

Reverse Osmosis in Port St. Lucie Expansion with Membrane Treatment Meets Demands of Rapid Growth

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The state of Florida continues to experience rapid population growth, creating challenges for almost every aspect of our utility infrastructure and resulting in ever-increasing water demands. The city of Port St. Lucie, located on the Atlantic Seaboard in St. Lucie County, has grown from approximately 10,000 residents to the current 135,000 residents in less than 20 years. During that period, the city's utility systems department has been tasked with providing and maintaining a public wastewater collection and water distribution system to serve these residents.

Starting in July 2003, the city added 12,689 people in a one-year period to reach a population of 118,396—an increase of 12 percent in 12 months. The four-year growth rate has also been significant—a 33.4-percent increase. As a result, Port St. Lucie was recently ranked as the nation's fastest-growing city of over 100,000 people, based on census data from 2003-2004. As this growth trend has emerged, the city council, city manager and the utility systems department have anticipated the need for updated, expandable supplies of potable water.

The city acquired the utility systems

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department in October 1994. At the time the utility was purchased, many residential customers relied upon private wells to supply their water and septic tanks to dispose of their wastewater. As the process of expanding the utility system and recommending additional facilities progressed, a small group of residents spoke on behalf of the entire community, stating that the facilities were not truly needed—that the community could exist and grow while relying upon its then-current water production method, the use of private wells, and individual point-of-use purification systems to improve quality. The city council put the measure before the community in a voting process that resulted in a resounding yes to move forward with improved facilities.

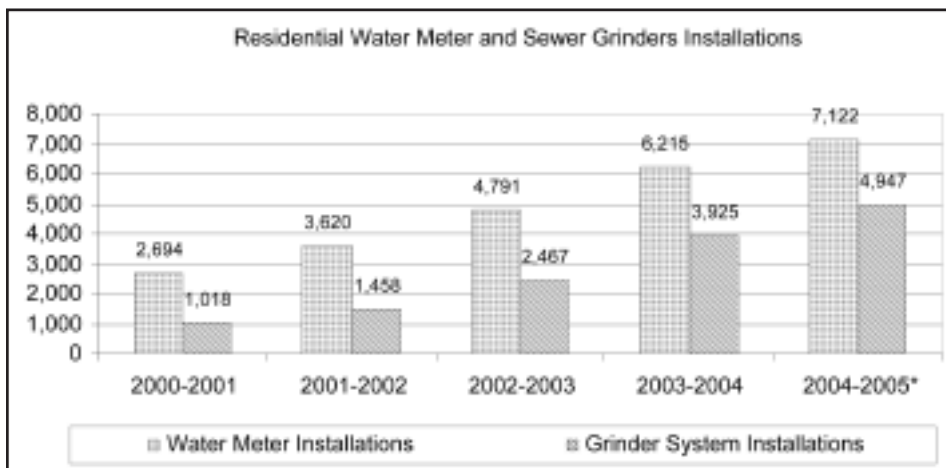
After water lines were completed in the initial expansion area, the city was tasked with satisfying the requests from a majority of citizens for potable-water connections. This accelerated demand led the utility systems department to closely examine and plan for timely expanded water production facilities.

Expanding the surficial-aquifer wellfield supplying the existing lime softening plant became problematic because of the number of wells required, the distance of the wells from the treatment plant, the difficulty in finding undeveloped property on which to site the wells, and impacts upon wetlands and existing residential wells. Brackish water in the Floridan Aquifer was identified as an alternative water source that could meet the city's needs.

In 1997 Port St. Lucie and its utility systems department determined that a reverse-osmosis (RO) water treatment plant would be the best method of providing the required additional capacity, while providing the high-

