**22.18**	**24.99**	**27.29**	**29.43**	**31.37**	**33.18**
LWC Planning Area Total		**129.26**	**147.01**	**161.19**	**174.46**	**186.57**	**197.99**

DSS = Domestic and Small Public Supply; LWC = Lower West Coast; mgd = million gallons per day; PWS = Public Water Supply.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

AGRICULTURAL IRRIGATION

The AGR category represents self-supplied water used for commercial crop irrigation, nurseries, greenhouses, livestock watering, pasture, and aquaculture. AGR is the largest water use category in the LWC Planning Area, accounting for 616 mgd (63 percent) of total water use in the region in 2014. More than 306,000 acres are dedicated to agricultural production in the LWC Planning Area. Large areas of Hendry, Collier, and Glades counties are dedicated to citrus, sugarcane, and fresh market vegetable cultivation. Some key highlights of the region's agricultural production include the following:

- Agricultural operations in the LWC Planning Area produced more than 30 million boxes of citrus during the 2014-2015 growing season, approximately 27 percent of the Florida harvest and 15 percent of the national harvest (United States Department of Agriculture – National Agricultural Statistics Service [USDA-NASS] 2016).
- Approximately 15 percent of Florida's sugarcane acreage is within the LWC Planning Area. Statewide, sugarcane was valued at more than $500 million in 2013 (Florida Department of Agriculture and Consumer Services [FDACS] 2016).
- In 2014, the crop and livestock production industry directly provided 15,423 full and part-time jobs and $1.2 billion of revenue within the LWC Planning Area. Lee and Collier counties alone accounted for 8,480 jobs and $518 million of revenue (Hodges and Rahmani 2016).

INFO ⓘ

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

Fresh Market Vegetables:
- Cucumbers
- Green beans
- Leafy greens
- Peppers
- Tomatoes
- Watermelons

Fruits (Non-Citrus):
- Blueberries
- Mangos

Field Crops:
- Corn
- Corn silage

Agricultural acreage data published by FDACS were used to estimate agricultural water demands for this 2017 LWC 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." For a detailed description of the analyses and adjustments, please see **Appendix B**. Agricultural irrigated acres are projected to remain relatively stable, increasing approximately 10 percent by 2040, primarily due to increases in fresh market vegetable production (**Figure 2-3**).

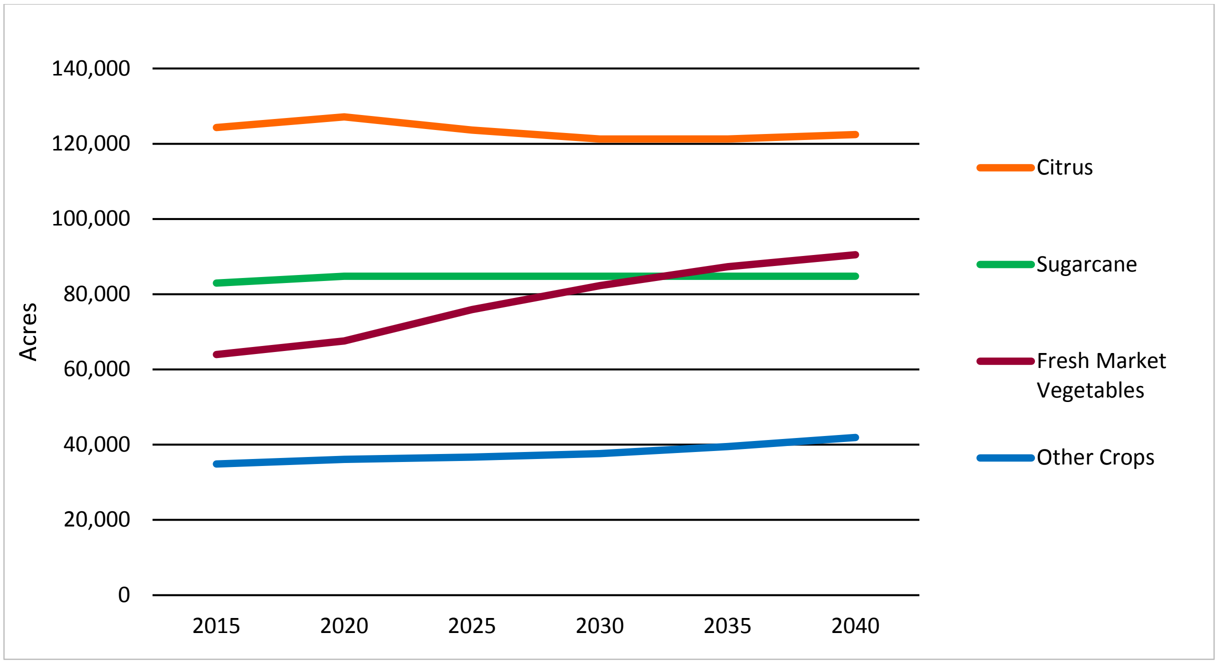


Figure 2-3. Projected growth of irrigated acreage for key crop types in the Lower West Coast Planning Area.

Agricultural water demand was determined using the Agricultural Field Scale Irrigation Requirements Simulation (AFSIRS) model, which incorporates estimated irrigated acreage, crop and soil types, growing seasons, and irrigation methods. Agricultural demand estimates and projections are based on the commercially grown crop categories in **Table 2-4** as generally developed by the Florida Department of Environmental Protection for use in water supply plans.

Table 2-4. Estimated agricultural irrigated acres and water demands (in mgd), by crop type, in the LWC Planning Area for 2014 and 2040 (projected).

Crop Type	2014		2040	
	Acres	Demand	Acres	Demand
Citrus	124,319	195.74	122,473	194.88
Sugarcane	82,959	210.04	84,775	214.18
Fresh Market Vegetables	63,967	130.02	90,488	174.49
Sod	5,904	16.21	5,987	16.53
Greenhouse/Nursery	3,920	9.59	4,246	10.41
Field Crops	1,599	3.90	3,922	8.82
Fruit (Non-Citrus)	389	0.52	446	0.62
Potatoes	1,186	2.56	905	1.97
Pasture/Hay	21,876	45.97	26,406	55.73
Livestock	--	1.20	--	1.20
Total	**306,119**	**615.75**	**339,648**	**678.83**

LWC = Lower West Coast; mgd = million gallons per day.
-- Livestock demand is based on animal population, not acreage.

Agricultural acreage and associated water demand estimates are challenging to project because of changes in land use patterns, economic development such as the pace of recovery in the housing market, global commodity forces, conversion to other crops, weather, and diseases (e.g., citrus greening, canker) that can impact acreage and production through 2040.

While sugarcane accounts for the largest portion of AGR water demand, citrus is the dominant crop in terms of acres in the LWC Planning Area, covering more than 124,000 acres in 2014 (**Table 2-4**). More than half of that acreage is in Hendry County, followed by Collier and Lee counties (**Appendix B**). Successive freeze events in the mid-1980s caused a dramatic statewide decline in citrus acreage (**Figure 2-4**) (Florida Citrus Mutual 2012). However, citrus acreage in the LWC Planning Area expanded into the 1990s. For the last two decades, the statewide citrus industry has been declining throughout Florida, largely due to citrus greening disease and citrus canker. Statewide harvest estimates continue to set historical lows. Research into controlling citrus greening disease is ongoing.

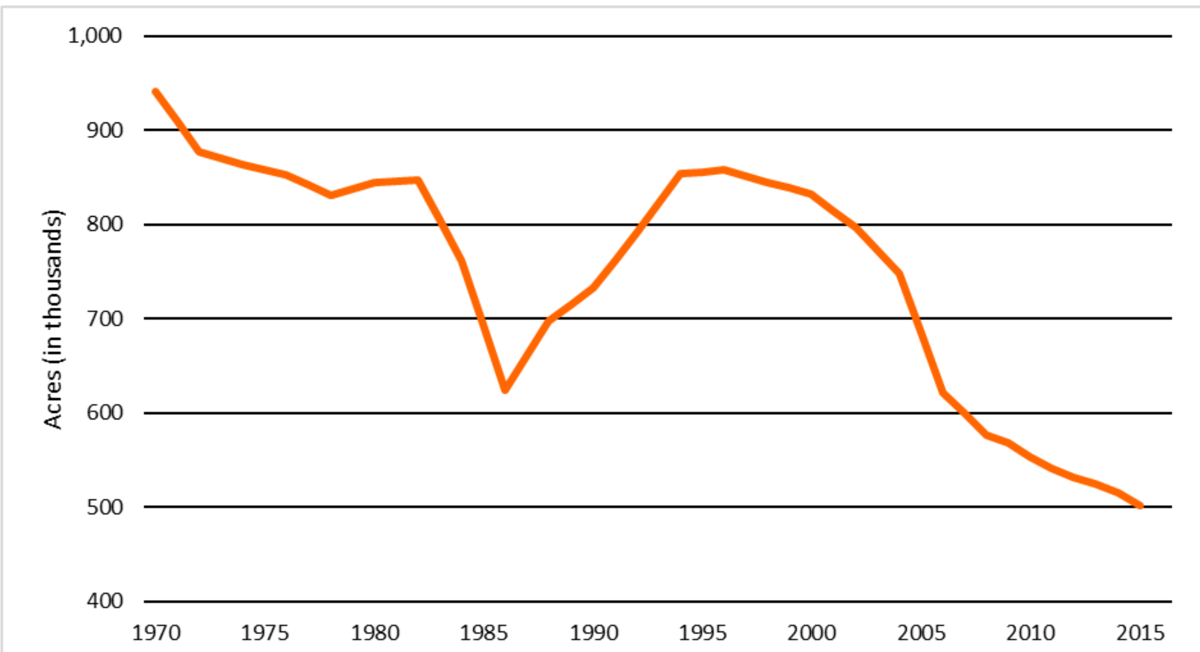


Figure 2-4. Historic statewide citrus acreage between 1970 and 2015 (Data from: USDA-NASS 2016).

Some fallow citrus lands are being temporarily converted to other crops and uses. Exchanging citrus for other crops could affect water demand in several ways. Many types of fresh market vegetables as well as sugarcane have a higher net irrigation requirement than citrus.

Little change is anticipated in AGR water demands for nearly all crops within the LWC Planning Area. However, fresh market vegetable water demands are projected to increase approximately 45 mgd by 2040. Overall, LWC Planning Area total gross water demands under average rainfall conditions for AGR are estimated to increase approximately 10 percent, from 616 mgd in 2014 to 679 mgd in 2040 (**Table 2-5**).

Table 2-5. Average gross water demands for the AGR use category in the LWC Planning Area between 2014 and 2040.

County	Average Gross Water Demand (mgd)					
	2014	2020	2025	2030	2035	2040
Charlotte*	34.33	35.77	36.63	37.56	39.39	41.26
Collier	146.84	145.10	143.77	143.66	143.16	142.28
Glades*	111.52	122.96	130.67	137.04	145.22	153.91
Hendry*	280.69	288.96	292.39	293.93	297.86	302.15
Lee	42.38	42.13	41.19	40.82	40.29	39.24
Total	**615.75**	**634.93**	**644.66**	**653.01**	**665.92**	**678.83**

AGR = Agricultural Irrigation; LWC = Lower West Coast; mgd = million gallons per day.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

RECREATIONAL/LANDSCAPE IRRIGATION

REC is the second largest water use category in the LWC Planning Area. REC water demands include irrigation for golf courses and other landscaped areas such as parks, sports fields, cemeteries, and homeowners' association common areas. Some of these demands are met with reclaimed water (see **Appendix B** for further information). REC demands supplied by PWS utilities are included in the PWS estimates.

Golf Irrigation

The LWC Planning Area has approximately 150 golf courses within its boundaries. In 2013, the National Golf Foundation nationally ranked Collier and Lee counties first and seventh, respectively, in golf holes per person (Swift 2013). From the 1990s to the national economic downturn in 2008, golf courses were built at a tremendous rate in the LWC Planning Area. Since then, the region has seen a minimal amount of new golf course construction. Many golf courses are struggling financially, and some areas are experiencing increasing pressure to convert golf courses to residential developments. Little to no golf course expansion is projected to continue; thus, REC water demands are expected to remain fairly static through 2040. The only additional golf course demands projected are from projects already planned and approved for construction. In 2014, approximately 60 percent of golf course irrigation demand was met with traditional groundwater and surface water sources. The remaining 40 percent was supplied by reclaimed water.

Other Landscape Irrigation

With the increase in permanent residents, residential and other landscaped areas are expected to grow through 2040. Traditional water supply sources account for approximately 61 percent of the 2014 landscape water demands, with reclaimed water supplementing the remaining 39 percent. Landscaped areas are projected to grow at a rate similar to the permanent resident population, and the ratio of reclaimed to potable water supply used to meet future demands is assumed to remain constant. By 2040, demands are expected to grow 38 percent for landscaped areas in the LWC Planning Area.

Total gross water demands for REC, as shown in **Table 2-6**, were calculated by adding demands from the golf sector to the demands from other landscaped areas (see **Appendix B** for further detail). Total estimated REC gross water demands are projected to increase 43 percent from 2014 to 2040.

Table 2-6. Average gross water demand for REC use in the LWC Planning Area between 2014 and 2040.

County	Average Gross Water Demand (mgd)					
	2014	2020	2025	2030	2035	2040
Charlotte*	0.09	1.14	1.96	3.04	3.86	4.94
Collier	68.22	73.12	76.96	80.51	83.78	86.96
Glades*	0.17	0.17	0.18	0.18	0.19	0.19
Hendry*	1.26	1.29	1.31	1.32	1.33	1.34
Lee	107.85	121.07	132.13	142.57	152.07	160.89
Total	**177.59**	**196.79**	**212.54**	**227.62**	**241.23**	**254.32**

LWC = Lower West Coast; mgd = million gallons per day; REC = Recreational/Landscape Irrigation.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

INDUSTRIAL/COMMERCIAL/INSTITUTIONAL

The ICI water use category includes industrial and commercial facilities for processing, manufacturing, and technical needs such as concrete, citrus and vegetable processing, and mining operations. 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. As noted in **Appendix B**, water demands for this category only cover gross water withdrawals or diversions that are not returned to the source.

Estimated ICI demands for 2014 are 25.4 mgd with modest growth (14 percent), resulting in total ICI demands of 29.1 mgd for 2040. Information from the SFWMD Water Use Regulatory Database was used to estimate 2014 water demand. Growth within the ICI category is expected to be driven by sand, gravel, and stone mining operations supporting new construction as a result of population growth within the LWC Planning Area. **Table 2-7** shows the estimates of existing and future water demand for ICI use through the 2040 planning horizon.

Table 2-7. Average gross water demand for ICI use in the LWC Planning Area between 2014 and 2040.

County	Average Gross Water Demand (mgd)					
	2014	2020	2025	2030	2035	2040
Charlotte*	1.50	1.65	1.81	1.95	2.08	2.20
Collier	6.50	6.29	6.39	6.48	6.56	6.63
Glades*	1.30	1.44	1.58	1.71	1.83	1.95
Hendry*	7.90	7.98	8.06	8.14	8.21	8.28
Lee	8.23	8.29	8.76	9.21	9.62	10.01
Total	**25.43**	**25.65**	**26.60**	**27.49**	**28.30**	**29.07**

ICI = Industrial/Commercial/Institutional; LWC = Lower West Coast; mgd = million gallons per day.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

POWER GENERATION

There are three major power generation facilities currently operational in the LWC Planning Area: the Florida Power & Light (FPL) facility in Fort Myers, the FPL Babcock Ranch Solar Energy Center, and the Lee County Solid Waste Energy Recovery Facility. The FPL Fort Myers facility uses brackish water from the Caloosahatchee River Estuary for its cooling towers; therefore, it is not considered part of the PWR water demands in this 2017 LWC Plan Update. An additional 0.4 mgd of groundwater is used by the FPL Fort Myers facility for energy generation and plant operation, which is accounted for in the demand estimates and projections.

The FPL Babcock Ranch Solar Energy Center began operations in 2016 and will provide power to the planned Babcock Ranch Community. Operating as a photovoltaic system, minimal amounts of water are used (primarily for dust control).

The Lee County Solid Waste Energy Recovery Facility relies entirely on reclaimed water provided by the City of Fort Myers, and is anticipated to continue relying on reclaimed water through the planning horizon. Therefore, it is not considered part of the PWR water demands in this 2017 LWC Plan Update.

Estimated PWR demand for 2014 is 0.4 mgd, stemming entirely from the FPL Fort Myers facility. Power supply needs are expected to increase as the population grows in the LWC Planning Area and other portions of South Florida. Future power generation capacity may include new solar projects, expansion and renovation of the FPL Fort Myers facility, or new thermoelectric facilities. Some future power demand may be met with the proposed (as of mid-2017) construction of the new FPL Hammock Solar Energy Facility in northwestern Hendry County, which would be powered by solar energy or natural gas. By 2040, PWR water demands are projected to be 15.4 mgd, based on consultation with FPL (E. Shea, FPL, pers. comm.). For further information, refer to **Appendix B**.

SUMMARY OF DEMAND ESTIMATES

Total average gross water demands in the LWC Planning Area are projected to be approximately 1,211 mgd by 2040, a 24 percent increase from 2014 demands (971 mgd). **Tables 2-8** and **2-9** are 5-year incremental summaries of all water use categories for the LWC Planning Area under average and 1-in-10 year drought conditions. 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, largely due to rapid population growth in Lee and Collier counties. PWS remains the third largest water use category in the LWC Planning Area.
- AGR average gross demands are projected to increase, primarily due to increases in fresh market vegetable acreage. AGR remains the largest water use category in the LWC Planning Area.
- REC demands are projected to increase, primarily due to expansion of landscaped areas, while golf course irrigated acreage is projected to remain fairly static.
- ICI demands are projected to remain relatively stable, reflecting population growth trends.
- PWR demands are projected to modestly increase, due to proposed increases in capacity.

Table 2-8. Summary of the average gross water demands for each water use category in the LWC Planning Area between 2014 and 2040.

Water Use Category	Average Gross Water Demand (mgd)					
	2014	2020	2025	2030	2035	2040
PWS	129.33	147.55	162.08	175.69	188.14	199.88
DSS	22.18	24.99	27.29	29.43	31.37	33.18
AGR	615.75	634.93	644.66	653.01	665.92	678.83
PWR	0.40	0.40	0.40	0.40	15.40	15.40
REC	177.59	196.79	212.54	227.62	241.23	254.32
ICI	25.43	25.65	26.60	27.49	28.30	29.07
Total	**970.68**	**1,030.31**	**1,073.56**	**1,113.64**	**1,170.35**	**1,210.68**

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

Table 2-9. Summary of the gross water demands under 1-in-10 year drought conditions for each water use category in the LWC Planning Area between 2014 and 2040.

Water Use Category	1-in-10 Year Drought Condition Gross Water Demand (mgd)					
	2014	2020	2025	2030	2035	2040
PWS	137.50	156.82	172.21	186.62	199.80	212.25
DSS	23.49	26.47	28.90	31.17	33.22	35.14
AGR	721.85	744.01	754.57	763.92	778.68	793.72
PWR*	0.40	0.40	0.40	0.40	15.40	15.40
REC	189.61	210.04	226.81	242.85	257.34	271.26
ICI*	25.43	25.65	26.60	27.49	28.30	29.07
Total	**1,098.27**	**1,163.39**	**1,209.49**	**1,252.45**	**1,312.74**	**1,356.84**

AGR = Agricultural Irrigation; DSS = Domestic and Small Public Supply; ICI = Industrial/Commercial/Institutional; LWC = Lower West 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

The demand projections presented in this 2017 LWC 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 2-10** shows the 2030 average gross demands projected for the region in the 2012 LWC Plan Update compared to the 2040 demands projected in this 2017 LWC Plan Update. The total demand projection for 2040 in this 2017 LWC Plan Update (1,211 mgd) is less than the estimated 2030 demand (1,218 to 1,263 mgd) previously projected in the 2012 LWC Plan Update.

Table 2-10. Comparison of gross water demands under average rainfall conditions projected in the 2012 LWC Plan Update (2030) and this 2017 LWC Plan Update (2040).

Water Use Category	2012 LWC Plan Update 2030 Demand (mgd)	2017 LWC Plan Update 2040 Demand (mgd)	Percent Difference
PWS	232.1	199.88	-14%
DSS	24	33.18	38%
AGR*	695.9 to 740.9	678.83	-3% to -8%
PWR	42.1	15.40	-63%
REC	188.5	254.32	35%
ICI	35.3	29.07	-18%
Total	**1,217.9 to 1,262.9**	**1,210.52**	**-1%** to **-4%**

AGR = Agricultural Irrigation; DSS = Domestic and Small Supply; ICI = Industrial/Commercial/Institutional; LWC = Lower West Coast; mgd = million gallons per day; PWR = Power Generation; PWS = Public Water Supply; REC = Recreational/Landscape Irrigation.
*The 2012 LWC Plan Update included 29,000 acres for transitional land, which is why it is expressed as a range.

REFERENCES

Badenhausen, K. 2016. The 10 Best Cities for Future Job Growth. Forbes Business. Retrieved from: https://www.forbes.com/sites/kurtbadenhausen/2016/10/19/the-10-best-cities-for-future-job-growth/#6e68574b1141.

FDACS. 2016. *2014 Florida Agriculture by the Numbers*. Florida Department of Agriculture and Consumer Services, Tallahassee, FL.

Florida Citrus Mutual. 2012. Timeline of Major Florida Freezes. Retrieved from: http://flcitrusmutual.com/render.aspx?p=/industry-issues/weather/freeze_timeline.aspx.

Hodges, A. and M. Rahmani. 2016. *Economic Contributions of Agriculture, Natural Resources and Food Industries in Florida in 2014*. University of Florida Institute of Food and Agricultural Sciences, Gainesville, FL.

Rayer, S. and Y. Wang. 2015. *Projections of Florida Population by County, 2020-2040, with Estimates for 2014*. Florida Population Studies Bulletin 171. Bureau of Economic and Business Research, University of Florida.

SFWMD. 2012. *2012 Lower West Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL.

Swift, A. 2013. *Study: Naples-Marco tops national leaderboard for golf holes per capita*. Naples Daily News. March 8, 2013.

United States Census Bureau. 2012. *Florida 2010 Census of Population and Housing*. United States Department of Commerce, Economics and Statistics Administration. Washington, D.C.

United States Census Bureau. 2016. *Estimates of Resident Population Change and Rankings: July 1, 2014 to July 1, 2015*. Population Division, U.S. Census Bureau.

USDA-NASS. 2016. *Citrus Statistics*. United States Department of Agriculture – National Agricultural Statistics Service. Retrieved from: https://www.nass.usda.gov/Statistics_by_State/Florida/Publications/Citrus/Citrus_Statistics/.

3

Demand Management: Water Conservation

Demand management is an important aspect of water use and planning, and when used effectively, can extend the sustainability of water supply resources. A key aspect of successful demand management is strategic planning. This involves understanding the constraints 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 behavior as well as developing cost-effective programs. Demand management can involve adjusting the timing of water use (e.g., shifting time of supply to off-peak usage through storage or increasing the ability of systems to operate during periods of droughts), but more commonly involves reducing the demand for water (i.e., conservation).

Water conservation involves reducing the quantity of water required to meet a demand; 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, so water use efficiency and conservation should be maximized regardless of the water source. 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 West Coast (LWC) Planning Area. Several of these actions have been implemented by local governments. Existing conservation initiatives in the LWC Planning Area include conservation rate structures, fixture replacement programs, irrigation ordinances, and public education programs. To estimate potential water savings achievable in the LWC Planning Area by 2040, data were analyzed using conservation best management practices (BMPs) and other methods. Supporting information (e.g., conservation BMPs and measures by user types) as well as tools and programs available to help local governments and utilities encourage users to achieve significant water use efficiency can be found in the South Florida Water Management District (SFWMD or District) *2016 Water Supply Plan Support Document* (SFWMD 2016).

In the LWC Planning Area, conservation efforts are reflected in the Public Water Supply (PWS) per capita use rate (measured in gallons per capita per day), which has been steadily declining since 2000 (**Figure 3-1**). This decline likely is the result of new construction designed for more efficient water use, the year-round irrigation rule [Chapter 40E-24, Florida Administrative Code (F.A.C.)], conservation rate structures, public education, and other conservation factors.

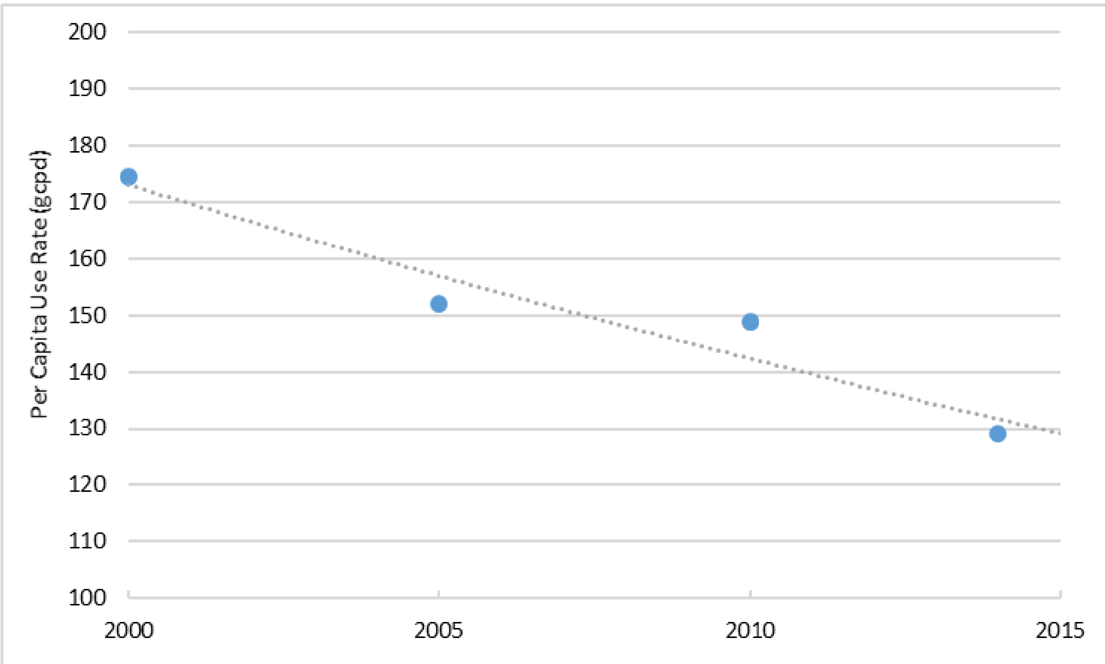


Figure 3-1. Net (finished) water per capita use rate (in gallons per capita per day) within the Lower West Coast Planning Area.

COMPREHENSIVE WATER CONSERVATION PROGRAM

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

- Regulatory initiatives may include establishing a goal-based water conservation plan, adopting local landscape and irrigation ordinances, and requiring utilities to establish rate structures that encourage water conservation. Regulatory tools can lead to significant 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 may 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 program is to achieve measurable reductions 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 and is nonbinding. The scope and implementation schedule of the action steps outlined in the program are subject to funding levels and voluntary participation by public water suppliers and other participating water users. The SFWMD's conservation program is more fully described in the Support Document (SFWMD 2016).

POTENTIAL FOR WATER CONSERVATION SAVINGS

Estimates of water conservation potential were created using conservation BMPs and measures for water users in the LWC Planning Area. The Alliance for Water Efficiency (AWE) Water Conservation Tracking Tool was used to generate estimates for nonagricultural categories. A mathematical calculation was utilized to generate an estimate for the agricultural category, and the methods for urban and agricultural categories are described in the following subsections.

Urban

Estimates of water conservation potential were made for PWS (including Domestic and Small Public Supply [DSS]) and Industrial/Commercial/Institutional (ICI) water use categories. The AWE Water Conservation Tracking Tool (Ver. 3.0), was used to estimate PWS single family (SF) and multi-family (MF) residential users.

The AWE Water Conservation Tracking Tool is an Excel-based tool for evaluating water savings, costs, and benefits of urban water conservation programs. In general, the tool's default savings assumptions for each conservation measure were used. County populations were the same as the populations used in this *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update) for demand projections. Water use was based on Florida Department of Environmental Protection net (finished) water monthly operating reports for potable water supply systems.

Residential conservation (demand reduction) estimates (**Table 3-1**) assume approximately 20 percent of pre-1994 (date that the United States Energy Policy Act of 1992 regarding water-efficient fixtures became effective) homes would be affected by the following measures by 2040:

- Water use surveys for residential users (SF, MF)
- High-efficiency toilets (SF, MF)
- High-efficiency showerheads (SF, MF)
- Lavatory faucets (SF, MF)

- High-efficiency washing machines (SF, MF)
- Irrigation controllers (SF)
- Turf replacement (SF)
- Efficient irrigation nozzles (SF)

Efficiency improvements in the ICI water use category have produced water savings of 15 to 50 percent, with 15 to 35 percent being typical (Dziegielewski et al. 2000). For the analysis in **Table 3-1**, 15 percent was used to provide a conservative estimate for ICI. Examples of ICI improvement measures include switching from water-cooled to air-cooled devices, automatic shut-off valves, use of combination ovens, facility water audits, high-efficiency ice-making machines, cooling tower and steam boiler efficiency improvements, and other similar measures. Estimates of water use and potential savings (in million gallons per year) for PWS-supplied ICI users and self-supplied ICI users were calculated using Florida Department of Revenue parcel data. All ICI use was correlated to square footage of building space under climate control (Morales et al. 2009).

Table 3-1. Water savings potential (in mgd) based on urban demand reduction estimates achievable by 2040 assuming a participation rate of 20 percent.

Use Sector	Charlotte[1]	Collier	Glades[1]	Hendry[1]	Lee	LWC Planning Area Total
Residential[2]	0.075	3.67	0.093	0.46	7.00	**11.30**
ICI[3]	0.017	0.66	0.003	0.03	0.95	**1.66**
Total	**0.092**	**4.33**	**0.096**	**0.49**	**7.95**	**12.96**

DSS = Domestic and Small Public Supply; ICI = Industrial/Commercial/Institutional; LWC = Lower West Coast; mgd = million gallons per day; PWS = Public Water Supply.
[1] Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.
[2] Includes all PWS and DSS residential users as well as indoor and outdoor water use conservation.
[3] Includes PWS and self-supplied users. Includes indoor water use savings potential only. A 15 percent savings was assumed.

Agriculture

To develop agricultural estimates, agricultural irrigation permits within the LWC Planning Area were reviewed to identify the irrigated acreage, crop type, irrigation type, and 1-in-10 year drought allocation. Of the permits reviewed, 93,496 acres were identified where water could be conserved by converting to a more efficient irrigation system. Permits from the Secondary Diversion and Impoundment use class were not included to prevent double counting those volumes.

The modified Blaney-Criddle formula, utilized in water use permitting, was used to calculate the 1-in-10 year drought demand as permitted as well as a new 1-in-10 year drought demand with the irrigation efficiency value for the most efficient irrigation method practical for individual crop types (e.g., converting a container nursery from sprinkler to micro-drip irrigation). The difference between the existing and revised demand calculation is the potential savings volume.

This evaluation resulted in an estimated total savings potential of 122 million gallons per day (mgd), representing a 40 percent savings for the identified permits. However, several assumptions were made in the estimation process that should be considered, including the following:

- Water use is at 1-in-10 year drought condition level rather than average conditions
- Permitted acreage is fully planted with the permitted crop type
- The irrigation method used at permit issuance has not changed
- The efficiency improvements will be made to the maximum extent possible and not to a method with an efficiency between the current method and the optimal method
- All permittees will make the efficiency improvements
- Crop type and acreage stay the same

Because all of the assumptions are unlikely to occur, it is conservatively assumed that the savings for crop irrigation will be approximately 10 percent of the estimate, for a calculated water savings potential of 12.24 mgd (**Table 3-2**). Higher participation rates and savings may be expected if incentive-based programs for agriculture are developed and funded. Additional savings could occur if other types of efficiency improvements are made, such as the introduction of computerized weather-based irrigation controllers.

There are 24,323 acres of irrigated pasture in the LWC Planning Area. Of these, 24,283 acres currently use gravity flow (flood/seepage) irrigation systems, which are the least expensive method to operate. The remaining 40 acres use portable guns. Water use for irrigated pasture is more difficult to predict because use is not consistent. A review of 2015 pumpage data in the LWC Planning Area revealed the reported water use for irrigated pasture ranged from none to the full allocation.

A change to traveling gun (sprinkler) irrigation from flood irrigation could result in estimated potential savings of 23.1 mgd. However, this change comes with operational and equipment costs, which means while the change may be possible, it may not be practical. Because of the issues identified earlier, a 5 percent adoption/implementation rate was utilized to calculate a savings potential of 1.15 mgd for planning purposes (**Table 3-2**).

Table 3-2. Water savings potential (in mgd) assuming a participation rate of 10 percent for crops and 5 percent for irrigated pasture.

Use Sector	Charlotte*	Collier	Glades*	Hendry*	Lee	LWC Planning Area Total
Crops (excluding pasture)	1.04	5.78	0.46	4.43	0.53	12.24
Pasture	0.25	0.01	0.33	0.55	0.01	1.15
Total	**1.29**	**5.79**	**0.79**	**4.98**	**0.54**	**13.39**

LWC = Lower West Coast; mgd = million gallons per day.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

CONSERVATION STRATEGIES

Conservation and water use efficiency programs generally are designed for a specific use or type of user. Fortunately, many conservation BMPs 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 conservation coordinators to decide which users they wish to target and what BMPs or measures are most appropriate, and 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 BMPs, measures, and programs can be found on the SFWMD website (www.sfwmd.gov; Search: Water Conservation).

Public Water Supply

There are many options available to conservation managers 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.

To design an effective conservation plan, PWS professionals should start with the following:

- Set clear demand management goals (e.g., lowering peak demand only versus overall per capita demand)
- 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 overall plan and the individual plan 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.

Domestic and Small Public Supply

Indoor and outdoor conservation options available to residential PWS users are applicable to DSS users also. 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 water use habits to maximize efficiency.

Agricultural Irrigation

The Florida Department of Agriculture and Consumer Services (FDACS) develops and adopts by rule agricultural BMPs to address water quality within the Agricultural Irrigation (AGR) use category. Many of the BMPs also contain an implicit water conservation component. As of September 2016, the LWC Planning Area had a total of 786,389 irrigated and nonirrigated acres enrolled in the FDACS BMP program. Citrus and field crops encompass approximately 38 percent of the enrolled acreage in the LWC Planning Area. Nursery, sod, and mixed-use crops account for another 7 percent. The remaining 55 percent of the enrolled acreage is used for cow and calf operations, where water conservation BMPs are less applicable.

Because of the costs associated with moving water (which affects the profitability of the overall crop), most farmers presumably are as efficient as practical using their existing irrigation systems and growing methods. Financial incentives may be necessary to help farmers transition to more efficient irrigation systems or growing methods.

Recreational/Landscape Irrigation

Under the Recreational/Landscape Irrigation (REC) use category, demand reduction is possible through implementation of 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. Other on-site options include capture of gray water or stormwater in cisterns to reuse for irrigation.

INFO

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

Golf courses are highly visible users of water in the REC category, with more than 150 courses currently in the LWC Planning Area. In 2014, the total gross demand for golf course irrigation was 51.8 mgd, with 20.8 mgd coming from reclaimed water sources. Although many golf courses are very efficient in their water use, those within the LWC Planning Area should consider upgrading to weather-based irrigation control technology if they have not done so already. 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.

Potential water savings are highly dependent on specific site conditions and pre-existing equipment. A professional water audit is recommended to estimate savings potential for a golf course or other recreational landscape. For more information on REC water demand, refer to **Chapter 2**.

Industrial/Commercial/Institutional

In water supply planning, this category is for ICI users that are self-supplied. However, in terms of water conservation, the BMPs apply to all ICI users, regardless of the water source. Due to the diverse use of water by industrial entities, the development of efficiency programs can be challenging. A broad approach 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 a metal finishing plant. 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 *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities: A Guide for Facility Managers* (SFWMD 2013) provides further information.

Power Generation

Power generation (PWR) facilities use a large quantity of water for cooling, but most of the water is returned to the source from which it was obtained; there are minimal efficiency gains to be had in the process. While minimal, indoor water use at power plants should be optimized through the use of high-efficiency water-using fixtures and equipment. Additional gains may be available using high-efficiency HVAC equipment.

CONSERVATION PROGRAMS

Per capita demand reduction in the LWC Planning Area and within individual PWS utility service areas will occur over time as users implement conservation BMPs 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 miss significant conservation savings potential. Therefore, many local governments, utilities, and state agencies sponsor water conservation programs. The SFWMD supports many of these programs through financial sponsorships, collaborative partnerships with other governmental and nongovernmental entities, or direct administration. An overview of some of the programs available can be found 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 BMPs, 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

The SFWMD will continue working with utilities implementing voluntary conservation initiatives and providing assistance with goal-based planning design, the use of analysis tools, and cost-share funding for conservation projects.

Cost-Share Funding Programs

The SFWMD administers a cost-sharing program, formerly known as the Water Savings Incentive Program (WaterSIP), which supported technology and hardware-based conservation projects. In Fiscal Year (FY) 2016, WaterSIP was combined with the District's alternative water supply development and stormwater cost-share projects under the name Cooperative Funding Program (CFP). Since 2007, WaterSIP and the CFP have funded conservation projects in the LWC 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. 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 3 municipalities and utilities in the LWC Planning Area (Marco Island Utilities, Port of the Islands Community Improvement District, and Florida Governmental Utility Authority) to sponsor Water CHAMP at 6 lodging properties, for a total of 944 rooms. Since Water CHAMP launched in 2002, water conservation has increasingly become a standard aspect of hotel and motel operations. A recent study by Cornell University (Bruns-Smith et al. 2015) found that 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 long as current supplies allow.

The Florida Water Star℠ program certifies buildings and associated outdoor space 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. To date, 38 properties in the LWC Planning Area have been certified under the Florida Water Star℠ program. Further descriptions of these programs can be found on the SFWMD's website 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 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. Descriptions of these District-sponsored and state-supported programs are available on the SFWMD website.

Agricultural Mobile Irrigation Labs

Agricultural mobile irrigation labs (MILs) evaluate the performance of irrigation systems and encourage the adoption of efficient irrigation hardware and management practices. The Collier Soil and Water Conservation District MIL services agricultural properties in Charlotte, Collier, Glades, Hendry, and Lee counties. From January 2015 to July 2016, the Collier MIL conducted 125 initial and 101 follow-up evaluations on select agricultural properties. For the reporting period, FDACS estimates an actual total water savings of 0.67 mgd and a potential water savings of 1.77 mgd for the evaluated acres.

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 eligible participants to install or implement structures and management practices that address impaired water quality and conservation of water resources on eligible agricultural land.

From FY2011 through FY2015, 18 irrigation efficiency projects were funded by EQIP in the LWC Planning Area. Ten of the projects were in Glades, Hendry, and Lee counties and included 13,173 acres of land-leveling for sugar cane, 75.9 acres of micro-irrigation installation, and 58.6 acres of improved irrigation water management practices. Eight of the projects were in Charlotte County and included installation of micro-irrigation systems for 519 acres, installation of tailwater recovery systems for 40.6 acres, and a 30-acre-foot irrigation storage reservoir. 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, provides assistance on water conservation efforts to conservation professionals, and offers use of its Water Conservation Tracking Tool free to members (www.allianceforwaterefficiency.org).
- **WaterSense –** Certifies water-efficiency 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. A regional partnership such as this does not currently exist in the LWC Planning Area, but the SFWMD encourages collaboration and would provide technical support if requested. Two noteworthy examples of regional partnerships from outside the LWC Planning Area are as follows:

- **Polk Regional Water Cooperative** – A partnership of 16 member governments (15 cities and Polk County) that proactively identify alternative water resources and projects to ensure future sustainability of regional water supplies. The Cooperative specifically identifies sustainable groundwater sources, develops strategies to meet water demands, determines needed infrastructure, and establishes consistent rules throughout the region.

- **Broward Water Partnership** – An affiliation of local governments, including 18 municipalities and water utilities, who have come together to encourage conservation in their communities. Toilet rebates for qualifying residents, businesses, and nonprofits are offered through the Broward Water Partnership. The Partnership also offers water-efficient showerheads and low-flow faucet aerators to eligible residents and pre-rinse spray valves for commercial kitchens.

REGULATORY INITIATIVES

Regulatory measures are key 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. Regulations that require users to make costly investments in efficiency improvements could be matched with financial assistance programs to ease the burden on those affected.

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 the 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 utilities may be able to require implementation as a condition of service.

Most jurisdictions in the LWC Planning Area follow a 3-days-per-week watering schedule as directed by the SFWMD's Year-Round Landscape Irrigation Rule [Chapter 40E-24, F.A.C.]. 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 alternative landscape irrigation ordinances based on local water demands, system limitations, or resource availability. Some municipalities in the LWC Planning Area have exercised this option. Unincorporated Lee County and the City of Cape Coral follow a more stringent 2-days-per-week schedule, and several jurisdictions have designated a reduced watering window. For additional information on watering restrictions, please refer to the Support Document (SFWMD 2016).

SUMMARY OF WATER CONSERVATION

Alternative water supply development projects typically involve costly construction of new treatment plants, wells, reservoirs, or other infrastructure. In contrast, conservation programs that achieve increased water savings through education, rebates, and new technologies often are much less expensive. Therefore, regardless of source, conservation should be maximized before more costly development options are implemented. Analysis suggests that Charlotte, Collier, Glades, Hendry, and Lee counties collectively can save approximately 26 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	County					Total by Sector
	Charlotte*	Collier	Glades*	Hendry*	Lee	
Urban	0.092	4.33	0.096	0.49	7.95	**12.96**
Agriculture	1.29	5.79	0.79	4.98	0.54	**13.39**
Total by County	**1.38**	**10.12**	**0.88**	**5.47**	**8.49**	**26.34**

LWC = Lower West Coast; mgd = million gallons per day.
* Values listed for Charlotte, Glades, and Hendry counties are only for the areas within the LWC Planning Area boundaries.

Local governments and utilities are encouraged to review the programs and opportunities discussed herein as well as the SFWMD's Comprehensive Water Conservation Program to help meet conservation goals. Regional and local agencies should conduct thorough analyses of their service areas, allocate adequate funding to assist individual users in making the necessary investments in conservation, and reduce the need for costlier projects in the future. Cities and utilities also should consider the use of conservation planning tools. SFWMD staff are available to assist conservation program developers with technical support, collaborative program implementation, ordinance review, and long-term demand management planning.

REFERENCES

Bruns-Smith, A., V. Choy, H. Chong, and R. Verma. 2015. *Environmental sustainability in the hospitality industry: Best practices, guest participation, and customer satisfaction*. Cornell Hospitality Report 15(3):6-16.

Dziegielewski, B., J.C. Kiefer, E.M. Optiz, G.A. Porter, G.L. Lantz, W.B. DeOreo, P.W. Mayer, and J.O. Nelson. 2000. *Commercial and Institutional End Uses of Water*. AWWA Research Foundation and the American Water Works Association. Denver, CO.

Morales, M.A., J.M. Martin, and J.P. Heaney. 2009. *Methods for Estimating Commercial, Industrial, and Institutional Water Use*. University of Florida, Conserve Florida Water Clearinghouse. Gainesville, FL.

SFWMD. 2013. *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities: A Guide for Facility Managers*. South Florida Water Management District, West Palm Beach, FL. Second Edition, July 2013.

SFWMD. 2016. *2016 Water Supply Plan Support Document*. South Florida Water Management District, West Palm Beach, FL.

University of Florida. 2014. *Nine Florida-Friendly Landscaping Principles*. Florida-Friendly Landscaping Program, Department of Environmental Horticulture, University of Florida, Gainesville, FL. Available at: http://fyn.ifas.ufl.edu/homeowners/nine_principles.htm.

4

Water Resource Protection

This chapter provides an overview of protections afforded to water resources in the Lower West Coast (LWC) Planning Area through statutory and regulatory criteria. The ability to meet the water demands described in **Chapter 2** largely depends on the future availability of water resources. Understanding the relationship of meeting water demands via withdrawals from water resources and the limitations that are imposed on those withdrawals and resources is critical to water supply planning.

TOPICS

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

Past analyses indicated that water from the surficial and intermediate aquifers as well as surface water from Lake Okeechobee and canals was insufficient to meet the growing needs of the LWC Planning Area during 1-in-10 year drought conditions. Potential impacts on wetlands, the possibility of exacerbating saltwater intrusion, and other factors limit the use of these water bodies as water sources. In 2003, the South Florida Water Management District (SFWMD or District) adopted Maximum Developable Limit criteria for surficial and intermediate aquifers within the LWC Planning Area. Additionally, Restricted Allocation Area (RAA) rules were adopted for the Lower East Coast Everglades Waterbodies in 2007 and for the Lake Okeechobee Basin (Lake Okeechobee and Lake Okeechobee Service Area) in 2008 to address lower lake management levels and storage under the United States Army Corps of Engineers' (USACE) interim Lake Okeechobee Regulation Schedule (2008 LORS).

To further protect water resources in the LWC Planning Area, Minimum Flows and Minimum Water Levels (MFLs) were adopted in 2001 for the Caloosahatchee River, LWC Aquifers, Lake Okeechobee, and the freshwater portions of Everglades National Park (ENP). In addition, Water Reservations for the protection of fish and wildlife were adopted for Picayune Strand and Fakahatchee Estuary in 2009 and the Caloosahatchee River (C-43) West Basin Storage Reservoir in 2014.

Following these actions, a variety of alternative water supply development projects were identified to avoid water resource impacts and competition between water users, and to provide a sustainable supply of water. 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.

The interaction between science, policy, statutory protection options, and regulatory programs aids in the protection of water supplies for natural systems. Water use permit applicants must provide reasonable assurance 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 of our water resources is discussed in **Chapter 7**.

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) (**Figure 4-1**). Each standard plays a role in the ultimate goal of achieving a sustainable water resource. For instance, programs regulating surface water management and water use permitting must prevent harm to the water resource. **Figure 4-1** represents the conceptual relationship among the water resource protection standards, associated conditions, and water shortage severity.

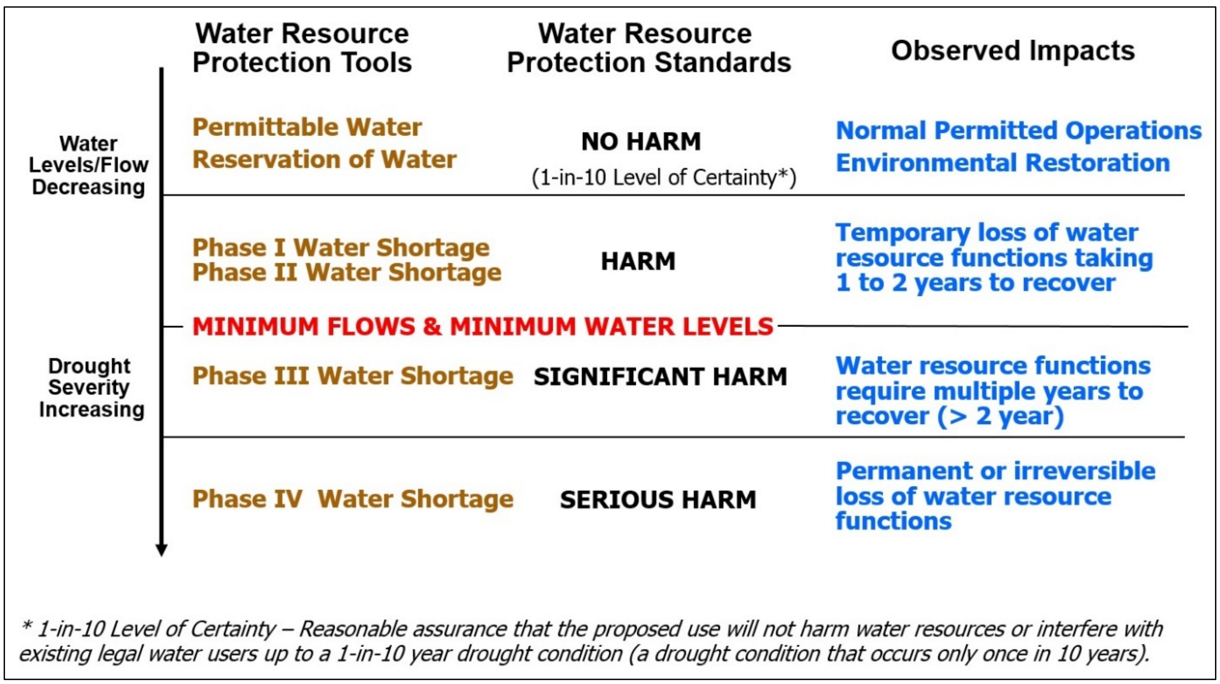


Figure 4-1. Conceptual relationship among water resource protection standards at various levels of water resource harm.

