

# Integrated Water Resource Management – Meeting the Needs of the Lower West Coast Region

Mark Elsner

The South Florida Water Management District (SFWMD) is the largest of five water management districts encompassing the state of Florida, with boundaries stretching from Orlando to Key West covering all or part of 16 counties. In the year 2000, the district completed water-supply plans for each of the four regions within its borders. The plans, which will be updated every five years, projected urban and agricultural water demands through 2020 and identified sufficient water sources to meet projected demands. In areas where historically used freshwater sources will not be sufficient to meet projected needs, alternative sources will have to be developed.

## Lower West Coast Region

The Lower West Coast Regional Water Supply Plan covers the district's Lower West Coast (LWC) Region in southwestern Florida. The region encompasses approximately 4,300 square miles and includes all of Lee County, most of Collier and Hendry counties, and portions of Charlotte, Glades, and Monroe counties (Figure 1). Municipalities in the region include:

- Cape Coral
- Fort Myers
- Fort Myers Beach
- Labelle
- Marco Island
- Moore Haven
- Naples
- Sanibel

Population in the LWC Region is expected to increase by almost 70 percent from 1995 levels to about 1 million people by the year 2020. This growth will create an additional 170 million gallons per day (MGD) of demand for potable and irrigation water beyond 1995 levels. Likewise, land devoted to agriculture—primarily citrus, vegetables, and sugarcane in the eastern portion of the region—is projected to increase by 10 percent to approximately 260,000 acres, requiring an additional 70 MGD of water above 1995 levels. Agriculture accounts for 74 and 64 percent of the overall water demands for 1995 and 2020, respectively. Also, there are numerous coastal and inland environmental resources within the region.

The LWC Region receives approximately 52 inches of rainfall per year on average. Nearly two-thirds of this rainfall occurs during the wet-season months from June through October. As the region is developed and natural storage to provide flood protection for development is depleted, much of this water is lost to tide.

Unlike southeastern Florida, the LWC Region is not connected to the Kissimmee-

Lake Okeechobee-Everglades regional water conveyance system, except for the Caloosahatchee Basin. As a result, the region's freshwater supplies are highly dependent on local rainfall for recharge.

There are five major aquifer systems in the LWC Region. The lower Tamiami Aquifer and the Water Table Aquifer are unconfined, found at zero to 200 feet below the surface, and are easily recharged from the surface. The Sandstone Aquifer and mid-Hawthorn Aquifer are semi-confined aquifers, dependent on leakage from aquifers above for recharge. The Floridan Aquifer, recharged outside the region, underlies the entire region but is brackish throughout the region.

The only significant source of surface water is the C-43 canal, which is connected to Lake Okeechobee. Other than the Caloosahatchee Basin, most of the water supply for urban and agriculture needs come from the Water Table Aquifer, the Sandstone Aquifer, and the lower Tamiami Aquifer.

## LWC Water Supply Plan

From a regional perspective, the LWC Water Supply Plan (SFWMD, 2000) con-

cluded that historically used freshwater sources will not be sufficient to meet the projected demands, but with appropriate management and diversification of water-supply sources, there is sufficient water to meet the needs of the LWC region during a one-in-10 drought condition through 2020. Several water-source options were identified to address the future needs of the region, including water conservation; the use of seawater, brackish groundwater, fresh groundwater, reclaimed water, and surface water; increased storage via aquifer storage and recovery, regional and local retention, and reservoirs; and development of a regional irrigation distribution system.

## Meeting Future Needs Of the LWC Region

Among all regions of the state, the LWC Region is a leader in development of alternative water supplies. Utilities in this region

