2026-2029

SUPPORT DOCUMENT

FOR WATER SUPPLY PLAN UPDATES

REFERENCE DOCUMENT

Cover Photos

Front Top: S-191 Basin Innovative Water Quality Project
Front Middle: Turning on the Pumps at the Start-up of the Caloosahatchee (C-43) Reservoir in July 2025
Back: Biscayne Bay Coastal Wetlands Project

Acknowledgments

The South Florida Water Management District thanks everyone who contributed to the development and production of this *2026–2029 Support Document for the Water Supply Plan Updates*.

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Acronyms and Abbreviations

AG	Agriculture
ASR	aquifer storage and recovery
AWS	alternative water supply
AWT	advanced wastewater treatment
BMP	best management practices
BOD	biochemical oxygen demand
C&SF Project	Central and Southern Florida Project
CERP	Comprehensive Everglades Restoration Plan
CFP	Cooperative Funding Program
CFWI	Central Florida Water Initiative
CII	Commercial/Industrial/Institutional
DBP	disinfection byproduct
District	South Florida Water Management District
DSS	Domestic Self-Supply
EQIP	Environmental Quality Incentives Program
F.A.C.	Florida Administrative Code
F.S.	Florida Statutes
FAS	Floridan aquifer system
FAWN	Florida Automated Weather Network
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
HVAC	heating, ventilation, and air conditioning
IAS	intermediate aquifer system
IX	ion exchange
L/R	Landscape/Recreational
LEC	Lower East Coast
LKB	Lower Kissimmee Basin
LWC	Lower West Coast
MCL	maximum contaminant level
MF	microfiltration
MFL	minimum flow and minimum water level

MIL	mobile irrigation lab
mg/L	milligrams per liter
mgd	million gallons per day
NEEPP	Northern Everglades and Estuaries Protection Program
NF	nanofiltration
O&M	operations and maintenance
PCUR	per capita use rate
PFAS	perfluoroalkyl and polyfluoroalkyl substances
PG	Power Generation
PS	Public Supply
RAA	restricted allocation area
RES	Residential
RO	reverse osmosis
SAS	surficial aquifer system
SFWMD	South Florida Water Management District
TSS	total suspended solids
TTHM	total trihalomethane
UEC	Upper East Coast
UF	ultrafiltration
UF/IFAS	University of Florida Institute of Food and Agricultural Sciences
UKB	Upper Kissimmee Basin
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UV	ultraviolet

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Introduction

TOPICS

- Water Supply Planning
- Legal Authority and Requirements
- Regional Water Supply Plans
- Regional and Local Planning Linkage

This *2026–2029 Support Document for Water Supply Plan Updates* (2026–2029 Support Document) supplements the regional water supply plan updates produced by the South Florida Water Management District (SFWMD or District) between 2026 and 2029. The 2026–2029 Support Document provides background information helpful in understanding the SFWMD's water supply planning process and highlights issues to be considered when developing comprehensive water supply plans with a 20-year planning horizon. **Figure 1-1** shows the SFWMD's jurisdiction and planning areas.

The SFWMD encompasses nearly 18,000 square miles in all or part of 16 counties from Orlando to the Florida Keys and is divided into five planning areas: Upper East Coast (UEC), Lower West Coast (LWC), Lower East Coast (LEC), Lower Kissimmee Basin (LKB), and Upper Kissimmee Basin (UKB). The SFWMD prepares water supply plans on a rolling annual basis for the UEC, LWC, LEC, and LKB planning areas. Development of comprehensive water supply plans specific to each region is key to identifying and understanding current and future water needs. This 2026–2029 Support Document complements the cycle of plans developed starting in 2026 with the UEC, followed by the LWC in 2027, the LEC in 2028, and the LKB in 2029.

The UKB is within the boundaries of the Central Florida Water Initiative (CFWI), where the South Florida, St. Johns River, and Southwest Florida water management districts meet. The CFWI planning area includes all of Orange, Osceola, Seminole, and Polk counties and southern Lake County. Together, the water management districts work with utilities, county and state agencies, and other stakeholders to develop a single regional water supply plan for this area to implement effective and consistent water resource planning, development, and management. The CFWI regional water supply plan has its own supporting documentation, including the *Central Florida Water Initiative Supplemental Applicant's Handbook* (CFWI 2022), together with Rules 62-41.300 through 62-41.305, Florida Administrative Code (F.A.C.), which provide a regulatory framework for joint water management strategies in the region. Additionally, the archive of materials (https://cfwiwater.com/RWSP.html) contains documents regarding solution strategies, wetland evaluation methodologies, groundwater modeling, and more.

The SFWMD includes several major natural systems, such as the Upper Chain of Lakes, Kissimmee River and floodplain, Lake Okeechobee, Caloosahatchee River and Estuary, St. Lucie River and Estuary, Big Cypress National Preserve, Everglades National Park/Florida Bay, and Biscayne National Park. Information about the geography and water resources of the SFWMD planning areas is available in the publication titled *Physical Features and Water Resources of the South Florida Water Management District* (SFWMD 2022).

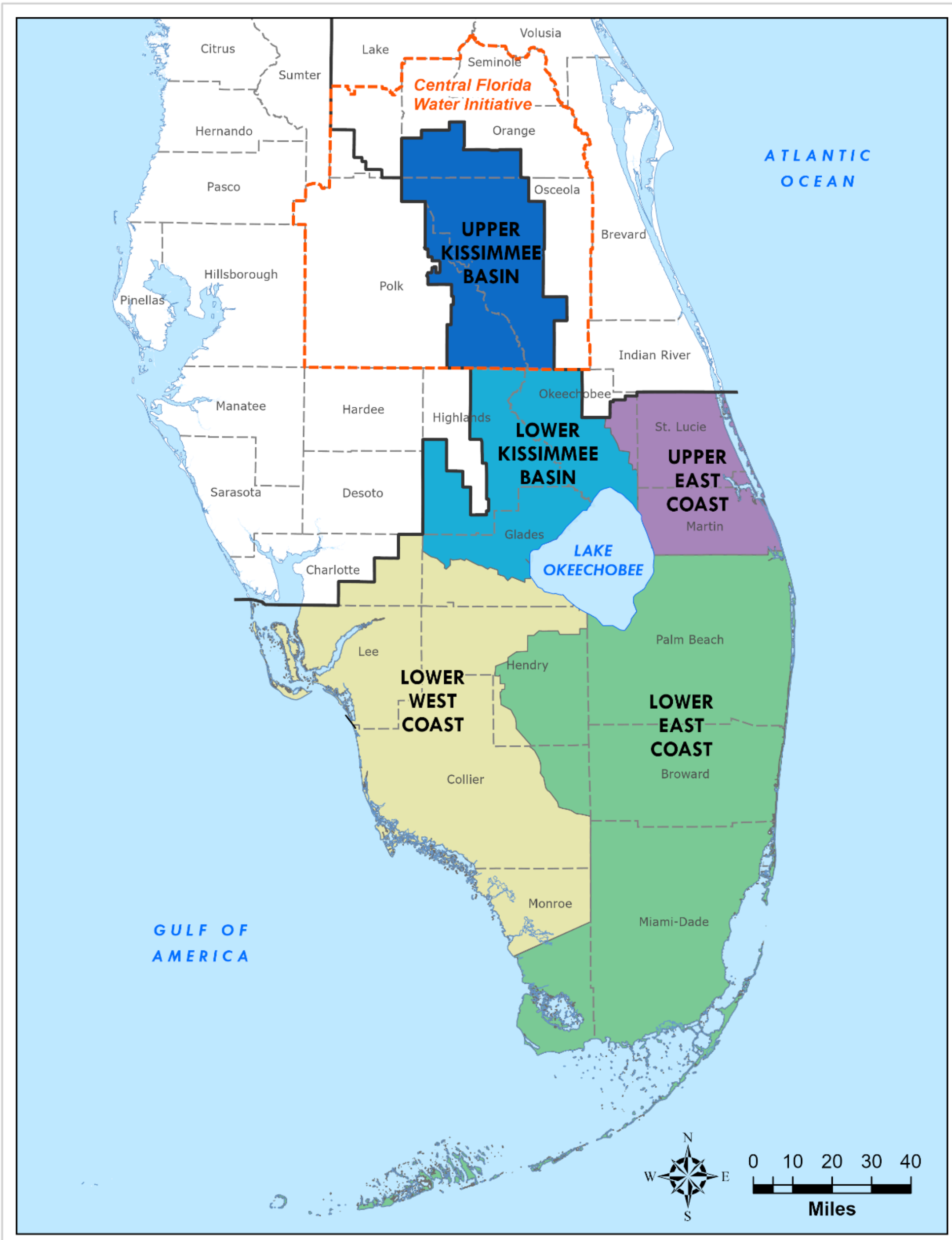

Figure 1-1. South Florida Water Management District water supply planning areas.

WATER SUPPLY PLANNING

More than 9.4 million people, plus farms and businesses, use on average more than 3.7 billion gallons of water every day in South Florida. By 2045, almost 2 million new residents are expected to make South Florida their home, increasing demand for fresh water. Ensuring an adequate supply of water to protect, enhance, and restore natural systems as well as meet all other existing and projected needs is a fundamental element of the SFWMD's mission. The goal of the water supply planning process is to determine each planning area's existing and future water needs, identify sufficient water supply sources, and develop sound, workable solutions to meet those needs while sustaining water resources and natural systems.

The SFWMD completes water supply planning in coordination with other agencies, local and tribal governments, utilities, agricultural industry and environmental representatives, and other stakeholders. Public involvement and understanding of agency responsibilities are critical in developing and implementing long-term plans and strategies. Coordination with local governments establishes a closer link between development decisions and water availability.


Miami

Legal Authority and Requirements

Approximately 50 years ago, Maloney et al. (1972) advocated a statewide, coordinated planning framework as the best way to accomplish proper water resource allocation. Subsequently, the Florida Water Resources Act of 1972 (Chapter 373, Florida Statutes [F.S.]) was enacted. Chapter 373, F.S., contains legal mandates for water supply planning and development by the water management districts in cooperation with the Florida Department of Environmental Protection (FDEP). The FDEP has general supervisory authority over the water management districts. One outcome of this legislation was the establishment of Florida's five regional water management districts. Other legal requirements related to water supply planning are included in Chapters 187 and 403, F.S. **Figure 1-2** shows the current legal framework for water supply planning in Florida.

In 1997, the Florida legislature enacted laws specifying the role of the water management districts in water resource and water supply planning and development. The legislative intent was to provide for human and environmental water demands for a 20-year planning horizon.

The State Comprehensive Plan (Chapter 187, F.S.) establishes the following:

> *Florida shall assure the availability of an adequate supply of water for all competing uses deemed reasonable and beneficial and shall maintain the functions of natural systems and the overall present level of surface and groundwater quality.*

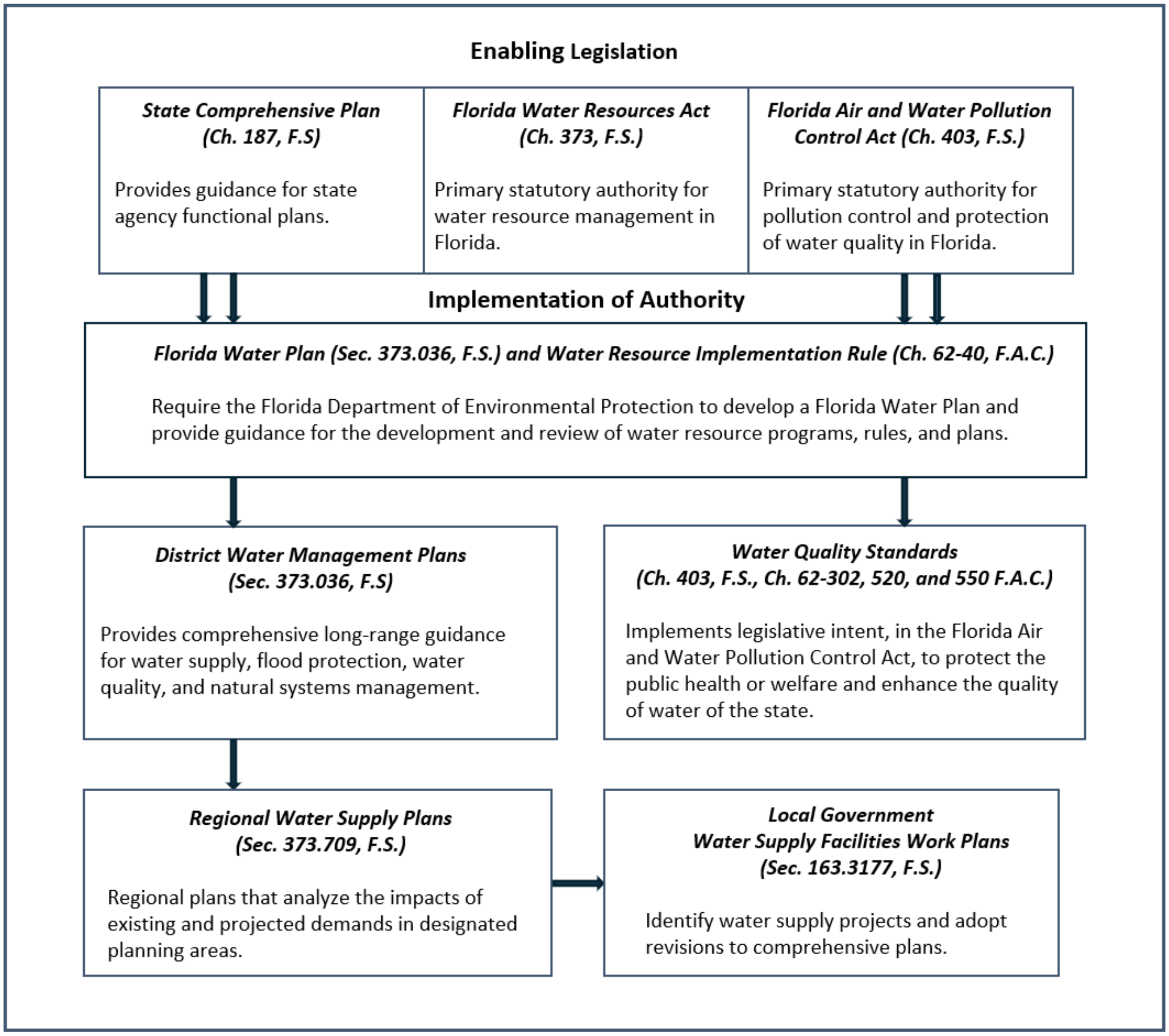

Figure 1-2. Legal framework for Florida water supply planning.

Section 373.036(1), F.S., requires the FDEP to develop the Florida Water Plan in coordination and cooperation with local governments, regional water supply authorities, government-owned and privately owned water utilities, multijurisdictional water supply entities, self-suppliers, and other affected and interested parties. The Florida Water Plan includes the following items:

- FDEP programs and activities related to water supply, water quality, flood protection, floodplain management, and natural systems
- FDEP water quality standards
- District water management plans
- Goals, objectives, and guidance for the development and review of programs, rules, and plans relating to water resources, based on statutory policies and directives

The Florida Water Plan now includes the State Water Policy (which was renamed the Water Resource Implementation Rule). The Water Resource Implementation Rule (Chapter 62-40, F.A.C.) sets forth goals, objectives, and guidance to develop and review water resource programs, rules, and plans. Relevant SFWMD documents resulting from this legislation include the following:

- Water Supply Policy Document (SFWMD 1991) – A compilation and discussion of the major water policies of the State of Florida and the SFWMD. This policy framework guided key decisions related to water supply planning and regulation by the District.
- Water Supply Needs and Sources (SFWMD 1992) – An analysis and assessment of the water demands and available resources, and an outline of supply and conservation strategies, for each county within the SFWMD. The document provided preliminary summaries to support development of the initial water supply plans.
- District Water Management Plan (SFWMD 1995) – The SFWMD approved District Water Management Plans in 1995 and 2000 (SFWMD 2000) as well as updates in 2001, 2002, and 2003 (SFWMD 2001, 2002, 2003). Beginning in 2004, the SFWMD chose to exercise its option to do an annual Water Resource Development Work Program report, published in the *South Florida Environmental Report – Volume II* available at http://www.sfwmd.gov/sfer, in lieu of the District Water Management Plan. In addition, the SFWMD Strategic Plan contains the long-range planning information formerly reported in the District Water Management Plan. The 2022-2027 Strategic Plan is available at https://www.sfwmd.gov/who-we-are/sfwmd-2022-2027-strategic-plan.
- Districtwide Water Supply Assessment (SFWMD 1998) – In 1997, Chapter 373, F.S., was modified to require each water management district to prepare a Districtwide Water Supply Assessment in order to identify areas where water demands may exceed available supplies within a 20-year planning horizon. The SFWMD Districtwide Water Supply Assessment confirmed the SFWMD's decision to prepare water supply plans that cumulatively cover the entire District.

As part of the legal authority and requirements for water supply planning in Chapter 373, F.S., Florida's Water Protection and Sustainability Program (Section 373.707, F.S.) specifies that regional water supply plans and local government Comprehensive Plans must ensure adequate potable water facilities are constructed and concurrently available to meet the demands of new development. The water supply planning region identified in each plan shall be considered a Water Resource Caution Area under Section 403.064, F.S., and affected parties may challenge the designation pursuant to Section 120.569, F.S.

LAW/CODE

Section 373.709(1), F.S.

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

Regional Water Supply Plans

Water supply plans and updates provide detailed information and recommended actions to ensure projected water needs can be met within each planning area. The SFWMD updates its regional water supply plans approximately every 5 years. Based on a minimum 20-year planning horizon, current regional water supply plans include the following:

- Population projections and water demand projections for six water use categories.
- Demand management and conservation measures.
- Water resource protection measures, such as water use permitting, minimum flows and minimum water levels (MFLs) and associated prevention and recovery strategies, water reservations, and restricted allocation areas.
- Identification of the water source options.
- Analyses of the water resources in the planning area.
- A water resource development component, including a funding strategy that must be reasonable and sufficient to pay the cost of constructing or implementing all the listed projects.
- A water supply development component identifying projects expected to create new water supply, timelines for implementation, and anticipated capacity increases.
- The MFLs and associated prevention and recovery strategies established for water resources within the planning area.
- Water reservations adopted by rule, pursuant to Section 373.223(4), F.S.
- Conclusions and summary of the future direction for water supply planning.

Regional and Local Planning Linkage

The SFWMD's water supply planning process is coordinated with and linked to the local water supply planning elements and activities of municipal/county governments and utilities. This collaboration with water supply planning entities is essential to the regional water supply plan development and approval process. While the SFWMD's regional water supply plans address regional and Districtwide water supply issues, local governments are required to plan for their water supply issues, primarily water and wastewater needs (as well as other infrastructure and public service elements), at the local level. Local water supply planning is accomplished through the comprehensive planning process required by Chapter 163, F.S. Comprehensive Plans, and subsequent amendments, must address water supply demand projections, identify and include details about water sources, and provide information about the availability and capacity of water supply facilities.

Local Government Comprehensive Plans

The Community Planning Act (Section 163.3161, F.S.) requires each municipality and county to adopt and maintain a Comprehensive Plan. In Florida, all proposed and approved development in the community must be consistent with the Comprehensive Plan. Each District water supply plan update contains information on state requirements for local government Comprehensive Plans, including the following guidance for water supply activities:

- Identify water supply sources needed to meet existing and projected water use demands for the established planning period of the Comprehensive Plan.

- Base future land use plans and amendments on the availability of water and associated public facilities.
- Identify alternative and traditional water supply, conservation, and reuse projects needed to meet the water needs identified in the regional water supply plan for the local government's jurisdiction.

Work Plans

Local Comprehensive Plans include Water Supply Facilities Work Plans (Work Plans), which are required by statute (Chapter 163, F.S.). Work Plans are part of the link between regional and local water supply planning efforts. They identify water supply, conservation, and reuse projects necessary to meet the local government's water needs for at least a 10-year horizon. Most local governments are required by statute to update their Work Plans and adopt revisions to their Comprehensive Plans within 18 months following the applicable water supply plan's approval pursuant to Section 163.3177(6)(c)4., F.S. Revisions may include population projections, established planning periods, existing and future water resource projects, intergovernmental coordination activities, conservation and reuse measures, and the capital improvements element.

The SFWMD works with public and private water supply utilities to evaluate the need for water supply development projects based on the most current applicable regional water supply plan update. The water supply projects proposed in the water supply plans for public and private water supply utilities are useful to local governments in the preparation of their Work Plans. The information in these Work Plans has assisted the SFWMD in coordinating with local government land use planning staff on future water supply planning and water use permitting. Although Comprehensive Plans, Work Plans, and water use permits (**Chapter 3**) are prepared at different times, each uses the latest and best available data. The regional and local water supply planning process is described below and illustrated in **Figure 1-3**.

PROCESS

Regional and Local Water Supply Planning Process

On an annual basis, the SFWMD receives input from PS utilities identifying water supply projects needed to meet projected future demands. The SFWMD also considers water supply projects in local government Water Supply Facilities Work Plans, Tribal Work Plans, and adopted Sector Plans, which are required to identify needed water supplies and available water sources in accordance with 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 as set forth in Section 373.709(8)(a), F.S. 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 pursuant to Section 373.709(8)(b), 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).

Pursuant to the 1987 Water Rights Compact, the Seminole Tribe of Florida submits Work Plans and amendments to the SFWMD describing new projects on a Tribal Reservation or Tribal Trust Lands.

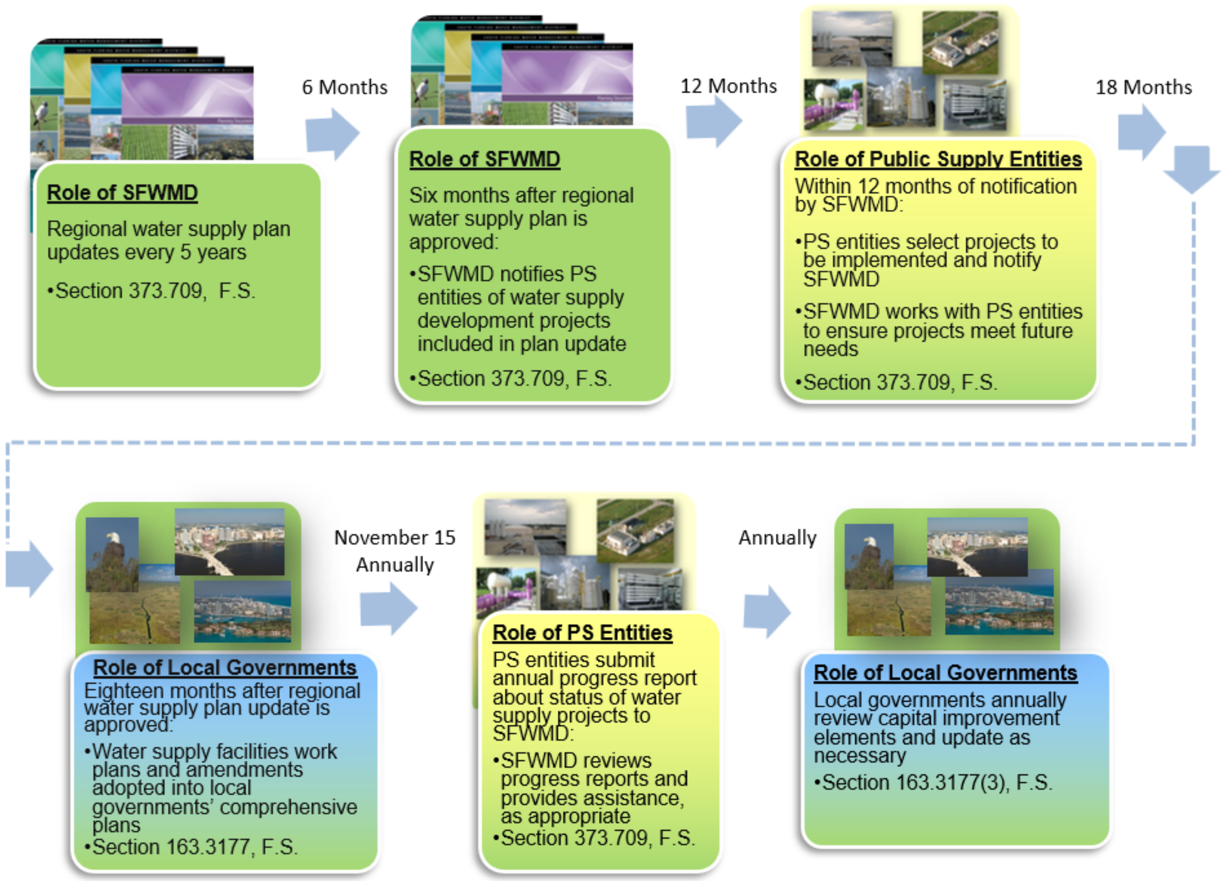

Figure 1-3. Linking regional water supply planning with local government comprehensive planning.

To assist local governments in updating their Comprehensive Plans and Work Plans, the SFWMD has developed technical assistance tools and informational documents, which are available on the SFWMD webpage (https://www.sfwmd.gov/doing-business-with-us/work-plans). Additional information about developing a Work Plan is available from the Florida Department of Commerce webpage (www.floridajobs.org/community-planning-and-development/programs/community-planning-table-of-contents/water-supply-planning).

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Water Conservation

Water conservation (conservation) includes any activity or action that reduces the demand for water, including those that prevent or reduce wasteful or unnecessary uses and those that improve efficiency for necessary uses. Conservation (a key component of demand management) is an integral part of water supply planning and water resource management at the South Florida Water Management District (SFWMD or District). Conservation can reduce, defer, or eliminate the need for expansion of water supply sources to meet current or future demands.

TOPICS

- Cost Effectiveness of Conservation
- Conservation in Water Supply Planning
- Conservation Measures
- Conservation Practices
- Conservation Programs
- Education, Outreach, and Marketing
- Regulatory Initiatives
- Conservation Actions by Water Use Category
- Summary of Water Conservation
- Other Resources

Conservation is addressed in this chapter through five elements:

- **Conservation measures** typically are related to replacement of inefficient hardware or system components, such as toilets, faucets, and showerheads. Hardware replacement is a preferred method of conserving water because once the more efficient hardware is installed, it will produce water savings throughout its service life.
- **Conservation practices** are activities or actions voluntarily undertaken to conserve water, such as water audits and limiting irrigated areas. Normally, practices are associated with the expenditure of time and labor to produce a water-saving result. A conservation practice can be a one-time effort that results in enduring water savings or may be a behavioral decision to use water in a manner that routinely results in water savings.
- **Conservation programs** are a more formalized combination of measures and practices, such as Florida Water Star or Mobile Irrigation Labs. A program may target specific user groups (e.g., homeowners, commercial buildings, agriculture) or be created for a particular purpose (e.g., distributing funding for conservation measures).
- **Education, outreach, and marketing** are essential to make water users aware of efficient water use principles they can employ and to instill an enduring conservation ethic. Although it relies on changing user behaviors, education frequently is the least expensive way to realize water savings.

- The first four elements can be undertaken voluntarily. The last element, **regulatory initiatives**, includes involuntary activities to strengthen water savings where necessary. Regulatory initiatives include mandated measures, practices, and programs.

This chapter is organized such that each conservation element is described in general terms, and a discussion of the elements by water use category is provided after. The **Appendix** contains a glossary of the measures and practices discussed in this chapter.

> **INFO**
>
> The following water use categories are used in regional water supply planning:
>
> - Public Supply (PS)
> - Domestic Self-Supply (DSS)
> - Agriculture (AG)
> - Commercial/Industrial/Institutional (CII)
> - Landscape/Recreational (L/R)
> - Power Generation (PG)

Conservation elements normally target the end user(s) of the water regardless of the water source, which may be from Public Supply (PS), groundwater, or surface water. As a result, these elements may apply to users in multiple water use categories. For example, PS utilities provide water to multiple use categories, which may result in a measure, practice, or program being promoted by the PS utility even if it does not directly affect the utility. For instance, a measure to improve irrigation efficiency could apply to irrigating a yard (PS or Domestic Self-Supply [DSS]), a crop (Agriculture [AG]), or a landscape around a nonresidential property (Landscape/Recreational [L/R]). Because residential users are included in both the PS and DSS water use categories, conservation measures, practices, and programs for residential users are presented in this chapter as Residential (RES).

COST EFFECTIVENESS OF CONSERVATION

As stated previously, water conservation can reduce, defer, or eliminate the need for expansion of water supply sources, including alternative water supply (AWS), to meet current and future demands. From a water supply perspective, demand reductions through conservation can result in fewer or smaller projects needed to meet future water needs. All water sources, both traditional and alternative, should be used efficiently to minimize water waste.

