5
Evaluation of Water Source Options

The Lower East Coast (LEC) Planning Area has historically relied on fresh water from aquifers and surface water sources to meet the region's water supply needs. As population and water demand have increased, the development of other water source options has also increased. This chapter presents an evaluation of water source options available within the LEC Planning Area through 2030 to accommodate future urban and agricultural growth in the planning area while still meeting the needs of the ecosystem.

In the LEC Planning Area, freshwater source options include groundwater from the Surficial Aquifer System (SAS) including the Biscayne aquifer, and surface water from Lake Okeechobee, the Water Conservation Areas (WCAs), and connected water bodies. Additional alternative water source options include brackish groundwater from the Floridan aquifer, reclaimed water, seawater, new storage capacity by using reservoirs or aquifer storage and recovery (ASR) systems, and water conservation.

To evaluate the water source options, consideration must be given to several key factors, such as future water needs, source availability, water quality requirements for intended uses, and cost. **Chapter 2** provides summaries of gross water demand for all water use categories: Public Water Supply (PWS), Domestic Self-Supply (DSS), Agricultural (AGR) Self-Supply, Industrial/Commercial/Institutional (ICI) Self-Supply, Recreational/Landscape (REC) Self-Supply, and Power Generation (PWR) Self-Supply. The LEC Planning Area population is expected to increase by 18 percent, from approximately 5.6 million in 2010 to 6.7 million by 2030. Gross water demand for all water use categories is projected to increase by 254 million gallons per day (MGD) (15 percent) by 2030.

The PWS and AGR Self-Supply categories account for more than 85 percent of all water use in the LEC Planning Area. These two categories rely primarily on different sources. Currently, PWS utilities in the LEC Planning Area utilize fresh groundwater from the SAS to supply the majority of potable water demand. Agricultural operations in the Everglades Agricultural Area (EAA) rely on surface water, while growers in the eastern portion of the planning area use a mix of groundwater and surface water. Consumptive use permit allocations and infrastructure already exist to meet a significant portion of the 2030 water needs for PWS and AGR Self-Supply. This is important because new allocations from the primary groundwater and surface water sources are limited. The Restricted Allocation Area criteria are described in **Chapter 3** and discussed briefly later in this chapter.

The combined allocation for all PWS utilities in the LEC planning Area exceeds the 2030 projected demand. Only a handful of utilities will need to identify options to meet their 2030 demand within their service area. These options include purchase of bulk water or construction of additional treatment capacity. In some cases, adequate treatment capacity exists, but their current allocation is less than the utilities 2030 demand. This includes utilities that have site-specific limitations on freshwater availability and have developed brackish groundwater wells and reverse osmosis (RO) treatment systems. Other utilities have plans to develop this source if needed by 2030. The disposition of each utility can be found in **Chapter 6**, which provides a summary each PWS utility's demand, allocation, treatment capacities and planned projects.

In the AGR Self-Supply water use category, the total acreage in production is expected to increase by 9 percent or 45,791 acres, with 39,090 acres of the increase occurring on lands already covered by consumptive use permit allocations in the EAA. These projected changes in agricultural acres are depicted in **Figure 1** and **Figure 2**.

Each water source option presented in this chapter includes a brief description about current and future use of the water source. Additional information about water source options and their related costs is provided in Chapter 5 of the *2011–2012 Water Supply Plan Support Document* (Support Document) (SFWMD 2011a). Water treatment technologies and associated costs are presented in Chapter 6 of the Support Document, the *Water Supply Cost Estimation Study* (CDM 2007a), and the *Water Supply Cost Estimation Study – Phase II Addendum* (CDM 2007b).

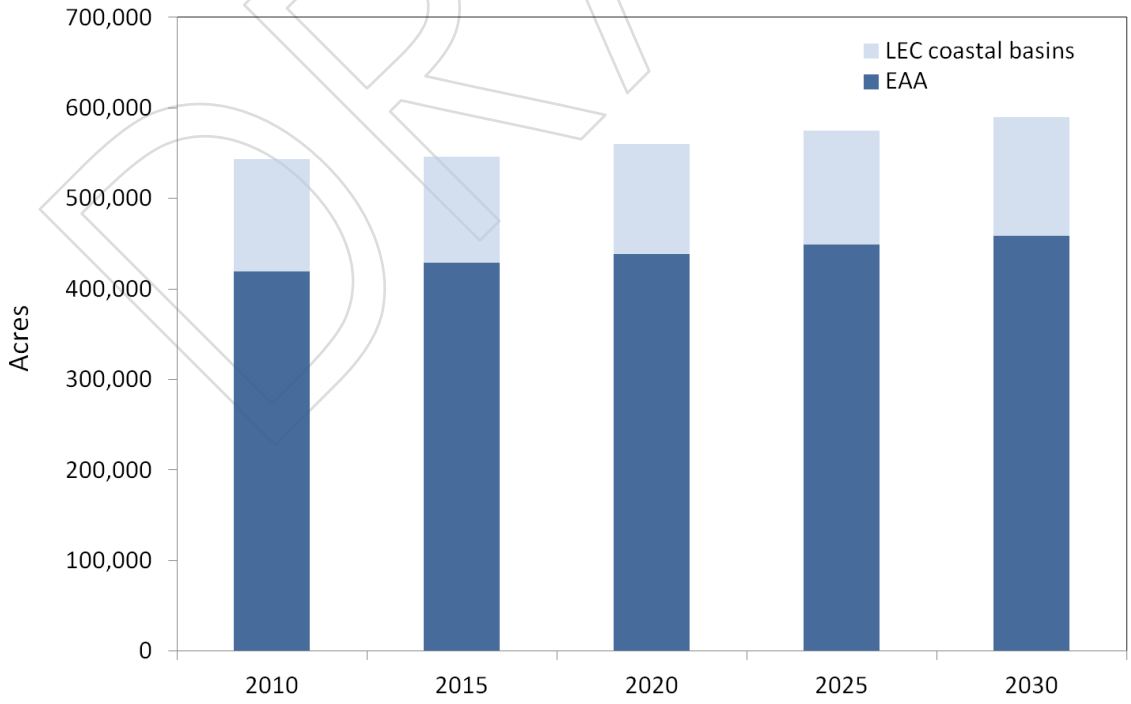

Figure 1. Predicted agricultural acreage within the LEC Planning Area for the EAA and the coastal basins.

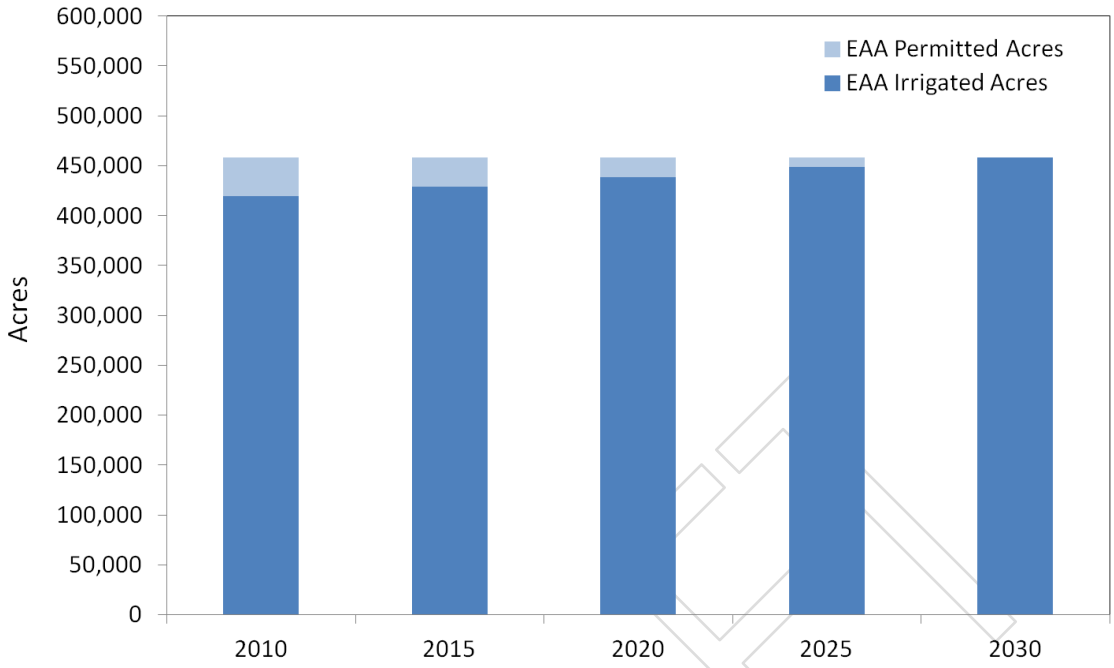

Figure 2. Growth EAA agricultural acreage projected to be in production between 2010 and 2030.

GROUNDWATER

Groundwater sources in the LEC Planning Area include fresh groundwater from the SAS, which includes the Biscayne aquifer, and brackish groundwater from the Upper Floridan aquifer. More information about these aquifers, including yields and characteristics specific to the LEC Planning Area, is provided in **Chapter 3** of this update and Chapter 10 of the Support Document.