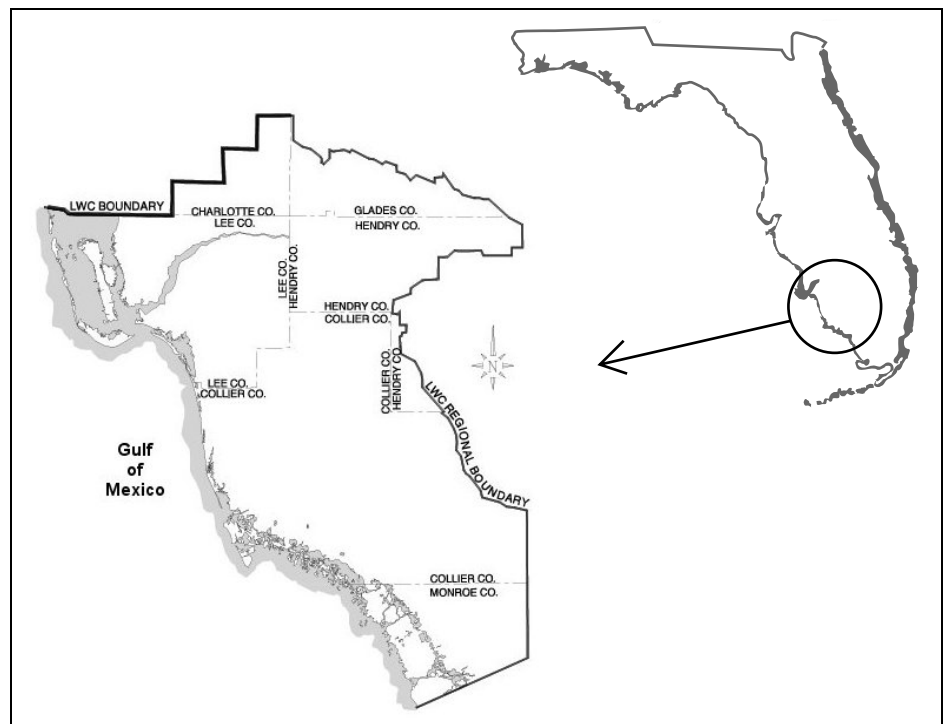


Figure 1: Lower West Coast Region

have embraced the use of reclaimed water, reusing almost 90 percent of the wastewater. Over 50 percent of the water allocated in the region for the public water supply is from the brackish Floridan Aquifer. Also, reservoirs are being constructed to meet environmental and agricultural demands, and aquifer storage and recovery of partially treated surface water, groundwater, and reclaimed water is in use or under development to make more water available during dry times.

Reclaimed-water systems are being interconnected and supplemental sources are being developed to meet urban irrigation demands, and co-location of a seawater desalination plant with a power plant is being evaluated to meet a portion of future potable-water demands. Regional and local retention projects are retaining more water in the watershed. The district has established a funding program to assist water users in developing alternative water supplies. Conservation initiatives have been implemented by local governments, utilities, and water users.

Through its conservation programs, the SWFWMD complements the development of alternative water supplies. The district is committed to fostering a year-round conservation ethic and supports technology, information, and public-service programs to encourage efficient water use. A cornerstone in this effort is a grant program that offers matching funds district-wide to utilities and local governments for water-efficient technology and equipment.

This year, eight projects were selected and awarded funding. The projects included irrigation-system retrofits and installation programs (primarily rain sensors), a shower-head exchange program, installation of ultra-low-volume indoor plumbing devices, low-flow showerheads for hotels, and automatic flushing devices for fire hydrants. These conservation projects save an estimated 171 million gallons of water per year. Applications for next year's program will be available in early 2004 on the district's Web site.

In addition to the grant program, the SWFWMD adopted a year-round landscape irrigation rule for Lee, Collier, and parts of Charlotte counties. To support public awareness and understanding of the benefits of this year-round conservation measure, a comprehensive, multi-media outreach and public-education campaign was launched.

The district also supports a mobile irrigation lab program in the region, featuring three specialized labs on wheels that evaluate the effectiveness of irrigation systems and then make recommendations on how the systems can be made more efficient—a valuable public service to owners of landscape and agricultural irrigation systems that saves both water and money.

## **Reclaimed Water**

The use of reclaimed water is significant in the LWC Region. Reclaimed water is highly treated domestic wastewater that is reused for a beneficial purpose, such as irrigating yards, agricultural land, golf courses, and other green space; providing industrial cooling water; and recharging groundwater. Reuse has allowed this region to continue to develop in several areas where freshwater is severely limited.