TOOLS	
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 technical criteria used to evaluate the quantity and the proposed water use's impact on the source include the following: • Potential for saltwater intrusion • Wetland and other surface water body impacts • Pollution • Impacts to off-site land uses • Interference with existing legal users • MFLs and their regulatory components • 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 water for the protection of fish and wildlife or public health and safety. When a volume of water is reserved, it is not available for allocation to consumptive uses [Section 373.223, F.S.]. Water Reservations can be developed based on existing water availability or consideration of future water supplies made available by water resource projects. The Water Resources Development Act of 2000 requires the SFWMD to use its reservation or allocation authority to protect water made available by Comprehensive Everglades Restoration Plan (CERP) projects as necessary for the natural system. Any volume of water not necessary for the protection of fish and wildlife or public health and safety may be certified as available and allocated to consumptive uses.
Water Shortage	Water shortages are declared by the District Governing Board when available groundwater or surface water is not sufficient to meet users' 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 purposes of the plans are to protect water resources from serious harm; assure 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 to protect natural systems from consumptive use impacts. RAA criteria established for specific 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 since the 2012 LWC Plan Update

In 2011, the Florida Department of Environmental Protection initiated a statewide effort to improve consistency in the consumptive/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 that became effective in 2014. The Applicant's Handbook (SFWMD 2015) contains the revised SFWMD water use permitting criteria.

In 2013, changes were made to Section 373.236, F.S., to extend the duration of water use permits in some situations. Permits approved for the development of alternative water supplies will be granted for at least 30 years if there is reasonable assurance that the conditions of the permit will be met for the duration. Additionally, permits with a duration of up to 50 years may be authorized if a municipality, other government body, or public utility is required to provide for the retirement of bonds used for the construction of waterworks or waste disposal facilities.

In 2013, the permitting threshold for individual permits requesting withdrawals from some surficial and intermediate aquifers was reduced from 100,000 gallons per day to 10,000 gallons per day. Permits for less than 10,000 gallons per day are classified as general permits.

Additional Protection Afforded Water Resources

The water resource protection criteria contained in the conditions for permit issuance enumerated in Rule 40E-2.301, Florida Administrative Code (F.A.C.), and the Applicant's Handbook (SFWMD 2015) include three additional mechanisms to protect water supplies for natural systems from consumptive uses: 1) the regulatory components of an adopted MFL prevention or recovery strategy, 2) implementation criteria for Water Reservations, and 3) RAA criteria. 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 protected by Water Reservation or RAA criteria prior to executing cost-share agreements for project construction.

In addition, the SFWMD considers the CERP project schedule and the related federal and state requirements to protect water for the natural system using its reservation or allocation authority. The USACE has verified that federal requirements have been met for several CERP projects by virtue of the SFWMD's adoption of Water Reservations and RAA rules. Taken together, these rules afford protection for water resources across significant portions of the LWC Planning Area. **Figure 4-2** presents a map of the CERP projects that have been planned for construction over the next 20 years.

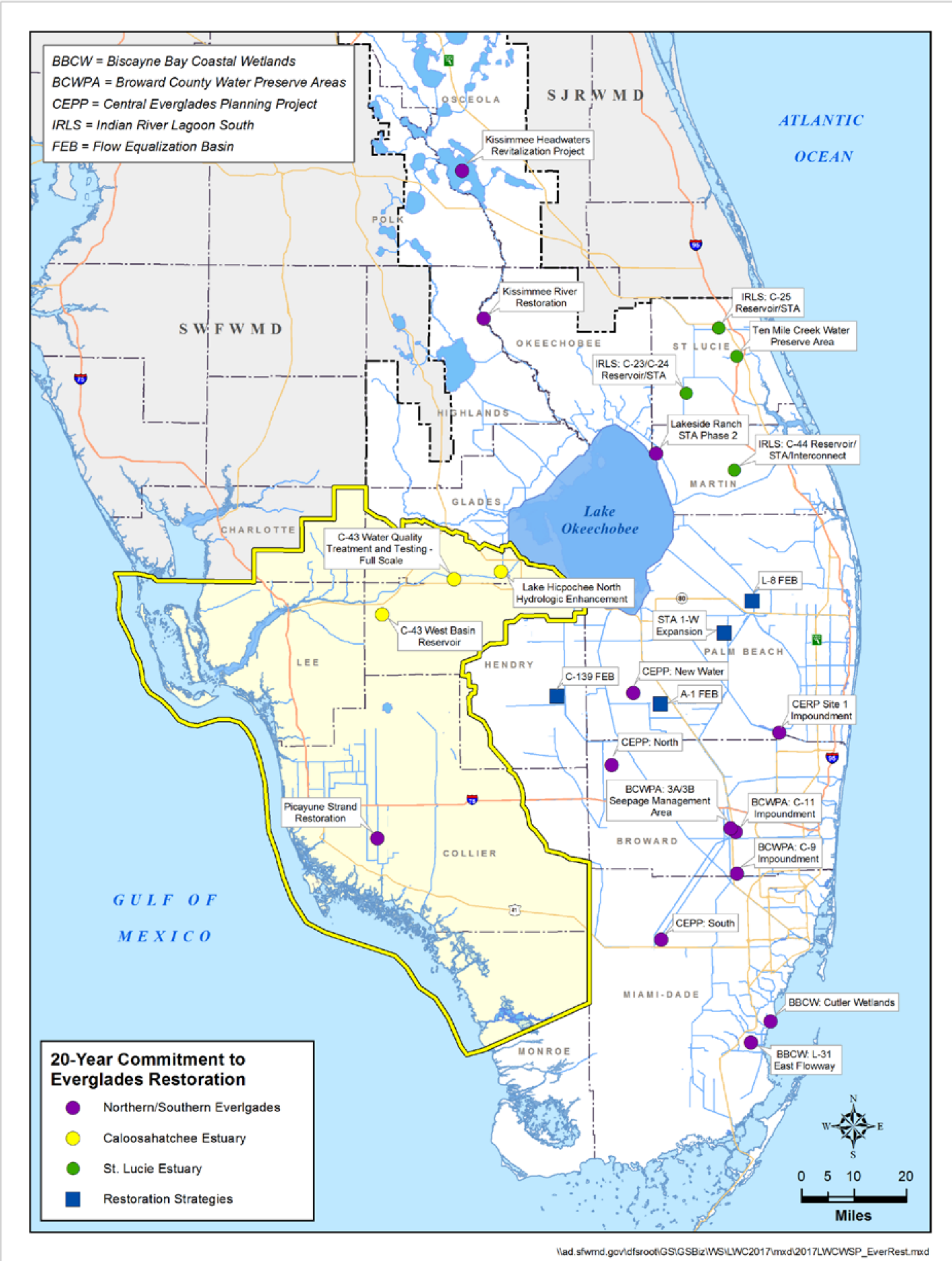


Figure 4-2. Comprehensive Everglades Restoration Plan (CERP) projects planned for construction over the next 20 years.

Minimum Flows and Minimum Water Levels

MFL criteria are flows or levels at which specific 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, 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".

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 waters, 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 updated. 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 2017) of the *2017 South Florida Environmental Report*. The priority list is based on the importance of the waters 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 waters that are experiencing or may reasonably be expected to experience adverse impacts.

The SFWMD develops and adopts recovery or prevention strategies for all priority water bodies simultaneously with MFL rule adoption. The SFWMD develops a recovery strategy for water bodies where MFLs currently are violated [Subsection 40E-8.021(25), F.A.C.]. The goal of a recovery strategy is to achieve the established MFL as soon as practicable. A prevention strategy is developed when MFLs currently are not violated, but are projected to be violated within 20 years of the establishment of the MFL [Subsection 40E-8.021(24), F.A.C.]. The goal of a prevention strategy is for the water body to continue to meet the established MFL criteria in the future.

The 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 have been adopted in the LWC Planning Area for the Caloosahatchee River, LWC Aquifers (the Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers), Lake Okeechobee, and the freshwater portions of ENP (**Figure 4-3**). A prevention strategy has been adopted for the LWC Aquifers, and recovery strategies have been adopted for the Caloosahatchee River, Lake Okeechobee, and the freshwater portions of ENP. MFLs and recovery and prevention strategies (including Maximum Developable Limits for LWC Aquifers) that have been adopted in the LWC Planning Area are discussed in more detail 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., on the SFWMD website (www.sfwmd.gov; Search: Minimum Flows and Levels). Additional information specific to the MFLs and recovery strategies for Lake Okeechobee and the Everglades can be found in the *2013 Lower East Coast Water Supply Plan Update* (SFWMD 2013).

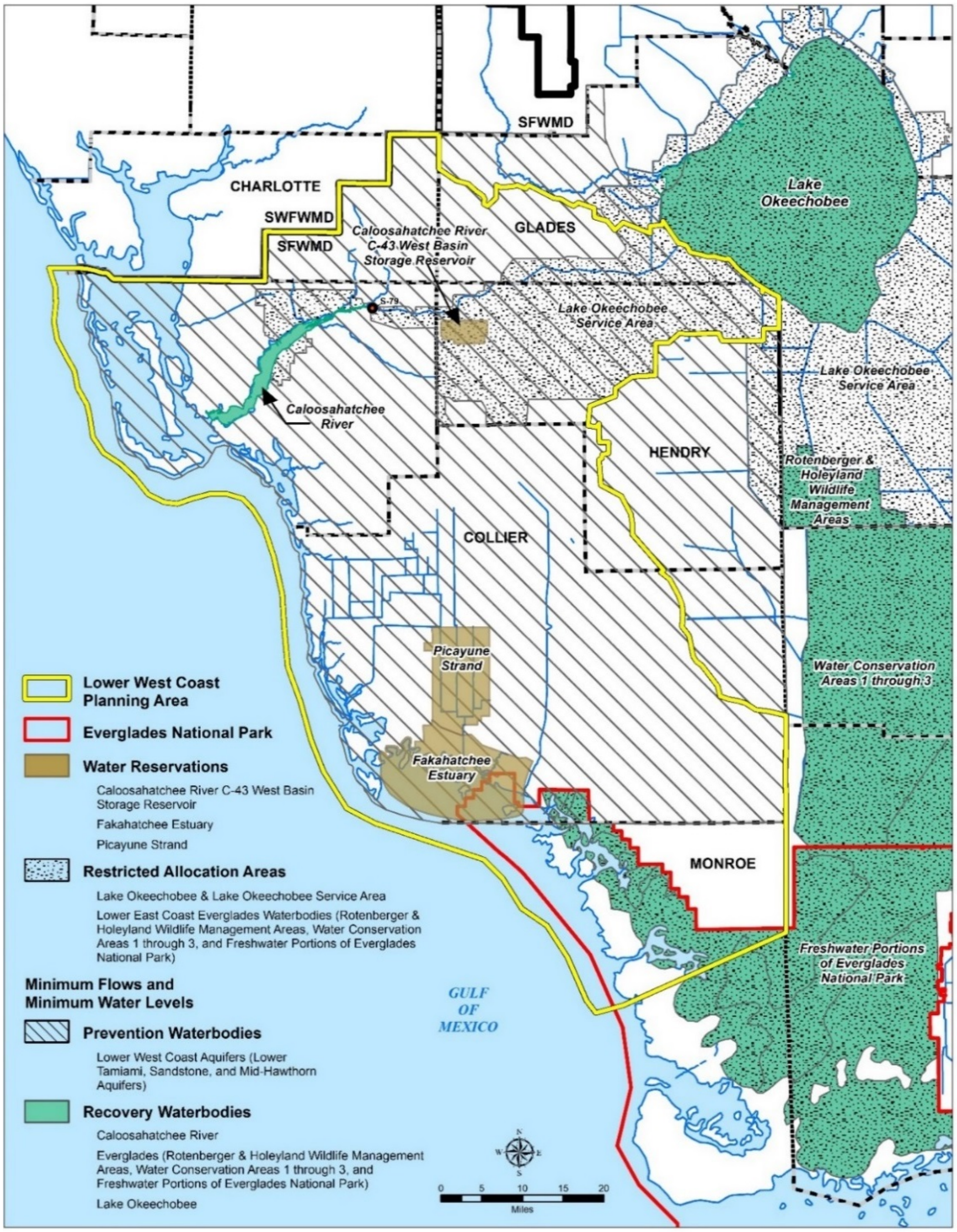


Figure 4-3. Adopted Minimum Flows and Minimum Water Levels, Water Reservations, and Restricted Allocation Areas in the Lower West Coast Planning Area.

Caloosahatchee River MFL

In 2001, the SFWMD adopted an MFL for the Caloosahatchee River [Subsection 40E-8.221(2), F.A.C.] (**Figure 4-3**). The current MFL criterion for the Caloosahatchee River is a minimum mean monthly flow of 300 cubic feet per second (cfs) at the S-79 structure, which at the time of MFL adoption in 2001 was determined necessary to maintain a balanced and healthy salinity regime to prevent an MFL exceedance (when the MFL is not met) and sustain submerged aquatic vegetation in the Caloosahatchee River Estuary (CRE). A recovery strategy was adopted for the Caloosahatchee River simultaneously with MFL adoption. The MFL has been under re-evaluation since 2013.

Lower West Coast Aquifers MFL

The LWC Aquifers (**Figure 4-3**) comprise the Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers. In 2001, the SFWMD adopted an MFL specifying that the minimum water levels for the LWC Aquifers must equal the elevation of the structural top of the aquifers [Subsection 40E-8.331, F.A.C.]. A prevention strategy was adopted for the LWC Aquifers simultaneously with MFL adoption.

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 4-3**). An MFL of 11 feet National Geodetic Vertical Datum of 1929 (NGVD29) was adopted for Lake Okeechobee in 2001 [Subsection 40E-8.221(1), F.A.C.]. A prevention strategy was adopted for Lake Okeechobee simultaneously with MFL adoption. The prevention strategy was changed to a recovery strategy with implementation of the 2008 Lake Okeechobee Regulation Schedule.

Everglades MFL

An MFL was adopted for the Everglades in 2001 [Subsection 40E-8.221(3), F.A.C.], which includes the lands and waters of the Water Conservation Areas, the Holeyland/Rotenberger wildlife management areas, and the freshwater portions of ENP [Subsection 40E-8.021(7), F.A.C.]. A small area of the freshwater portion of ENP lies within the LWC Planning Area (**Figure 4-3**). The MFL criteria are based on changes and structural alterations to the pre-drainage conditions of the Everglades that existed at the time of MFL adoption. A recovery strategy was adopted for the Everglades simultaneously with MFL adoption.

Water Reservations

Section 373.709, F.S., requires regional water supply plans to include reservations of water for the planning area, which are adopted by rule. A Water Reservation sets aside water for the protection of fish and wildlife or public health and safety. A Water Reservation rule defines the volume of water being set aside for the associated natural system and any unreserved water available for allocation to consumptive uses. When a volume of water is reserved, it is unavailable for future allocation to consumptive uses. Water Reservations do not: 1) establish operating regimes, 2) drought-proof natural systems, or 3) ensure wildlife proliferation.

Water Reservations are established based on existing water availability and consideration of future water supplies that water resource projects make available. The Water Resources Development Act of 2000, and Section 373.470, F.S., require increased water supplies identified in CERP project implementation reports to be reserved or allocated by the SFWMD prior to execution of cost-share agreements between the USACE and the SFWMD to construct such projects. Additionally, Water Reservations may be used as recovery or prevention strategies for MFL water bodies.

Water Reservations have been adopted in the LWC Planning Area for the Caloosahatchee River (C-43) West Basin Storage Reservoir (2014), Picayune Strand (2009), and Fakahatchee Estuary (2009) (**Figure 4-3**). Information on all Water Reservations that have been adopted throughout the District can be found on the SFWMD website (www.sfwmd.gov; Search: Water Reservations) and in Chapter 40E-10, F.A.C.

Water Reservation for the Caloosahatchee River (C-43) West Basin Storage Reservoir

CERP identifies restoration of the CRE as an integral step in achieving system-wide benefits in the South Florida ecosystem. Promoting a balanced and healthy salinity regime in the CRE is essential for maintaining the ecological integrity and associated economic benefits of this unique habitat on Florida's southwest coast.

In 2014, the SFWMD adopted a Water Reservation rule [Subsection 40E-10.041(3), F.A.C.] for the Caloosahatchee River (C-43) West Basin Storage Reservoir, a CERP project being constructed through a SFWMD/USACE cost-share agreement to support USACE efforts to restore the CRE. The reservoir and Water Reservation rule also serve as the recovery strategy for the Caloosahatchee River MFL (**Figure 4-3**). It is a prospective reservation, meaning the water will be available when the reservoir is built and operational. The Water Reservation reserves from consumptive use all water contained within and released from the reservoir, which will occupy 10,700 acres and provide 170,000 acre-feet of water storage when completed (for further details, see **Chapter 7**). Capture and release of surface water flows and a portion of Lake Okeechobee releases will reduce the amount of freshwater flows to the CRE during wet periods, and also help to maintain a desirable minimum flow of fresh water to the estuary during dry periods. Moderating flows in this manner is anticipated to achieve a more balanced salinity regime in the CRE. Site preparation for the reservoir and construction began in 2015. Construction is expected to be completed by 2022, to be followed by 1 to 2 years of operational testing and verification before the reservoir is put into full operation.

Water Reservation for Picayune Strand

Picayune Strand is located in the southwestern corner of Florida between Alligator Alley (Interstate 75) and Tamiami Trail (U.S. 41), and north of Fakahatchee Estuary in the Ten Thousand Islands and the Everglades (**Figure 4-4**). Picayune Strand occupies a 55,000-acre area that was disturbed by partial development in the 1960s, including construction of canals, levies, and roads, that altered the natural hydrology of the site.

Today, the native wetlands and uplands of Picayune Strand are being restored to pre-development condition through the CERP Picayune Strand Restoration Project

(**Figure 4-5**). Although shown in **Figures 4-4** and **4-5**, Merritt Canal has been plugged. Restoring the historical hydrology of the site will provide much needed freshwater flows to the southern coastal wetlands of the Ten Thousand Islands region collectively known as Fakahatchee Estuary. Expected benefits also include a more natural fire regime and improved aquifer recharge.

As required for CERP projects, the Picayune Strand Water Reservation was adopted in 2009 to support the Picayune Strand Restoration Project and to protect fish and wildlife [Subsection 40E-10.041(1), F.A.C.]. This quantity of water includes all surface water contained within Picayune Strand, all surface water flowing into Picayune Strand simulated at weirs Miller2 (Miller Canal), FU3 (Faka Union Canal), and Lucky LA (Merritt Canal) **(Figure 4-6)** as well as all groundwater in the water table and unconfined portions of the Lower Tamiami aquifer underlying Picayune Strand.

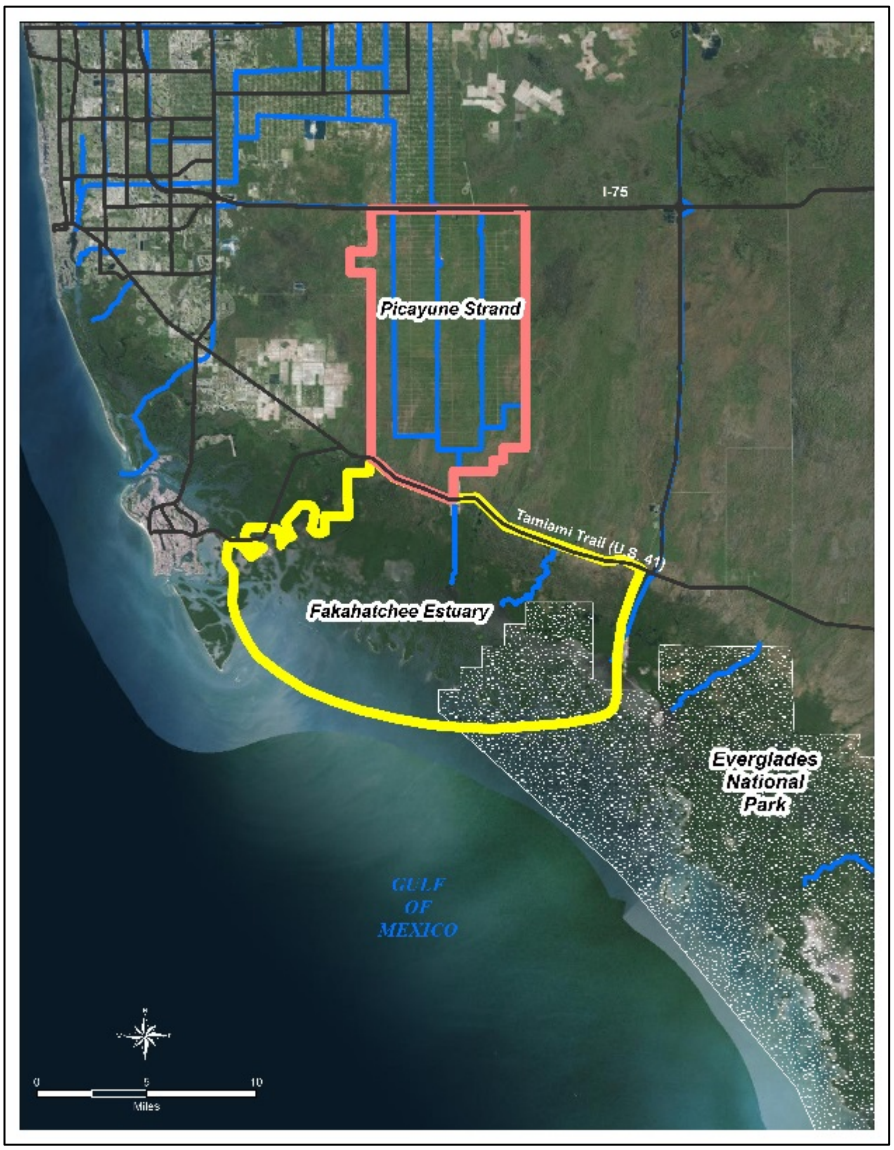


Figure 4-4. Location of Picayune Strand and Fakahatchee Estuary Water Reservations relative to Everglades National Park.

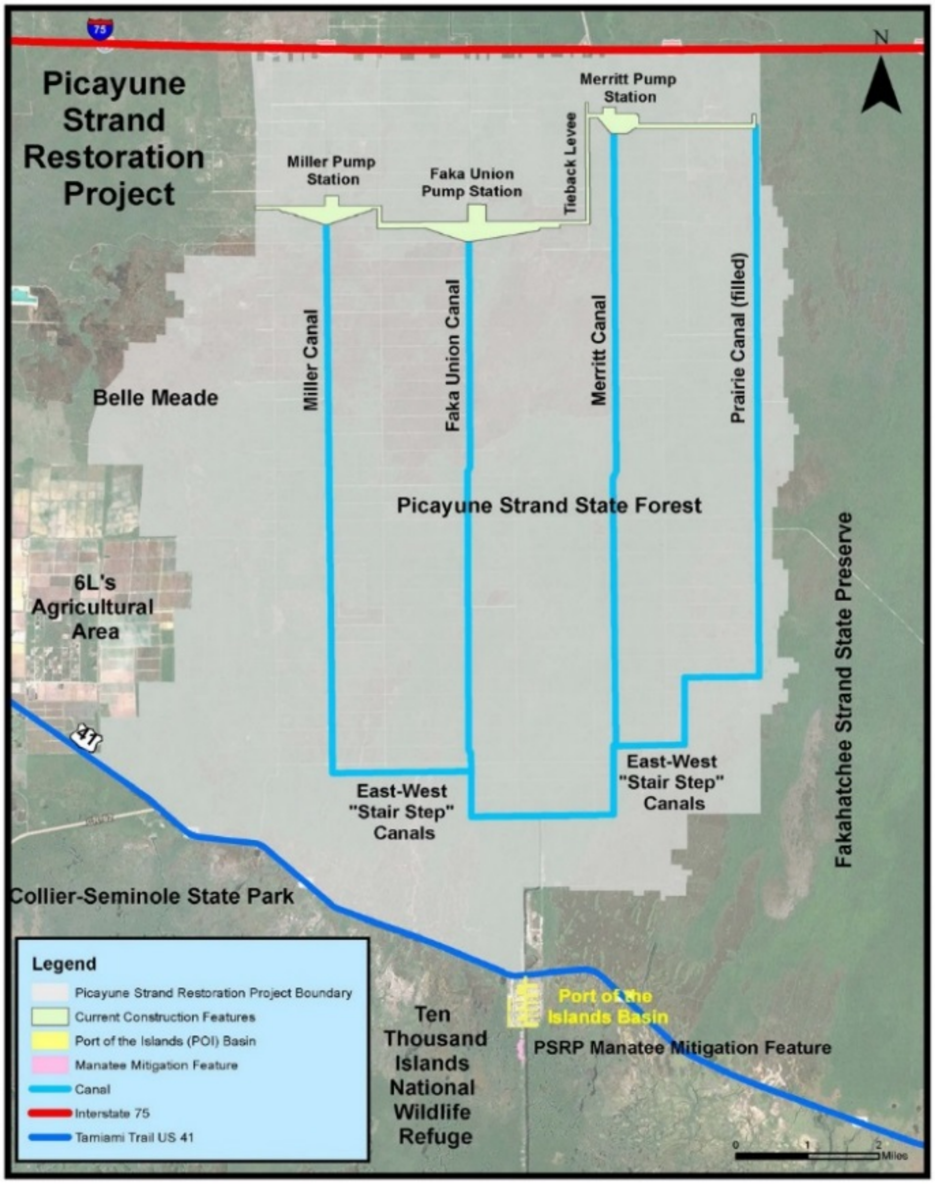


Figure 4-5. Comprehensive Everglades Restoration Plan (CERP) Picayune Strand Restoration Project site (From: United States Army Corps of Engineers 2017).

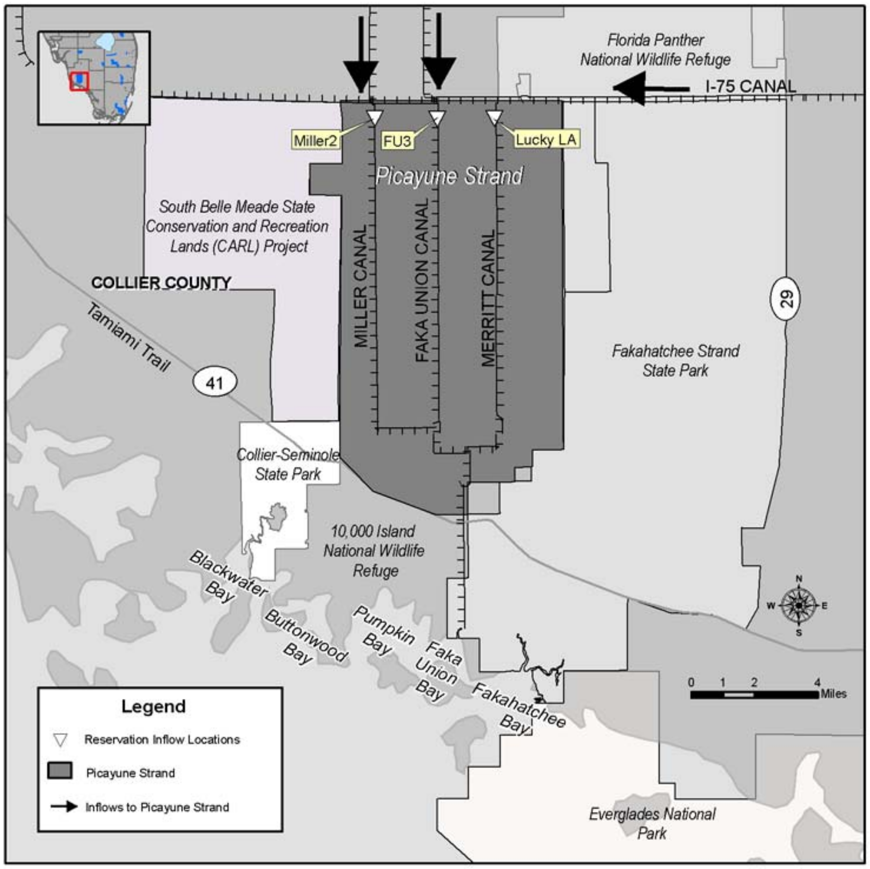


Figure 4-6. Historic water inflow locations into Picayune Strand from Miller, Faka Union, and Merritt canals.

Water Reservation for Fakahatchee Estuary

Subsection 40E-10.021(1), F.A.C., defines Fakahatchee Estuary as the area within the Ten Thousand Islands region including the river/bay systems known as Blackwater River/Blackwater Bay, Whitney River/Buttonwood Bay, Pumpkin River/Pumpkin Bay, Wood River, Little Wood River, Faka Union Canal/Faka Union Bay, and Fakahatchee Bay (**Figure 4-6**). Covering almost 100,000 acres, Fakahatchee Estuary is part of the largest expanse of mangrove forest in North America and is home to a rich diversity of native wildlife, including several endangered species (USFWS 2017).

A Water Reservation for Fakahatchee Estuary was adopted in 2009, for the protection of fish and wildlife [Subsection 40E-10.041(2), F.A.C.], simultaneously with the adoption of the Water Reservation for Picayune Strand. The reservation protects water made available to the estuary through Picayune Strand Restoration Project, which has a main objective to improve flows to the southern coastal estuaries. The Fakahatchee Estuary Water Reservation rule identifies, and reserves from consumptive use, the water needed to protect fish and wildlife in the estuary. The quantity of water reserved for Fakahatchee Estuary includes all surface water flowing into Fakahatchee Estuary simulated at weir FU1 (Faka Union Canal) and transects Miller@41, FU@41, Merrit@41, and Fakahatchee@41 (**Figure 4-7**) as well as all groundwater in the water table and unconfined portions of the Lower Tamiami aquifer underlying Fakahatchee Estuary.

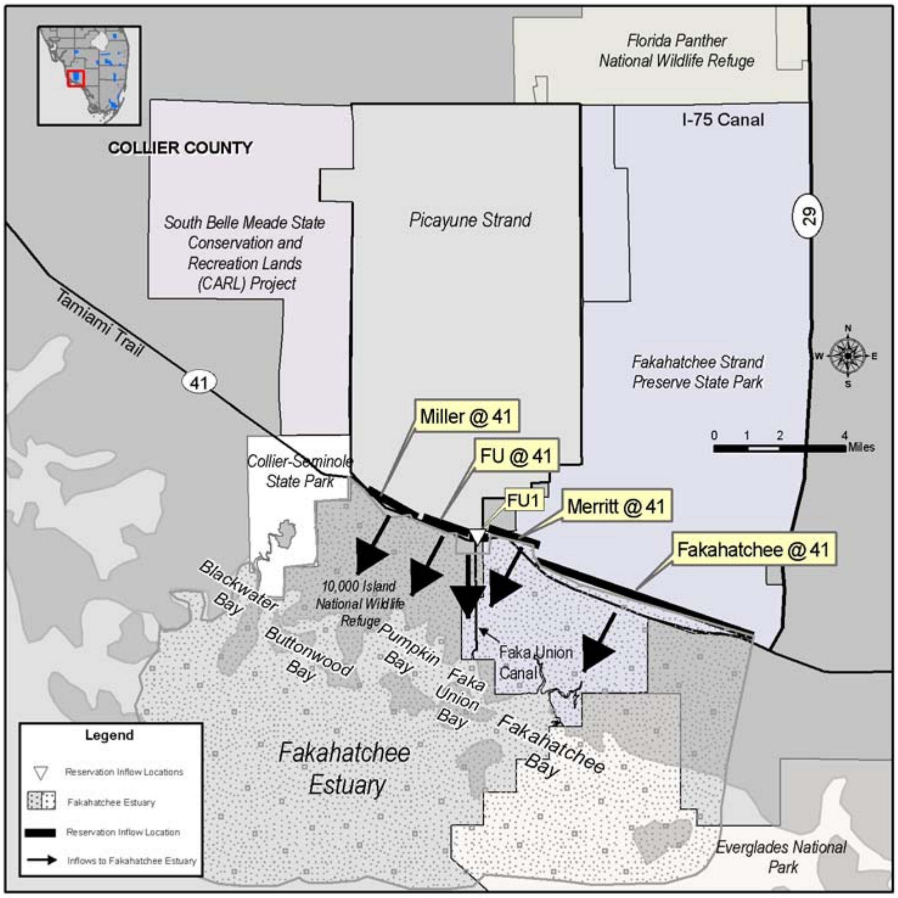


Figure 4-7. Historic inflow locations into Fakahatchee Estuary from Picayune Strand.

Restricted Allocation Areas

RAAs are defined geographic areas where water allocations from water resources (e.g., lakes, wetlands, canals, aquifers) are limited to some base condition. Further allocations beyond the base condition are restricted or prohibited. RAAs are established where there is a lack of water available to meet the projected needs of a region. RAAs may be established to protect water for natural systems and future restoration projects (e.g., CERP), and they may be designated as parts of adopted MFL recovery or prevention strategies. RAA criteria for specific 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. **Figure 4-3** shows the locations of established RAAs in the LWC Planning Area.

RAA for the Lower East Coast Everglades Water Bodies

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]). The area is more than 1.5 million acres in size and includes Water Conservation Areas 1, 2A, 2B, 3A, and 3B; the Holeyland/Rotenberger Wildlife Management Areas; and the freshwater portions of ENP. A small portion of this RAA, located in the northwest corner of ENP, lies within the LWC Planning Area (**Figure 4-3**). In the RAA, water allocations generally are limited to base condition water uses permitted as of April 1, 2006.

RAA for Lake Okeechobee and Lake Okeechobee Service Area

An RAA was established for Lake Okeechobee and the Lake Okeechobee Service Area in 2008 (Subsection 3.2.1.F of the Applicant's Handbook [SFWMD 2015]). The area is more than 1.8 million acres in size and includes Lake Okeechobee and the integrated conveyance systems that are hydraulically connected to, and receive water from, Lake Okeechobee, such as the Caloosahatchee River, the St. Lucie Canal, and secondary canal systems that receive Lake Okeechobee water for water supply purposes via gravity flow or pump. A significant portion of the RAA lies within the LWC Planning Area (**Figure 4-3**). In the RAA, water allocations generally are limited to base condition water uses that occurred from April 1, 2001 to January 1, 2008. The RAA serves as a part of the MFL recovery strategy for Lake Okeechobee.

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, which can result in long-term, irreversible, or permanent loss of water resource functions [Subsection 40E-8.021(30), F.A.C.].

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 reduction in use. Chapters 40E-21 and 40E-22, F.A.C., contain regional water shortage plans and restrictions related to specific water bodies, including the C-43 Canal and Lake Okeechobee. Further information on water shortage management is available in the *2016 Water Supply Plan Update Support Document* (SFWMD 2016).

MONITORING PROGRAMS

SFWMD Hydrogeologic Monitoring in the LWC Planning Area

The SFWMD has implemented numerous monitoring efforts throughout the District to support various state, county, and utility projects, with the intent of better understanding potential impacts to surface water and groundwater resources. Monitoring efforts in the LWC Planning Area include the following:

- **Caloosahatchee River Estuary water quality monitoring** – The SFWMD maintains an active monitoring network associated with surface water quality and hydraulic conditions within the Caloosahatchee River Estuary. Additionally, numerous scientific investigations are under way in support of the Caloosahatchee River MFL re-evaluation (**Appendix C**). Parameters include rainfall, flows, salinity, nutrients, chlorophyll, and aquatic habitat (e.g., oysters, submerged aquatic vegetation). A detailed discussion of the most recent monitoring efforts in the estuary can be found in Volume I – Chapter 8C (Zheng et al. 2017) of the *2017 South Florida Environmental Report*.

- **Floridan aquifer system (FAS) water quality sampling and analysis** – The SFWMD samples and analyzes a comprehensive set of water parameters from a network of FAS wells within the LWC Planning Area on a 5-year rotational basis to provide long-term data on salinity and other basic water quality parameters. The data are stored and made available to the public through the District's DBHYDRO environmental database. **Figure 4-8** presents a map of the FAS wells composing the well network in the LWC Planning Area.
- **Florida Geological Survey potentiometric surface mapping support** – The SFWMD extracts and compiles water level data from the Upper Floridan aquifer in the LWC Planning Area and provides the data to the Florida Geological Survey for construction of annual state-wide potentiometric surface maps, which are available to the public.
- **Well replacement** – During road expansion efforts in Collier County, the SFWMD constructed new monitoring wells to replace wells that were to be destroyed in an effort to maintain consistency in water level data collected from strategic locations within the LWC Planning Area.
- **Underground injection control well instrumentation** – The SFWMD worked with utilities operating deep injection well systems at Marco Island and Fort Myers Beach to install continuously recording water level sensors that provide additional coverage of water level monitoring within the FAS.
- **Saltwater interface mapping** – The SFWMD reviewed recent water quality data and prepared updated maps of the extent of saltwater intrusion within the surficial and intermediate aquifer systems in Collier and Lee counties.

Lee County Hydrological Monitoring Program

The Lee County Hydrological Monitoring Program is responsible for collecting watershed data from a network of monitoring equipment, which consists of the following:

- Rain gauges equipped to allow real-time access;
- Stage recorders that record water levels in surface waterways; and
- Monitor wells that record water levels in shallow aquifers.

Currently, the network comprises approximately 190 shallow monitor wells, 23 recording rain gauges, and 11 continuous stage recorders. In addition, Lee County has a joint agreement with the United States Geological Survey to operate eight additional continuous stage recorders.

Collier County Monitoring Programs

Several surface water, groundwater, and sediment monitoring programs are in place in Collier County to comply with the Water Pollution Control Program Ordinance 89-20, the Growth Management Plan's Conservation and Coastal Management Element, and the Natural Groundwater Aquifer Recharge Sub-Element. The programs consist of the following:

- **Surface Water Quality Monitoring** – This project monitors ambient water quality conditions in canals and provides data for long-term trend analysis. Surface water quality monitoring currently is performed at 50 fixed locations. Samples are analyzed regularly for general water quality parameters such as bacteria, nutrients, and metals.

- **SFWMD Groundwater Quality Monitoring** – Under an agreement between Collier County and the SFWMD, 45 groundwater sites are sampled semiannually for general water quality parameters, nutrients, and metals, and every 5 years for pesticides, as funding allows.
- **Sediment Quality Monitoring** – A sediment study is conducted every 5 years to determine the chronic anthropogenic impacts of urban and agricultural land uses on the canals and flow-ways that discharge into estuaries or percolate into groundwater.

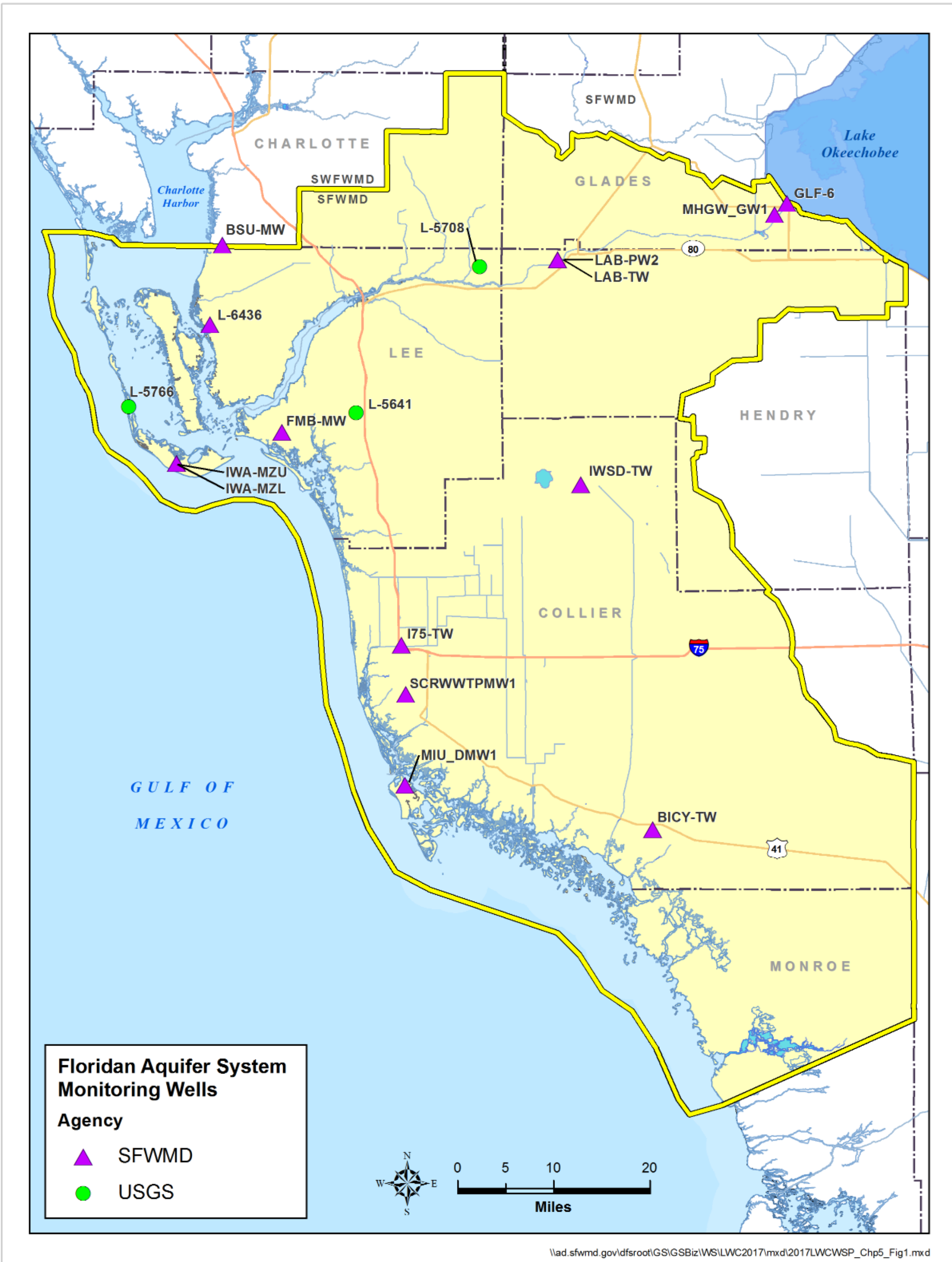


Figure 4-8. Floridan aquifer system monitoring wells in the Lower West Coast Planning Area.

SUMMARY OF WATER RESOURCE PROTECTION

The following accomplishments have been made towards fulfilling the resource protection recommendations made in previous plans:

- In 2011, the Florida Department of Environmental Protection initiated a statewide effort to improve consistency in the consumptive/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 that became effective in 2014. The Applicant's Handbook (SFWMD 2015) contains the revised SFWMD water use permitting criteria.
- In 2013, changes were made to Section 373.236, F.S., to extend the duration of water use permits in some situations. For example, alternative water supply development permits will be granted for at least 30 years if there is reasonable assurance that the conditions of the permit will be met for the duration.
- A prospective Water Reservation rule was adopted in 2014 for the Caloosahatchee River (C-43) West Basin Storage Reservoir, and construction of the reservoir has begun.
- Re-evaluation of the adopted MFL criteria for the Caloosahatchee River is under way.
- In 2015, the SFWMD published (Geddes et al. 2015) detailed hydrogeologic maps indicating the elevation of the structural top of the Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers (**Appendix C**). The maps establish the MFL elevations of the aquifers throughout the LWC Planning Area.

REFERENCES

Edwards, T. 2017. Chapter 3: 2017 Priority Waterbodies List and Schedule. In: *2017 South Florida Environmental Report – Volume II*. South Florida Water Management District, West Palm Beach, FL.

Geddes, E., E. Richardson, and A. Dodd. 2015. *Hydrogeologic Unit Mapping Update for the Lower West Coast Water Supply Planning Area*. Technical Publication WS-35. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2013. *2013 Lower East Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, Florida. 294 pp.

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 7, 2015.

SFWMD. 2016. *2016 Water Supply Plan Update Support Document.* South Florida Water Management District, West Palm Beach, FL. March 2016.

USACE. 2017. *Picayune Strand Restoration Project Fact Sheet*. United States Army Corps of Engineers, Jacksonville, FL and South Florida Water Management District, West Palm Beach, FL. April 2017.

USFWS. 2017. *Ten Thousand Islands National Wildlife Refuge*. United States Fish & Wildlife Service. Available at: https://www.fws.gov/refuges/profiles/index.cfm?id=41555.

Zheng, F., P. Doering, Z. Chen, L. Baldwin, B. Orlando, R. Robbins, and B. Welch. 2017. Chapter 8C: St. Lucie and Caloosahatchee River Watershed Research and Water Quality Monitoring Results and Activities. In: *2017 South Florida Environmental Report – Volume I*. South Florida Water Management District, West Palm Beach, FL.

5

Water Source Options

This chapter presents water supply source options that could be available through 2040 within the Lower West Coast (LWC) Planning Area to accommodate future urban and agricultural growth while still meeting the needs of the ecosystem. **Chapter 6** presents evaluations of the current condition and availability of water from each source.

TOPICS

- Surface Water
- Groundwater
- Reclaimed Water
- New Water Storage Capacity
- Seawater
- Summary of Water Source Options

In the LWC Planning Area, fresh water is considered a traditional water source and includes surface water from Lake Okeechobee, a regional network of connected canals, and groundwater from the surficial aquifer system (SAS) or the freshwater portions of the intermediate aquifer system (IAS). In areas where the IAS has been impacted by lateral saltwater intrusion or upward vertical migration, the groundwater is brackish and considered an alternative water source. Alternative water sources also include brackish groundwater from the Floridan aquifer system (FAS), reclaimed water, seawater, water stored through aquifer storage and recovery (ASR), or stormwater stored in above-ground reservoirs.

This chapter includes descriptions of water source options, current and projected uses, and factors that affect availability for water supply purposes. 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

Surface water is natural water that has not penetrated much below the surface of the ground. Surface water resources in the LWC Planning Area consist of lakes, rivers, reservoirs, and canals constructed for navigation, flood control, and drainage. Most surface water in the LWC Planning Area is a result of local rainfall and associated basin runoff. A primary surface water source in the LWC Planning Area is the C-43 Canal and its connected canals. Water is discharged from Lake Okeechobee to the C-43 Canal through the S-77 water control structure and then into the Caloosahatchee River Estuary downstream of the S-79 structure. The Caloosahatchee River Estuary covers approximately 26 miles west towards Shell Point. The C-43 Canal and Caloosahatchee River Estuary receive surface water from Lake Okeechobee; runoff from four subwatersheds—S-4, East Caloosahatchee, West Caloosahatchee, and Tidal

Caloosahatchee (**Figure 5-1**); and a small amount of base groundwater flow from the SAS. The watershed includes creeks, wetland tributaries, canals, and drainage ditches that provide limited storage and allow conveyance of surface water. The Cape Coral and Big Cypress Basin canal systems also provide surface water supply, and to a lesser extent, local irrigation needs are met using stormwater ponds.

