THIS PAPER WAS PRESENTED AT THE:

AWWA ANNUAL CONFERENCE

Orlando, Florida

June 21, 1988

RESPONSIBLE RECYCLING

William D. Johnson
Director
Public Utilities Department
City of St. Petersburg
St. Petersburg, Florida

INTRODUCTION

Recycling, reclaiming, reusing, and recovering, are all terms generally used to describe the utilization of wastewater for irrigation and certain industrial applications in the State of Florida. Many factors must be incorporated when a community is considering implementing a wastewater reuse program. A successful program will be dependent upon the ability of the treatment facility to consistently produce a high quality product. Of primary concern will be the design, construction, operation, and monitoring of the treatment facility.

This paper will discuss a practical approach to developing and operating a successful urban irrigation system using recycled wastewater.

BACKGROUND

Florida is a water paradox. It receives an average of 55 inches of rain annually, the second highest of any state in the country. For the most part, it is underlain by the Floridan Aquifer, one of the largest and most productive groundwater sources in the nation. Yet, several areas in Florida are experiencing periodic water shortages, and many Florida communities are scrambling to provide an adequate water supply for its residents. Why is this?

Of the 55 inches of rain received each year in the Tampa Bay area, almost 50 percent falls during the months of June, July and August. However, approximately 40 inches of the 55 inches are lost to evapotranspiration, leaving a balance of 15 inches available. Unfortunately, because of Florida's flat topography, there is little opportunity to impound water by constructing dams and using surface water as a water supply source. Thus, a majority of the remaining 15 inches becomes runoff, eventually flowing into the Atlantic Ocean and the Gulf of Mexico.

We also have to consider that almost 1000 persons each day make Florida their new home. The water supply problem is further compounded because the majority of the new residents choose to live in coastal areas, where the groundwater supply is most limited. This is because of the threat of saltwater intrusion.

Growth brings other water supply problems. Development alters drainage patterns which adversely affect recharge. Also, many wetlands have been destroyed. Finally, contamination of the groundwater is becoming a serious problem. Several communities have lost their water supply due to contamination and others are threatened.

As you can see, there are many pressures on Florida's water resources. This paper will discuss how one coastal Florida community, the City of St. Petersburg, has met the challenge of providing an adequate water supply for its citizens and, at the same time, implemented a precedent-setting program.

THE ST. PETERSBURG EXPERIENCE

St. Petersburg is a gulf-coast community of approximately 250,000 persons. It is Florida's fourth largest city. The City experienced rapid expansion during the period between 1950 and the mid-1970's. It was also providing water service to four other growing communities. The City's water supply capability was becoming stressed. In order to appreciate the difficult position the City faced, the following is a brief review of the City's efforts to meet its water needs for over 50 years.

Geographically, the City of St. Petersburg is located on a peninsula. It is bordered on its eastern, western and southern sides by saltwater, and by incorporated communities on its northern boundary. Hydrologically, St. Petersburg is an island, with no significant streams or groundwater suitable for a water supply within its corporative limits.

In the early 1900's, the municipal wells located within St. Petersburg were being pumped for increasingly longer intervals because of a growing population. By the mid-1920's, chloride levels in the groundwater began to increase due to saltwater intrusion. Realizing that it was facing a potential water crisis, the City entered into a contract with a private water company to provide St. Petersburg with a new water supply. The company purchased a section of land in adjacent Hillsborough County, developed a wellfield, constructed a water plant, and laid approximately thirty miles of 36 inch water main from the water plant to a water repumping station the company had constructed north of the City. At that time, it was a massive project.

In the early 1940's, St Petersburg purchased the company's assets, including a second undeveloped section of land in Hillsborough County, as well as Weekie-Wachee Springs, located in Hernando County. The water company bought the springs with the intention of utilizing it as a water source at some future date when it would be more cost-effective. The spring is located over sixty miles from St. Petersburg. A major tourist attraction has been developed at the spring.

In the early 1960's, the unused property in Hillsborough County was developed into what is now known as the Section 21 Wellfield. A second repumping station, and a new 48 inch, - thirty mile long pipeline were constructed.

In the late 1960's, a third property was purchased and developed as a wellfield. It was a section of land located approximately 40 miles from St. Petersburg in Pasco County.