Fresh Groundwater

Fresh groundwater is the primary source of supply for potable water consumption, landscape irrigation, and industrial and commercial uses in the LEC Planning Area. In the urban areas of the LEC Planning Area, PWS relies heavily on the SAS, including the Biscayne aquifer. The SAS produces good quality fresh water from relatively shallow wells. In many cases, the ambient water quality meets primary and secondary drinking water quality standards. These aquifers are recharged by local rainfall, groundwater seepage from the WCAs and Everglades National Park, and surface water deliveries from the WCAs. Typically, enough water is available to meet urban demand during dry seasons, and support the hydrology of natural systems at the land surface. When sufficient water is available, additional surface water from Lake Okeechobee can be routed through the WCAs to urban canals to maintain water levels and recharge the aquifer.. During droughts, lower regional groundwater levels may cause inland movement of saline water at the interface of the aquifer with seawater. In this case, water shortages restrictions may be declared by the South Florida Water Management District (SFWMD) to conserve freshwater supplies.

Figure 3 shows the distribution of SFWMD-permitted SAS wells for PWS utilities producing over 0.1 MGD. The map reveals that well capacities generally increase from Palm Beach County to the south towards Miami-Dade County as a result of the presence of the Biscayne aquifer within SAS. The transmissivity of the Biscayne aquifer increases from north to south. In 2010, PWS utilities utilized 788 MGD of fresh groundwater to supply 94 percent of their total potable water demands. Existing allocations of fresh groundwater exceed projected 2030 demand for more than half of the PWS utilities. Most of the 2030 demand will continue to be met by fresh groundwater from the SAS. More details about actual and permitted withdrawals from each source can be found in **Appendix D** of this document.

All of the estimated 19.2 MGD of DSS in 2010 were from fresh groundwater. By 2030, DSS demand throughout the LEC Planning Area is expected to increase slightly to 20.0 MGD. Domestic wells are exempt from consumptive use permitting requirements and will continue to be supplied by fresh groundwater from the SAS.

Agriculture in Broward and Miami-Dade counties is dependent upon withdrawals from the Biscayne aquifer to supply supplemental irrigation for crops, livestock, and other purposes. Fresh groundwater supplied approximately 10 percent of the total AGR Self-Supply water demand in the LEC Planning Area. In 2010, the AGR demand met by fresh groundwater was approximately 68 MGD and is expected to remain somewhat constant for the next 20 years. The remainder of agriculture acreage and demand is supplied by fresh surface water and discussed below.

Fresh groundwater accounted for 40 percent of the total REC Self-Supply demand and 60 percent of the total ICI Self-Supply demand in 2010. The remainder of the water for these two categories was derived from diverse sources including surface water, brackish groundwater, and reclaimed water. The primary use for water in this category is for irrigation of parks, athletic fields, golf courses and large landscaped areas. Growth in the REC Self-Supply category is expected to be small, about 3 percent. The increased demand will likely be met by the same three sources, depending on availability at specific locations. The largest water users in the ICI Self-Supply category are the aggregates mining and food processing industries, such as sugar mills. By 2030, ICI Self-Supply demand is expected to increase by 28 percent. The increase will largely be met by groundwater where available.

Fresh groundwater provided less than 10 percent of the total water demand for power generation in the LEC Planning Area in 2010. It is anticipated that a similar volume of fresh groundwater will be used for PWR Self-Supply in 2030, while reliance on other sources will expand. Reclaimed water use for cooling has recently expanded and is anticipated to continue to grow as a source to meet PWR Self-Supply needs through 2030.

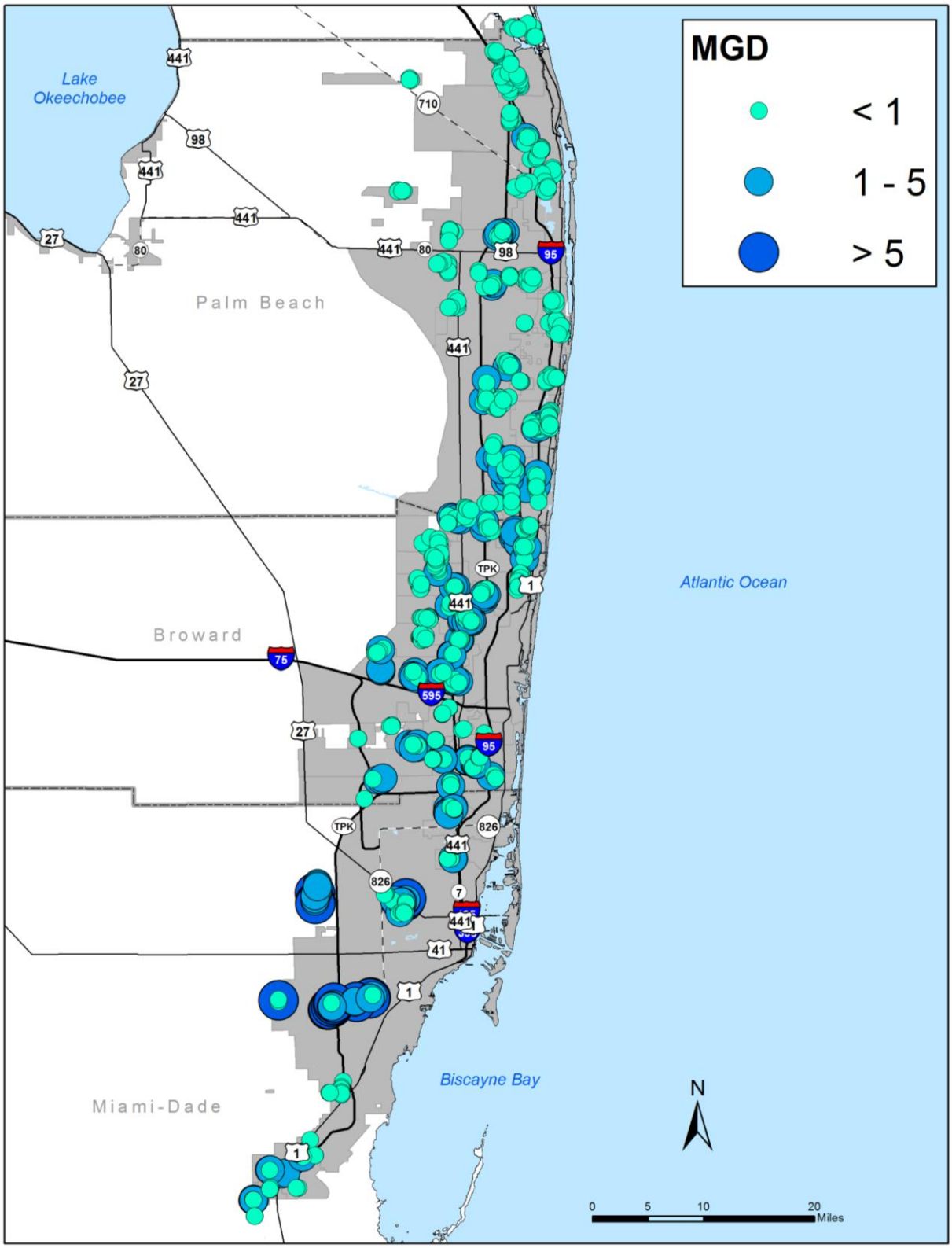

Figure 3. Location and magnitude of PWS production wells in the LEC Planning Area.

Limits on Availability

The SAS, including the Biscayne aquifer, is a source of limited availability to the extent that withdrawals result in induced seepage from the Central and Southern Florida Flood Control Project (C&SF Project), except when stormwater discharge or wet season discharge occurs, as defined by Section 1.7.2.2.B of the *Basis of Review for Water Use Permit Applications within the South Florida Water Management District*, commonly referred as the Basis of Review (SFWMD 2010). The SFWMD adopted Everglades and Loxahatchee River Watershed Restricted Allocation Area criteria (Section 3.2.1.E, Basis of Review) in 2007. A more detailed discussion of the criteria can be found in **Chapter 3**.

Brackish Groundwater

Brackish groundwater is defined as water with a chloride concentration greater than 250 milligrams per liter (mg/L) and less than 19,000 mg/L. In the LEC Planning Area, water produced from the Floridan Aquifer System (FAS), the Upper Floridan aquifer specifically, typically contains chlorides in excess of 500 mg/L. Appropriate desalination treatment technologies must be used before this type of water supply can be suitable for human consumption.

In the LEC Planning Area, the Upper Floridan aquifer provides brackish groundwater to supplement PWS and PWR Self-Supply demands. PWS utilities typically use RO to remove excess salinity. The approximate production efficiency or recovery for brackish water RO facilities districtwide is between 75 and 85 percent, dependent upon the membrane technology employed and the salinity of the water from the aquifer (Carollo Engineers, Inc. 2009). Some utilities blend brackish Upper Floridan aquifer water with fresh groundwater and treat the blended product with lime softening or nanofiltration technology to meet drinking water standards. Blending can reduce treatment costs and increase production efficiency, while meeting drinking water standards.