If a PS utility or other industry expects additional water will be needed to meet future needs, at least one of three actions must be taken:

1) Reduce current and/or future demands through increased efficiency (conservation) to utilize existing water supply volumes.
2) Increase withdrawals from the current water source to meet the projected needs.
3) Develop an AWS source to meet the projected needs.

Implementation of conservation measures, practices, and programs often is among the lowest-cost solutions to meet future water needs and has been shown to reduce costs over the long term, if properly planned and implemented. **Table 2-1** compares the costs of saving 1,000 gallons through conservation and of developing 1,000 gallons of water supply through new facility construction or expansion of an existing facility.

Table 2-1. Comparison of conservation costs and alternative water supply development costs for 1,000 gallons of water.

Conservation[a]	New Treatment Facility Construction[b]				Expansion of Existing Treatment Facility[b]			
Typical Conservation Programs	Nanofiltration		Reverse Osmosis		Nanofiltration Train		Reverse Osmosis Train	
	Capacity							
	1 mgd	5 mgd	1 mgd	5 mgd	1 mgd	5 mgd	1 mgd	5 mgd
Cost/Kgal								
$0.07 – $3.00	$5.50	$4.73	$10.58	$8.22	$4.21	$3.44	$9.39	$7.01

Kgal = 1,000 gallons; mgd = million gallons per day.
[a] Data from Hazen and Sawyer (2013).
[b] Data from Kimley Horn (2023).

Conservation projects exceeding $3.00 per 1,000 gallons of water saved typically are not implemented by PS utilities because that is the point at which developing AWS becomes price competitive. However, the cost threshold of conservation measures should be compared to the location-specific cost for additional water supply. In some cases, conservation projects may still be the most cost effective and appropriate.

CONSERVATION IN WATER SUPPLY PLANNING

The SFWMD's regional water supply plans identify sufficient traditional and AWS projects and conservation elements that meet or exceed the projected demands for the planning horizon (20 years or more). Conservation potential for all water use categories is estimated by the SFWMD during the planning process, as described in each water supply plan. In Florida, where irrigation occurs year-round, the largest portion of water used by urban water users often is for landscape irrigation. Moreover, an estimated 50% of water used outdoors is wasted due to inefficient watering methods and systems (United States Environmental Protection Agency [USEPA] 2025). Therefore, improvements to landscape irrigation efficiency are considered a primary conservation focus area for urban water users.

Although conservation can be a more cost-effective method of meeting future water needs, very few conservation projects are proposed by users in the regional water supply plans as a means of meeting future demands. Moreover, most water users, including PS utilities, do not account for increased conservation and efficiency in projecting future water needs. Water supply plans do include a list of water conservation projects that received previous cost-share support from the District through its Cooperative Funding Program (CFP).

For the PS water use category, historical water conservation savings are captured and accounted for in water supply plans through calculation of the per capita use rate (PCUR). For each PS utility, a net (finished) water PCUR is developed using past population estimates and finished water data reported to the Florida Department of Environmental Protection (FDEP). The PCUR for each utility is a 5-year average, calculated by dividing annual net (finished) water volume by the corresponding service area population for each year. For PS demand projections, PCURs are assumed to remain constant through the planning horizon. Any demand reductions due to historical conservation practices are implicitly factored into the projections by using the 5-year average PCUR. Future water conservation savings are not normally factored into the demand projections, unless specifically identified by a PS utility.

CONSERVATION MEASURES

Water use efficiency and conservation measures are actions that encourage use of high-efficiency equipment or hardware that yield water savings. A single conservation measure can be used for multiple applications (e.g., residential, commercial, agricultural) and/or be an element of one or more conservation program(s). Conservation measures (hardware) are presented in **Table 2-2**. A glossary of the presented conservation measures is contained in the **Appendix**.

Table 2-2. Conservation measures and applicable water use categories.

Conservation Measure	PS*	RES	AG	CII	L/R	PG
Indoor/Outdoor						
Air cooled devices				X		
Automatic shutoff valve use				X		
Indoor						
Clothes washer high-efficiency replacement		X		X		
Combination oven high-efficiency replacement				X		
Dishwasher high-efficiency replacement		X		X		
Faucet aerator high-efficiency replacement		X		X		
Faucet installation, metered flow				X		
Heating ventilation and air conditioning (HVAC) efficiency improvements				X		
Hot water use (efficient)		X		X		
Ice making machines high-efficiency replacement				X		
Metering and submetering (indoor)				X		X
Pre-rinse spray valve high-efficiency replacement				X		
Showerhead high-efficiency replacement		X		X		
Steam cooker high-efficiency replacement				X		
Toilet fill cycle diverters		X		X		
Toilet high-efficiency replacement		X		X		
Toilet, redesigned flapper use		X		X		
Toilet replacement, dual flush		X		X		
Toilets, flapperless use		X		X		
Urinal high-efficiency replacement				X		
Urinal replacement, waterless				X		
Outdoor						
Auto pump start/stop			X			
Automated valves			X		X	
Car wash equipment, low flow/recirculating				X		
Fully enclosed seepage irrigation system conversion			X			
Gated and flexible pipe for field water distribution systems			X			
Irrigation efficiency nozzle and head use		X	X	X	X	

Table 2-2. Continued.

Conservation Measure	PS*	RES	AG	CII	L/R	PG
Outdoor (Continued)						
Irrigation retrofit/replacement		X	X	X	X	
Isolation valve use			X		X	
Line flushing, automatic devices	X					
Line flushing, looping	X					
Line flushing, unidirectional	X					
Linear move sprinkler irrigation system conversion			X			
Lining of irrigation canals and on-farm irrigation ditches			X			
Low-pressure center pivot sprinkler irrigation system conversion			X			
Metering and submetering water (outdoor)			X	X	X	
Microirrigation use (drip/bubbler/microspray) conversion		X	X	X	X	
Multistage greenhouse control systems			X			
On-farm irrigation ditch replacement with pipelines			X			
Rain sensor shutoff device		X	X	X	X	X
Shade control structures			X			
Smart irrigation controllers (evapotranspiration and soil moisture based)		X	X	X	X	
Soil moisture sensor(s)		X	X	X	X	
Tensiometers in field or container blocks			X			
Water control structures			X			
Water table observation well(s)			X			
Weather station with evapotranspiration measurement			X	X	X	
Wind blocks			X			
Other						
Advanced metering infrastructure and advanced metering analytics	X					
Treatment system efficiency increases	X					

AG = Agriculture; CII = Commercial/Industrial/Institutional; L/R = Landscape/Recreational; PG = Power Generation; PS = Public Supply; RES = Residential.
* PS conservation measures apply specifically to the utility and not the end user(s).

CONSERVATION PRACTICES

Conservation practices normally are voluntary activities associated with the expenditure of time and labor to produce water savings. Practices can be a one-time effort or a recurring behavioral decision to use water in an efficient manner. A single conservation practice may apply to a single user group, to many user groups (e.g., residential, commercial, agricultural), and/or be part of one or more conservation program(s). Conservation practices are presented in **Table 2-3**. A glossary of the presented conservation practices is contained in the **Appendix**.

Table 2-3. Conservation practices and applicable water use categories.

Conservation Practice	PS*	RES	AG	CII	L/R	PG
Indoor/Outdoor						
Full-facility water use assessment/audit				X		
On-site generated gray water reuse		X		X		
Process water control and recycling				X		
Indoor						
Dish and clothes washer practices		X		X		
Food preparation and washing		X		X		
Garbage disposal efficient usage		X		X		
HVAC cycles of concentration				X		
Indoor high-efficiency codes adoption		X		X		
Indoor residential water use assessment/audit		X				
Restriction of one-pass (once-through) equipment				X		
Retrofit at resale requirement		X		X		
Steam boiler efficiency				X		
Water use ethic	X	X	X	X	X	X
Water use survey		X				
Outdoor						
Allow lawn to go dormant		X		X	X	
Brush control/management			X			
Contour farming			X			
Conversion of supplemental irrigated farmland to dry-land farmland			X			
Crop residue management and conservation tillage			X			
Cyclic scheduled irrigation			X		X	
Distribution system audits, leak detection and repair	X			X		X
Fertilization efficiency practices		X	X	X	X	
Furrow dikes			X			
Green roofs				X		
Group plants according to water needs		X	X	X	X	
Irrigation codes, adoption of higher efficiency		X		X	X	
Irrigation scheduling		X	X	X	X	
Irrigation system audit/evaluation		X	X	X	X	
Landscape codes, adoption of water use efficiency		X		X	X	
Laser land leveling			X			
Licensed irrigation and design (professional, working with)		X		X	X	
Limiting high-volume irrigation areas		X		X	X	
Limiting irrigated areas		X		X	X	
Limiting turf traffic on golf courses					X	
Limiting use of turfgrass		X		X	X	
Mowing heights adjustment		X		X	X	
Net irrigation requirement-based irrigation determination		X	X	X	X	
On-site rain harvesting and reuse				X		
Routine system maintenance		X	X	X	X	
Sidewalk and driveway cleaning practices		X		X	X	
Soil amendment use for water efficiency		X	X	X	X	
Soil cultivation techniques (spiking, slicing, and core aerification)			X		X	

Table 2-3. Continued.

Conservation Practice	PS*	RES	AG	CII	L/R	PG
Outdoor (Continued)						
Surge flow irrigation use for field water distribution systems			X			
Swimming pool and hot tub water use efficiency		X		X	X	
Turfgrass maintenance for water use efficiency		X		X	X	
Turfgrass, improved cultivar uses		X		X	X	
Volumetric measurement of irrigation water use			X			
Water use efficiency improvement plan development		X	X	X	X	
Other						
Conservation analyses using a planning tool	X					
Goal-based water conservation planning	X					
Improved billing and accounting software	X					
Other proven water conservation techniques and ideas	X	X	X	X	X	X
Rate structure	X					
Water budget development		X	X	X	X	

AG = Agriculture; CII = Commercial/Industrial/Institutional; HVAC = heating, ventilation, and air conditioning; L/R = Landscape/Recreational; PG = Power Generation; PS = Public Supply; RES = Residential.
* PS conservation practices apply specifically to the utility and not to the end user(s).

CONSERVATION PROGRAMS

Conservation programs are a combination of education, measures, activities, and practices to increase water use efficiency within specific user groups. PS utilities and local governments are the primary entities that develop specific conservation programs, but other agencies or organizations may assume a leadership role in promoting conservation at the local, regional, and state level.

Voluntary and incentive-based, practices and measures are an integral part of water conservation programs. This type of program offers support and guidance for users looking to conserve water. Other benefits include public recognition for taking steps to improve efficiency, planning for future utility rate increases, and investing in efficiency measures before regulatory changes are imposed. Some programs provide financial incentives to users who upgrade to more efficient water-using devices. This is important because implementing conservation measures and practices often requires capital investments, and many water users have little discretionary income for efficiency upgrades. AG users operate under fluctuating market conditions and are subject to outside pressures, including weather, pests, and pathogens. To attain higher levels of efficiency, significant capital costs are often required. Nonagricultural business owners can experience similar difficulties as well. Therefore, financial incentives and assistance for these water users may be necessary to ease the financial burden of making critical investments. Conservation programs are presented in **Table 2-4** and further described below.

Table 2-4. Conservation programs and applicable water use categories.

Conservation Program	PS	RES	AG	CII	L/R	PG
Indoor						
Green Restaurant Association Program				X		
Outdoor						
Agricultural Mobile Irrigation Labs			X			
Environmental Quality Incentives Program			X			
Florida-Friendly Landscaping Program		X		X	X	
Water Use Audits for Urban Landscapes		X			X	
Holistic						
Florida Green Building Coalition				X		
Florida Green Lodging Program				X		
Florida Water Star		X		X		
Green Globes				X		
Leadership in Energy and Environmental Design				X		
WaterSense		X		X		

AG = Agriculture; CII = Commercial/Industrial/Institutional; L/R = Landscape/Recreational; PG = Power Generation; PS = Public Supply; RES = Residential.

Certification and Recognition Programs

There are several national and statewide certification and recognition programs that direct builders, property owners, and building managers toward meeting environmentally friendly standards. Some are holistic programs that include criteria affecting water use, energy efficiency, climate-adaptive landscaping, sustainable building materials, site selection, indoor environmental quality, and/or greenhouse gas emissions. In addition, there are some single focus programs that target one area of impact and/or one industry. Single focus certification or recognition programs usually are less expensive than holistic programs. There also are programs that focus on water auditing and programs that provide partial funding for conservation projects. Local governments, utilities, and water management districts can collaborate to promote and incentivize participation in certification and recognition programs or have their own facilities meet the program standards.

Florida-Friendly Landscaping Program

The Florida-Friendly Landscaping Program is a joint venture of the FDEP and the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS). The program works in cooperation with the state's five water management districts as well as other agencies and organizations to achieve the common goals of water conservation and water quality protection. The nine principles of Florida-friendly landscaping are contained in Section 373.185(1)(b), Florida Statutes (F.S.). These principles guide property owners on how to design and maintain a beautiful landscape using minimal water, pesticide, and fertilizer inputs while preserving local water resources and wildlife. Watering efficiently and planting the right plant in the right place are two of the nine program principles that conserve water. The program promotes low-maintenance and drought tolerant plants, environmentally sustainable landscaping, and high-efficiency irrigation practices. This program incorporates the replacement of turf and shrubs that require large amounts of water with climate-adaptive species. When landscaping with plant material appropriate for local soils and natural hydrology, outdoor irrigation can be greatly reduced or eliminated. By reducing irrigation, a Florida-friendly landscape can also reduce the amount of stormwater runoff. Landscapes are evaluated based on a checklist of program practices and receive a yard sign to display as well as a recognition certificate. Recognitions are offered for three different categories of landscapes: home, commercial, and new construction.

Florida Green Building Coalition

The Florida Green Building Coalition's certification program applies holistic efficiency standards to residential and commercial buildings. Facilities are evaluated using a points-based system that governs sustainability practices and hardware at the facility. This program is functionally linked to the Florida Water Star program.

Florida Green Lodging Program

The FDEP's Florida Green Lodging Program recognizes lodging facilities that have made a commitment to conserve and protect Florida's natural resources. Water conservation is one of the areas of sustainable operations criteria. Facilities are evaluated using a points-based system governing sustainability practices and hardware.

Florida Water Star

Florida Water Star is a voluntary, points-based certification program that improves water efficiency in the built environment by encouraging the use of appropriate water-saving landscapes, irrigation systems, and household appliances and fixtures. Florida Water Star is endorsed by all water management districts in Florida and offers the following certification levels:

- **Standard Silver** – for new and existing residential buildings
- **Gold** – for additional water savings in residential buildings
- **Community** – for master-planned communities
- **Commercial/Institutional** – for new and existing nonresidential buildings (e.g., offices, retail and service establishments, institutional and nonindustrial commercial buildings)

Local governments that adopt Florida Water Star Standard Silver criteria as their water conservation standard for new residential properties can expect new homes in their jurisdictions to use up to 35% less water than their current residential stock of single-family homes with permanent in-ground irrigation systems. Savings of up to 45% may be attainable for homes built to Florida Water Star Gold criteria. This program is linked to the Florida-Friendly Landscaping Program and Florida Green Building Coalition such that efforts that meet the criteria of one program may be credited toward certification in one or both of the other programs.

In partnership with the Florida Nursery, Growers, and Landscape Association and the Florida Irrigation Society, irrigation and landscape professionals are provided training on Florida Water Star program criteria. Once accredited, these professionals are certified as knowledgeable in the design and installation of water-efficient irrigation systems.

Green Globes

Green Globes is an online green building rating and certification tool for a wide range of commercial, institutional, and multiresidential building types. It is a points-based system that applies standards and design principles to water efficiency, energy, indoor environment, materials, project management, and site selection.

Green Restaurant Association Program

The Green Restaurant Association Program certifies restaurants that have implemented a suite of sustainability actions, including water use efficiency measures and practices. The water use efficiency criteria include measures for landscaping, kitchens, restrooms, and other areas.

Leadership in Energy and Environmental Design

The United States Green Building Council's Leadership in Energy and Environmental Design (LEED) certification program is a points-based program that certifies buildings, homes, and neighborhoods that are using environmentally friendly strategies and practices. The program applies indoor and outdoor water efficiency standards and design principles.

WaterSense

WaterSense is a partnership and certification program developed by the USEPA. The program promotes and provides information on improving water use efficiency and certifies (through a third party) water-efficient products. Products and services that have earned the WaterSense label are certified to be at least 20% more efficient than standard or conventional equivalent models without sacrificing performance.

Water Auditing Programs

A water use audit is a systematic and comprehensive survey and evaluation of all water-using fixtures, appliances, equipment, and practices. This investigation should always precede an efficiency improvement program at any large facility. Specifically, water audits can accomplish the following:

- Identify leaks and wasteful use.
- Identify inefficient devices.
- Ensure new (efficient) devices are operating properly.
- Recommend modifications to systems and equipment design, management, and maintenance.
- Recommend improvements that will provide the best returns on investment.
- Provide a benchmark for measuring water-efficiency program successes.

Agricultural Mobile Irrigation Labs

The Florida Department of Agriculture and Consumer Services (FDACS) administers Florida's agricultural Mobile Irrigation Lab (MIL) program, which performs free evaluations of agricultural irrigation system efficiency and makes recommendations for physical and operational improvements that conserve water. Recommendations may include modification of irrigation systems and equipment, alteration of irrigation scheduling, and other aspects of system management. System design, maintenance, efficiency, uniformity, and/or operations costs are evaluated. Presently, five operating MILs cover all counties within the District except Monroe County. Local municipalities are encouraged to investigate opportunities to expand the deployment of MILs. Further information about MILs can be found at https://www.fdacs.gov/Agriculture-Industry/Water/Mobile-Irrigation-Labs.

Water Use Audits for Urban Landscapes

Landscape and irrigation water audits measure the performance of a landscape irrigation system and provide insight on the appropriate use and placement of plants. In addition, the audit can provide recommendations for operation and management of the irrigation system to improve water use efficiency. Recommendations may include adjusting irrigation timers to follow a water-conserving schedule; replacing sprinkler heads to ensure the system is providing adequate coverage and not spraying impervious surfaces; installing computerized irrigation controllers with rainfall and soil moisture sensors; and suggesting changes to the plants used in a particular landscape. Local municipalities are encouraged to investigate opportunities to expand the deployment of landscape audit programs. At the time of this publication, the SFWMD is aware of the following local audit programs within its boundaries. These local programs are not affiliated with the FDACS MIL network.

Broward County's Natural Resources Division administers the NatureScape Broward irrigation service program, which audits large-scale irrigation systems at schools, parks, and residential areas using PS utility-supplied water for irrigation. The audits are provided for the 16 municipalities and water utilities of the Broward Water Partnership. More information about NatureScape Broward can be found on the program webpage at https://www.broward.org/naturescape/Pages/Default.aspx.

Miami-Dade County's Water and Sewer Department also supports irrigation audits with its Landscape Irrigation Rebate Program. This program targets single-family homes (at no cost to the homeowner) and homeowners' associations to evaluate irrigation systems, recommend efficiency improvements, and provide monetary incentives to implement recommendations. This program is a partnership between Miami-Dade County's Water and Sewer Department, the Florida Yards and Neighborhoods Program, and the UF/IFAS Extension.

While not specifically a water audit program, Toho Water Authority offers a free outdoor water usage analysis, which includes checking the irrigation system for leaks and breaks, checking and resetting the system controller for proper operation, and providing a free rain sensor, if needed. For customers with high water usage, Orange County Utilities offers a similar program, which checks for irrigation system leaks and breaks, irrigation of hardscapes, functioning rain sensors, and proper scheduling of irrigation controllers. The Orlando Utilities Commission also offers the Water Wise Neighbor Program, which provides high-efficiency water fixtures, to customers and free water conservation audits, including irrigation system calibration and water efficiency courses.

Funding Programs

Local governments and utilities are encouraged to take advantage of cost-share funding and other collaborative opportunities to implement conservation strategies and programs. Such entities may wish to provide their own cost-share funding in the form of rebates or other incentives to individual homeowners and businesses for deployment of water-conserving devices or hardware. Larger users like homeowners' associations, businesses, and agricultural operations should research available funding programs for conservation activities. Two funding programs available within the District are discussed here. More information about the programs can be found on their individual program webpages and on the SFWMD's water conservation webpage at https://www.sfwmd.gov/conserve.

SFWMD Cooperative Funding Program

The Water Conservation component of the SFWMD CFP seeks to financially support projects that improve water use efficiency and conservation. The CFP provides financial incentives to local governments and utilities, homeowners' associations, commercial entities, and agricultural operations to implement technology and hardware-based water conservation projects. Historically, funding for the CFP has come from both ad valorem taxes and the Florida Legislature through the FDEP. The CFP provides partial funding for technology and hardware-based water conservation measures and programs. CFP funding is considered annually during the SFWMD's budget development. Additional information regarding the CFP can be found on the SFWMD's webpage https://www.sfwmd.gov/doing-business-with-us/coop-funding.

Environmental Quality Incentives Program

The United States Department of Agriculture Natural Resources Conservation Service promotes agricultural production and environmental quality through the Environmental Quality Incentives Program (EQIP). Financial and technical assistance is offered to voluntary participants to install or implement structural changes and management practices that address impaired water quality and conservation of water resources on eligible agricultural land.

Florida Department of Agriculture and Consumer Services Cost-Share Program

The FDACS's Office of Agricultural Water Policy administers the Best Management Practices (BMP) Cost-Share Program for agricultural producers. Projects eligible for funding are those that help improve water quality and enhance water conservation. Producers are eligible to apply for funding through enrollment in the BMP Cost-Share Program.

EDUCATION, OUTREACH, AND MARKETING

Education, outreach, and marketing are essential to promote adoption of conservation-based behaviors and accomplish a measurable reduction in water use. Education and outreach efforts deliver important knowledge about the water supply challenges that water managers and municipalities face as well as formulated solutions and the need for regulatory measures. Education and technical assistance programs with an education component inform people about the impact of improved water efficiency and instill a lasting conservation ethic. Additionally, an educational component can be part of a rebate or audit program. Without education, even motivated water users may lack the knowledge to properly implement conservation measures and practices.

Although water savings attributed to educational campaigns are difficult to quantify, these campaigns are vital to a successful conservation program and behavioral adoption among users. Campaigns are normally tailored to a specific user group or subgroup (e.g., residents, schools, commercial properties). The SFWMD provides support to PS utilities, local governments, and others in their efforts to promote, develop, and implement conservation. Throughout the District's 16 counties, active partnerships provide opportunities for conservation workshops, outdoor community events, and collaborative public forums that help raise awareness and inform residents about long-term protection and conservation of water resources.

The SFWMD has established partnerships with other conservation sponsors, including the FDEP; Florida section of the American Water Works Association; UF/IFAS; Florida Nursery, Growers, and Landscape Association; USEPA; and other water management districts.

Combined with conservation measures and practices, educational and outreach elements, including those listed below, can yield substantial water savings.

- Educational programs for elementary to high school students
- Media campaigns (e.g., social media, radio, television, billboards, newspaper inserts, printed materials) for the general public
- Creation of a dedicated local or regional conservation position
- Informative and user-friendly conservation webpages
- Informative billing inserts and descriptive billing for end users (e.g., explaining conservation rate structures, comparing a customer's usage to similar users)
- Providing speakers for local events and community organizations
- Water use efficiency training for landscape, irrigation, and building management professionals
- Florida-friendly landscaping demonstration gardens
- Conservation workshops and exhibits for targeted groups and the general public

REGULATORY INITIATIVES

Regulations can be used to shift improved practices or efficiency devices into mainstream use and, when applied at the regional or state level, simplify working conditions for commercial users operating in multiple counties. Regulations may require users to make investments in efficiency improvements, so some regulations could be matched with financial assistance programs.

Regulations can be adopted statewide by statute, regionally through water management districts by rule, or locally through city and county governments by ordinance. In addition, PS utilities may be able to require that builders or homeowners meet efficiency codes as a condition of service. Conservation-related ordinances that local governments can adopt include those requiring greater water efficiency in construction, such as the International Green Construction Code and standards derived from the Florida Water Star program and

Florida Green Building Coalition. Ordinances and codes can be adopted wholly or partially, depending on existing conditions in the locality or within a service area.

The SFWMD has promulgated two rules (regulatory-based actions) to reduce water demands: Consumptive Use (Chapter 40E-2, Florida Administrative Code [F.A.C.]) and Mandatory Year-Round Landscape Irrigation Conservation Measures (Chapter 40E-24, F.A.C.)

Consumptive Use Permitting Process

Water conservation measures and practices are required for a proposed or continued use to meet the conditions of permit issuance for all water use permits in the SFWMD. Specifically, Section 2.3.2 of the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (Applicant's Handbook; SFWMD 2022) requires a conservation plan or program at the time of permit application for commercial, industrial, power plant, and landscape/recreational use categories and a standard or goal-based conservation plan for public water supply uses. More information about water use permitting and conservation requirements is provided in **Chapter 3**.

Year-Round Landscape Irrigation Rule

As mentioned earlier, a large percentage of water demand in South Florida is for landscape irrigation. Most water needs for turf and landscape material are met by natural rainfall. Some supplemental irrigation is required at times to maintain healthy plant growth. However, most homeowners do not know the appropriate amount of water to apply, so the frequency and duration of irrigation often leads to overwatering.

Lawn Irrigation

To address this issue, the SFWMD adopted the Mandatory Year-Round Landscape Irrigation Conservation Measures (Year-Round Irrigation Rule) in 2003 (Chapter 40E-24, F.A.C.). In 2010, the SFWMD updated Chapter 40E-24, F.A.C. to permanently restrict irrigation times and days throughout the entire District to reduce outdoor water use. The rule permanently restricts the times and number of days landscape irrigation is allowed within the District's jurisdiction and follows scientifically sound recommendations for lawn irrigation. In response to the rule, most local governments enacted/updated irrigation ordinances to promote water conservation in their respective counties and municipalities and follow the District's Year-Round Irrigation Rule. In 2021, at the Governing Board's direction, the District undertook an initiative to persuade all 155 counties and local municipalities within its jurisdiction to consider updating or enacting irrigation ordinances that comport with the District's rule.

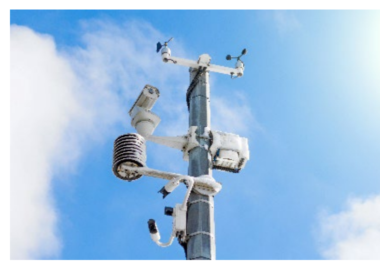
This rule applies to all users, with the exception of permitted agricultural operations, and to all sources of water (e.g., PS utility, lake, pond, canal, well) except reclaimed water. Provisions for new landscaping and other situations exist, with some limitations. Local governments may adopt more stringent alternative landscape irrigation ordinances based on local water demands, system limitations, or resource availability.

The initiative is still ongoing at the time of this writing and includes the following provisions:

- Landscape irrigation frequency is limited to 2 days per week, with a 3-days-per-week provision in some counties.
- No irrigation is allowed on any day between 10 a.m. and 4 p.m. (when evapotranspiration rates are the highest).
- Irrigation using reclaimed water, rain-harvesting systems, and various low-volume methods, such as microirrigation, container watering, and hand watering with a hose and automatic shutoff nozzle, can be conducted at any time.
- Additional watering is allowed for up to 90 days following the installation of new lawns and landscaping, with specific limits.

Rain-Canceling Devices

Section 373.62, F.S., requires automatic lawn and landscape irrigation systems be properly equipped with technology that inhibits or interrupts operation of the system during periods of sufficient rainfall (soil moisture). These devices typically take the form of a rain shutoff switch but may also incorporate soil moisture sensors and weather station technology.



Weather Station

Local Ordinances

Ordinances help local governments and other governing bodies expedite adoption of conservation-oriented standards in new construction areas and where major renovations of existing structures occurs. Appropriate water conservation ordinances include the following:

- **Building codes** implement standards requiring high-efficiency fixtures and devices (indoor use) and standards for high-efficiency irrigation design (outdoor use). Fixture and device standards typically set an allowable flow rate for toilets, faucets, and showers. Examples of irrigation standards include using water-efficient or pressure regulating sprinkler heads, requiring head-to-head coverage, using microirrigation (where applicable), and irrigating plants with similar water needs separately from other plant types with different water needs.
- **Florida-friendly landscaping** requires implementation of one or more of the nine principles of the Florida-Friendly Landscaping Program in landscape design at residential and commercial properties.
- **Landscaping codes** require high-efficiency landscape design. Examples include using plants adapted to the local environment, limiting the use of plants/turf with large water needs, requiring some part of the landscape to remain unirrigated, and incorporating principles of the Florida-Friendly Landscaping Program.