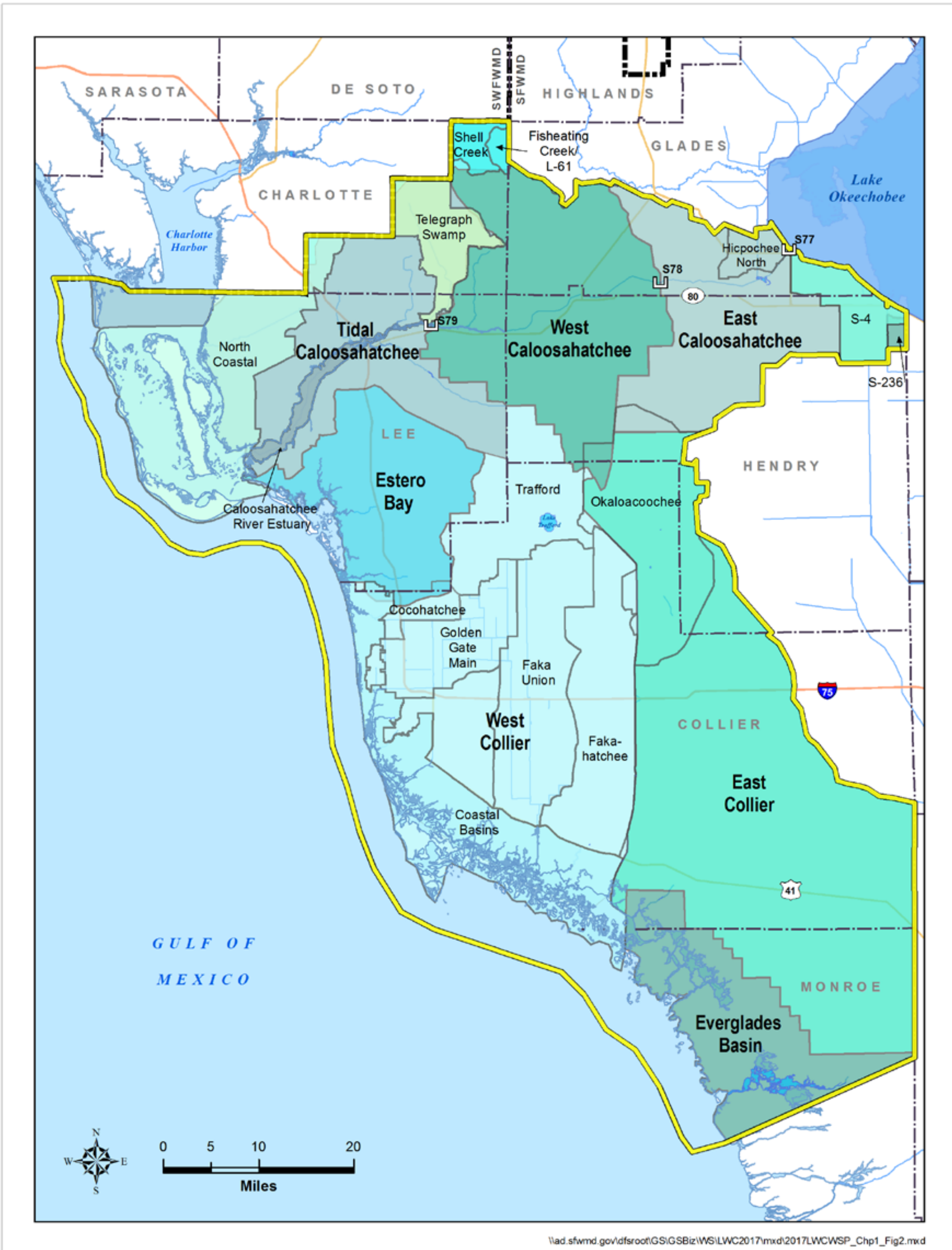


Figure 5-1. Lower West Coast Planning Area drainage basins.

Agricultural Irrigation (AGR) is the largest water use category in the LWC Planning Area and the primary user of surface water. Additional surface water may be available for AGR in some areas and quantities will depend on local conditions.

Water availability from Lake Okeechobee and its hydraulically connected water bodies is limited due to implementation of the 2008 Lake Okeechobee Regulation Schedule as well as SFWMD water use permit criteria. Concerns about the integrity of the Herbert Hoover Dike, which surrounds Lake Okeechobee, have resulted in a lowered regulation schedule that has reduced the level of certainty of Lake Okeechobee Service Area users experiencing water shortage restrictions from 1-in-10 years to 1-in-6 years. The estimated completion date for the Herbert Hoover Dike rehabilitation is 2025.

GROUNDWATER

Groundwater is produced from three major aquifer systems in the LWC Planning Area: the SAS, the IAS, and the FAS (**Figure 5-2**). The SAS and portions of the IAS provide fresh groundwater, while other portions of the IAS and upper portion of the FAS provide brackish groundwater. For a detailed description of the geology within the LWC Planning Area, including mapping of the hydrostratigraphic unit, see Geddes et al. (2015).

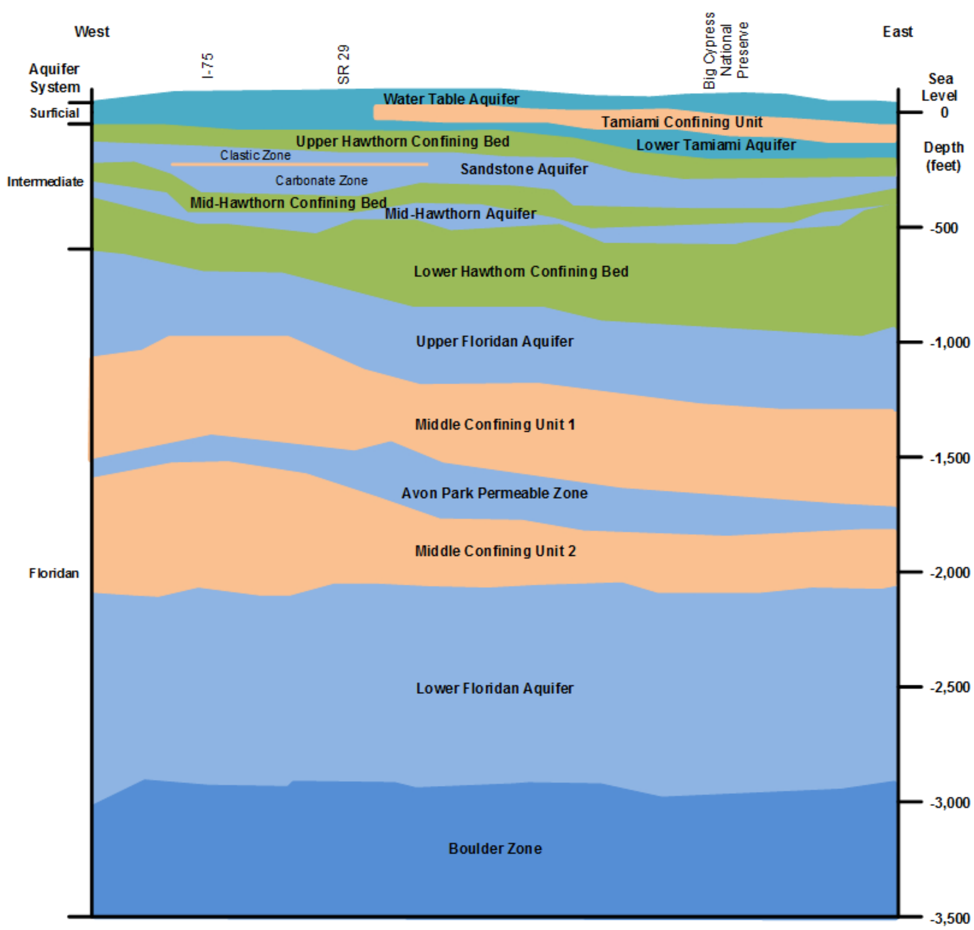


Figure 5-2. Generalized hydrogeologic cross-section of the Lower West Coast Planning Area.

In the LWC Planning Area, the SAS is composed of two water-bearing zones: the Water Table aquifer and the Lower Tamiami aquifer, which usually are separated by a semi-confining unit. The IAS also is composed of two water-bearing zones: the Sandstone aquifer and the Mid-Hawthorn aquifer, which are separated by the Mid-Hawthorn confining unit. The Lower Hawthorn confining unit separates the IAS from the FAS. The FAS is composed of the Upper Floridan aquifer and the Lower Floridan aquifer, which are separated by multiple confining units. The Upper Floridan aquifer is further subdivided into the Suwannee and Avon Park Permeable producing zones.

Fresh Groundwater

Surficial Aquifer System

Historically, the SAS has been the primary source of potable water for public consumption and urban irrigation throughout the LWC Planning Area. From a regional perspective, the development of the SAS has been maximized over time, and potential increases in allocation are limited, especially in coastal areas. The SAS is recharged by infiltration from rain and local surface water bodies. Water availability from the SAS is limited by the rate of recharge and water movement in the aquifer, wetland impacts and off-site land use, proximity to contamination sources, saltwater intrusion, and other existing legal users.. **Figure 5-3** presents a map of individually permitted wells (not including domestic wells) currently penetrating the various groundwater aquifers discussed in this section.

WATER OPTIONS

Freshwater sources include sources historically used as the region's primary sources of water. Water quality and availability determine the viability of freshwater sources and differ among regions. Where freshwater sources have limited availability, alternative water sources must be identified and developed. 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).

In 2009, the SAS provided approximately 50 percent of the water in the Public Water Supply (PWS) category. However, by 2014 only about 40 percent of PWS was from the SAS. The percentage of SAS use for PWS is projected to continue decreasing over time as the use of other alternative water sources (e.g., reclaimed and brackish water) increases.

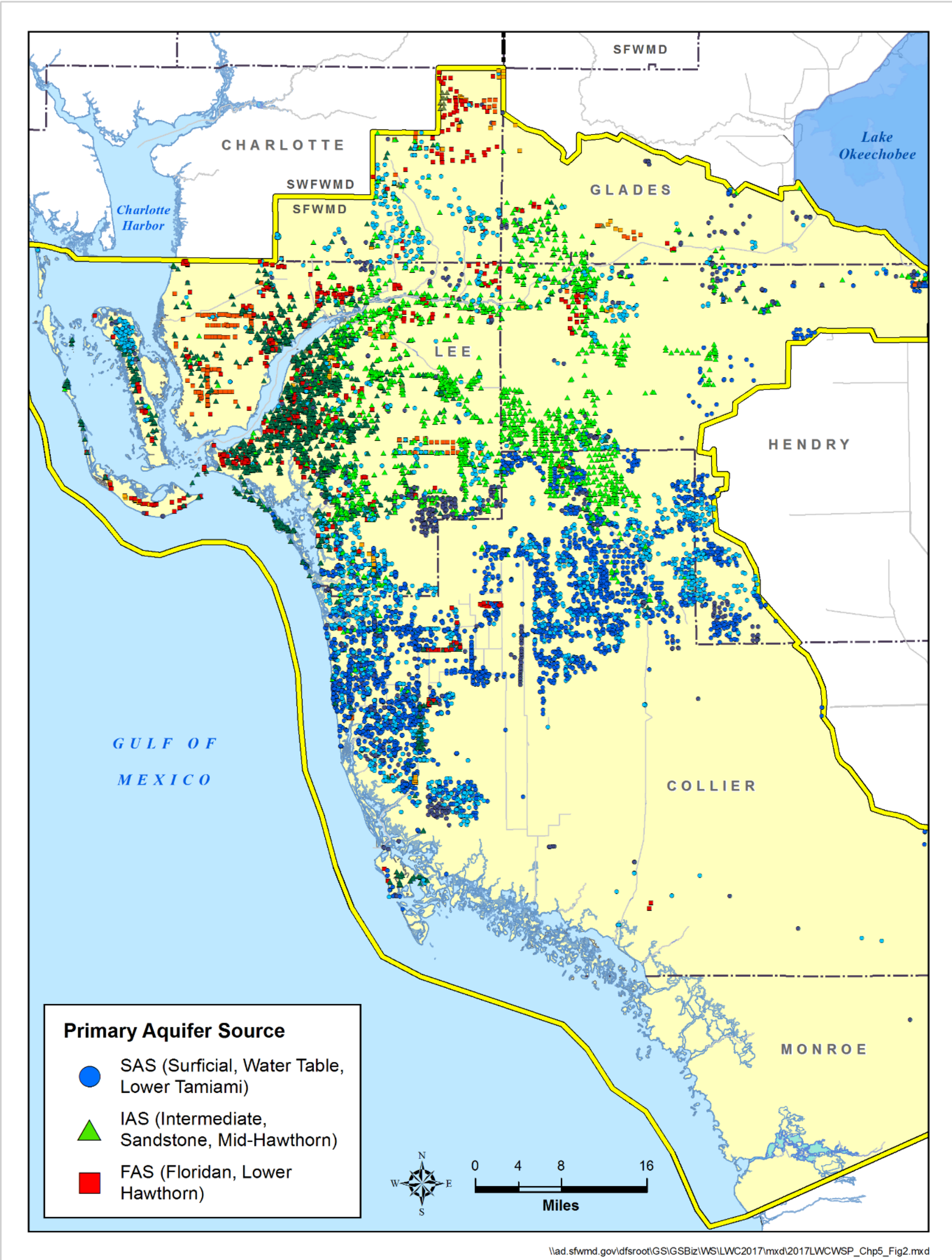


Figure 5-3. Wells penetrating the aquifers in the Lower West Coast Planning Area. (Note: Variations of color represent subdivisions within the aquifer systems.)

Intermediate Aquifer System

The IAS is composed of relatively thin, discontinuous beds of sand, sandstone, and limestone that provide moderate quantities of water when present. There are several confining sequences that divide the water bearing units in this aquifer, which is contained within the Hawthorn Group. The IAS provides fresh groundwater throughout most of the region; however, there are locations where the aquifers have been impacted by lateral saltwater intrusion from coastal seawater or by upward vertical intrusion from wells that have tapped deeper underlying brackish aquifers. In 2014, the IAS provided approximately 15 percent of water to the PWS utilities in the LWC Planning Area.

Sandstone Aquifer

The Sandstone aquifer, where present, is contained entirely within the Peace River Formation of the Hawthorn Group. It typically occurs as two distinct permeable units, an upper clastic zone and a lower carbonate zone. The Sandstone aquifer is composed of sandstone, sandy limestones, dolostones, and calcareous sands. These may be contiguous or separated by varying amounts of low-permeability silt and clay. The Sandstone aquifer is separated from the underlying Mid-Hawthorn aquifer by low-permeability clays and marls of the basal Peace River Formation, which is present throughout the LWC Planning Area.

Mid-Hawthorn Aquifer

The Mid-Hawthorn aquifer, where present, is composed of biomicritic limestone, phosphate, shell, and lime mud. It lies entirely within the Arcadia Formation of the Hawthorn Group. Where the Sandstone aquifer is absent or insignificant, the entire thickness of the Peace River Formation isolates the Mid-Hawthorn aquifer from the overlying SAS. The confinement from the underlying Lower Hawthorn producing zone consists of carbonate muds and terrigenous clays of the upper Arcadia Formation and is present throughout the LWC Planning Area. Use of the Mid-Hawthorn aquifer primarily occurs in the western part of the LWC Planning Area.

Brackish Groundwater

The FAS is substantially more productive than the SAS and IAS in the LWC Planning Area, and is used extensively by PWS utilities. The FAS also is under artesian conditions (i.e., the wells flow naturally at land surface without the need for a pump).

> **WATER OPTIONS**
>
> Brackish water has a chloride concentration greater than 250 mg/L and less than 19,000 mg/L (seawater). The terms fresh, brackish, salt, and brine are used to describe the quality of water. Although brackish supplies in the low range of these salinities may be used for some agricultural purposes. Advanced treatment technologies, such as reverse osmosis, electrodialysis, or electrodialysis reversal, must be employed before this type of supply is suitable for human consumption.

Water quality in the FAS decreases substantially from north to south within the LWC Planning Area, increasing in hardness and salinity (chlorides). Salinity also increases with depth, making the deeper producing zones less desirable for development than shallower parts of the system.

Nine of the 23 utilities in the LWC Planning Area currently withdraw from the FAS as a drinking water source. All the utilities use reverse osmosis (RO) to remove excess salinity as part of the treatment process. **Figure 5-4** maps the reverse osmosis water treatment plants in the LWC Planning Area. To some extent, FAS water can be blended with fresh water and treated with lime softening or nanofiltration technology to meet drinking water standards for chloride concentrations. The ability to use blending depends on the water quality of the FAS water and other treated water produced by the utility. Blending can increase production efficiency.

In 2014, approximately 45 percent of the water supply used by PWS in the LWC Planning Area was derived from the FAS. The ratio of FAS to SAS use to meet demands has increased since 1999 (**Figure 5-5**). The use of the FAS as a supply source for PWS is expected to increase to accommodate the region's growth through 2040. In this *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update), local utilities have proposed an additional 51.5 million gallons per day (mgd) of brackish water development by 2040.

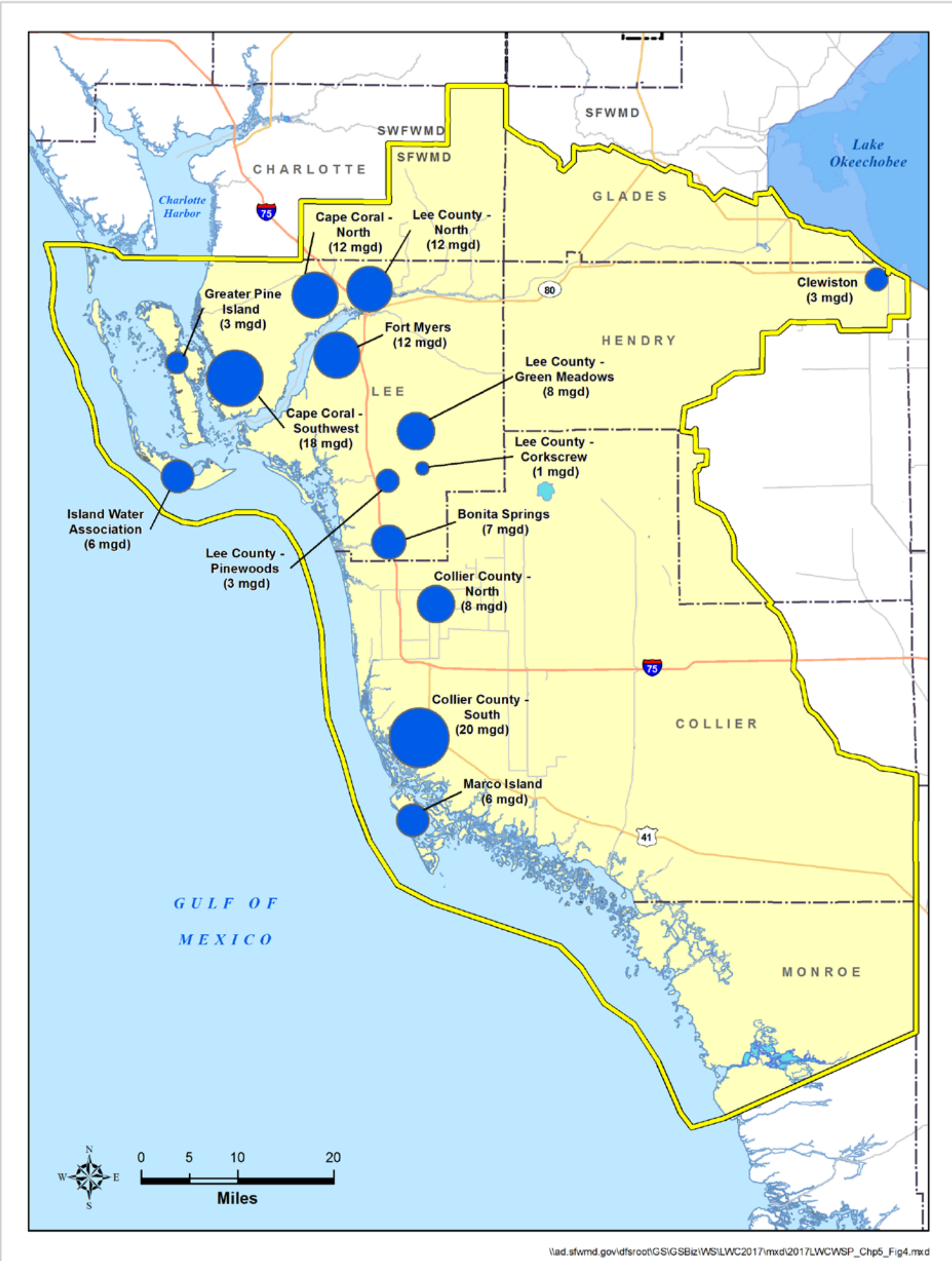


Figure 5-4. Water treatment plants and capacities using reverse osmosis in the Lower West Coast Planning Area.

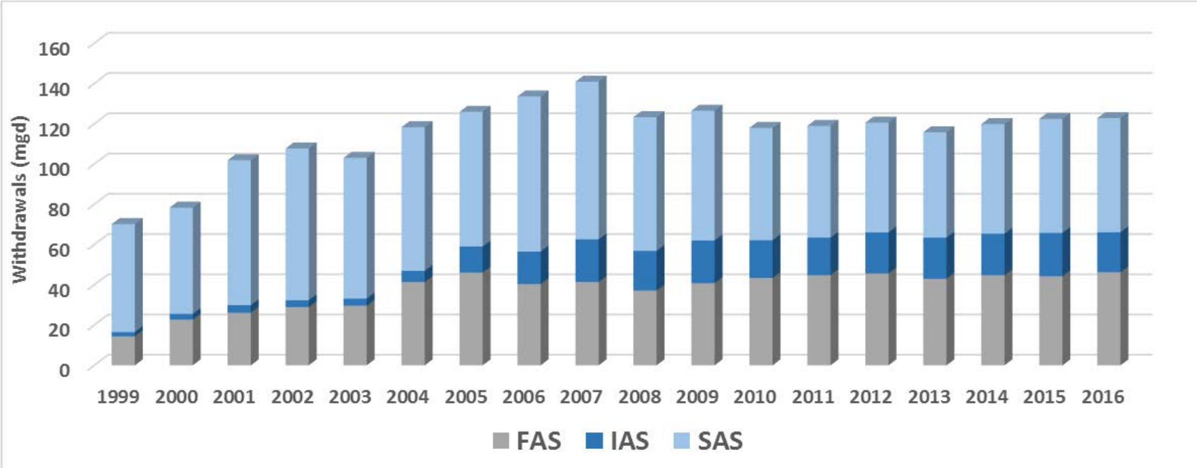


Figure 5-5. Public water supply utility withdrawals by source in the Lower West Coast Planning Area (1999 to 2016).

RECLAIMED WATER

Reclaimed water is wastewater that has received at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility (WWTF) [Rule 62-610.200, Florida Administrative Code (F.A.C.)]. Reuse is 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.” Reclaimed water is a key component of water resource management in South Florida. Potential uses of reclaimed water include landscape irrigation (e.g., medians, residential lots), golf course irrigation, agricultural irrigation, groundwater recharge, industrial uses, and environmental enhancement. Reclaimed water also can be treated for direct or indirect potable reuse. Although no utilities in the LWC Planning Area have proposed potable reuse projects by utilities elsewhere in Florida.

The State of Florida encourages and promotes the use of reclaimed water. The Water Resource Implementation Rule [Chapter 62-40, F.A.C.] requires the Florida Department of Environmental Protection (FDEP) and water management districts to advocate and direct the reuse of reclaimed water as an integral part of water management programs, rules, and plans. The SFWMD requires all individual water use permit applicants to use reclaimed water unless the applicant demonstrates it is not feasible. Reclaimed water provides additional water supply for uses that do not require potable water.

Existing Reuse in LWC Planning Area

The primary use of reclaimed water in the LWC Planning Area is for irrigation of public access areas, including residential lots, golf courses, parks, schools, and other green spaces. Reclaimed water also is used to recharge groundwater through rapid infiltration basins, percolation ponds, and spray fields.

In the LWC Planning Area, wastewater management has evolved over the last 25 years from package plants and subregional facilities to an integrated system of larger regional facilities and a network of reclaimed water pipelines. The volume of reclaimed water used for a beneficial purpose increased more than 137 percent between 1994 and 2015 (**Figure 5-6**). Over this period, the volume of reclaimed water use varied annually, depending on the addition of new users and area rainfall. Some utilities, including Cape Coral and the City of Naples, also supplement reclaimed water with fresh groundwater or surface water to extend their reclaimed supply. In Collier County, ASR wells are used to store reclaimed or surface water during the wet season for recovery when needed for supplementing reclaimed supplies.

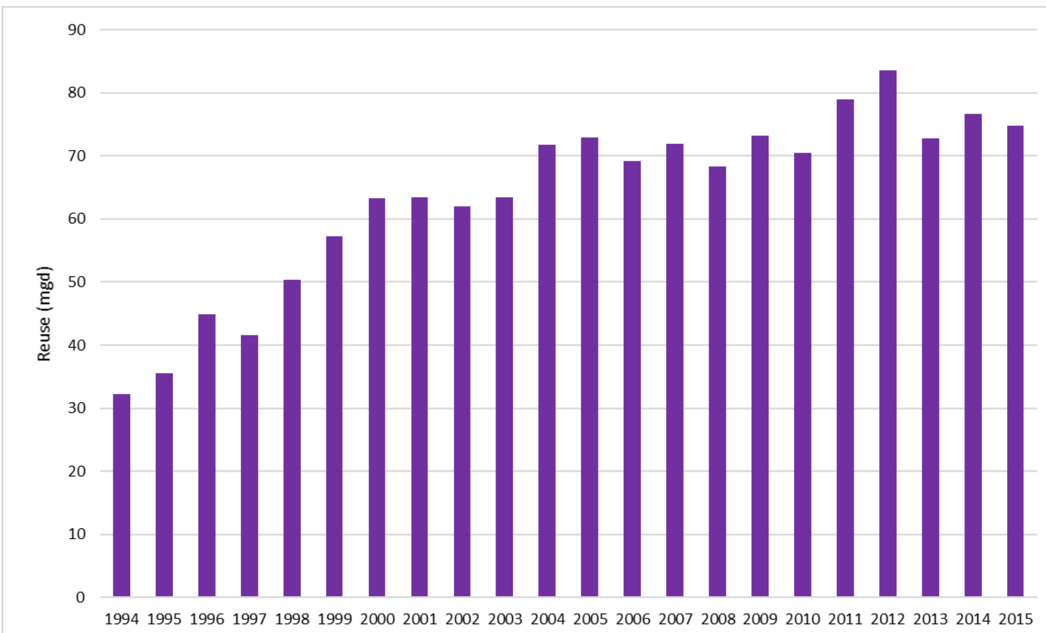
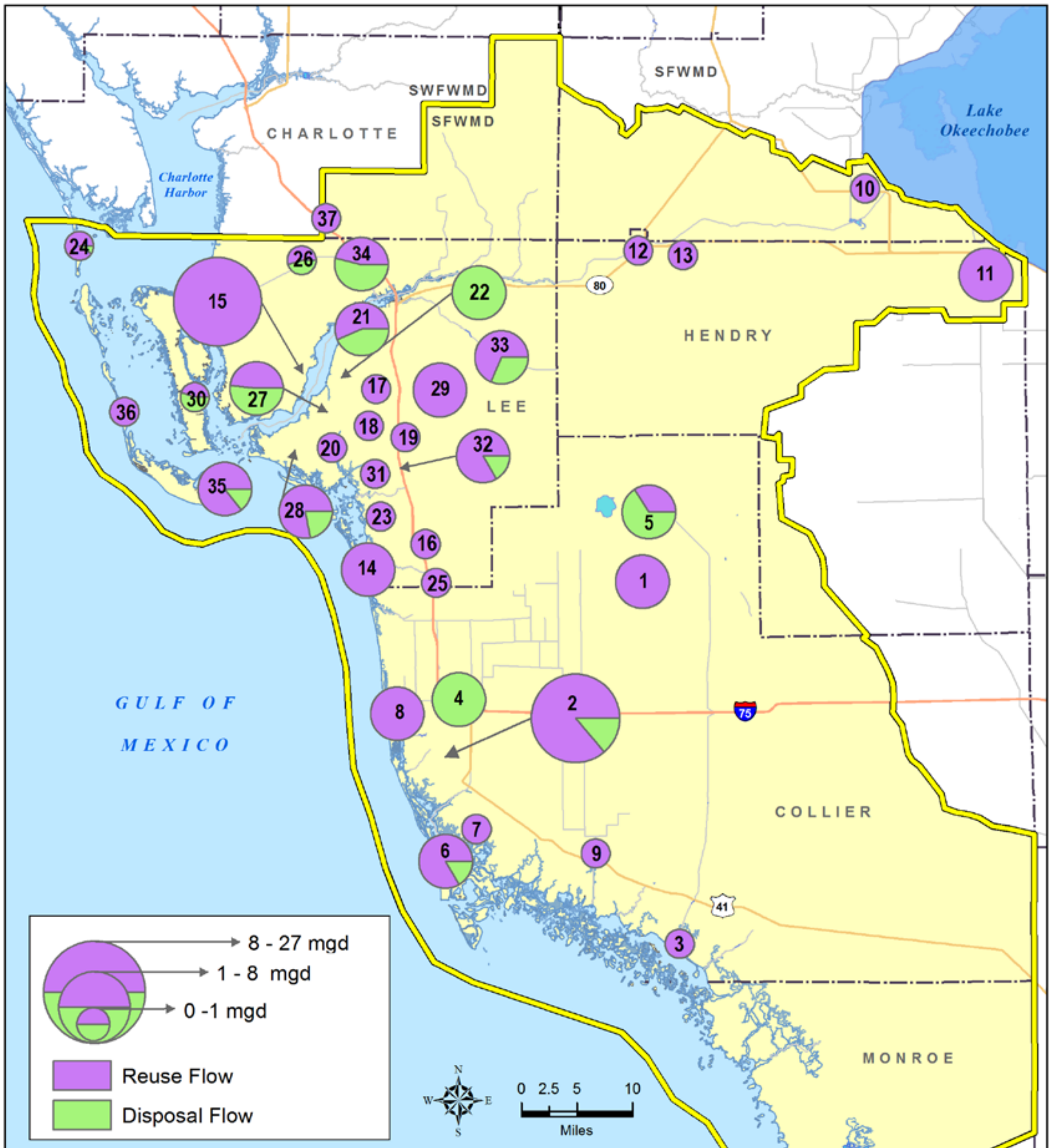


Figure 5-6. Water reuse in the Lower West Coast Planning Area since 1994.

In 2014, 39 WWTFs in the LWC Planning Area had a permitted capacity of 0.1 mgd or greater (**Figure 5-7**); 37 of these facilities reuse at least part of their wastewater. The regional permitted capacity of the WWTFs in the LWC Planning Area totals 158.8 mgd, with an average of 76.7 mgd of wastewater treated in 2014. Regionally, 76.7 mgd (100 percent) of reclaimed water was reused in 2014, if the 21.4 mgd of supplemental water is included. Most water reuse in 2014 was for irrigation at residences, golf courses, parks, and schools. Public access irrigation accounted for 69.1 mgd of the 76.7 mgd reused in 2014. The remaining 7.6 mgd of water reuse was for groundwater recharge, and other miscellaneous applications like agriculture, wetlands, cooling water, treatment processes, and toilet flushing. Effluent not reused was disposed of through deep well injection (8.5 mgd) or surface-water disposal (11.9 mgd).

The *2014 FDEP Reuse Inventory Report* (FDEP 2015a) indicated that 88 percent of wastewater flow in Collier County and 100 percent in Lee County, with supplemental water included in the calculation, was reused. A listing of reclaimed water facilities and capacities is provided in **Appendix D**.



1	Ave Maria Utility	11	Clewiston	20	Forest Utilities	29	Lee County - Gateway
2	Collier County - North & South	12	LaBelle WWTF	21	Fort Myers - Central	30	Lee County - Pine Island
3	Everglades City	13	Port LaBelle WWTP	22	Fort Myers - South	31	Lee County - San Carlos
4	FGUA - Golden Gate	14	Bonita Springs - East & West	23	Fountain Lakes	32	Lee County - Three Oaks
5	Immokalee	15	Cape Coral - Everest & Southwest	24	Gasparilla Island	33	FGUA - Lehigh Acres
6	Marco Island	16	Citrus Park - North	25	Hunter's Ridge	34	FGUA - Del Prado (North Fort Myers)
7	Marco Shores	17	Cross Creek	26	FGUA - Lake Fairways	35	Sanibel - Donax
8	Naples	18	Eagle Ridge	27	Lee County - Fiesta Village	36	FGUA - South Seas Plantation
9	Port of the Islands - South	19	Fiddlesticks Country Club	28	Lee County - Fort Myers Beach	37	Charlotte Correctional Institution
10	Glades County Correctional	Note: #2, #14, and #15 each include 2 facilities.					

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Figure 5-7. Wastewater treatment facilities in the Lower West Coast Planning Area.

Reclaimed Water System Interconnects

Reclaimed water system interconnects may be owned or operated by different utilities, or may be shared between two or more domestic WWTFs that provide reclaimed water for reuse activities. When two or more reclaimed water systems are interconnected, additional system flexibility is attained, increasing efficiency and reliability. The two largest reuse systems in the LWC Planning Area (Collier County and Lee County) utilize interconnects within their multi-facility systems to increase efficiencies. Interconnects between the City of Fort Myers and Cape Coral and between North Fort Myers and Cape Coral are under consideration.

2015 Report on Expansion of Beneficial Use of Reclaimed Water, Stormwater and Excess Surface Water (Senate Bill 536)

The Florida Legislature, recognizing the importance of sustainable water supplies to the state's economy, environment, and quality of life, passed Senate Bill 536 in the 2014 Legislative Session. Senate Bill 536 directed the FDEP to conduct a comprehensive study by December 2015 to determine how the use of reclaimed water, stormwater, and excess surface water could be expanded to assist in meeting future demands.

The *Report on Expansion of Beneficial Use of Reclaimed Water, Stormwater and Excess Surface Water (Senate Bill 536)* (FDEP 2015b) included a review and analysis of the historic development, regulatory framework, current status, and potential for future expansion of reclaimed water, stormwater, excess surface water, and storage. The report discussed impediments and constraints to increasing the use of reclaimed water, stormwater, and excess surface water for water supply, and made recommendations to mitigate or eliminate impediments and provide incentives for increased beneficial use of these water sources.

In addition to statewide recommendations, the report concluded that the SFWMD should continue regional water resource development projects that address a range of water-related needs, including urban and agricultural water supply, and also should continue implementation of storage reservoir projects as part of the Comprehensive Everglades Restoration Plan.

Future Reuse in LWC Planning Area

Utilities are projecting wastewater flows, including supplemental water, will increase from 77 mgd in 2014 to approximately 163 mgd by 2040. Utilities distributing reclaimed water intend to continue and expand their reuse systems as additional reclaimed water and users become available. In addition, opportunities exist to increase water reuse and decrease disposal through interconnects between reuse systems. The major utilities providing reclaimed water are Collier County, Cape Coral, Lee County, Bonita Springs/Resource Conservation Systems, and the City of Naples.

Utilities are well positioned to expand their reclaimed water distribution networks as development occurs. Some utilities are continuing efforts to increase their storage and supplementation capabilities, including the use of ASR wells, in anticipation of increased reclaimed water demand in the future. In many areas, local government development approval includes the use of reclaimed water and the extension of reclaimed water pipelines. Utility projections estimate an additional 89 mgd of reuse by 2040. Many utilities are proposing to use reclaimed water for irrigation in new residential developments, which could replace the use of potable water for irrigation in the developments and reduce the projected PWS demands on the FAS.

Supplemental Sources

The use of supplemental water supplies to increase reliability and meet demands for reclaimed water has been a significant part of water reuse in the LWC Planning Area and is expected to increase in the future. Supplemental sources enable a utility to maximize use of reclaimed water by improving year-round reliability or to initiate reuse before new anticipated wastewater flows are available. Use of supplemental water supplies is subject to water use permitting by the SFWMD.

The City of Cape Coral utilizes the largest amount of supplemental water in the LWC Planning Area and the state. In 2014, almost 15 mgd of supplemental surface water was used by Cape Coral in their water reuse system. Other utilities in the LWC Planning Area that used supplemental sources greater than 1 mgd in 2014 include the City of Naples (1.79 mgd of surface water), Bonita Springs/Resource Conservation Systems (1.70 mgd of groundwater and stormwater), Lee County (1.28 mgd of groundwater), and Collier County (1.05 mgd of groundwater) (**Appendix D**).

NEW WATER STORAGE CAPACITY

Storage is an essential component of any supply system experiencing fluctuation in supply and demand. Capturing and storing excess surface water, groundwater, and reclaimed water during dry conditions increases the use of available water. Two-thirds of South Florida's annual rainfall occurs in the wet season. Without sufficient storage capacity, much of this water discharges to tide through the surface water management system. In the LWC Planning Area, potential types of water storage include ASR and reservoirs.

Aquifer Storage and Recovery

ASR is the underground storage of stormwater, surface water, fresh groundwater, drinking water, or reclaimed water into an acceptable aquifer. The water is stored with the intent to recover it for use in the future. In this process, the aquifer acts as an underground reservoir for injected water. The 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) for use at a later date. The percent of water that is recovered depends on subsurface conditions, storage (residence) time, and water quality. The level of treatment required during recovery depends on whether the water is for public consumption, irrigation, surface water augmentation, or wetlands enhancement.

The volume of water made available through ASR depends on several factors, such as well yield, water availability, aquifer characteristics, variability in water supply and demand, and use type. Uncertainty of storage and yield capabilities as well as water quality characteristics present risks for success, but ASR can provide storage of water that would otherwise be lost to tide, deep well injection, or evaporation.

Most of the ASR systems in the District have been built by PWS utilities as a method of storing potable water during periods of low seasonal demand for subsequent recovery during periods of high demand. **Figure 5-8** shows the locations of ASR projects constructed in the LWC Planning Area and the water source type. To date, ASR systems have been built in the LWC Planning Area by Collier County, Lee County, Marco Island, and the City of Naples.

- **Collier County ASR Program** – The Livingston Road ASR system was developed to enhance Collier County's irrigation-quality water program. Two ASR wells have been constructed, and testing has begun. Collier County also is considering ASR systems at Manatee Road and Carica Road.
- **Lee County ASR Program** – The Corkscrew water treatment plant (WTP) ASR system consists of five ASR wells that store potable treated water. The Olga WTP ASR system was constructed in 2006 to store treated surface water from the C-43 Canal for potable use. This system currently is inactive.
- **Marco Lakes ASR System** – The Marco Lakes ASR system consists of seven ASR wells that capture water from Henderson Creek and store the water in the Lower Hawthorn aquifer. Recovered water is routed to a WTP on the island via pipeline to supplement PWS deliveries.
- **City of Naples ASR Program** – The Naples ASR system has three active ASR wells and a fourth well under construction to store reclaimed water, which will be combined with excess water from the Golden Gate Canal to provide irrigation quality water.

Artificial recharge via injection or ASR into aquifers with a total dissolved solids concentration less than 10,000 milligrams per liter (mg/L) are subject to permitting by the SFWMD [Chapter 40E-5, F.A.C.]. The permit ensures that withdrawal, storage, and recovery of the water will not impact resources and that injected water will not interfere with existing legal uses.

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 mechanisms that are in place in the Florida rules to provide for protection of aquifers and people from the operation of ASR systems. The interpretation of the regulations recognizes implementation of monitoring, treatment technology, and administrative or institutional controls that currently 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 was intended to provide a clear path towards the issuance of permits for ASR systems that otherwise might not meet all state water quality standards for recharged, stored, or recovered water. Several ASR systems throughout Florida are moving forward with operation and permitting under this new guidance.

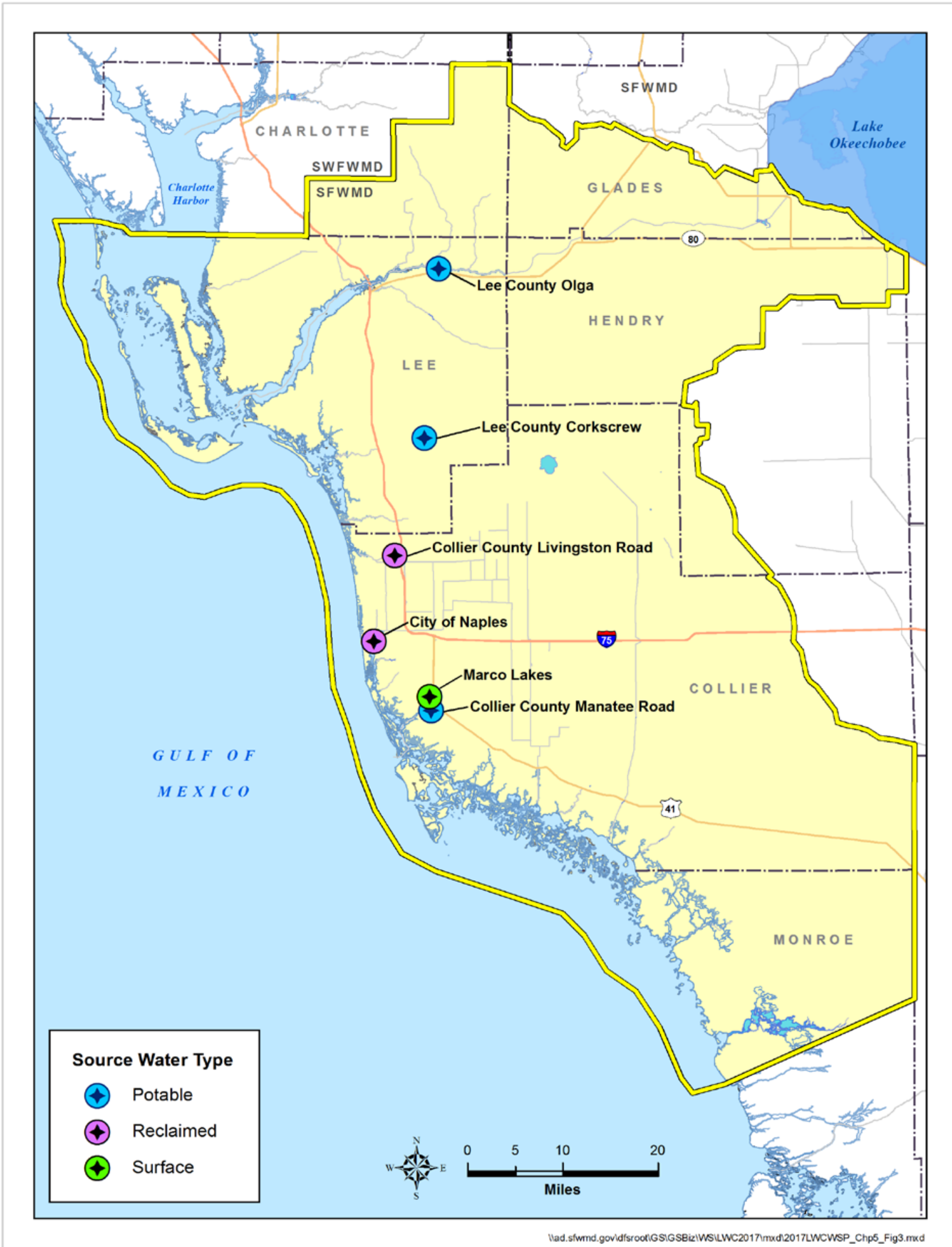


Figure 5-8. Map of active aquifer storage and recovery (ASR) projects in the Lower West Coast Planning Area.

Local and Regional Reservoirs

Reservoirs can improve water quality and provide supplemental water supply for municipalities, agricultural and industrial uses, and environmental management. Water typically is pumped from rivers or canals and stored in reservoirs, which provide storage of water, primarily during wet conditions for use in the dry season. For example, small-scale (local) reservoirs such as the Four Corners Reservoir (described in **Chapter 8**) can be used by individual farms for storage of recycled irrigation water or collection of local stormwater runoff. These reservoirs may provide water quality treatment before off-site discharge. Large-scale reservoirs (regional) can be used for basin runoff, stormwater attenuation, water quality treatment in conjunction with Stormwater Treatment Areas, and storage of seasonally available supplies for use during dry periods.

SEAWATER

Another water source option for the LWC Planning Area is the use of desalinated seawater from the Gulf of Mexico. Although the ocean is an abundant source of water from a quantitative perspective, seawater has a chloride concentration at or above 19,000 mg/L and the removal of salt (desalination) is required before potable and irrigation uses are feasible. To accomplish salt removal, a desalination treatment technology such as distillation, RO, or electrodialysis reversal is needed.

Significant advances in treatment and efficiencies in seawater desalination have occurred over the past decade. As a result, seawater treatment costs are declining. The cost of standalone seawater desalination facilities remains moderately higher than brackish water desalination. Continued advances may result in further use of seawater for water supply in the future.

Approximately 80 miles north of the LWC Planning Area, the Tampa Bay Seawater Desalination Plant became fully operational in 2007. The system uses RO technology to process 44 mgd of seawater to deliver 25 mgd of desalinated net (finished) water to Tampa Bay Water's regional distribution facilities. The Tampa Bay Seawater Desalination Plant is the second largest seawater desalination plant in the United States.

In December 2015, the Claude "Bud" Lewis Carlsbad Desalination Plant, owned by Poseidon Water, was opened near San Diego, California. The Carlsbad WTP is now the largest seawater desalination plant in the United States. The plant was built at a cost of approximately $1 billion, and will provide 50 mgd of net (finished) water. The plant has a treatment efficiency of 50 percent, and produces water at a cost of $6 to $7 per thousand gallons.

Carlsbad desalination plant membranes (Photo courtesy of Poseidon Water).

SUMMARY OF WATER SOURCE OPTIONS

Water source options depend on location, use type, demand, regulatory requirements, and cost. As competition for limited water resources increases, development of alternatives will increase as well. Water conservation measures are considered an option to meet regional water needs by reducing water use demands.

Overall, with continued diversification of water supply source options such as the Upper Floridan aquifer, reclaimed water, water storage, and appropriate water conservation measures (demand management), the future water demands of the LWC Planning Area can be met during a 1-in-10 year drought condition through 2040. Certain surface water sources such as the C-43 Canal and Lake Okeechobee do not currently have sufficient water available under 1-in-10 year drought conditions at their permitted withdrawal amounts. Surface water users within the Lake Okeechobee Service Area only have a 1-in-6 year drought level of certainty.

The FAS in the LWC Planning Area is a brackish water source that typically requires blending or desalination treatment before use. This 2017 LWC Plan Update shows development of these brackish sources have equaled development of freshwater sources for potable water demands. Development of the FAS is expected to continue through 2040.

Reclaimed water is a key component of water resource management in South Florida. Currently, approximately 71 percent of the wastewater treated (not including supplemental water) in the LWC Planning Area is reused, primarily for public access irrigation. Effluent not reused was disposed of through surface water discharge or deep well injection. Further development of reclaimed water as a water source option is expected through 2040.

Two-thirds of South Florida's annual rainfall occurs in the wet season; however, without sufficient storage capacity, much of this water discharges to tide. In the LWC Planning Area, potential types of needed water storage are under development, including ASR systems and above-ground reservoirs.

REFERENCES

FDEP. 2015a. *2014 Reuse Inventory*. Water Reuse Program, Florida Department of Environmental Protection, Tallahassee, Florida.