St Petersburg now owned substantial blocks of land in three counties. The counties became alarmed that they might not be able to provide adequate water for their own growing populations because

of St. Petersburg's water withdrawals.

When St. Petersburg joined with Pinellas County in the early 1970's to develop another wellfield in Pasco County, Pasco, Hillsborough and Hernando counties joined together to have legislation enacted to block any future water development by municipalities outside of their jurisdiction! The period of 1970 through 1978 is known as the "water-war" years. A regional water supply agency was eventually formed and will be discussed later in this paper.

St. Petersburg faced a twofold problem in the early to mid 1970's. First, it needed additional water, but it was becoming uncertain if permission could be obtained to develop a new supply. Because of costs, ecological concerns, and the possibility of worsening the already strained relations with other counties, the development of Weeki Wachee Springs as a water supply source for the City was not considered a workable alternative. One option was to drastically reduce its future water demand. Secondly, because of rapid growth, the City's four wastewater treatment plants needed to be enlarged. At that same time, regulations were adopted by the State of Florida requiring that effluent from wastewater treatment plants in the Tampa Bay area be treated to advanced levels, including tertiary treatment and nutrient removal prior to discharging to surface waters, or the discharge must cease.

Recognizing that turf irrigation is a major water-consuming activity in Florida, especially during the dry spring months when groundwater levels are usually at their lowest point, St.Petersburg decided to take a very innovative and bold step to solve its water supply and wastewater treatment problems. It would upgrade and expand the wastewater treatment plants to tertiary treatment, but would not remove nutrients. It would then cease discharging to surface waters by using the highly treated effluent as irrigation water for recreational areas and businesses by means of a secondary or "reclaimed water" piping network. Deep injection wells would be constructed as a backup system whereby effluent could be pumped into the saltwater aquifer that underlies the peninsula when the demand for reclaimed water fell below the plant discharge rate and storage capability.

This was a very bold proposal in the early 1970's. Up to that time, no major community had considered undertaking the development of an urban irrigation system using recycled wastewater on such a large scale. And there was no confirmation that deep injection wells would work in the area.

From 1977 through 1987, St. Petersburg spent over $100 million upgrading and expanding the four wastewater treatment plants and constructing over 200 miles of reclaimed water piping. This includes a recently constructed system expansion that now provides reclaimed water for residential areas within the City that have been declared "water quality critical." These are locations where shallow groundwater wells will not produce adequate water for lawn sprinkling, or the water quality is unsuitable. The only alternative is to use potable water for lawn irrigation which is both very expensive and poor utilization of a limited resource.

In 1987, almost 20 million gallons of reclaimed water were used each day for irrigation purposes by over 5,000 customers. By the year 2000, it is estimated that St. Petersburg's reclaimed water system will have the potential to serve approximately 17,000 customers, and irrigate almost 9,000 acres.

St. Petersburg's recycling system is vital to helping the City meet its long-term water needs. The value of the system is readily illustrated when comparing our future water needs with and without the reclaimed water product.

In 1987, the West Coast Regional Water Supply Authority prepared a Needs and Sources Report. The Authority is the agency formed as a result of the "Water Wars," and charged with the responsibility of developing new water supplies for several Tampa Bay area counties and communities, including St. Petersburg. Their report projected that by the year 2020, if a twenty-year drought event occurred that could restrict the permitted withdrawals from the City-owned wellfields, the City could anticipate a 23.0 mgd shortfall on a maximum demand day if reclaimed water was not available for irrigation purposes. However, if the reclaimed water system has been expanded to its full potential by that time, then instead of a 23.0 mgd shortfall, the City will have 1.0 mgd remaining pumping capacity from its wellfields, even at greatly reduced withdrawal rates. In the water-critical Tampa Bay area, where water is a limited resource with potentially strong political overtones associated with any water development effort, the importance of St. Petersburg being able to satisfy its water needs indefinitely with existing resources cannot be overemphasized. Cost is another concern. If new water sources are developed, the water will be very expensive since it would have to be pumped f m far inland or, as an alternative, desalinization facilities would have to be built within St.Petersburg. As additional benefits, an expansion of the existing 68.0 MGD lime softening water treatment plant and construction of a third major transmission line will not, in all probability, be needed because additional potable water will not be required.