Brackish water use from the Floridan Aquifer System (FAS) began in the late 1970s, and increased in the 1990s, with more significant use after 2000. By 2010, approximately 30 MGD of PWS was produced from brackish water sources in the LEC Planning Area (**Figure 4**). As of 2012, there were 11 PWS treatment plant facilities with a brackish water source and treatment system in the LEC Planning Area. Combined, these facilities have an installed treatment capacity of 86 MGD. Overall, 23 utilities in the planning area have obtained Upper Floridan aquifer allocations totaling 190 MGD, but most of the that volume has not been needed, and likely will not be needed prior to 2030, based on current demand projections.

Additional users of water from the Upper Floridan aquifer include four golf courses—Seminole, Breakers, and Everglades Club golf courses in Palm Beach County and Card Sound Golf Club in Monroe County. Only one power generating facility—the Florida Power & Light (FPL) Turkey Point Plant Unit 5—uses groundwater drawn from the Upper Floridan aquifer for cooling.

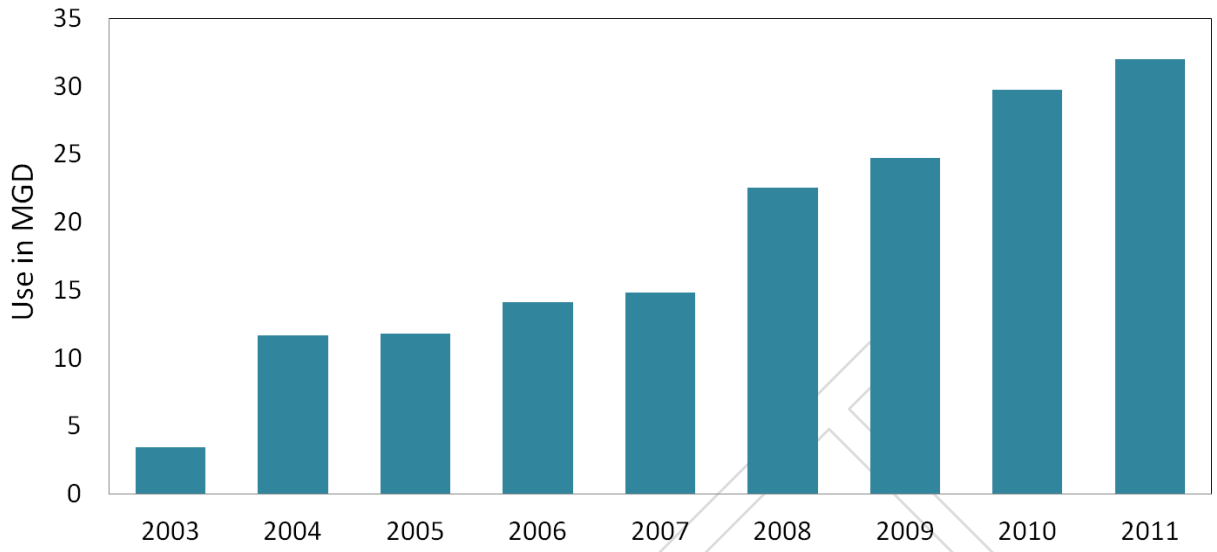

Figure 4. PWS withdrawals from brackish water sources in the LEC Planning Area for 2003–2011.

SURFACE WATER

Surface water has been a major source of water in the LEC Planning Area and will continue to be in the future. Lake Okeechobee, its connected conveyance system and the WCAs are the most significant surface water sources for the LEC Planning Area. Surface water from these sources supplies water to the regional system via canals and recharges the SAS. Lake Okeechobee serves as a backup water supply source for both agricultural and urban users in the coastal basins of the LEC Planning Area during droughts and dry times.

Within the PWS category, the City of West Palm Beach is the only utility within the LEC Planning Area to rely on surface water as its primary source. The city, which also supplies water to the towns of Palm Beach and South Palm Beach, is currently exploring options to diversify its future water supply sources to include both fresh and brackish groundwater. Although located outside of the LEC Planning Area, the Okeechobee Utility Authority is the only utility to directly tap Lake Okeechobee as a PWS source. Since the last plan update, three utilities in the LEC Planning Area and one in the Lower West Coast Planning Area have abandoned the lake in favor of the Floridan aquifer as their primary water source.

The majority of AGR Self-Supply acreage in Palm Beach and Hendry counties is in the EAA. These demands are met by surface water withdrawals from canals connected to Lake Okeechobee. In addition, agriculture in eastern Palm Beach County relies on and the regional canal network and WCA 1 surface water, as well as deliveries from Lake Okeechobee, for supplemental irrigation. Combined, they are the largest users of surface water in the LEC Planning Area. In 2010, AGR Self-Supply accounted for approximately 90 percent of surface water withdrawals in the LEC Planning Area. Overall, AGR irrigation is expected to increase by 9 percent by 2030. Most of the projected increase in demand is expected to occur in areas where consumptive use permits have been issued. In 2010 land

in the EAA had consumptive use permits for an area greater than what was in cultivated. Some land in the EAA was fallow in 2012. By 2030, all of the land permitted for supplemental irrigation in the EAA is expected to be in cultivation, approximately 458,240 acres.

All of LOSA is dependent, in part, on the surface water withdrawals from canals connected to Lake Okeechobee (see Figure 2 in **Chapter 1**). The portion of the Lake Okeechobee Service Area (LOSA) outside of the EAA that is irrigated totals approximately 156,171 acres. Like the EAA, supplemental irrigation with fresh surface water will be provided from the canals connected to the lake consistent with their consumptive use permits.

Limits on Availability

As discussed in **Chapter 3**, in October 2008, Restricted Allocation Area criteria for the Lake Okeechobee Service Area were developed as part of the Minimum Flow and Level (MFL) recovery strategy for Lake Okeechobee. The recovery strategy was needed as a result of the adoption by the United States Army Corps of Engineers (USACE) of the federal regulation Lake Okeechobee regulation schedule known as 2008 LORS, which generally lowered the water levels in Lake Okeechobee. The criteria limit allocations from Lake Okeechobee and connected surface waters, including the Caloosahatchee River (C-43 Canal) and St. Lucie River (C-44 Canal), to base condition water uses that occurred from April 1, 2001 to January 1, 2008. MFL criteria have also been established for the Caloosahatchee River (C-43 Canal). For more information see **Chapter 3** and **Appendix C**.

RECLAIMED WATER

Reclaimed water receives at least secondary treatment and basic disinfection and is reused after flowing out of a domestic wastewater treatment facility. In the LEC Planning Area, reclaimed water is used for landscape irrigation (e.g., medians, residential lots and golf courses), groundwater recharge, cooling water, and environmental enhancement.

The State of Florida encourages and promotes the use of reclaimed water. The Water Resource Implementation Rule (Chapter 62-40, Florida Administrative Code [F.A.C.]) requires the Florida Department of Environmental Protection (FDEP) and water management districts to advocate and direct the use of reclaimed water as an integral part of water management programs, rules, and plans. The SFWMD requires all applicants for consumptive use permits proposing to irrigate with more than 0.1 MGD of water and those applicants within a mandatory reuse zone to use reclaimed water if it is feasible to do so.

The use of reclaimed water in the LEC Planning Area helps to reduce potential resource impacts by decreasing the reliance on traditional fresh sources such as groundwater and surface water. Wastewater reuse, by reducing use of the traditional wastewater disposal methods (ocean outfalls and deep well injection), conserves a freshwater resource and provides an environmentally sound alternative. Reclaimed water also provides additional

supply for uses not requiring potable water, such as irrigation, although back-up disposal methods are needed in wet periods when irrigation demand is low.

Existing Reuse in the LEC Planning Area

Wastewater management has generally evolved from smaller sub-regional facilities to a partially integrated system of larger regional facilities and a limited, but growing network of pipelines to carry reclaimed water to end users. The volume of reclaimed water used for a beneficial purpose, such as landscape irrigation and cooling water has increased eight-fold from 1994 to 2011 as shown in **Figure 5**. Most of this growth has occurred in Palm Beach County. Over this period, the volume of reclaimed water use varied from year to year, depending on the addition of new users and rainfall. This information was provided by the SFWMD and taken from the *2011 Reuse Inventory* (FDEP 2012).