FDEP. 2015b. *Report on Expansion of Beneficial Use of Reclaimed Water, Stormwater and Excess Surface Water (Senate Bill 536)*. Office of Water Policy, Florida Department of Environmental Protection, Tallahassee, Florida.

Geddes, E., E. Richardson, and A. Dodd. 2015. *Hydrogeologic Unit Mapping Update for the Lower West Coast Water Supply Planning Area*. Technical Publication WS-35. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2016. *2016 Water Supply Plan Update Support Document.* South Florida Water Management District, West Palm Beach, FL. March 2016.

United States Environmental Protection Agency. 2017. *Secondary Drinking Water Standards: Guidance for Nuisance Chemicals*. Retrieved from: https://www.epa.gov/dwstandardsregulations/secondary-drinking-water-standards-guidance-nuisance-chemicals.

6

Water Resource Issues and Analyses

Building on the resource evaluation efforts described in the *2012 Lower West Coast Water Supply Plan Update* (2012 LWC Plan Update), this chapter reviews water resource issues and analyses within the LWC Planning Area. The issues identified in this chapter may affect the use of existing water resources and the development of new supplies to meet projected water demands for 2040. Water supply to meet the demands described in **Chapter 2** largely depends on the availability of water resources. Understanding the relationship and effect of meeting water demands through withdrawals from water resources is critical to water supply planning. A summary of the resource protection tools under Florida law is provided in **Chapter 4**.

TOPICS

The following sources were used to identify and evaluate water resource issues:

- Input from planning area stakeholders and the public
- Analyses and results from previous LWC water supply plan updates
- Water Supply Facilities Work Plans and capital improvements elements from local governments
- Activities and progress since the 2012 LWC Plan Update, including water supply diversification
- Water use permits and permit applications
- Water supply demand projections for 2040
- Hydrologic data for the surficial, intermediate, and Floridan aquifer systems (SAS, IAS, and FAS) from monitoring wells located in the LWC Planning Area
- Updated saltwater interface maps for Lee and Collier counties

- Data and information from the Comprehensive Everglades Restoration Plan (CERP), including status of CERP projects such as the Caloosahatchee River (C-43) West Basin Storage Reservoir
- Status of the Hebert Hoover Dike repairs
- Analyses performed as part of the 2008 Lake Okeechobee Regulation Schedule (2008 LORS)

Based on information from the aforementioned sources, issues identified in the 2012 LWC Plan Update (SFWMD 2012) were determined to be valid for this 5-year plan update. The projected water demands in this plan update are similar to those previously analyzed, and the findings and conclusions of previous plan updates are representative of current and projected scenarios. The projected 2040 gross water demands for all water use categories in this plan update are 1 to 4 percent less than the projected 2030 demands in the 2012 LWC Plan Update (**Chapter 2**). The decrease in demand is the result of source diversification, water conservation, alternative water supply expansion, and implementation of water supply and resource development projects.

SUMMARY OF ISSUES IDENTIFIED FOR 2040

Traditional freshwater sources in the LWC Planning Area may not be sufficient to meet 2040 projected water use demands. Past analyses indicated that fresh groundwater from the SAS and IAS, and surface water from the Caloosahatchee River Basin are not adequate to meet the growing needs of the LWC Planning Area during 1-in-10 year drought conditions. The following water supply issues continue to influence water supply planning efforts in LWC Planning Area:

- Increased withdrawals from the SAS and the freshwater portion of the IAS are generally limited due to potential impacts on wetlands and existing legal water uses, including Domestic and Small Public Supply (DSS); the potential for saltwater intrusion; and the possibility of reaching aquifer Maximum Developable Limits (MDLs). New or increased allocations will be evaluated on an application-by-application basis to determine if a project meets water use permitting criteria.
    - In some areas, such as Lehigh Acres, cumulative DSS withdrawals are affecting aquifer water levels.
- Surface water allocations from Lake Okeechobee and hydraulically connected surface waters are limited by the Lake Okeechobee Service Area Restricted Allocation Area criteria.
    - While the 2008 LORS is in effect, water users in the Lake Okeechobee Service Area have a reduced (1-in-6 year) level of certainty for experiencing water shortage restrictions.
- Peak freshwater discharges during the wet season are affecting the health of the Caloosahatchee River Estuary. Additional storage is required in the basin and in the regional system to attenuate damaging peak flow events.
- Surface water availability and current storage capacity is insufficient for the C-43 Canal and Caloosahatchee River Estuary during dry conditions.

Previous LWC water supply plan updates identified a variety of alternative water supply development projects to avoid water resource impacts as well as competition between water users, and to provide a sustainable supply of water. Projects include the use of reclaimed water, storage of water using aquifer storage and recovery (ASR) wells, and development and use of brackish water sources.

While the development of fresh groundwater in many areas of the LWC Planning Area has been maximized, it may be available in some places. 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. There are different considerations for each water use category based on specific needs. These considerations are discussed in more detail in **Chapter 2**.

SURFACE WATER RESOURCES

Traditionally, surface water from Lake Okeechobee and the C-43 Canal and Caloosahatchee River Estuary watershed has been the primary source of water supply for agriculture in the LWC Planning Area. As discussed in the 2012 LWC Plan Update, surface water availability from existing canal and storage networks within the Lake Okeechobee Service Area is insufficient to meet agricultural water use demands and environmental needs during 1-in-10 year drought conditions. Past analyses concluded that additional storage was necessary to provide adequate resources to meet existing legal user and natural system needs in the LWC Planning Area.

The lack of storage within the C-43 Canal and Caloosahatchee River Estuary watershed contributes to the following:

- The discharge of large volumes of water to tide, which adversely impacts estuarine ecosystems due to sudden declines in salinity during major storm events
- The discharge of water to tide during the wet season, making it unavailable to the ecosystem during the dry season
- The lack of sufficient dry season flows, which causes elevated salinity within the estuary

Construction of the CERP Caloosahatchee River (C-43) West Basin Storage Reservoir (**Chapter 4** and **Appendix C**) will provide surface water storage for the watershed and is a component of the recovery strategy for the Caloosahatchee River minimum flow and minimum water level (MFL). The main objective of the project is to capture excess wet season flows in order to enhance dry season flows to the Caloosahatchee River Estuary. Construction of the reservoir has been initiated and is anticipated to be completed in 2022. Additional reservoirs or water storage solutions to increase water storage capacity have been proposed by agricultural entities.

Lake Okeechobee provides supplemental water to the Caloosahatchee River Estuary via the C-43 Canal during the dry season. However, concerns about the integrity of the Herbert Hoover Dike surrounding Lake Okeechobee resulted in the United States Army Corps of Engineers (USACE) revising the water level operational protocol (the 2008 Lake Okeechobee

Regulation Schedule), which limits water availability to the C-43 Canal and its tributaries. The USACE currently is rehabilitating the Herbert Hoover Dike, with an expected completion date of 2025. Once the project is complete, the USACE may consider revising the regulation schedule. The SFWMD anticipates any additional water from Lake Okeechobee resulting from operational changes or a revised regulation schedule could return the lake to an MFL prevention strategy, increase the level of certainty (from 1-in-6 years back to 1-in-10 years) for existing legal uses, and support other environmental objectives.

SURFICIAL AND INTERMEDIATE AQUIFER SYSTEMS ANALYSIS

Throughout the LWC Planning Area, the SAS and IAS historically served as the major sources of fresh groundwater for Public Water Supply (PWS), Recreational/Landscape Irrigation (REC), and Agricultural Irrigation (AGR). However, past and present analyses of the SAS and IAS indicate it is a limited water resource in many areas. Previous analyses demonstrated that the SAS and IAS could not be the primary sources for all projected water demands in the LWC Planning Area without harming the environment or the resource. Alternative sources would need to be developed to meet increases in demand. The SFWMD currently is developing a regional SAS/IAS groundwater model to evaluate current and future conditions within the LWC Planning Area. The model results should be available in 2018-2019.

Additional limited supplies may be developed and permitted from the SAS and IAS depending on local resource conditions, changing land use, and the viability of other supply options. Increases in withdrawals from the SAS and IAS are constrained by saltwater intrusion, wetland impacts, impacts to existing legal users, and other regulatory considerations. Withdrawals from the freshwater portion of the SAS and IAS also are limited due to the regulatory protections provided by aquifer MDLs, as discussed in **Chapter 4** and **Appendix C**. Applications for increased withdrawals from the SAS and IAS will be reviewed on a project-specific basis to determine if water use permitting criteria will be met.

The hydrologic data used in this plan update show a wide range in water levels in the SAS and IAS. The SAS (and its associated wetlands) depends on rainfall for aquifer recharge. During dry conditions, recharge diminishes, drainage persists, and irrigation and other demands increase, compounding stress on the SAS and wetland systems. Typically, the IAS is recharged by seepage from above or laterally.

Surficial Aquifer Water Levels

The Water Table and Lower Tamiami aquifers within the SAS are the primary water sources for DSS, REC, and AGR as well as a major source for PWS in Collier, Lee, and Hendry counties. As such, the shallow aquifers are critically important to the region. Throughout the LWC Planning Area, there are no consistent downward or upward trends in SAS water levels; however, individual wells may show temporal trends. **Figures 6-1** and **6-2** show water levels and trends for two SAS wells in northwestern Collier County that are approximately 10 miles apart. Seasonal variations in water levels from wet and dry seasons are typical in rainfall-driven aquifers. Both wells show a 5-foot variation in water levels between the annual wet and dry seasons. Both wells also reveal a subtle increase in dry-season water levels over the past 5 years, in response to relatively recent wet conditions in the LWC Planning Area.

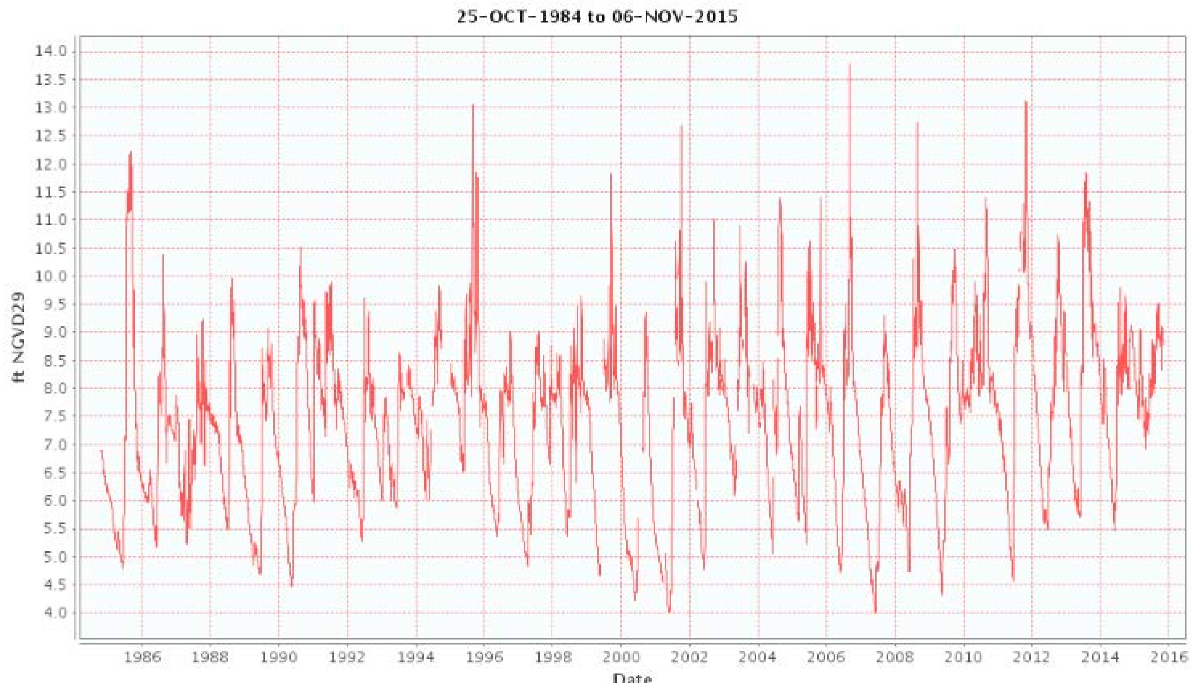


Figure 6-1. Water levels in the surficial aquifer system at well C-953 (40 feet deep) in northwestern Collier County.

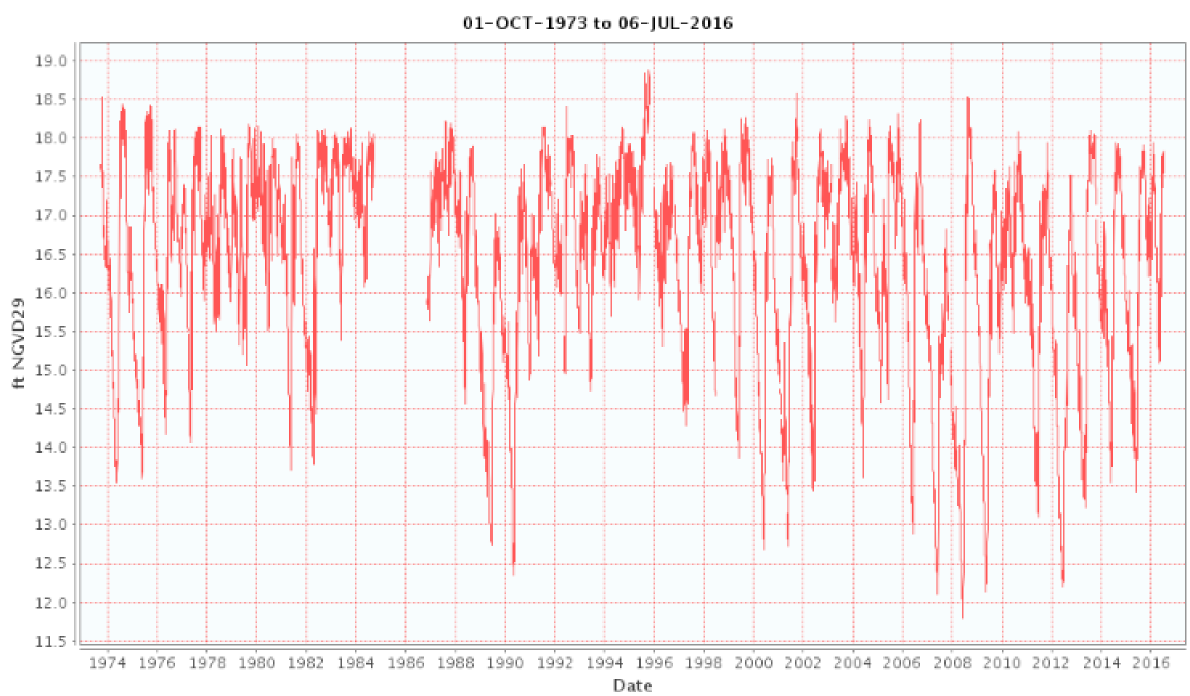


Figure 6-2. Water levels in the surficial aquifer system at well C-492 (64 feet deep) in northwestern Collier County.

Intermediate Aquifer Water Levels

In the LWC Planning Area, the IAS includes the Sandstone and Mid-Hawthorn aquifers. The Sandstone aquifer is used predominantly for AGR, and the Mid-Hawthorn aquifer often is a supplemental source for REC and PWS. Water level monitoring indicates upward and downward trends depending on the location and the aquifer. **Figures 6-3** to **6-5** shows declining Sandstone aquifer water levels in Lehigh Acres. Since 2007, record low water levels have occurred for the period of record (1980 to 2016) in well L-729 and other Sandstone aquifer wells in Lehigh Acres. Reduced water levels caused some DSS wells to become inoperable. During the 2007 drought, 64 percent of the 526 replacement wells permitted by Lee County were in Lehigh Acres. However, Sandstone aquifer water levels have recovered in wellfield areas where Lee County Utilities has reduced its withdrawals from this aquifer. Overall, DSS and other withdrawals from the Sandstone aquifer have increased in the LWC Planning Area.

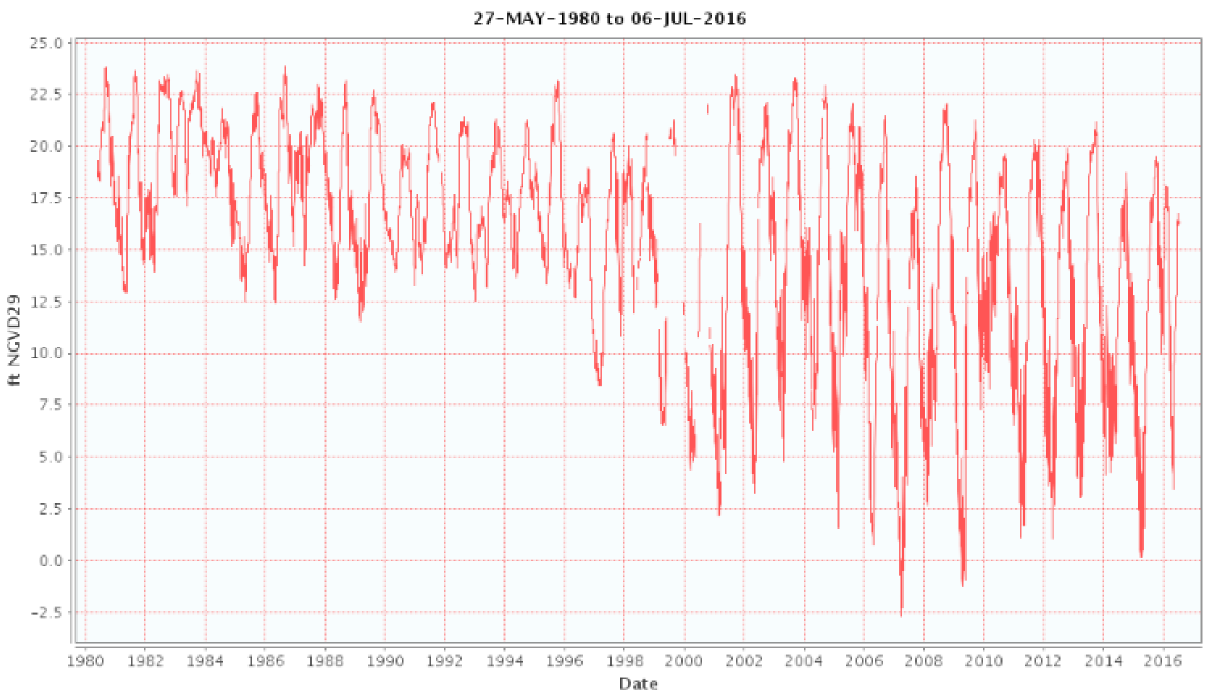


Figure 6-3. Water levels in the Sandstone aquifer at well L-729 (130 feet deep) in southern Lehigh Acres.

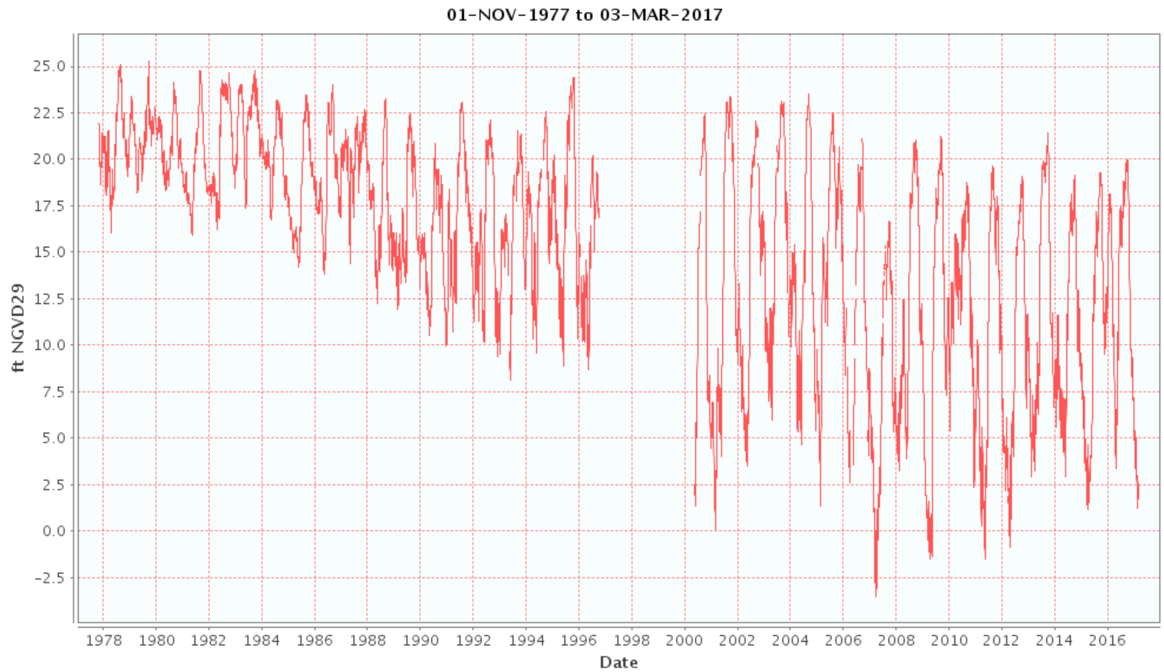


Figure 6-4. Water levels in the Sandstone aquifer at well L-2186 (160 feet deep) in Lehigh Acres.

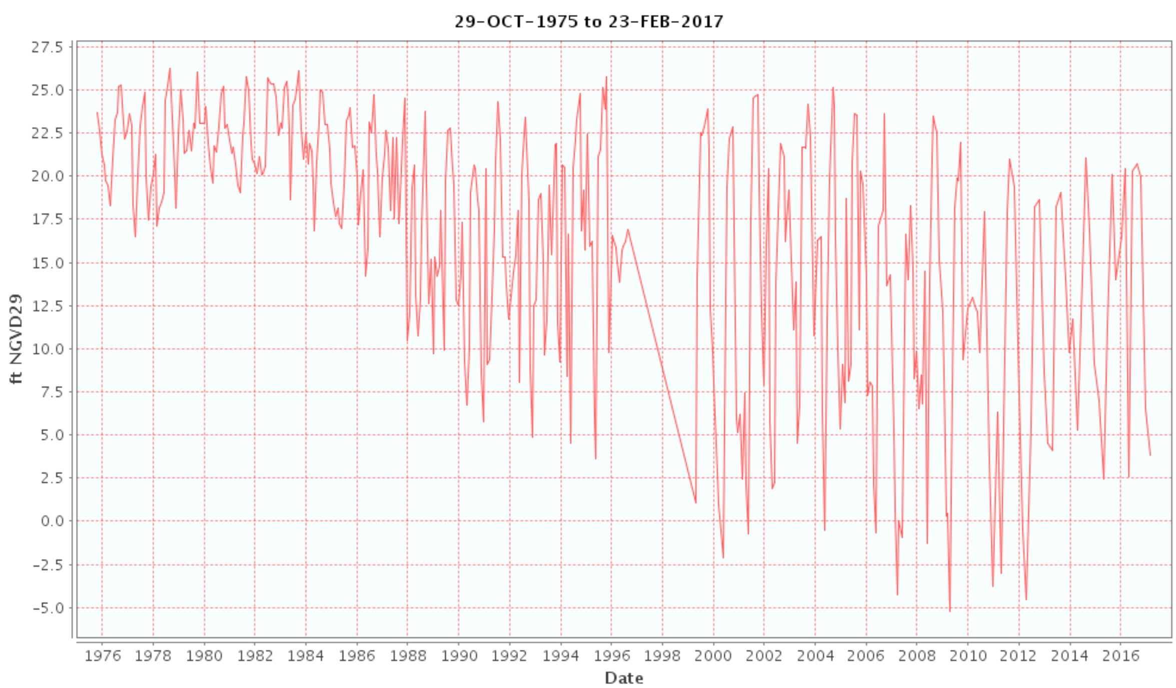


Figure 6-5. Water levels in the Sandstone aquifer at well L-1965 (225 feet deep) in eastern Lehigh Acres.

In March 2017, the water level in well L-2186 was less than 10 feet above the MDL due to extreme dry conditions. As the population in this region is expected to increase over the next few decades, water levels are expected to continue declining toward the MDL.

In 2010, the SFWMD installed two Sandstone aquifer monitor wells to more accurately delineate the top of the Sandstone aquifer in Lehigh Acres (McMillan and Anderson 2015). This project and the results from other drilling in the area demonstrate the variability in the elevations of the top of the Sandstone aquifer in the area.

In contrast to the general declining trends observed for the IAS in Lehigh Acres, water levels within the Mid-Hawthorn aquifer have risen substantially in southern Cape Coral due to PWS service area expansion, which decreased DSS withdrawals (**Figure 6-6**). PWS for this portion of the city is derived from the FAS, which is hydraulically isolated from the IAS and SAS. Expansion of the Cape Coral Utility's service area as well as increased use of the FAS and reclaimed water were identified in the 2012 LWC Plan Update as partial solutions to diminishing IAS water availability in the area. In the northern portion of Cape Coral and the southern portion of Fort Myers not served by PWS, water levels in the Mid-Hawthorn aquifer have continued to decline (**Figure 6-7**). Continued reliance on this aquifer will cause further declines in waters levels and points to the need for alternative water supply development to ensure adequate future supply (see **Chapter 5**).

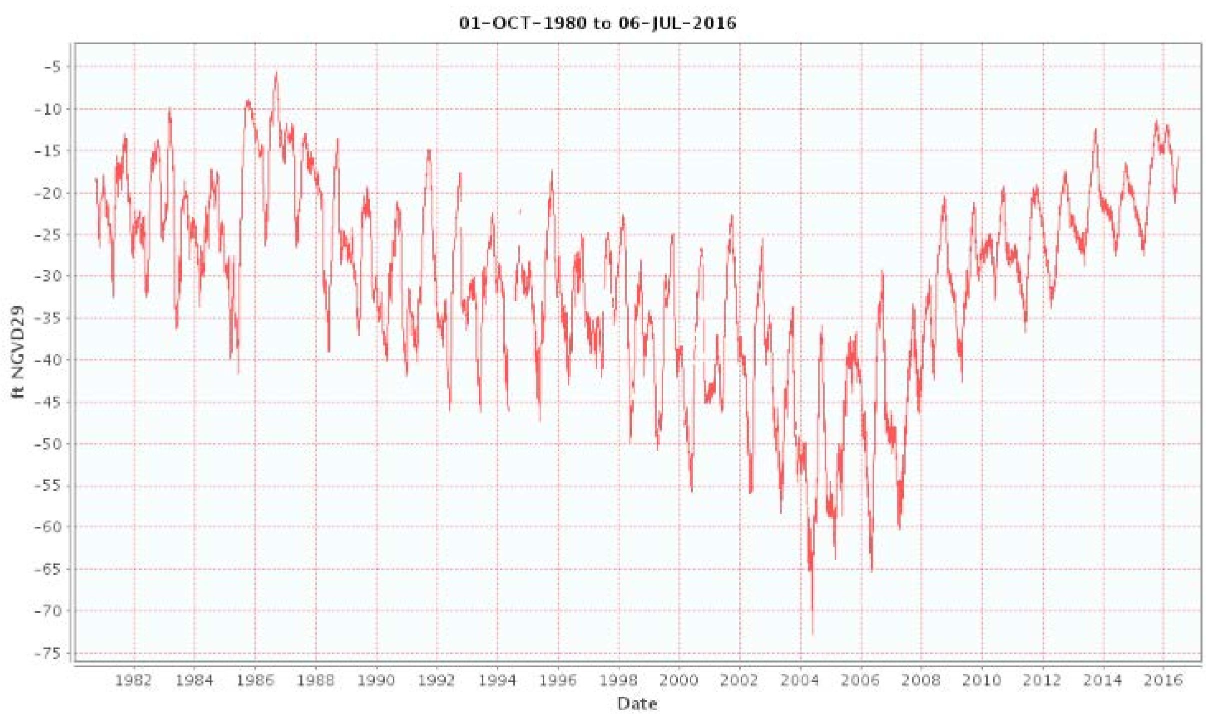


Figure 6-6. Water levels in the Mid-Hawthorn aquifer at well L-581 (177 feet deep) in southern Cape Coral, Florida.

Figure 6-7. Water levels in the Mid-Hawthorn aquifer at well L-4820 (190 feet deep) in northern Cape Coral, Florida.

Surficial and Intermediate Aquifer Chloride Concentrations

Saltwater intrusion is the inland movement of the saltwater interface or the sustained upward movement of saline groundwater (upconing). Upward leakage from deeper brackish aquifers can occur through a variety of mechanisms such as over pumpage or open intervals from improperly abandoned wells. Therefore, monitoring of chloride concentrations is crucial to the protection of fresh groundwater.

Monitoring sites have shown that some areas inland of coastal Collier and Lee counties have chloride concentrations greater than 250 milligrams per liter (mg/L), a secondary drinking water standard, in the SAS and IAS. Data with sufficient periods of record indicate chloride concentrations have increased over time at some locations, but have decreased at other locations. **Appendix E** contains well location maps and chloride concentration data from wells completed in the Water Table, Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers.

An increasing chloride trend can be seen in central Collier County, where chloride concentrations in United States Geological Survey (USGS) SAS well C-953 have increased over the past three decades, but is still below 250 mg/L (**Figure 6-8**). In other wells, such as USGS well C-600 in southwestern Collier County, chlorides have remained stable and consistently below 250 mg/L (**Figure 6-9**).

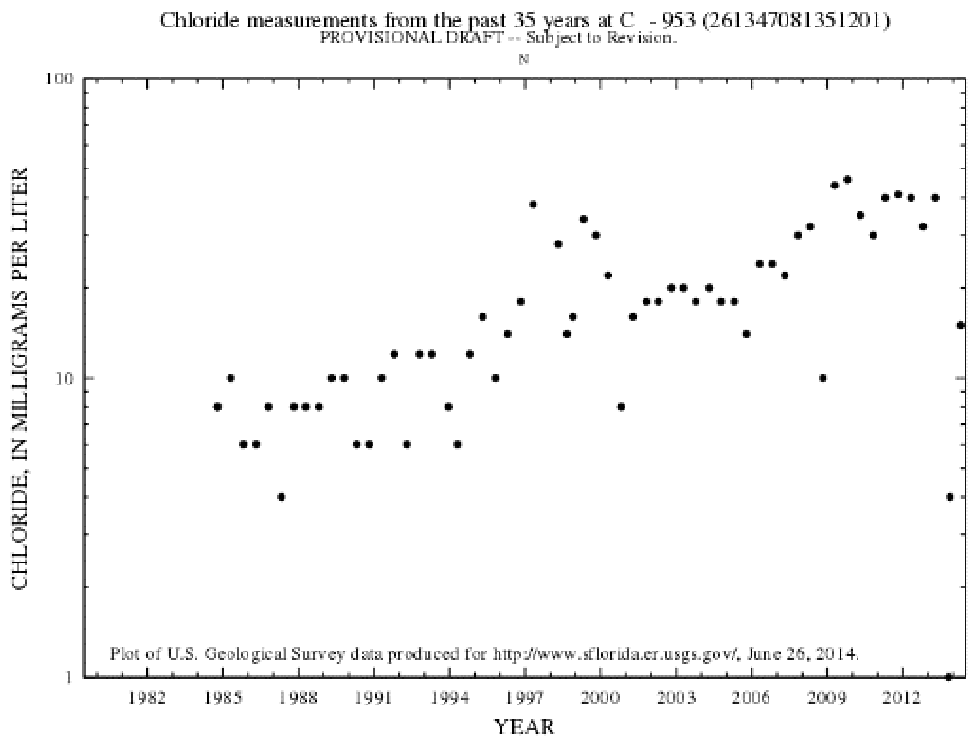


Figure 6-8. Chloride concentrations at USGS well C-953 (40 feet deep), in central Collier County, Florida, completed in the surficial aquifer system.

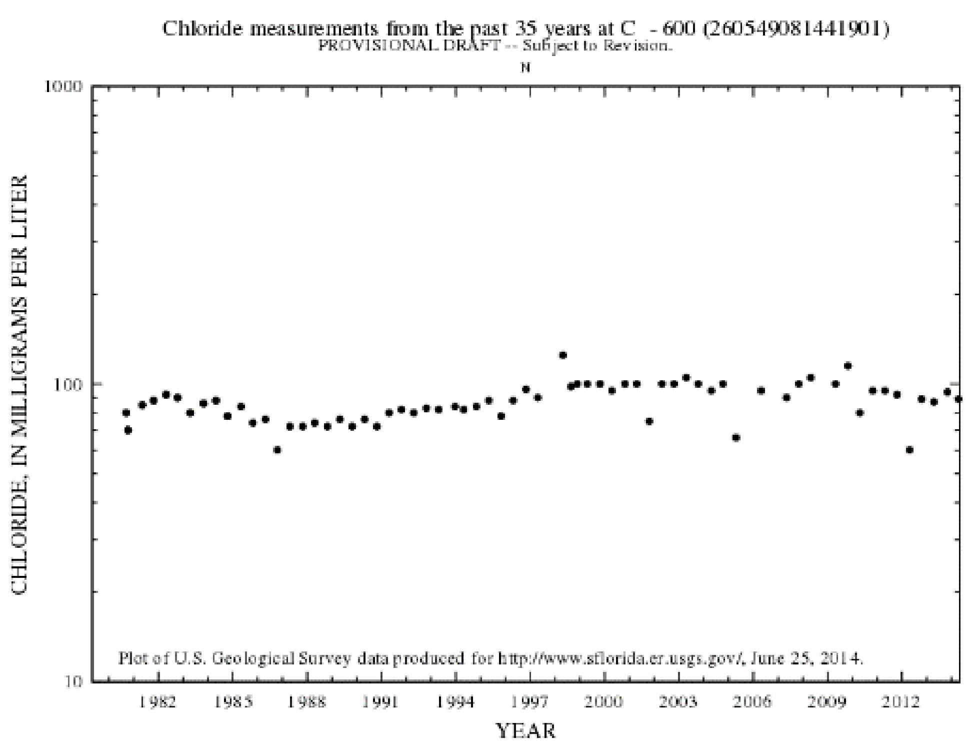


Figure 6-9. Chloride concentrations at USGS well C-600 (52 feet deep) in southwestern Collier County, Florida, completed in the Lower Tamiami aquifer.

Within the IAS, trends can be highly variable and salinities range widely. USGS well L-2820 in Lee County, completed in the Mid-Hawthorn aquifer, has exhibited high but stable chloride concentrations for the past 30 years (**Figure 6-10**). Also completed in the Mid-Hawthorn aquifer, USGS well L-735 has shown high variability in chloride concentrations over the same period (**Figure 6-11**).

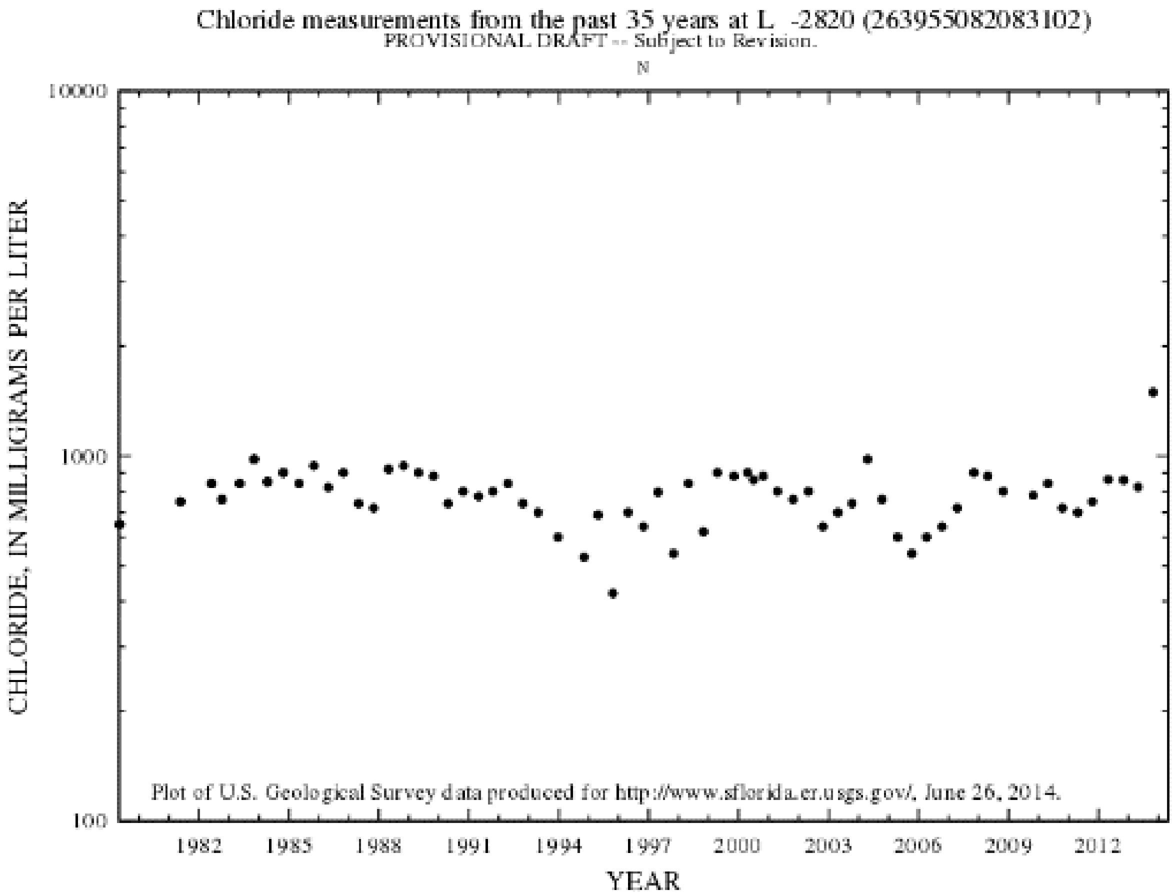


Figure 6-10. Chloride concentrations at USGS well L-2820 (241 feet deep) in Lee County, Florida, completed in the Mid-Hawthorn aquifer.

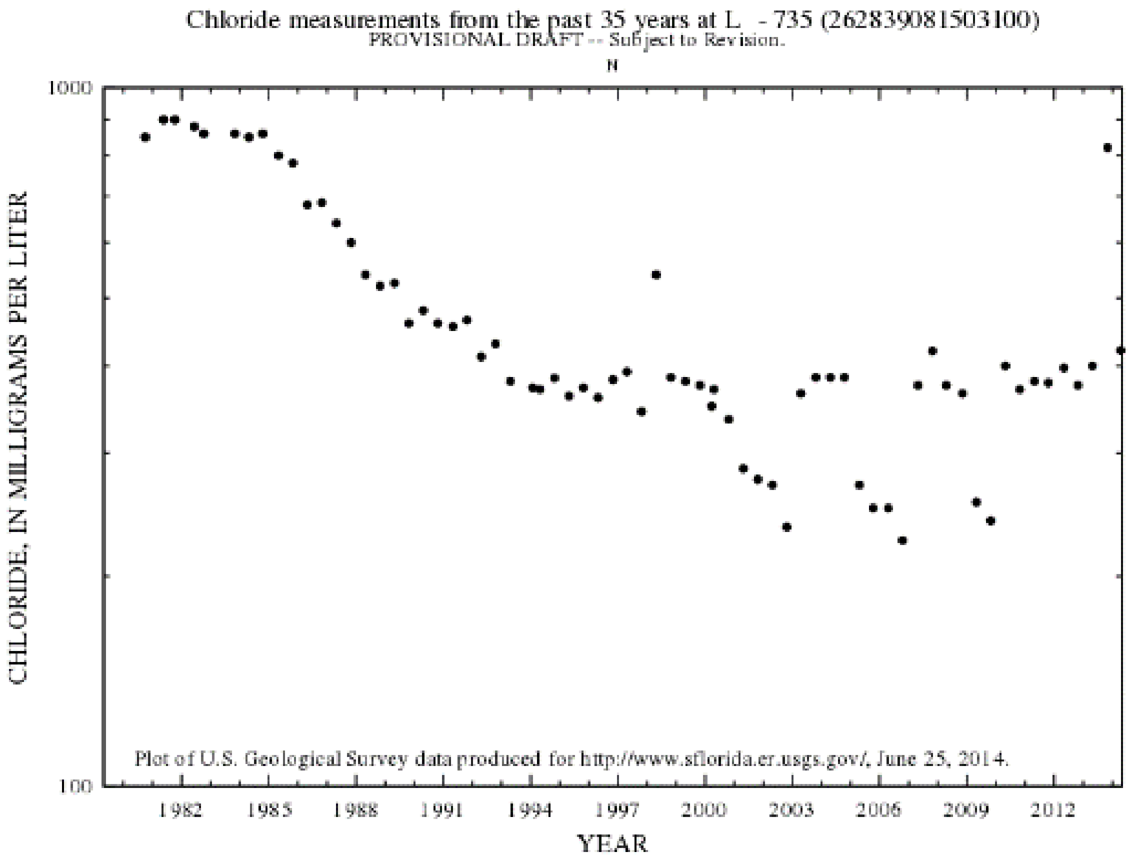


Figure 6-11. Chloride concentrations at USGS well L-735 (240 feet deep) in Lee County, Florida, completed in the Mid-Hawthorn aquifer.

Saltwater Intrusion Mapping

The SFWMD periodically develops maps documenting the position of the saltwater interface to understand the potential effects on wellfields and coastal aquifers (**Appendix E**). Salinity data from monitor wells were compiled from multiple sources (e.g., USGS, SFWMD, water use permittees) and contoured to estimate the position of the saltwater interface, defined herein as the line with a 250 mg/L chloride concentration. Two series of maps have been developed, 2009 and 2014, with plans to update the maps every 5 years. 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. A discussion of PWS utilities that are vulnerable to saltwater intrusion during drought conditions (i.e., Utilities at Risk and Utilities of Concern) is provided in **Appendix E**.

In general, the 2014 maps are similar to the 2009 maps; however, relatively small differences indicate that the 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. The 2014 maps for the Water Table, Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers can be found in **Appendix E**.

FLORIDAN AQUIFER SYSTEM ANALYSIS

The FAS is used primarily by PWS utilities as an alternative water source, and several utilities are anticipating expansion of FAS wellfields to meet future demands (**Chapter 8**, Table 8-5). The FAS is brackish in the LWC Planning Area and requires desalination treatment prior to use. The SFWMD's Regional Floridan Groundwater (RFGW) monitoring program consists of a network of monitoring wells tracking conditions in the FAS, including water levels and water quality, which are crucial to evaluating the water supply potential of the FAS. Monitoring provides a better understanding of the hydrogeologic system through long-term systematic data collection, which is used to evaluate current conditions, detect temporal trends, and develop and calibrate groundwater models. **Figure 6-12** shows the locations of the RFGW well sites selected for water level or water quality evaluation in this plan update.

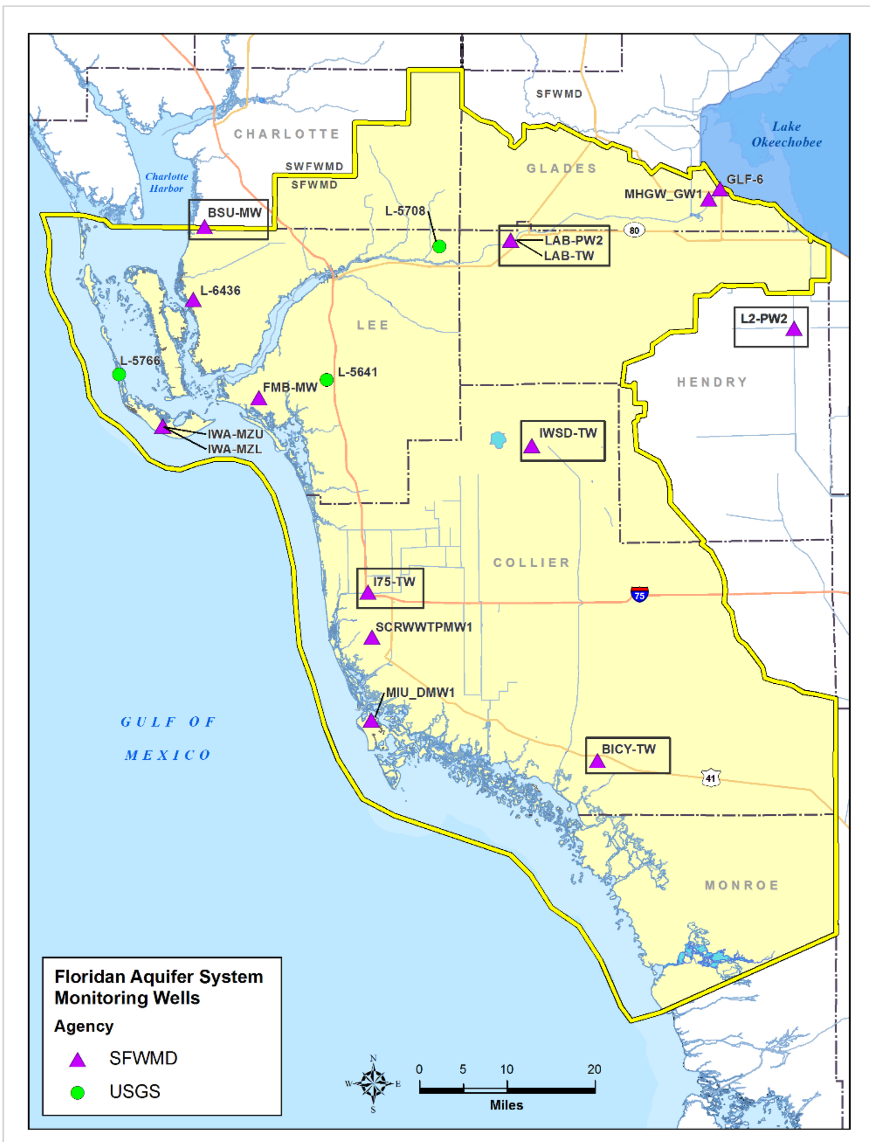


Figure 6-12. Regional Floridan Groundwater monitoring wells in the Lower West Coast Planning Area.

Upper Floridan Aquifer Water Levels

Six RFGW wells completed in the Upper Floridan aquifer (UFA) were identified (**Table 6-1**) within the LWC Planning Area that have long-term water level and water quality (chloride and/or total dissolved solids) data. Some of the wells are not suitable for both water level and water quality evaluation due to data limitations, such as an incomplete period of record. Several water level and water quality plots are shown below.

Table 6-1. Upper Floridan aquifer monitor wells in the Lower West Coast Planning Area with long-term water level and water quality data.

Well Name	County	Open Hole Depth Interval (feet bls)	Latitude	Longitude	Period of Record
BSU-MW	Charlotte	1,207-1,287	264620.877	820202.737	6/1999-2/2016
BICY-TW	Collier	838-996	255337.612	811833.75	6/2004-8/2015
I75-TW	Collier	905-1,050	261013.403	814350.032	6/2004-2/2016
IWSD-TW	Collier	1,060-1,140	262449.5	812552.9	6/2004-2/2016
LAB-PW2	Hendry	674-837	264511.442	812817.716	12/1997-6/2015
L2-PW2	Hendry	810-1,125	263628.811	805657.738	6/2004-2/2016

bls = below land surface.

Groundwater levels in the UFA fluctuate seasonally. Water levels in RFGW wells usually are considered beyond the area of influence of localized pumpage for irrigation or PWS due to their remote locations. **Table 6-2** lists the minimum, maximum, and average groundwater elevations in feet above National Geodetic Vertical Datum of 1929 (NGVD29). **Figure 6-12** shows the location of four wells selected from the RFGW network for examination of UFA water level fluctuations.

Table 6-2. Minimum, maximum, and average groundwater levels (in feet NGVD29) for select wells in the Lower West Coast Planning Area.