The success of the St. Petersburg reuse program has provided an example for other communities in Florida to undertake similar programs and encouraged the regulatory agencies to approve large scale reuse programs involving residential irrigation. Representatives from environmental and health agencies representing many foreign nations have visited St. Petersburg to inspect and discuss the City's reclaimed water system.

St. Petersburg now finds itself in a unique position. It operates the largest urban irrigation system in the world using a reclaimed water product as the water source. All spray sites are located over a non-potable, brackish aquifer. The City's wellfields are located 30+ miles hydrologically upstream from the spray sites. However, Hillsborough County, where two of the three major wellfields serving St. Petersburg are located, is planning a major effluent spray field/wetlands augmentation project on land adjacent to St. Petersburg's wellfields. What is St. Petersburg's position about Hillsborough County's plans?

If Hillsborough County implements a "Responsible Recycling" program similar to St. Petersburg's program, then we are not objecting to their plans. Now, what is "Responsible Recycling"?

DISCUSSION

After being associated with St. Petersburg's highly successful program for almost six years, and combining that association with almost thirty years of wastewater operations experience, I have concluded that the following criteria must be implemented if wastewater reuse programs are to gain increased public acceptance through safe and reliable performance.

First, the recycled water system must be readily identifiable. St. Petersburg color-codes all PVC piping, using blue for potable water, green for sewer force mains, and brown for reclaimed water; all buried ductile iron piping is affixed with a coded brown tape or painted brown to denote it as part of the reclaimed water system; fire hydrants are located throughout the system and are color-coded with a brown stem and yellow cap. Hydrants are needed to periodically flush lines and serve as a back-up for fire suppression; valve box covers are shaped differently than potable water system valve box covers; all customers using reclaimed water must have an in-ground irrigation system, and no hose bibs are permitted at any point in the irrigation system; backflow prevention devices have been installed at every potable water system meter wherever reclaimed water is available in order to provide maximum protection of the potable water system. Finally, comprehensive rules and regulations governing connection to and usage of the system have been adopted by the City.

The next matter is, in my opinion, of even greater importance than the previously mentioned items. It concerns the ability to deliver a high-quality product water on a continual basis.

The wastewater treatment facility discharging into a reclaimed water system must be designed, constructed, operated, and monitored in the most responsible manner possible. Items that must be provided are:

1) An advanced treatment facility that is adequate to handle all projected hydraulic and organic loadings. It should also have the capability for chemical addition at various points in the plant to enhance process control and treatment capability if needed.

2) The plant should meet Class I reliability and have a great deal of operational flexibility in order to rapidly change operating modes.

3) It should be staffed 24 hours per day, 7 days per week with operators holding advanced certification in charge of each shift.

4) An effective pretreatment program should be established so that harmful chemicals that could adversely effect treatment do not enter the wastewater collection system and possibly reach the spray sites.

5) The effluent quality should be monitored 24 hours per day, 7 days per week.

Another consideration is that when irrigating near a water supply aquifer, it must be confirmed that the hydrogeology of the spray site is amenable to receiving recycled effluent (i.e., no fractures or sinkholes). A survey using ground-penetrating radar is one method used to evaluate a potential spray site.

Of primary concern is the expertise and dedication of the operational staff. The importance of capable operations personnel cannot be overemphasized.

Our new plants are state-of-the-art. They literally "manufacture" water. A key to the future success of this city's or any city's reclaimed water program is enhanced operator awareness. Wastewater operators must consider their responsibilities as similar to water plant operators. In addition to being concerned about BOD and suspended solids removal, they must think in terms of turbidity, priority pollutants, total and fecal coliform levels, and the other parameters typically monitored in water treatment plants. This is especially critical when a staff has been involved in the transition of a plant from either primary or secondary treatment to complex tertiary treatment.

Regulatory agencies need to recognize that an approved alternate method of discharge must be available when irrigation demands are less than product availability, or when effluent quality temporarily falls below the established criteria for the reclaimed water product. Although deep injection wells are provided in St. Petersburg, their construction will not be possible in many communities. Surface water discharge will often be the only viable alternative. During these periods, a higher level of treatment may be required (i.e., nutrient removal) which, in turn, will necessitate an operational staff that can rapidly adjust the plant's operating mode from one process to another. Also, problems within the collection system may adversely impact plant performance and the operational staff will be required to respond without delay. The staff must always remember that the quality of the product going into the reclaimed system is of first importance. Again, an alternate point of discharge is necessary.