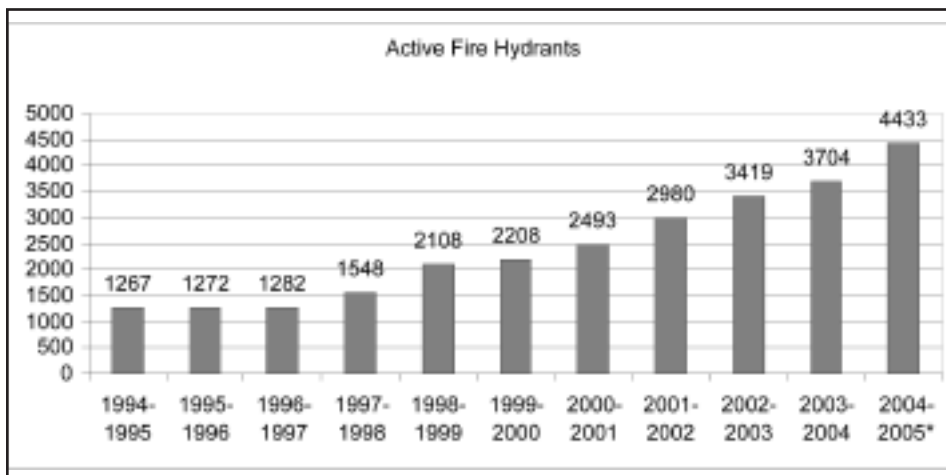
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Figure 1



• 2004-05 data is through the first 10 months of the fiscal year.

Figure 2



The James E. Anderson RO Water Treatment Facility was placed into service in early 2005, and currently supplies potable water to the northern service area in Port St. Lucie. The facility has an initial capacity of 6 MGD with the ability for the phased expansion to a capacity of 22 MGD.

The reverse-osmosis post-treatment consists of degasifiers and odor control scrubbers for removal of hydrogen sulfide, followed by disinfection and stabilization.



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 est-quality water available to city residents. The city made the decision to design and construct such a facility with an initial capacity to treat 4 million gallons per day (MGD) and an expansion capability to 10 MGD. The proposed facility was to be co-located with the city's existing lime softening facility.

Construction of the Prineville Reverse Osmosis Water Treatment Plant was completed in September 1999, providing Port St. Lucie with a total treatment capacity (lime softening and RO blend) of 10.85 MGD. Eighteen months after the start-up of the initial phase, the city began planning for the expansion of the facility to its build-out capacity of 10 MGD and also began site selection and planning to design and construct a second RO treatment facility that would be expandable to a capacity of 20 MGD.

The James E. Anderson Reverse Osmosis Water Treatment Facility

This most recent component of the city's water-supply facilities is the James E. Anderson (JEA) Reverse Osmosis Water Treatment Plant, which was brought online in the spring of 2005. Named after a former city councilman, it is a state-of-the-art water treatment facility located toward the north-west corner of the city's service area.

In early 2000, planning began for con-

struction of the new JEA facility, which was slated to have an initial installed capacity of 4 MGD and a design build-out capacity of 20 MGD. As the design moved forward, city officials realized that growth in the service area and the increase in demands had exceeded previous estimates. To ensure that sufficient capacity would be available to accommodate the increased growth, they increased the scope of the project following the 90-percent design review to include an additional RO skid to bring the initial installed treatment capacity to 6 MGD.

One critical part of the planning was the phasing of the design and construction to meet tight deadlines and keep pace with the area's growth. To meet these challenges, the facility was designed and constructed in two phases, which provided a higher level of service to commercial and residential customers in the northern part of the city's service area.

The first phase was a remote potable-water pumping station that would later serve as the potable-water storage and high-service pumping facilities for the remainder of the plant. Phase 1 consisted of three 4-million-gallon ground storage reservoirs, supplemental disinfection facilities, auxiliary power facilities, high-service pumping facilities, and deep injection wells.

Phase 2 consisted of process and operations buildings and the primary treatment processes, including the chemical and physical pretreatment facilities, membrane treatment facilities, and post-treatment facilities. Raw water was provided by four Floridan Aquifer wells, each with a total depth of 1,350

feet.

Some of the unique process features at the JEA plant include:

- ◆ Use of energy recovery devices on the RO skids to provide boosting of the second-stage feed water by recovering excess energy from the concentrate flow stream.
- ◆ Use of post-RO acidification to optimize hydrogen sulfide removal in the counter current forced-draft aerators.
- ◆ A higher-capacity membrane cleaning system to allow cleaning of the entire first stage of an RO treatment skid in one pass, reducing the down time required to clean each skid.
- ◆ Split process flow stream to allow future skids in the process building to operate under differing pretreatment conditions.
- ◆ A design that will readily accommodate expansion. The facility layout allows for phased expansion to its future 20-MGD build-out capacity in increments of 2 MGD or larger, while minimizing the construction time required for expansion.
- ◆ Redundant primary power feeds and power transformer facilities.