- **Local ordinances** require moisture-sensing devices on automatic lawn and landscape irrigation systems to be properly installed, repaired, and operated by licensed contractors, property owners, or property managers. Ordinances provide requirements for licensing of contractors that work on such irrigation systems and impose penalties for noncompliance.
- **Permanent year-round landscape irrigation** promotes consistency across South Florida between local government rules/ordinances and the SFWMD's Year-Round Irrigation Rule, so residents can understand and comply with all irrigation requirements. The local ordinance may be more restrictive than the SFWMD's rule in terms of allowable irrigation days and times and may impose penalties for violations.

SFWMD staff are available to review local government conservation ordinances and provide feedback during ordinance development.

CONSERVATION ACTIONS BY WATER USE CATEGORY

The following subsections address conservation measures, practices, and programs that may be applicable to one or more of the six water use categories. A single measure or a combination of these can be part of a robust conservation program. The design and selection of conservation programs depends on the target group and is directed by a conservation strategy created to effectively reach that group.

Public Supply

In the PS water use category, per capita water use demand reduction has occurred gradually across the country since the 1980s, largely because of passive savings. Passive water savings are a result of the introduction of water-efficient fixtures and appliances into the marketplace via national and local ordinances and through the natural replacement of existing water-using devices with more water-efficient models. However, relying on passive savings alone would delay or ignore substantial conservation savings potential. Active implementation of conservation measures to increase water use efficiency among specific user groups could realize conservation savings more expeditiously. One such tool is development and implementation of a goal-based conservation plan.

To receive a water use permit from the SFWMD, all PS utilities are required to meet the regulatory criteria found in Section 2.3.2.F of the Applicant's Handbook (SFWMD 2022). In general, the conservation requirement is to implement a standard or goal-based conservation plan. A standard plan contains five elements: 1) a public education program, 2) an outdoor conservation program, 3) a water-conserving rate structure, 4) a water loss reduction program (if water losses exceed 10%), and 5) an indoor conservation program. A goal-based plan must contain the measures selected for implementation and an explanation of why the standard conservation program elements were not selected.

An effective PS conservation plan should include the following:

- Clear demand management goals (e.g., lowering peak demand, reducing overall per capita demand)
- Full water system auditing, including an evaluation of supply sources and existing PS utility infrastructure
- A demand forecast based on population projections, end user characteristics, and age of facilities in the service area
- Identification and selection of potential conservation measures that would provide the greatest return on investment
- An implementation strategy based on available budget, staffing, and desired timeline

This information will drive the structure of the conservation plan and its individual components. Conservation measures and practices that could be employed by PS utilities are identified in **Tables 2-2** and **2-3**. As stated earlier in the chapter, the PS measures and practices apply specifically to the utilities, not the end users served by the utilities. A glossary of conservation measures and practices is contained in the **Appendix**.

A PS utility can reduce demands further by creating its own water conservation program targeting specific end users. As PS utilities provide water to the other user groups, selecting measures or practices that apply to those groups may be appropriate in the overall PS conservation program. PS utilities are strongly encouraged to use a conservation planning tool, such as the Alliance for Water Efficiency tool (AWE 2021), when creating a 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.

There are many options available for PS utilities to design and implement effective conservation programs. Many PS conservation programs feature rebates and incentives to replace older, less efficient indoor plumbing fixtures and appliances in existing residential and commercial buildings. Programs may also facilitate reductions in outdoor water use through irrigation system performance audits or through the distribution of rain and soil moisture sensors as well as computerized irrigation controllers. For new construction, utilities and local governments could mandate (through ordinance) or provide rebates to incentivize water-efficient construction standards. The Florida Water Star program could provide a pre-packaged framework for such an effort. PS utilities may also consider providing funding for landscape and irrigation water audits, which measure the performance of landscape irrigation systems and provide insight on the appropriate use and placement of plants.

Residential

Residential (RES) users are included in both the PS and DSS water use categories for regional water supply planning. This section discusses residential indoor and outdoor water conservation strategies, regardless of whether the water is supplied by a PS utility or DSS source (i.e., private well). Therefore, for the purposes of this chapter, these end users are discussed together under the RES category. Potential conservation strategies for RES users include replacing old plumbing fixtures and water-using appliances with water-efficient models, detecting and repairing household water leaks, and installing smart irrigation devices. Local governments are encouraged to conduct educational outreach to promote and incentivize conservation for RES users. All domestic users must limit landscape irrigation to the hours and days specified in Chapter 40E-24, F.A.C., or in local ordinances. Some PS utilities offer programs to reduce the areal coverage of irrigated turf through turf "buyback" programs. Conservation measures, practices, and programs that could be employed by RES users are presented in **Tables 2-2** to **2-4**. A glossary of conservation measures and practices is contained in the **Appendix**.

Agriculture

Local and regional efforts to increase water conservation in the AG use category should focus on row and field crops, aquaculture, orchards, nurseries, and livestock operations. Moderate efficiency gains, resulting in lower water use, could be realized in the AG sector by replacing outdated or inefficient irrigation systems with newer, more efficient ones. The selection of a more efficient system depends on the crop type, soil composition, water source, and water availability. In addition to converting to more efficient irrigation systems, many agricultural operations can benefit from optimizing the operation, management, and maintenance of existing irrigation systems. Adjustment of irrigation scheduling (e.g., time between irrigation events, amount of water applied) based on crop needs, soil conditions, and weather can improve irrigation water use efficiency. Precision irrigation devices (e.g., soil moisture sensors, automated pump controls, weather-sensing devices) can improve agricultural irrigation scheduling, including operations currently using efficient irrigation delivery systems. The FDACS agricultural MIL program (described earlier) can assist with these efforts. EQIP may also be able to provide technical and financial assistance. Conservation measures, practices, and programs that could be employed in the AG sector are identified in **Tables 2-2** to **2-4**. A glossary of conservation measures and practices is contained in the **Appendix**.

Microspray Irrigation

Because the costs associated with moving water affect profitability, most agricultural operations presumably are as efficient as practical with their existing irrigation systems and growing methods. Also, profit margins may limit growers' ability to transition to new irrigation systems or methods. Growers should investigate the feasibility of self-funding or seek financial assistance through cost-share programs or other sources of funding, including those discussed earlier. Funding sources for the implementation of these projects may be shared between the grower, FDACS, water management districts, legislative appropriations, soil and water conservation districts, local governments, resource conservation and development districts, the United States Department of Agriculture Natural Resources Conservation Service, and other partners where funding is made available.

Florida Automated Weather Network

The Florida Automated Weather Network (FAWN) is a statewide research and data project operated by UF/IFAS. FAWN provides weather information throughout the state at 15-minute intervals. FAWN management tools provide decision support functions to growers, using historical weather data and crop modeling technology to help maximize irrigation efficiency. The SFWMD has supported FAWN with funding for more than a decade. Access to the FAWN database is available via http://fawn.ifas.ufl.edu/data.

Agricultural Best Management Practices Program

FDACS develops and adopts agricultural BMPs, by rule, for different types of agricultural operations. The BMPs were designed primarily to reduce negative impacts on water quality while maintaining or enhancing agricultural production. However, some BMPs (e.g., citrus, dairy, nurseries, sod, specialty fruit and nut crops, vegetable and agronomic crops) also improve water use efficiency and could reduce the amount of water needed to meet crop demands in average to wet years. All AG users are encouraged to enroll in the FDACS BMP program.

Additional Practices

Some additional conservation measures exist for AG users for deployment during times of cold or freezing weather. The volume of water conserved is difficult to quantify because there are few water use records for frost/freeze events and such events are sporadic in nature. Additional measures specific to frost/freeze events, as defined in the **Appendix**, include the following:

- Crop row covers/frost blankets
- Selective inverted sinks
- Sprinkler heads and spacing retrofits
- Use of fog for cold protection in greenhouses/shade houses
- Wind machines

Commercial/Industrial/Institutional

From a water conservation standpoint, CII water use includes users in office buildings, industrial facilities, restaurants, movie theaters, long-term care facilities, and hospitals. This definition is slightly different from that used in the water use permitting process. CII users typically receive water from PS utilities, but some may receive utility-supplied water for potable uses and self-supplied water for other uses (e.g., landscape irrigation, industrial processes). Larger CII users outside of a PS utility service area are more likely to be self-supplied. Industrial water uses encompass a wide variety of activities, including process water at industrial plants, dust suppression, some parts of agricultural production, and commodity manufacturing.

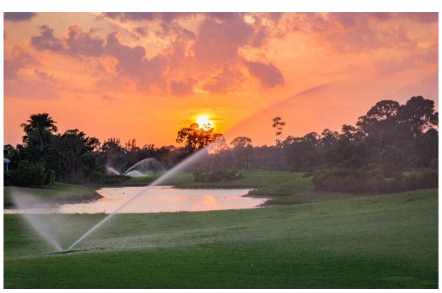
Due to the diverse use of water by industrial entities, development of water-efficiency programs can be challenging. A broad approach could seek to increase efficiency in water use areas common to most CII users, such as domestic indoor water uses and heating, ventilation, and air conditioning (HVAC) applications. Other conservation elements may only be applicable to certain operations or facility types. Specific examples include autoclaves in hospitals, food steamers in restaurants, and process water in a metal finishing plant. CII 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 (discussed below) is the first step in understanding how a facility uses water and identifying conservation opportunities that will provide the best return on investment. Conservation strategies could also target outdoor water use (irrigation) at CII facilities. There are recognition programs applicable to CII users, and funding may be available to users making efficiency upgrades at their facilities that would result in water savings. Conservation measures, practices, and programs that could be employed by CII users are presented in **Tables 2-2** to **2-4**. A glossary of conservation measures and practices is contained in the **Appendix**.

To receive a water use permit from the SFWMD, all commercial and industrial users are required to meet the regulatory criteria found in Section 2.3.2.D of the Applicant's Handbook (SFWMD 2022). In general, the requirements are to perform a water audit, develop an employee and consumer education program regarding water conservation, and provide a time frame for implementation.

Water Use Audits for Commercial and Institutional Users

To assist users conducting water use audits at commercial and institutional facilities, the SFWMD (2013) published *Water Efficiency and Self-Conducted Water Audits at Commercial and Institutional Facilities, A Guide for Facility Managers*. This guide assists facility managers through detailed, self-conducted water use assessment procedures and an evaluation of water use and conservation potential for the most common points of water use at commercial and institutional facilities. Conservation professionals are encouraged to incorporate this guide into their outreach efforts toward commercial and institutional water users. While SFWMD staff cannot conduct audits as a standing service, staff will meet with large users to help acquaint them with the guidebook and its companion water use and savings spreadsheet calculators.

Landscape/Recreational



Golf Course Irrigation

The L/R water use category includes irrigation water at parks, athletic fields, golf courses, landscaped areas (e.g., homeowners' association common areas, greenspace at commercial centers and office buildings), roadway medians, and cemeteries. Under the L/R use category, conservation is possible through implementation of Florida-Friendly Landscaping Program principles, rain or soil moisture sensors, advanced irrigation technology, proper irrigation system design and scheduling, and maintenance of automatic irrigation systems.

Irrigation systems using smart controllers (computerized controllers that use precision irrigation methods to calculate evapotranspiration and/or soil moisture) can achieve savings beyond those achieved using rain sensors and simple timer-based irrigation control systems. An estimated 30% to 40% reduction in water use can be achieved with weather-based controllers in residential settings (from a timer-based controller) if they are properly installed and programmed (Water Research Foundation 2016). Similar savings in nonresidential applications are anticipated but were not included in the evaluation.

Golf courses typically have a high degree of water use efficiency; however, opportunities to improve efficiency may exist. The Golf Course Superintendents Association of America (2021) published *Best Management Practices for the Enhancement of Environmental Quality on Florida Golf Courses* with many elements focused on efficient water use and water conservation.

Conservation measures, practices, and programs that could be employed by L/R users are presented in **Tables 2-2** to **2-4**. A glossary of conservation measures and practices is contained in the **Appendix**.

To receive a water use permit from the SFWMD, all L/R users are required to meet the regulatory criteria found in Section 2.3.2.E of the Applicant's Handbook (SFWMD 2022). In general, the requirements are to use Florida-Friendly Landscaping Program principles, where applicable; install and use rain sensors or other methods to override irrigation systems when adequate rainfall has occurred; and limit irrigation to the hours and days specified in Chapter 40E-24, F.A.C. (the Year-Round Irrigation Rule), or as allowed under local government ordinance.

Power Generation

Power Generation (PG) facilities use large quantities of water for cooling, but most of the water is returned to the source from which it was obtained; therefore, there are minimal efficiency gains to be had in the process. While minimal, indoor water use at PG facilities should be optimized by using high-efficiency water-using fixtures and equipment. Additional gains may be available using high-efficiency HVAC equipment. Conservation measures and practices that could be employed by PG users are presented in **Tables 2-2** and **2-3**. A glossary of conservation measures and practices is contained in the **Appendix**.

To receive a water use permit from the SFWMD, all PG users are required to meet the regulatory criteria found in Section 2.3.2.D of the Applicant's Handbook (SFWMD 2022). In general, the requirements are to perform a water audit, develop an employee and consumer education program regarding water conservation, and provide a time frame for implementation.

SUMMARY OF WATER CONSERVATION

Water conservation is part of the solution to meet long-term water supply needs throughout the District. Because conservation typically is less expensive to implement than developing new water sources, including expansion of treatment capacity at existing facilities, conservation should be maximized before more costly development options are implemented, regardless of water source.

Local governments and utilities are encouraged to review the programs and opportunities discussed in this chapter to help establish local conservation programs. SFWMD staff can assist local governments, utilities, and large-end users wishing to develop long-term water use efficiency programs. SFWMD assistance can include technical support, collaborative educational campaigns, ordinance review, and long-term demand management planning. Upon request, the SFWMD can provide technical assistance on water efficient technology, hardware, and practices to water users in all categories. Water conservation technical documents and educational materials can be found on the SFWMD's water conservation webpage at https://www.sfwmd.gov/conserve.

OTHER RESOURCES

The following water conservation resources 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 to conservation professionals, and offers use of its Water Conservation Tracking Tool free to members (https://allianceforwaterefficiency.org).
- **Consortium for Energy Efficiency** – Provides energy-efficient products and services, with water-efficiency crossover benefits (https://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 (https://www.energystar.gov).
- **Florida Chapter of the Golf Course Superintendents Association of America** – Promotes sustainable turf management and engages in communication and education efforts with various interested organizations and regulatory and governmental agencies (https://floridagcsa.com).
- **Florida Irrigation Society** – Promotes sound irrigation practices through awareness and education. Members include irrigation contractors, designers, and consultants as well as educators and students, equipment manufacturers and distributors, and municipalities (https://www.fisstate.org).
- **Florida Nursery, Growers, and Landscape Association** – Represents Florida's environmental horticulture industry. The association spearheads marketing programs, provides promotional and educational venues for members, and has a history of partnering with Florida's water management districts to promote water-efficient landscaping and irrigation practices (https://fngla.org).
- **Florida Section of the American Water Works Association Water Use Efficiency Division** – A division within the Technical & Education Council that assists PS utilities in implementing a cost-effective water conservation program and conforming to requirements for a water use permit (https://www.fsawwa.org).
- **Frontier Energy Food Service Technology Center** – Industry leader in commercial kitchen energy and water efficiency and appliance performance (https://frontierenergy.com/food-service-technology-center).

- **Green Industries Best Management Practices (GI-BMP)** – A program developed by UF/IFAS which provides training and certification in the Florida-Friendly Landscaping Program for landscape professionals (https://ffl.ifas.ufl.edu/ffl-and-you/gi-bmp-program).
- **Irrigation Association** – Promotes efficient irrigation technologies, products, and services. The Irrigation Association is the leading membership organization for irrigation equipment and system manufacturers, dealers, distributors, designers, consultants, contractors and end users (https://www.irrigation.org).

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3

Water Use Permitting

TOPICS
Water Use Permitting
Coordination with Water Supply Plans
Water Conservation in Water Use Permitting
Summary of Water Use Permitting

This chapter provides information related to water use permitting in the South Florida Water Management District (SFWMD or District), including statutory requirements. Water use permitting is an important part of water supply and water resource protection. Water use permitting authorizes the right to use water via a permit, while preventing harm to the water resource, including related natural systems. Harm is defined in Rule 40E-8.021, Florida Administrative Code (F.A.C.), as the temporary loss of water resource functions, as defined for consumptive use permitting in Chapter 40E-2, F.A.C., that results from a change in surface or groundwater hydrology and takes a period of 1 to 2 years of average rainfall conditions to recover. The water resource protection criteria contained in the conditions for permit issuance enumerated in Rule 40E-2.301, F.A.C., and the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (Applicant's Handbook; SFWMD 2022) include, among others, three additional mechanisms to protect water resources: 1) implementation criteria for regulatory components of an adopted minimum flow and minimum water level (MFL) prevention or recovery strategy, 2) implementation criteria for water reservations, and 3) restricted allocation area (RAA) criteria. These resource protection mechanisms are described in **Chapter 4**.

WATER USE PERMITTING

Water use, or the consumptive use of water, is any use of water that reduces the supply from which it is withdrawn or diverted. The SFWMD's water use permitting program protects the supply and quality (i.e., chlorides, turbidity) of surface water and groundwater resources by requiring permit applicants to demonstrate that their proposed use 1) is reasonable-beneficial as defined in Section 373.019, Florida Statutes (F.S.); 2) will not interfere with any existing legal use of water; and 3) is consistent with the public interest pursuant to Section 373.223(1), F.S. The SFWMD rules classify water use permits for activities, such as the following:

- Agricultural irrigation
- Golf course irrigation
- Landscape irrigation
- Nursery irrigation
- Livestock and aquaculture
- Public water supply
- Dewatering (construction and mining)
- Diversion and impoundment
- Commercial and industrial uses

Water use permits are issued by water management districts and the Florida Department of Environmental Protection (FDEP) pursuant to Chapter 373, F.S. The specific conditions of issuance are described in Section 373.223, F.S., and Chapter 40E-2, F.A.C.

Types of Water Use Permits

Presently, the SFWMD issues three types of water use permits:

- **General Permit by Rule –** For single-family/duplex landscaping, small dewatering projects, and closed-loop systems
- **Noticed General Permit –** For uses with a cumulative average daily use of less than 0.10 million gallons per day (mgd) on an annual basis that meet facility and geographic restrictions based on source
- **Individual –** For uses with a cumulative average daily use greater than 0.10 mgd on an annual basis or otherwise do not meet Noticed General Permit thresholds

A water use permit is not required for strictly domestic use at a single-family dwelling or duplex provided that the water is obtained from one withdrawal facility for each single-family dwelling or duplex. Another exemption is for water used strictly for firefighting purposes. Individual permits for more than 15 million gallons per month and Master Dewatering permits require approval from the SFWMD's Executive Director or designee. All other permits are approved by SFWMD staff.

Changes to Water Use Permitting

Water supply plans published in 2000 recommended incorporation of resource protection criteria [e.g., MFLs, water reservations, RAAs (**Chapter 4**)], level of certainty, special designations, and permit durations into water use permitting criteria. A series of rulemaking efforts was completed in September 2003, resulting in amendments to various rules, including Chapters 40E-1, 40E-2, 40E-5, 40E-8, and 40E-21, F.A.C. Among the most notable changes were amendments to permit duration, permit renewal, wetland protection, supplemental irrigation requirements, saline water intrusion, aquifer storage and recovery, and model evaluation criteria.

In 2011, the FDEP led a statewide initiative to improve consistency in the water use permitting programs implemented by the state's five water management districts. The initiative resulted in changes to the SFWMD water use permitting rules and criteria, which became effective in 2014 and are listed in the Applicant's Handbook. The Applicant's Handbook was updated in 2022 to incorporate new criteria for the Kissimmee River and Chain of Lakes water reservations as well as the Everglades Agricultural Area Reservoir water reservation.

In addition, the FDEP completed rulemaking for the Central Florida Water Initiative (CFWI) in January 2022. The CFWI is a collaborative water supply planning process involving the FDEP, the St. Johns River Water Management District, the South Florida Water Management District, the Southwest Florida Water Management District, the Florida Department of Agriculture and Consumer Services, regional water utilities, and other stakeholders. The CFWI Planning Area includes all of Orange, Osceola, Polk, and Seminole counties and southern

Lake County. Section 373.0465, F.S., directs the FDEP to adopt uniform rules for application within the CFWI Planning Area. Rules 62-41.300 through 62-41.305, F.A.C., and the *Central Florida Water Initiative Supplemental Applicant's Handbook* (CFWI 2022) provide a uniform regulatory framework to allow for the allocation of available groundwater in the area, subject to avoidance and mitigation measures to prevent harm. This regulatory framework is one component of a comprehensive joint water management strategy for regional water resource management that also includes regional water supply planning, alternative water supply project funding, and water resource investigations and analyses. These rules apply to consumptive use permit applicants in the CFWI Planning Area and supersede portions of Chapters 40C-2, 40D-2 and 40E-2, F.A.C., regulating the consumptive use of water in the CFWI Planning Area.

Permitting Criteria

As stated above, to obtain a water use permit, a permit applicant must provide assurances the requested use is reasonable-beneficial, will not interfere with any existing legal use of water, and is consistent with the public interest, pursuant to Section 373.223, F.S. As part of the reasonable-beneficial use test, relevant portions of the state Water Resource Implementation Rule (Chapter 62-40, F.A.C.), adopted by the FDEP, must be reviewed and addressed. The SFWMD implements this test pursuant to rules adopted in Chapter 40E-2, F.A.C., and the criteria in the Applicant's Handbook (SFWMD 2022). Permits are written to ensure uses are consistent with the overall objectives of the District and are not harmful to the water resources of the area (Section 373.219, F.S.).

Considerations for issuance of a water use permit include impact evaluation criteria that establish the hydrologic change that can occur without causing harm. For the purposes of water use permit applications, SFWMD staff consider water resource availability, the potential for harm (Chapter 40E-8, F.A.C.), and other environmental considerations:

- Saline water intrusion
- Wetland and other surface water body drawdown
- Pollution movement
- Impacts to off-site land uses
- Use of lowest-quality water available
- Interference with existing legal uses
- MFLs
- Water reservations
- RAAs

Detailed criteria concerning proposed water uses and evaluation of potential impacts are contained in Section 3.0 of the Applicant's Handbook (SFWMD 2022).

The SFWMD water use permitting rules and criteria require a water conservation plan or program to be submitted at the time of permit application for public water supply, commercial, industrial, power plant, and landscape and golf course irrigation projects. Further information about conservation efforts is provided later in this chapter and in **Chapter 2**.

In addition to water conservation requirements, the SFWMD water use permitting rules and criteria require consideration of the lowest quality of water available for the intended use when applying for a new water use permit, permit renewal, or modification of an existing permit. If a source of water of lower quality is available and feasible to meet all or a portion of the demand, it must be used in place of traditional sources, such as fresh groundwater or surface water. Lower-quality water may include reclaimed water, recycled irrigation water return flow, captured stormwater, or saline water. Water use permit applicants with projects located within a mandatory reuse zone and all applicants requesting allocations greater than 0.10 mgd must evaluate the feasibility of using reclaimed water, in accordance with the reuse requirements in Section 2.2.4.B of the Applicant's Handbook (SFWMD 2022).

The level-of-certainty planning goal established in Section 373.709, F.S., is a 1-in-10-year drought event. To be consistent, the SFWMD implemented the level-of-certainty planning goal in its water use permitting program. Permit applicants must demonstrate the conditions for issuance of a permit are satisfied during 1-in-10-year drought conditions. Demands are calculated, assuming 1-in-10-year drought conditions for relevant uses (e.g., public water supply and agriculture, landscape and recreational irrigation), and impacts resulting from a proposed withdrawal are analyzed.

Permit Duration and Renewal

Water use permits typically are issued for a period of 20 years unless circumstances warrant a shorter or longer permit duration. For example, permits for new uses of water, increased allocations, or from a source of limited availability often have a duration of 5 years. If an application for renewal is submitted before the permit expiration date, the existing permit remains in effect until the pending application is processed. Some permits, depending on allocation and site-specific conditions, may require compliance monitoring and reporting, which may include calibrated pumpage, wetland monitoring, saline water monitoring, water level monitoring, 10-year compliance reports, or other project-specific limitations.

COORDINATION WITH WATER SUPPLY PLANS

Water supply plans require significant coordination during plan development to address the many areas of water management (e.g., planning, permitting, restoration, science). The importance of this coordination is underscored by a 2012 FDEP memorandum to the water management districts that provides guidance on improving linkages between regional water supply plans and consumptive use permitting. Key objectives in the memorandum include ensuring that water supply projects identified in the regional water supply plans have a likelihood of being permittable and that staff would have knowledge of these projects to facilitate permitting. By increasing internal coordination during the water supply planning process, both planning and permitting staff are more familiar with proposed projects and able to facilitate the permitting process.

In the SFWMD, proposed projects for each water supply plan are screened by water supply planning and water use permitting staff to determine if a proposed project is likely to be permittable by using the following set of questions:

- Does the proposed project use a source of limited availability?
- Is the project located in an RAA?
- Is the proposed source an MFL water body or is it connected, directly or indirectly, to an MFL water body? If yes, is the proposed use consistent with the MFL prevention or recovery?
- 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, saline water intrusion, pollution, MFLs)?
- Have existing legal users of the same source had resource-related compliance issues?
- Have any new technical studies been completed related to source availability?

Each proposed use of water must meet the conditions for permit issuance found in Section 373.223, F.S., and the implementing rules found in Chapter 40E-2, F.A.C. Water use permits typically are required for water supply development projects, which are outlined in each regional water supply plan update. Permitting requirements (and exemptions) are found in Section 373.219, F.S.; Rule 40E-2.051, F.A.C.; and the Applicant's Handbook (SFWMD 2022).

The availability of water from some surface water and groundwater sources is restricted due to existing water demands, source limitations, and resource issues (e.g., saline water intrusion, environmental needs, and aquifer protection criteria). New or increased allocations from these sources will be evaluated on an application-by-application basis to determine if the proposed use meets water use permitting criteria. The permitting of small volumes from these sources may be feasible given local conditions, reductions in historical water use, and availability of new resources.

WATER CONSERVATION IN WATER USE PERMITTING

Water conservation measures and practices are required for a proposed or continued use to meet the conditions of permit issuance for all water use permits in the SFWMD. Specifically, water use permitting criteria in Section 2.3.2 of the Applicant's Handbook (SFWMD 2022) require a conservation plan or program at the time of permit application for commercial, industrial, power plant, and landscape/recreational use categories and a standard or goal-based conservation plan for public water supply uses. More information about statewide and Districtwide conservation programs and objectives are provided in **Chapter 2**.

Public Supply

All applicants for a public water supply water use permit are required to develop and implement a standard or goal-based water conservation plan as described in Sections 2.3.2.F.1.a and 2.3.2.F.1.b, respectively, of the Applicant's Handbook (SFWMD 2022) that maintains or increases overall utility-specific water conservation effectiveness. For standard water conservation plans, permit applicants are required to implement the following five elements, as necessary, to achieve efficient use to the extent economically, environmentally, and technically feasible:

1) A water conservation public education program
2) An outdoor water use conservation program
3) Selection of a rate structure designed to promote efficient use
4) A water loss reduction program, if required
5) An indoor water conservation program

The water conservation plan is subject to the schedule and reporting requirements specified in the permit. If implementation of the plan fails to demonstrate progress toward increasing water use efficiency, the permittee can request a permit modification, if necessary, to revise the plan to address the deficiency in accordance with Section 2.3.2.F.1 of the Applicant's Handbook (SFWMD 2022). Permittees can extend the duration of their permit based on quantifiable savings attributed to water conservation.

Public supply utilities may propose a goal-based water conservation plan in lieu of a standard water conservation plan. A goal-based plan allows a permit applicant to select plan elements that differ from the standard plan but are appropriate to the applicant's service area. If any standard plan elements are not included, the applicant must provide reasonable assurances that the alternative elements will achieve effective conservation at least as well as the standard plan. A goal-based water conservation plan must contain the following:

- A description of water conservation measures selected, including an implementation schedule for each measure
- An explanation of why the alternative elements are appropriate to achieve effective water conservation in the applicant's service area if any of the five elements of the standard water conservation plan are not selected

Agriculture

Conservation measures specific to the agricultural use type generally focuses on the irrigation system. Standard irrigation systems include microirrigation, overhead sprinkler, and flood/seepage irrigation. In order to demonstrate a reasonable-beneficial demand, for certain crops such as citrus and container nurseries, water use permit applicants are required to use microirrigation or other systems of equivalent efficiency for new uses. The irrigation method should be matched to the specific needs of each crop type. This rule applies to all initial consumptive use applicants whose irrigation systems are not constructed. Flood/seepage irrigation systems typically are used for small vegetables, corn, rice, and sugarcane production.