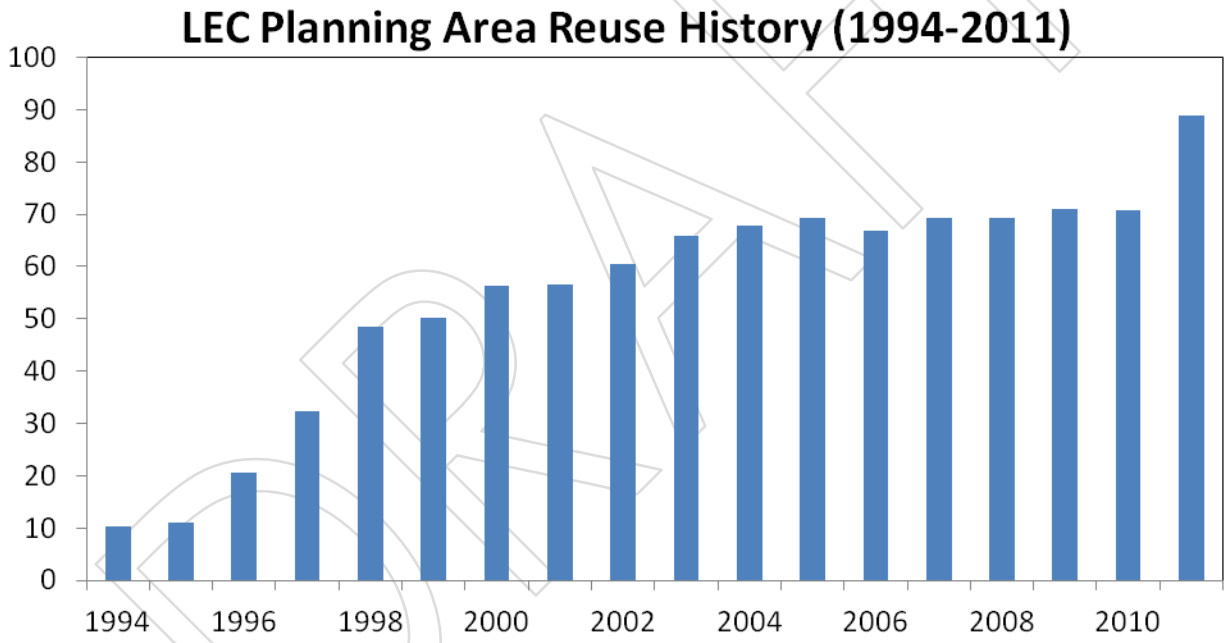

Figure 5. Annual reclaimed water reuse in the LEC Planning Area from 1994 to 2011.

In 2010, 44 wastewater treatment facilities in the LEC Planning Area had a permitted capacity of 0.1 MGD or greater. These facilities had a total wastewater treatment capacity of 860 MGD to meet peak daily flows and treated an average of 636 MGD of wastewater in 2010. The Miami-Dade Central District Wastewater Treatment Plant, operated by the Miami-Dade County Water and Sewer Department (MDWASD), remains the area's largest wastewater treatment facility, with a capacity of 143.0 MGD.

In 2010, 594 MGD of the LEC Planning Area's 636 MGD of treated wastewater supply was disposed through deep well injection (353 MGD) ocean outfalls (240 MGD). About 1 MGD was disposed through shallow injection wells in the Florida Keys area of Monroe County.

Of the 44 wastewater treatment facilities, 25 facilities reused at least a portion of their wastewater. In 2010, 71 MGD of the wastewater treated in the LEC Planning Area was reused for a beneficial purpose. Nearly 41 MGD of reclaimed water was used for irrigation of almost 20,000 residences, 55 golf courses, 47 parks, and 12 schools, mostly within Palm Beach County (FDEP 2011). Over 6 MGD of the reclaimed water supply was reused for groundwater recharge, mainly by the City of Homestead in Miami-Dade County, through rapid infiltration basins and percolation ponds. The remaining 24 MGD of reclaimed water was reused for various purposes, including hydration of two created wetlands in Palm Beach County and use at wastewater treatment facilities. Summaries of wastewater and reclaimed water facilities, including their capacities and locations, are provided in **Appendix D**.

The total amount of water reused in the LEC Planning Area in 2010 (71 MGD) exceeds the difference between wastewater treated (636 MGD) and wastewater disposed (594 MGD). There are two main reasons why total wastewater treated and disposed cannot be simply subtracted to quantify the volume reused. First, reclaimed water reused at the wastewater treatment facility may be double-counted by adding both to the treated wastewater flow and water reuse flow totals. This occurs, for example, when the utility reuses water at the treatment plant, then returns it to the disposal system. Second, several utilities have permits to blend either groundwater or surface water with their reclaimed water. This supplemental water is added into the total water reuse without being treated at the facility.

The reclaimed water is one of three primary sources of cooling water for PWR Self-Supply, along with tidal water and seawater. These sources do not require permitting by the SFWMD and, as a result, are not included in the demand numbers provided in **Chapter 2** and **Appendix A**. Starting in late 2010, the use of reclaimed water for industrial cooling increased when Palm Beach County began providing the FPL West County Energy Center with reclaimed water from the East Central Regional Wastewater Treatment Facility. The average flow of reclaimed water to the West County Energy Center, as reported in the FDEP *2010 Reuse Inventory*, was 11.8 MGD (FDEP 2011). This flow is expected to approach 20 MGD with FPL's first full year of reporting, and up to 26 MGD in the future. It should be noted that the addition of the FPL West County Energy Center as a reclaimed water customer followed the reporting period for the *2010 Reuse Inventory* (FDEP 2011), which is used as the baseline year for this document. As a result, this reuse is not reflected in the totals provided above and in **Appendix D**.

Future Reuse in the LEC Planning Area

Wastewater flows are projected to increase from 636 MGD in 2010 to an estimated 825 MGD by 2030. In 2010, 25 of the 44 wastewater facilities reused at least a portion of their treated effluent. By 2030, 42 of the 44 utilities operating wastewater facilities have indicated that they will be reusing some portion of their treated wastewater flow. FPL has proposed to use of up to 90 MGD of reclaimed water obtained from MDWASD to cool a planned expansion of nuclear powered generation at Turkey Point (Units 6 and 7).

The most significant increase in the projected reuse is expected by the utilities impacted by the 2008 amendment to the Florida statutes concerning use of ocean outfall for disposal. Those facilities and the state requirements are discussed below.

Leah Schad Memorial Ocean Outfall Program

In 2008, the Florida Legislature enacted an Ocean Outfall statute (Subsection 403.086(9), Florida Statutes (F.S.) requiring the elimination of the use of six ocean outfalls in southeastern Florida as a primary means for disposal of treated domestic wastewater and the reuse of at least 60 percent of the outfall flows by 2025. This statute became effective on July 1, 2008.

The 2008 Leah Schad Memorial Ocean Outfall Program applies to each of the facilities/utilities that have existing permits to discharge through an ocean outfall. All of the wastewater/reuse facilities utilizing ocean outfalls are located in the LEC Planning Area. The facilities are as follows:

- South Central Regional Water Reclamation Facility (Delray Beach and Boynton Beach)
- Boca Raton Water Reclamation Facility
- Broward County North Regional Water Reclamation Facility
- Hollywood Southern Regional Water Reclamation Facility
- Miami-Dade North District Wastewater Treatment Plant (MDWASD)
- Miami-Dade Central District Wastewater Treatment Plant (MDWASD)

Additionally, Cooper City and the Town of Davie are permitted to discharge through the outfall operated by the City of Hollywood at their Southern Regional Water Reclamation Facility. Therefore, these two facilities also have obligations to meet the outfall requirements.

Requirements of the outfall program include the following:

- Discharge through ocean outfalls must meet either advanced wastewater treatment and management by December 31, 2018, or an equivalent reduction in outfall nutrient loading.
- A functioning reuse system that reuses a minimum of 60 percent of the facility's actual flow on an annual basis must be installed, no later than December 31, 2025.
- Timely submission of certain progress and planning summary documents.
- The SFWMD must include projects that promote the elimination of wastewater ocean outfalls in its regional water supply plans.
- State or SFWMD funding assistance must give first consideration to water supply development projects that replace existing sources or implement reuse projects to eliminate ocean outfalls.

By 2025, 60 percent of wastewater discharged through ocean outfalls must be beneficially reused as defined in Chapter 62-610, F.A.C. This percentage is computed from a baseline discharge flow of the ocean outfalls from 2003 through 2007. The baseline flows and the 60 percent reuse requirement for each utility are provided in **Table 1**. The reuse requirements for Miami-Dade County facilities may be met countywide since the North District, Central District, and Southern District facilities are owned and operated by the MDWASD and are interconnected.

Table 1. Baseline flows and 60 percent reuse requirement for the utilities affected by the 2008 Ocean Outfall statute.

Utility	Baseline Flow (MGD)	60 Percent Reuse Requirement (MGD)
South Central Regional Water Reclamation Facility	12.9	7.7
Boca Raton Water Reclamation Facility	10.3	6.2
Broward County North Regional Water Reclamation Facility	37.4	22.4
Hollywood Southern Regional Water Reclamation Facility	36.7	22.0
Cooper City Wastewater Treatment Facility	1.5	0.9
Davie Wastewater Treatment Plant	1.9	1.1
Miami-Dade North District Wastewater Treatment Plant (MDWASD)	81.0	117.5
Miami-Dade Central District Wastewater Treatment Plant (MDWASD)	114.8	
Totals	**296.5**	**177.8**

Each of the utilities using ocean outfalls was required to submit an annual report by June 2010 to the FDEP on the implementation of the ocean outfall statute. The utilities continue to implement and plan for these changes. The status of those changes for each of the ocean outfall utilities is as follows:

- **South Central Regional Water Reclamation Facility –** A deep injection well was installed to handle disposal. The ocean outfall will now only be used as a back-up for emergencies. Sixty percent water reuse requirement is expected to be met by primarily increasing public access irrigation in the cities of Boynton Beach and Delray Beach.
- **Boca Raton Water Reclamation Facility –** The city is planning to increase capacity of its facility to provide 100 percent reuse. Reclaimed water will be provided for public access irrigation at additional locations in, or near, the city.
- **Broward County North Regional Water Reclamation Facility –** Broward County is considering meeting the 60 percent reuse requirement by expanding its public access irrigation in northern Broward and southern Palm Beach counties, including expanding reuse systems in the cities of Pompano Beach and Coconut Creek.
- **Hollywood Southern Regional Water Reclamation Facility –** Hollywood is considering recharging the upper Floridan aquifer with reclaimed water to meet the 60 percent reuse requirement.