The region has one of the highest reuse rates in Florida. In 2001, Collier County's 107 gallons per day (GPD) of reclaimed water used per person was the highest reuse per capita in the state, and the LWC Region's average rate of 87 GPD per person is one of the state's highest. The use of reclaimed water in the coastal portions of the LWC Planning Area has reduced demands on fresh groundwater sources, potential impacts to natural systems, and seawater intrusion.

Several utilities have a waiting list for reclaimed water to become available. In 2001, 40 LWC wastewater facilities with a capacity of 0.10 MGD or greater treated an average of 71 MGD of wastewater and reused 89 percent, or 63 MGD, for a beneficial purpose (FDEP, 2002). Most of the reclaimed water was used for irrigating public-access areas, including 31,000 residential lots, 69 golf courses, 33 parks, and 10 schools.

Supplemental water sources have been developed by two utilities to meet peak demands. Collier County created a wellfield in the vicinity of a rock-mining pit to supplement its reclaimed-water supplies. The city of Cape Coral tapped its extensive freshwater canal system to supplement its reclaimed-water system and diverted surface water into its canal system that otherwise would have been lost to tide.

In the future, the volume of reclaimed water that will be reused is projected to increase as wastewater flows increase due to development, and as current and proposed reuse programs are implemented. Some of the reuse systems have been interconnected to maximize the use of reclaimed water.

## **Regional Irrigation Distribution System**

The LWC Water Supply Plan concluded that reclaimed water and groundwater will not be sufficient to meet future urban irrigation needs in the coastal portions of the region. To satisfy future demands for irrigation water, the concept of a regional irrigation distribution system is being explored by the SWFWMD in cooperation with local utilities and governments.

The system would make irrigation water available to local supply entities and utilities for

distribution. Several different configurations are being investigated, including one large regional system, several subregional systems, and distribution on a utility-by-utility basis.

A regional feasibility analysis completed in 2002 found that this system could potentially provide a total future flow of 213 MGD with unit costs ranging from \$0.67 to \$1.03 per thousand gallons. The recommended alternative involves interconnecting reclaimed water transmission/distribution systems of the regional wastewater treatment facilities, developing supplemental sources, and incorporating storage into these systems. Supply sources would include reclaimed water, surface water, and groundwater.

Since demands and availability of these sources vary seasonally, storage via aquifer storage and recovery is a critical component of this system to store water during periods of surplus for use during periods of deficit. It was recommended that the system be evaluated on a subregional basis using existing reclaimed-water distribution infrastructure, and be developed via interlocal agreements between utilities. A consultant has been selected and the subregional analysis is underway.

## **Brackish Water Sources**

There are two major sources of brackish water in the region: the Floridan Aquifer and the Gulf of Mexico.

**Floridan Aquifer**—The Floridan Aquifer has been a major source of water for regional potable-water suppliers in the region, and use of the aquifer is projected to increase to meet additional future demands. There are 11 regional potable-water supply systems in the LWC Region. Six of these systems have tapped the Floridan Aquifer for water supply and two others are constructing Floridan Aquifer wells and reverse-osmosis treatment systems.

### **Existing Brackish Water Users**

- Cape Coral
- Collier County
- Island Water Association (Sanibel)
- Greater Pine Island
- Marco Island
- Fort Myers

### **Under Construction**

- Bonita Springs
- Lee County

Over 50 percent of the water allocated for the public water supply in the LWC Region is from the Floridan Aquifer. All coastal utilities plan to use this aquifer to meet their increasing demands for water. The aquifer is brackish in this area of the state and requires desalination treatment prior to use.

**Seawater**—In addition to the Floridan Aquifer, Lee County Utilities is considering seawater as a supply source. The county, in

*Continued on page 22*

Continued from page 21

cooperation with Florida Power & Light Co. and the SFWMD, is investigating the potential of co-locating a desalination facility at Florida Power & Light's Fort Myers Power Plant. If the project proves feasible, county officials envision an ultimate capacity of 30 MGD, built in 10-MGD phases.

Co-locating such a desalination facility with a power-generating facility that uses seawater for cooling is one way to reduce the cost of seawater desalination (SFWMD, 2002). One cost-reducing benefit comes from sharing facility components. There is the cost savings associated with using the existing intake and discharge structures of the power plant to provide raw water to the desalination plant and to provide a means to dispose of the desalination-process concentrate by blending it with the power plant's cooling-water discharge. Another significant advantage of using power-plant cooling water as a source is that the elevated temperature of the water reduces the pressure and associated energy necessary to produce the product water.