Drip Irrigation

Commercial/Industrial/Power Plants

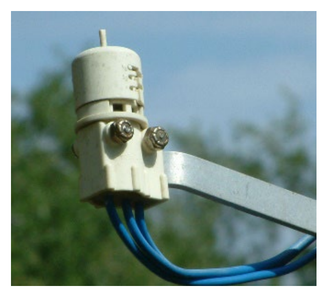
Similar to public water supply, all commercial, industrial, and power plant water use permit applicants are required to submit a water conservation plan to the SFWMD at the time of permit application. Water conservation plans for commercial, industrial, and power plant permit applicants must include the following:

- An audit of water use
- An implementation plan for water conservation measures if found to be cost effective during the audit, including leak detection/repair programs, recovery/recycling, and processes to reduce water consumption
- An employee awareness and consumer education program concerning water conservation
- Procedures and time frames for implementation of tasks

A well-planned and scheduled audit program is a prerequisite for improving and sustaining water use efficiency in an industrial or commercial facility. A water use audit or assessment is a systematic review of all water consumption from point of entry to discharge. A comprehensive audit examines historical water use, identifies on-site water sources and potential opportunities for reducing unnecessary water use, measures or calculates all on-site water consumption, detects leaks, and calculates a facility's true cost of water.

Landscape/Recreational

Applicants for landscape and golf course projects are required to develop a conservation plan and submit it with the permit application. The plan must include the following:



Rain Sensor

- Use of Florida-Friendly Landscaping Program principles for new or modified projects
- Installation and use of rain sensor devices, automatic switches, or other automated mechanisms that can override operation of the irrigation system when adequate rainfall has occurred
- Limitations to irrigation hours to comply with local government ordinances

SUMMARY OF WATER USE PERMITTING

Water use permitting is an important resource protection tool as it prevents harm to water resources, including related natural systems. The SFWMD's water use permitting program protects water supply and quality by requiring permit applicants to demonstrate that their proposed use meets the conditions discussed in this chapter. Many factors are considered when reviewing permit applications, including source limitations, existing legal users, and regulatory protection criteria. Additionally, water conservation practices must be included as part of the permit.

REFERENCES

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4

Water Resource Protection

TOPICS
Water Resource Protection Standards
Natural Systems Protection
Summary of Water Resource Protection

Florida's Water Resource Implementation Rule, Chapter 62-40, Florida Administrative Code (F.A.C.), outlines specific factors to consider when protecting natural systems, including protection of natural seasonal changes in water flows or levels, water levels in aquifer systems, and environmental values associated with aquatic and wetland ecology. Water resource protection standards use regulatory mechanisms, such as water use permitting (**Chapter 3**), minimum flows and minimum water levels (MFLs), water reservations, and restricted allocation areas (RAAs), to protect natural system water (i.e., wetlands, rivers, lakes, estuaries, and aquifers) from being allocated for consumptive use in quantities that are harmful.

WATER RESOURCE PROTECTION STANDARDS

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 pursuant to Section 373.016(3)(d), F.S. The South Florida Water Management District (SFWMD or District) developed water resource protection standards consistent with legislative direction that are implemented to prevent various levels of harm (no harm, harm, significant harm, and serious harm). Each standard plays a role in achieving sustainable water resources. For instance, programs regulating surface water management and water use permitting must prevent harm to the water resource, including related natural systems. **Figure 4-1** represents the conceptual relationship among water resource protection tools and standards, observed impacts, and water shortage severity.

WATER RESOURCE PROTECTION STANDARDS

The terms harm, significant harm, and serious harm are defined in Rule 40E-8.021, F.A.C., and apply throughout the SFWMD's water use permitting rules. The definitions are as follows:

Harm – The temporary loss of water resource functions, as defined for consumptive use permitting in Chapter 40E-2, F.A.C., that results from a change in surface or groundwater hydrology and takes a period of 1 to 2 years of average rainfall conditions to recover.

Significant Harm – The temporary loss of water resource functions, resulting from a change in surface or groundwater hydrology, that takes more than 2 years to recover but which is considered less severe than serious harm. The specific water resource functions addressed by an MFL and the duration of the recovery period associated with significant harm are defined for each priority water body based on the specific MFL's technical support document. Detailed information about MFLs is available on the SFWMD webpage http://www.sfwmd.gov/mfls.

Serious Harm – The long-term loss of water resource functions, as addressed in Chapters 40E-21 and 40E-22, F.A.C., resulting from a change in surface or groundwater hydrology.

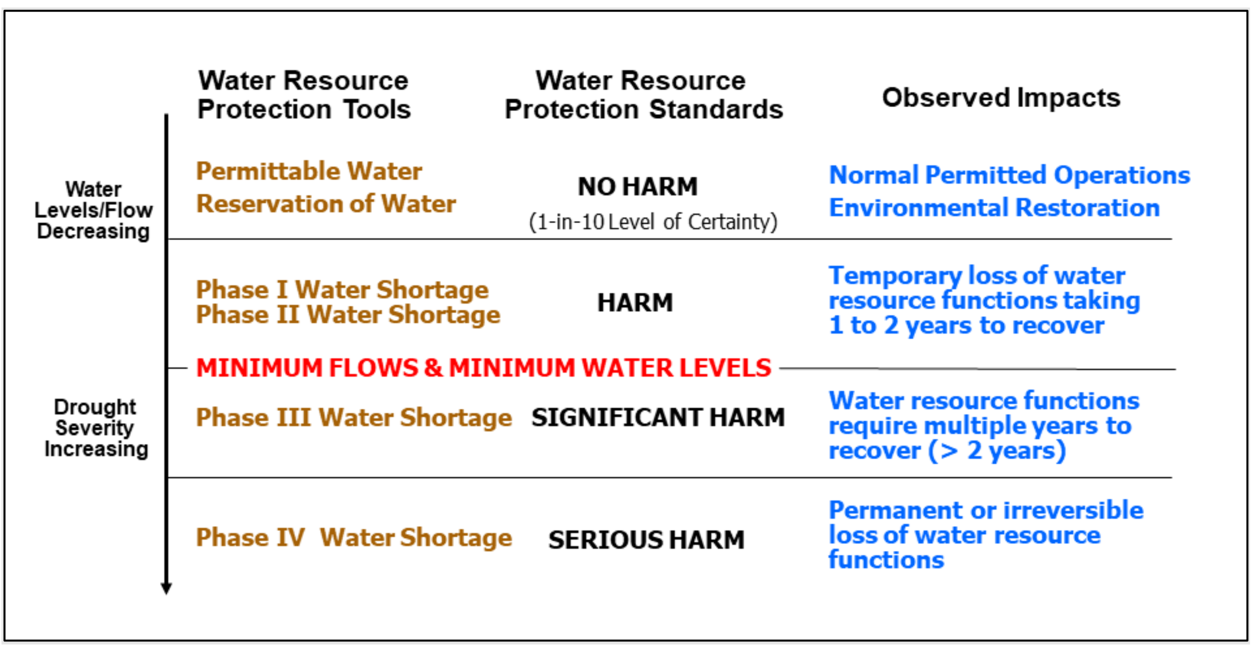


Figure 4-1. Conceptual relationship among water resource protection standards at various levels of water resource harm (Modified from Rule 40E-8.421, F.A.C.).

Resource Protection Tools	
Water Use Permitting (**Chapter 3**)	Unless exempt by statute or identified in the Water Rights Compact of 1987, 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 Rule 40E-2.301, 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 2022). Potential impacts from the use of water proposed in a water use permit application are evaluated to prevent the following: • Saline water intrusion • Wetland and other surface water body impacts • Pollution movement • Impacts to off-site land uses • Interference with existing legal users • Violation of regulatory components of MFLs • Exceedance of water resource availability
Minimum Flows and Minimum Water Levels (MFLs)	MFL criteria are flows or water 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 simultaneously adopt a prevention or recovery strategy pursuant to Section 373.0421, F.S. and Subsection 62-40.473(5), F.A.C.
Water Reservations	A water reservation sets aside a volume of water for the protection of fish and wildlife or public health and safety (Section 373.223, F.S.). Reserved volumes of water are unavailable for allocation to consumptive uses. However, any unreserved volumes of water may be certified as available and allocated to consumptive uses. Water reservations are developed based on existing water availability or in consideration of future water supplies made available by water resource development projects. The Water Resources Development Act of 2000 and Section 373.470(3)(c), F.S., require the SFWMD to legally allocate or reserve the increase in water supplies resulting from a Comprehensive Everglades Restoration Plan (CERP) project before execution of a cost-share agreement with the United States Army Corps of Engineers (USACE) to construct the project. Detailed information about water reservations is available on the SFWMD webpage http://www.sfwmd.gov/reservations.
Restricted Allocation Areas (RAAs)	RAA criteria are established by rule for specific sources where there are water resource limitations. RAA criteria established for specific sources or areas of the SFWMD are listed in Section 3.2.1 of the Applicant's Handbook (SFWMD 2022), which is incorporated by reference in Rule 40E-2.091, F.A.C. Detailed information about RAAs is available on the SFWMD webpage http://www.sfwmd.gov/raas.
Water Shortage	Water shortages are declared by the District's Governing Board when available groundwater or surface water is insufficient to meet user needs or when conditions require temporary reductions in total use to protect the resource from serious harm. The SFWMD's Water Shortage Plan and regional water shortage plans are contained in Chapters 40E-21 and 40E-22, F.A.C. The water shortage plans 1) ensure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social, and health-related impacts; 2) provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and 3) promote greater security for water use permittees.

NATURAL SYSTEMS PROTECTION

The overall goal of Chapter 373, F.S., is to ensure the sustainability of water resources in Florida (Section 373.016, F.S.). Chapter 373, F.S., provides Florida's water management districts with the authority to develop and adopt MFLs, water reservations, and RAAs.

Minimum Flows and Minimum Water Levels

MFLs in the SFWMD are defined and adopted by rule in Chapter 40E-8, F.A.C. MFLs are flows or levels at which water resources, or the ecology of the area, would experience significant harm (as defined above) from further withdrawals. An MFL exceedance occurs when the water level or flow falls below the MFL for longer than the specified duration as defined in Subsection 40E-8.021(17), F.A.C. An MFL violation occurs when an MFL exceedance happens more often than the identified return frequency. In natural systems, MFLs should not be exceeded unless rainfall amounts reach 1-in-10-year drought conditions.

When developing and adopting MFLs, the District's Governing Board considers changes and structural alterations to watersheds, surface water bodies, and aquifers as well as the effects such changes or alterations have had and the constraints such changes or alterations have placed on the hydrology of an affected watershed, surface water body, or aquifer (Section 373.0421, F.S.).

The SFWMD continues to fulfill its statutory obligation to identify key water bodies for which MFLs should be developed or re-evaluated. Each water management district must provide an annual Priority Water Body List and Schedule for development of MFLs and water reservations to the Florida Department of Environmental Protection in accordance with Section 373.042(3), F.S. The SFWMD's priority list is available in the annual updates to Chapter 3 of the *South Florida Environmental Report – Volume II*, available at http://www.sfwmd.gov/sfer. The priority list is based on the importance of the water bodies to the state or region and the existence of, or potential for, significant harm to the water resources or ecology of the state or region and includes water bodies that are experiencing or may reasonably be expected to experience adverse impacts.

As of 2025, nine MFLs have been adopted for water bodies in the SFWMD (**Figure 4-2**). Additional information about each MFL is provided in the most recent applicable regional water supply plan update.

- Biscayne Aquifer
- Caloosahatchee River
- Everglades (water conservation areas 1 to 3, freshwater portion of Everglades National Park, and Rotenberger and Holey Land wildlife management areas)
- Florida Bay
- Lake Istokpoga
- Lake Okeechobee
- Lower West Coast Aquifers (Lower Tamiami, Sandstone, and Mid-Hawthorn)
- Northwest Fork of the Loxahatchee River
- St. Lucie Estuary

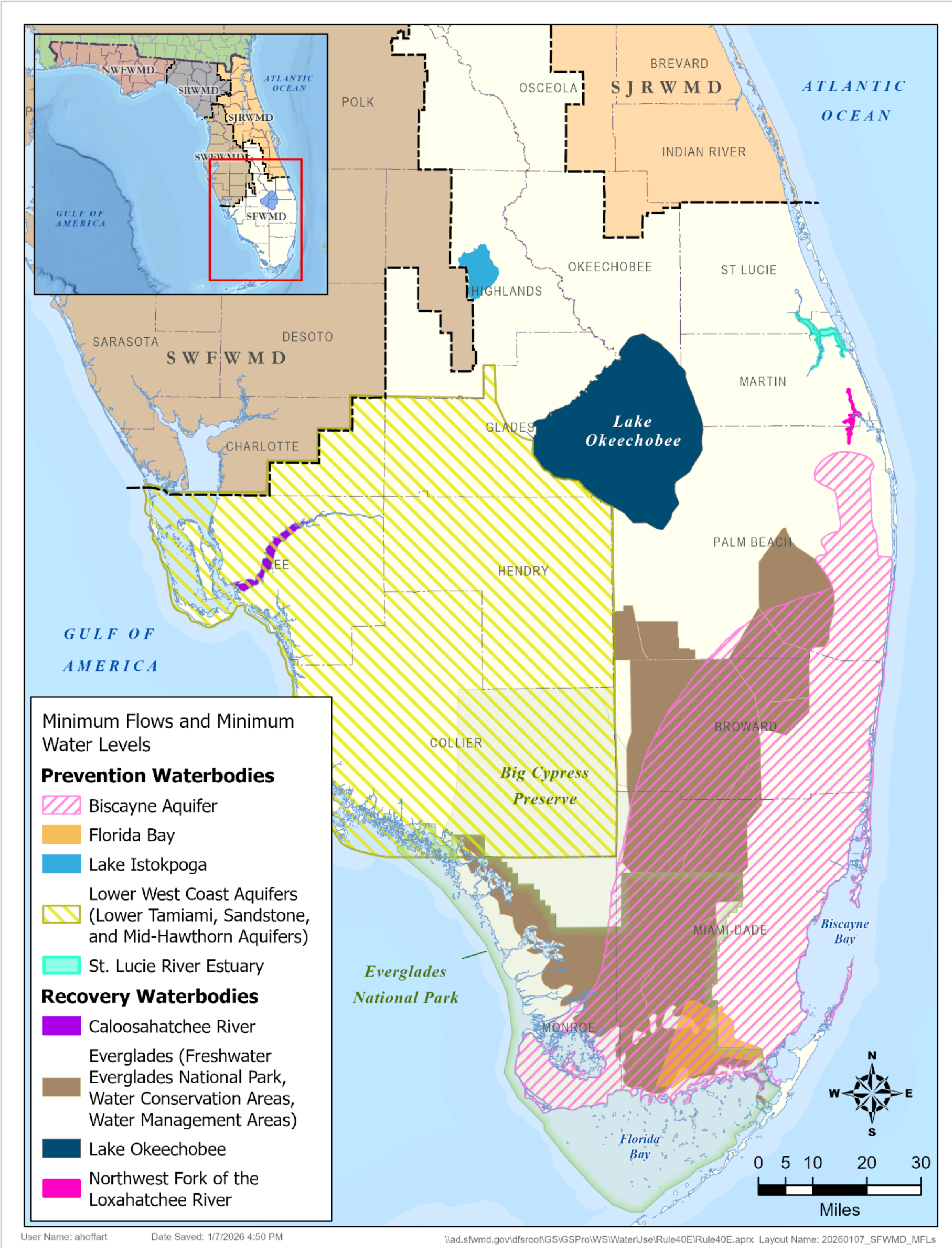


Figure 4-2. Minimum flow and minimum water level (MFL) water bodies within the South Florida Water Management District.

INFO

MFL water bodies approaching their MFL threshold criteria are factors the District's Governing Board considers when contemplating water shortage restrictions. The District's Governing Board may impose water shortage restrictions (see *Water Shortage Rules* section) if an MFL exceedance occurs, or is projected to occur, during climatic conditions more severe than a 1-in-10-year drought, to the extent consumptive uses contribute to such exceedance.

MFL Prevention and Recovery Strategies

Water management districts must adopt and implement a prevention or recovery strategy for water bodies with flows or levels that are below, or are projected to fall below within 20 years, the adopted MFL criteria (Section 373.0421, F.S.). Analyses of current and future conditions are conducted for each water body for which MFL criteria are defined. The SFWMD adopts prevention and recovery strategies when the MFL is initially adopted (Rule 40E-8.421, F.A.C.) and, where needed, when an MFL is re-evaluated or revised.

- Prevention strategies are developed when MFL criteria are not currently violated but are projected to be violated within 20 years of the establishment of the MFL as described in Subsection 40E-8.021(24), F.A.C. The goal of a prevention strategy is to continue to meet the adopted MFL criteria over the next 20-year planning horizon.

- Recovery strategies are developed when MFL criteria are currently violated as described in Subsection 40E-8.021(25), F.A.C. The goal of a recovery strategy is to achieve the adopted MFL as soon as practicable.

Regional water supply plans must contain prevention and recovery strategies needed to achieve compliance with MFLs adopted for priority water bodies in the planning area (Section 373.709, F.S.). MFL prevention and recovery 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. The phasing or timetable for each project must be included in the strategy. Section 373.0421(2)(b), F.S. provides the following:

> *The recovery or prevention strategy must include a phased-in approach or a timetable which 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 concurrent with and, to the maximum extent practical, to offset reductions in permitted withdrawals, consistent with this chapter.*

Prevention and recovery and strategies must include development of additional water supplies and other actions, consistent with authority granted in Section 373.0421, F.S. These consist of multiple components, including capital projects, regulatory measures and requirements, water shortage measures, environmental projects, and research and monitoring. Additionally, the strategy must include a phased-in approach or a timetable that allows 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 to offset reductions, to the maximum extent practical, in permitted withdrawals.

TOOLS

MFL Prevention and Recovery Strategy Components	
Capital Projects	Capital projects include the planning, design, permitting, and construction of features to provide water to meet MFL criteria. The scale of these projects can range from relatively simple water control structures or conveyance improvements to large, regionally important features, such as reservoirs, water preserve areas, or wetlands. Many of these projects are established through cost-share agreements or other partnerships among multiple agencies to provide funding and direction that would be impossible for a single agency to support.
Regulatory Measures and Requirements	Regulatory criteria may be adopted as part of an MFL prevention or recovery strategy. When a recovery strategy has been adopted for an MFL water body, existing permitted allocations will not be modified or revoked prior to permit expiration unless the permitted use changes or a new or alternative source is in place and operating to supply the water historically provided from the MFL water body. For new, renewed, and modified water use permit applications, applicants are required to comply with all conditions of issuance. The rules implementing water resource protection tools, including Chapters 40E-2 and 40E-8, F.A.C., and Section 3.9 of the Applicant's Handbook (SFWMD 2022), identify the specific criteria and constraints that will be applied to evaluate consumptive uses proposing to withdraw from MFL water bodies.
Water Shortage Measures	The SFWMD may impose water shortage restrictions to curb water use withdrawals pursuant to Sections 373.175 and 373.246, F.S. The SFWMD implements its water shortage authority by equitably distributing available water resources among all water users, which includes consideration of the water resources (Chapters 40E-21 and 40E-22, F.A.C.). Under this program, different phases of water shortage restrictions with varying levels of cutbacks are imposed relative to drought conditions. The four phases of water shortage restrictions are based on progressively increasing resource impacts leading up to serious harm. Adopted MFLs are considered in the evaluation of current water conditions as described in Paragraph 40E-21.221(3)(d), F.A.C. and as one of the criteria for imposing water use restrictions as described in Paragraph 40E-21.271(3)(d), F.A.C. Consistent with Section 373.0421(2), F.S., Chapter 40E-8, F.A.C., does not solely rely on water shortage restrictions for MFL prevention or recovery strategies. However, when a drought occurs, the SFWMD relies on the water shortage plan of Chapter 40E-21, F.A.C., as needed to address regional system water availability. To the extent practicable, the SFWMD attempts to implement water deliveries from Lake Okeechobee to reduce or prevent MFL criteria from being exceeded. Approved adaptive protocols for Lake Okeechobee operations provide guidance to water managers for implementation of discretionary water supply deliveries for ecosystem and other benefits when the lake stage is in the low, base flow, and beneficial use sub-bands, as identified in the *Final Adaptive Protocols for Lake Okeechobee Operations* (SFWMD 2010).
Environmental Projects and Other Research and Monitoring	Operational protocols and habitat enhancement projects are implemented to improve flows and levels, mitigate impacts from flow or level extremes, and protect key habitats. Periodic assessment of flows and levels, vegetation and infauna population monitoring, and other research and monitoring may be included to assess the effects of MFLs and ensure sufficient water is available from the regional system to meet the MFLs.

Water Use Permitting Criteria for MFLs

Lake Okeechobee Everglades Agricultural Area

Unless exempt by statute or identified in the Water Rights Compact of 1987, 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. Water use permit applicants must provide reasonable assurances that the proposed water use 1) is reasonable-beneficial as defined in Section 373.019 F.S.; 2) will not interfere with any existing legal use of water; and 3) is consistent with the public interest pursuant to Section 373.223(1), F.S. The conditions of permit issuance are more specifically enumerated in Rule 40E-2.301, F.A.C. The proposed water use must also comply with the water resource protection criteria contained in the Applicant's Handbook (SFWMD 2022).

As discussed in **Chapter 3**, as a condition of permit issuance, water use permitting rules require an applicant to provide reasonable assurances that a proposed use of water is in accordance with any MFL and implementation strategy established pursuant to Sections 373.042 and 373.0421, F.S., as stated in Paragraph 40E-2.301(1)(i), F.A.C. Applications for water use are reviewed based on the prevention or recovery strategy approved at the time of permit application review.

Rule 40E-8.021, F.A.C., identifies two categories of impact criteria: direct withdrawals and indirect withdrawals from the MFL water body. Each category is considered in the review of a permit application. Direct withdrawals are those from surface water facilities physically located within the boundaries of an MFL surface water body or groundwater withdrawals that cause a water table drawdown greater than 0.1 foot at any location beneath the MFL surface water body or aquifer, up through a 1-in-10-year drought. Indirect withdrawals are from a water source for a consumptive use that receives surface water or groundwater from or is tributary to an MFL water body. The Applicant's Handbook (SFWMD 2022) describes evaluation criteria for permit renewals and new or modified permits for water bodies subject to an MFL prevention or recovery strategy.

Water Reservations

Regional water supply plans must list the water resource development projects that support water supply development for all existing and future reasonable-beneficial uses and natural systems as identified in the adopted water reservations (Section 373.709, F.S.). Water reservations in the SFWMD are defined and adopted by rule in Chapter 40E-10, F.A.C. A water reservation sets aside a volume of water for the protection of fish and wildlife or public health and safety. Water reservations are developed based on existing water availability or in consideration of future water supplies made available by water resource development projects. Reserved volumes of water are unavailable for allocation to consumptive uses (Section 373.223, F.S.). Water reservations do not 1) establish operating regimes,

2) drought-proof natural systems, 3) ensure wildlife proliferation, 4) prevent the use of unreserved water or water allocated in consumptive use permits, or 5) improve water quality. Additionally, water reservations may be components of MFL prevention or recovery strategies and be adopted to protect water for Comprehensive Everglades Restoration Plan (CERP) projects prior to their construction (see *Water Reservations and RAAs for CERP Projects* section).

Pursuant to Section 373.223(4), F.S., the quantification of the water to be reserved can include a seasonal component and a location component. In quantifying water to be reserved, existing legal uses of water are protected as long as they are not contrary to public interest. The District's Governing Board has the authority to make this determination. Reasonable assurances are provided for existing legal users as cited in Section 373.1501(6)(d), F.S.:

> *Consistent with this chapter, the purposes for the restudy provided in the Water Resources Development Act of 1996, and other applicable federal law, provide reasonable assurances that the quantity of water available to existing legal users shall not be diminished by implementation of project components so as to adversely impact existing legal users, that existing levels of service for flood protection will not be diminished outside the geographic area of the project component, and that water management practices will continue to adapt to meet the needs of the restored natural environment.*

Fakahatchee Estuary

Chapter 40E-10, F.A.C., defines the quantity, location, and timing of waters reserved from allocation in accordance with Section 373.223(4), F.S. As of 2025, seven water reservations have been adopted for water bodies within the District (**Figure 4-3**). Additional information about each water reservation is provided in the most recent applicable regional water supply plan update.

- Caloosahatchee River C-43 West Basin Storage Reservoir
- Everglades Agricultural Area Reservoir (A-2 Reservoir)
- Fakahatchee Estuary
- Kissimmee River and Chain of Lakes
- North Fork of the St. Lucie River
- Nearshore Central Biscayne Bay
- Picayune Strand

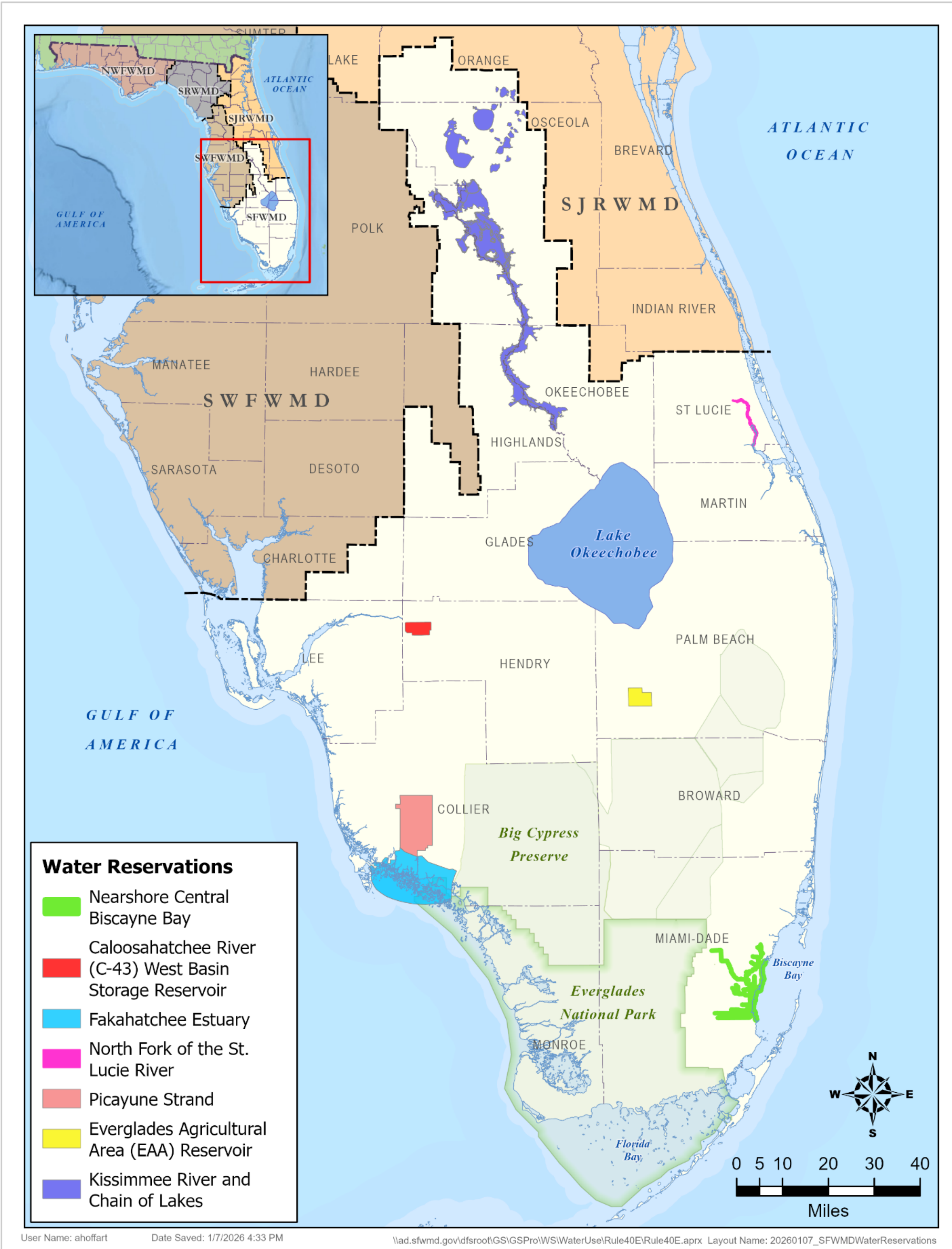


Figure 4-3. Water reservation water bodies within the South Florida Water Management District.