- **Cooper City Wastewater Treatment Facility –** It is anticipated that Cooper City will be working together with one of its neighboring utilities to meet the ocean outfall requirements.
- **Davie Wastewater Treatment Plant –** Davie is in the process of constructing a city-owned water reclamation facility, thereby reducing the amount of wastewater effluent that is sent to the Hollywood Southern Regional Water Reclamation Facility. Reclaimed water from the new facility will be reused for public access irrigation in the city.
- **Miami-Dade North and South District Wastewater Treatment Plant –** The MDSAWD is considering a combination of alternatives to meet the 60 percent reuse requirement. These alternatives include providing up to 90 MGD of reclaimed water to the FPL Turkey Point Plant for cooling water, and recharging the Upper Floridan aquifer.

Supplemental Sources to Meet Reuse Demand

In some service areas, the demand for reuse exceeds the volume of wastewater treated by the utility. Meeting demands with reclaimed water may require the use of supplemental water supplies such as surface water, groundwater, or potable water, which enable a utility to maximize its use of reclaimed water. However, during times of drought, other water sources, such as surface water, groundwater, or potable water, may not be available to supplement reclaimed water supplies. Use of supplemental water supplies is subject to consumptive use permitting by the SFWMD. The availability of these supplies to supplement reclaimed water will be evaluated on an application-by-application basis.

Two LEC Planning Area utilities used supplemental water in their water reuse systems in 2010. Usage (flow) is expressed in terms of annual average MGD, but tends to be greater during the dry season and less during the wet season. The Seacoast Utility Authority used a combination of surface water (0.7 MGD), drinking water (0.2 MGD), and groundwater (0.2 MGD) for supplementation. The City of Boca Raton used 0.6 MGD of supplemental groundwater in their water reuse system.

STORAGE: SURFACE WATER OR GROUNDWATER

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

Aquifer Storage and Recovery

ASR is the underground storage of injected water into an acceptable aquifer. Water is collected during times when it is plentiful, typically during the wet season in south Florida and pumped into an aquifer through a well. In south Florida, most ASR systems store treated water in the FAS, which contains brackish water. When recharged into the aquifer, the stored water displaces the brackish water. The aquifer acts as an underground reservoir for the injected water. ASR provides for storage of large quantities of water for long-term storage and ultimate recovery that would otherwise be unavailable due to land limitations or lost to tide or evaporation.

Potable water, surface water, groundwater, or reclaimed water can be stored using ASR technology. The quantity and quality of water recovered depends on subsurface conditions. The level of treatment required after storage and recovery depends on whether the water is for public consumption, irrigation, surface water augmentation, or wetlands enhancement. The volume of water made available through ASR wells depends on factors such as well yield, water availability, variability in water supply and demand, background water quality in the ASR well's storage zone, and use type. Uncertainty of storage and yield capabilities and water quality characteristics present associated risks for success.

To date, thirteen ASR systems have been constructed by ten different utilities and by the USACE and SFWMD within the LEC Planning Area (**Error! Reference source not found.**). Many of these ASR wells store treated drinking water, although other source waters stored include raw groundwater, and raw or partially-treated surface water..Since then, many of the systems have become idle, awaiting resolution of regulatory issues relating to the requirement to disinfect the recharge water and/or the mobilization of arsenic in the subsurface environment.

The inactivity at some of these wells is related to a regulatory change in the primary drinking water standard for arsenic (i.e., reduction of the standard from 50 to 10 parts per billion). The revision of the arsenic standard has added uncertainty to obtaining an operation permit from the FDEP for ASR systems. As a result of this uncertainty, some of the utilities such as Palm Beach County Water Utilities, Sunrise, and Fort Lauderdale have opted to convert the ASR wells to supply wells, used solely for withdrawing water from the Florida aquifer for blending with other water sources in the treatment system.

Since the *2005–2006 Lower East Coast Water Supply Plan Update* (2005–2006 LEC Plan Update) (SFWMD 2006) was published, new ASR test wells and monitoring wells have been constructed by the City of Boynton Beach, MDWASD, and Florida Keys Aqueduct Authority (FKAA). The new Boynton Beach ASR well is now in service and represents the second ASR well in operation for that utility. The MDWASD has five ASR wells and associated monitoring wells at the West and Southwest wellfields. Most recently, they have installed ultraviolet disinfection systems on their ASR wells and anticipate cycle testing during 2013. The results of the FKAA well indicated that subsurface conditions at the water treatment plant site were not conducive to ASR implementation.

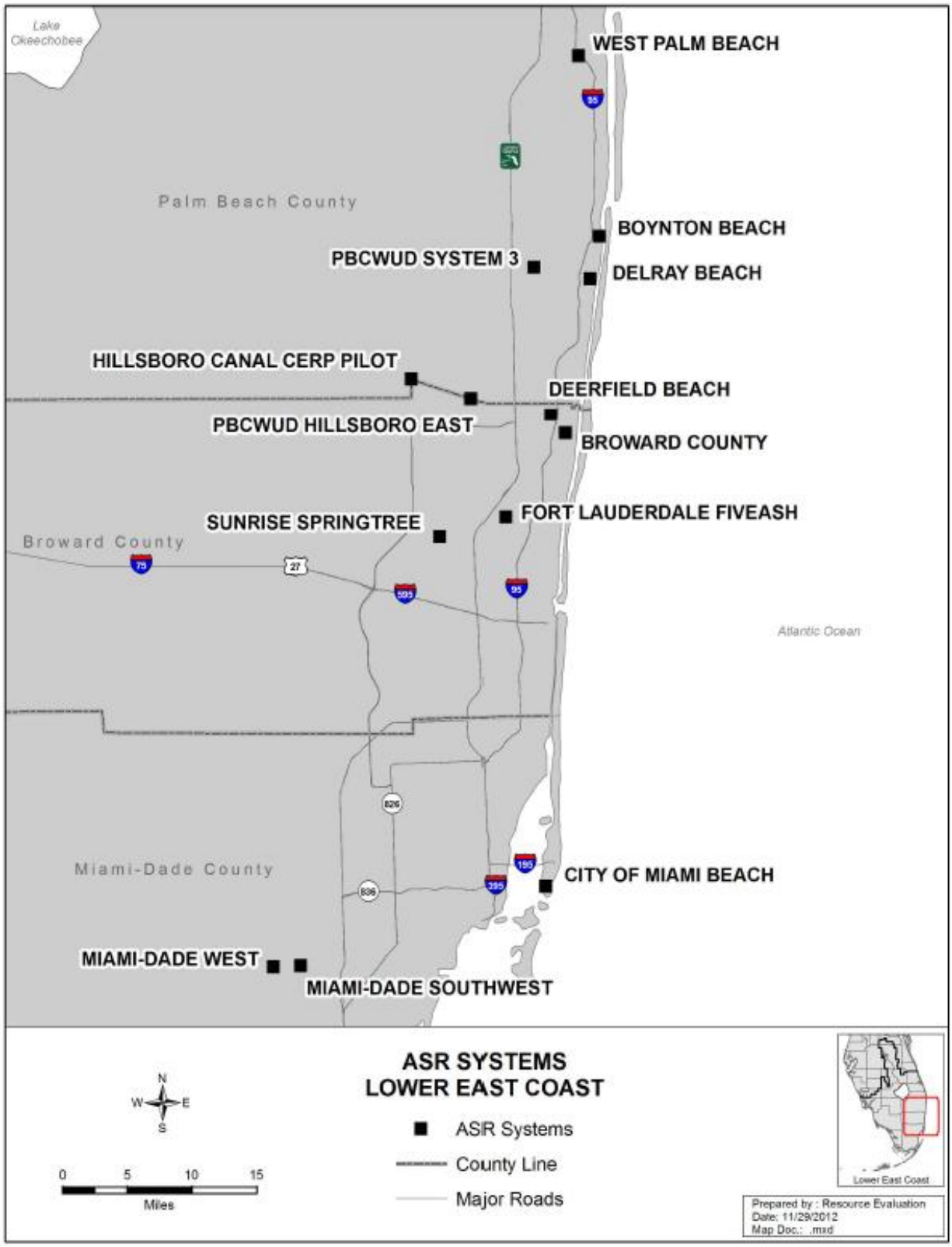

Figure 6. Location of ASR systems within the LEC Planning Area.

Aquifer Storage and Recovery Investigations

To further the understanding of storing injected water into an aquifer, several investigations have been conducted.