To summarize my philosophy about wastewater reuse, there must be a **recycling mentality**, that is, a product is being manufactured and will literally be delivered to a customer's doorstep. There must not be a **disposal mentality**, or a "get rid of it quickly" attitude.

If wastewater is considered a valuable resource requiring proper treatment and handling by qualified technicians at all times, with uncompromised quality control, then the public will accept the reclaimed water product with a high degree of confidence.

CITY OF ST. PETERSBURG

REUSE OF TREATED WASTEWATER

By: William D. Johnson
Director
Public Utilities Department

PROBLEM

In the early 1970's, because of rapid growth, the City of St. Petersburg's four wastewater treatment plants needed to be enlarged. At that time, regulations were adopted by the State of Florida requiring that effluent (treated wastewater) from wastewater treatment plants in the Tampa Bay area be treated to advanced levels (tertiary treatment, nutrient removal) prior to discharging to surface waters or the discharge must cease.

Also, impending regional water supply problems due to competition for the area's limited ground water reserves because of rapid growth throughout the Tampa Bay area, prompted the City to investigate alternate means to reduce the potable water demands.

RESPONSE

Upgrade and expand the wastewater treatment plants to tertiary treatment, but not remove nutrients. Cease discharging to surface waters by using the highly-treated effluent containing nutrients to provide irrigation water throughout the City by means of a secondary or "reclaimed water" piping network. Deep injection wells would be constructed whereby effluent could be pumped into a saltwater aquifer when the demand for reclaimed water fell below the plant discharge rate.

This program was considered to be more cost-effective than treating the effluent to an advanced (nutrient removal) level. Also, the potable water demand was expected to drop substantially as upgraded plants were placed on-line and the reclaimed water system was expanded.

RESULTS

Since 1976, all four of the City's wastewater treatment plants have been upgraded, expanded and connected to the reclaimed water system. Improvements to the final plant were completed in the Fall of 1987. As a result, none of the City's four wastewater treatment plants are now discharging into surface waters, making St. Petersburg the largest community in the United States achieving zero-discharge.

The reclaimed water system now encompasses over 200 miles of piping. This includes a recently constructed system expansion that provides reclaimed water for residential areas within the City that have been declared "water quality critical."

These are locations where shallow ground water wells will not produce adequate water for lawn sprinkling, or the water is of such poor quality that it cannot be used. The only alternative is to use potable water for lawn irrigation.