Well Name	Minimum Level	Maximum Level	Average Level
BICY-TW	36.52	40.03	38.30
I75-TW	30.88	36.32	33.60
LAB-PW2	49.48	53.92	51.70
L2-PW2	56.57	59.32	57.87

As shown in **Figure 6-13**, water levels at well BICY-TW, located in Big Cypress Swamp, seasonally fluctuate approximately 3 feet, and there is variability over the long term. Notable dry seasons such as 2007, 2011, and 2017 are followed by a rebound of water levels to the previous wet season levels. The wet seasons from 2012 through 2015 showed slightly higher water levels than historically observed (back to 2003).

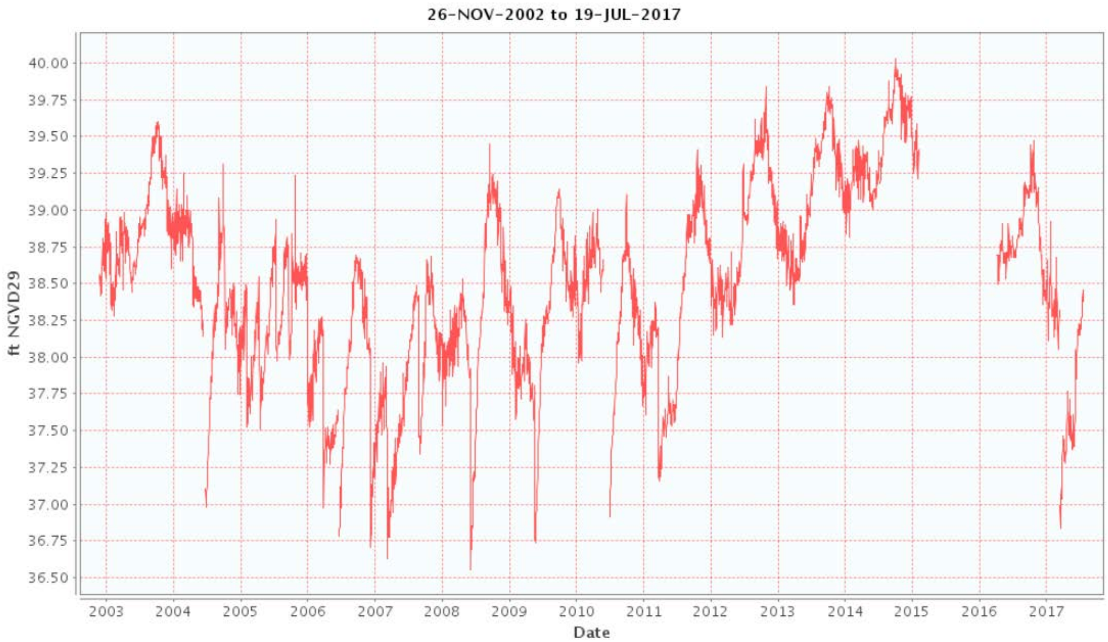


Figure 6-13. Water levels in Upper Floridan aquifer monitor well BICY-TW, Big Cypress Swamp, Florida.

As shown in **Figure 6-14**, water levels at well I75-TW, located near Naples, seasonally fluctuate approximately 2 feet; however, there are longer-term trends in observed water levels. For example, from a high in 2003 of +36.32 feet NGVD29, a downward trend continued through 2007, when the record low was recorded at +30.88 feet NGVD29. During the subsequent 10 years, there was a gradual rebound throughout each wet-dry season cycle, with a high of +35.75 feet NGVD29 following the 2016 wet season.

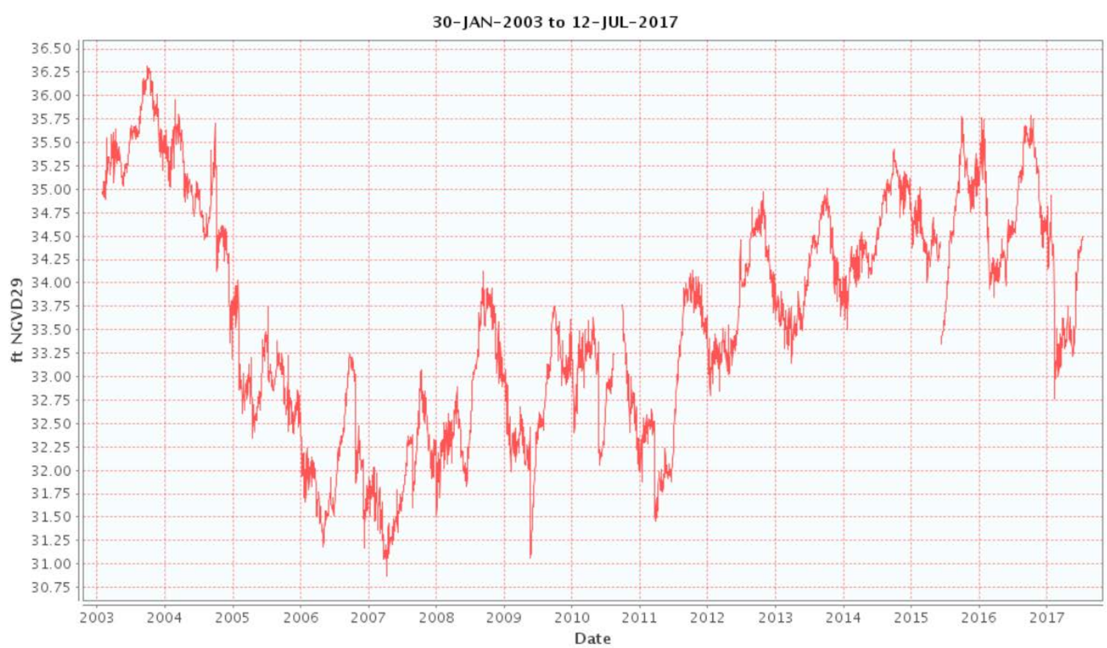


Figure 6-14. Water levels in Upper Floridan aquifer monitor well I75-TW, Naples, Florida.

As shown in **Figure 6-15**, water levels at well LAB-PW2, located in LaBelle, seasonally fluctuate 3 to 4 feet but the long-term trend is relatively stable. Notable dry seasons such as 2007, 2011, and 2017 are followed by a rebound of water levels to the previous wet season levels.

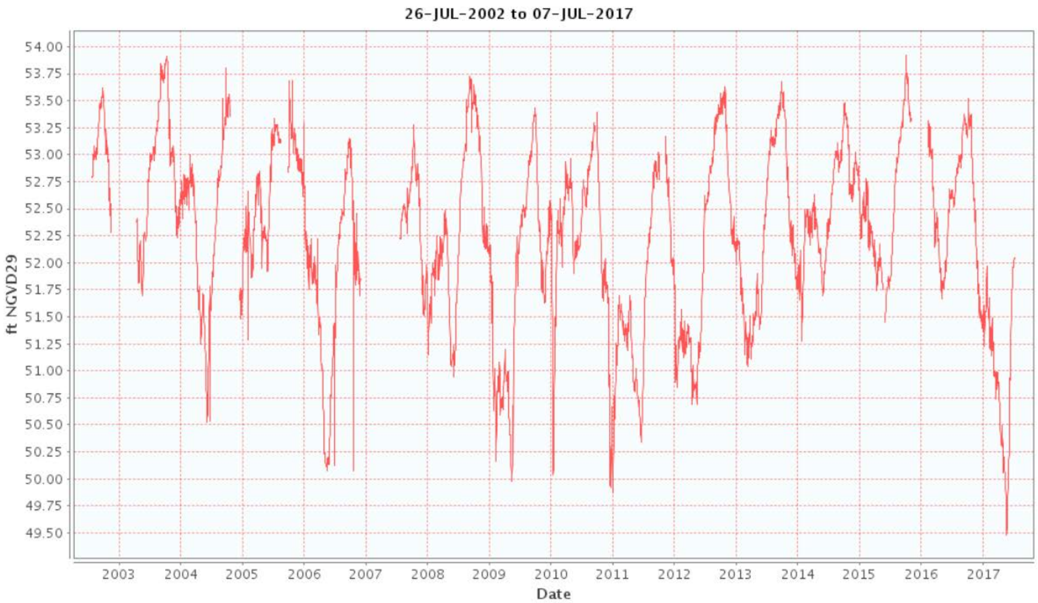


Figure 6-15. Water levels in Upper Floridan aquifer monitor well LAB-PW2, LaBelle, Florida.

As shown in **Figure 6-16**, water levels at well L2-PW2, located in western Hendry County, seasonally fluctuate approximately 2 feet but the long-term trend is relatively stable. Notable dry seasons such as 2007, 2011, and 2017 are followed by a rebound of water levels to the previous wet season levels.

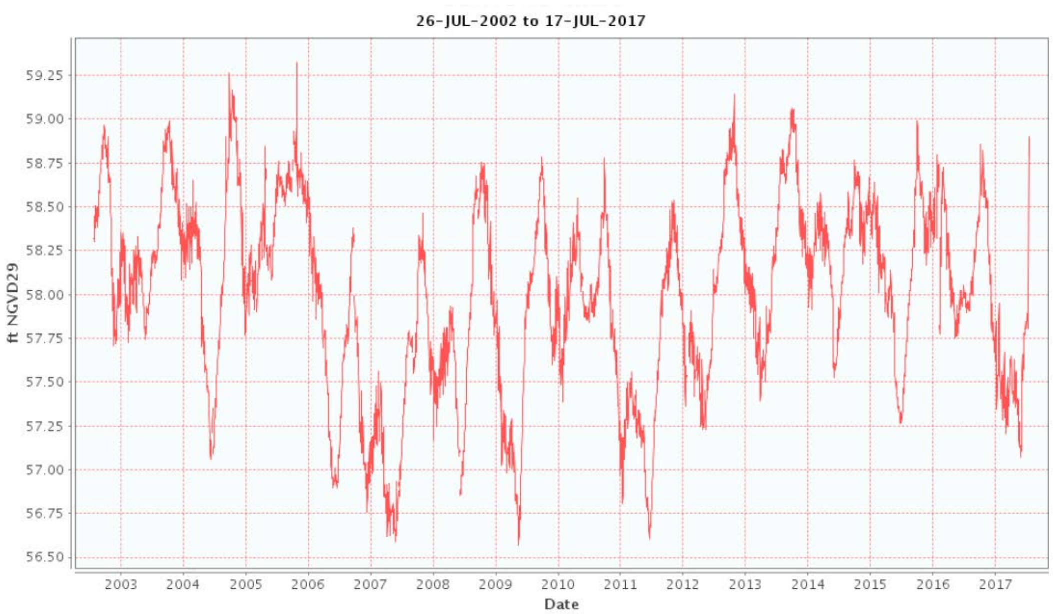


Figure 6-16. Water levels in Upper Floridan aquifer monitor well L2-PW2, western Hendry County, Florida.

In summary, water levels in areas far from large UFA pumping locations show seasonal fluctuations in response to regional patterns of recharge in central Florida. Fluctuations of 2 to 3 feet are typical and most wells show relatively stable long-term trends.

Upper Floridan Aquifer Water Quality

Water quality trends were determined for six UFA wells in the LWC Planning Area, and the results are varied (**Table 6-3**). Wells BSU-MW and LAB-PW2 showed a slight increasing trend in chloride concentration with time; however, these wells also had relatively low chloride concentrations (646 to 1,000 mg/L). Wells IWSD-TW, BICY-TW, L2-PW2, and I75-TW had decreasing chloride concentration trends and ranged from 564 to 4,300 mg/L.

Table 6-3. Chloride concentrations (in mg/L) from Upper Floridan aquifer monitor wells in in the LWC Planning Area.

Well Name	Minimum Concentration	Maximum Concentration	Average Concentration	Period of Record	Trend
BSU-MW	650	807	722	7/2004-2/2016	Upward
BICY-TW	1,700	3,000	2,610	6/2004-12/2015	Downward
I75-TW	3,005	4,300	3,744	6/2004-2/2016	Downward
IWSD-TW	1,000	1,300	1,164	6/2004-1/2016	Downward
LAB-PW2	646	1,000	741	6/2004-1/2016	Upward
L2-PW2	564	820	657	6/2004-2/2016	Downward

LWC = Lower West Coast; mg/L = milligrams per liter.

As shown in **Figure 6-17**, well BSU-MW, located in southwestern Charlotte County, has chloride concentrations fluctuating approximately 160 mg/L over the period of record. The minimum chloride concentration (650 mg/L) was in December 2006 and the maximum chloride concentration (807 mg/L) was in February 2016, indicating an upward trend.

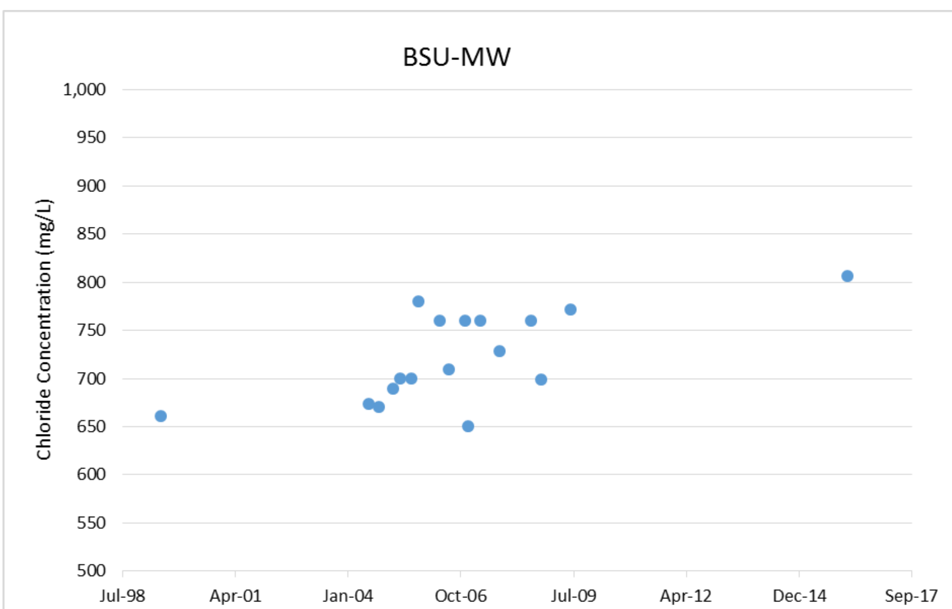


Figure 6-17. Chloride concentrations in Upper Floridan aquifer monitor well BSU-MW, southwestern Charlotte County, Florida.

As shown in **Figure 6-18**, well BICY-TW, located in Big Cypress Swamp, has chloride concentrations fluctuating approximately 1,300 mg/L over the period of record. There is a slight downward trend in chloride concentrations at well BICY-TW; however, concentrations predominantly fall around the average for the period of record (2,610 mg/L).

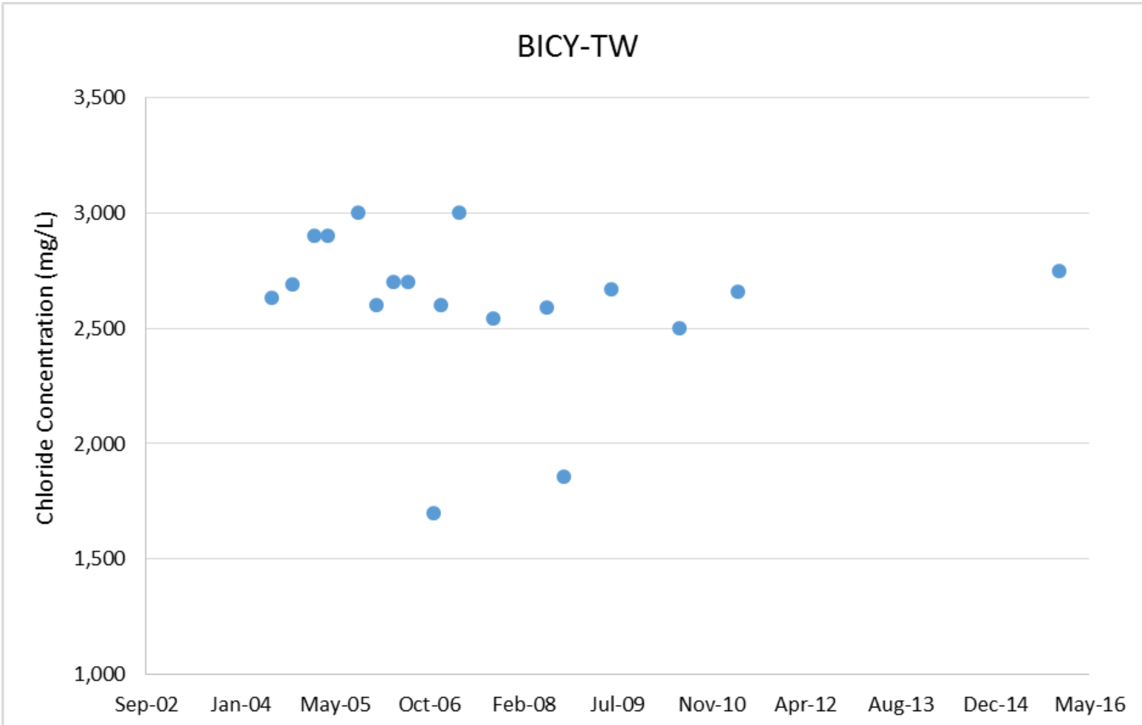


Figure 6-18. Chloride concentrations in Upper Floridan aquifer monitor well BICY-TW, Big Cypress Swamp, Florida.

As shown in **Figure 6-19**, well I75-TW, located near Naples, has chloride concentrations fluctuating approximately 1,300 mg/L over the period of record. There is a downward trend in chloride concentration, with the most recent sample (February 2016) showing the second lowest chloride concentration (3,302 mg/L) for the period of record.

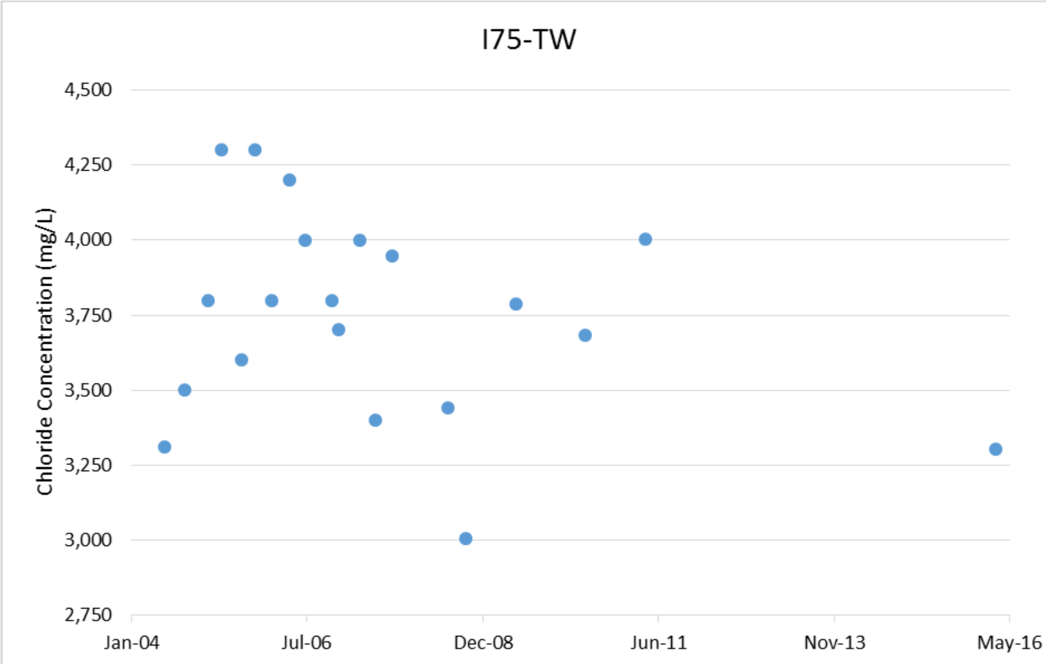


Figure 6-19. Chloride concentrations in Upper Floridan aquifer monitor well I75-TW, Naples, Florida.

As shown in **Figure 6-20**, well ISWD-TW, located in Immokalee, has chloride concentrations fluctuating approximately 300 mg/L over the period of record. Both the minimum and maximum chloride concentrations occurred in 2005 (September and February, respectively). The trend is relatively flat, falling along the average chloride concentration.

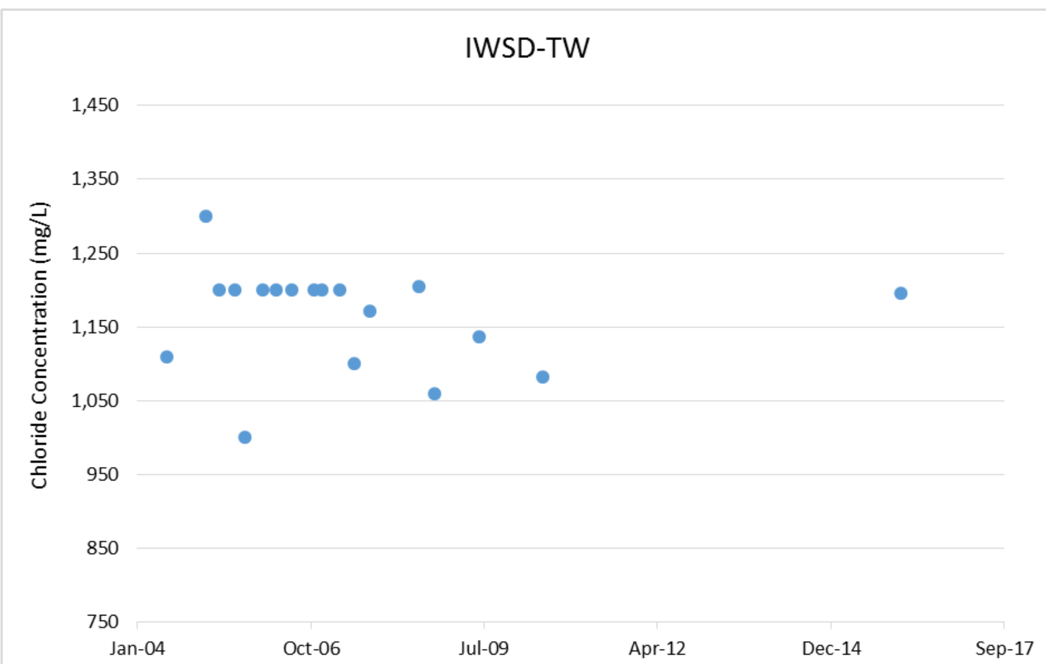


Figure 6-20. Chloride concentrations in Upper Floridan aquifer monitor well IWSD-TW, Immokalee, Florida.

As shown in **Figure 6-21**, well LAB-PW2, located in LaBelle, has chloride concentrations fluctuating approximately 350 mg/L over the period of record. The maximum chloride concentration (1,000 mg/L) was in January 2007. Recent chloride concentrations at well LAB-PW2 are more in line with the average for the period of record shown.

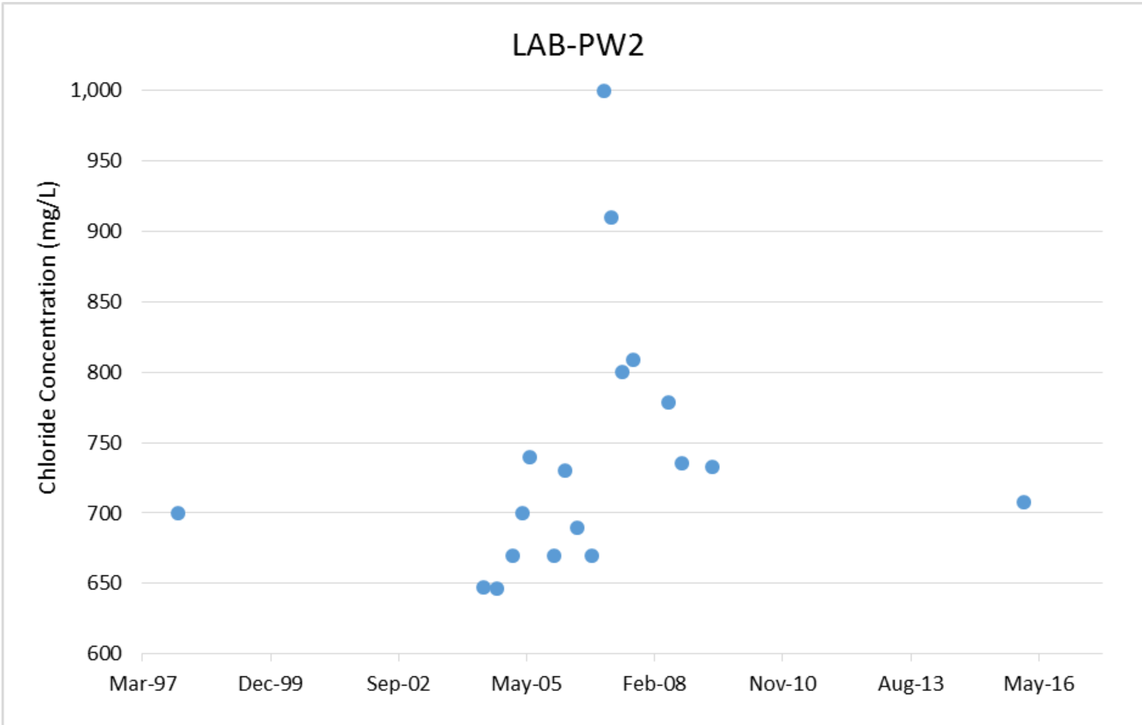


Figure 6-21. Chloride concentrations in Upper Floridan aquifer monitor well LAB-PW2, LaBelle, Florida.

As shown in **Figure 6-22**, well L2-PW2, located in western Hendry County, has chloride concentrations fluctuating approximately 260 mg/L over the period of record. There is a slight downward trend in chloride concentrations; however, concentrations generally fall around the average for the period of record.

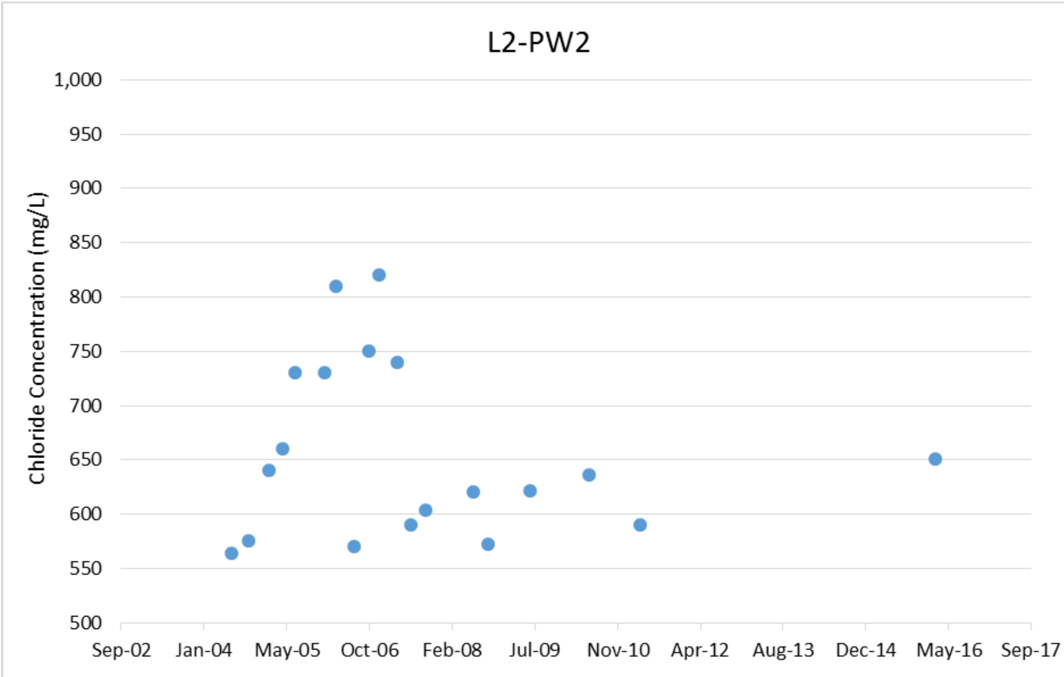


Figure 6-22. Chloride concentrations in Upper Floridan aquifer monitor well L2-PW2, western Hendry County, Florida.

Public Water Supply Utilities Using the Upper Floridan Aquifer

With the advent of reverse osmosis (RO) treatment for brackish water, several utilities are withdrawing water from the UFA for PWS purposes. Nearly all PWS utilities in the LWC Planning Area that utilize the UFA have had one or more production wells experience a degradation in water quality. The following examples discuss changes in chloride concentrations over time in some PWS wellfields.

City of Fort Myers RO Wellfield

The Fort Myers RO wellfield is located south of the Caloosahatchee River Estuary and west of Interstate 75. The RO treatment plant began operation in 2011, with an initial capacity of 6 million gallons per day (mgd) of net (finished) water using seven production wells. By 2007, the system had been expanded to 13 mgd using 16 production wells. Plans are in place to build out the current RO plant with a capacity of 20 mgd of net (finished) water using 19 UFA production wells.

Figure 6-23 shows chloride concentrations over time for 14 of the 19 UFA production wells in the Fort Myers RO wellfield. Several wells have chloride concentrations around 1,000 to 1,500 mg/L. However, many wells show notable increases in chloride concentrations 4 to 5 years after installation. These wells generally started with a chloride concentration below 1,500 mg/L, but exhibit two- to three-fold increases by 2017. Five of the 19 UFA production wells, such as P-10 (**Figure 6-24**), had to be removed from **Figure 6-23** because the high chloride concentrations affected the plot scale. Well P-10 started with a chloride concentration of approximately 1,750 mg/L, but by 2014, the concentration had increased to approximately 9,000 mg/L.

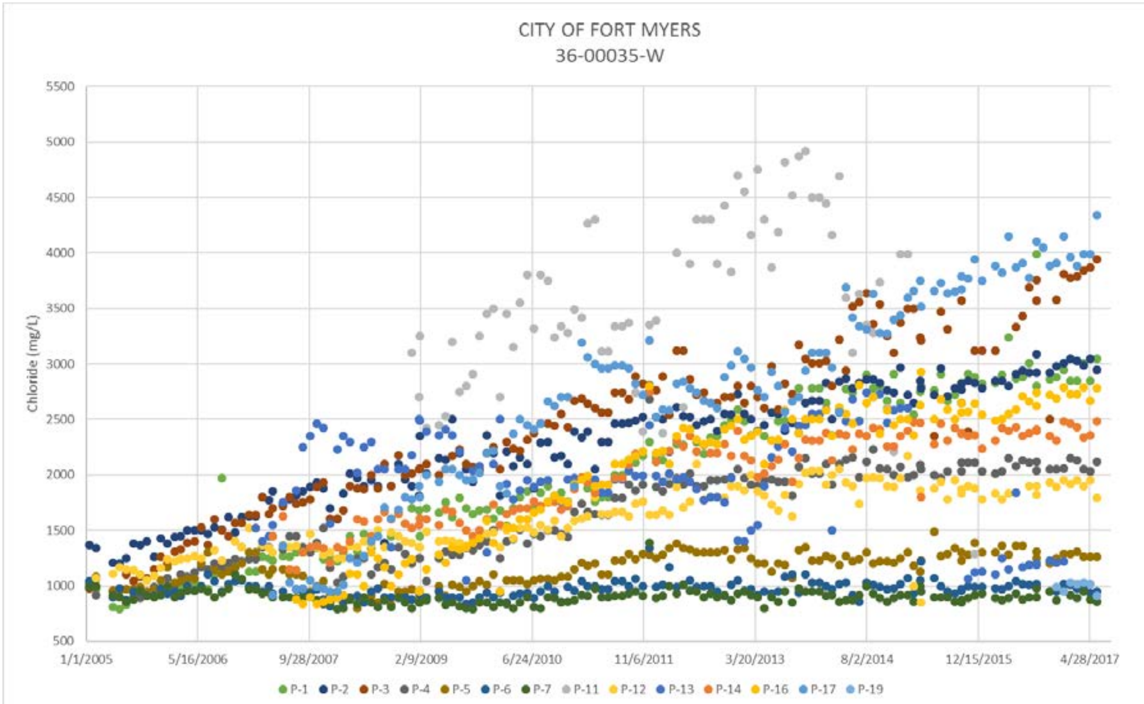


Figure 6-23. Changes in chloride concentrations in 14 of the 19 production wells in the Fort Myers reverse osmosis wellfield.

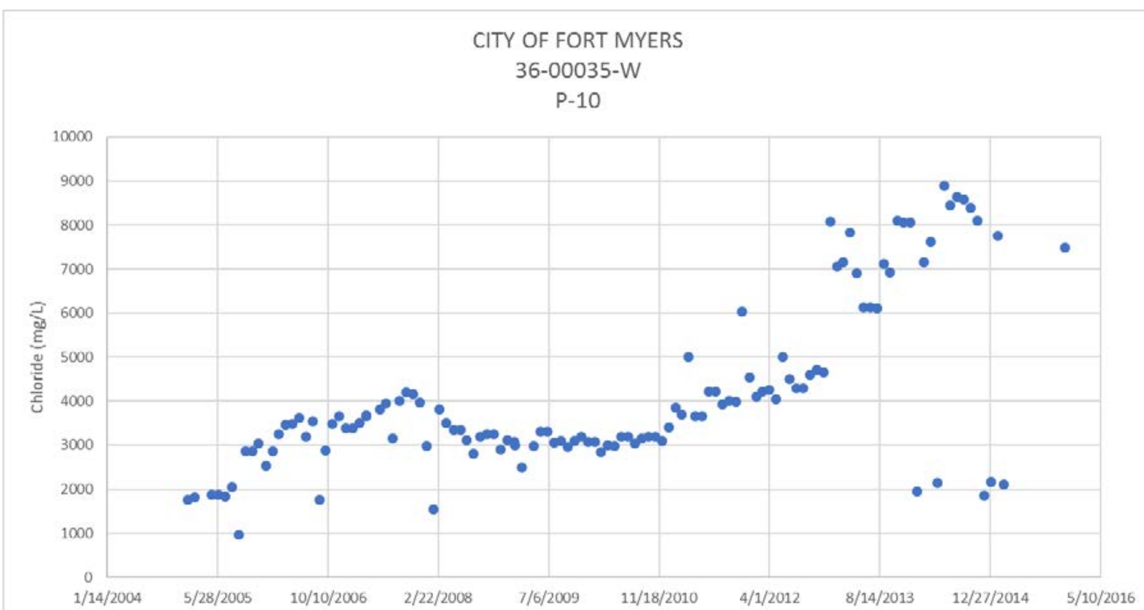


Figure 6-24. Production well P-10 in the Fort Myers reverse osmosis wellfield, showing chloride concentration increases.

North Lee County RO Wellfield

The North Lee County RO wellfield is located north of the Caloosahatchee River Estuary and east of Interstate 75. **Figure 6-25** presents the change in chloride concentrations over time for 19 production wells in the North Lee County RO wellfield. Starting in 2006, most wells had chloride concentrations between 750 and 1,250 mg/L. However, within a year, chloride concentrations at well PW-6 increased to approximately 4,000 mg/L, and the well was taken off line. Starting in 2009, chloride concentrations at production well PW-9 increased and remained in the 3,000 to 3,500 mg/L range. Chloride concentrations at wells put on line in 2010 and 2013 remain under 1,500 mg/L and most are less than 1,000 mg/L.

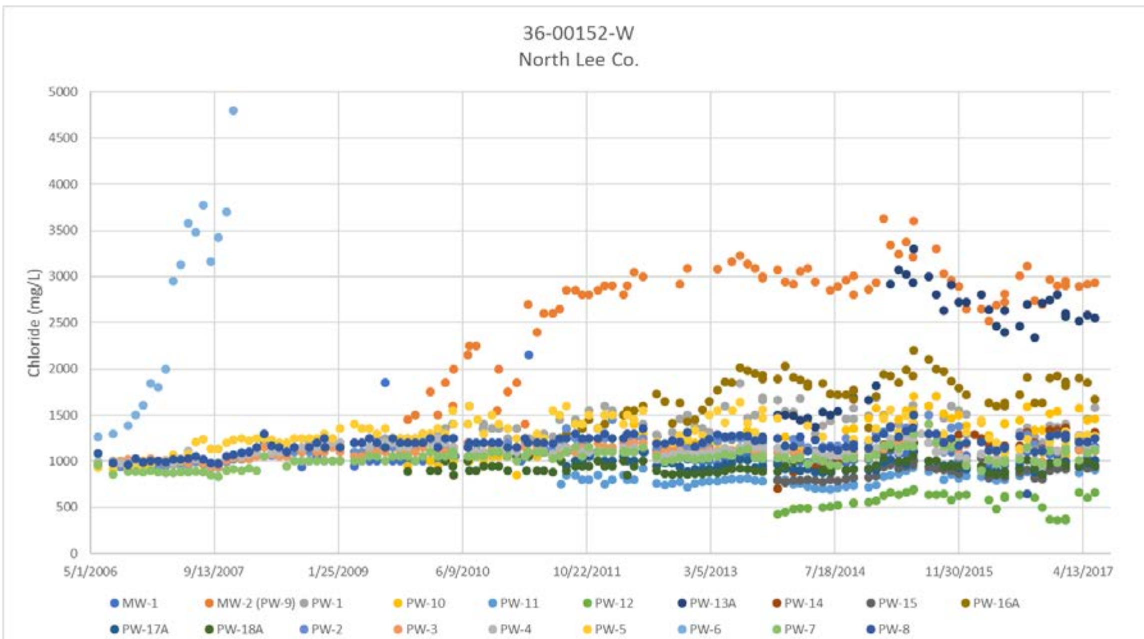


Figure 6-25. Changes in chloride concentrations in the 19 production wells in the North Lee County reverse osmosis wellfield.

Collier County North RO Wellfield

The Collier County North RO wellfield has many UFA wells. For simplicity, three wells that represent the major trends among the many production wells are shown in **Figure 6-26**. Wells with chloride concentrations of approximately 750 to 2,000 mg/L (8 wells) mostly remain stable at the initial concentration throughout the period of record. Wells with chloride concentrations of approximately 2,000 to 3,000 mg/L (44 wells) appear to have slowly increasing chloride concentrations. Wells with chloride concentrations of approximately 3,000 to 6,000 mg/L (15 wells) undergo periodic increases in chloride concentration of 500 to 1,000 mg/L.

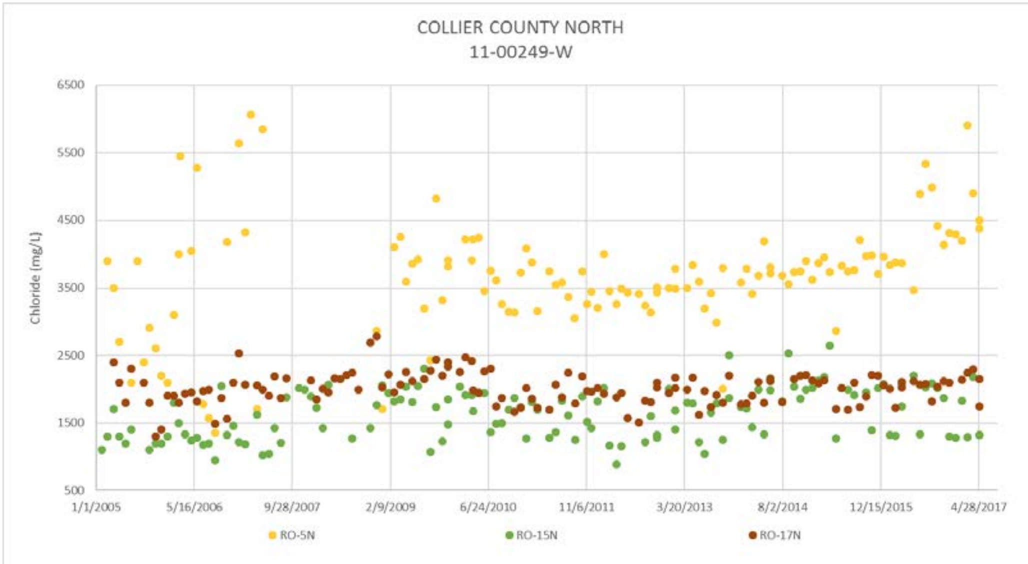


Figure 6-26. Changes in chloride concentrations in select production wells that represent the three major trends in the Collier County North reverse osmosis wellfield.

Cape Coral South RO Wellfield

The City of Cape Coral was one of the first utilities to convert to RO treatment for potable water supply and has two UFA wellfields (North and South). As shown in **Figure 6-27**, most Cape Coral South RO production wells had initial chloride concentrations between 500 and 1,500 mg/L, and most of these wells stayed in that range from 2005 to 2017. There are a few outlier wells that have increased chloride concentrations up to 3,500 mg/L.

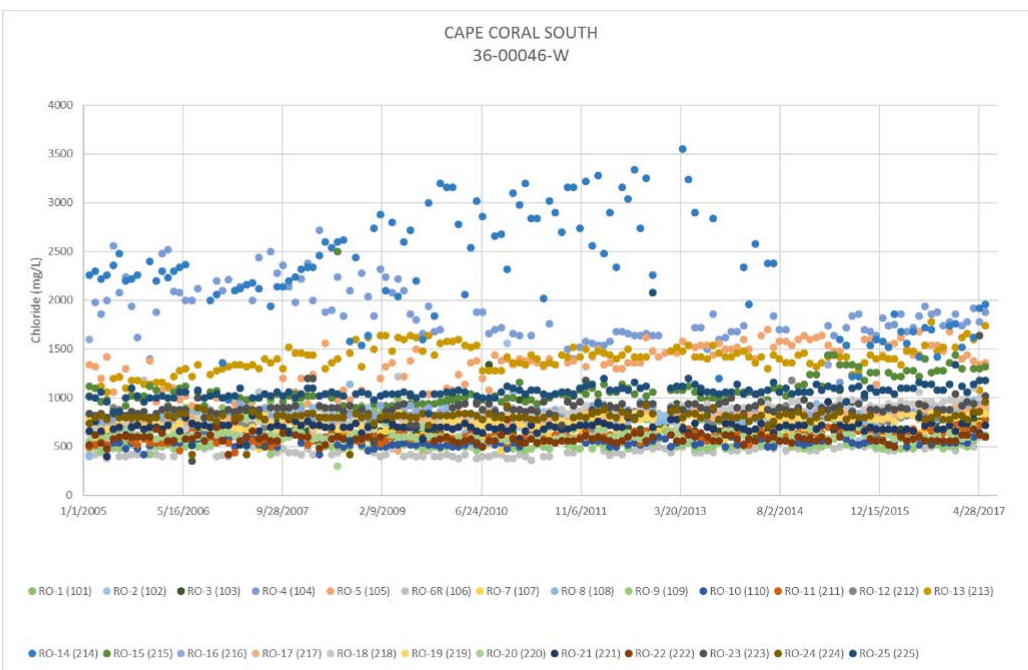


Figure 6-27. Changes in chloride concentrations in production wells in the Cape Coral South reverse osmosis wellfield.

Cape Coral North RO Wellfield

The Cape Coral North RO wellfield is orientated east-west along the northwestern portion of Cape Coral. Although there is a general upward trend in chloride concentrations, most wells remain in the 500 to 1,500 mg/L range. There are a few outliers (wells 318, 307, and 324) with chloride concentrations ranging from 1,500 to 3,000 mg/L and spiking at 4,000 mg/L (**Figure 6-28**).

Cape Coral constructed several monitor wells to track potential saltwater intrusion towards the UFA wellfields. Once such well, Well X, is located in the Cape Coral North RO wellfield area and is considerably deeper (1,101 feet deep) than the UFA production wells (approximately 750 feet deep). Although Well X had an initial chloride concentration between 1,500 and 3,000 mg/L, it increased to approximately 10,000 mg/L within a few years and has remained at that level (**Figure 6-29**). It appears that saltwater migrated from below due to UFA wellfield pumping but has reached some level of stability. Cape Coral should continue to monitor and manage the North RO wellfield to prevent further upward migration of saltwater into the UFA.

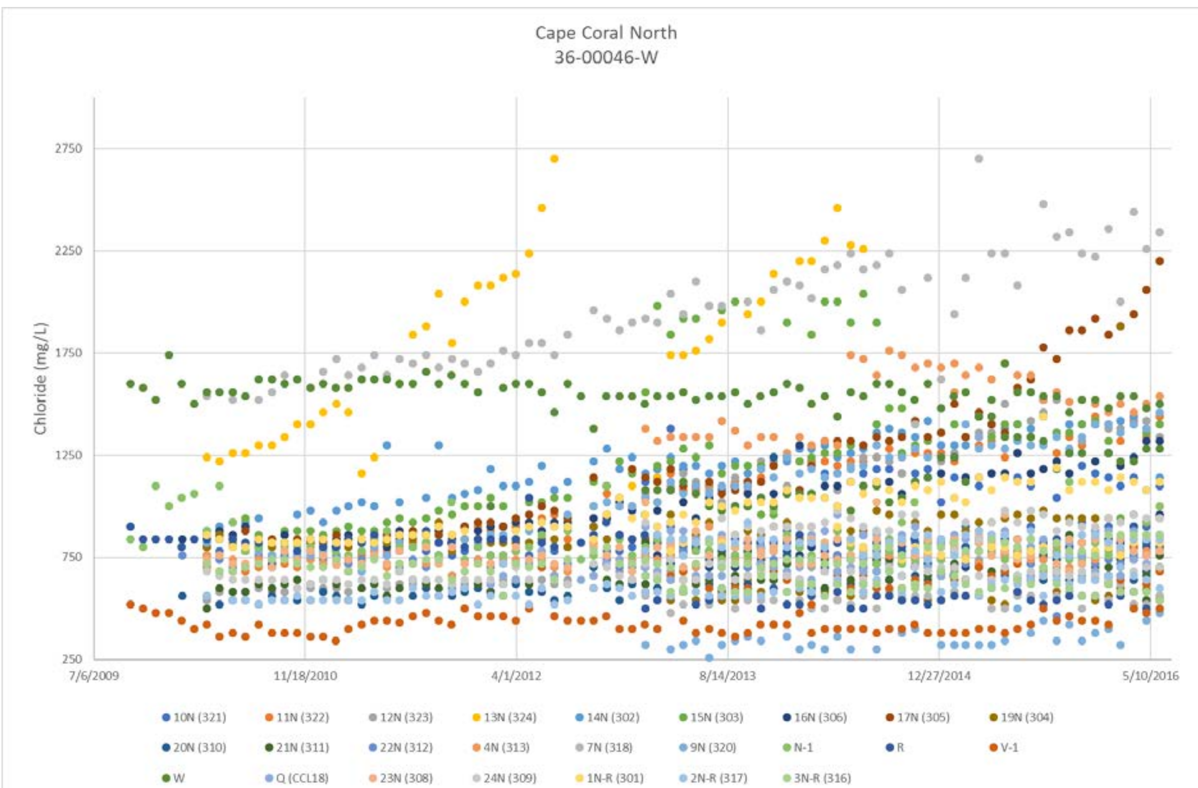


Figure 6-28. Changes in chloride concentrations in production wells in the Cape Coral North reverse osmosis wellfield.