Restricted Allocation Areas

RAAs are defined geographic areas where utilization of specific water supply sources (e.g., lakes, rivers, wetlands, canals, aquifers) is restricted due to concerns regarding water availability. RAAs are adopted for a variety of reasons, including 1) where there is insufficient water to meet the projected needs of a region, 2) to protect water for natural systems and future restoration projects (e.g., CERP), or 3) as part of MFL prevention or recovery strategies. RAAs are listed in Section 3.2.1 of the Applicant's Handbook (SFWMD 2022), which is incorporated by reference in Rule 40E-2.091, F.A.C. Water allocations beyond the criteria listed in the Applicant's Handbook are restricted or prohibited.

As of 2025, eight RAAs have been adopted for the following geographic areas within the District (**Figure 4-4**). Additional information about each RAA is provided in the most recent applicable regional water supply plan update.

- C-18W Reservoir Aquifer Storage and Recovery Groundwater Buffer Zone
- C-23, C-24, and C-25 Canal System
- Floridan Aquifer Wells in Martin and St. Lucie Counties
- L-1, L-2, and L-3 Canal System
- Lake Istokpoga/Indian Prairie Canal System
- Lake Okeechobee and Lake Okeechobee Service Area
- Lower East Coast Everglades Waterbodies
- North Palm Beach County/Loxahatchee River Watershed Waterbodies

Loxahatchee River

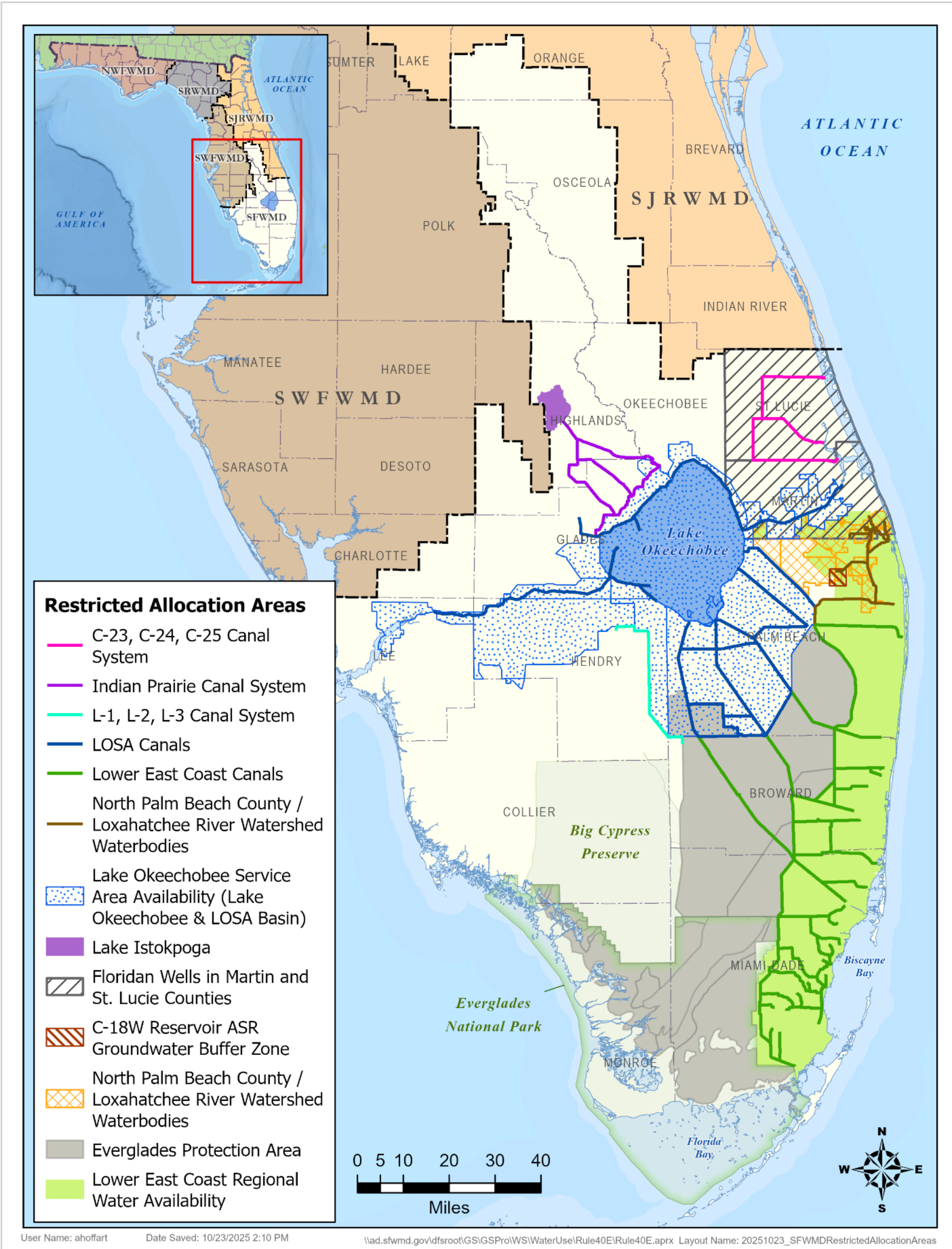


Figure 4-4. Water bodies with adopted restricted allocation area (RAA) criteria within the South Florida Water Management District.

Water Reservations and RAAs for CERP Projects

The Water Resources Development Act of 2000 and Section 373.470(3)(c), F.S., require the SFWMD to allocate or reserve the increase in water supplies resulting from a CERP project before executing a cost-share agreement with the United States Army Corps of Engineers (USACE) to construct the project. The SFWMD fulfills this requirement by adopting water reservation and/or RAA rules. The USACE then verifies that the federal requirements are met. Together, these measures protect water resources across substantial portions of the District. Any water made available by a CERP project beyond that needed for the natural system may be certified by the District's Governing Board as available and allocated to consumptive uses to meet the CERP goal of water made available for other water-related uses.

Water Shortage Rules

Water shortages are declared by the District's Governing Board to prevent serious harm from occurring to water resources, including related natural systems (Sections 373.175 and 373.246, F.S.). Serious harm is defined as the long-term loss of water resource functions resulting from a change in surface water or groundwater hydrology pursuant to Subsection 40E-8.021, F.A.C. (**Figure 4-1**).

Drought Conditions

The water shortage plans described in Chapters 40E-21 and 40E-22, F.A.C., are applied to manage water use when insufficient groundwater or surface water is available to meet user needs or when conditions require temporary water use reduction. Chapter 40E-22, F.A.C., contains regional water shortage plans and restrictions related to specific water bodies. The water shortage plans 1) ensure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social, and health-related impacts; 2) provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and 3) promote greater security for water use permittees.

SUMMARY OF WATER RESOURCE PROTECTION

Projects and programs to protect and restore natural resources are essential to ensuring an adequate supply of water for natural systems. Natural systems protection efforts also involve resource protection criteria or standards to protect the water resources necessary for the sustained health of a natural system. Various scientific, policy, and legal tools are used to protect water supplies for the needs of natural systems, as well as water supply regulatory programs which protect, enhance, mitigate, and monitor wetlands and water resources.

NAVIGATE

Detailed information about MFLs is available on the SFWMD webpage at http://www.sfwmd.gov/mfls.

Detailed information about water reservations is available on the SFWMD webpage at http://www.sfwmd.gov/reservations.

Detailed information about RAAs is contained in the Applicant's Handbook (SFWMD 2022), which can be accessed through the SFWMD webpage http://www.sfwmd.gov/raas.

MFL, water reservation, and RAA status updates are provided annually in Chapter 3 of the *South Florida Environmental Report – Volume II*, available at http://www.sfwmd.gov/sfer. Additional updates can be found in the most recent applicable regional water supply plan update.

REFERENCES

SFWMD. 2010. *Final Adaptive Protocols for Lake Okeechobee Operations*. Developed in cooperation with the United States Army Corps of Engineers, Jacksonville, FL, and the Florida Department of Environmental Protection, Tallahassee, FL. South Florida Water Management District, West Palm Beach, FL. September 2010.

SFWMD. 2022. *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District*. South Florida Water Management District, West Palm Beach, FL. June 2022.

5

Ecosystem Restoration and Water Resource Development

TOPICS
Ecosystem Restoration
Districtwide Water Resource Development Projects
Summary of Ecosystem Restoration and Water Resource Development

When discussing natural systems or ecosystem programs and projects, protection and restoration activities often are connected. Generally, natural systems protection efforts involve resource protection criteria or standards to protect the water resources necessary for the sustained health of a natural system, whereas restoration efforts focus on recovering the original characteristics of an ecosystem. This chapter discusses ecosystem restoration and water resource development projects that occur throughout the South Florida Water Management District (SFWMD or District) and often cross planning area boundaries. General resource protection criteria are addressed in **Chapter 4**, and specific resource protection projects are described in the applicable regional water supply plans.

ECOSYSTEM RESTORATION

Changes in South Florida's hydrology and habitats over the past century have caused degradation of a vital subtropical wetland system. Because of development and drainage in the Greater Everglades, the right quantity and quality of water is not always available during dry periods for both the environment and the human population. Conversely, in wet times, a lack of storage capacity, natural or man-made, often causes damaging flooding in the Everglades and coastal estuaries.

The SFWMD takes a systemwide approach to protecting and restoring the Southern and Northern Everglades. These interdependent ecosystems originate in Central Florida near metropolitan Orlando and stretch southward to the coastal estuaries and bays of South Florida. Restoration scientists, planners, and engineers plan to recover many of the original characteristics of the Everglades that would allow the Everglades to function as a cohesive ecosystem. Such characteristics include interconnected wetlands, low concentrations of nutrients in freshwater wetlands, sheetflow, healthy and productive estuaries, hardy native plant communities, and an abundance of native wetland flora and fauna.

There are several separate restoration efforts under way throughout the District. Some projects are related under the umbrella of a larger restoration program (e.g., the South Florida Ecosystem Restoration Program). Projects in the Everglades require involvement from federal and state partners such as the United States Army Corps of Engineers (USACE), Florida Department of Environmental Protection (FDEP), and Florida Department of Agriculture and Consumer Services (FDACS). Everglades restoration projects are designed to address multiple concerns, such as ecosystem health, environmental protection, and water resources for fish and wildlife and consumptive use.


Roseate Spoonbill in the Everglades

Recognizing its ecological importance, the Everglades system is the focus of one of the largest ecological restoration projects in the world, the South Florida Ecosystem Restoration Program. The status of projects related to the South Florida Ecosystem Restoration Program is updated annually and published in the Integrated Delivery Schedule, available on the USACE webpage (https://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/Integrated-Delivery-Schedule/). The Integrated Delivery Schedule summarizes upcoming schedules and costs for project activities related to the current and planned Comprehensive Everglades Restoration Plan (CERP) components as well as components not related to CERP, including foundation projects associated with the Central and Southern Florida Project (C&SF Project). Many of these projects are discussed in the SFWMD's regional water supply plan updates.

This section provides a high-level overview of some of the major initiatives and projects under way at the SFWMD. The SFWMD and its partners (e.g., USACE, FDEP) maintain updated information about each undertaking on the various project webpages. The links to dedicated project webpages and related documentation are included in this chapter for easy referencing.

Comprehensive Everglades Restoration Plan

CERP is a major component of the South Florida Ecosystem Restoration Program (https://www.evergladesrestoration.gov/) and the driving force behind many restoration projects in the District today. The project area spans more than 18,000 square miles and is designed to improve the health of more than 3,750 square miles (2.4 million acres) of South Florida ecosystems (USACE 2024). Authorized by Congress in the Water Resources Development Act of 2000, CERP was built upon previously authorized hydrologic restoration projects and foundational projects, which were assumed to be complete during the planning process and therefore able to serve as a foundation for CERP implementation, such as the following:

- Modified Water Deliveries to Everglades National Park
- Kissimmee River Restoration
- C-111 South Dade Project
- Tamiami Trail Next Steps
- Southern Corkscrew Regional Ecosystem Watershed

Kissimmee River Restoration Area

The status and details of these projects, as well as other CERP projects, are provided in the applicable regional water supply plans, which are updated every 5 years, and in the *South Florida Environmental Report*, which is updated annually and available at http://www.sfwmd.gov/sfer.

CERP serves as a framework for modifications and operational changes to the C&SF Project to restore, preserve, and protect the land and water within the SFWMD's boundary while providing for other water-related needs in the region. The USACE is the lead federal agency, and the SFWMD is the lead state agency for this multidecadal effort. The USACE and SFWMD jointly implement CERP with a 50-50 cost-share plan that includes the planning, design, and construction of projects.

CERP is composed of a series of projects designed to 1) capture, store, and redistribute fresh water; and 2) restore the Everglades ecosystem by improving the quality, quantity, timing, and distribution of water flows (**Figure 5-1**). Together, the various components of CERP will benefit the ecological function of the South Florida ecosystem, while improving regional water quality conditions, deliveries to coastal estuaries, urban and agricultural water supply, and existing levels of flood protection.

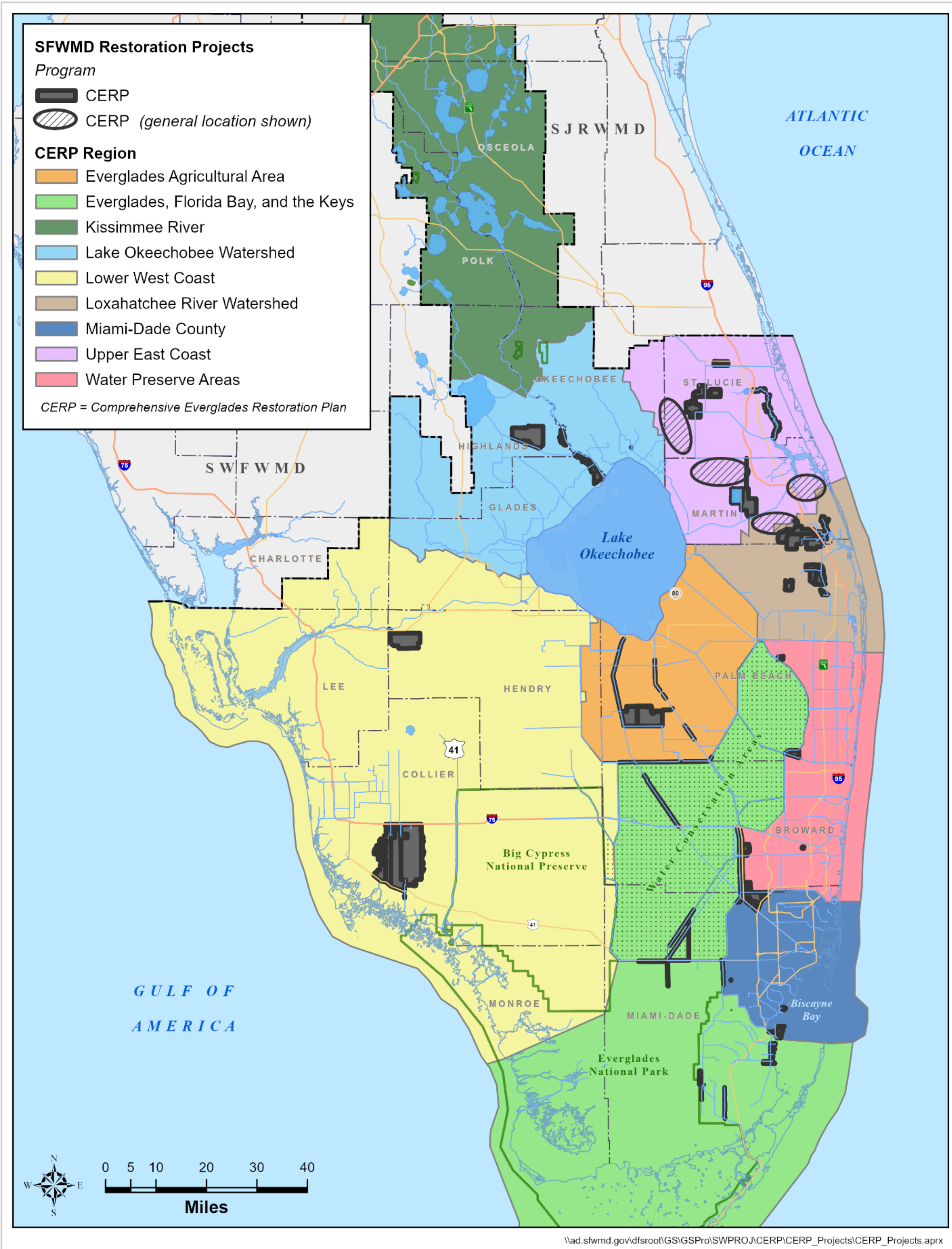


Figure 5-1. Comprehensive Everglades Restoration Plan (CERP) regions and projects.

Northern Everglades and Estuaries Protection Program

Underscoring the state's commitment to ecosystem restoration, the Florida legislature expanded the Lake Okeechobee Protection Act in 2007 to include the protection and restoration of the interconnected Kissimmee, Lake Okeechobee, Caloosahatchee, and St. Lucie watersheds. This interagency initiative, known as the Northern Everglades and Estuaries Protection Program (NEEPP), focuses on the water storage and water treatment needed to improve and restore the Northern Everglades and coastal estuaries. As part of this initiative, the SFWMD and the State of Florida will expand water storage areas, construct treatment marshes, and expedite environmental management initiatives to enhance the ecological health of Lake Okeechobee and downstream coastal estuaries. NEEPP requires the SFWMD, in collaboration with the FDEP and FDACS as coordinating agencies and in cooperation with local governments, to develop and implement protection plans for three northern watersheds: Lake Okeechobee, Caloosahatchee River, and St. Lucie River. While Northern Everglades projects have been conceptually identified in these protection plans, specific projects and activities are included in annual work plans and updates in the *South Florida Environmental Report – Volume I*. Information about NEEPP is available from http://www.sfwmd.gov/northerneverglades.

DISTRICTWIDE WATER RESOURCE DEVELOPMENT PROJECTS

Water resource development is defined in Section 373.019(24), Florida Statutes (F.S.) as follows:

> *…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.*

Water resource development projects encompassing more than one planning area generally are considered Districtwide projects. The estimated costs and time frames for completion of Districtwide water resource development projects are summarized in Chapter 5A of the annual *South Florida Environmental Report – Volume II*. The following categories are types of Districtwide water resource development projects:

- Minimum flow and minimum water level (MFL), water reservation, and restricted allocation area (RAA) rule activities
- Comprehensive Water Conservation Program
- Alternative water supply (AWS)
- Drilling and testing groundwater resources
- Groundwater assessment through data collection
- Groundwater, surface water, and wetland monitoring
- Hydrologic modeling

MFL, Water Reservation, and RAA Rule Activities

MFLs, water reservations, and RAA rules as well as other 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**.

Comprehensive Water Conservation Program

The long-standing conservation goal of the SFWMD is to prevent and reduce wasteful, uneconomical, impractical, or unreasonable use of water resources. This goal is addressed through planning, regulation, use of alternative sources, including reclaimed water, public education, and demand reduction through conservation technology, best management practices, and water-saving 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 is discussed further in **Chapter 2**.

Alternative Water Supply

AWS projects and source diversification are important supplements to traditional water sources in order to meet current and future water needs Districtwide. For over two decades, the AWS component of the SFWMD Cooperative Funding Program has provided cost-share funding for projects that increase water supply. These projects include development of saltwater or brackish water, reclaimed or recycled water, surface water captured during heavy rainfalls, sources made available through addition of new storage capacity, and stormwater (for use by a water use permittee), among others. Annual updates for AWS-related projects and associated funding are contained in the *Water Resource Development Work Program Report*, the *South Florida Environmental Report*, and other state reports.

Drilling and Testing

The SFWMD installs and continually tests groundwater monitor wells of various depths throughout the District to track aquifer water levels and water quality. Data from these wells enhance the SFWMD's knowledge of South Florida hydrogeology, improve the accuracy of regional groundwater models, and support decision-making regarding approval of water use permits.

Floridan Aquifer Well Drilling

Groundwater Assessment

Groundwater assessment includes analyzing results of drilling and aquifer testing programs as well as development of hydrostratigraphic maps and saltwater interface maps (for the coastal water supply planning areas).

Saltwater Interface Mapping

The SFWMD periodically develops maps documenting the inland extent of saltwater intrusion to understand the potential effects on wellfields and coastal aquifers in all coastal counties except Miami-Dade County. Miami-Dade County contracts with the United States Geological Survey (USGS) to develop its saltwater intrusion maps, as defined by the 1,000 milligrams per liter (mg/L) chloride concentration in groundwater. The SFWMD compiles salinity data from monitor wells from multiple sources (e.g., USGS, SFWMD, water use permittees) to estimate the farthest inland extent of the saltwater interface, as defined by the 250 mg/L chloride concentration in groundwater. The SFWMD has developed maps for 2009, 2014, 2019, and 2024 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. An interactive salinity analysis map viewer managed by the USGS is available at https://fl.water.usgs.gov/mapper/. The SFWMD's 2009, 2014, 2019, and 2024 saltwater interface maps are available on the SFWMD webpage https://www.sfwmd.gov/documents-by-tag/saltwaterinterface.

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

Groundwater, Surface Water, and Wetland Monitoring

Information regarding groundwater and surface water levels is essential to manage and protect South Florida's water resources. Real-time data combined with historical information about the changes in water levels, weather, rainfall, and water quality inform 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 Insights—the SFWMD's corporate environmental database—which contains hydrologic, meteorologic, hydrogeologic, and water quality data. Data are available on the SFWMD webpage https://insights.sfwmd.gov. The USGS monitors, archives, and publishes data annually.

Districtwide groundwater monitoring activities include the following:

- **USGS groundwater level monitoring** – In an ongoing effort by the USGS with funding support from the SFWMD to collect groundwater level monitoring data, 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 (https://www.usgs.gov/apps/ngwmn/index.jsp).

- **SFWMD groundwater level monitoring** – In an ongoing effort by the SFWMD to monitor groundwater levels throughout the District, as of 2025, the project includes 408 active SFWMD groundwater stations for the surficial aquifer system (SAS), intermediate aquifer system (IAS), and Floridan aquifer system (FAS) as well as an additional 700 USGS groundwater stations. Data are collected, analyzed, validated, and archived in DBHYDRO Insights.
- **Groundwater quality monitoring** – Samples of chloride and total dissolved solids are collected annually at 60 key SAS wells for saltwater intrusion monitoring with an additional 30 SAS wells every 5 years in support of saltwater intrusion mapping for the coastal water supply planning areas. FAS wells are sampled for major ions and field parameters on a 5-year rotating basis based on upcoming water supply plan updates. Samples are analyzed and validated by the SFWMD Laboratory and archived in DBHYDRO Insights. Groundwater quality data are used for mapping and in support of density-dependent groundwater modeling.
- **Hydrogeologic database improvements** – A data lens is now available in DBHYDRO Insights, a map-based application providing quick access to hydrogeologic data, such as well construction, borehole, lithology, and hydrostratigraphy, among other data categories.
- **FAS well installation, testing, and maintenance** – The SFWMD monitors water levels and water quality at 108 FAS well sites in the SFWMD, as of 2025. Well maintenance is conducted as needed. Data are collected, analyzed, validated, and archived in DBHYDRO Insights.
- **Water use permitting water level and water quality monitoring** – Some SFWMD water use permittees submit water level and/or water quality data from selected SAS and FAS monitor and production wells to the SFWMD. The data are available for each permit in the SFWMD RegPermitting database at https://www.sfwmd.gov/doing-business-with-us/permits.
- **MFL-required monitoring** – In support of adopted MFL prevention and recovery strategies, the SFWMD monitors changes in surface water and groundwater levels, flows, and specific MFL-related constituents; the location of the saltwater interface; and the floral and faunal populations.
- **Monthly water level measurements** – The SFWMD conducts ongoing water level monitoring, including data collection, analyses, and validation, at select sites to supplement the existing groundwater level monitoring networks.
- **Surface water monitoring** – The SFWMD monitors the water levels and water quality of several surface water bodies. Data are collected, analyzed, validated, and archived in DBHYDRO Insights.

- **Wetland monitoring** – The SFWMD monitors salinity and other water quality parameters; water depth; soils and nutrients; and types and quantities of vegetation, fish, and wildlife from several wetland areas within the District planning areas, such as the Biscayne Bay Coastal Wetlands, Picayune Strand, C-111 Spreader Canal, Everglades stormwater treatment areas, and Cypress Creek. Wetland monitoring within the Central Florida Water Initiative (CFWI) Planning Area focuses on tracking the health and function of wetlands as indicators of regional water resource sustainability. Monitoring in the CFWI Planning Area includes collecting hydrologic data, completing vegetation and soil transects, and documenting ecological responses.

Hydrologic Modeling

Regional surface water and groundwater flow models simulate the rate and direction of water movement through the SFWMD's water resources system and subsurface. The models include the major components of the hydrologic cycle and are used to understand the effects of current and future water management operations and water supply use under varied climatic and hydrologic conditions. For surface water modeling, the Regional Simulation Model uses climate records and technical details about regional canals, water control structures, local topography, and storage reservoirs to simulate the complex systems in South Florida. The SFWMD has applied the Regional Simulation Model to several Everglades restoration projects as well as the Kissimmee-Okeechobee-Everglades system and the Big Cypress predrainage watershed. For groundwater modeling, the SFWMD has developed several subregional models that collectively cover the entire District (**Figure 5-2**). These groundwater models simulate groundwater flow, and sometimes water quality, within the SAS, IAS, and FAS based on current and future withdrawal scenarios. More details about each model, including simulations using updated demands, are provided in the applicable water supply plan updates and model documentation reports.

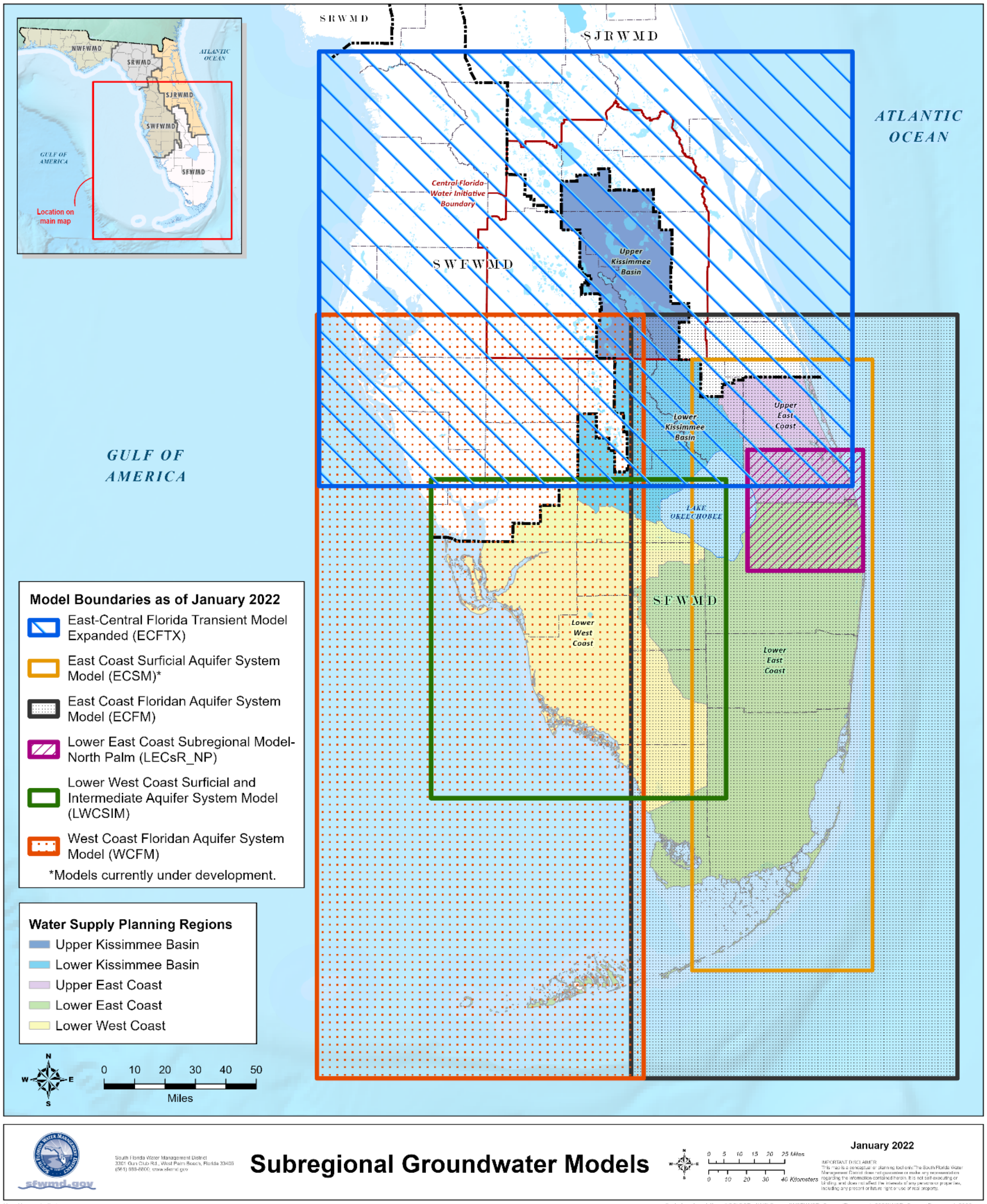


Figure 5-2. Subregional groundwater model boundaries within the South Florida Water Management District.