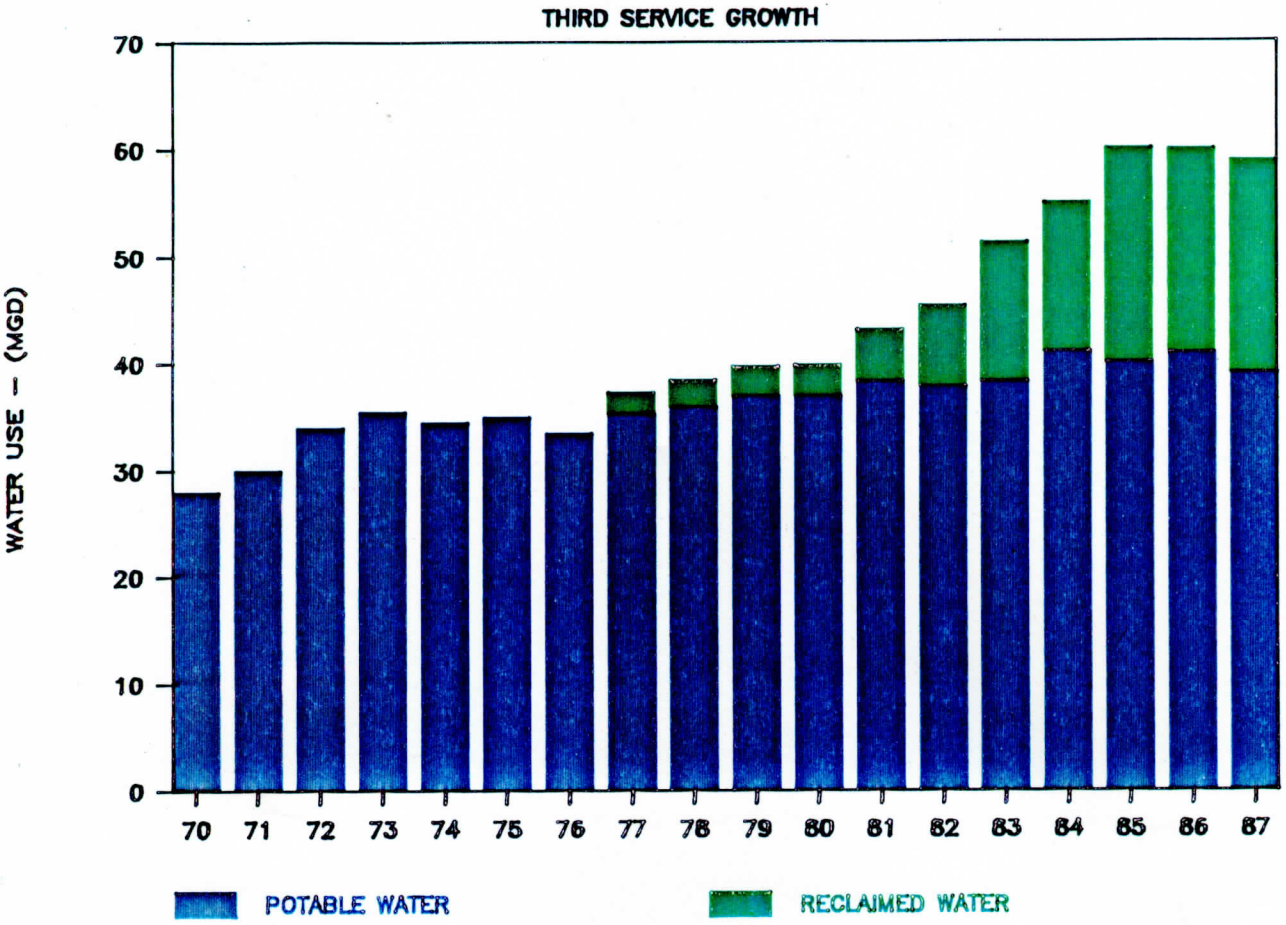
In 1987, almost 20 million gallons of reclaimed water was used each day for irrigation purposes. This usage will substantially increase as the system expands. By the year 2000, it is estimated that the reclaimed water system will have the potential to serve approximately 17,000 customers, irrigating almost 9,000 acres.

Approximately $35 million has been expended to construct the separate piping network to provide reclaimed water for irrigation purposes. The program is considered to be very successful. Although the population in the St. Petersburg service area increases yearly, potable water usage has not increased significantly since 1979. Concurrently, the quality of the coastal waters has improved in recent years, primarily due to the elimination of effluent discharge to surface waters from St. Petersburg and four other coastal communities for which the City provides wastewater treatment.

In summary, expenditures to-date of over $100 million to eliminate the discharge of treated wastewater from St. Petersburg's wastewater treatment facilities are indicative of the City's commitment to protect the coastal waters in the Tampa Bay area, and also reduce the demand on the area's limited potable water resources.

February 1988

CITY OF ST PETERSBURG



RECLAIMED WATER STATISTICS

	'81	'82	'83	'84	'85	'86	'87	88
RECLAIMED WATER PUMPED (MGD)	5.0	7.5	13.0	14.0	20.0	18.9	19.8	20.3
NUMBER OF RECLAIMED WATER CUSTOMERS								
RESIDENTIAL	11	291	472	761	2,927	4,720	5,107	5216
COMMERCIAL / INDUSTRIAL / OTHER	112	123	138	143	173	244	249	254
MILES OF PIPE (ALL SIZES)	72	90	94	142	190	228	228	
POTABLE WATER PUMPED (MGD)	38.3	37.9	38.3	41.1	40.1	~~41.0~~ 40.2	39.1	38.7

St. Petersburg's Reclaimed Water System

How It Works