### **Storage**

Storage is critical to meeting the water needs of the region. With demands and water availability varying seasonally, storage allows capturing water when it is available for later use. Aquifer storage and recovery, reservoirs, and regional and local retention projects are being developed in the region to store drinking water, surface water, partially treated surface water, groundwater, and reclaimed water.

**Aquifer Storage and Recovery**—Aquifer storage and recovery (ASR) is the underground storage of injected fresh water into an acceptable aquifer (typically the Floridan Aquifer in southwestern Florida) during times when water is available, and recovering this water during high-demand periods. The aquifer acts as an underground reservoir for the injected water, reducing water loss due to evaporation. The freshwater forms a bubble that floats on the higher-density saltwater for later retrieval. Current regulations require injected water to meet drinking-water standards when the receiving aquifer is classified as an Underground Source of Drinking Water (USDW) aquifer, unless an aquifer exemption is obtained from the United States Environmental Protection Agency.

There are 29 ASR projects in the LWC Region, from operating wells to wells for which permits are being sought. Source water for these projects include drinking water, partially treated surface water, and reclaimed water. Utilities using or pursuing ASR in the region are:

- Bonita Springs
- Collier County
- Lee County
- Lehigh Utilities
- Marco Island

In addition to local ASR applications, the SFWMD, in cooperation with the Army Corps of Engineers, is investigating the potential of large-scale application of ASR, including the Caloosahatchee Basin.

**Reservoirs**—This option involves capturing and storing excess surface water in an above-ground impoundment during rainy periods and releasing it during drier periods for environmental and human purposes. As part of the Comprehensive Everglades Restoration Plan (CERP), the C-43 Basin Storage Reservoir and ASR component project is underway. The project includes an above-ground reservoir with a total storage capacity of approximately 160,000 acre-feet located in the C-43 Basin in Hendry, Glades, or Lee Counties. The purpose of this project is to capture C-43 Basin runoff and releases from Lake Okeechobee. The reservoir will be designed for water-supply benefits and some flood attenuation, for environmental water-supply deliveries to the Caloosahatchee Estuary, and for water-quality benefits to reduce salinity and nutrient impacts of runoff to the estuary.

**Regional and Local Retention**—Regional and local retention investigates opportunities to increase water storage in watersheds through the manipulation and modification of the drainage system that serves that area, while still maintaining an appropriate level of flood protection. Much of the LWC Region has been drained to support agricultural and urban development, resulting in lowered groundwater tables. Increasing drainage-canal water levels can significantly increase water stored in the watershed, both as surface water and groundwater. Several regional and local retention projects are being proposed and implemented in the region, including the Big Cypress Basin Watershed Management Plan, the East Lee County Aquifer Recharge Project, and the city of Cape Coral's Gator Slough/Reuse System Enhancement Program.

Big Cypress Basin officials have estimated that implementation of the Big Cypress Basin Watershed Management Plan will increase water storage in the region by at least 60,000 acre-feet or 19,600 million gallons. The plan considers a range of alternative water-management strategies to augment water supply and restore historic flow-ways by interbasin transfer through modifications of its primary canal network.

The East County Water Control District (ECWCD) provides drainage for Lehigh Acres and western Hendry County encompassing approximately 70,000 acres. This district is currently implementing its East

Lee County Aquifer Recharge Project, which involves modifying and replacing control structures to raise surface-water and groundwater levels within the ECWCD. One of the phases covers over 9,000 acres and will reduce runoff by adding about 220 acre-feet of storage in the canals, increase detention, increase recharge to the Water Table and Sandstone aquifers, and restore the hydroperiod to 400 acres of wetlands. (ECWCD, 1999).

The city of Cape Coral is also using regional retention to increase water availability in its canal system to supplement the city's reuse irrigation system. The Gator Slough/Reuse System Enhancement Program involves improving weir structures, raising heights of some weirs and rehabilitating others, and removing vegetation from the slough. The project increases the amount of water stored at the end of the wet season in the Cape Coral area, reduces excessive and harmful discharges of freshwater to the Matlacha Pass Estuary, increases drainage efficiency, and reduces flooding problems in the North Fort Myers area.