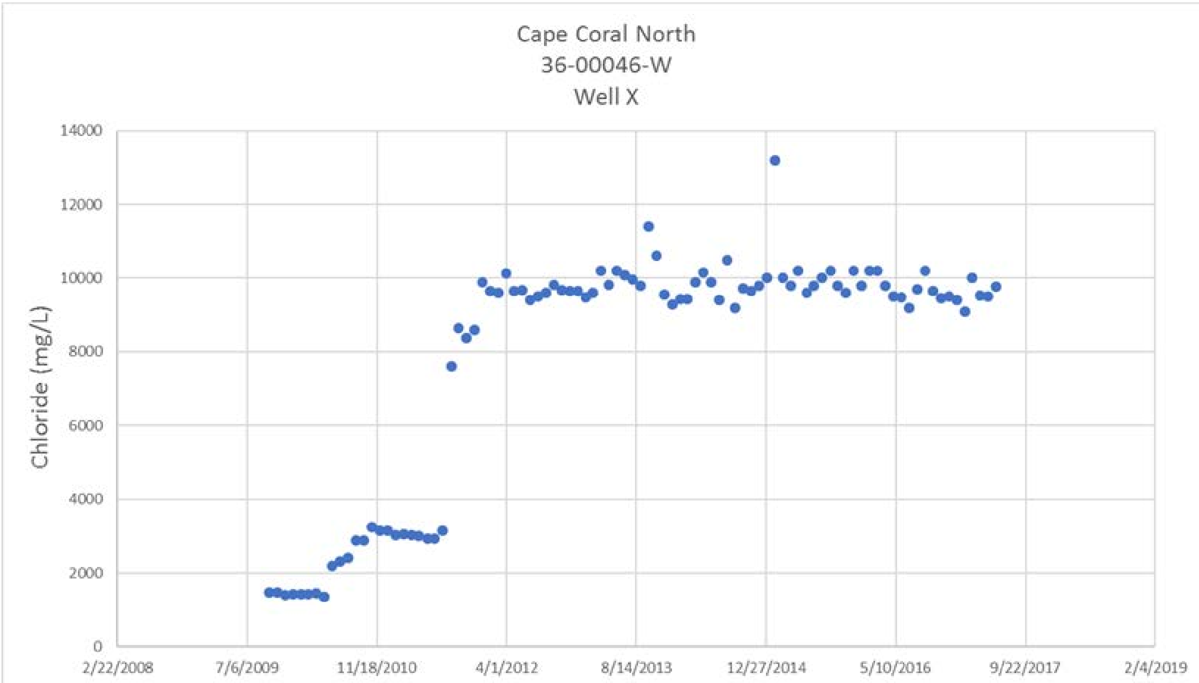


Figure 6-29. Changes in chloride concentration in monitor well X in the Cape Coral North reverse osmosis wellfield.

Floridan Aquifer System Conclusions

Review of the most recent data indicates that UFA wellfields that are properly managed can be relied upon to meet current and projected PWS demands. This section documents water level and water quality trends associated with operation of UFA wellfields to meet PWS demands in the LWC Planning Area. Each UFA wellfield has experienced some level of water quality degradation, which is likely to continue. Water quality degradation can be minimized by PWS utilities through the following activities:

- Maximizing safe well spacing to minimize interference effects and reduce stress on the UFA.
- Plugging and abandoning individual wells experiencing chloride concentration increases and replacing them with new wells elsewhere within the wellfield area.
- Partially back-plugging individual wells to isolate poor-quality layers from overlying high-quality layers, thereby keeping the wells in operation.
- Reducing pumping rates at individual wells, thereby minimizing the potential for poor-quality water to enter the well's production zone from below.
- Rotating the operation of individual wells, thereby reducing the overall pumping stress on the well's production zone and theoretically reducing the influx of poor-quality water from below.
- Installing monitor wells to provide early warning to changing wellfield operational schemes to predict and minimize upconing or lateral movement of poor-quality water.

The projected 2040 gross water demands for all categories of water use in this plan update are approximately 1 to 4 percent less than the 2030 projected demands in the 2012 LWC Plan Update (see **Chapter 2**). Previous water supply planning analyses and water use permitting activities have indicated that the FAS could supply sufficient water to meet the regional PWS demands through the planning horizon. Sustainable withdrawal rates depend on localized aquifer properties, water quality, and proximity to other FAS production wells.

SEA LEVEL RISE AND CLIMATE CHANGE

Rising sea levels and increased air temperatures have been documented within the SFWMD and around the world. Other changes, such as wider variability in rainfall and increases in evapotranspiration, are more difficult to model and predict. Global models suggest substantial changes may occur in rainfall patterns, including longer dry periods between major rain events and greater volumes of rain when wet conditions occur. Due to the scale of global models, unique meteorologic processes are not accounted for at state, regional, and local levels, and there is considerable variability in the potential effects of climate change at these scales.

Changes in rainfall patterns in South Florida are difficult to predict because rainfall varies seasonally and at decadal scales. Rainfall variability is partly due to global climate and atmospheric influences such as the El Niño Southern Oscillation and the Atlantic Multi-Decadal Oscillation. Another major factor in rainfall variability is the occurrence of tropical activity, which can create large rainfall volumes. Future changes in the frequency and intensity of tropical storms or extended dry periods may impact regional water availability.

If warming air temperatures cause an increase in evapotranspiration, as many experts expect, water demands likely would increase for the PWS, AGR, and REC water use categories. More frequent, intense rainfall events with longer interim dry periods could increase total annual rainfall but decrease effective rainfall as more water may be lost to runoff.

When reliable information is available, sea level rise and climate change may be considered in infrastructure design and in the establishment of Minimum Flows and Minimum Water Levels (MFLs) and Water Reservations for water bodies and aquifers. Regional tide gauge records suggest that sea level has been rising 7 to 9 inches over the past century. Satellite data from 1992 to present show that the rate of sea level rise recently increased to more than 12 inches in 100 years. While regional predictions for southwestern Florida are not available, data from southeastern region of the state suggest that future sea level rise could be as much as 1 to 2 feet over the next 50 years.

For water supply in the LWC Planning Area, the primary and immediate concern regarding sea level rise is the inland migration of seawater and possibly coastal flooding of low-lying areas. In coastal South Florida, saltwater intrusion has been an issue since humans began draining lands for development and withdrawing groundwater for drinking or irrigation. Potential acceleration of sea level rise will exacerbate the situation.

SOURCE DIVERSIFICATION FOR PWS UTILITIES

In order to meet the challenge of increasing needs, limited availability of traditional freshwater sources, and saltwater intrusion, utilities have diversified sources, expanded interconnections, and changed treatment technologies.

In 2016, net (finished) water from the LWC Planning Area PWS utilities was 40 percent from the SAS, 15 percent from the IAS, and 45 percent from the FAS. Use of the FAS by utilities is expected to continue increasing to meet growth in PWS demands. **Figure 6-30** displays the shifting share of supply sources from 1999 to 2016 utilized by LWC Planning Area utilities. Additional discussion of the source diversification trend can be found in **Chapter 5**.

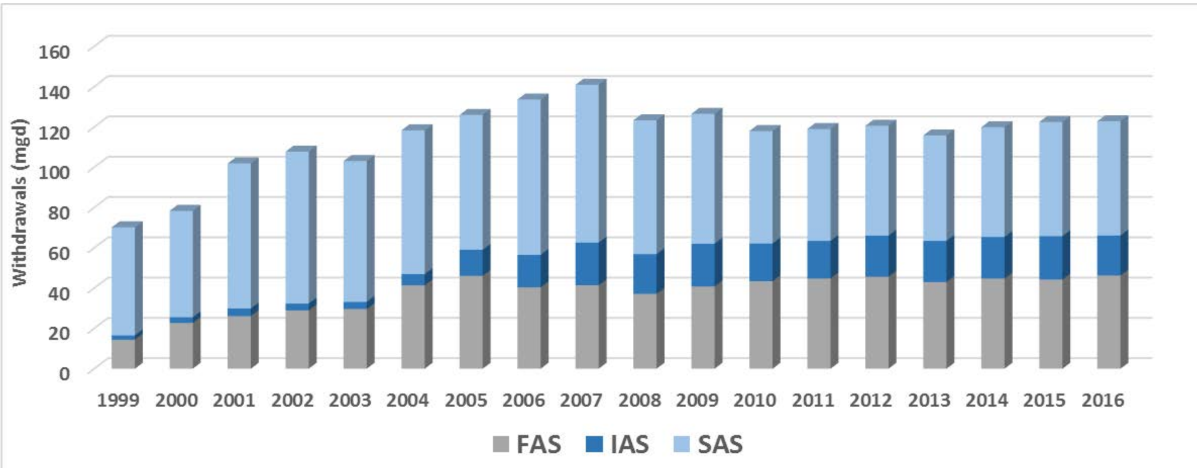


Figure 6-30. Public water supply utility withdrawals by source in the Lower West Coast Planning Area (1999 to 2016).

SUMMARY OF WATER RESOURCE ANALYSES

The findings and conclusions of previous plan updates continue to represent the issues needing to be reviewed to meet the 2040 projected water demands within the LWC Planning Area. The following are findings regarding the availability of water resources within the LWC Planning Area to meet the projected 2040 water demands:

- New uses of surface water from Lake Okeechobee and the C-43 Canal are limited in accordance with the Lake Okeechobee Service Area Restricted Allocation Area criteria. These criteria effectively limit future additional withdrawals from Lake Okeechobee and all surface waters that are hydraulically connected to the lake.
- The Caloosahatchee River Estuary is protected by an MFL, which is undergoing re-evaluation, and the Caloosahatchee River (C-43) West Basin Storage Reservoir has a Water Reservation to prevent allocation of the stored project water.
- Surface water and fresh groundwater from the SAS and IAS will remain primary sources for existing agricultural uses. Expansion of surface water and groundwater withdrawals is limited due to resource constraints.

- The SAS and IAS historically have served as the primary sources of water to meet urban demands in the LWC Planning Area. Expansion of SAS and IAS withdrawals is limited due to resource constraints, impacts to existing users, environmental impacts to natural systems as well as water level decreases restricted by MDLs.
- Most PWS utilities in the LWC Planning Area have the FAS as a source of potable water to meet some or all of their demands. The FAS will continue to provide a substantial and increasing portion of the water needed to meet 2040 projected demands.
- To address sustainability of brackish water sources of the IAS and FAS, the SFWMD should coordinate with utilities to facilitate long-term management of the FAS for PWS to encourage greater spacing between new wells, lower the capacity of wells, and continue refinement of wellfield operational plans.
- The monitoring networks used for saltwater intrusion, aquifer assessment, and groundwater modeling are a hybrid of regional monitoring and monitoring required by or performed by regulatory programs. Efforts should be made to identify wells considered critical to long-term monitoring to ensure these wells are maintained or replaced as necessary.
- To meet the changing conditions from saltwater intrusion, rising sea level, and increasing uncertainty in climatic conditions, utilities should continue to diversify their sources of water supply and treatment technologies. Utilities should consider expanding interconnections with other utilities and diversifying sources, storage, and recharge options discussed in **Chapter 5**.

REFERENCES

Intergovernmental Panel on Climate Change. 2013. *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex, and P.M. Midgley [eds.]). Cambridge University Press, Cambridge, United Kingdom. 1,535 pp.

McMillan, C. and S. Anderson. 2015. *Sandstone Aquifer at Lehigh Acres Maximum Developable Limits*. Technical Publication WS-38. South Florida Water Management District, West Palm Beach, FL.

Melillo, J.M., T.C. Richmond, and G.W. Yohe (eds.). 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Change Research Program. 841 pp.

SFWMD. 2012. *2012 Lower West Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL.

Southeast Florida Regional Climate Change Compact. 2015. *Unified Sea Level Rise Projection for Southeast Florida*. Prepared by the Sea Level Rise Work Group for the Southeast Florida Regional Climate Change Compact Steering Committee. 35 pp.

7

Water Resource Development Projects

This chapter addresses the roles of the South Florida Water Management District (SFWMD or District) and other parties in water resource development projects, and provides a summary of projects in the Lower West Coast (LWC) Planning Area. The efforts presented in this chapter reflect current budget categories the SFWMD uses for funding new and ongoing water resource development projects. This chapter was created using the Fiscal Year (FY) 2017 Districtwide water resource budget and includes schedules and costs for FY2017 to FY2021. Additional detail on the status of these projects can be found in Volume II – Chapter 5A (Hoppes 2017) of the *2017 South Florida Environmental Report* (SFER).

TOPICS

- Regional Groundwater Models
- Districtwide Water Resource Development Projects
- Comprehensive Everglades Restoration Plan
- Additional Water Storage and Watershed Management Efforts
- Northern Everglades and Estuaries Protection Program
- Big Cypress Basin Funding Programs
- Summary of Water Resource Development Projects

Florida water law identifies two categories of activities to meet water needs: water resource development (subject of this chapter) and water supply development (**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 an adequate 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 are useful for appropriate facility design, identifying safe aquifer yields, and evaluating the economic viability of projects, but do not increase water availability.

Water supply development projects (**Chapter 8**) generally are the responsibility of water users (e.g., utilities) and involve the water source options described in **Chapter 5** to meet specific needs. These projects typically include construction of wellfields, water treatment plants, distribution lines, reclaimed water facilities, and storage devices.

Water resource planning in the LWC Planning Area is influenced by the Comprehensive Everglades Restoration Plan (CERP). 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 efforts have multiple implementation phases, which are supported by water resource development activities such as modeling, land acquisition, project controls, and technical services. CERP efforts are described in this chapter and in the 2017 SFER (SFWMD 2017).

REGIONAL GROUNDWATER MODELS

The SFWMD funds development and application of numerical models for evaluation of groundwater and surface water resources in the District's five planning areas. The models support development of regional water supply plans, Minimum Flows and Minimum Water Levels (MFLs), Water Reservations, and other projects benefitting water resources. In the LWC Planning Area, water resource development projects generally include monitoring for MFLs and groundwater modeling.

Regional groundwater flow models simulate the rate and direction of water movement through the subsurface. Such models include the major components of the hydrologic cycle and are used in water supply planning to understand the effects of current and future water use. SFWMD staff currently are performing the following modeling efforts with an emphasis on the LWC Planning Area.

West Coast Floridan Model

Use of the Floridan aquifer system (FAS) as a water source is anticipated to increase with growing demand for water and limited availability of freshwater sources throughout South Florida. The West Coast Floridan Model is a density-dependent groundwater flow and transport model of the FAS. The model area covers the entire west coast of the District, extending from the Southwest Florida Water Management District boundary in Charlotte County to the Florida Keys. Once the model is completed and calibrated, it will be used to evaluate potential changes to regional conditions of the FAS in the LWC Planning Area. The model is anticipated to be available for simulations of current and future demand scenarios by 2018-2019.

Lower West Coast Surficial and Intermediate Aquifer Systems Model

The Lower West Coast Surficial and Intermediate Aquifer Systems Model was completed in 2006 and has been used to evaluate specific water use permits but has not been used for planning purposes. SFWMD staff are updating this model, incorporating new hydrostratigraphic, water level, water use, and saltwater interface data that cover both the surficial and intermediate aquifer systems (SAS and IAS). A hydrostratigraphic reinterpretation report was completed in 2016, and the calibrated model is undergoing peer review. After the peer review is completed, the model will be used to evaluate regional water resources for future water supply plan updates. Model results are expected to be available in 2018-2019.

DISTRICTWIDE WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects encompassing more than one planning area generally are considered Districtwide projects. **Table 7-1** summarizes the estimated costs and time frames for completion of Districtwide water resource development projects. Aspects specifically pertaining or relevant to the LWC Planning Area are identified within the context of Districtwide projects. **Table 7-1** does not include other programs, such as CERP, that have their own budgets and primarily are ecosystem restoration projects. The following ongoing and future projects are discussed in this section:

- MFL, Water Reservation, and Restricted Allocation Area (RAA) Rule Activities
- Comprehensive Water Conservation Program
- Alternative Water Supply
- Drilling and Testing
- Groundwater Assessment
- Groundwater, Surface Water, and Wetland Monitoring

Table 7-1. Fiscal Year 2016-2017 through Fiscal Year 2020-2021 implementation schedule and projected expenditures (including salaries, benefits, and operating expenses) for water resource development activities within the SFWMD. All activities are ongoing unless noted otherwise (From: Hoppes 2017).

Regional Water Activities	Plan Implementation Costs ($ thousands)					Total
	2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	
Water Supply Planning	1,344	1,344	1,344	1,344	1,344	**6,720**
CFWI Water Supply Planning Project	3,695	541	541	541	541	**5,859**
CFWI/Model Peer Review Estimated finish date: 2017	72	0	0	0	0	**72**
Comprehensive Plan and Documents Review, and Technical Assistance to Local Governments	206	206	206	206	206	**1,030**
Water Supply Implementation	252	252	252	252	252	**1,260**
Subtotal	**5,569**	**2,343**	**2,343**	**2,343**	**2,343**	**14,941**
Districtwide Water Activities						
MFL, Water Reservation, and RAA Activities	502	380	380	380	380	**2,022**
Comprehensive Water Conservation Program	1,333	343	343	343	343	**2,705**
BCB Alternative Water Supply	739	0	0	0	0	**739**
Cooperative Funding Program	3,899	90	0	0	0	**3,989**
Groundwater Monitoring	1,559	1,450	1,450	1,450	1,450	**7,359**
Groundwater Modeling	562	775	775	775	775	**3,662**
Estimated portion of C&SF Project Operation & Maintenance budget allocated to Water Supply*	104,491	104,491	104,491	104,491	104,491	**522,455**
Subtotal	**113,085**	**107,529**	**107,439**	**107,439**	**107,439**	**542,931**
Total	**118,654**	**109,872**	**109,782**	**109,782**	**109,782**	**557,872**

BCB = Big Cypress Basin; C&SF Project = Central and Southern Florida Project; CFWI = Central Florida Water Initiative; MFL = Minimum Flow and Minimum Water Level; RAA = Restricted Allocation Area; SFWMD = South Florida Water Management District.
* Approximated based on 50 percent of the FY2016-2017 Operation & Maintenance budget.

MFL, Water Reservation, and RAA Rule Activities

MFLs, Water Reservations, and RAA rules as well as water resource protection measures have been developed to ensure the sustainability of water resources within the SFWMD. For information on MFLs, Water Reservations, and RAAs, see **Chapter 4**, which summarizes the rules in effect as of 2016. Additional information can be found in **Appendix C**.

Comprehensive Water Conservation Program

The long-standing conservation goal of the SFWMD is to prevent and reduce wasteful, uneconomical, impractical, or unreasonable uses of water resources. This 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 funding programs.

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

Alternative Water Supply

Alternative water supply (AWS) projects and source diversification are critical supplements to traditional water sources in order to meet current and future water needs. Prior to 2016, the District's AWS Funding Program helped water users develop reclaimed water projects, water reclamation facilities, brackish water wellfields, reverse osmosis treatment facilities, stormwater capture systems, and aquifer storage and recovery (ASR) well systems. From FY2010 to FY2015, the SFWMD, in cooperation with the State of Florida, provided more than $15.5 million in AWS funding for 52 projects in the LWC Planning Area; however, future funding is subject to budget constraints. A full description of AWS-related projects and associated funding is contained in the SFWMD's Alternative Water Supply Annual Reports, prepared pursuant to Section 373.707(7), F.S., and published in annual updates of the SFER. Information on AWS projects funded by the Cooperative Funding Program can be found in **Chapter 8**.

Drilling and Testing

Drilling and testing includes the installation of wells for short- to long-term monitoring of aquifer water levels and water quality. This work includes contract and staff time for drilling and well construction, geophysical logging, pump tests, sediment analysis, and lithologic descriptions.

Knowledge of South Florida hydrogeology is enhanced through construction of exploratory/test wells. Such increased understanding has improved the accuracy of the SFWMD's groundwater modeling and decision-making regarding approval of water use permits.

Floridan Aquifer Well Drilling

Groundwater Assessment

Groundwater assessment includes results of drilling and testing programs as well as development of hydrostratigraphic maps and saltwater interface maps. The SFWMD creates maps of the estimated position of the freshwater-saltwater interface in the coastal SAS of Collier and Lee counties to document the inland extent of saltwater within the aquifers for future comparison. The most recent saltwater interface data were developed in 2014 (**Appendix E**). Saltwater interface maps for Monroe County are prepared by the United States Geological Survey (USGS).

Groundwater, Surface Water, and Wetland Monitoring

Information regarding groundwater and surface water levels is essential to managing and protecting South Florida's water resources. Real-time data combined with historical information about water levels, weather, rainfall, and water quality changes assist in water resource decisions.

Water level and water quality monitoring provides critical information for developing groundwater models, assessing groundwater conditions, and managing 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 stores hydrologic, meteorologic, hydrogeologic, and water quality data. The USGS also monitors, archives, and publishes data annually.

Districtwide groundwater monitoring activities include the following:

- **USGS contract for water level monitoring –** An ongoing effort by the USGS to collect data via groundwater level monitoring. The project includes well and recorder maintenance as well as archiving data in a USGS database for sites throughout the SFWMD. Real-time and periodic data can be accessed through a map interface developed and maintained for this contract (https://www.sflorida.er.usgs.gov/ddn_data/index.html).
- **Groundwater monitoring –** An ongoing effort by the SFWMD to monitor groundwater levels throughout the District. As of 2015, Districtwide monitoring includes 755 active groundwater stations for the SAS, IAS, and FAS. Data are collected, analyzed, validated, and archived in DBHYDRO.
- **Regional FAS exploration and well maintenance –** Water level and water quality monitoring is ongoing at 100 FAS well sites in the SFWMD, as of 2015. Well maintenance is conducted as needed. Data are collected, analyzed, validated, and archived in DBHYDRO.
- **Hydrogeologic database improvements –** Backlogged data are uploaded and miscellaneous database corrections are made.
- **Monthly groundwater level measurements** – Continued water level monitoring, including data collection, analysis, and validation, at select sites to supplement the existing groundwater level network.

COMPREHENSIVE EVERGLADES RESTORATION PLAN

CERP provides a guide to restore, protect, and preserve 18,000 square miles of the Everglades. The United States Congress approved the restoration plan in the Water Resources Development Act of 2000. Annual updates of CERP implementation can be found on the CERP website (http://www.evergladesplan.org) and in annual updates of the SFER (www.sfwmd.gov; Search: SFER). CERP projects in the LWC Planning Area include the following:

- Caloosahatchee River (C-43) West Basin Storage Reservoir
- Picayune Strand Restoration Project
- Southwest Florida Comprehensive Watershed Plan (formerly known as Southwest Florida Feasibility Study)
- ASR Regional Study and Pilot Projects
- Lake Okeechobee Watershed Restoration Project
- Western Everglades Restoration Project

Caloosahatchee River (C-43) West Basin Storage Reservoir

The Caloosahatchee River (C-43) West Basin Storage Reservoir (C-43 Reservoir) is a critical CERP project that will moderate flows to the Caloosahatchee River Estuary and help achieve a more balanced salinity regime. Early in the twentieth century, the Caloosahatchee River was channelized (i.e., deepened and straightened), water control structures (e.g., S-78, S-79) were built, and canals were dug in the river basin to drain agricultural lands and urban areas. As a result of the modifications, during periods of prolonged low rainfall, freshwater flow to the estuary is greatly reduced, increasing salinity above tolerance levels for various ecosystem components. During periods of heavy rainfall, large volumes of nutrient- and sediment-rich fresh water are transported into the estuary, affecting habitat quality for seagrasses, oysters, and other aquatic organisms. The C-43 Reservoir is designed to capture and store up to 170,000 acre-feet of water from the Caloosahatchee River Basin or from Lake Okeechobee when releases are necessary due to high lake levels. During dry periods, the stored water can be released to supplement low river flows and maintain optimal salinity levels in the estuary. The area of ecosystem benefits encompasses almost 80,000 acres of riverine and coastal waters.

Construction of the C-43 Reservoir began in late 2015 and is anticipated to be completed in late 2022. As of 2017, the first of two construction packages are under way, including the required preloading of structures that will be constructed within the dam. The full project involves construction of two pumping stations and the reservoir, which has two cells (**Figure 7-1**). In addition, the reservoir has a perimeter canal that provides seepage management and ensures water can be provided to adjacent landowners. Plans are in place to increase the capacity of the Townsend Canal to accommodate filling the C-43 Reservoir.

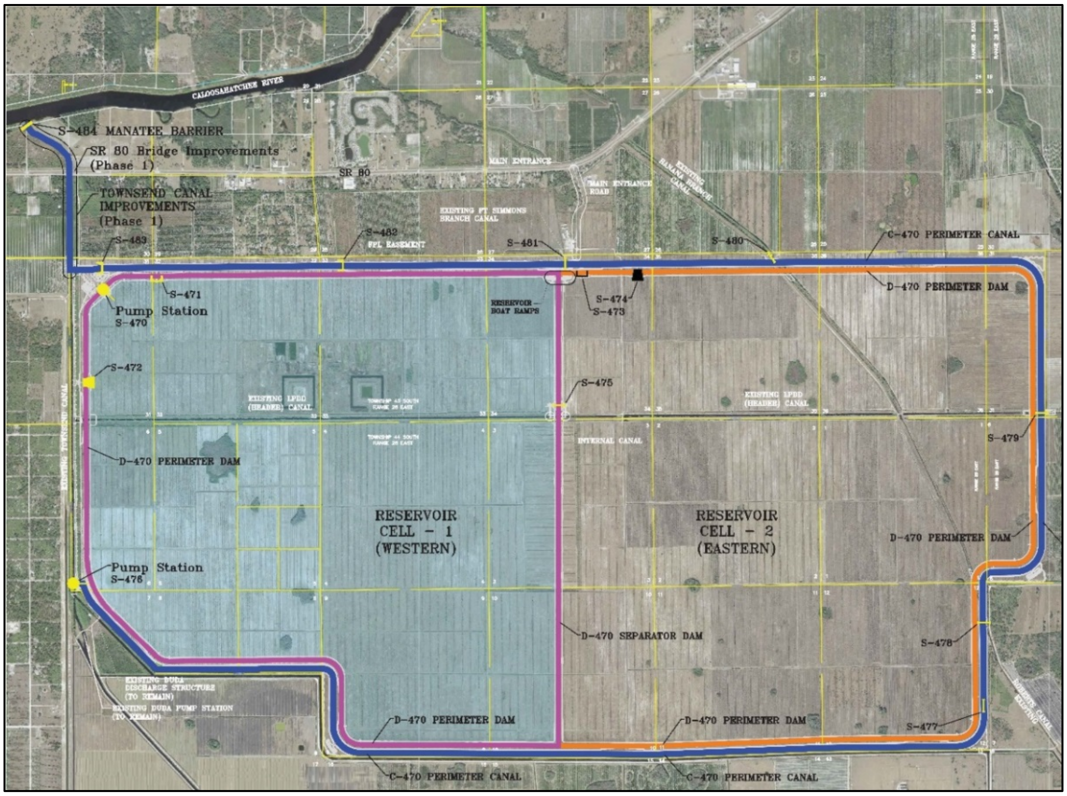


Figure 7-1. The Caloosahatchee River (C-43) West Basin Storage Reservoir site plan.

Picayune Strand Restoration Project

The Picayune Strand Restoration Project is designed to restore more than 55,000 acres of public lands by reducing over-drainage and returning natural and beneficial sheetflow to the project site and adjacent areas, including the Fakahatchee Strand Preserve State Park, Florida Panther National Wildlife Refuge, Ten Thousand Islands National Wildlife Refuge, Collier-Seminole State Park, and related estuaries. Since the filling of the Prairie Canal and removal of the roads east of Merritt Canal in 2007, the Merritt Pump Station has been constructed and the Merritt Canal plugged. Thus, the Merritt/Prairie Phase of the restoration project is fully operational, resulting in the hydrologic restoration of about 11,000 acres in the northeastern corner of Picayune Strand and 9,000 acres in the northwestern area of Fakahatchee Strand State Preserve Park. Approximately 210 miles of roads and 57 miles of old forest trams have been degraded east of Miller Canal. In late 2016, Faka Union Pump Station construction was completed, and the pump station began the 12-month Operational, Testing, and Monitoring Period. The Faka

Merritt Pump Station

Union Canal will not be plugged until the Southwestern Protection Feature is completed. The feature is a small levee that will provide flood protection to privately held lands on the southwestern boundary of the restoration project. The Southwestern Protection Feature is scheduled to begin construction in 2019, with completion in 2020. The Miller Pump Station is under construction and will be completed in late 2017. Like the Faka Union Canal, the Miller Canal will not be plugged until the Southwestern Protection Feature is completed.

Southwest Florida Comprehensive Watershed Plan

As part of CERP, the United States Congress authorized the Southwest Florida Feasibility Study (now known as the Southwest Florida Comprehensive Watershed Plan) in the Water Resources Development Act of 2000. The purpose of the study was to 1) perform a comprehensive assessment of all watersheds in southwest Florida, and 2) develop a regional restoration plan that addressed all water resource issues within the watersheds. Issues addressed by the study included loss of natural ecosystems, fragmentation of natural areas, degradation of wildlife habitat, alteration of natural freshwater flows to wetlands and estuaries, and water quality degradation in surface waters. The Southwest Florida Comprehensive Watershed Plan (United States Army Corps of Engineers [USACE] and SFWMD 2015a) was completed in early 2015.

ASR Regional Study and Pilot Projects

As part of CERP, the SFWMD and the USACE jointly developed the ASR Regional Study. The study documents the results of more than a decade of scientific and engineering investigations and will serve as a technical guide when considering ASR as part of future Everglades restoration efforts (USACE and SFWMD 2015b).

The ASR Regional Study incorporated the results from two pilot ASR systems; one was constructed and tested along the Kissimmee River and the other along the Hillsboro Canal in western Boca Raton. The study included results from numerous exploratory tests and regional investigations conducted by a multi-agency, multi-disciplinary team of scientists and engineers to address technical uncertainties. The investigations included a groundwater flow model, baseline ecological studies, and geochemical analyses, which were integrated into a comprehensive regional environmental risk assessment. Essential findings from the projects are as follows:

- Economically efficient, large-capacity (5 million gallons per day) ASR systems can be constructed in South Florida. However, an exploratory program should be conducted before building surface facilities due to variability in aquifer characteristics. For example, an exploratory well constructed at the Caloosahatchee River (C-43) West Basin Storage Reservoir indicated that the FAS was not suitable for construction of ASR wells due to the unconsolidated nature of the strata.
- To date, no flaws have been uncovered that might hinder implementation of ASR as part of CERP. Results of groundwater modeling indicate that the overall number of wells should be reduced from the originally proposed 333 wells to approximately 140 wells.

- The potential for rock fracturing and land subsidence resulting from ASR is very low, provided that the wells are spaced at safe distances from each other and that pumping pressures are kept low.
- Water recovered from the ASR pilot projects did not result in any quantifiable acute or chronic toxicologic effects on tested species, except for a temporal inhibition of reproduction in a cladoceran (a type of water flea), which should be verified by additional testing.
- The potential for mercury methylation from ASR within the FAS is very low. However, sulfate concentrations in the FAS are higher than in surface water; therefore, recovery of ASR systems should be maintained so as not to result in deleterious concentrations of sulfate.
- Some reduction in nutrients was observed during ASR, which is postulated to be a result of microbial uptake, aquifer matrix filtration, or mineral precipitation.
- Implementation of ASR as part of CERP should proceed in a phased approach, including expansion and continued testing of multi-well facilities and construction of new ASR systems at environmental restoration features that could be optimized by underground water storage, treatment, and recovery.

The National Research Council (NRC) 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" (NRC 2015). An incremental adaptive restoration approach for future ASR systems as part of CERP should involve one or more clusters of ASR wells, possibly including wells in the upper FAS and the Avon Park Permeable Zone, to address critical uncertainties such as recovery efficiencies, performance, long-term water quality, and ecological effects.

Lake Okeechobee Watershed Restoration Project

In 2016, the USACE and SFWMD began planning efforts for the Lake Okeechobee Watershed Restoration Project (LOWRP), which aims to:

- Improve the quality, quantity, timing, and distribution of water entering Lake Okeechobee;
- Provide for better management of lake water levels;
- Reduce high-volume discharges to the Caloosahatchee and St. Lucie river estuaries downstream of the lake; and
- Improve systemwide operational flexibility.

The LOWRP preliminary project area covers a large portion of the Lake Okeechobee watershed north of the lake (**Figure 7-2**). Project features under consideration to meet the project goals include surface reservoirs, ASR wells, and re-establishment of former wetland areas. The planning process is anticipated to proceed through 2018.

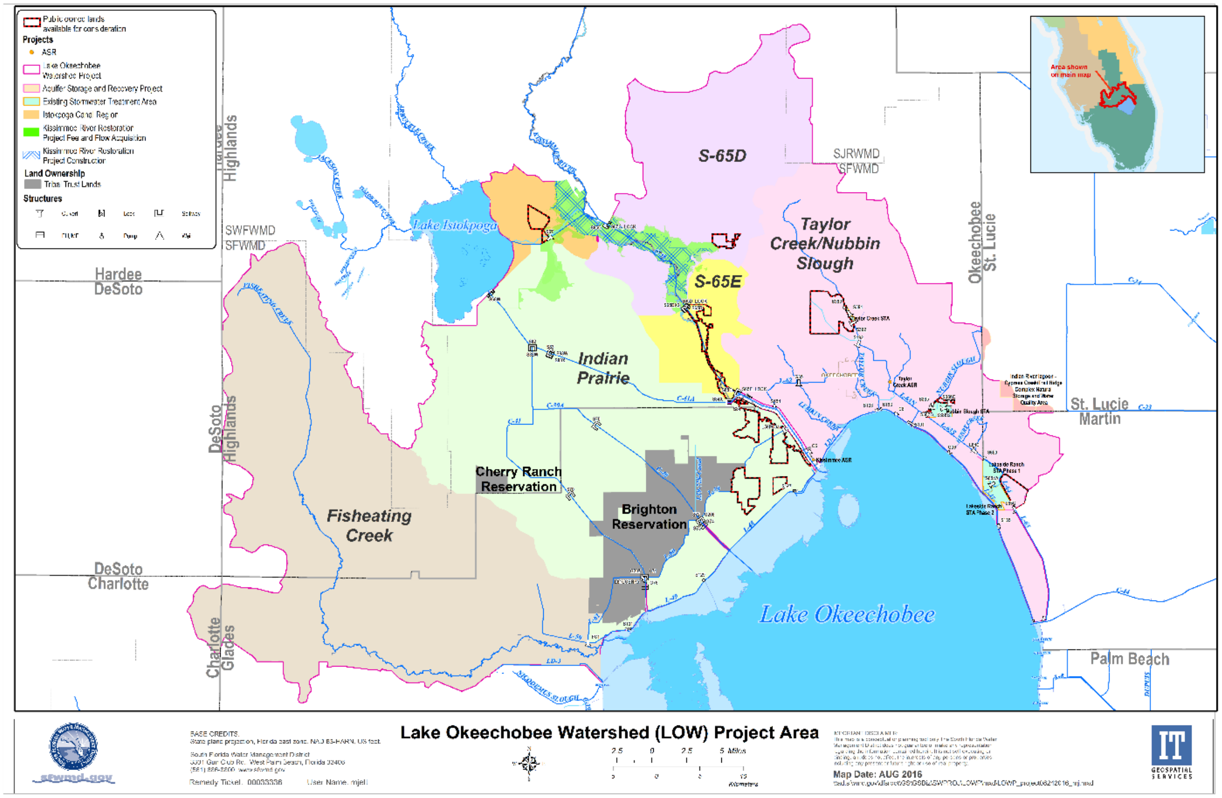


Figure 7-2. Lake Okeechobee Watershed Restoration Project area.

Western Everglades Restoration Project

In 2016, the USACE and SFWMD began planning efforts for the Western Everglades Restoration Project. Part of CERP, the Western Everglades Restoration Project will develop a plan to restore and reconnect the western Everglades ecosystem by improving the quality, quantity, timing, and distribution of flows to the area (**Figure 7-3**). The goals and objectives of the project include the following:

- Re-establish sheetflow from the West Feeder Canal across the Big Cypress Seminole Indian Reservation and into Big Cypress National Preserve;
- Maintain existing levels of flood protection; and
- Ensure that inflows to the North and West Feeder Canals meet applicable water quality standards.

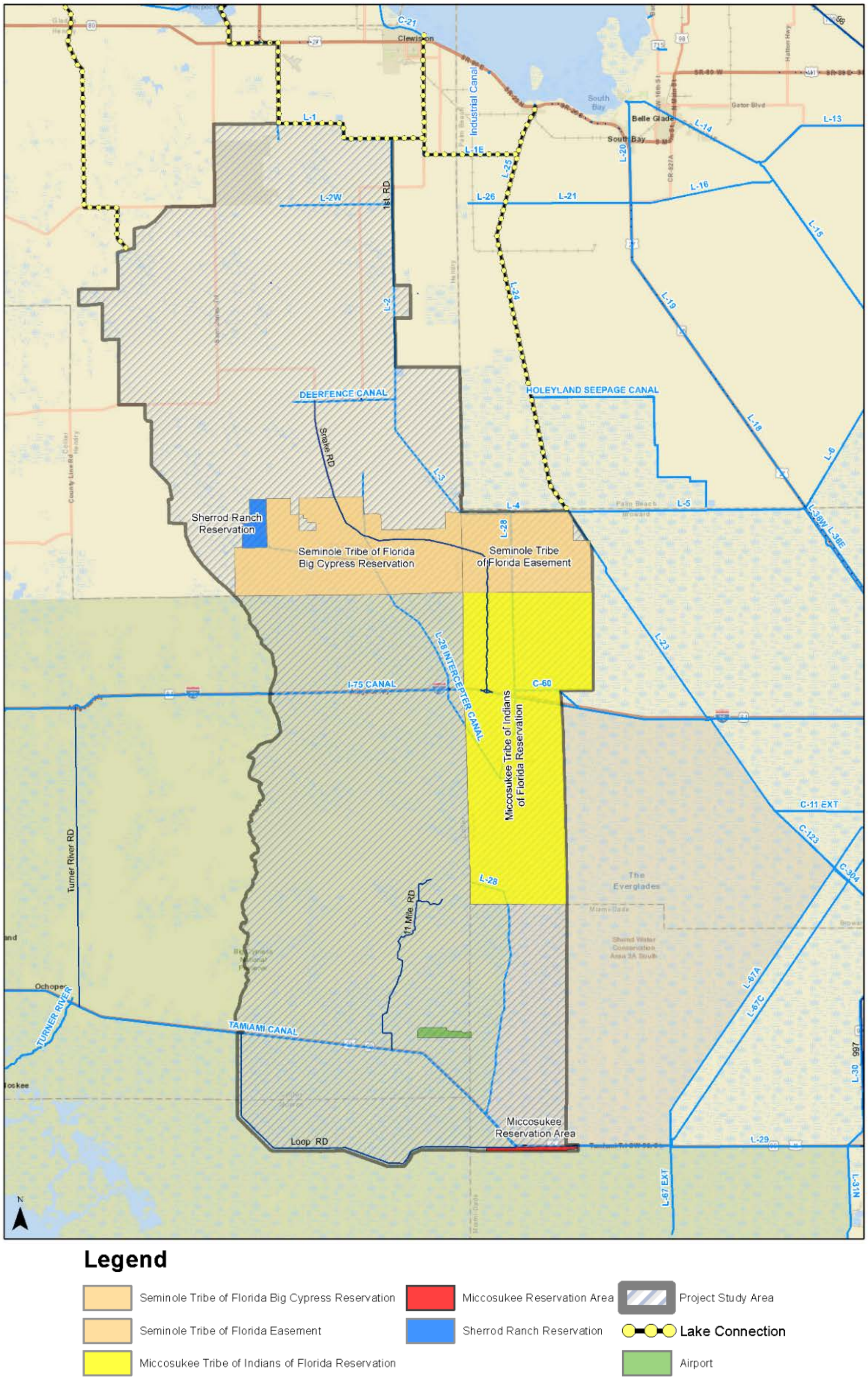


Figure 7-3. Western Everglades Restoration Project area.

ADDITIONAL WATER STORAGE AND WATERSHED MANAGEMENT EFFORTS

Dispersed Water Management Program

The SFWMD participates in the multi-agency Dispersed Water Management Program, which works cooperatively with public, private, and tribal landowners to retain stormwater on the landscape rather than discharging it downstream when discharges to downstream water bodies may be harmful. Without significant alterations, shallow water is distributed and retained on property 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.

Dispersed Water Management

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.

While there are no active dispersed water management projects in the LWC Planning Area, **Figures 7-4** to **7-6** (and the associated tables) present a variety of SFWMD surface water projects that achieve water storage, improve water quality, enhance habitat, and benefit fish and wildlife that depend on wetlands and surface water.

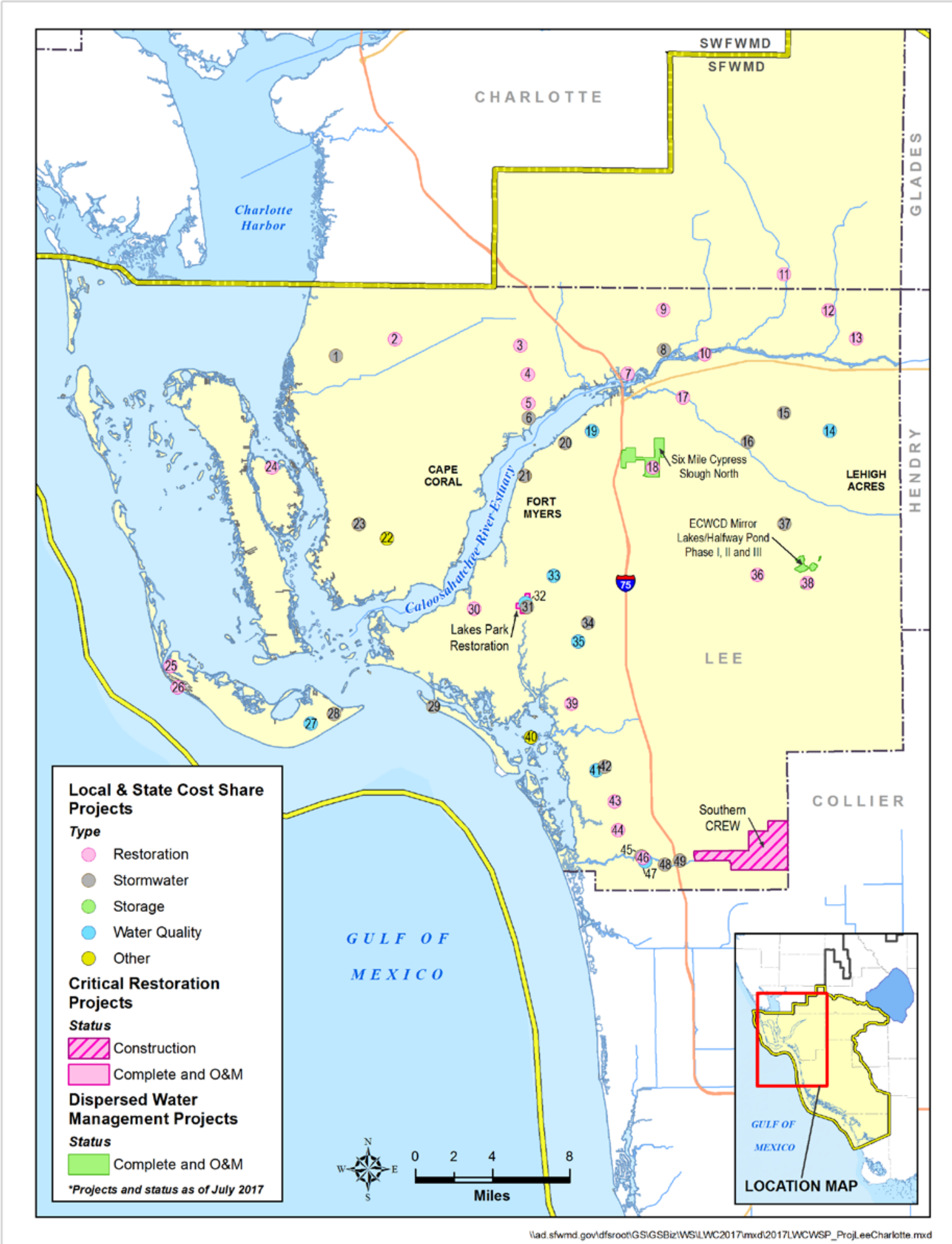


Figure 7-4. Local and state cooperative surface water management projects in Lee and Charlotte counties within the Lower West Coast Planning Area. Project names are listed in **Table 7-2**.

Table 7-2. Local and state cooperative surface water management projects in Lee and Charlotte counties within the Lower West Coast Planning Area.

Map ID	Project Title
1	Burnt Store Road Region Flow Redistribution Project
2	Yucca Pens Hydrologic Restoration
3	North Lee County Hydrologic Restoration
4	North Fort Myers Surface Water Restoration Project
5	Powell Creek Stormwater Restoration
6	Powell Creek Algal Turf Scrubber
7	Caloosahatchee Creeks Preserve Hydrological Restoration
8	Kickapoo Creek Stormwater System Analysis
9	Camp Caloosa Exotic Pest Plant Control Project
10	Columbus G. McLeod Preserve Shoreline Stabilization
11	Fichter's Creek Restoration Project
12	Four Corners Restoration – Daniels Preserve
13	Four Corners Restoration – Bob Jones Preserve
14	East County Water Control District Water Quality Projects
15	Hickey Widening Engineering/Permitting
16	Harns Marsh Improvements
17	Orange River Hydrologic Restoration
18	Six Mile Cypress Slough Preserve North Hydrological Restoration
19	Billy's Creek Filter Marsh Park
20	Ford Canal Filter Marsh Analysis
21	Manuel's Branch Canal Silt Reduction Structures
22	Florida Yards and Neighborhoods Program
23	Cape Coral Catch Basins Retrofit Program
24	Charlotte Harbor Buffer Preserve Hydrological Restoration
25	Dinkins Bayou Restoration
26	Bowman Beach Park Restoration
27	Jordan Marsh Water Quality Treatment Park
28	Sanibel Sanitary Sewer Expansion
29	Fort Myers Beach Stormwater Management Study
30	Deep Lagoon Preserve
31	Lakes Park Aeration Project
32	Filter Marsh Construction
33	Ten Mile Canal Water Quality Improvement Project
34	Black Hawk Stormwater Retrofit/East Briarcliff Road
35	Briarcliff Filter Marsh
36	Wild Turkey Strand Restoration
37	Yellowtail Structure Construction
38	Moving Water South, Phase II
39	Estero Tributary Restoration
40	Estero Bay Monitoring and Reporting
41	Halfway Creek Water Quality Improvements – Water Quality
42	Halfway Creek Water Quality Improvements – Stormwater
43	San Carlos Estates Water Control District Tributary Restoration and Wetland Creation
44	Estero Watershed Basin Restoration Projects
45	City of Bonita Springs Stormwater Retrofits and Water Quality Improvements
46	City of Bonita Springs Water Quality Improvements
47	Felts Avenue Bio-Reactor
48	Bonita Springs Imperial Bonita Estates
49	Jefferson Flow Way Analysis

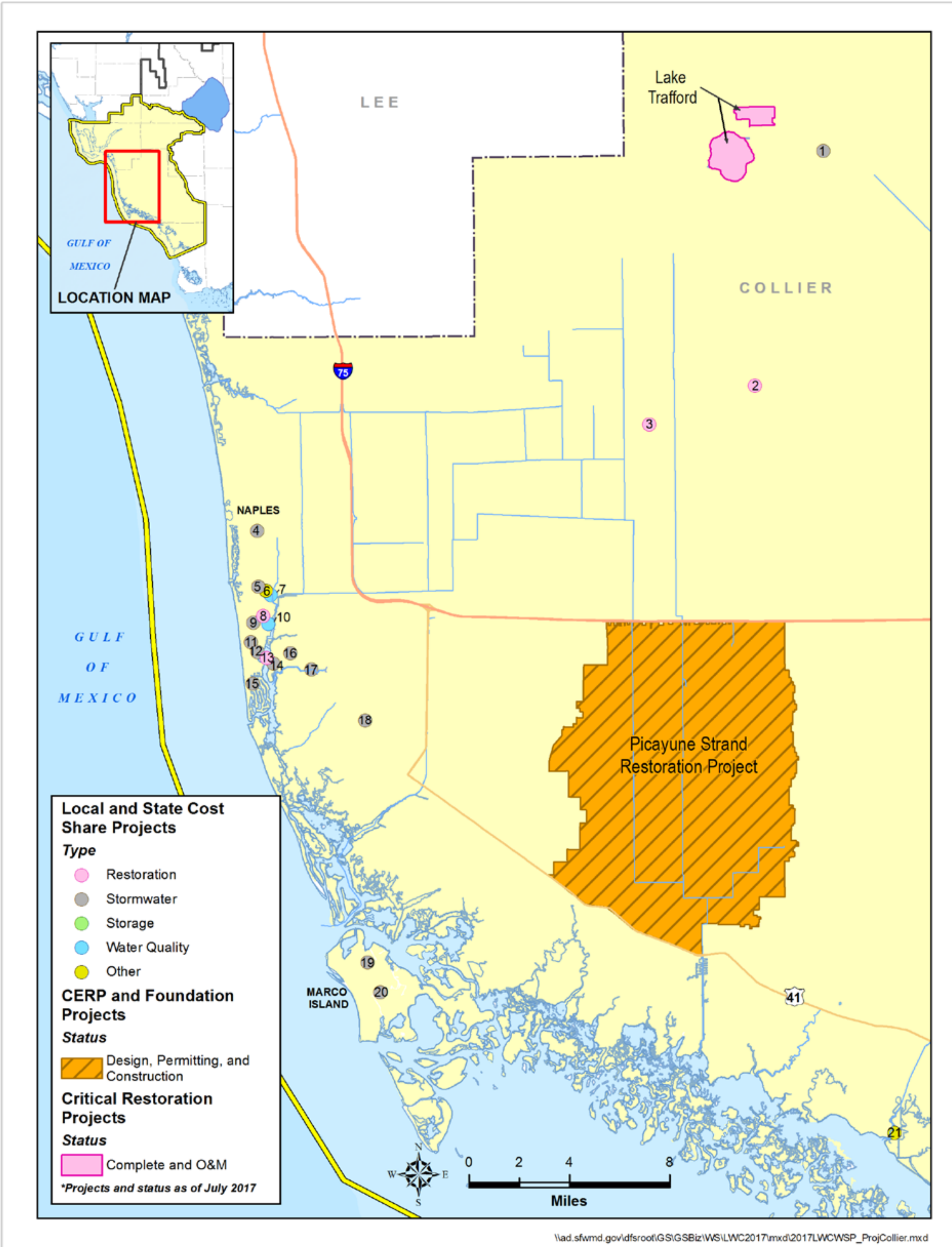


Figure 7-5. Local and state cooperative surface water management projects in Collier County within the Lower West Coast Planning Area. Project names are listed in **Table 7-3**.