During the 2004 hurricane season, the plant took near-direct hits by hurricanes Frances and Jeanne, causing disruptions to the anticipated completion date scheduled for the end of that year. In late February of 2005, the need for the facility became imminent as the neighboring private utility, St. Lucie West, could not meet high demands and was temporarily shut down by the Florida Department of Environmental Protection (FDEP). Via the emergency interconnects with St. Lucie West, the city's water system provided water to the customers within the St. Lucie West service area, but restrictions in the private utility's transmission main system prevented pressure from being maintained for multistory buildings in the

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The high-service pumping facilities are designed to allow phased expansion as the plant capacity increases.

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Working closely with the West Palm Beach Office of the FDEP, the city made the decision to begin water production at the newly constructed JEA facilities earlier than previously anticipated in an effort to meet increased demands and provide a higher distribution pressure to the St. Lucie West system. The facility went on line in less than one week after the need was identified and has been in operation since that time while the site work and construction of the ancillary facilities were completed.

As Phase 2 construction neared completion in July 2005, the city authorized the design and construction services for the full expansion of the JEA plant to 22 MGD. The expansion project is anticipated to be completed by the summer of 2008, with a likely intermediate milestone of 10 MGD in expanded capacity to be required by the spring of 2007.

The JEA plant expansion will consist of the following facilities and equipment:

- ◆ Seven Floridan Aquifer supply wells
- ◆ One Floridan Aquifer blend well
- ◆ Three feed-water micron filters
- ◆ Seven high-pressure feed pumps
- ◆ Seven RO treatment skids
- ◆ Three post-treatment degasifiers
- ◆ One two-stage odor-control wet scrubber system
- ◆ Two finished-water transfer pumps
- ◆ Five high-service pumps
- ◆ Additional process and yard piping
- ◆ Two 4.0-MG potable ground storage reservoirs
- ◆ Auxiliary power generator facilities
- ◆ Electrical gear & drives

The Utility Systems Department

The utility systems department provides water and wastewater service to the city of Port St. Lucie and portions of the unincorporated areas of St. Lucie County. Staffed by more than 214 men and women, it is divided

into nine distinct operating divisions or teams: systems support, instrumentation/controls, engineering, water distribution and wastewater collections (field operations), water treatment facilities, wastewater treatment

facilities, warehouse/purchasing, laboratory, and mapping. These teams administer the utility's aggressive capital improvement program.

Some of the recent figures for Port St. Lucie's utilities infrastructure include:

- ◆ Purchased water connections: 56,040
- ◆ Water customers billed in July 2005: 49,196
- ◆ Utility service area: 134 square miles
- ◆ Service area within city limits: 112 square miles
- ◆ Miles of water main: 1,030
- ◆ Miles of sewer main: 894
- ◆ Average number of residential water meter installations per month: 712
- ◆ Average number of residential wastewater grinder installations per month: 495
- ◆ Installed fire hydrants: 4,433
- ◆ Wastewater lift stations: 176

Figures 1 and 2 demonstrate the growth of both the water and wastewater customers in the city from 2000 to the present. Most of the new wastewater connections are installed as grinder pump and low-pressure force main systems.

Port St. Lucie Utility System Milestones

- 1994 October 1st – Utility under city ownership
Connections: Water = 17,228;
Wastewater = 10,800
Treatment Capacity: Water = 4 MGD; Wastewater = 4.7 MGD
- 2000 January 19th – Grand Opening of Prineville RO Water Plant with 4.0 MGD capacity
- 2003 April 23rd – 10.713 million gallons treated water demand
Treatment Capacity: 16.85 MGD
- 2004 October 1st – 10th Anniversary
Connections: Water = 48,156;
Wastewater = 31,537
- 2005 Treatment Capacity: Water = 25.15 MGD; Wastewater = 10.8 MGD
Connections (June 1st): Water = 54,201; Wastewater = 36,711

From 1994 until the present, the number of connections has increased 315 percent and 340 percent for water and wastewater customers respectively. Much of that growth could not have been possible without the planning and resourcefulness of the utility systems department and their work with local developers to stay ahead of the growth curve. As many areas around the state try to cope with the demands of growth by moratorium and similar methods, it would be fair to say that smart planning by a utility with the assistance of local developers may be the best solution for all parties.



Three 2-MGD reverse-osmosis skids provide treatment of the brackish raw water from the Floridan Aquifer.