The city is currently in Phase III of the program, which involves installing a horizontal well and constructing a pump station and pipeline to transfer water from one area to another. It is estimated that this project will increase the effective capacity of the reuse system by 19 MGD (City of Cape Coral, 1999).

### **Conservation**

This option incorporates water-conservation measures that address demand reduction, including practices that achieve long-term, permanent reductions in water use. The other water-source options discussed earlier make additional water available through new sources or storage; however, elements of conservation are incorporated in each of those options. For example, reclaimed water could replace existing potable water or groundwater for irrigation, resulting in reduced demands on these sources.

**Urban**—Most of the local governments/utilities in the LWC Region have adopted ordinances regarding no irrigation between the hours of 10 a.m. and 4 p.m., Xeriscape landscaping, the use of ultra-low-volume plumbing fixtures, and the use of rain-sensor devices. They also have adopted water-conservation rate structures and have implemented leak-detection/repair programs and public-education programs. Local governments in the region have supported the SFWMD in establishing a mandatory year-round landscape irrigation rule for Lee and Collier counties and those

portions of Charlotte County within the region. This new rule became effective in July 2003 and limits irrigation to three days per week.

**Agriculture**—Within the agricultural industry, many efforts have been initiated to use water more efficiently. Since 1993, citrus and container nurseries have been required to use micro irrigation or other systems of equivalent efficiency. Although this requirement applies to new installations or modifications to existing irrigation systems, many existing operations have been retrofitted. Currently more than 70 percent of the citrus in the planning area are being irrigated using micro irrigation systems, increasing the efficiency of citrus irrigation to 85 percent from 50 percent for the previously used flood irrigation. Older systems are being converted on an ongoing basis.

**Mobile Irrigation Labs**—There are three mobile irrigation labs (MILs) operating in the region. These specialized labs on wheels are used to evaluate the effectiveness of irrigation systems and then to recommend ways to make the systems more efficient. The result is a savings in water, energy, time, and money for the users. Lab personnel also work with agricultural and urban irrigators to demonstrate how to educate the public about efficient irrigation. The MILs are a partnership between the SFWMD, the Natural Resources Conservation Service, and the Soil and Water Conservation Districts. The expertise of lab personnel is a free public service.

### **Funding**

The South Florida Water Management District has had an alternative water-supply funding program for over a decade. Alternative water-supply funding was formalized in 1995 by the Florida Legislature with the passage of statutes establishing the alternative water-supply grant program. The SFWMD has provided over \$26 million district-wide in alternative water-supply grants for 113 projects since 1995, including water-reuse projects, the use of brackish-water sources, and aquifer storage and recovery. These projects have resulted in over 250 MGD of water being made available.

### **One Size Does Not Fit All**

The integration of various water-supply sources has allowed the LWC Region to continue to grow, while not causing harm to its natural resources. The type and magnitude of the development of alternative water-supply sources should be tailored to each specific area, and the demographics of each area should be taken into account, including water-use habits. In areas where the majority

of water is used indoors, conservation will probably have a more positive effect than implementation of other alternatives. Diversification reduces the dependence on regional water resources, offsets the need for conventional sources to meet future water needs, and can reduce the effects of water shortages on communities.

### **References**

1. SFWMD. 2000. *Lower West Coast Regional Water Supply Plan*. South Florida Water Management District, West Palm Beach, FL.
2. SFWMD. 2002. *Feasibility Study for Co-Locating Reverse Osmosis Treatment Facilities*

*with Electrical Power Plants*. Prepared by Water Resource Associates Inc. for the South Florida Water Management District, West Palm Beach, FL.

3. FDEP. 2002. *2001 Reuse Inventory*. Florida Department of Environmental Protection, Tallahassee, FL.

4. ECWCD. 1999. *SFWMD alternative water supply fiscal year 1999 funding application*. East County Water Control District, Lehigh Acres, FL.

5. City of Cape Coral. 1999. *SFWMD alternative water supply funding program fiscal year 1999 – Gator Slough/Reuse System Enhancements: Ph III*. City of Cape Coral Utilities Division, Cape Coral, FL.