Table 7-3. Local and state cooperative surface water management projects in Collier County within the Lower West Coast Planning Area.

Map ID	Project Title
1	Immokalee Stormwater Master Plan
2	Camp Keais Strand Exotic Plant Control Project
3	Northern Golden Gate Estates Flow-way Restoration
4	Gordon River Basin Stormwater System Improvements
5	Basin V Water Quality and Flood Mitigation Improvements
6	Naples Zoo Septic System Replacement
7	Conservancy of Southwest Florida Filter Marsh
8	Lake Manor Restoration
9	Naples Bay Swale Program
10	Riverside Circle Filter Marsh
11	Basin III Drainage and Water Quality Improvements
12	Broad Avenue South Filter Marsh Preliminary Design
13	Oyster Reef Restoration in Naples Bay
14	Royal Harbor Water Quality Improvement Project
15	Water Quality and Flood Mitigation Improvements
16	Gateway Triangle Stormwater Improvements
17	Haldeman Creek Weir Replacement
18	Lely Area Stormwater Improvement Project
19	Marco Island Citywide Stormwater Drainage and Water Quality Improvements
20	Inlet Retrofit/Existing Outfall Replacement
21	Everglades City Water Management Master Plan

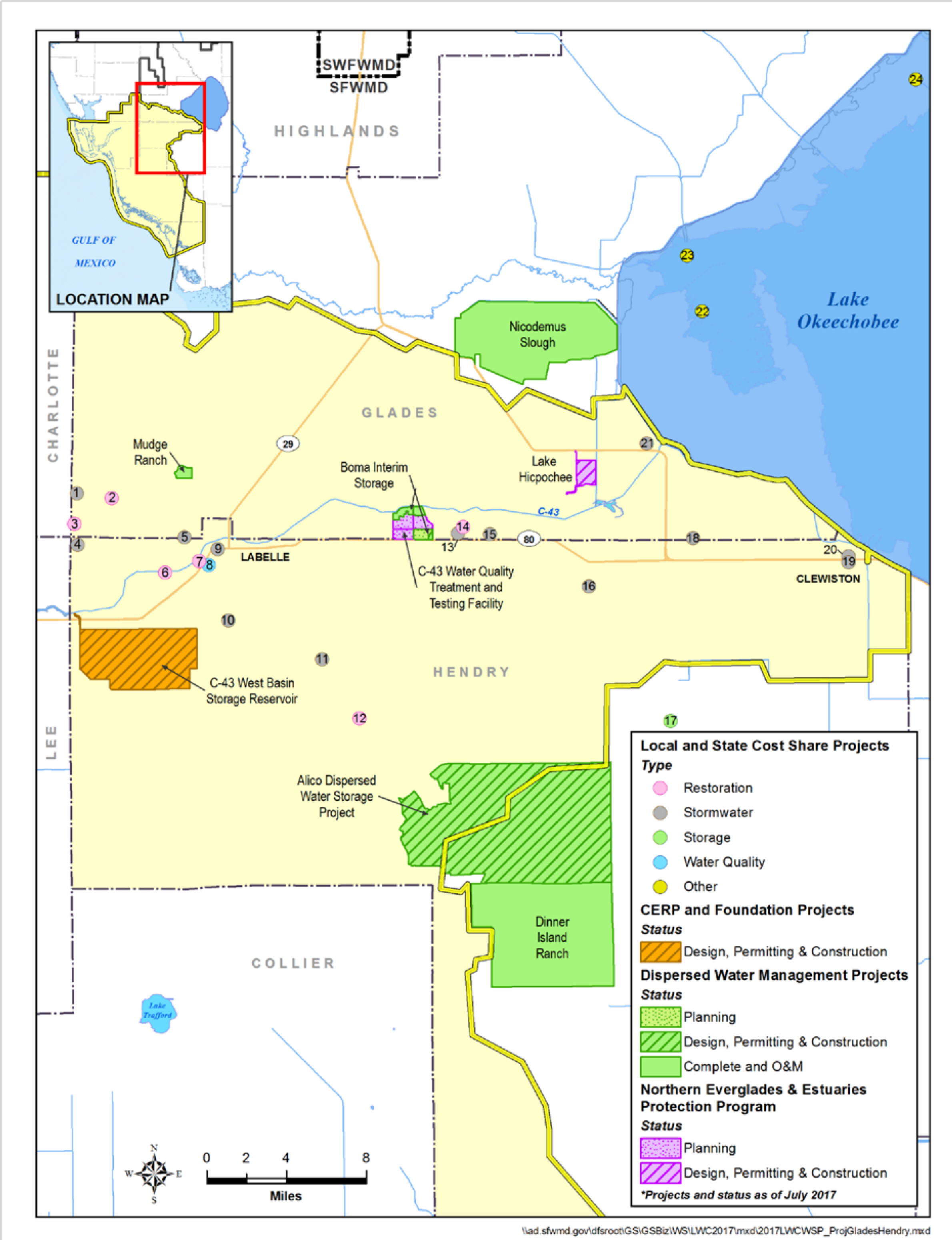


Figure 7-6. Local and state cooperative surface water management projects in Glades and Hendry counties within the Lower West Coast Planning Area. Project names are listed in **Table 7-4**.

Table 7-4. Local and state cooperative surface water management projects in Glades and Hendry counties within the Lower West Coast Planning Area.

Map ID	Project Title
1	County Line Ditch Maintenance
2	Glades County Tributary Restoration Best Management Practice
3	Spanish Creek Restoration
4	Four Corners Stormwater Management System Improvements
5	Pollywog Creek
6	Caloosahatchee Oxbow Restoration
7	Hendry County Oxbow Restoration
8	LaBelle Water Quality Park
9	LaBelle Citywide Stormwater System Improvements
10	Hendry County Stormwater Retrofit
11	Hendry County Tributary Restoration and Best Management Practice Implementation
12	Okaloacoochee Slough Pasture Restoration
13	Horseshoe Acres
14	Glades County Tributary Restoration Best Management Practice
15	Indian Hills Ditch
16	Western Boulevard Ditch
17	Pump Station #11 Project
18	Nine Mile Canal Water Quality Improvements
19	Ventura Avenue Stormwater Improvement and Drainage Upgrade Project
20	Clewiston Stormwater Improvements
21	Ranch Lakes Estates
22	North Shore Channel Improvements – Moore Haven Canal
23	North Shore Channel Improvements – Harney Pond
24	North Shore Channel Improvements

C-43 Water Quality Treatment Feature

The C-43 Water Quality Treatment Feature (often referred to as the "Boma" project) is approximately 1,765 acres of active and fallow citrus land adjacent to the C-43 Canal (**Figure 7-7**) that was purchased by the SFWMD and Lee County in 2008 for development of a shallow water storage and treatment system. The SFWMD currently is conducting a bioassay study for use in larger-scale mesocosms designed to reduce nitrogen within the Caloosahatchee River Estuary. Pending confirmation of additional funding, the design, construction**,** and operation of mesocosms are planned to occur through 2018.

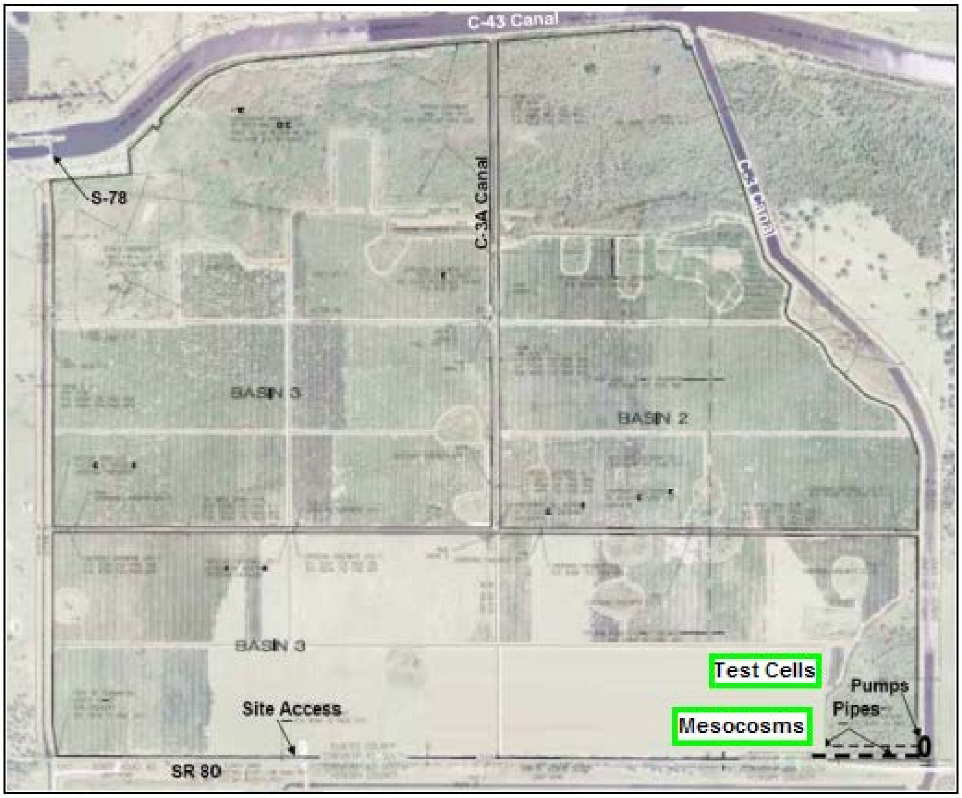


Figure 7-7. The C-43 Water Quality Treatment Feature.

Lake Hicpochee Hydrologic Enhancement Project

Lake Hicpochee was one of three lakes historically considered the headwaters of the Caloosahatchee River. The channelization of the C-43 Canal in the 1800s resulted in detrimental impacts to the lake. In 2014, the SFWMD acquired approximately 715 acres of land for a shallow storage feature north of Lake Hicpochee (**Figure 7-8**) to store and deliver water to the lakebed. The project will capture surface water from the C-19 Canal, then store the water before distributing it (via spreader canal) to the northwestern area of Lake Hicpochee. Construction of the project began in 2016 and is anticipated to be complete by 2019.

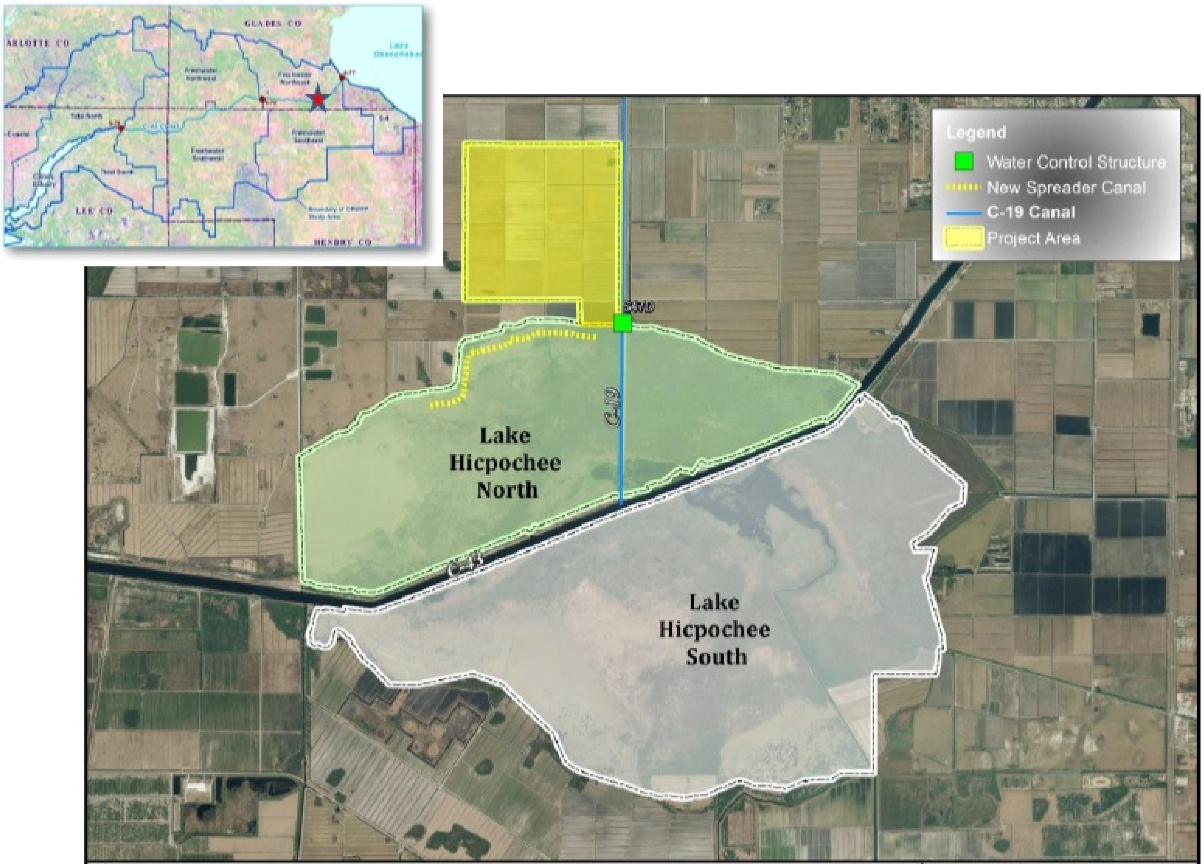


Figure 7-8. The Lake Hicpochee Hydrologic Enhancement Project.

NORTHERN EVERGLADES AND ESTUARIES PROTECTION PROGRAM

In 2007, the Florida Legislature authorized the Northern Everglades and Estuaries Protection Program (NEEPP) [Section 373.4595, F.S.], which expanded the existing Lake Okeechobee Protection Act. Legislation required the completion of watershed protection plans for the Lake Okeechobee, Caloosahatchee River, and St. Lucie River watersheds as part of NEEPP. The plans build on existing approaches and consolidate restoration efforts throughout the Northern Everglades system. The two plans relevant to the LWC Planning Area are described here. More details about specific projects and activities under the watershed protection plans are included in annual updates of the SFER (www.sfwmd.gov; Search: SFER). Further information about NEEPP can be found on the SFWMD website (www.sfwmd.gov; Search: Northern Everglades and Estuaries).

Lake Okeechobee Watershed Protection Plan

The NEEPP mandated the SFWMD, FDEP, and FDACS develop a Lake Okeechobee Watershed Protection Plan. The plan initially was developed in 2004 (SFWMD et al. 2004) and was updated in 2007, 2008, 2011, and 2015 (SFWMD et al. 2007, 2008, 2011; Sharfstein et al. 2015). The plan includes source controls (e.g., best management practices) and several subregional and regional technologies, such as stormwater treatment areas and alternative treatment technologies, to improve the quality of water within the watershed and delivered to Lake Okeechobee. Several measures are included in the plan to improve water levels within the lake as well as the quantity and timing of discharges from Lake Okeechobee to the northern estuaries to achieve more desirable salinity ranges. These measures include reservoirs, Dispersed Water Management Program projects, ASR, and deep well injection.

Caloosahatchee River Watershed Protection Plan

The Caloosahatchee River Watershed Protection Plan was submitted to the Florida Legislature on January 1, 2009 (SFWMD et al. 2009). It identified major influences that negatively affect the Caloosahatchee River Estuary's ecological health (primarily water quality, quantity, timing, and distribution) and proposed strategies to minimize those stressors. The plan was updated in 2012 (Balci and Bertolotti 2012) and 2015 (Buzzelli et al. 2015). The plan contains the following three main components:

- **Pollutant Control Program** – A multifaceted approach to reducing pollutant loads by improving the management of pollutant sources within the watershed. This component comprises source control programs implemented by the coordinating agencies, including best management practices, on-site treatment technologies, stormwater and wastewater infrastructure upgrades and master planning, and regulatory programs focused on water quality and quantity.
- **Construction Project** – This component identifies water quality and storage projects to improve hydrology, water quality, and aquatic habitats within the watershed. It includes regional, subregional, and local water quality and quantity projects (e.g., reservoirs, stormwater treatment areas, chemical treatment, local stormwater projects).
- **Research and Water Quality Monitoring Program** – This program builds on the SFWMD's existing research program and is intended to carry out, comply with, or assess the plans, programs, and other responsibilities created by the Caloosahatchee River Watershed Protection Plan. The program also will assess the water volumes and timing from the Lake Okeechobee and Caloosahatchee River watersheds and their relative contributions to the estuary. The primary purpose of this component is to track progress toward achieving water quality and storage targets.

BIG CYPRESS BASIN FUNDING PROGRAMS

The Big Cypress Basin Board is responsible for the operation, maintenance, planning, and capital improvements of approximately 153 miles of canals and 45 water control structures within Collier County and part of Monroe County. The southwest Florida representative on the District Governing Board serves as the chair of the Big Cypress Basin Board.

The Big Cypress Basin $19 million Capital Improvement Program (FY2012 to FY2016) included projects on the Golden Gate Canal System, Naples Bay, and Henderson Creek. The projects provide water resource benefits through reduction of over-drainage and restoration of groundwater and surface water levels to more natural conditions. Additionally, the improvements enhance water supply opportunities by increasing groundwater storage and improving the timing and duration of surface water discharges.

Big Cypress Swamp

The Big Cypress Basin Board provides cooperative funding to locate stormwater and AWS projects within the basin. In July 2017, the Big Cypress Basin Board awarded $2.1 million in cooperative funding grants to the following three projects:

- **Naples Bay Restoration and Water Quality Improvements at the Cove** – Stormwater and ecosystem restoration through dredging, constructing a pollution control device, and installing a living shoreline that includes native cordgrass and oyster habitat.
- **City of Naples and Collier County West Goodlette-Frank Road Area Joint Stormwater and Septic Tank Replacement Project** – Conversion of residential septic tanks to a central sanitary sewer collection system and stormwater improvements. The project will increase the volume of reclaimed water available for water supply use.
- **Collier County Lely Branch Water Control Structure Project** – Construction of a new weir on the Lely Branch Canal, which will limit the need for regulatory releases of floodwater during the wet season. This will result in increasing shallow groundwater levels and reducing over-drainage of wetlands and native habitats.

SUMMARY OF WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development projects serve various purposes in support of water supply development. Benefits of the water resource development projects reviewed in this chapter include the following:

- Improved understanding of the hydrogeology and water availability of the region
- Increased future water supply availability
- Preservation of existing supplies through better understanding, management, and continued monitoring of resources
- Water retention to protect water sources and provide an efficient way to expand current water supplies
- Development of SAS/IAS and FAS groundwater models for evaluation of regional groundwater conditions
- Coordination with other agencies and stakeholders to exchange hydrogeologic knowledge and data
- Comprehensive planning and construction of environmental restoration projects associated with the Everglades
- Partnering with local landowners to create dispersed water storage features
- Implementation of subregional watershed planning initiatives

REFERENCES

Balci, P. and L. Bertolotti. 2012. Appendix 10-2: Caloosahatchee River Watershed Protection Plan Update. In: *2012 South Florida Environmental Report – Volume I*. South Florida Water Management District, West Palm Beach, FL.

Buzzelli, C., K. Carter, L. Bertolotti, and P. Doering. 2015. Chapter 10: St. Lucie and Caloosahatchee River Watershed Protection Plan Annual and Three-Year Updates. In: *2015 South Florida Environmental Report – Volume I*. South Florida Water Management District, West Palm Beach, FL.

Hoppes, L. 2017. Chapter 5A: 2017 Five-Year Water Resource Development Work Program. In: *2017 South Florida Environmental Report – Volume II*. South Florida Water Management District, West Palm Beach, FL.

National Research Council. 2015. Review of the Everglades Aquifer Storage and Recovery Regional Study. National Research Council of the National Academies. The National Academy Press. Washington, D.C.

SFWMD. 2016. *2016 Water Supply Plan Update Support Document.* South Florida Water Management District, West Palm Beach, FL. March 2016.

SFWMD. 2017. *2017 South Florida Environmental Report*. South Florida Water Management District, West Palm Beach, FL.

SFWMD, FDEP, and FDACS. 2004. *Lake Okeechobee Watershed Protection Plan*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL.

SFWMD, FDEP, and FDACS. 2007. *Lake Okeechobee Watershed Protection Plan Evaluation Report*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL.

SFWMD, FDEP, and FDACS. 2008. *Lake Okeechobee Watershed Construction Project Phase II Technical Plan*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL.

SFWMD, FDEP, and FDACS. 2009. *Caloosahatchee River Watershed Protection Plan*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL.

SFWMD, FDEP, and FDACS. 2011. *Lake Okeechobee Watershed Protection Plan Update*. South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL.

Sharfstein, B., J. Zhang, and L. Bertolotti. 2015. Chapter 8: Lake Okeechobee Watershed Protection Program Annual Update. In: *2015 South Florida Environmental Report – Volume I*. South Florida Water Management District, West Palm Beach, FL.

USACE and SFWMD. 2015a. *Southwest Florida Comprehensive Watershed Plan*. United States Army Corps of Engineers, Jacksonville, FL and South Florida Water Management District, West Palm Beach, FL. October 2015.

USACE and SFWMD. 2015b. *Central and Southern Florida Project Comprehensive Everglades Restoration Plan Final Technical Data Report of the Aquifer Storage and Recover Regional Study*. United States Army Corps of Engineers, Jacksonville, FL and South Florida Water Management District, West Palm Beach, FL. May 2015.

8

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

This chapter summarizes the proposed water supply development projects anticipated to meet water needs in the Lower West Coast (LWC) Planning Area for the 2014 to 2040 planning period. Water users such as Public Water Supply (PWS) utilities; local governments; and self-suppliers, including Industrial/Commercial/Institutional (ICI) and Agricultural Irrigation (AGR) users, are primarily responsible for water supply development projects. All proposed potable and nonpotable water and conservation projects were proposed by and will be implemented by PWS utilities. For each PWS utility supplying 0.1 million gallons per day (mgd) or more to its service area (see **Appendix A**), a utility summary is included in **Appendix F**. Each summary includes population and demand projections (see **Chapter 2** and **Appendix B**), permitted water allocations, potable water and wastewater permitted capacities, and the water supply development projects proposed by each utility. For other water use categories, specific projects are identified as provided to the South Florida Water Management District (SFWMD or District) for this *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update).

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 (see **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, and must meet or exceed projected water demands. 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 coordination between the SFWMD's water use permitting and water supply planning staff on projects included in regional water supply plans and updates (FDEP 2012).

By increasing coordination during the water supply planning process, SFWMD staff are more familiar with permit applicant's projects, have supporting data, and will be able to facilitate the permitting process. The proposed projects considered for this 2017 LWC Plan Update were reviewed at a screening level by SFWMD water use permitting and water supply planning staff 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 from 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 strategies?
- 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?

However, 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 presently existing legal use of water; and 3) is consistent with the public interest. Water use permits typically are required for water supply development projects. Exceptions to permitting requirements 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 new water supply from the surficial aquifer system (SAS) and the intermediate aquifer system (IAS) in the LWC Planning Area is limited due to existing water demands, source limitations, and resource issues such as saltwater intrusion, environmental needs, and aquifer protection criteria (see **Chapter 4**). New or increased allocations from the SAS and IAS will be evaluated on an application-by-application basis to determine if a project meets water use permitting criteria. Some SAS and IAS development may be feasible given local conditions, such as reductions in historical water use and availability of new resources. A discussion of the demand and supply conditions for each of the six major water use categories can be found in the following sections.

PROJECTS IDENTIFIED FOR THIS PLAN UPDATE

This plan update promotes conservation and continued diversification of sources for water supply development projects needed to meet future demands. Projects proposed for inclusion in this plan update were evaluated based on factors discussed in the previous section, level of detail provided (e.g., project scope, cost, and schedule), and whether the project is expected to increase conservation or contribute to new water supply, possibly increasing a utility's permit allocation(s) or a treatment system's rated capacity.

Users are not required to select a project included in this 2017 LWC 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. A project may not be selected for implementation if there is insufficient need; several utilities proposed projects that exceed 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, the utility must identify another method to meet its needs and advise the SFWMD of the alternative project(s). The local government then needs to include the project information in its Water Supply Facilities Work Plan.


Water Treatment Plant

Public Water Supply

PWS demand includes all potable uses served by public and private utilities with a pumping capacity of 0.1 mgd or greater. As of 2014, PWS demand in the LWC Planning Area was met by fresh groundwater from the SAS (46 percent), brackish groundwater from the upper Floridan aquifer system (FAS) (37 percent), and groundwater from the IAS (17 percent). The PWS average net (finished) water demand is projected to grow from 107.1 mgd in 2014 to 164.8 mgd by 2040, a 54 percent increase. A combination of existing and additional capacity developed by new water supply development projects will be used to meet the demand.

In addition to meeting demands, utilities may propose water supply development projects to address specific situations such as accommodating a change in treatment processes or sources, or optimizing distribution systems to match future demand locations. Although reuse and conservation of potable 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 displayed in the utility profiles contained in **Appendix F** and summarized in **Tables 8-1**, **8-2**, and **8-5**.

In this plan update, 7 utilities have proposed 14 new projects to implement system expansions, source diversification, changes in treatment technology, expansion of existing plants, and construction of new production wells.

The following key utility projects have been proposed:

- Town and Country Utilities Company is planning a multi-phased 3.8 mgd freshwater nanofiltration water treatment plant (WTP) expansion.
- Ave Maria Utility Company is planning a 2.5 mgd brackish reverse osmosis WTP expansion.

- Collier County Water-Sewer District plans to add an additional intermediate aquifer well that will provide 1.0 mgd water, expand brackish water treatment by 3.0 mgd, and expand freshwater treatment by 2.5 mgd at their North County WTP.
- Immokalee Water and Sewer District is planning a 2.5 mgd brackish WTP expansion.
- Bonita Springs Utilities is planning second and third phase expansions of their reverse osmosis WTP, which will provide a total of 7.0 mgd of additional water.
- Cape Coral Utilities is planning an 18.0 mgd brackish WTP expansion at their South Plant and a 2.0 mgd capacity expansion at their Palm Tree pumping station.
- Lee County Utilities is planning a 14.0 mgd brackish WTP expansion at Green Meadows, and a 5.0 mgd brackish WTP expansion at the North Lee County system. They are planning to construct aquifer storage and recovery (ASR) wells at the Corkscrew wellfield for 3.4 mgd of additional potable water from the IAS.

Only 2 of the 22 PWS utilities (Orange Tree Utility Company was integrated into the Collier County Water-Sewer District in January 2017) in the LWC Planning Area need to construct projects in order to meet projected 2040 demands: Town and Country Utilities Company and Ave Maria Utilities Company. Florida Governmental Utility Authority – Lehigh Acres has a 0.2-mgd shortfall for 2040; however, new projects are not needed because of a bulk water agreement for up to 2.0 mgd with the City of Fort Myers Utility. In total, the proposed PWS development projects could create new treatment capacity, yielding 64.7 mgd of net (finished) water (**Table 8-1**). Combined with existing capacity (230.3 mgd), this will exceed the projected 2040 PWS total net (finished) demand of 165 mgd.

Table 8-1. Proposed potable PWS development projects and capacity for 2014 to 2040.

Water Source	Number of Projects[a,b]	Capacity (mgd)
SAS	2	5.0
IAS	5	8.2
FAS	8	51.5
Project Total	**14**	**64.7**

FAS = Floridan aquifer system; IAS = intermediate aquifer system; mgd = million gallons per day; PWS = Public Water Supply; 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).

PWS utilities also have proposed nonpotable water supply projects using reclaimed water, surface water, and stormwater that could create 52.9 mgd of additional water supply for landscape and golf course irrigation as well as groundwater recharge (**Table 8-2**). The proposed nonpotable water projects include construction and expansion of reclaimed water production facilities, a reclaimed water storage facility, and ASR and 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. Such projects will meet several types of demand such as landscape and golf course irrigation as well as groundwater recharge. The *2015 FDEP Reuse Inventory Report* (FDEP 2016) indicated that 55 percent of wastewater generated in Charlotte County, 86 percent generated in Collier County, 100 percent generated in Hendry County, and 95 percent generated in Lee County is reused for irrigation and aquifer recharge.

Table 8-2. Proposed nonpotable water supply development projects and capacity for 2014 to 2040.

Water Source	Number of Projects[a,b]	Capacity (mgd)
Reclaimed	10	39.0
Reclaimed Storage/ASR	2	6.5
Surface Water/Stormwater	4	7.4
Project Total	**16**	**52.9**

ASR = aquifer storage and recovery; mgd = million gallons per day.
[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 (more than one project at the same water treatment plant).

Domestic and Small Public Supply

Domestic and Small Public Supply (DSS) includes potable water used by households served by small utilities (less than 0.1 mgd) or self-supplied by private wells. DSS average net (finished) demands in the LWC Planning Area are projected to increase from 22.2 mgd in 2014 to 33.2 mgd in 2040. DSS needs currently are met with fresh groundwater from the SAS and IAS. All future needs in this use category are expected to be met using fresh groundwater supplies. As such, no water supply development projects are proposed for this use class.

Agricultural Irrigation

The AGR category includes self-supplied water used for commercial crop irrigation, greenhouses, nurseries, livestock watering, pasture, and aquaculture. AGR is the largest water use category in the LWC Planning Area and is projected to remain so over the planning horizon. However, among all the water use categories, AGR has the smallest increase in projected demand for 2040. Gross agricultural water demand is projected to rise only 10 percent, from 615.8 mgd in 2014 to 678.8 mgd in 2040, and irrigated acreage slightly increases by 33,529 acres. **Chapter 2** and **Appendix B** provide more information about agricultural water use and projected demands.

Fresh surface water and groundwater are the primary water sources for AGR in the LWC 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 criteria restrict allocation of surface water derived from Lake Okeechobee water bodies for consumptive use. Lake Okeechobee water bodies include integrated conveyance systems that are hydraulically connected to and receive water from Lake Okeechobee, such as the C-43 Canal. The RAA criteria apply to new projects, existing unpermitted projects, and modifications or renewals to existing projects located within the Lake Okeechobee Service Area, which limits surface water increases in allocation 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 options are not available for all crop types. New water supply 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 some crops, but there are no sources near the areas with agricultural needs in the LWC Planning Area. The use of more efficient irrigation systems for various agricultural operations could substantially reduce the amount of water needed to meet future crop demands.

Continued use of best management practices (BMPs), including water conservation, could reduce the amount of water needed to meet crop demands (see **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 the 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.

Four Corners Reservoir

The Four Corners Reservoir is a project proposed by the Florida Citrus Company, LLC. The project consists of a 640-acre reservoir, intake/discharge structures, conveyance improvements, and other associated facilities in Lee County, near the confluence of Lee, Charlotte, Hendry, and Glades counties. The land is within the County Line Drainage District and currently is owned by Florida Citrus Company, LLC (**Figure 8-1**). The reservoir would be supplied by stormwater runoff from local watersheds that discharge to the C-43 Canal. Hazen and Sawyer et al. (2017) indicate the project may result in water quality improvements in the form of nutrient reduction. Water from the reservoir could be directed to nearby conservation lands owned by Lee County or be available as an alternative water supply (AWS). Design alternatives under consideration in Hazen and Sawyer et al. (2017) would store between 1,120 to 11,979 acre-feet of water, depending on the reservoir depth.

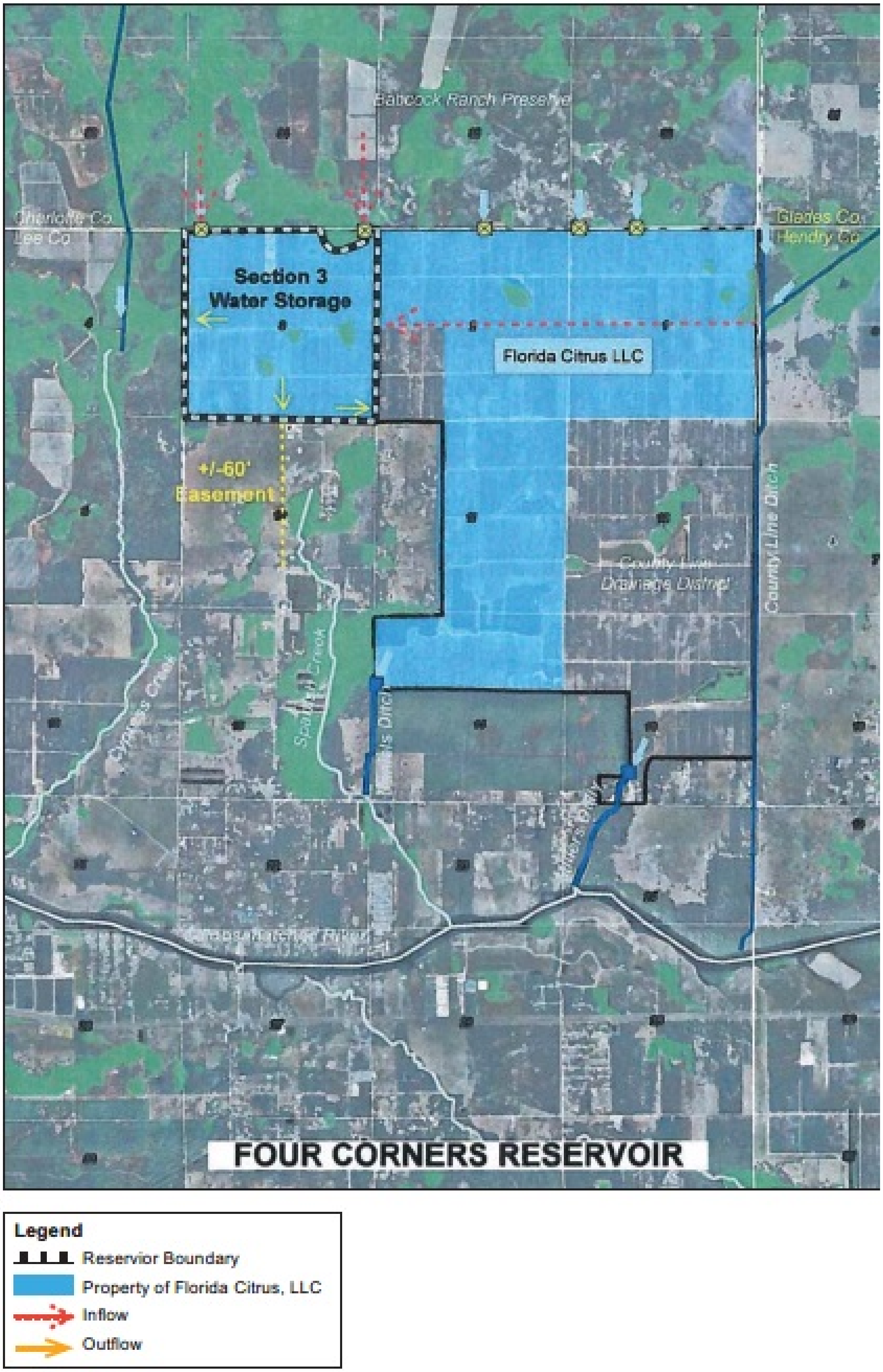


Figure 8-1. Proposed Four Corners Reservoir location (From: Hazen and Sawyer et al. 2017).

Recreational/Landscape Irrigation

The Recreational/Landscape Irrigation (REC) category includes self-supplied water used for irrigation of golf courses, sports fields, parks, cemeteries, and large common areas (e.g., land managed by homeowners' associations and commercial developments). Historically, irrigation supplies for this category include local fresh groundwater and surface water from canals or ponds in stormwater management systems. Some golf courses use brackish groundwater treated by reverse osmosis while irrigation for new golf courses often includes reclaimed water and on-site blending of brackish groundwater with surface water. In the LWC Planning Area, REC average gross demand is projected to increase from 177.6 mgd in 2014 to 254.3 mgd in 2040.

The projected increase in growth for this category is expected to be met, for the most part, by currently proposed reclaimed water projects. In the LWC Planning Area, reclaimed water is used to irrigate large landscaped areas as well as residential and commercial parcels. Projects submitted by wastewater treatment utilities specify that significant additional volumes of reclaimed water will be made available in the future. Expanded utility wastewater treatment capacity is expected to add 45.3 mgd of reuse by 2040. The additional supply may provide an opportunity to allow current irrigation to change from fresh water to reclaimed water. Where reclaimed water is not available, users may qualify for limited freshwater withdrawals on an application-by-application basis.

Industrial/Commercial/Institutional

The ICI water use category includes self-supplied water associated with the production of goods or provision of services by industrial, commercial, and institutional establishments. Users historically have relied on fresh groundwater and, to a limited extent, fresh surface water for their supply. The projected average gross demand for this category is estimated to be 29.0 mgd by 2040, which is a slight increase from current (2014) demands of 25.4 mgd.

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 conditions. If reclaimed water is available to meet existing and 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 LWC Planning Area and other portions of South Florida. The Power Generation (PWR) water use category (self-supplied water used by power generation facilities, excluding the use of seawater) is projected to increase from 0.4 mgd in 2014 to 15.4 mgd in 2040. Future power generation capacity may include new solar projects, expansion and renovation of the Florida Power & Light (FPL) Fort Myers facility, or new thermoelectric facilities. Some future demand may be met with the proposed (as of mid-2017) construction of a new FPL energy project in Hendry County, the Hammock Solar Energy Facility. The proposed facility would be limited to a capacity of 74.5 megawatts, and would powered by solar energy or natural gas. Because the availability of fresh water is limited in the LWC Planning Area, alternative water sources may be the most feasible options for meeting future PWR needs.

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 assistance to local water users to develop alternative water supplies and measurable 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 in this 2017 LWC 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 project options based on the ability to permit and finance, and technical 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 that are consistent with the District's core mission. Historically, the SFWMD has provided funding for AWS and measurable water conservation 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 to promote local projects that complement ongoing regional restoration, flood control, water quality, and water supply efforts within the District's 16-county jurisdiction.

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 projects that increase water supply. When available, the SFWMD provides matching funds for qualified projects. From FY2012 through FY2017, the SFWMD provided more than $13.7 million in AWS funding for 30 projects located throughout the District. During this time, 19 projects were funded, completed, or are under construction in the LWC Planning Area, generating 18.28 mgd of additional water capacity and 43 mgd of additional distribution, or storage from an alternative source (**Table 8-3**). See **Chapter 5** for more information.

Table 8-3. Alternative water supply projects in LWC Planning Area supported by the CFP (FY2012 to FY2017).

Project Name	Entity Name	County	Fiscal Year	Capacity (mgd)	Alternative Water Source
Funded through the Big Cypress Basin Board					
ASR Well at Livingston Rd	Collier County Water-Sewer District	Collier	2012	2.00[a]	ASR
North County Regional WTP Modification	Collier County Water-Sewer District	Collier	2012	8.00	Brackish
Golden Gate Canal Intake Structure and Transmission Line	Naples, City of – Utility Department	Collier	2012	10.00[b]	Surface/ Stormwater
Reclaimed Water Production Facility Phase III – Expansion	Marco Island Utilities	Collier	2012	5.00[b]	Reclaimed
ASR Well at Livingston Rd Phase II	Collier County Water-Sewer District	Collier	2013	2.00[a]	ASR
Reclaimed Water Distribution System Expansion	Marco Island Utilities	Collier	2013	2.00[b]	Reclaimed
Reclaimed Water System Expansion - North of Central Avenue	Naples, City of – Utility Department	Collier	2013	2.00[a]	Reclaimed
ASR Well #3 at the Wastewater Treatment Plant	Naples, City of – Utility Department	Collier	2014	0.00	Reclaimed
Livingston Road ASR Wellfield, Well #2	Collier County Water-Sewer District	Collier	2014	2.00[a]	ASR
Reclaimed Water System Expansion - North of Central Avenue Phase III	Naples, City of – Utility Department	Collier	2014	2.00[a]	Reclaimed
Reclaimed Water System Expansion Phase 4	Naples, City of – Utility Department	Collier	2016	0.26[a]	Reclaimed
ASR Well #4	Naples, City of – Utility Department	Collier	2016	1.00	ASR
Reclaimed Water System Expansion Phase 5	Naples, City of – Utility Department	Collier	2017-2018	0.26[a]	Reclaimed
Funded through the District Governing Board					
1.5 mgd Reverse Osmosis WTP, Phase 1B	LaBelle, City of – Department of Public Works	Hendry	2012	1.50	Brackish
1.5 mgd Reverse Osmosis WTP, Phase 2	LaBelle, City of – Department of Public Works	Hendry	2014	1.50[b]	Brackish
Phase III Reclaimed Water System Expansion – Lined Storage Pond and Reclaimed Water Main Extension along Anthem Parkway	Ave Maria Utility Company	Collier	2017-2018	0.60	Reclaimed
Reclaimed Water ASR (Fort Myers Beach/ Fiesta Village)	Lee County Utilities	Lee	2017-2018	0.18	ASR
Water North 2 Utility Expansion Program – Irrigation Canal Pump Station East #10	Cape Coral Utilities	Lee	2017-2018	7.00	Reclaimed
Water North 2 Utility Expansion Program – Irrigation Transmission	Cape Coral Utilities	Lee	2017-2018	24.00[a]	Reclaimed
			Total Capacity	**18.28 mgd**	

ASR = aquifer storage and recovery; CFP = Cooperative Funding Program; FY = Fiscal Year; LWC = Lower West Coast; mgd = million gallons per day; WTP = water treatment plant.
[a] Distribution type project; water counted in plant capacity.
[b] Support facility/phased project; water counted previously or in future years.

Water Conservation

This component of the CFP, formerly known as the WaterSIP, provides cost-share funding for projects that reduce urban water use. The SFWMD has provided matching funds up to $50,000 or up to 50 percent, whichever is less, to water providers and users (e.g., cities, utilities, industrial groups, schools, hospitals, homeowners' associations) for water-saving technologies. These technologies include low-flow plumbing fixtures, rain sensors, fire hydrant flushing devices, and other hardware. From FY2012 to FY2017, the SFWMD partially funded more than $2 million towards 65 projects through this program, with an estimated water savings of 1.1 billion gallons per year, or 3.11 mgd. During this time, 7 projects were funded, completed, or being implemented in the LWC Planning Area through this program. These projects were estimated to save 67.9 million gallons per year (**Table 8-4**). See **Chapter 3** for more information.

Table 8-4. Water conservation projects completed in LWC Planning Area supported by the CFP (FY2012 to FY2017).

Project Name	Entity Name	County	Fiscal Year	Proposed Water (mgy) Savings	Project Type
Automatic Hydrant Flushing and Best Engineering Practice	Cape Coral Utilities	Lee	2012	3.50	Automatic Line Flushing Devices
Fixed Network System for Leak Detection	Port LaBelle Utility System of Hendry County	Hendry	2012	2.00	Other
Mobile Meter Reading III	LaBelle, City of – Department of Public Works	Hendry	2012	1.57	Other
Belle Lago HOA - Controller Upgrade Project	Belle Lago Homeowners' Association	Lee	2015	32.00	Irrigation
Bayrock Grove Irrigation Monitoring	Agreserves Inc. dba Deseret Farms of Ruskin	Hendry	2017-2018	20.00	Irrigation
Indoor Plumbing Replacement	LaBelle, City of	Hendry	2017-2018	1.32	Indoor Plumbing
Irrigation Water Conservation Project	Bishopwood East of Forest Glen Neighborhood Association, Inc.	Collier	2017-2018	7.5	Irrigation
			Estimated Total Water Savings	**67.89 mgy**	

dba = doing business as; CFP = Cooperative Funding Program; FY = Fiscal Year; LWC = Lower West Coast; mgy = million gallons per year.

SUMMARY OF WATER SUPPLY DEVELOPMENT PROJECTS

Meeting water demands in the LWC Planning Area requires continued use of diverse water sources, including brackish groundwater, reclaimed water, seasonally available surface water, ASR, and water conservation. Total gross water demands within the LWC Planning Area, from all sources, are projected to rise by approximately 240 mgd by 2040. During the planning horizon, there is a projected 54 percent increase in average gross PWS demand. Based on the evaluation for this plan update, groundwater and surface water supplies are believed to be adequate to meet all projected PWS demands through 2040.

Among the DSS, ICI, and PWR water use categories, no specific new projects have been proposed. Future needs can be met under existing permit allocations by using existing traditional and alternative sources, and through conservation.

Despite the limitations of fresh surface water and groundwater sources, there currently is sufficient water supply allocation to meet AGR needs in the LWC Planning Area. As there is only a slight increase in 2040 demand projections, traditional sources are expected to be adequate to meet future needs. Water conservation along with BMPs can assist in reducing crop demands. In addition, the proposed AGR Four Corners Reservoir project could provide up to 10 mgd of water supply.

Only 2 of the 22 PWS utilities with a capacity of 0.1 mgd or greater located within the LWC Planning Area need to construct projects in order to meet projected 2040 demands. The proposed PWS development projects could generate 64.7 mgd of new water treatment capacity to meet the PWS net (finished) demand of 164.8 mgd, exceeding the 57.7 mgd of net (finished) potable water needed from 2014 to 2040 to meet PWS demand. The new capacity consists of 51.5 mgd produced by FAS water source projects, 8.2 mgd produced by IAS water source projects, and an additional 5.0 mgd produced by SAS water source projects. A summary of the existing and proposed projects and capacities is provided in **Tables 8-5** and **8-6**.