SUMMARY OF ECOSYSTEM RESTORATION AND WATER RESOURCE DEVELOPMENT

Ecosystem restoration and water resource development are important parts of the SFWMD's work. In partnership with the USACE, the SFWMD is designing and implementing multiple components of the South Florida Ecosystem Restoration Program, including CERP projects. CERP and other ecosystem restoration project activities will restore, protect, and preserve water resources throughout Central and South Florida. Complementing these efforts are Districtwide water resource development projects, which are critical to understanding the quantity and quality of South Florida's water resources.

REFERENCES

USACE. 2024. *Integrated Delivery Schedule 2024 Update*. United States Army Corps of Engineers, Jacksonville, FL. December 2024.

Everglades

6

Water Source Options and Treatment

This chapter discusses water source options and water treatment processes for potable (suitable for drinking) and alternative water supplies (AWS). The scope of this *2026–2029 Support Document for Water Supply Plan Updates* does not include a comprehensive discussion of process technologies and components. Readers should use the information as a starting point for understanding some of the fundamental considerations and costs of incorporating new water supplies and treatment capabilities within specific localities. For summaries of the estimated costs for constructing, operating, and maintaining the more commonly used treatment systems within the South Florida Water Management District (SFWMD or District), please refer to the recently completed *Water Supply Cost Estimation Study* by Kimley-Horn and Associates, Inc. (Cost Study; Kimley-Horn 2023). In some cases, the SFWMD, local governments and municipalities, contractors, and vendors may have more current information from recently constructed water supply projects.

TOPICS

WATER SOURCE OPTIONS

Within the SFWMD, groundwater is the primary source for utilities treating water for Public Supply (PS). Some groundwater is fresh and requires minimal treatment, while other water is brackish and requires substantial treatment to meet all drinking water standards. The water supply sources available for PS and other water use categories include the following:

- **Groundwater** – Water beneath the surface of the ground is primarily withdrawn from three South Florida aquifer systems: the surficial aquifer system (SAS), intermediate aquifer system (IAS), and Floridan aquifer system (FAS).
- **Surface Water** – Water from lakes, rivers, and canals is used as a water supply occasionally for PS and extensively for irrigation of Agriculture (AG) and Landscape/Recreational (L/R) areas.

- **Seawater** – The seawater sources surrounding the southern Florida peninsula require desalination treatment using reverse osmosis (RO) for all uses other than industrial or Power Generation (PG) cooling processes.
- **Reclaimed Water** – Reclaimed water is water that is reused after receiving at least secondary treatment and basic disinfection, flowing out of a domestic wastewater treatment facility.

Additional water source options include storage solutions, such as aquifer storage and recovery (ASR) systems and regional and local surface water retention features. Utility interconnects, a physical connection between the distribution systems of two PS utilities, are used to address a temporary shortfall or for long-term water supply.

Aquifer Storage and Recovery


Aquifer Storage and Recovery along the Kissimmee River near Lake Okeechobee

ASR systems are composed of injection and monitor wells, a water treatment facility, and related features, such as pipelines and pumps. The volume of water that may be injected into an ASR well is limited by several factors, including aquifer storage capacity, water quality in the aquifer, and water availability. A combination of these factors determines the number of wells that can be constructed at a specific ASR site.

Treatment costs for meeting federal and state water quality regulations are the main driver for treatment associated with ASR systems, particularly regarding disinfection technology. Disinfection is required to inactivate biologic pathogens that may enter the aquifer through an ASR well. Therefore, the source of the water also affects treatment and monitoring.

Arsenic remains a potential challenge for existing and future ASR systems. The injection of water into an aquifer can release naturally occurring arsenic contained within the surrounding rock.

Regional and Local Retention

Projects in this category capture and store excess surface water and include reservoirs, retention of water in secondary canals, and use of excess surface water to supplement irrigation-quality reclaimed water. In addition to providing storage for water supply, reservoirs also enable the capture and storage of excess stormwater, reducing excess freshwater flows to coastal estuaries and improving water quality.

The source of water, its chemical constituents (water quality), and the intended use dictate the treatment technologies and processes, and thus cost, necessary to meet water quality standards. Surface water has more suspended solids and bacteria than is found in groundwater. Additionally, the water quality and temperature of surface water has seasonal variability. Generally, groundwater has a more constant water temperature and water quality. For reclaimed water and uses other than potable supply, the intended use will generally determine the type of treatment needed to produce water meeting applicable water quality criteria or use requirements.

WATER QUALITY AND TREATMENT CONSIDERATIONS

This section reviews water quality considerations and the most commonly used technologies and processes for treating water supplies from each water source. Treatment systems for both traditional freshwater supplies and advanced treatment systems used for AWS and to remove contaminants are discussed.

Water Quality Standards

Water for potable and nonpotable water uses have different water quality requirements and treatability constraints. Potable water has specific quality standards to protect human health, while water quality limits for nonpotable uses vary and are dictated by the intended use of the water. Potable water needs to meet the standards of the federal Safe Drinking Water Act, delegated to and implemented by the Florida Department of Environmental Protection (FDEP).

Drinking Water Standards

There are two types of drinking water standards, primary and secondary. Both standards establish maximum contaminant levels (MCLs) for public drinking water systems. Primary drinking water standards include contaminants that can pose health hazards when present in excess of the MCL. Secondary drinking water standards, commonly referred to as aesthetic standards, are parameters that may be characterized by objectionable appearance, odor, or taste of the water but are not necessarily health hazards. Current MCLs for drinking water in Florida are available from https://floridadep.gov/water/source-drinking-water/content/rules-information-and-related-programs.

Nonpotable Water Standards

Nonpotable water uses include AG and L/R (e.g., golf courses, athletic fields) irrigation as well as some Commercial/Industrial/Institutional (CII) uses. The water quality standards for each type of use may vary. A meaningful assessment of irrigation water quality, regardless of source, should consider local factors, such as specific chemical properties, irrigated crops, climate, and irrigation practices.

AG irrigation uses require that the salinity of the water not exceed levels damaging to crops, either by direct application or through salt buildup in the soil. In addition, water constituents harmful to irrigation system infrastructure or equipment (e.g., iron or calcium) must be at acceptable levels or economically removable. High iron content usually is not a factor in water used for flood irrigation of food crops but requires removal for irrigation of ornamental crops. Excessive iron must be removed for use in microirrigation systems, which become clogged by iron precipitates.

Water used for L/R irrigation purposes, including golf courses, often has additional aesthetic requirements, such as color and odor. Water for CII uses is required to meet certain criteria (e.g., the suspended solids and salinity of the water cannot be so high as to build up scales or sediments in the equipment).

Wastewater Treatment Plant in the Florida Keys

In addition to water quality considerations associated with the intended use of nonpotable water, reclaimed water is subject to wastewater treatment standards ensuring the safety of its intended use. Additional wastewater treatment requirements are required to fit certain reuse purposes. High-level disinfection is needed for pathogen inactivation for public access irrigation uses, whereas secondary wastewater treatment may be sufficient for spray fields and supplementing some irrigation uses. Greater levels of treatment are needed to remove nitrogen and phosphorus to meet more stringent nutrient discharge requirements for other end uses, or to achieve indirect or direct potable reclaimed water quality standards by removing additional residual and trace constituents. Problems that might be associated with reclaimed water are only of concern if they hinder the use of the water or require special management techniques to allow its use.

GROUNDWATER CONTAMINATION AND IMPACTS TO WATER SUPPLY

Some contaminants can be costly and difficult for water treatment facilities to remove from drinking water supplies. The cost and degree of difficulty depends on the contaminant (i.e., any physical, chemical, biological, or radiological substance or matter in water) pursuant to Section 403.852(9), Florida Statutes.

An effective groundwater monitoring program is critical for accurate determination of groundwater degradation. Improperly located monitor wells can result in the oversight of a contaminant plume. In addition, certain unacceptable parameters may not be observed in the groundwater for many years, depending on soil adsorption capacities and groundwater gradient. The following discussion reviews major groundwater contamination sources.

Groundwater Contamination Sources

Aquifers can be contaminated in several ways. Anthropogenic activities occurring on ground surfaces can contaminate the SAS, while saltwater intrusion presents a potential threat to deeper portions of the SAS and aquifers deeper below ground surface. Once a contaminant enters an aquifer, it can be difficult to remove. In many cases, leaks, spills, or discharges of contaminants result in contamination of large areas of the aquifer. Therefore, preventing contamination of the aquifer by protecting PS wells and wellfields from activities that present a possible contamination threat is preferable. Many counties have enacted ordinances for wellfield protection.

Saltwater Intrusion

Saltwater intrusion is the movement of saline water into freshwater aquifers and can occur laterally or vertically (**Figure 6-1**). The intrusion of saline water could occur in most coastal aquifers hydraulically connected to seawater. Within the SFWMD, salinity control structures have been installed in all canals that connect to tidal basins to limit saltwater encroachment and maintain higher freshwater heads on the inland side.

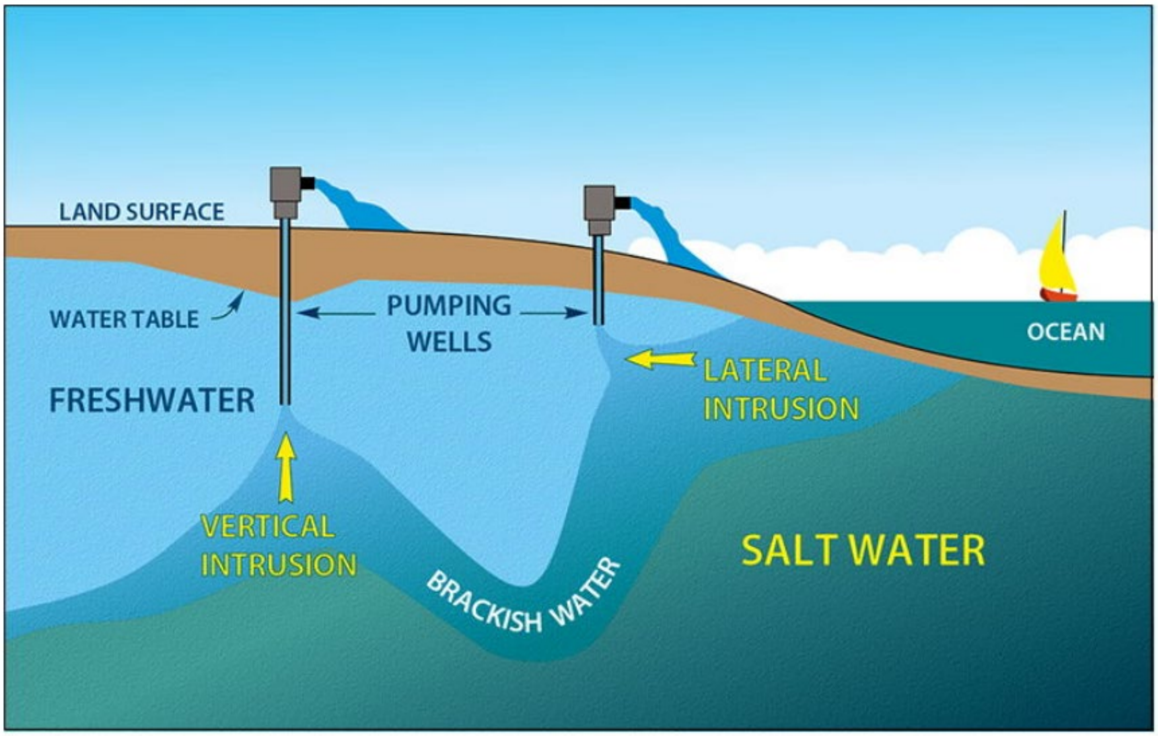


Figure 6-1. Conceptual drawing of lateral and vertical saltwater intrusion within coastal aquifers (Feltgen 2015).

Freshwater aquifers that overlie saline aquifers also could be contaminated by saline water. Relict seawater (connate water with high salinity) is found in some areas of the District in deeper portions of the SAS. As the freshwater aquifer is pumped, upconing of saline water may occur, which could degrade water supplies. Where the potential for lateral saline water intrusion or upconing is a concern, water use permittees in the SFWMD are required to establish monitor wells to provide information about the quality of the water in the aquifers.

In the past, cross-contamination of shallow aquifers containing fresh water has occurred from FAS wells with saline water within local areas of the District. The causes of contamination vary. Hundreds of artesian wells were drilled into the FAS for AG water supply and oil exploration from the 1930s through the 1950s. The wells were constructed with casings that extend to approximately 200 feet or less below land surface. This construction method exposed shallower freshwater zones to invasion by higher salinity water from the FAS.

Over time, the steel casings of some of these wells have corroded, allowing interaquifer exchange of fresh and saline water. Occasionally, an abandoned well was also plugged improperly or simply left open to free flow on the land surface and contaminate the SAS with saline water. In addition, FAS water is used as a supplemental source for agriculture during periods of water shortage, and the brackish water can infiltrate the SAS.

The Water Quality Assurance Act passed in 1981 requires FAS wells to be equipped with a valve capable of controlling discharge from the well. Property owners are responsible for wells located on their land. Permit holders are required to maintain their wells and properly abandon them when necessary.

The SFWMD RegPermitting database available on the Permits webpage at (https://www.sfwmd.gov/doing-business-with-us/permits) includes compliance data associated with respective water use permits. Saltwater intrusion data collected from coastal PS utilities and other permittees are maintained as a component of this compliance data and include information about chlorides, specific conductance, and water levels. In addition, the SFWMD maintains extensive groundwater monitoring networks and partners with the United States Geological Survey (USGS) to provide additional support for ongoing monitoring. The USGS monitors, archives, and publishes data annually. Real-time and periodic data can be accessed through a map interface (https://dashboard.waterdata.usgs.gov). The SFWMD archives surface and groundwater information, water quality, and other data in its corporate environmental database, DBHydro Insights. Data are available on the SFWMD webpage https://insights.sfwmd.gov.

The effects of saltwater intrusion, upconing, aquifer cross-contamination, and connate water can create complex and somewhat unpredictable scenarios for local groundwater quality. Although monitor wells provide a great deal of information about varying water quality, there are limits as to how many wells can be installed. Where more saltwater interface data are required, additional methods can be considered. For example, geophysical logging and geochemical techniques can provide additional information about the depth and extent of saltwater intrusion.

Emerging Contaminants

In addition to the approximately 90 contaminants regulated by the United States Environmental Protection Agency (USEPA) under the National Primary Drinking Water Regulations (USEPA 2025b), the USEPA and USGS are researching and collecting data on a wide range of previously undetected chemicals, referred to as emerging contaminants, or contaminants of emerging concern, recently discovered in water supplies. Emerging contaminants, or contaminants of emerging concern, include a wide range of chemical compounds, industrial pollutants, and human by-products, such as pharmaceuticals, cleaning products, pesticides, and fertilizers. As technology has advanced to the point that trace quantities of these chemicals can now be detected, in some cases at higher levels than expected, a substantial amount of research is devoted to determining the distribution and occurrence (USGS 2019) of these substances in drinking water and water supplies as well as the associated health implications and methods of treatment for contaminants that may be considered a health risk (USEPA 2025a). Microconstituent removal may become a performance standard in the future that requires more costly advanced treatment technologies.

Solid Waste Sites

Although groundwater monitoring began in the early 1980s for landfills, inactive sites may still pose a threat to groundwater resources. Many of Florida's older landfills and dumps were used with little or no control over the types of material disposed.

Leachate is the contaminant-laden liquid that drains from a landfill. Leachates often contain high concentrations of nitrogen and ammonia compounds, iron, sodium, sulfate, and total organic carbon, which elevate biochemical oxygen demand (BOD). Less common constituents that may also be present include metals, such as lead or chromium, and volatile or synthetic organic compounds associated with industrial solvents, such as trichloroethylene, tetrachloroethylene, and benzene. The presence and concentration of contaminants in the leachate depend on several factors that dictate the extent and character of the resulting groundwater impacts, including the following:

- Landfill size and age
- Types and quantities of waste produced in the area
- Local hydrogeology
- Landfill design and filling techniques

The FDEP is responsible for rule development, solid waste policy, and implementation of the solid waste management program. More information is available from https://floridadep.gov/waste/permitting-compliance-assistance/content/solid-waste-section.

Hazardous Waste Sites

The FDEP sponsors several programs that provide support for hazardous waste site cleanup, including the following:

- Early Detection Incentive Program
- Petroleum Liability and Restoration Program
- Abandoned Tank Restoration Program
- Petroleum Cleanup Participation Program
- Preapproved Advanced Cleanup Program

Locations and cleanup status can be obtained through the FDEP Waste Management Section. The FDEP website provides current listings of hazardous waste sites, available from https://floridadep.gov/waste/permitting-compliance-assistance/documents/hazardous-waste-facility-list.

Superfund Program Sites

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, commonly known as "Superfund," authorized the USEPA to identify and remediate uncontrolled or abandoned hazardous waste sites. The National Priorities List targets sites considered to have high health and environmental risks. More information about the USEPA's Superfund Program is available from https://www.epa.gov/superfund/what-superfund.

Septic Tanks

Septic systems are a common method of on-site waste disposal for single-family homes and small commercial facilities. Septic tanks exist throughout the District's planning areas and are a threat to groundwater resources used as drinking water supply. Older systems installed prior to regulatory separation requirements between the bottom of the tank's associated drain field and the top of the seasonal high-water table are a particular threat. In many neighborhoods served by septic tanks, centralized wastewater collection systems are being installed to minimize or eliminate this source of contamination.

POTABLE WATER TREATMENT FACILITIES AND TECHNOLOGY

The technology and processes employed to produce potable water that meets all drinking water standards are presented in the following sections of this chapter. Chlorination, lime softening, ion exchange, and membrane processes are currently employed by PS water treatment facilities within the District's jurisdiction. The type of treatment needed depends on the quality and type of source water. Higher levels of treatment are needed to meet increasingly stringent drinking water quality standards. Advanced water treatment technology is typically required wherever lower quality raw water sources are pursued to meet future demand.

Potable Water Treatment Facilities

In the SFWMD, potable water is supplied by three main types of treatment facilities:

1) Regional, municipal, or privately owned water treatment facilities
2) Small developer/homeowner association or utility-owned water treatment facilities
3) Self-supplied domestic wells serving individual residences

It is common for smaller interim facilities to be constructed until regional potable water becomes available. The smaller water treatment facility (package plant) typically is abandoned upon connection to the regional water system. A brief description of the various water treatment methods is followed by cost information for advanced water treatment technologies, which are the most common types of new water treatment facilities built within the SFWMD, due to the limited availability of water from traditional freshwater supplies and growing concerns about emerging contaminants as previously discussed.

Belle Glade Water Treatment Facility

Potable Water Treatment Technology Processes and Components

The goal of water treatment technology processes and components is to remove existing contaminants in the water or reduce the concentration of contaminants, so the water becomes fit for its desired end use. Lime softening is an inexpensive treatment process commonly used in water treatment facilities throughout Florida to reduce hardness. However, many of these facilities are approaching their end of life and need to be replaced. Utilities are typically switching to membrane treatment technology processes to produce higher quality finished water and to meet potentially more stringent water quality standards. In membrane filtration, water passes through a thin film of semipermeable membrane, which retains contaminants according to their size. Membrane processes can remove dissolved salts and organic materials that react with chlorine disinfectant byproduct (DBP) precursors. These processes can provide softening as well. The most used membrane processes to treat drinking water are ultrafiltration (UF), microfiltration (MF), nanofiltration (NF), and RO (**Figure 6-2**). Each membrane process, discussed in the subsections below, offers a different solution depending on the raw water source (feedwater) quality. All membrane processes are pressure-driven, with higher energy costs associated with higher pressures required for increasing levels of filtration. These processes require disposal of the reject (concentrate) water that contains concentrated amounts of dissolved salts and other contaminates.

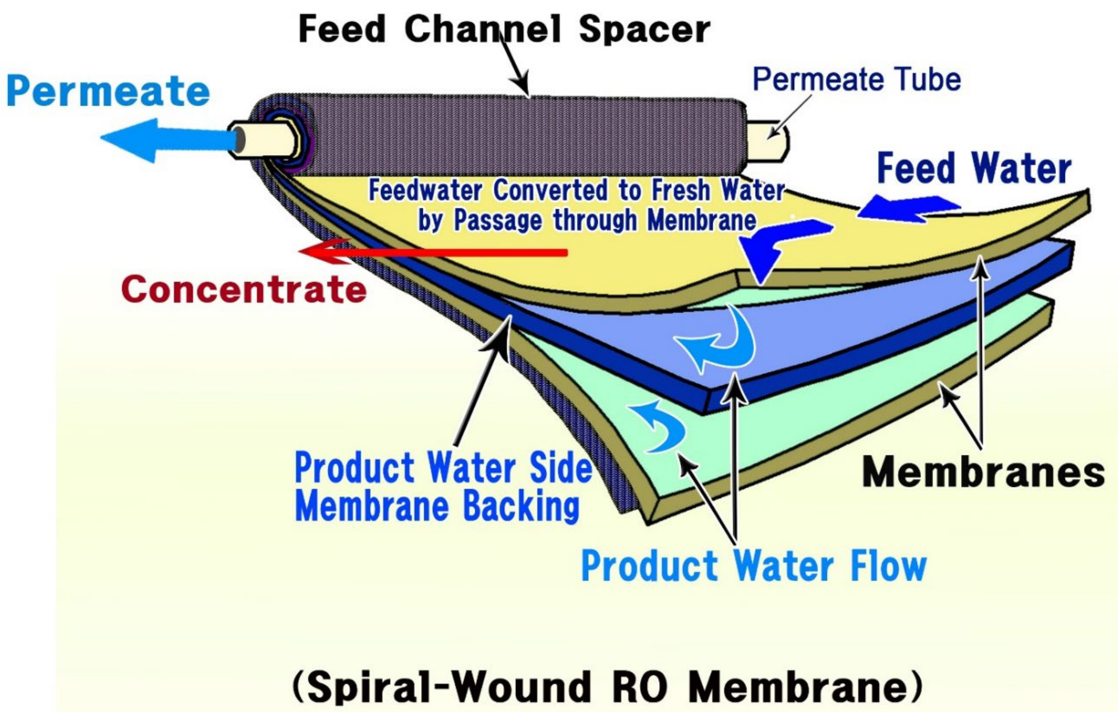


Figure 6-2. Spiral-wound reverse osmosis membrane.

Application of a particular technology depends not only on the raw water quality and characteristics but also on the desired treated (finished) water quality. Technology continues to improve as the USEPA adopts more stringent water quality regulations. No single water treatment technology process is applicable for the entire range of inorganic and organic compounds. While the rejection of many inorganic compounds by RO and NF membranes is well documented, the rejection of small organic molecules within the range of the microconstituent category is much more complex. It is not appropriate to generalize that all organic molecules over a specific molecular weight will be highly rejected by a given RO or NF membrane. Methods to determine the actual rejection rate of a particular microconstituent or group of microconstituents by a particular membrane include bench scale and pilot testing. The treatment recovery rate of potable water refers to the percentage of raw water that is converted to potable water. The treatment recovery rate depends on the raw water quality and the process setup as shown in **Table 6-1**.

Table 6-1. General water treatment technology process recovery rates of potable water.

Process	Recovery Rate (%)	Comments
RO seawater	30 – 50	Depends on the TDS level of the raw water
RO brackish	70 – 90	
NF	80 – 95	Can remove turbidity, microorganisms, DBP precursors, and hardness as well as a fraction of the dissolved salts and typically separate larger nondissolved materials
UF and MF	85 – 97	
Lime softening	95 – 99	Effective at reducing water hardness for some raw water but is relatively ineffective at controlling contaminants

DBP = disinfection byproduct; MF = microfiltration; NF = nanofiltration; RO = reverse osmosis; TDS = total dissolved solids; UF = ultrafiltration.

Ultrafiltration and Microfiltration Processes

UF and MF are low-pressure membrane water treatment technology processes. UF removes nonionic matter, higher molecular weight substances, and colloids (extremely fine-sized suspended materials that will not settle out of the water column). MF can remove micrometer and submicrometer particles but is limited to coarser materials than UF and allows some additional dissolved substances to pass through.

Treatment technologies such as UF and MF remove suspended particles by a sieving type of filtration process. The small pore sizes in UF and MF membranes represent a physical barrier to larger-sized contaminants, such as bacteria as well as *Cryptosporidium* and *Giardia* cysts. Due to the larger pore size of the membranes used for MF, the process is not as effective as UF for removing viruses.

Nanofiltration Process

NF is a diffusion-controlled membrane filtration process using nominal pore size and higher pressure than UF and MF. NF systems can remove virtually all viruses, bacteria, cysts, synthetic and organic compounds, and humic materials.

NF membranes generally are effective for removing molecules with high molecular weight (e.g., dissolved organics, such as DBP precursors) and hardness ions. NF membranes commonly are applied for softening, which is sometimes referred to as membrane softening. One advantage of NF technology is its effectiveness at removing organics that function as total trihalomethane (TTHM) and other DBP precursors. In recent years, utilities have been replacing aging lime softening facilities with NF processes to accommodate current and projected regulatory standards, including MCLs for perfluoroalkyl and polyfluoroalkyl substances (PFAS).

Desalination/Reverse Osmosis Process

Reverse Osmosis Treatment Facility

Desalination processes treat saline water to remove or reduce chlorides and dissolved solids, resulting in the production of fresh water suitable for human consumption or irrigation. Although other technologies exist, such as distillation, electrodialysis, and electrodialysis reversal, utilities in the SFWMD typically use RO for producing potable water from brackish and seawater sources.

RO is a high-pressure process that relies on forcing water molecules (raw water) through a semipermeable membrane to produce fresh water (product water or permeate). Heavy metals, dissolved salts, and compounds such as leads and nitrates are unable to pass through the membrane and therefore are left behind for disposal as concentrate or reject water.

RO membranes are effective in desalination of brackish and seawater raw water supplies. In addition to treating a wide range of salinities, RO rejects naturally occurring and synthetic organic compounds, metals, and microbiological contaminants effectively.

Due to the level of removal efficiency, a typical RO application may require a raw water blend stream (bypassing the RO process) with the finished water, or the post-treatment addition of calcium hardness, alkalinity, and a corrosion inhibitor to produce a stable finished water that does not present corrosion concerns for the downstream distribution system.

Since seawater contains higher percentages of dissolved solids than brackish sources, the cost of seawater desalination is higher than the cost of brackish groundwater desalination. The higher salt content of seawater requires specialized intake facilities and concentrate disposal, higher energy demands, and additional maintenance costs, making seawater a less desirable water source. However, technological advancements and incremental improvements in productivity and efficiency of RO membranes, pumps, energy recovery devices, and overall system configurations have reduced the cost of production of desalinated seawater. Some utilities with seawater desalination plants have found that a pilot test facility is helpful to understand the issues associated with the source water that will be processed by the plant to more effectively design the full desalination plant.

The cost of seawater desalination appears to be reduced when the desalination facility is co-located with power generating facilities that use seawater for cooling. There are many potential benefits of co-locating desalination facilities with electric power plants (e.g., sharing facility components). Cost savings also are associated with using the existing intake and discharge structures of the power plant to provide raw water to the desalination facility and a means for concentrate disposal. It is possible to dispose of the desalination process concentrate by blending it with the power plant's coolant water discharge. Another significant advantage of using power plant cooling water as a source is that the temperature of the water is elevated, which reduces the pressure and associated energy needed to produce the finished water product.

As of September 2025, there are 41 brackish and 2 seawater RO desalination PS facilities operating within the SFWMD, with 7 brackish and 2 seawater desalination projects proposed for construction by 2045. The existing RO facilities have the capacity to produce 296 million gallons per day (mgd). The proposed projects will increase the overall production capacity by 52 mgd, bringing the Districtwide total desalination capacity to 353 mgd by 2045.