CERP Aquifer Storage and Recovery Pilot Project

The SFWMD and the USACE are conducting pilot tests on two ASR systems within the SFWMD boundaries to evaluate the feasibility of ASR for the large-scale storage of surface water as part of the Comprehensive Everglades Restoration Plan (CERP). The Hillsboro Canal ASR Pilot Project, located in western Boca Raton, has recently completed three test cycles. The pilot facility recharged treated surface water into the FAS, at a depth of approximately 1,000 feet below sea level. Prior to recharge, the surface water passed through a coarse screen filter and was disinfected via ultraviolet radiation. The test cycles consisted of recharge periods between 30 to 90 days (at a daily rate of 5 MGD), storage periods from 0 to 80 days, and recovery set to limits defined by a National Pollutant Discharge Elimination System permit for the Hillsboro Canal.

The results of the pilot project indicate that high capacity ASR wells, on the order of 5 MGD per well, can be successfully installed and operated in this vicinity. Recovery efficiencies ranged from approximately 20 to 40 percent, which is not uncommon for the initial test cycles at ASR systems in the LEC Planning Area. Further improvement in the recovery efficiencies would be anticipated with continued cycling testing and investment in a freshwater "target storage volume" in the vicinity of the ASR well. A complete report on the CERP Hillsboro Canal ASR Pilot Project is expected in 2013.

The second CERP ASR project is located in Okeechobee County at the confluence of the Kissimmee River and Lake Okeechobee. The pilot operation of this 5 MGD facility is scheduled to be completed in mid-2013. Recent test cycles have produced 100 percent recovery and resulted in reduced phosphorus concentrations.

Aquifer Storage and Recovery Pretreatment Investigation

This project investigated methods to suppress the freeing of arsenic from the aquifer-rock matrix that is associated with ASR activities. This project was cooperatively funded by the City of Bradenton, the Southwest Florida Water Management District, the St. Johns River Water Management District, and the SFWMD (through the CERP). The pilot project began in 2008 and was completed in 2012. The project consisted of 1) evaluation of arsenic mobilization processes occurring during ASR activities; 2) bench-scale studies on storage zone cores; and 3) development of a degasification "pretreatment" system to remove dissolved oxygen from source water prior to recharge into an ASR well. The results of the investigation indicated the removal of dissolved oxygen from the recharge water successfully resulted in the elimination of arsenic mobilization within the aquifer. These findings are significant in that they represent a technical solution to the arsenic mobilization issue associated with some ASR systems.

Local and Regional Reservoirs

Surface water reservoirs provide storage of water, primarily captured during wet weather conditions, for use in the dry season. Water is typically captured and pumped from rivers or canals and stored in aboveground or inground reservoirs. For example, small-scale (local) reservoirs are used by individual farms for storage of recycled irrigation water or the collection of local stormwater runoff. These reservoirs may also provide water quality treatment before off-site discharge. Large-scale reservoirs (regional) are used for stormwater attenuation, water quality treatment in conjunction with stormwater treatment areas, and storage of seasonally available supplies.

New surface reservoirs constructed near canals or surface water bodies are referred to as off-stream reservoirs. Captured stormwater projects are planned for water management, water quality, and water supply purposes. Projects to capture, treat and store water are discussed in **Chapter 4**.

The concept of storing excess surface water runoff in regional reservoirs has generated significant interest in the northern portion of the LEC Planning Area. In the L-8 basin, the SFWMD has purchased a 46,000 acre-feet (ac-ft). below-ground impoundment that was created by rock mining operations. Construction is underway to build facilities designed to convey water into and out of the impoundment. Immediately adjacent to the existing reservoir, another mining operation is underway that may provide an additional 75,000 ac-ft of storage (commonly known as the C-51 Reservoir). Preliminary design and cost studies have been jointly conducted by the SFWMD and PWS utilities to investigate the feasibility of using these facilities to capture and store excess surface water runoff from the L-8 and C-51 basins for beneficial uses. The LEC Planning Area utilities are currently evaluating a variety of potential implementation and funding options for the project, while the SFWMD continues to explore a potential operational role.

SEAWATER

The use of desalinated seawater from the Atlantic Ocean is an additional water source option for the LEC Planning Area. The ocean is an essentially unlimited source of water; however, desalination is required before use of seawater for water supply purposes. Desalination treatment technologies include distillation, RO or electrodialysis reversal. To date, there are two seawater desalination treatment plants in the LEC Planning Area. Both are in Monroe County and operated by the FKAA. One is located on Stock Island—the first desalination plant built in Florida—and the other is in Marathon.

Significant advances in treatment and efficiencies in seawater desalinization have occurred over the past decade. As a result, while seawater treatment costs are declining, costs remain moderately higher than brackish water desalination. In December 2006, the SFWMD completed a feasibility study, *Technical and Economic Feasibility of Co-located Desalination Facilities*, for co-locating seawater treatment facilities with power plants in south Florida

(Metcalf & Eddy 2006). The study concluded that the most feasible three sites are co-located with FPL facilities in Fort Myers, Fort Lauderdale and Port Everglades.

WATER CONSERVATION

Water conservation is an integral part of water supply planning and water resource management. For planning purposes, water conservation is also considered a water source option because it can reduce, defer or eliminate the need for expansion of the water supply infrastructure.

This section describes the state of water conservation in the LEC Planning Area and some additional water conservation opportunities, programs and tools that are available. The majority of these programs and tools apply to the PWS use category. This section also discusses best management practices (BMPs) and water conservation opportunities for agricultural and landscape irrigation. Information about the SFWMD Comprehensive Water Conservation Program, water conservation-related laws and rules, available planning resources, and funding opportunities is also presented. Additional information can be found in **Appendix E** and the Support Document,

Public Water Supply

For PWS, one key indicator of long-term water conservation effectiveness is the per capita use rates (PCURs) or finished water demand over time. Per capita consumption is calculated as PWS withdrawals in gallons per day divided by the number of permanent residents. While per capita use is an effective measure of conservation effectiveness for a single community or utility over time, it is much less effective when comparing one community or utility to another. Significant differences between communities, such as industrial use, seasonal populations, and other demographic differences can affect the total amount of water used by a community. **Table 2** presents regional utility PCURs by county in 2000, 2005 and 2010.

Table 2. PCURs in gallons per capita per day (GPCD) in the LEC Planning Area for PWS finished water.

County	2000 Per Capita Use Rate (GPCD)	2005 Per Capita Use Rate (GPCD)	2010 Per Capita Use Rate (GPCD)
Palm Beach	219	203	157
Broward	153	139	124
Miami-Dade	168	157	139
Monroe	216	211	198
Planning Area Average	**176**	**163**	**140**

Table 2 shows a pronounced downward trend in the use of finished water per person per day. This reduction in water use suggests that a water conservation ethic may be emerging. Some factors contributing to this decline include increased water reuse, recent declines in

the economy, and the effects of the year-round irrigation rule. Regardless, water efficient appliances, plumbing retrofits, minimum building code standards, education and other water conservation-oriented practices contribute to the reduction in finished water use. The SFWMD's objective is to continue this water use trend by working with water users to achieve significant long-term water savings. For a discussion about estimating the effects of water conservation, see the Support Document.

A variety of options are available to municipalities and water supply utilities for developing and enhancing water conservation programs. These options include high-level plans, such as goal-based programs, as well as specific solutions, such as plumbing retrofits and smart irrigation technology. Utilities may direct conservation measures to individual users through water conservation rate structures, retrofits and rebates. Water conservation can also be promoted at the utility level by addressing plant efficiencies, use of reclaimed water, and automatic flushing devices. An effective program includes several programmatic water conservation components. Some of these components related to rate structures are discussed below.

Water conservation planning tools are available to help PWS utilities develop water conservation plans with a numerical goal for achievable water savings. The Conserve Florida Water Clearinghouse's *EZ Guide* (2009) generates estimates of indoor water use and savings for utility service areas using data from varying entities such as county property appraiser offices and the Florida Department of Revenue. These data, along with population estimates, are used to create estimates of water consumption for structures built during each plumbing code era and for each water use sector (e.g., single and multiple family residential, industrial, commercial and institutional). The *EZ Guide* output results include water savings, costs, and net benefits for each recommended water conservation option. The *EZ Guide* is available from the Conserve Florida Water Clearinghouse website (http://www.conservefloridawater.org) at no cost.

Appendix E provides the status for PWS water conservation program implementation for municipalities and water utilities in the LEC Planning Area. Many of the options prescribed for PWS users are also applicable for DSS users. The tables in the appendix reveal that conservation efforts have enjoyed widespread acceptance in the LEC within the PWS sector. Out of 54 water utilities that were surveyed, 53 of them had public education programs and 50 of them had ongoing leak detection and repair programs. As of 2012, 45 of the utilities have implemented water conservation rate structures and 40 utilities had implemented a Florida-Friendly Landscape™ Ordinance.

The Broward Water Partnership

The Broward Water Partnership is a government service consisting of 18 municipalities and water utilities who have come together to help save water, money and the environment. The goal of the partnership is to achieve at least a ten percent reduction in countywide water demand. The partnership was initiated in 2011 with the intent to provide regional programming and messaging to residential and commercial water users. Some partners offer rebates of up to $100 each for qualifying residents, businesses and nonprofits for the

replacement of toilets and low efficiency fixtures. To date, 1,180 high efficiency toilets have been installed and $120,000 in rebates has been awarded. It is estimated that up to 30 MGD may be saved by this program by 2030. More information on the partnership can be found at www.conservationpays.com.