Table 8-5. Current and projected potable water supply capacities for PWS utilities in the LWC Planning Area.

County	PWS Utility	Surface Water		SAS		IAS		FAS		ASR		Reclaimed[d]	
		Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed[a]
Charlotte	Town and Country Utilities Company					0.25	3.75					0.20	3.30
Collier	Ave Maria Utility Company			1.00	2.50							0.90	2.50
	Collier County Water-Sewer District			32.00	2.50		1.00	20.00	3.00			40.10	6.50
	Everglades, City of			0.50								0.20	
	FGUA Golden Gate			2.10								1.50	
	Immokalee Water and Sewer District			5.60					2.50			2.50	3.00
	Marco Island Utilities	6.67								6.00[b]		5.22	
	Naples Utility Department, City of			30.00								10.00	0.20
	Orange Tree Utility Company			0.75									
	Port of the Islands CID			0.44								0.20	
Glades	Moore Haven Utilities			0.96								0.20	
	Silver Lake Utilities						0.10						
Hendry	Clewiston Utilities							3.00				1.50	
	LaBelle Department of Public Works, City of			1.00				1.50				0.75	0.75
	Port LaBelle Utility System					0.90						0.50	
Lee	Bonita Springs Utilities			9.00				6.60	7.00			11.00	
	Cape Coral Utilities							30.00	20.00			28.40	8.80
	Citrus Park RV Resort			0.54								0.20	
	FGUA Lake Fairways					0.20						0.30	
	FGUA Lehigh Acres					3.10						3.00	
	Fort Myers Public Utility, City of							13.00				11.00	23.00
	Greater Pine Island Water Association							3.29				0.25	
	Island Water Association							5.99				2.38	
	Lee County Utilities			29.00				16.90	19.00		3.40[c]	20.55	4.60
	Total	**6.67**	**0.00**	**112.89**	**5.00**	**4.45**	**4.85**	**100.28**	**51.50**	**6.00**	**3.40**	**140.85**	**52.65**

ASR = aquifer storage and recovery; FAS = Floridan aquifer system; FGUA = Florida Governmental Utility Authority; IAS = intermediate aquifer system; LWC = Lower West Coast; PWS = Public Water Supply; SAS = surficial aquifer system.

[a] Includes reclaimed water production, distribution and storage projects and nonpotable surface water/stormwater projects. It does not include distribution lines or infrastructure projects that do not generate new nonpotable water.

[b] ASR wells are in the FAS.

[c] ASR wells are in the IAS.

[d] Reclaimed water is not a potable water source.

Table 8-6. Proposed potable and nonpotable PWS development projects in the LWC Planning Area (2014 to 2040).*

County	Project Name	Implementing Agency or Entity	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Potable SAS						
Collier	Lower Tamiami Wells and 2.50-mgd RO WTP	Ave Maria Utility Company	Expansion of WTP to ultimate buildout capacity of 3.0 mgd	2.50	6.30	2025
Collier	NE Traditional Source and WTP	Collier County Water-Sewer District	Expansion of SAS wells and NE WTP	2.50	30.00	2033
Potable IAS						
Charlotte	1.00-mgd Expansion of WTP, from 0.25 to 1.25 mgd	Town and Country Utilities Company	Phased expansion of IAS wells and WTP to ultimate buildout capacity of 4.00 mgd	1.00	7.00	2018
Charlotte	1.25-mgd Expansion of WTP, from 1.25 to 2.50 mgd	Town and Country Utilities Company	Phased expansion of IAS wells and WTP to ultimate buildout capacity of 4.00 mgd	1.25	1.25	2021
Charlotte	1.50-mgd Expansion of WTP, from 2.50 to 4.00 mgd	Town and Country Utilities Company	Phased expansion of IAS wells and WTP to ultimate buildout capacity of 4.00 mgd	1.50	1.10	2026
Collier	NRO Well 109	Collier County Utilities Water-Sewer District	The completion and activation of NRO well 109	1.00	0.40	2016
Lee	Corkscrew Groundwater ASR Wells for Potable Water	Lee County Utilities	ASR wells constructed to provide supplemental supply for the Corkscrew and/or Green Meadows WTP	3.40	21.97	2025
Potable FAS						
Collier	NE Floridan Wells and RO WTP	Collier County Utilities Water-Sewer District	Expansion of RO wells and NE WTP	3.00	60.00	2033
Collier	2.50-mgd RO WTP	Immokalee Water and Sewer	Expansion of RO WTP	2.50	10.00	2022

Table 8-6. (Continued).

County	Project Name	Implementing Agency or Entity	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Lee	RO WTP Phase 2	Bonita Springs Utilities	Expansion of RO WTP	2.00	15.00	2018
Lee	RO WTP Expansion and Wellfield	Bonita Springs Utilities	Expansion of RO wells and WTP	5.00	40.00	2022
Lee	Palm Tree Pumping Station	Cape Coral Utilities	Flow and capacity expansion at pump station	2.00	2.00	2016
Lee	South RO WTP, Plant #2 Replacement	Cape Coral Utilities	Replacement of South RO WTP	18.00	20.00	2022
Lee	Green Meadows RO WTP Expansion and Floridan wells	Lee County Utilities	Expansion of RO wells and WTP	14.00	88.70	2017
Lee	North Lee County WTP and Wellfield Expansion	Lee County Utilities	Expansion of RO wells and WTP	5.00	38.88	2022
Nonpotable Reclaimed						
Charlotte	0.80-mgd Expansion of WWTF, from 0.20 to 1.00 mgd	Town and Country Utilities Company	Phased expansion of WWTF to ultimate buildout capacity of 3.5 mgd	1.50	12.00	2021
Charlotte	1.00-mgd Expansion of WWTF, from 1.00 to 2.00 mgd	Town and Country Utilities Company	Phased expansion of WWTF to ultimate buildout capacity of 3.5 mgd	0.80	6.00	2026
Charlotte	1.50-mgd Expansion of WWTF, from 2.00 to 3.50 mgd	Town and Country Utilities Company	Phased expansion of WWTF to ultimate buildout capacity of 3.5 mgd	1.00	8.00	2029
Collier	Phased Expansion of Reclamation Plant	Ave Maria Utility Company	Phased expansion of the reclamation plant to a total capacity of 3.25 mgd	2.50	2.04	2024
Collier	3.00-mgd Reclaimed Water Facility	Immokalee Water and Sewer	Expansion of reclamation treatment facility	3.00	2.00	2020

Table 8-6. (Continued).

County	Project Name	Implementing Agency or Entity	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Collier	Phase IV Reclaimed Water System Expansion	Naples Utility Department, City	Phased expansion of reclamation treatment facility	0.20	2.90	2016
Hendry	WWTF Expansion	LaBelle Department of Public Works, City of	Expansion of reclamation treatment facility	0.75	1.80	2016
Lee	Reuse Interconnect City of Cape Coral and City of Fort Myers	Cape Coral Utilities	Construction of a reclaimed water supply system across the Caloosahatchee River linking the City of Cape Coral with the City of Fort Myers reclaimed water discharge system	6.00	11.80	2020
Lee	12.0-mgd Reclamation Plant, South AWWT Facility	Fort Myers Utility, City of	Construction of reclamation treatment facility	12.00	18.60	2021
Lee	WWTF Upgrades, Central AWWT Facility	Fort Myers Utility, City of	Expansion of reclamation treatment facility	11.00	8.50	2020
Nonpotable Reclaimed Storage/ASR						
Collier	Livingston Rd ASR 3-5	Collier County Utilities Water-Sewer District	Addition of 3 ASR wells for storage of IQ water	4.50	15.00	2021
Lee	West ASR Wells for Reclaimed Water	Lee County Utilities	Phased expansion of ASR well system	2.00	6.36	2025
Nonpotable Surface Water/Stormwater						
Collier	SCWRF IQ Supplement	Collier County Utilities Water-Sewer District	IQ water for distribution during dry season	2.00	10.00	2016
Lee	ADM-47 ASR and Irrigation Supply	Cape Coral Utilities	ASR and IQ water for distribution during dry season	1.00	2.00	2016

Table 8-6. (Continued).

County	Project Name	Implementing Agency or Entity	Project Description	Project Capacity (mgd)	Total Capital ($M)	Estimated Completion Date
Lee	Canal Weir Improvements	Cape Coral Utilities	Raising of fixed weir heights to impound additional irrigation supply	1.80	2.00	2017
Lee	Three Oaks IQ Water Supplemental Supply	Lee County Utilities	IQ water for distribution during dry season	2.60	2.70	2015

ASR = aquifer storage and recovery; AWWT = advanced wastewater treatment; FAS = Floridan aquifer system; IAS = intermediate aquifer system; IQ = irrigation quality; LWC = Lower West Coast; mgd = million gallons per day; PWS = Public Water Supply; RO = reverse osmosis; SAS = surficial aquifer system; WTP = water treatment plant; WWTF = wastewater treatment facility.

* Based on planning-level screening, water supply projects are identified in this plan update to meet 2040 projected demands and generally 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.

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. 2016. *2015 Reuse Inventory*. Water Reuse Program, Florida Department of Environmental Protection, Tallahassee, FL.

Hazen and Sawyer; Amec Foster Wheeler; and Grandusky, Lamb and Associates, LLC. 2017. *Environmental Benefits of the Four Corners Reservoir under Four Configurations*. Prepared for Florida Citrus Company, LLC. April 21, 2017.

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 5, 2015.

9

Future Direction

TOPICS
Demand Summary
Demand Management: Water Conservation
Water Source Options
Coordination
Sea Level Rise and Climate Change
Conclusions

This chapter of the *2017 Lower West Coast Water Supply Plan Update* (2017 LWC Plan Update) summarizes the future direction of water supply planning in the LWC Planning Area of the South Florida Water Management District (SFWMD or District). This plan update assesses the water supply demand and available sources for the LWC Planning Area through 2040. Water demand is expected to increase by approximately 240 million gallons per day (mgd) in the LWC Planning Area by 2040, primarily due to increases in Public Water Supply (PWS), Agricultural Irrigation (AGR), and Recreational/Landscape Irrigation (REC) water use categories, as discussed in **Chapter 2**. Water conservation is an important component of integrated water resource management and may reduce, defer, or eliminate the need to expand water supply infrastructure. Water conservation by all users is a key element in meeting future water needs (**Chapter 3**).

Meeting a 1-in-10 year drought condition level of certainty for surface water users within the Lake Okeechobee Service Area (LOSA) portion of the planning area is not possible within the next 5 years due to the relationship of the federal and state projects outlined in this plan update and operations of Lake Okeechobee under the 2008 Lake Okeechobee Regulation Schedule. Rehabilitation of the Herbert Hoover Dike by the United States Army Corps of Engineers is critical to protect residents near the lake, and completing the project in part or wholly may enable revision of the lake regulation schedule. The SFWMD anticipates any additional water from Lake Okeechobee resulting from revision of the lake regulation schedule could return the lake to a Minimum Flow and Minimum Water Level (MFL) prevention strategy, increase the level of certainty (from 1-in-6 years back to 1-in-10 years) to existing permitted users, and support other environmental objectives.

Guidance in this 2017 LWC 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. All water users are encouraged to be prudent with water use decisions and to use water efficiently. The SFWMD's future direction for water supply planning in the LWC Planning Area recommends continued coordination with agricultural stakeholders, utilities, and other water users; protection of natural resources; diversification of water supply sources; and monitoring to develop responses to changes in water levels and quality in surface water and groundwater.

DEMAND SUMMARY

Total projected average annual demands for all water use categories for 2040 are estimated to be 1,211 mgd (**Table 9-1**). Although demands are increasing, the total demand projection for 2040 in this 2017 LWC Plan Update (1,211 mgd) is less than the estimated 2030 demand (1,218 to 1,263 mgd) previously projected in the 2012 LWC Plan Update (SFWMD 2012).

Table 9-1. Comparison of gross water demands under average rainfall conditions projected in the 2012 LWC Plan Update (2030) and this 2017 LWC Plan Update (2040).

Water Use Category	2012 LWC Plan Update 2030 Demand (mgd)	2017 LWC Plan Update 2040 Demand (mgd)	Percent Difference
PWS	232.1	199.9	-14%
DSS	24	33.2	38%
AGR*	695.9 to 740.9	678.8	-3% to -8%
PWR	42.1	15.4	-63%
REC	188.5	254.3	35%
ICI	35.3	29.1	-18%
Total	**1,217.9 to 1,262.9**	**1,210.7**	**-1%** to **-4%**

AGR = Agricultural Irrigation; DSS = Domestic and Small Supply; ICI = Industrial/Commercial/Institutional; LWC = Lower West Coast; mgd = million gallons per day; PWR = Power Generation; PWS = Public Water Supply; REC = Recreational/Landscape Irrigation.
*The 2012 LWC Plan Update (SFWMD 2012) included 29,000 acres for transitional land, which is why it is expressed as a range.

DEMAND MANAGEMENT: WATER CONSERVATION

The continued implementation of robust water conservation programs throughout the LWC Planning Area offers the potential to reduce future water demand by all water use categories (**Chapter 3**). The continuing decline in per capita use rates shows, in part, the effectiveness of conservation by PWS utilities. All water users are urged to implement water conservation measures to reduce water supply demands and defer the construction of capital intensive projects. The following conservation-related actions are recommended:

- The SFWMD will continue to implement the 2008 Comprehensive Water Conservation Program.
- Local governments should evaluate the implementation of existing and additional water conservation measures appropriate for their jurisdiction, such as two-days-per-week landscape irrigation ordinances. Upon request, SFWMD staff are available to assist local governments with model ordinance methodologies and their implementation.
- Local governments should develop or enhance existing ordinances to be consistent with Florida-Friendly Landscaping™ provisions [Chapter 373.185, F.S.].
- Public education programs can help instill a year-round conservation ethic. Local governments and utilities are encouraged to continue providing water conservation-related educational programs in cooperation with the SFWMD.

- PWS utilities are encouraged to use a water conservation planning tool to implement measures with a numerical goal for achievable water savings. As a guideline, water conservation measures should include general policy considerations and technology retrofits as described in this plan update.
- Utilities are encouraged to develop goal-based water conservation plans. SFWMD staff are available to assist utilities in developing such plans.
- Water users should implement best management practices to increase water conservation and water use efficiency, which are economical measures to help meet future demands.
- Landscape water users should implement advanced irrigation technology, improve landscape design and management practices, and participate in recognition programs to further increase landscape water use efficiency.
- When applicable, agricultural water users are encouraged to use Florida Automated Weather Network irrigation tools.
- Installation of higher-efficiency irrigation systems by agricultural water users is encouraged, where appropriate, for specific crop types.
- Industrial, commercial, and institutional entities are encouraged to utilize the *Water Efficiency Self-Assessment Guide for Commercial and Institutional Managers* (SFWMD 2011) to improve water use efficiency and reduce operating costs.

WATER SOURCE OPTIONS

The LWC Planning Area has relied on surface water from the C-43 Canal, Lake Okeechobee, and associated canals and tributaries for AGR with supplemental groundwater during dry periods. Fresh groundwater from the surficial and intermediate aquifer systems (SAS and IAS) and brackish groundwater from the Floridan aquifer system (FAS) are the primary water sources for PWS and other urban and industrial uses (**Chapter 5**).

Withdrawals from the SAS are not likely to increase in many areas, especially along the coast, due to potential impacts on wetlands as well as the increased potential for saltwater intrusion into freshwater sources. During prolonged dry periods, areas in the SAS and IAS water levels have declined to near the Maximum Developable Limit. Therefore, use of the FAS and portions of the IAS likely will increase to meet future water demands in the LWC Planning Area. Since the 2012 LWC Plan Update (SFWMD 2012), the use of brackish groundwater from the FAS for water supply has increased. Blending brackish groundwater with fresh water from the SAS, IAS, or surface water is a practical solution to meet some of the region's AGR needs when surface water availability is limited. However, if crops change, supplemented water from the FAS may not meet AGR needs due to water quality sensitivity of various crops.

Reclaimed water can be used to meet new uses or replace freshwater sources and potable water currently used for irrigation or industrial purposes. 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 water supply for AGR, PWS, natural systems, and other needs.

The SFWMD offers guidance in the following sections for consideration by local governments, utilities, agricultural entities, other water users, and SFWMD water supply managers and staff as a basis for the future direction of water supply planning in the LWC Planning Area.

Surface Water

Surface water supply sources in the LWC Planning Area include Lake Okeechobee, the C-43 Canal, and connected secondary canal systems located in the LOSA as well as regional canals in Collier County (e.g., Golden Gate and Henderson Creek canals). Water availability from these systems are limited due to existing legal users, limited storage, and environmental needs. Additional water storage features could enhance water availability. Surface water is used by AGR, and to a much lesser extent PWS and REC.

- Complete construction of the Caloosahatchee River (C-43) West Basin Storage Reservoir (C-43 Reservoir). The joint state-federal Comprehensive Everglades Restoration Plan (CERP) identifies restoration of the Caloosahatchee River Estuary as an integral step in achieving systemwide benefits in the South Florida ecosystem. The C-43 Reservoir will moderate flows to the estuary and help achieve a more balanced salinity regime. The project should be completed by 2022 to help meet the MFL criteria for the Caloosahatchee River Estuary.
- Local governments, utilities, and agricultural operations are encouraged to create additional storage capacity for surface water, when feasible.
- Complete re-evaluation of the Caloosahatchee River MFL and codify subsequent changes, if any, to the adopted MFL rule.
- Rehabilitation of the Herbert Hoover Dike by the United States Army Corps of Engineers is critical to protect residents near the lake. The project is expected to be complete by 2025 and may enable revision of the lake regulation schedule.

Groundwater

Groundwater is the primary source of water for potable use, with approximately 60 percent of PWS demand in 2014 met with fresh groundwater from the SAS and IAS and 40 percent met with brackish groundwater from the FAS. Many agricultural stakeholders also use groundwater from the SAS and IAS as a supplemental source. The Lower West Coast Surficial and Intermediate Aquifers Model is being developed by the SFWMD to simulate groundwater flow and levels to represent existing and potential future hydrologic conditions in the LWC Planning Area. Model results should be available in 2018-2019.

Surficial Aquifer System

- The potential use of the SAS for new or increased allocations will be evaluated on an application-by-application basis to determine if the project meets water use permitting criteria.
- Design of wells and wellfield locations, configurations, and pumping regimes should maximize withdrawals while avoiding harm to natural systems and reducing potential impacts from saltwater intrusion.

- To reduce the LWC Planning Area's reliance on the SAS, water users are encouraged to develop alternative water sources to meet future water demands.
- Utilities should continue to expand interconnections with other utilities.
- Utilities should consider implementing groundwater recharge systems utilizing surface or reclaimed water as an impact offset or substitution credit (see *Reclaimed Water* section).
- Utilities should consider using the concentrate from membrane softening of SAS and IAS water beneficially (e.g., blending with reclaimed water, if feasible).
- Coordinated saltwater intrusion monitoring is essential to ensure resource protection of the SAS and IAS.

Intermediate Aquifer System

- An overall downward trend in water levels of the Sandstone aquifer in Lehigh Acres has been seen over the last 10 years, with some evidence of a slight rise in water levels over the last 3 years. Accelerating the extension of PWS distribution lines into such communities, coupled with mandatory hook-up to available municipal lines and proper abandonment of Domestic and Small Public Supply (DSS) wells should be considered.
- Local governments should continue discussing a long-term water supply strategy for sustainable DSS in the Lehigh Acres area.
- Updated maps of the top of the Lower Tamiami, Sandstone, and Mid-Hawthorn aquifers have been prepared by the SFWMD. Water level monitoring in the LWC Planning Area is critical to ensure the MFL for these aquifers is being met. Joint data collection among local governments, utilities, and the SFWMD is encouraged to maximize data collection and quality for use in future evaluations and numerical modeling.

Floridan Aquifer System

- Local utilities are proposing significant increases in FAS water source development over the next 20 years. Local water users and utilities developing FAS well drilling programs are encouraged to collaborate with the SFWMD. Water quality, water level, and hydrologic data from such wells can be utilized in SFWMD models and can increase knowledge and understanding of the FAS. Brackish groundwater from the FAS may be blended with fresh groundwater and surface water in stormwater ponds to produce acceptable irrigation-quality water. Blended water supplies depend on the water sources, volume of stored water, and natural system requirements, and they require monitoring to ensure acceptable water quality is maintained.

- The SFWMD should use the West Coast Floridan Model to understand the potential impact of existing and projected use of the FAS. The model focuses on the various production zones of the FAS within Charlotte, Glades, Lee, Hendry, and Collier counties. The recalibrated and revised transient model will be used in water supply planning efforts regarding the use of the FAS and potential impacts of water withdrawals on the resource and existing users. The model is being updated with new hydrostratigraphic and time-series (e.g., water level, water quality) data and the orientation of the grid has been shifted to match up with the East Coast Floridan Model to improve model calibration and provide better confidence in the results. Model results should be available in 2018-2019.
- Landowners are encouraged to plug and abandon inactive or dysfunctional FAS wells in accordance with existing rules and regulations.
- Utilities should use an incremental wellfield development approach to design, test, and monitor production wells in order to minimize sudden changes in water quality due to geologic variability in the FAS and over-stressing production zones.

Reclaimed Water

- Utilities are urged to expand the use of reclaimed water and minimize deep injection well or other disposal practices.
- Reclaimed water providers should consider the use of supplemental water supplies to meet peak demands. However, during times of drought, availability of supplemental water sources such as surface water, groundwater, or stormwater may be limited. Use of supplemental sources is subject to water use permitting by the SFWMD.
- To maximize the use of reclaimed water, utilities should extend their supply of reclaimed water by implementing feasible options such as supplemental sources, increased storage, metering for customers, tiered rate structures, limiting days of the week for landscape irrigation, and interconnects with other reclaimed water utilities.
- 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. Mandatory reuse zones are geographic areas designated by local governments through ordinance where reclaimed water use is required. These zones are described in the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (SFWMD 2015).
- Local government and utilities should support development of additional reclaimed water lines for golf and landscape irrigation to decrease reliance on traditional freshwater sources.

- Utilities should consider implementing groundwater recharge systems utilizing reclaimed water as an impact offset or substitution credit. Section 373.250, Florida Statutes (F.S.), recognizes the use of "substitution credits" and "impact offsets" to promote increased availability and distribution of reclaimed water and decrease impacts on traditional water sources. The Florida Department of Environmental Protection has included this language into Chapter 62-40, Florida Administrative Code (F.A.C.), and the SFWMD adopted the changes into its rules to be consistent, where appropriate.
- Irrigation for new golf courses should use reclaimed water when available or continue to include on-site blending of brackish groundwater with surface water, if water use permit criteria are met.

New Storage Capacity for Surface Water or Groundwater

- All users should consider developing new storage and stormwater capture options. In the LWC Planning Area, potential types of water storage include ASR wells, reservoirs, and surface water impoundments and ponds. Proposed projects that develop new storage and create additional water supply may be considered alternative water sources.
- Construction of new or retrofitted surface water storage systems, coupled with lower-quality groundwater, for agricultural operations will provide additional supply for irrigation.
- To meet future demands, expansion of ASR and other viable storage options is needed to extend the use of current water resources. ASR stores excess water supplies for use during peak demand periods.
- Users considering ASR systems should refer to the 2013 regulatory guidance by the United States Environmental Protection Agency, which offers additional flexibility in ASR permitting. The guidance recognizes the water resource benefits provided through ASR, and was intended to provide a clear path towards the issuance of permits for ASR systems.
- If the LWC Planning Area experiences changes in crop types and irrigated acreage, agricultural operations may need to construct additional surface water storage systems to increase water availability.

COORDINATION

Coordination and collaboration among regional, local government, and utility planning entities throughout the water supply planning process are essential. Examples of coordination activities include the following:

- Water Supply Facilities Work Plans are due within 18 months of approval of this 2017 LWC Plan Update. Local governments and utilities need to provide linkages and coordination between the plan update and the local government water supply-related elements of their Comprehensive Plans.

- The SFWMD should continue implementing CERP projects within the region in coordination with the Big Cypress Basin Board.
- The SFWMD should continue to work with the Florida Department of Agriculture and Consumer Services and agricultural stakeholders on development of the Florida Statewide Agricultural Irrigation Demand simulation for future crop projections.
- The SFWMD should support stakeholders with use of regional groundwater models.

SEA LEVEL RISE AND CLIMATE CHANGE

Potential changes in the rate of Sea level rise, air temperature, and rainfall patterns could affect hydrologic conditions, and thus water supply sources, as well as patterns of water demand. Recommendations related to climate change include the following:

- Because of potential changes in climatic patterns, the SFWMD should investigate the ability to develop future scenarios of climate patterns and sea level for use in the 5-year cycle of water supply planning.
- The SFWMD should continue to partner with utilities, other water management districts, local government representatives, and academic institutions such as the Florida Climate Institute, and the organizations in the Florida Water and Climate Alliance, a stakeholder-scientist partnership committed to support decision-making in water resource management, planning, and supply operations in Florida.
- The SFWMD should continue to update saltwater interface maps at least every 5 years. Following the map update, the SFWMD should review the PWS utilities to identify Utilities at Risk and Utilities of Concern.
- The SFWMD, in coordination with stakeholders and local governments, should identify methods to evaluate the potential impacts of sea level rise and climate change in the planning area.

CONCLUSIONS

This 2017 LWC Plan Update assesses the water supply demand and available sources for the LWC Planning Area through 2040. With construction of the identified PWS projects, sufficient water appears to be available to meet the 2040 projected water demand during 1-in-10 year drought conditions for most users. Currently, this level of certainty is reduced to 1-in-6 year drought conditions for surface water users that rely on Lake Okeechobee (primarily agricultural users) within the LOSA portion of the planning area.

Demands were developed based on the best available information. There is uncertainty in agricultural projections because citrus acreage has declined dramatically as a result of disease and fallow citrus land may be converted to other crops. The SFWMD anticipates that when the plan is updated in 5 years, the trend in agricultural water use will be clearer, reducing uncertainty in agricultural demand projections.

This plan update concludes that future water needs of the region can be met through the 2040 planning horizon with appropriate management, conservation, and implementation of projects identified herein. The SFWMD anticipates any additional water from Lake

Okeechobee resulting from revision of the lake regulation schedule could return the lake to an MFL prevention strategy, increase the level of certainty to existing permitted users, and support other environmental objectives. Meeting future water needs depends on the following:

- Construction of potable water supply development projects by 2 PWS utilities.
- Implementation of the C-43 Reservoir project and other projects identified in MFL prevention and recovery strategies.
- Utilization of the flexibility within the 2008 Lake Okeechobee Regulation Schedule as incremental dam safety improvements are completed; and in the longer term, completion of the seepage berm construction or equivalent repairs to the Herbert Hoover Dike for Reaches 1, 2, and 3 by the United States Army Corps of Engineers and implementation of a revised Lake Okeechobee Regulation Schedule.

Successful implementation of this 2017 LWC Plan Update requires close coordination and collaboration with agricultural interests, local governments, utility water supply planning entities, and other stakeholders. This partnering should ensure that water resources in the LWC Planning Area continue to be prudently managed and available to meet future demand.

REFERENCES

SFWMD. 2011. *Water Efficiency Self-Assessment Guide for Commercial and Institutional Managers*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2012. *2012 Lower West Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, 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 5, 2015.

Glossary

1-in-10 year drought A drought of such intensity that it is expected to have a 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; 43,560 cubic feet; 1,233.5 cubic meters; 325,872 gallons, which is approximately the amount of water it takes to serve two typical families for one year.

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 estimating irrigation demands that is 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) The water used to irrigate crops, to water livestock, and for aquaculture (i.e., fish production) that is not supplied by a Public Water Supply utility.

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 *Applicant's Handbook for Water Use Permit Applications*. Read in conjunction with Chapter 40E-2, Florida Administrative Code (F.A.C.), the Applicant's Handbook further specifies the general procedures and information used by SFWMD staff for review of water use permit applications with the primary goal of meeting SFWMD water resource objectives.

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 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. (Laney and Davidson 1986).

Artesian A commonly used expression, generally synonymous with "confined" and referring to subsurface (ground) bodies of water, which, due to underground drainage from higher elevations and confining layers above and below the water body (referred to as an Artesian aquifer), result in groundwater at pressures greater than atmospheric pressures.

Available supply The maximum amount of reliable water supply, including surface water, groundwater and purchases under secure contracts.

Average daily demand A water system's average daily use based on total annual water production (total annual gallons or cubic feet divided by 365).

Average rainfall year A year having rainfall with a 50 percent probability of being exceeded over a 12-month period.

Basin (groundwater) A hydrologic unit containing one large aquifer, or several connecting and interconnecting aquifers.

Basin (surface water) 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.

Blaney-Criddle A formula to calculate evapotranspiration (ET) based on mean temperature and number of daylight hours. The "Modified Blaney-Criddle" is a variation of Blaney-Criddle, which multiplies the ET from Blaney-Criddle by a coefficient that relates mean air temperature to the growth stage of a crop. Additionally, effective rainfall is calculated using the mean temperature and hours of daylight, the Blaney-Criddle ET, average monthly rainfall, and a soil factor. Further calculations consider average rainfall to drought rainfall (1-in-10 year drought conditions).

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 facilities via deep injection wells.

Brackish water Water with a chloride level greater than 250 milligrams per liter (mg/L) and less than 19,000 mg/L.

Canal A human-made waterway that is used for draining or irrigating land or for navigation by boat.

Canal recharge (see *Recharge*)

Capacity Capacity represents the ability to treat, move, or reuse water. Typically, capacity is expressed in million gallons of per day (mgd).

Captured stormwater/surface water Water captured predominantly during wet-weather flow and stored aboveground or underground for future beneficial use.

Central and Southern Florida Project (C&SF Project) A complete system of canals, storage areas, and water control structures spanning the area from Lake Okeechobee to both the east and west coasts and from Orlando south to the Everglades. It was designed and constructed during the 1950s by the U.S. Army Corps of Engineers (USACE) to provide flood control and improve navigation and recreation.

Comprehensive Everglades Restoration Plan (CERP) The 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).

Critical habitat A specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Cubic feet per second (cfs) A rate of the flow (e.g., in streams and rivers). It is 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 or railroad.

DBHYDRO The SFWMD's corporate environmental database, storing hydrologic, meteorologic, hydrogeologic, and water quality data.

Demand The quantity of water 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 to prevent overflow of lowlands; a levee.

Discharge The rate of water movement past a reference point, measured as volume per unit time (usually expressed as gallons per minute or cubic feet or meters per second).

Disinfection The process of inactivating microorganisms that causes disease. All potable water requires disinfection as part of the treatment process prior to distribution. Disinfection methods include chlorination, ultraviolet (UV) radiation, and ozonation.

Disposal Effluent disposal involves the wasteful practice of releasing treated effluent back to the environment using ocean outfalls, surface water discharges, and deep injection wells.

Domestic and Small Public Supply (DSS) The water used by households whose primary source of water is water treatment facilities and/or private wells with pumpages of less than 100,000 gallons per day.

Domestic Use Use of water for household purposes, such as drinking, bathing, cooking, or sanitation.

Domestic wastewater Wastewater derived principally from residential dwellings, business or commercial buildings, institutions, and the like; sanitary wastewater; sewage.

Drainage basin Describes the land area where precipitation ultimately drains to a particular watercourse (river, stream) or body of water (lake, reservoir). Drainage basins in South Florida are defined by Rule and are periodically redefined to reflect changes in the regional drainage network.

Drought A long period of abnormally low rainfall, especially one that adversely affects growing or living conditions.

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 “disposed” of.

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.

Estuary The part of the wide lower course of a river where its current is met by ocean tides or an arm of the sea at the lower end of a river where fresh and salt water meet.

Evapotranspiration 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.

Existing legal use of water A water use authorized under a District water use permit or existing and exempt from permit requirements.

Fallow Land left unseeded during a growing season. The act of plowing land and leaving it unseeded. The condition or period of being unseeded.

Feasibility study The phase of a project where the purpose is to describe and evaluate alternative plans and fully describe a recommended project.

Finished water Water that has completed a purification or treatment process; water that has passed through all the processes in a water treatment facility and is ready to be delivered to consumers. Contrast with *Raw Water*.

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) FDACS communicates the needs of the agricultural industry to the Florida legislature, the FDEP and the water management districts, and ensures participation of agriculture in the development and implementation of water policy decisions. The FDACS also oversees Florida's Soil and Water Conservation districts, which coordinate closely with the U.S. Department of Agriculture–Natural Resources Conservation Service.

Florida Department of Economic Opportunity (FDEO) Through the Division of Community Development, the FDEO manages the state's land planning and community development responsibilities, ensuring that new growth fosters economic development while protecting resources of state significance.

Florida Department of Environmental Protection (FDEP) The SFWMD operates under the general supervisory authority of the FDEP, which includes budgetary oversight.

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 aquifer system composed of the Upper Floridan and Lower Floridan aquifers. It is the principal source of water supply north of Lake Okeechobee, and the Upper Floridan aquifer is used for drinking water supply in parts of Martin and St. Lucie counties. From Jupiter to south Miami, water from the Floridan aquifer system is mineralized (total dissolved solids are greater than 1,000 mg/L) along coastal areas and in south Florida.

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 rate The rate at which water moves by a given point; in rivers it is usually measured in cubic meters per second (m^3/sec) or cubic feet per second (cfs).

Flow regime Seasonal variation in river runoff response usually expressed as monthly mean flow.

Fresh water An aqueous solution with a chloride concentration less than or equal to 250 milligrams per liter (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.

Governing Board Governing Board of the South Florida Water Management District.

Gross (raw) water demand is the amount of water withdrawn from the water resource to meet a particular need of a water user or customer. Gross demand is the amount of water allocated in a consumptive use permit. Gross or raw water demands are nearly always higher than net or user/customer water demands.

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 heads Elevation of water table.

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 The state of an area pertaining to the amount and form 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.

Hydrostratigraphic unit Bodies of rock with considerable lateral extent that act as a reasonably distinct hydrologic system.

Hydrostratigraphy A geologic framework consisting of a body or rock having considerable lateral extent and composing a reasonably distinct hydrologic system.

Impermeable Solid material, such as rock or clay that does not allow water to pass through.

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) Water used by industrial, commercial, or institutional operations withdrawing a minimum water quantity of 100,000 gallons per day (0.1 mgd) from individual on-site wells.

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 deliver drinking water.

Institute of Food and Agricultural Sciences (IFAS) Agricultural branch of the University of Florida that performs research, education, and extension.

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.

Intrusion (see *Saltwater intrusion*)

Irrigation The application of water to crops and other plants by artificial means.

Irrigation audit A procedure in which an irrigation systems application rate and uniformity are measured.

Irrigation efficiency The average percent of total water pumped or delivered for use that is delivered to the root zone of a plant.

Irrigation system efficiency A measure of the effectiveness of an irrigation system in delivering water to a crop for irrigation and freeze protection purposes. It is expressed as the ratio of the volume of water used for supplemental crop evapotranspiration to the volume pumped or delivered for use.

Irrigation water use A water use classification, which incorporates all uses of water for supplemental irrigation purposes, including golf, nursery, agriculture, recreation, and landscape.

Lake Okeechobee Located in central Florida, the lake, at 730 square miles, is the second-largest freshwater lake wholly within the United States and the largest freshwater lake in Florida.

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.

Leakance The vertical movement of water from one aquifer to another across a confining zone or zones due to differences in hydraulic head. Movement may be upward or downward depending on hydraulic head potential in source aquifer and receiving aquifer. This variable is typically expressed in units of gallons per day per cubic foot.

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 is to assure the water supply needs of existing and future reasonable-beneficial uses are met during a 1-in-10 year drought event.

Maximum daily allocation The maximum quantity permitted to be withdrawn in any single 24-hour period.

Maximum monthly allocation The maximum quantity of water assigned to the permit to be withdrawn during the month in the growing season when the largest supplemental crop requirement is needed by the specific crop for which the allocation is permitted.

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. 3) (FEMA) For purposes of the National Flood Insurance Program (NFIP), the National Geodetic Vertical Datum of 1929 (NGVD29) or other datum, to which base flood elevations shown on a community's Flood Insurance Rate Map (FIRM) are referenced.

Micro-irrigation The application of small quantities of water on or below the soil surface as drops or tiny streams of spray through emitters or applicators placed along a water delivery line. Micro-irrigation includes a number of methods or concepts, such as bubbler, drip, trickle, mist or microspray, and subsurface irrigation.

Million gallons per day (mgd) A rate of flow of water equal to 133,680.56 cubic feet per day, or 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). To hold one million gallons of water, a swimming pool approximately 267 feet long (almost as long as a football field), 50 feet wide, and 10 feet deep would be needed.

Minimum Flow and Minimum Water Level (MFL) A flow established by the District 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 Laboratory (MIL) A vehicle furnished with irrigation evaluation equipment, which 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.

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.

Monthly average daily flow The total volume of wastewater flowing into a wastewater facility during a calendar month, divided by the number of days in that month and expressed in units of mgd.

Monthly average flow The total volume of wastewater flowing into a wastewater facility during a calendar month, and expressed in units of mgd.

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 A self-sustaining living system that supports an interdependent network of aquatic, wetland-dependent, and upland living resources.

Net rainfall The portion of rainfall that reaches a stream channel or the concentration point as direct surface flow.

Net water demands The water demands of the end user, after accounting for treatment and process losses and inefficiencies (e.g., irrigation inefficiency). When discussing public water supply, the term "finished water demand" is commonly used.

North American Vertical Datum of 1988 (NAVD88) The official civilian vertical control datum (reference for elevation data) for surveying and mapping activities in the United States.

Nutrients Organic or inorganic compounds essential for the survival of an organism. In aquatic environments, nitrogen and phosphorus are important nutrients that affect the growth rate of plants.

Outflow 1) The act or process of flowing out of. 2) The measured quantity of water that has left an area or water body during a certain period of time.

Outlet An opening through which water can be freely discharged from a reservoir.

Peak flow The maximum instantaneous discharge of a stream or river at a given location. Peak flow usually occurs at or near the time of maximum stage.

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.

Planning Area The SFWMD is divided into four areas within which planning activities are focused: Lower Kissimmee Basin (LKB), Upper East Coast (UEC), Lower West Coast (LWC), and Lower East Coast (LEC).

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 pierced in a confined aquifer.

Potentiometric surface A surface that represents the hydraulic head in an aquifer and is defined by the level to which water will rise above a datum plane in wells that penetrate the 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.

Primary wastewater treatment The first stage of the wastewater-treatment process where mechanical methods, such as filters and scrapers, are used to remove pollutants. Solid material in sewage also settles out in this process.

Priority Water Bodies List and Schedule Section 373.042(2), F.S., requires each of the five water management districts to provide the Florida Department of Environmental Protection with an annual list and schedule of specific surface water bodies and groundwater aquifers with Minimum Flows and Minimum Water Levels and Water Reservation rules that will be adopted to protect them from the effects of consumptive use allocations.

Process water Water used for non-potable industrial usage, 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 0.1 million gallons per day.

Public Water Supply (PWS) demand All potable (drinking quality) water supplied by water treatment facilities with projected average pumpages greater than 100,000 gallons per day to all types of customers, not just residential.

Rapid infiltration basin (RIB) A wastewater treatment method by which wastewater is applied in deep and permeable deposits of highly porous soils for percolation through deep and highly porous soil.

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 facility. 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 nearly always higher than User/Customer Demands because of inherent 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 (canal) The discharge of highly treated wastewater or reclaimed water into canals or surface water bodies for beneficial recharge of groundwater or downstream augmentation.

Recharge (groundwater) The natural or intentional infiltration of surface water into the ground to raise groundwater levels.

Recharge (hydrologic) The downward movement of water through soil to groundwater; the process by which water is added to the zone of saturation; or the introduction of surface water or groundwater to groundwater storage, such as an aquifer. Recharge or replenishment of groundwater supplies consists of three types:

1) Natural Recharge, which consists of precipitation or other natural surface flows making their way into groundwater supplies.

2) Artificial or Induced Recharge, which includes actions by man specifically designed to increase supplies in groundwater reservoirs through various methods, such as water spreading (flooding), ditches and pumping techniques.

3) Incidental Recharge, which consists of actions, such as irrigation and water diversion, which add to groundwater supplies, but are intended for other purposes. Recharge may also refer to the amount of water so added.

Recharge area (groundwater) The land area over which precipitation infiltrates into soil and percolates downward to replenish an aquifer; the area in which water reaches the zone of saturation by surface infiltration. Infiltration moves downward into the deeper parts of an aquifer in a recharge area. Also referred to as a recharge zone.

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 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 greater than 0.1 mgd. The golf course subcategory includes those operations not supplied by a Public Water Supply or regional reuse facility.

Regional Water Supply Plan Detailed water supply plan developed by the District 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 20 years and recommends projects to meet identified needs.

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 Area designated within the District 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.

Retention The prevention of stormwater runoff from direct discharge into receiving waters; included as examples are systems that discharge through percolation, exfiltration, filtered bleed-down, and evaporation processes.

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 different irrigation system, such as a conversion from an overhead sprinkler system to a micro-irrigation system (Basis of Review, SFWMD 2010a).

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 (RO) A membrane process for desalting water using applied pressure to drive the feedwater (source water) through a semipermeable membrane.

Rule Of or pertaining to the District's regulatory programs, which are set forth in various rules 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.

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.

Salinity Of or relating to chemical salts usually measured in parts per thousand (ppm), milligrams per liter (mg/L), or practical salinity units.

Salt water (see *Seawater or Salt water*)

Seawater or **Salt water** Water with a chloride concentration at or above 19,000 mg/L.

Secondary wastewater treatment Treatment that follows primary wastewater treatment. It involves the biological process of reducing suspended, colloidal, and dissolved organic matter in effluent from primary treatment systems, which generally removes 80 to 95 percent of the oxygen-demanding substances and suspended matter. Secondary wastewater treatment may be accomplished by biological or chemical-physical methods. Activated sludge and trickling filters are two of the most common means of secondary treatment. Treatment is accomplished by bringing together waste, bacteria, and oxygen in trickling filters or in the activated sludge process. Disinfection is the final stage of secondary treatment.

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 loss 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. During the process of priming (a field during initial irrigation), the loss is called Absorption Loss.

Seepage irrigation Irrigation that conveys water through open ditches. Water is either applied to the soil surface (possibly in furrows) and held for a period of time to allow infiltration, or is applied to the soil subsurface by raising the water table to wet the root zone.

Seepage irrigation system A means to artificially supply water for plant growth that relies primarily on gravity to move the water over and through the soil, and does not rely on emitters, sprinklers, or any other type of device to deliver water to the vicinity of expected plant use.

Self-supply The water used to satisfy a water need, not supplied by a public water supply utility.

Semi-confined aquifer A completely saturated aquifer that is bounded above by a semi-pervious layer, which has a low, though measurable permeability, and below by a layer that is either impervious or semi-pervious.

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, which result from a change in surface water or groundwater hydrology, that takes more than two 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 runoff, irrigation runoff, or drainage from areas, such as roads and roofs.

Stormwater discharge Precipitation and snowmelt runoff from roadways, parking lots, roof drains that is collected in gutters and drains; a major source of nonpoint source pollution to water bodies and a challenge to sewage treatment facilities in municipalities where the 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.

Substrate 1) The substances used for food by microorganisms in liquid suspension, as in wastewater treatment. 2) The physical surface upon which an organism lives; the natural or artificial surface upon which an organism grows or to which it is attached. 3) The layer of material beneath the surface soil.

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 within certain areas of south Florida. 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.

Tailwater that is typically of lower elevation or on the discharge side of the structure.

Treatment facility Any plant or other works used for the purpose of treating, stabilizing, or holding wastewater.

Tributary A stream that flows into a larger stream or other body of water.

Unconfined aquifer A permeable geologic unit or units only partly filled with water and overlying a relatively impervious layer. Its upper boundary is formed by a free water table or phreatic surface under atmospheric pressure. Also referred to as water table aquifer.

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.

Upconing Upward migration of mineralized or saline water as a result of a pressure variation caused by withdrawals.

Utilities of Concern Utilities that have wellfields near the saltwater interface, which have a western wellfield, and/or an alternative source that is not threatened by saltwater intrusion.

Utilities at Risk Utilities with wellfields near the saltwater interface that do not have a western wellfield, have not developed alternative sources of water, and have limited ability to meet user needs through interconnects with other utilities.

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 budget An accounting of total water use or projected water use for a given location or activity.

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 water source option because it reduces the need for future expansion of the 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. These are located in the western portions of Miami-Dade, Broward and Palm Beach counties, and preserve over 1,350 square miles, or about 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, 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, which is, whether it is for recreation, fishing, drinking, navigation, shellfish harvesting, or agriculture.

Water Reservation A water reservation is 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 Advisory Commission (WRAC) The SFWMD Water Resources Advisory Commission serves as an advisory body to the Governing Board. The WRAC is 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 the collection and evaluation of surface water and groundwater data; structural and nonstructural programs to protect and manage the water resources; the development of regional water resource implementation programs; the 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 sub-watershed 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 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 (see *Regional Water Supply Plan*)

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 withdrawal of water for consumptive use.

Wellfield One or more wells producing water from a subsurface source. A tract of land that contains a number of wells for supplying a large municipality or irrigation district.

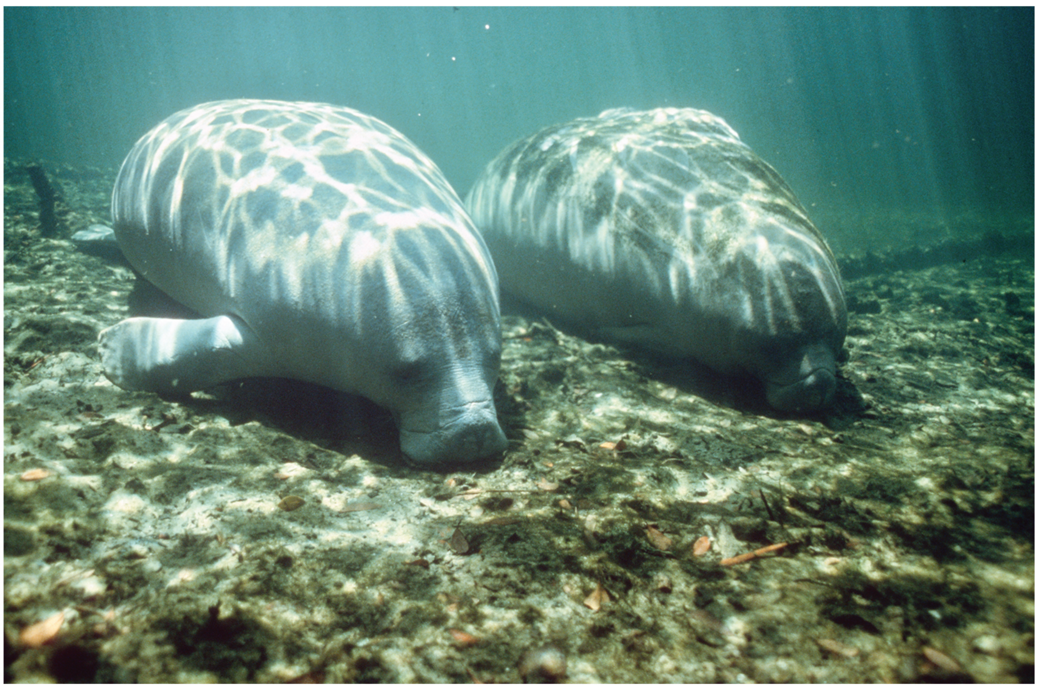
Wetland An area that is inundated or saturated by surface water or groundwater with vegetation adapted for life under those soil conditions (e.g., swamps, bogs, marshes).

Withdrawal Water removed from a ground- or surface-water source for use.

Withdrawal demand (see *Raw water demand*)

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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