

## **INTEGRATING WASTEWATER REUSE SYSTEMS INTO MUNICIPAL WATERSHED MANAGEMENT STRATEGY**

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In 1958, the United Nations Economic and Social Council issued the following statement: "No higher quality water, unless there is a surplus of it, should be used for a purpose that can tolerate a lower grade." We believe the U.N. was responding to a growing worldwide concern for the availability of source water for drinking. At that time, populations had not yet reached today's critical levels in some parts of the world. Water supplies were showing signs of stress, but the world did not respond immediately to this call for conservation measures. Fast forward to the 1980's; Felicia Marcus, a former EPA Regional Administrator for Region 9, stated that "water recycling is a critical element for managing our water resources. Through water conservation and water recycling, we can meet environmental needs and still have sustainable development and a viable economy." This statement reflects the position of a growing number in our country that, because of the ever-increasing population of the U.S. and the increased demand for water per household, we need to stop disposing of our water after one use. Water and wastewater providers in the US can and should take the lead in fully utilizing an untapped resource by recycling our water for specific everyday uses. This statement also reflects the underlying premise that, if we do not consider water recycling an important part of our watershed management strategies, then we will have a difficult time maintaining the desired levels of development and economic success we have become accustomed to. To be sure, water reuse will be a necessary component of everyday life if we are to survive globally.

Municipalities have historically considered reclaimed water a viable alternative for use in urban, industrial, agricultural, and recreational uses. Many have found that other practical uses include habitat restoration and enhancement, groundwater aquifer recharge and indirect augmentation of potable water supplies. Municipalities and wastewater treatment providers are finding that there are certain drivers that propel the use of reclaimed water in the U.S. and around the world. These include increasing water demands, water scarcity and droughts, environmental protection and watershed enhancement, wastewater management needs, socio-economic factors and public health protection. These drivers are steering the world towards more deliberate and thoughtful approaches to management of our finite potable water supply. The U.S. EPA Guidelines for Water Reuse in September of 2004 listed a number of water reuse accomplishments worldwide. Included was the fact that agricultural irrigation is the largest use of water, accounting for up to 80% of global demand. The EPA also found that Israel is a world leader with over 70% of water collected, treated and reused for agricultural purposes. They also listed Japan as a world leader in urban reuse with a total of 8% of reclaimed water used for urban purposes.

Our own Water Reuse Association, in keeping statistics for reclaimed water use in the U.S., states that more than 1.7 billion gallons of water is reused everyday in the U.S. and that reclaimed water use is growing at a rate of up to 15% per year. Recent records show that at least 27 states have water reclamation facilities. Florida, Texas, California and Arizona account for the majority of water reuse in the U.S. In 2006, it was reported that California was reclaiming over 525 MGD and has a goal of doubling use of reclaimed water by 2010. In 2007, over 650 million gallons of reclaimed water was reused by municipalities in the state of Florida. Florida has a goal of reclaiming over a billion gallons of water per day by 2010.

Sitting out in the audience today are professionals who have faced stressed source water supplies for years. One might wonder why two engineers from Tennessee are speaking to you today about the use of reclaimed water in municipalities. Tennessee and the southeastern region of the U.S. are normally thought of as lush, green areas,

with minimal rainfall and source water deficits. Tennessee has an average rainfall of up to 50 inches per year, and source water has not historically been a problem for that state or the surrounding area. However, Tennessee and the Southeastern US are currently in the middle of a drought period. The U.S.G.S. has not officially categorized this drought, but it is anticipated that it can be equated to a 50-year to 100-year drought, depending on the exact location. The dry period we are experiencing at this time has been responsible for water restrictions throughout the area over the past two years. These measures have caused municipalities to plan ahead for sufficient water in locations where this type of planning has not historically been needed to meet normal daily demands. We have found that many of the areas that have developed reclaimed water systems are looking for ways to maximize the benefit of these systems to prolong or supplement limited potable water supplies.

In addition to the benefits of extending the potable water supply, reclaimed systems offer opportunities for alternative methods of disposing of highly treated effluent from wastewater plants. In some areas, receiving streams may not have the required assimilative capacity for additional discharges without experiencing detrimental effects. In these cases, a reclaimed water system can provide a means of increasing treatment plant effluent volumes either for dedicated disposal or for beneficial reuse.

The Tennessee Municipal Technical Advisory Service accumulates information and publishes data each year on water and wastewater systems in Tennessee. In 2006, a survey was taken of wastewater treatment systems around the state. Seven of the wastewater treatment plants surveyed in Tennessee reported that they use reclaimed water in 2006. Of those that were surveyed, up to 18% of the wastewater treated by the respondents was reused. Of those uses that were reported, there were seven residential developments that used reclaimed water. There were also five golf courses and parks, two school campuses and one agricultural irrigation system that reported using reclaimed water. Keep in mind that this survey was carried out in 2006, just as the current dry period was beginning in Tennessee. It is anticipated that, after two unusually dry summers, a larger demand for reclaimed water has been created and will perpetuate expansion of existing systems across the state.

The Tennessee Department of Environment and Conservation (TDEC) has set advanced treatment limits with a high degree of disinfection for reclaimed water systems throughout the state. Currently, the following limits apply:

<i>Measured Parameter</i>	<i>Required Limit</i>
Total Suspended Solids (TSS)	≤ 5 mg/L
Biochemical Oxygen Demand (BOD)	≤ 10 mg/L
Turbidity	≤ 2 NTU
Fecal Coliform	≤ 14 Colonies per 100 mL
pH	6 to 9

In order for providers to operate and maintain reclaimed water systems in the state of Tennessee, these treatment limits must be followed. The State of Tennessee has also required a chlorine residual of 2 mg/l be maintained in distribution systems at the furthest point as a minimum to ensure inhibition of bacterial growth. By requiring these strict limits, TDEC has been able to allow unrestricted use of reclaimed water for non-potable use.