Ion Exchange

Ion exchange (IX) is a process using reversible chemical reactions for removing undesirable dissolved ions from raw water and replacing them with other similarly charged ions (**Figure 6-3**). Raw water is pretreated using filtration to remove suspended solids before being passed through a reaction tank containing either a cation or anion resin exchange medium, typically either synthetic or naturally occurring zeolite resin beads. Pre-treatment for preventing sediment from collecting in the resin is critical, since IX systems cannot be backwashed after being placed into service. Once the resin beads become saturated with undesirable ions, the resin must be regenerated with a brine solution flush, replacing the undesirable ions on the resin. The undesirable ions are flushed out of the resin beads and reaction tank as part of the regenerate brine wastewater. A dual stage process using separate cation and anion exchange tanks can be used to create deionized water. IX is often used to remove calcium and magnesium for water softening. However, it is being used more frequently for the removal of other unwanted dissolved ionic contaminants, including PFAS. Pilot studies conducted at the City of Stuart's water treatment facility using both granular activated carbon and IX technologies demonstrated that IX most effectively reduced the concentration of PFAS (Kimley-Horn 2023).

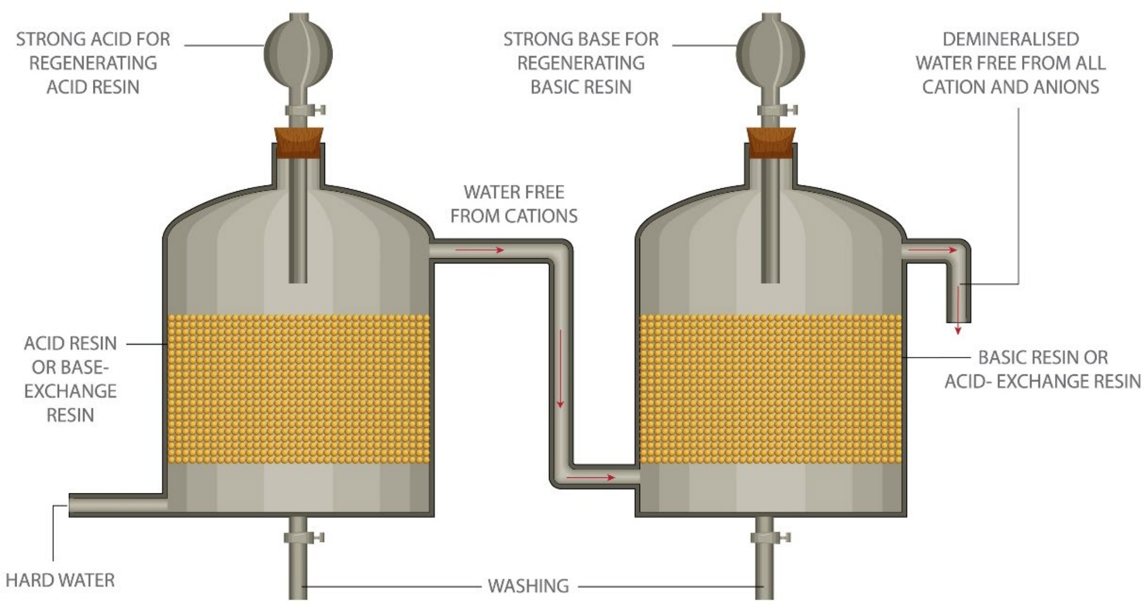


Figure 6-3. Ion exchange resins are used in water purification.

Lime Softening

Lime softening refers to the addition of lime (calcium hydroxide) to raw water to reduce water hardness. When lime is added to raw water, a chemical reaction occurs that reduces water hardness by precipitating calcium carbonate and magnesium hydroxide. While the lime softening process is effective at reducing hardness for some source water, it is relatively ineffective at controlling contaminants such as chlorides, nitrates, TTHM precursors, and PFAS. Chloride concentration levels of raw water sources expected to serve lime softening facilities should be below the 250 milligrams per liter (mg/L) chloride MCL to avoid possible exceedance of the standard in the treated water. Additionally, lime softening facilities with raw water sources having nitrate concentrations exceeding the MCL likely require additional treatment. Disinfectants may be added at several places during the treatment process. To achieve better disinfection efficiency, the disinfectant is added after the lime softening process. Many existing lime softening facilities are modifying their treatment processes because of new and pending drinking water quality standards.

Pre-treatment Technology Processes and Components

Source water requires some pre-treatment to remove particulates, suspended sediments, and volatile substances. Pre-treatment includes aeration, coagulation, flocculation, sedimentation, and filtration processes. The type of pre-treatment will vary based on the source water.

Aeration Process

In the aeration process, air is brought into contact with water to transfer volatile substances to or from the water, a process referred to as desorption or stripping. Aeration in water treatment is used primarily to accomplish the following:

- Reduce the concentration of taste- and odor-causing substances, and to a limited extent, oxidize organic matter.
- Remove substances that may interfere with or add to the cost of subsequent water treatment (e.g., the removal of carbon dioxide from water before lime softening).
- Add oxygen to water, primarily for oxidation of iron and manganese, so the elements may be removed by further treatment.
- Remove radon gas or volatile organic compounds considered hazardous to public health.

Desorption or stripping can be achieved through packed towers, diffused aeration, or tray aerators.

- **Packed Towers** – A packed tower consists of a cylindrical shell containing packing material, which usually is individual pieces randomly placed into the column. The shapes of the packing material vary and can be made of ceramic, stainless steel, or plastic. Water is introduced at the top of the tower and falls through the tower as air is passing upward.

- **Diffused Aeration** – Diffused aeration consists of bringing air bubbles in contact with water. Air is compressed and then released at the bottom of the water through bubble diffusers. The diffusers distribute the air uniformly through the water cross section and produce the desired air bubble size.
- **Tray Aerators** – Cascading tray aerators depend on surface aeration that takes place as water passes over a series of vertically arranged trays. Water is introduced at the top of a series of trays and aeration of the water takes place as the water cascades from one tray to the other.

Coagulation, Flocculation, and Sedimentation Processes

Coagulation, flocculation, and sedimentation processes remove suspended material and color, and may be used as pre-treatment for other processes or technologies, such as RO. Coagulation is the process of combining small particles into larger aggregates. During coagulation, a chemical such as alum (aluminum sulfate) is added to raw water. When the water is stirred, the alum forms sticky globs, or flocs, which attach to small particles composed of bacteria, silt, and other contaminants. The water is kept in a settling tank or basin where the flocs sink to the bottom. This prolonged phase of purification is called flocculation and sedimentation. Rapid filters are then used to retain most of the flocs and other particles that escape the chemical coagulation and sedimentation processes.

A high-rate ballasted clarification process, consisting of a proprietary system with the trade name ACTIFLO®, has replaced the traditional rapid-mix coagulation, flocculation, and sedimentation process. The high-rate ballasted process is used to treat large flow rates with variable raw water quality.

The ACTIFLO® process operates like a conventional coagulation, flocculation, and sedimentation design, except that sand with a grain size of 130 to 150 micrometers (i.e., microsand) is added to the water during the flocculation process to enhance coagulation and settling. The microsand adds surface area in the coagulation process, substantially improving the frequency of collision of dispersed or colloidal particles in the raw water with oppositely charged coagulated flocculation. This action accelerates the coagulation and flocculation processes. The microsand also provides "ballast" to the flocculation, resulting in settling velocities that are 25 to 35 times faster than produced in conventional flocculation and sedimentation processes. When compared to the conventional coagulation, flocculation, and sedimentation processes, this combination of improved coagulation efficiency and rapid flocculation settling provides the following:

- Higher quality settled water (as measured via particle counts in the 2 to 4 micrometer range)
- More stable performance during raw water upset conditions
- Reduced coagulant demand (particularly under high algae conditions)
- Reduced process footprint

Filtration Process

The filtration process removes particulate matter from the water supply. Filtration involves passing water through layers of sand, activated carbon, and other granular material to remove microorganisms, including viruses, bacteria, and parasites, such as *Cryptosporidium*. Filtration attempts to mimic the natural filtration of water as it moves through the ground. After the water is filtered, it is treated with chemical disinfectants, such as chlorine to kill any organisms that might have made it through the filtration process. The most common filtration methods are rapid filtration, slow sand filtration, activated carbon filtration, and membrane filtration.

- **Rapid Filtration** – Rapid filters are deep beds of sand, anthracite and sand, or granular activated carbon with particle sizes of approximately 1 millimeter. The filters are operated at flow velocities of approximately 15 to 50 feet per hour. Rapid sand filtration typically follows settling basins in conventional water treatment units.
- **Slow Sand Filtration** – Slow sand filtration is a biological treatment process. Typically, a slow sand filter has a depth of 2 feet and operates at flow rates of 0.3 to 1.0 feet per hour. The vital process in slow sand filtration is the formation of a biologically active layer, called the Schmutzdecke, in the top 20 millimeter of the sand bed. This layer provides effective surface filtration of very small particles, including viruses, bacteria, and parasites. Any particles that pass through the Schmutzdecke may be retained in the remaining depth of the sand bed by the same mechanisms that exist in rapid filtration.
- **Activated Carbon Filtration** – Activated carbon filters remove organic compounds that impart taste and odor to the water. Carbon filtering uses activated carbon to remove contaminants and impurities using chemical adsorption. The carbon filter is designed to provide a large surface area that allows maximum exposure to the filter media. Carbon filters are most effective in removing chlorine, sediment, and volatile organic compounds from water. They are not effective in removing minerals, salts, and dissolved inorganic compounds. The efficacy of a carbon filter is also based on the flow rate. Carbon filters are used as pre-treatment devices for RO systems.

Disinfection Process Components

All potable water requires disinfection as part of the treatment process before distribution. Disinfection, the process of inactivating disease-causing microorganisms, provides essential public health protection. Disinfection methods include chlorination, ultraviolet (UV) light radiation, and ozonation.

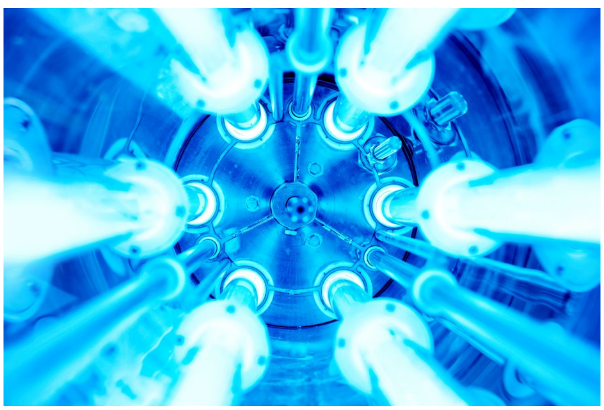
PS facilities are required to provide adequate disinfection of finished/treated water and a disinfectant residual in the water distribution system. Disinfectants may be added at several places in the treatment process, but adequate disinfectant residual and contact time must be provided prior to consumption by the consumer.

Chlorination

Chlorine is a common disinfectant. However, the use of free chlorine as a disinfectant often results in the formation of unacceptable levels of TTHMs and other DBPs when free chlorine combines with naturally occurring organics in the raw water source. Existing treatment processes are being modified to comply with changing water quality standards. Add-on treatment technologies that effectively remove these compounds or prevent their formation include ozone disinfection, granular activated carbon, enhanced coagulation, membrane systems, and switching from chlorine to chlorine dioxide (USEPA 2020).

The primary disinfectants used by utilities within the SFWMD are chlorine dioxide or chlorine used with ammonia to form chloramine, and on-site generation of sodium hypochlorite. The rate of disinfection depends on the concentration and form of available chlorine residual, time of contact, pH, temperature, and other factors. Current disinfection practice is based on establishing an amount of chlorine residual during treatment and then maintaining an adequate residual to the customer's faucet.

Ultraviolet Light



Ultraviolet Lamps in a Water Treatment Facility

The UV light disinfection process does not use chemicals. Microorganisms, including viruses, bacteria, and algae, are inactivated within seconds of radiation with UV light. The UV disinfection process takes place as water flows through an irradiation chamber. Microorganisms in the water are inactivated when the UV light is absorbed. A photochemical effect is created, and vital processes are stopped within the cells, thus rendering the microorganisms harmless. Ultraviolet light inactivates microbes by damaging their nucleic acids, thereby preventing the microbe from replicating. When a microbe cannot replicate, it is incapable of infecting a host. UV light is effective in inactivating *Cryptosporidium*. One major advantage of UV light disinfection is that it is capable of disinfecting water faster than chlorine, and without the need for retention tanks or potentially harmful chemicals (USEPA 2020).

Ozonation

Ozonation is a water disinfection method that uses the same type of ozone found in the atmosphere. By adding ozone to the water supply and then sending an electric charge through the water, water suppliers inactivate disease-causing microbes, including *Giardia* and *Cryptosporidium*. Contact times required for disinfection by ozone are short (seconds to several minutes) compared to the longer disinfection time required by chlorine. Ozonation does not produce the DBPs associated with chlorine disinfection and is also an effective way to alleviate most taste and odor issues (USEPA 2020).

Ozonation is widely used in western Europe. However, in the United States, use of ozonation is limited. The cost of ozonation is approximately four times higher than that of traditional chlorine disinfection because of the greater amount of electricity needed for water treatment. Another disadvantage of ozonation is that unlike chlorine, ozone dissipates quickly in water supplies. Therefore, contaminants entering the water after it is disinfected could go untreated as the water leaves the facility, so an additional disinfectant is required to maintain a residual in the distribution system.

Distribution Process Components

Distribution process components are likely to be common among the various water treatment technology processes. The process components listed in this section include finished water storage and high service pumping.

Finished Water Storage

Finished water storage facilities, such as ground storage tanks and towers, provide storage of treated water before it is distributed to users. The storage provides a reserve of water to avoid service interruption during system emergencies, helps maintain uniform system pressure, permits reduction in sizes of distribution mains, and helps meet peak system demands while allowing a water treatment facility to operate at a relatively constant rate. The finished water storage requirements and associated costs are assumed to be the same for various treatment technologies for each facility capacity.

High Service Pumping

High service pumps are used to pump treated water into the water distribution system. The high service pumping requirements and associated costs are assumed to be the same for various treatment technologies and dependent on facility capacity.

Groundwater Supply Wells

Groundwater supply systems are composed of wellfields and related features, such as pipelines and pumps. The raw water production of each well is limited by several factors, including the rate of water movement in the aquifers, rate of recharge, aquifer storage capacity, potential environmental impacts, proximity to sources of contamination, proximity to existing legal users, and the potential for saltwater intrusion. A combination of these factors determines the number, depth, diameter, and distribution of wells that can be constructed at a specific site. These factors also affect the rate at which the wells can be pumped. Many utilities have found that a test well and aquifer testing was helpful to understand the hydrogeology of the site and design the wellfield and wells. When estimating costs for a well construction project, it is recommended to review the costs of recent similar projects near the site.

WATER RECLAMATION TREATMENT TECHNOLOGY

Wastewater Treatment Facility

Demand for water is expected to increase in the long term as withdrawals from traditional sources, such as fresh groundwater and surface water, are becoming increasingly limited. Increasing demand will need to be met with AWS, including reclaimed water, which can be used to augment or offset withdrawals from traditional sources.

Wastewater treatment facilities use integrated processes to treat wastewater to a desired quality. At a minimum, wastewater facilities in Florida provide secondary treatment. Wastewater that has received at least secondary treatment and basic disinfection after flowing out of a domestic wastewater treatment facility and is reused is considered reclaimed water. In Fiscal Year 2023, 107 wastewater facilities located within the SFWMD, permitted to treat 0.1 mgd or greater (with the exception of Sebring Airport, permitted to treat 0.9 mgd) produced and applied approximately 300 mgd of reclaimed water for beneficial purposes since 2017 (SFWMD 2025).

The intended use of reclaimed water determines the water quality and treatment requirements. The following information includes an overview of secondary and advanced treatment technology and processes used to produce reclaimed water. It does not include related components, such as transmission systems, storage, alternative disposal, and modifications to the application area for wastewater treatment.

Secondary Treatment

Secondary treatment involves the use of biological processes to remove biodegradable organic matter and some suspended solids and reduce BOD and total suspended solids (TSS). Common processes include activated sludge, trickling filters, and oxidation ponds. Secondary treatment, when basic disinfection is applied, is the minimum treatment level required for reclaimed water and is limited to end uses, such as spray fields, rapid infiltration systems, restricted access irrigation, and some industrial uses. Additional levels of disinfection are required for application in public access areas. Application to areas subject to a Basin Management Action Plan (BMAP), with limits for nitrogen and phosphorus, and other reclaimed water end use types require additional levels of treatment and disinfection.

Advanced Secondary Treatment

Advanced secondary treatment is not formally defined in Florida law but typically refers to secondary treatment of wastewater with the addition of filtration and high-level disinfection to enhance removal of biodegradable organic matter and TSS and to reduce BOD and pathogens. Nutrient removal steps may be added, such as biological nitrogen removal and chemical phosphorus precipitation.

Granular Media Filtration Followed by Ultraviolet Disinfection

Filtration is a component of advanced secondary wastewater treatment, which, accompanied by high-level disinfection, provides a reclaimed water quality that can be used for public access irrigation. Granular media filtration, typically sand, is a polishing step that lowers the levels of TSS and associated contaminants in treated wastewater. This filtration, followed by UV disinfection, kills pathogenic microorganisms in the wastewater before being discharged into the environment. Types of granular media filters include slow sand, rapid sand, deep bed, upflow, pulsed bed dual, and multimedia. To achieve high-level disinfection in an advanced secondary treatment process, monitoring and chemical feed equipment are also needed.

Advanced Wastewater Treatment

Advanced wastewater treatment (AWT) commonly refers to treatment processes designed to enhance nitrogen and phosphorus removal and overall water quality by also further reducing pathogens, trace contaminants, toxics, and micropollutants. These treatment processes include biological nutrient removal, membrane bioreactors, MF, and RO. AWT provides a level of treatment that meets effluent limits of 5 mg/L TSS, 5 mg/L carbonaceous BOD, 3 mg/L total nitrogen, and 1 mg/L total phosphorus on an annual average basis and has received high-level disinfection as described in 403.086 (4)(a), Florida Statutes.

In the past, AWT was associated with facilities that use stream discharge for effluent disposal. However, AWT is now employed to allow use of reclaimed water for wetland restoration, groundwater recharge systems, direct and indirect potable reuse, and other advanced uses of reclaimed water.

Four- and Five-Stage Bardenpho Processes

Many AWT process configurations have been developed to accomplish biological nutrient removal from advanced secondary treatment effluent. Two configurations used in Florida to provide high levels of nitrogen and phosphorus removal are the four- and five-stage Bardenpho processes. Bardenpho processes are wastewater treatment methods that use modifications of the activated sludge process to foster biological nutrient removal of nitrogen and phosphorus. Bardenpho processes use a series of alternating aerobic, anoxic, and anaerobic zones to create different conditions for microorganisms. The four-stage Bardenpho process primarily targets nitrogen removal, while the five-stage Bardenpho process incorporates an additional anaerobic zone for enhanced removal of both nitrogen and phosphorus.

Membrane Bioreactor Process

A membrane bioreactor combines a biological process with membrane filtration. In a membrane bioreactor system, microorganisms break down organic matter, while the membrane component uses low-pressure MF or UF membranes to filter solids, bacteria, and other contaminants. The membranes are typically immersed in an aeration tank, which eliminates the need for clarification and tertiary filtration. However, some applications use a separate membrane tank. Membrane bioreactor systems produce higher quality effluent as well as better removal of pathogens and suspended solids than conventional treatment processes. Additionally, these systems overcome the limitations of poor settling of sludge in conventional activated sludge processes in full-scale municipal wastewater treatment.

Microfiltration/Reverse Osmosis Process

MF and RO treatment systems, discussed in previous subsections, can be added to an advanced secondary treatment facility, or used in series with advanced oxidation or disinfection for newly constructed facilities, to achieve a level of treatment suitable for direct and indirect potable reuse.

COST STUDY

In an effort to provide a useful resource to assist SFWMD staff, PS utilities, local governments, and other public and private water users, the SFWMD contracted with Kimley-Horn and Associates, Inc. to update the previous and obsolete *Water Supply Cost Estimation Study* and *Water Supply Cost Estimation Study – Phase II Addendum* (CDM 2007a,b). The updated *Water Supply Cost Estimation Study* (Cost Study; Kimley-Horn 2023) provides estimates for more recent capital and operation and maintenance (O&M) costs for the development of water supplies in the SFWMD's water supply planning areas. Capital and O&M costs are important for evaluating AWS projects associated with water supply planning.

The Cost Study includes estimates, in December 2021 dollars, of engineering and construction costs as well as cost-estimation relationships and curves for the most relevant AWS technologies. Costs are planning-level estimates of the total capital investment and O&M costs of water supply development projects and components.

The systems and components evaluated in the Cost Study include the following:

- Water supply wells
- Advanced water treatment technologies
- Water reclamation and advanced wastewater treatment technologies
- Deep injection wells
- Aquifer storage and recovery
- Surface water storage
- Pipeline systems
- Ancillary treatment components (disinfection, high service pumps, and storage facilities)

The Cost Study also includes additional case studies, including a recently constructed seawater treatment facility and an ion exchange water treatment facility designed for the treatment of PFAS.

Aquifer Storage and Recovery Project

The updated planning-level cost estimates also provide a useful reference to support the development and review of Water Supply Facilities Work Plans, discussed in **Chapter 1**. Total capital cost estimates and the identification of funding sources are needed for updates to the Five-Year Schedule of Capital Improvements as PS utilities are required to anticipate future demands for water and plan for additional water supply development projects. The Cost Study also serves as a useful reference for developing and reviewing applications for AWS funding assistance through the SFWMD's Cooperative Funding Program, discussed in **Chapter 2**, and for evaluating and comparing the cost effectiveness as cost per 1,000 gallons of water for AWS projects.

Cost estimates in the Cost Study are based primarily on data gathered from projects constructed during a 10-year period between 2011 and 2021. To estimate the current costs (in December 2021 dollars) of the projects included in the dataset, the Engineering News Record Construction Cost Index and Material Price Index were used, where appropriate. The cost estimates account for market impacts and fluctuations experienced between August 2020 and December 2021 due to dramatic shifts in demand and materials availability resulting from the Coronavirus (COVID-19) pandemic and increases in tariffs for imported materials. As the Cost Study was being finalized in 2022, an overall 6.8% increase was anticipated as compared to 2021, and upward pressures on construction, labor, and material costs were expected to continue rising into the foreseeable future (Zevin and Rubin 2021). Other sources of cost estimation in the study include RSMeans (a construction cost-estimating software, http://www.rsmeansonline.com), and information gathered from suppliers, contractors, and vendors.

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Appendix: Conservation Glossary

This appendix contains a glossary of conservation measures and practices as discussed in **Chapter 2**. This information was initially developed by the Central Florida Water Initiative (CFWI) conservation team. The measures and practices herein have been edited, as needed, for this 2026–2029 *Support Document for the Water Supply Plan Updates*.

INFO

Water Use Categories

Public Supply (PS)*

Domestic Self-Supply (DSS)

Residential (RES)*

Agriculture (AG)

Landscape/Recreational (L/R)

Commercial/Industrial/Institutional (CII)

Power Generation (PG)

*Note: PS conservation measures and practices apply specifically to the utility and not the end user(s). Because residential users are included in the PS and DSS water use categories, conservation measures and practices for residential users are presented in **Chapter 2** as Residential (RES).

CONSERVATION MEASURES (HARDWARE)

Indoor

Clothes washer, high-efficiency replacement (RES, CII) – Replacing conventional clothes washers with water-efficient models (ENERGY STAR qualified). High-efficiency models often feature innovative tub designs and high-speed spin cycles and typically are more energy efficient than conventional models.

Combination oven, high-efficiency replacement (CII) – Replacing conventional combination ovens in commercial kitchens with water-efficient models. A combination oven can function as a steam cooker or a conventional (hot air) oven. Conventional models consume up to 40 gallons of water per hour. Boilerless models and modern boiler-type models can save more than 100,000 gallons of water per year compared with traditional models. High-efficiency models are programmable with low-energy idle settings.

Dishwasher, high-efficiency replacement (RES, CII) – Replacing standard dishwashers with water-efficient models (ENERGY STAR qualified). High-efficiency dishwashers include several innovations, such as “soil” sensors, high-efficiency jets, and dish rack designs that reduce energy and water consumption and improve performance.

Faucet aerator, high-efficiency replacement (RES, CII) – Replacing existing faucet aerators with United States Environmental Protection Agency (USEPA) WaterSense-labeled, high-efficiency kitchen and bathroom faucet aerators.

Faucet installation, metered-flow (CII) – Installing faucets equipped with sensor-triggered, timed flows (typically 0.25 gallons per cycle), reducing waste from manual operation or unattended running.

Heating, ventilation, and air conditioning (HVAC), efficiency improvements (CII) – Increasing HVAC cooling tower water use efficiency through the use of conductivity meters (to determine when to bleed off water), drift eliminators (to reduce water drifting away from towers), makeup and blowdown submeters (to calculate cycles of concentrations), and/or possibly pre-treatment devices and chemicals.

Hot water use (efficient) (RES, CII) – Using close proximity “instant hot” heaters or electric showers that instantly heat water as it passes through the unit. Water savings are obtained by avoiding the purging of cold water first as the hot water moves from the water heater or boiler source through the system to the point of use.

Ice making machines, high-efficiency replacement (CII) – Replacing conventional ice making machines with water-efficient models (ENERGY STAR qualified). Efficient models use approximately 23% less water than standard models.

Metering and submetering (indoor), installation (CII, PG) – Installing water meters and/or submeters at pumping facilities, at critical locations throughout a manufacturing system, or on other high-volume, water-using equipment. Information collected from meters can help detect leaks as well as calculate and maintain system efficiencies.

Pre-rinse spray valve, high-efficiency replacement (CII) – Replacing conventional pre-rinse spray valves with more efficient models, such as USEPA WaterSense-labeled equivalent products. These devices are used primarily in restaurants and bars but are also found in commercial office buildings and institutions that have cafeterias. Other possible applications include food processing/washing stations.

Showerhead, high-efficiency replacement (RES, CII) – Replacing conventional showerheads with more efficient models, such as USEPA WaterSense-labeled equivalent products.

Steam cooker, high-efficiency replacement (CII) – Replacing conventional commercial kitchen steamers with water-efficient models (ENERGY STAR qualified). On average, ENERGY STAR qualified steam cookers use 3 gallons of water per hour versus approximately 40 gallons of water per hour for standard steam cooker models.

Toilet, fill cycle diverter use (RES, CII) – Using a diverter to redirect water that would typically drain down the overflow tube back into the toilet tank during the fill cycle. The diverter increases efficiency by conserving up to 50% of the fill cycle water, which would otherwise flow down the drain.

Toilet, flapperless use (RES, CII) – Using toilets designed to hold flush water in a pan within the tank, thus not requiring any flapper and avoiding potential losses from this leak source. Kits may be available to convert conventional tanks to flapperless.

Toilet, high-efficiency replacement (RES, CII) – Replacing conventional toilets (using more than 1.6 gallons per flush) with more efficient models, such as USEPA WaterSense-labeled equivalent products.

Toilet, redesigned flapper use (RES, CII) – Using toilet flappers designed for longer life. Standard rubber flappers deteriorate over time due to toilet bowl cleaners placed in the toilet tank or chemicals used by utilities. Use of a long-life flapper decreases the frequency of leaking tank toilets due to flapper deterioration.

Toilet, replacement, dual flush (RES, CII) – Replacing a standard tank toilet with more efficient models, such as USEPA WaterSense-labeled, dual-flush toilets, which feature two buttons or handles to flush with different volumes of water. The smaller volume (typically 0.8 to 1.1 gallons) is designed for liquid waste, and the larger volume (typically 1.28 to 1.6 gallons) is designed for solid waste.

Urinal, high-efficiency replacement (CII) – Replacing conventional urinals with more efficient models, such as USEPA WaterSense-labeled equivalent products.

Urinal, replacement, waterless (CII) – Replacing conventional urinals with more efficient models, such as USEPA WaterSense-labeled equivalent products. This practice could be applied to new CII facilities but may have limited application. This device is recommended primarily in new construction as there are challenges to successful implementation in existing buildings. In all applications, special maintenance is required.

Indoor/Outdoor

Air-cooled device use (CII) – Replacing water-cooled devices with air-cooled devices and equipment at CII facilities. Examples of equipment that can use air cooling include air compressors, vacuum pumps, ice machines, refrigeration condensers, hydraulic equipment, and X-ray processing equipment.

Automatic shutoff valve use (CII) – Using water valves that automatically stop water flow when a user-determined water level, volume, or time interval is reached. Water savings are increased compared with manually operating valves primarily due to operator inconsistencies (e.g., letting water flow too long).

Outdoor

Auto pump start/stop use (AG) – Using these devices to start and stop irrigation pump engines automatically. The grower controls the pumps remotely or by using other sensor data, such as air temperature, rain, or soil moisture. Water is conserved by allowing growers or farm managers, who are responsible for multiple pumps (often more than 10 pumps), to start and stop pumps based on crop needs instead of when time allows them to visit each pump station.