Water Conservation Rate Structures

Water pricing is an effective means to promote water conservation. A water conservation-based rate structure provides a financial incentive to reduce use. In the LEC Planning Area, the majority of public water providers have a block rate structure (also referred to as a "tiered" rate structure) in place. The block rate structure is generally expected to have the largest impact on heavy irrigation users. The customer's responsiveness to water conservation rate structures depends on the existing price structure, incentives of the new price structure, the customer base, and their water uses. **Appendix E** provides water rates by utility for residential customers in the LEC Planning Area.

Goal-Based Water Use Efficiency Plans

A good example of a goal-based water use efficiency plan is the *Miami-Dade County Water Use Efficiency Five-Year Plan* (Miami-Dade County 2006). This initial five-year plan became the basis for the *Miami-Dade County Water Use Efficiency 20-Year Plan* (Miami-Dade County 2007), which is expected to generate an estimated 19.6 MGD in water savings by 2026. Since 2006, each dollar the MDWASD spent implementing its water conservation plan deferred or eliminated between $5 and $9 in capital project costs. This calculation is based on the initial cost estimates of water supply development and quantified water conservation savings observed through 2009.

The water conservation plan implementation, together with smaller-than-projected population growth rates, culminated in a per capita water demand reduction from 154 GPCD in 2005 (before the plan was adopted) to 140 GPCD in 2009. Since 2006, the MDWASD spent $3,046,000 implementing its water conservation plan. The county achieved a three-year cumulative water savings of 9.59 MGD. Note that the implementation cost does not include costs associated with water loss reduction efforts.

The drop in per capita water demand enabled the MDWASD to reschedule its water supply development plan and extend the life of its consumptive use permit. **Figure 7** shows the original and revised water supply project schedules, and the pre- and post-conservation finished water demand curves. The development of Projects 1 and 2 (totaling 11.9 MGD of new water supply at a cost of $16.7 million) was a limiting condition of the MDWASD consumptive water permit. If these projects were completed, they would bridge the MDWASD water supply needs until the Floridan wells (Projects 3, 5 and 8) became operational.

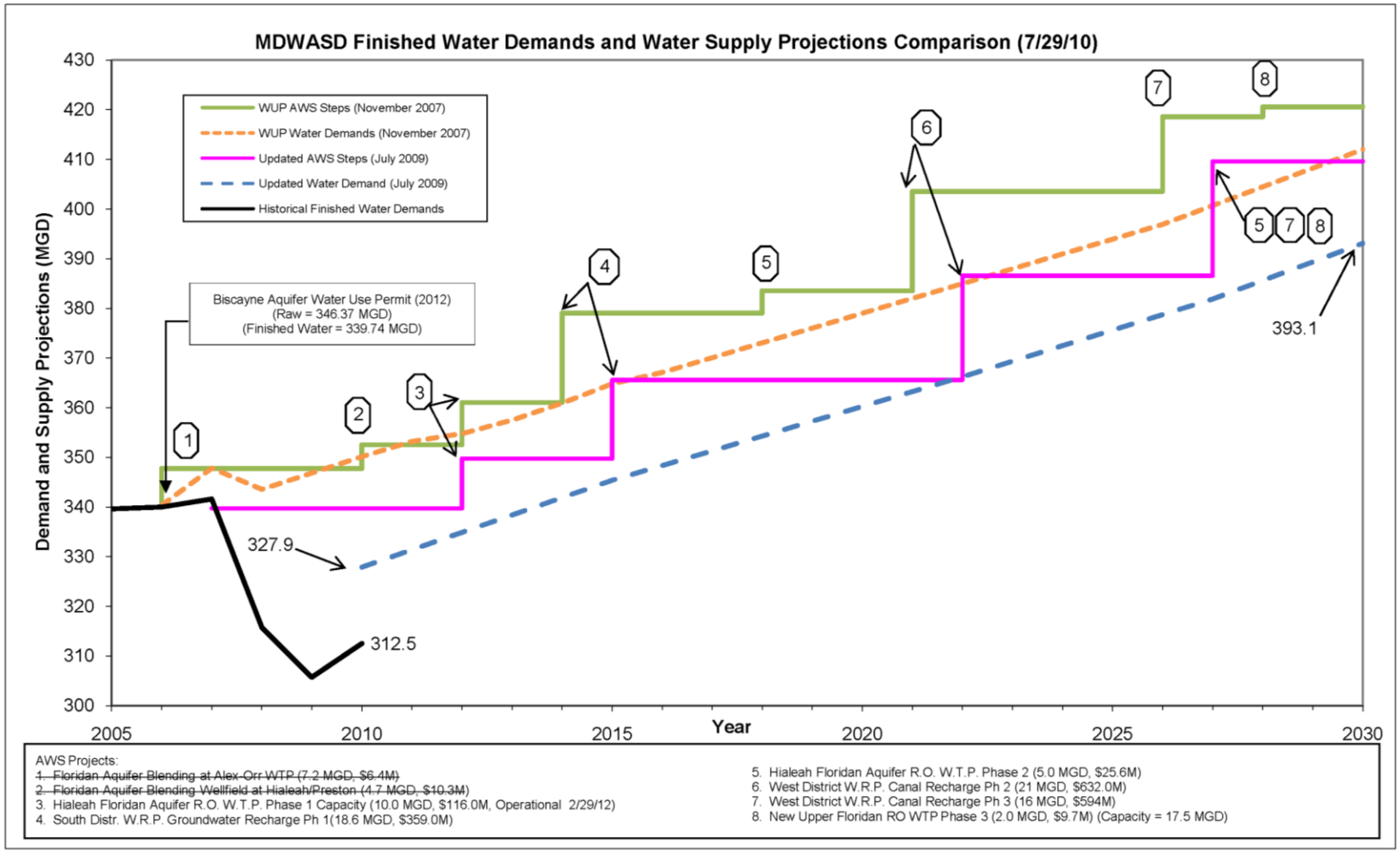

Figure 7. MDWASD finished water demands and water supply projections comparison.

Key: AWS – alternative water supply; Distr. – district; M – million; MDWASD – Miami-Dade Water and Sewer Department; MGD – million gallons per day; Ph – phase; RO and R.O. – reverse osmosis; WRP and W.R.P. – water reclamation plant; WTP and W.T.P. – water treatment plant; WUP – water (consumptive) use permit

Projects 1 and 2 were initially halted due to water quality issues, but were not replaced. Water savings achieved through conservation efforts is credited as one reason why the county's projects were not replaced. As a result of the 17-MGD drop in GPCD since 2006, the MDWASD remained within its Biscayne aquifer water supply allocation and subsequently shifted its 2027 demand to 2030. The SFWMD has since extended the MDWASD current consumptive use permit by three years, to 2030, which defers additional expenses incurred for modeling and other necessary permit application preparation work. Miami-Dade County's new water supply development schedule postpones the construction of four of its remaining six projects.

Landscape and Recreation Use

REC Self-Supply water use includes water to irrigate parks, athletic fields, golf courses, large landscaped areas (e.g., homeowner association common areas and the areas around malls and office buildings), roadway medians, golf courses, and cemeteries. The demand for water used for this purpose generally increases at a rate similar to population growth. Florida-Friendly Landscaping™ and smart irrigation technologies help minimize the demand increase.

Nationally, 58 percent of average total annual PWS water use is for outdoor purposes (Mayer et al. 1999), and 80–90 percent of outdoor water use is for landscape irrigation (USEPA 2011). Up to 50 percent of the water applied to urban landscapes is lost to wind, evaporation and improper irrigation system design, installation or maintenance with no direct benefit to the landscape (USEPA 2011). Demand reduction is possible through the use of increasing efficacy of landscape irrigation, which includes Florida-Friendly Landscaping™ principles, rain sensors, advanced irrigation technology, and proper irrigation system design, scheduling and maintenance of automatic irrigation systems.

Mandatory Year-Round Landscape Irrigation Conservation Measures Rule

In March 2010, the Mandatory Year-Round Landscape Irrigation Conservation Measures (Chapter 40E-24, F.A.C.) became effective, following considerable input from various water users, including utilities and large water users. Broadly, this rule limits irrigation of existing landscapes to two days per week districtwide with no sprinkler irrigation allowed between 10 a.m. and 4 p.m. There is a provision for up to three-day-per-week irrigation in counties wholly located within the jurisdictional boundaries of the SFWMD, including Palm Beach, Broward, Miami-Dade and Monroe counties. The chapter also provides local governments across the region the flexibility to adopt alternative landscape irrigation ordinances that are at least as stringent as the SFWMD's rule. **Table 3** provides a summary of the irrigation rules for the counties and cities located within the LEC Planning Area.

The SFWMD provides a model irrigation ordinance and technical support for local governments seeking to adopt an ordinance consistent with Chapter 40E-24. For additional information, see the Support Document.

Table 3. Landscape irrigation limits within the LEC Planning Area.