Automated valve use (AG, L/R) – Using irrigation system valves, which can be operated remotely or automatically shut off when a sensor indicates a certain water level, soil moisture level, irrigation volume, or time interval is reached. Water savings are realized over manually operated valves primarily due to operator inconsistencies (e.g., letting water flow too long).

Car wash equipment, low flow/recirculating (CII) – Using either a portable, high-pressure, low-flow device to replace use of a hose for car washing or using a recirculating system that captures, treats, and reuses wash and rinse water at commercial car wash facilities.

Fully enclosed seepage irrigation system conversion (AG) – Replacing open or semiclosed seepage irrigation systems with more efficient, fully enclosed seepage systems. Fully enclosed seepage irrigation systems increase irrigation efficiency by reducing losses due to evaporation and runoff from open or semiclosed seepage irrigation systems.

Gated and flexible pipe for field water distribution systems (AG) – Using gated and flexible irrigation piping in an agricultural operation. This measure is applicable to agricultural producers who plant row crops and is used to convey irrigation water to furrow- or border-irrigated fields. Gated and flexible pipe reduces seepage losses associated with open-channel distribution and increases efficiency and uniformity of delivery to the furrows (e.g., by reducing deep percolation of irrigation water near the head of the field). Cost effectiveness varies based on site-specific seepage rates in open channels and field layout (i.e., furrow spacing). Furrow dikes typically are used in arid and semi-arid regions, so applicability in Florida is limited.

Irrigation, canal/ditch lining (AG) – Lining of open conveyance canals and on-farm ditches with impervious material to decrease conveyance losses from seepage.

Irrigation, efficiency nozzle and head use (AG, RES, CII, L/R) – Increasing irrigation efficiency by switching irrigation hardware to more efficient nozzles and heads. Efficiency can be achieved through increased distribution uniformity and less drift loss.

Irrigation, retrofit/replacement with a more efficient irrigation system or system components (AG, RES, CII, L/R) – Replacing an existing irrigation system or component with a more efficient system or component. Some examples are listed herein as individual measures.

Isolation valve use (AG, L/R) –Using valves that separate main irrigation lines and major laterals from the water supply source. These valves isolate all or part of the system for repairs, maintenance, or winter shutdown. These devices can save water as they allow for the repair of a portion of the system without running the entire system.

Line flushing, automatic device use (PS) – Flushing water lines is a routine practice of utilities to meet and maintain water quality requirements within distribution lines. Using an automatic device can achieve and maintain the desired water quality levels in a water distribution system by releasing prescribed volumes of water at a regulated frequency or (when smart technology is incorporated) per automatic on-site water quality sampling. These devices typically are more efficient than manually opening a fire hydrant.

Line flushing, looping (PS) – Line looping is a design approach for water supply conduit infrastructure that involves the installation of new piping to connect existing dead-end lines to existing sections of piping with higher demands (usually the main trunk line). By installing flow-regulating valves and diverting additional flows through the local area where the dead-end line was located, the need for flushing often can be reduced or eliminated.

Line flushing, unidirectional (PS) – Unidirectional line flushing is a routine practice of utilities to meet and maintain water quality requirements and to scour biofouling and sediments from distribution lines. Distribution lines are flushed at high velocity in a pattern whereby only previously scoured pipes (clean) precede the next section of pipe targeted for cleaning. This method of flushing has been shown to scour distribution lines using less water than other methods.

Linear move sprinkler irrigation system conversion (AG) – Replacing less efficient systems with linear move sprinklers for improved application efficiency. Linear move systems deliver water in a straight line and work well for square-, rectangular-, and round-shaped fields.

Low-pressure, center-pivot sprinkler irrigation system conversion (AG) – Replacing an irrigation system with more efficient, low-pressure, center-pivot sprinklers. These systems increase irrigation efficiency by reducing losses due to evaporation and runoff compared to high-pressure, center-pivot systems or seepage irrigation systems.

Metering and submetering water (outdoor) installation (AG, CII, L/R) – Installing water meters in pumping facilities and at critical locations throughout an irrigation system. Irrigation meters typically register flow rate and total volume. Information collected from meters can help detect leaks and calculate irrigation efficiencies.

Microirrigation (drip/bubbler/microspray) conversion (AG, RES, CII, L/R) – Increasing irrigation efficiency by switching irrigation methods to low-flow hardware in landscape beds. Most types of microirrigation deliver water below the plant canopy and directly to the root ball, resulting in higher application efficiencies than sprinklers. Microirrigation emitters apply less than 30 gallons per hour.

Multistage greenhouse control systems (AG) – In Florida, greenhouses commonly are cooled using fog or fan and pad evaporative systems. As temperatures rise, multistage controllers can separately open greenhouse vents, then run cooling fans and delay turning on the fog or wetting system for the evaporative cooling pads until needed. These controllers operate in the reverse direction as temperatures drop. These adjustments in water use can reduce the amount of water lost to evaporation.

On-farm irrigation ditch replacement with pipelines (AG) – Replacing on-farm conveyance ditches with pipelines to decrease conveyance losses from seepage by replacement of open channels with pipelines. This is applicable to irrigated farms that use an open ditch to convey irrigation water, and as an alternative to lining the ditch. It is limited by ditch capacity (typically limited to ditches with less than 5 cubic feet per second capacity) and cost. Cost effectiveness varies based on site-specific seepage rates in open channels and required pipe size based on capacity.

Rain sensor shutoff device use (AG, RES, CII, L/R, PG) – Using a device that interrupts the operation of an automatic irrigation system during and shortly after significant rainfall events. Water is conserved by preventing the application of irrigation water when it is not necessary. Functioning automatic shutoff devices are required by state statute on all irrigation systems regardless of the year built.

Shade control structure use (AG) – Installing structures to provide shade and temperature control from direct sunlight and to reduce evapotranspiration (ET) and soil drying, thus reducing irrigation needs. Shade structures provide other advantages for crops, such as bird protection, hail protection, and some wind protection. Because shade structures can reduce air mixing during cold radiation events, temperatures inside often are colder than outside, so supplemental heating may be needed.

Smart irrigation controller use (AG, RES, CII, L/R) – Smart (or advanced) irrigation controllers are those that monitor and use information about site conditions (e.g., soil moisture, rain, wind, slope, soil, plant type) and apply the amount of water necessary to meet plant needs based on those factors and plant species (https://www.irrigation.org/). There are generally two types of smart controllers: climatologically based controllers (also known as weather- or ET-based controllers) and soil moisture sensor-based controllers. Water is conserved by automatically controlling the system based on crop water needs.

There are three types of ET-based controllers:

1) Signal-based controllers receive remote weather and climate data.
2) Historical ET-based controllers use a pre-programmed crop water use curve for different regions.
3) On-site, sensor-based controllers use real-time, on-site measurements of soil and weather conditions to calculate ET continuously and adjust the irrigation scheduling accordingly.

There are two types of soil moisture sensor-based controllers:

1) Bypass systems are most commonly used for small sites, including most residential lots. A soil moisture sensor-based system will irrigate according to soil moisture thresholds, set by the user, which should correspond to plant species' needs, accounting for soil and other local climate conditions. This arrangement will bypass a scheduled irrigation event if soil moisture content is sufficient due to antecedent rainfall or irrigation.
2) On-demand soil moisture sensor controller systems are set to irrigate when soil moisture falls below a set threshold and terminate the irrigation event when the threshold has been met.

Soil moisture sensor use (AG, RES, CII, L/R) – Using these devices to interrupt the operation of an irrigation system when the soil reaches field capacity or excess irrigation water is draining below the root zone of the crop. Water is conserved by preventing the application of water when it is not necessary. Soil moisture sensors can also indicate when the soil moisture drops too low and irrigation is required. In some cases, this measure has increased water use.

Tensiometer use in field or container blocks (AG) – Using a tensiometer to measure soil moisture or soil water content. By knowing the water content in the root zone, a grower can make an informed decision about when irrigation is necessary.

Water control structure use (AG) – Using a structure or series of structures in a water management system to convey water, control the direction or rate of flow, and/or maintain a desired water surface elevation. Typical water control structures consist of a combination of drops, chutes, turnouts, surface water inlets, pipe drop inlets, box inlets, head gates, flashboard risers, culverts, and pipes, all in varying sizes and shapes.

Water table observation wells (AG) – Placing monitoring wells in agricultural fields to show the grower how high the water table is in the field. The depth to the water table indicates whether further irrigation is required and prevents irrigation when it is not needed. Depth readings can be taken manually or monitored remotely. This practice is most effective with certain soil types, such as those with a spodic or clay horizon.

Weather station with ET measurement (AG, CII, L/R) – An irrigation controller or computerized system incorporates real-time weather data to update scheduled irrigation events automatically. This can include a rain sensor that interrupts the operation of an automatic irrigation system during and after rainfall events, or a temperature and relative humidity sensor that helps the grower decide when to turn the irrigation system on or off for frost or freeze protection. Some irrigation controllers do not automatically change scheduled irrigation events, but the data collected by the weather station can be used by the grower to limit irrigation to only the amount of water that was not supplied by rainfall.

Wind blocks (AG) – Planting of trees or bushes along the perimeter of a field to reduce and deflect winds, thus reducing evaporation. Lower evaporation rates can translate to lower irrigation needs.

Other

Advanced metering infrastructure and advanced metering analytics (PS) – Automatic meter reading refers to technology that automatically collects consumption data from water meters and transfers that data to a central database for billing, troubleshooting, and analyzing. Advanced metering infrastructure represents the networking technology of fixed network meter systems that go beyond automatic meter reading into remote utility management. In addition to saving labor costs, these technologies help water providers more accurately monitor water use and demand management program effectiveness, detect leaks, and account for revenue and nonrevenue water. Advanced metering analytics is the use of computer technology to analyze water use and identify high water users, potential leaks, and use patterns.

Treatment system efficiency increases (PS) – A utility may be able to reduce water losses within the water treatment process and at the treatment plant via the following actions: metering unit processes, increasing water use efficiency of the treatment components, recirculating water where feasible, routinely checking for water leaks, and outfitting storage tanks and reservoirs with overflow check valves.

CONSERVATION PRACTICES

Indoor

Dish and clothes washer practices (RES, CII) – Eliminating the running of partial loads in favor of running only fully loaded appliances.

Food preparation and washing (RES, CII) – Decreasing the water used to rinse, wash, and prepare food.

Garbage disposal efficient use (RES, CII) – Decreasing the time and flow rate of disposal and food grinder water use. Regular maintenance and water use monitoring (to maintain efficiency settings) can reduce water use. Automatic shutoff (every 15 minutes) can help reduce loss as well. Using cold water only will reduce energy consumption. This practice may also include the scraping of food waste directly into the garbage and avoiding the use of a grinder or disposal altogether.

HVAC cycles of concentration (CII) – Using various methods and technologies to increase the cycles of concentration in cooling tower operations. A cycle of concentration is related to how often fresh water can be pumped around the system before the water accumulates impurities and has to be bled off from the system or augmented with fresh water. The higher the cycles of concentration, the less makeup water is required, thereby maximizing water efficiency.

Indoor high-efficiency codes adoption (RES, CII) – Adopting indoor water use codes to require high-efficiency fixtures and devices in new construction and in major renovations of existing structures. New appliances and fixtures typically reduce water use by 20% (or more) compared to equivalent conventional models. Additionally, indoor water use codes can be adopted in conjunction with or separately from high-efficiency irrigation and landscaping standards. High-efficiency indoor water use codes can be adopted statewide, by local governments per ordinance, or by water management districts via rule. Some utilities may be able to require implementation of high-efficiency codes as a condition of service.

Indoor residential water use assessment/audit (RES) – Many utilities provide indoor water audits to customers upon request, or the audit may be initiated by the utility as a result of high water use on a customer's bill. The purpose of the audit is to assess the customer's water use to determine how much can be saved versus how much is being used and to educate and assist the customer in conserving water and reducing the water bill. Water conservation kits and conservation literature often are provided to the customer as part of the audit. Auditors typically check the water meter for movement in order to detect water leaks; check the faucets, shower heads, and hot water heaters for leaks; and check under cabinet sinks, the hot and cold water hoses on the customer's clothes washer, and the outside water spigots and hoses for leaks.

Restriction of one-pass (once-through) equipment (CII) – Precluding any processes or equipment in new facilities that use water only once before discharge. Types of equipment that typically use one-pass cooling are ice machines, X-ray equipment, ice cream and yogurt machines, walk-in coolers, vacuum pumps, air compressors, condensers, hydraulic equipment, degreasers, CT scanners, and some air conditioning equipment.

Retrofit at resale requirement (RES, CII) – Local ordinances or conditions of service that require replacing inefficient fixtures and/or appliances at the time of housing resale or major improvement (renovations).

Steam boiler efficiency (CII) – Increasing the operating efficiency of steam boiler equipment. This may entail improving water quality, increasing boiler cycles, and/or capturing and reusing boiler condensate for makeup water.

Water use ethic (PS, AG, RES, CII, L/R, PG) – Encapsulates all water-conserving behaviors that are voluntarily employed (e.g., fewer toilet flushes, shortened or limited faucet and shower use).

Water use survey (RES) – A questionnaire-based survey designed to gain an understanding of a user's or community's water use (e.g., volumes used for specific tasks, patterns/timing of use). The data acquired can be used by property owners and/or conservation professionals to better understand use patterns and to identify practices, measures, and/or design programs to increase water use efficiency.

Indoor/Outdoor

Full-facility water use assessment/audit (CII) – A formal, comprehensive assessment or audit of all aspects of a CII facility's water use (indoors and outdoors). This self-audit process precedes the development of a water use efficiency improvement plan. The South Florida Water Management District (SFWMD) has developed a full-facility water use efficiency self-audit guidebook for commercial and institutional facilities (SFWMD Commercial Institutional Self-Audit Guidebook) that may also have some applicability to residential settings (see *Water use efficiency improvement plan development* below).

On-site generated gray water reuse (RES, CII) – Capturing gray water from sinks and showers, treating it, and reusing it for some other purpose (typically toilet flushing).

Process water control and recycling (CII) – Capturing water from part of a commercial or industrial process for reuse in another on-site process.

Outdoor

Allow lawn to go dormant (RES, CII, L/R) – Curtailing or discontinuing lawn irrigation during the winter months when grass is dormant.

Brush control/management (AG) – Removing and/or reducing brush to reduce ET. It is typically applicable to nonirrigated land in areas with sufficient rainfall. Brush near a crop field competes with the crop for the available water, resulting in a need for increased irrigation.

Contour farming (AG) – Creating beds of consistent elevation on properties with sloped land reduces runoff and increases water infiltration, so less supplemental irrigation is required.

Conversion of supplemental irrigated farmland to dry-land farmland (AG) – Switching to a crop that does not require irrigation to supplement rainfall.

Crop residue management and conservation tillage (AG) – Tilling the soil improves the soil's ability to hold moisture, reduces the amount of runoff from the field, and reduces evaporation of water from the soil surface.

Cyclic scheduled irrigation (AG, L/R) – Irrigating over a short period of time until surface water pooling starts, then stopping irrigation to allow infiltration. This is applicable to nearly all direct application (i.e., surface) irrigation methods. Applying irrigation in short bursts rather than in longer cycles ensures effective infiltration with minimal runoff. This conserves water by reducing runoff, thereby increasing application efficiency. Cyclic irrigation can also be used to decrease water loss in container nurseries.

Distribution system audits, leak detection, and repair (PS, CII, PG) – A water distribution system audit primarily helps utilities understand the various components of their water balance and their nonrevenue water sources and costs. Tools are available to help utility managers conduct this type of analysis. Acoustic equipment often is used to pinpoint leaks in the distribution system. A successful leak management strategy requires pressure management, active leakage control, pipeline and asset management, and rapid and quality repairs.

Fertilization efficiency practices (AG, RES, CII, L/R) – Optimizing fertilizer use (through application timing, volume, and watering methods) with the goal of protecting groundwater and surface water quality. Additionally, efficient fertilizer use can reduce the need to irrigate.

Furrow dikes (AG) – Adding dikes in irrigation furrows to control distribution of surface water within a field, which reduces runoff and increases infiltration of rain or applied irrigation. Furrow dikes typically are used in arid and semi-arid regions, so applicability in Florida is limited.

Green roofs (CII) – Installing a roof that is partially or completely covered with vegetation. A green roof absorbs rain (reducing stormwater runoff) and provides insulation to reduce heating, thus reducing indoor cooling loads. By reducing cooling loads, less water is consumed by cooling tower units.

Group plants according to water needs/hydrozoning (AG, RES, CII, L/R) – The practice of grouping plants with similar water needs together to avoid overwatering.

Irrigation codes, adoption of higher efficiency (RES, CII, L/R) – Adopting codes with high-efficiency irrigation design standards for a region, county, municipality, or utility service area. The codes aim to reduce the volume of water used to meet plant needs (supplemental to rainfall) and to deliver water in application patterns that minimize waste. Examples include requiring water-efficient and/or pressure-regulating sprinkler heads, head-to-head coverage, the use of microirrigation (where applicable), and irrigation of plants with similar water needs separate from other plant types with different needs. Codes can be adopted in conjunction with or separately from high-efficiency landscaping and/or indoor standards. High-efficiency irrigation water use codes can be adopted statewide, by local governments per ordinance, or by water management districts via rule. Some utilities may be able to require implementation of high-efficiency irrigation practices as a condition of service.

Irrigation, scheduling (AG, RES, CII, L/R) – Developing an irrigation schedule to determine when and how much to irrigate based on the irrigation system type and efficiency, weather conditions, crop requirements, and soil characteristics. Local weather stations and soil moisture sensors can help adapt the schedule to the real-time site conditions. Water savings are obtained by not overwatering plants.

Irrigation, system audit/evaluation (AG, RES, CII, L/R) – Evaluating in-ground irrigation systems. Most audit evaluations include inspection of the irrigation equipment and controllers, performance of sprinkler precipitation tests, calculation of a site-specific water budget, and derivation of an irrigation schedule based on test and local weather data that serve as a precursor to a water-efficiency improvement program. The SFWMD has developed a full-facility water use efficiency self-audit guidebook for commercial and institutional facilities, including irrigation system evaluation procedures (SFWMD Commercial Institutional Self-Audit Guidebook). Many elements in this guidebook may also have applicability to residential systems.

Landscape codes, adoption of water efficiency (RES, CII, L/R) – Adopting codes with high-efficiency landscape design standards for a region, county, municipality, or utility service area. The codes aim to reduce the volume of water used (supplemental to rainfall) to meet plant needs. Examples include using plants adapted to the local environment, limiting the use of plants with high-irrigation needs, and requiring some part of the landscape to remain unirrigated. These codes can be adopted in conjunction with or separately from high-efficiency irrigation and/or indoor standards. High-efficiency landscape codes can be adopted statewide, by local governments per ordinance, or by water management districts via rule. Some utilities may be able to require implementation of high-efficiency practices as a condition of service.

Landscape efficiency audit (RES, CII, L/R) – A formal audit of a landscape to evaluate elements that can improve water use efficiency. The audit typically includes an inspection of the compatibility of a plant with the local climate and soil conditions, placement (with respect to shading and size at maturity), grouping (plants arranged with similar needs, such as water and fertilizer), and management (including mulching, weeding, and pruning) The SFWMD full-facility water use efficiency self-audit guidebook for commercial and institutional facilities (SFWMD Commercial Institutional Self-Audit Guidebook) could also be referenced for residential landscapes.

Laser land leveling (AG) – A laser transmitter can produce a horizontal laser plane, grading a field to the conditions needed to conserve water on the site. This practice increases irrigation uniformity and decreases runoff.

Licensed irrigation and design (working with a professional) (RES, CII, L/R) – Contracting with an irrigation company licensed with a local government or the state. This ensures that projects are overseen by an individual who has demonstrated technical and financial competency and experience at the management level. Obtaining a state license is currently voluntary.

Limiting high-volume irrigation areas (RES, CII, L/R) – Decreasing or eliminating high-volume irrigation areas within a landscape, such as sprinklers or emitters with flow rates of 30 gallons per hour or 0.5 gallons per minute or greater.

Limiting irrigated areas (RES, CII, L/R) – Decreasing or eliminating irrigation by adding or increasing areas landscaped with plants that do not need irrigation supplemental to the area's natural rainfall and can withstand periods of drought. In practice, this usually allows irrigation only to establish plant material but not to sustain mature growth.

Limiting turfgrass traffic on golf courses (L/R) – Limiting cart and pedestrian traffic to paths in order to minimize turf wear and limit soil compaction, thus reducing stress and water needs of the turf.

Limiting use of turfgrass (RES, CII, L/R) – The appropriate and prudent use of turfgrass where it serves an identified purpose. When integrated in the landscape with intention, turfgrass has many benefits, such as controlling erosion control, creating recreational areas, and reducing stormwater runoff. However, turfgrass often requires the greatest amount of irrigation supplemental to rainfall in a man-made landscape and is typically overused. This is congruent with the Florida-Friendly Landscaping Program's principle of planting the right plant in the right place.

Mowing height adjustment (RES, L/R) – Using the correct mowing height for turfgrass to reduce water needs during the hot summer months. Increased mowing height allows grass roots to grow deeper, which allows them to survive longer without supplemental irrigation.

Net irrigation requirement-based irrigation determination (AG, RES, CII, L/R) – Calculating the specific water needs of an irrigated landscape based on plant material, soil type, irrigation system efficiency, and weather. The difference between the daily crop demand (ET) and the daily effective rainfall (amount of natural rainfall available to the plant's root zone, excluding deep percolation, runoff, and plant interception) will closely predict the daily net irrigation requirement. This practice involves a trained technician (irrigation manager or auditor) tracking a water balance estimate to give the grower a refined schedule of when to irrigate and how much water to apply.

On-site rain harvesting and reuse (CII) – Capturing and storing rainfall runoff in a barrel (small-scale) or cistern (large-scale). This water typically is used for irrigation but can be used for other purposes. While not conservation in a traditional sense (as no improvement in water use efficiency occurs as a direct result), this practice can reduce demand from potable or other supply sources.

Routine system maintenance (AG, RES, CII, L/R) – Inspecting irrigation system components for compromised integrity and ensuring any previously replaced emitters are compatible with the original irrigation system design. Pressure losses through leaks and inappropriately sized components can cause inefficiencies and nonuniform irrigation patterns throughout the production field.

Sidewalk and driveway cleaning practices (RES, CII, L/R) – Removing debris with a broom or leaf blower rather than with a hose to conserve water.

Soil amendment use for water efficiency (AG, RES, CII, L/R) – Amending the soil to improve its physical properties (e.g., water retention, permeability, water infiltration, drainage, aeration, structure). Improved soil conditions can decrease the frequency of required irrigation.

Soil cultivation techniques (spiking, slicing, and core aerification) (AG, L/R) – Spiking, slicing, and/or core aerification of the soil to improve permeability, water infiltration, drainage, aeration, and structure. Improved soil conditions can decrease the frequency of required irrigation.

Surge flow irrigation use for field water distribution systems (AG) – Intermittently applying water to furrows in seepage irrigation systems. This practice is applicable to agricultural producers who currently use gated or flexible pipe (see *Gated and flexible pipe for field water distribution systems* above) to distribute irrigation water to furrow irrigated fields and who have soil types that swell and reduce infiltration rates in response to irrigation. This practice increases efficiency and uniformity of delivery to the furrows (by reducing deep percolation of irrigation water near the head of the field) and reduces the potential for ponding and runoff. Water saved by switching to surge flow is estimated to be between 10% and 40%.

Swimming pool and hot tub water use efficiency (RES, CII, L/R) – Active practices, such as routinely and consistently using pool covers, detecting and repairing leaks, and reducing drains and fills by increasing water quality.

Turfgrass, improved cultivar uses (RES, CII, L/R) – Using drought-tolerant turfgrass cultivars. Cultivars should be selected to accommodate the intended use pattern and survive in the local soil and climate conditions with minimal or no need for irrigation supplemental to rainfall.

Turfgrass, maintenance for water efficiency (RES, CII, L/R) – Employing management techniques directed at increasing drought tolerance of turf. Techniques include proper mowing height, fertilizer application, thatching, aerating, seeding, and top dressing applications.

Volumetric measurement of irrigation water use (AG) – Maintaining an accurate assessment of the irrigation water use. Helpful direct volumetric measuring devices include properly calibrated (propeller/magnetic flux/ultrasonic) flow meters and pipe pressure meters. Indirect measuring devices include energy use of the pump and duration of the irrigation event.

Water use efficiency improvement plan development (AG, CII, L/R, PG) – Intentionally developing a written water use plan focused on increased water use efficiency. The plan should outline a specific implementation roll-out and monitoring program. This typically is preceded by a comprehensive water use audit (or survey).

Other

Conservation analysis, using a planning tool (PS) – Using predictive models, which can evaluate conservation measures and practices, to estimate the associated program costs, savings, impacts on revenues, and other financial considerations. These planning tools help utilities develop water conservation plans with a numerical goal for achievable water savings. Goals typically are expressed as gallons per capita per day or a specified volume reduction.

Crop row covers/frost blankets (AG) – Fabrics that cover crops during frost/freeze events help prevent damage to the plants. These products serve as weak insulators but reduce convectional heat loss, thereby creating a microclimate around the plant that is warmer than outside the cover. This practice can reduce or eliminate the need to irrigate during frost/freeze events. Crop row covers/frost blankets can be used if there is a sufficient labor force available to deploy and anchor the covers before the freeze event.

Fog for cold protection in greenhouses/shade houses (AG) – In protected growing systems, using a low-volume fog system can effectively provide heat and reduce heat loss from the soil and plant surfaces when cold protection is required. The use of a low-volume system reduces the volume of water required for crop protection compared to a mist or sprinkler system.

Goal-based water conservation planning (PS) – Creating a demand management plan tied to a measurable, numeric goal (gallons per capita per day or a volume) to be met within a specified time according to an implementation schedule. A well-designed plan identifies a variety of measures and practices that target specific user groups. The circumstances of the utility will determine which conservation practices and measures are economically feasible and desirable to implement. Water conservation planning tools are available to help utilities develop these plans.

Improved billing and accounting software (PS) – Improved billing and accounting software is used by utilities to decrease nonrevenue water by identifying billing and data-handling errors and inconsistencies and by identifying meter inaccuracies. Many billing software packages have built-in analysis functions that can identify potential data-handling errors, by either meter readers or the utility's billing department, and report errors for verification. In addition, billing software can report monthly estimated readings and zero reads, both of which may indicate a problem with a customer's meter. Site visits help identify meters that need replacing.

Other proven water conservation techniques and ideas (PS, AG, RES, CII, L/R, PG) – Allows new water conservation and water savings techniques, measures, and ideas to be included for water conservation and/or savings. These measures should be proven to have a net water resource benefit and may include practices currently being researched, unknown, or not recognized.

Rate structure (PS) – The primary purpose of water pricing is to cover utility costs, but it can simultaneously be an effective means to promote water conservation through rate structure design. A conservation-based rate structure provides a financial incentive for end users to reduce wasteful water use. A rate structure that responsibly minimizes fixed charges, places more emphasis on volume-related charges, and has an inclining block rate structure will typically conserve more water than a flat or uniform rate structure that generates the same amount of revenue. Users faced with proper rate incentives will achieve water conservation by implementing conservation measures. Forecasting and rate models designed to analyze the effects of rate structures can be used to help utilities develop rates for their service area.

Selective inverted sink (AG) – Using an engine-driven propeller, placed parallel to the ground surface where crops are grown, to push cold air that accumulates in low areas upward, creating a suction effect that draws down warmer air during a radiation frost/freeze event. The use of inverted sinks can reduce the need to irrigate during certain frost/freeze events.

Sprinkler heads and spacing retrofits (AG) – Upgrading irrigation systems used for frost protection to improve uniformity and reduce application rates. Retrofitting can include adjusting sprinkler spacing or changing the sprinkler type to optimize rewetting intervals and coverage.

Water budget development (AG, RES, CII, L/R) – Evaluating natural rainfall and plant ET to determine the relationship between input and output of water to and from the site. The budget considers plant type, plant water needs, irrigation system design, and the water received by the crop's root zone via rainfall or irrigation during times of water deficit. Water budgets are associated with a specific amount of time (i.e., weekly) to schedule irrigation events and reduce or eliminate overwatering.

Wind machines (AG) – The movement of air by an engine-driven wind machine mixes warmer air above a temperature inversion layer with cooler air at ground level during a radiation frost/freeze event. The use of wind machines may require selective inverted sinks (see *Selective inverted sink* above) and reduces the need to irrigate during certain frost/freeze events. Wind machines are only effective during radiation freezes (calm wind conditions), during which temperature inversions develop as cold air builds up near the ground (crop). Wind machines may eliminate the need to use water for cold protection during some radiation freezes, but water may still be needed when advective freezes occur.

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