County	Local Year-round Ordinance	Number of Days Allowed	Regulation Source
Palm Beach	No	3[a]	SFWMD
Broward*	Yes	2	Local
Miami-Dade*	Yes	2	Local
Monroe	No	3	SFWMD

a. City of Lantana residents are permitted to irrigate twice weekly. All other municipalities and unincorporated areas are permitted to irrigate three days per week unless under water restrictions.

b. "*" denotes county-wide

Golf Courses

As of 2010, 184 permitted golf courses were located within the LEC Planning Area. The combined irrigated area of these golf courses is approximately 27,500 acres. Estimated annual gross irrigation demand is 80 MGD. Golf course irrigation accounts for approximately 37 percent of the region's total recreational water demand and is met by various sources.

The Comprehensive Water Conservation Program calls for SFWMD staff to confirm the use of appropriate irrigation inhibiting technology, such as properly functioning rain sensors or soil moisture sensors, on existing golf courses. According to program guidelines, golf courses must also continue to employ best management and design practices and adopt new irrigation technologies to improve landscape water use efficiency wherever feasible.

Agricultural Use

Agriculture is the second largest water user in the LEC Planning Area. As such, the AGR Self-Supply water use category offers significant water conservation potential. The consumptive use permitting process bases water allocations for agriculture on a number of factors, including the crop type, growing and irrigation methods, and site-specific parameters such as soil type and anticipated rainfall. Because a number of these factors are fixed, demand reduction must be based on aspects that can be changed, such as irrigation and growing methods. Generally, these types of changes are expensive and require extensive planning and consideration.

The SFWMD requires new citrus and container nursery projects to use micro-irrigation or other systems of equivalent efficiency. Flood/seepage irrigation type systems are typically used for tomato, corn, rice, and sugarcane production. While these types of irrigation are not as efficient as micro-irrigation, flood irrigation and tailwater recovery is reused in many areas and does provide some recharge to the SAS.

Agricultural Best Management Practices

Agricultural BMPs are actions agricultural businesses can take to protect or improve water quality or quantity while maintaining or even enhancing agricultural production. The

Florida Department of Agriculture and Consumer Services (FDACS) and FDEP develop and adopt BMPs by rule for different types of agricultural operations, specific regions or statewide. Most BMPs in the region are established to improve water quality; however, some contain an implicit water conservation component. Tailwater recovery and irrigation efficiency are BMPs identified as having implicit water conservation benefits. Tailwater recovery is a planned system to conserve irrigation water supplies through the capture and recycling of water that runs off the field while also improving off-site water quality. Irrigation efficiency can be improved by either replacing an irrigation system or by optimizing the operations and maintenance of an existing irrigation system. The selection of a new system depends on the type of crop, soil, water source and water availability. A review of irrigation scheduling—time between irrigation events and amount of water applied—might result in an increase of irrigation efficiency.

Growers and ranchers in the LEC Planning Area commonly rely on visual inspections and climatic conditions such as rainfall gauges, evapotranspiration, and weather forecasts to schedule their irrigation. Many farmers use soil moisture sensors to understand soil conditions for particular fields and crops. Soil moisture sensors can be valuable tools for agricultural irrigation scheduling.

Agricultural Mobile Irrigation Labs

Agricultural mobile irrigation labs evaluate the performance of irrigation systems and encourage the adoption of efficient irrigation management practices that conserve water. Three agricultural mobile irrigation labs service the LEC Planning Area and are managed and administered by the Soil Water Conservation Services in Broward, Palm Beach and Miami-Dade counties. From 2006 to the third quarter of 2012, evaluations were conducted on 8,893 agricultural acres in the LEC Planning Area. An estimated water savings of 1,076 millions of gallons per year (MGY), or an equivalent of 2.95 MGD was realized. The actual water savings data are obtained from a small number of farms and based on follow-up evaluations.

Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP), implemented through the United States Department of Agriculture – Natural Resources Conservation Service, was reauthorized in the Farm Security and Rural Investment Act of 2002 to provide a voluntary conservation program for farmers and ranchers. The program promotes agricultural production and environmental quality as compatible national goals. Financial and technical assistance is offered to eligible participants to install or implement structural and management practices that address impaired water quality and conservation of water resources on eligible agricultural land. For example, reduction of soil erosion and sedimentation can have a positive impact on water quality and improve irrigation efficiency. During Fiscal Year (FY) 2009 and FY 2010, 16 farms covering 9,158 acres and 12 farms encompassing 2,668 acres, respectively, participated in the program in the LEC Planning Area.

Industrial, Commercial and Institutional Use

All applications for a consumptive use permit for ICI Self-Supply use must demonstrate that the volume requested is reasonable and relates to planned facility operations. The request must contain a water balance for the complete operation that includes the needs of the production process, personal needs of the employees and customers, and any treatment losses. Consumptive use permit applicants must submit a water conservation plan at the time of permit application. The water conservation plan shall incorporate the following minimum components (Section 2.4.1, Basis of Review):

- A water audit for current operational processes
- Within the first year of permit issuance or audit completion, if found to be cost-effective, the following shall be implemented:
  - A leak detection and repair program
  - Recovery/recycling or other program providing for technological, procedural or programmatic improvements to the facilities
  - Use of processes to decrease water consumption
- Develop and implement an employee awareness and consumer education program concerning water conservation
- Procedures and time frames for implementation

To assist ICI Self-Supply users, the SFWMD published the *Water Efficiency Self-Assessment Conducted Water Audits at Commercial and Institutional Facilities Guide Managers* (SFWMD 2011b). This guide assists facility managers through self-conducted water use assessment procedures, in a detailed step-by-step manner, for the most common points of water use at commercial or institutional facilities.

Water Conservation Summary

Cooperative water conservation efforts among water users, utilities, local governments and the SFWMD are necessary to accomplish water savings. The SFWMD will continue to track the progress of utilities and municipalities developing sources to meet future demands. The SFWMD also intends to effect long-term reductions in water consumption across all water use categories by promoting and implementing many of the water conservation measures and the Comprehensive Water Conservation Program initiatives presented in this chapter.

Appendix E of this update includes the status of water conservation implementation, water conservation rate structures, water conservation versus development of additional water supplies, goal-based water conservation plans and associated water sources/irrigated acreage, and the WaterSIP projects funded in FY 2009.

SUMMARY OF WATER SOURCE OPTIONS

Overall, this update recommends continued diversification of water supply source options, such as use of the Upper Floridan aquifer, ASR, reclaimed water, and appropriate water conservation. The future water demands of the LEC Planning Area can be met during a 1-in-10 year drought condition over the 20-year planning horizon using appropriate source options. The source options are dependent on location, use type, demand, regulatory requirements, and cost. As competition for limited water resources increases, development of alternatives has become more common.

REFERENCES

Carollo Engineers, Inc. 2009. *Water Desalination Concentrate Management and Piloting*. Prepared by Carollo Engineers, Inc., Sunrise, FL, for South Florida Water Management District, West Palm Beach, FL.

CDM. 2007a. *Water Supply Cost Estimation Study.* Prepared by Camp Dresser & McKee, Inc., Naples, FL, for South Florida Water Management District, West Palm Beach, FL.

CDM. 2007b. *Water Supply Cost Estimation Study – Phase II Addendum.* Prepared by Camp Dresser & McKee, Inc., Naples, FL, for South Florida Water Management District, West Palm Beach, FL.

Conserve Florida Water Clearinghouse. 2009. *EZ Guide, Version 1.1*. Conserve Florida Water Clearinghouse, University of Florida, Gainesville, FL.

FDEP. 2011. *2010 Reuse Inventory*. FDEP Water Reuse Program. Florida Department of Environmental Protection, Tallahassee, FL. Available at http://www.dep.state.fl.us/water/reuse/inventory.htm.

FDEP. 2012. *2011 Reuse Inventory*. FDEP Water Reuse Program. Florida Department of Environmental Protection, Tallahassee, FL. Available at http://www.dep.state.fl.us/water/reuse/inventory.htm.

Mayer, P.W., W.B. DeOreo, E.M. Opitz, J.C. Kiefer, W.Y. Davis, B. Dziegielewski and J.O. Nelson. 1999. *Residential End Uses of Water*. American Water Works Association (AWWA) Research Foundation, Denver, CO.

Metcalf & Eddy. 2006. *Technical and Economic Feasibility of Co-located Desalination Facilities*. Prepared by Metcalf & Eddy, Wakefield, MA, for South Florida Water Management District, West Palm Beach, FL.

Miami-Dade County. 2006. *Miami-Dade County Water Use Efficiency Five-Year Plan*. Miami-Dade County Water and Sewer Department, Miami, FL.

Miami-Dade County. 2007. *Miami-Dade County Water Use Efficiency 20-Year Plan*. Miami-Dade County Water and Sewer Department, Miami, FL.

SFWMD. 2006. *2005–2006 Lower East Coast Water Supply Plan Update*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2010. *Basis of Review for Water Use Permit Application within the South Florida Water Management District*. South Florida Water Management District, West Palm Beach, FL.

SFWMD. 2011a. *2011–2012 Water Supply Plan Support Document.* South Florida Water Management District, West Palm Beach, FL.

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

USEPA. 2011. *WaterSense/Outdoor, Smart Outdoor Practices*. United States Environmental Protection Agency, Washington, DC. Available at www.epa.gov/WaterSense/outdoor/.