#### CASE STUDY: TWO EXISTING SYSTEMS

Two established reclaimed water systems have been operating for extended periods in middle Tennessee, one since 1992. Franklin, Tennessee and Murfreesboro, Tennessee are located in the central part of the state. The populations of these two cities have been growing tremendously since the early 1980's. Throughout these years of growth, each municipality has gone through multiple upgrades of their wastewater treatment and disposal facilities. Part of the strategy for implementation of reclaimed water systems for each city has been to augment the potable water supply and also to provide for disposal alternatives from the wastewater treatment plants. Each of these cities is located on smaller rivers, Franklin being located on the Harpeth River and Murfreesboro on the West Fork

of the Stones River. Both of these rivers are listed on the EPA 303d list of impaired streams. The flows in these streams have historically been adequate to supply each City with sufficient potable water, at least before growth accelerated. However, both systems have found it necessary to turn to larger source water supplies as populations have grown. The City of Franklin purchases water from another utility provider with a much larger source water supply in the Cumberland River, which runs through Nashville, Tennessee. Murfreesboro has recently run a raw water line to the nearby Percy Priest Reservoir in order to augment their raw water supply.

## FRANKLIN, TENNESSEE

In Franklin, the initial reclaimed water system began development in September of 1991 to provide irrigation water to The Legends Golf Club of Tennessee. This represented the first public/private partnership for water reuse in the state. At that time, the state of Tennessee did not have any reclaimed water systems nor did they have standards to follow in setting up and operating a reclaimed water system. As a result, the City of Franklin developed its own criteria for this public/private water reuse partnership. In the early years, up to 1 MGD of reclaimed water was used during the spring, summer and fall months.

The City had also begun considering the reclaimed water system an integral component of the wastewater treatment system. The WWTP operating permit provided limits for mass discharges based on an effluent of 6 MGD under the existing processes. The reclaimed water system was considered an innovative, secondary method disposing of highly treated effluent in a productive manner. Since that time, the permit limits have become even more restrictive, and the reclaimed water system continues to play a crucial role in the disposal of treated wastewater at Franklin. City officials consider the system to be a safety valve for increased flows to the WWTP while holding discharges below permitted levels.

By September of 2002, other businesses had expressed an interest in using reclaimed water for irrigation and process water. The City of Franklin undertook a feasibility study to explore the expansion of the effluent water reuse system. They undertook preliminary design for the extension of the distribution system and began looking at opportunities to expand the reuse water program. A Mission Statement was adopted by the City Board of Mayor and Aldermen at that time. As recorded by City Ordinance, it reads: "To effectively manage our water resources in a safe and beneficial way that conserves the natural water supplies and recycles highly treated wastewater in an environmentally, responsible manner; and to ensure dependable and sustainable water supply for the citizens of Franklin." This Mission Statement was adopted and ratified by City Ordinance in 2002. As part of the same legislation, the City actually required that reclaimed water be used in select new development within the City if certain criteria were met.

By 2004, an ordinance was passed whereby all developments of five acres or more, or 10 building units or more, with mandatory landscaping requirements, were required to evaluate the potential for water reuse opportunities. These evaluations would be considered by the Director of the Water Management Department and he or she would decide whether there was a sufficient opportunity for beneficial water reuse within that particular development. If so, the City would then issue a reclaimed water permit for such developments as they came on-line. Developments that followed the adoption of this ordinance would be required to extend reclaimed water lines from the existing system to their project site if they were within 1,000 feet of an existing reclaimed water line. Dual-pipe water systems would be required in such developments if they were identified as potential reclaimed water customers by the City.

An effluent disposal assessment fee would be required for all new sewer customers within the City's sewer service area in order to develop the reclaimed water system city-wide. A rate study was performed based on the concept of partial recovery of expenditures for the reclaimed system. Research of reclaimed rates in other parts of the country led the City to plan for subsidizing the operation of the reclaimed system with sewer rates. In February of 2004 reclaimed water rates were set at \$0.87 per 1,000 gallons. At that time, the potable water rate within the City was \$3.24 per 1,000 gallons (after the first 1,000 gal). Although the potable water rate has recently increased to

\$3.54 per 1,000 gallons, the rate for reclaimed water has remained at \$.87 per 1,000 gallons, providing additional incentive for potential customers to use reclaimed water for irrigation and industrial purposes. A table of current water rates in the City of Franklin is shown below.

<i>Water Rates</i>	<i>First 1,000 Gallons</i>	<i>Next 9,000 Gallons</i>	<i>Next 15,000 Gallons</i>	<i>All Additional Usage</i>
Residential - Inside City	\$5.22	\$3.54	\$4.43	\$5.31
Residential-Outside City	\$8.22	\$5.52	\$6.07	\$6.62
Commercial - Inside City	\$8.01	\$3.60	\$3.60	\$3.60
Commercial – Outside City	\$9.81	\$5.60	\$5.60	\$5.60
Reclaimed Water - All	\$0.87	\$0.87	\$0.87	\$0.87

A new high service pump station has recently been completed and put into service in Franklin. The pumping system has a current capacity of 6 MGD with provisions to double the future capacity to 12 MGD with the addition of pumps. The pumping system is designed to maintain pressure throughout the distribution system so that smaller users are able to run irrigation systems off of a minimum system pressure. The distribution system consists of approximately 60,000 lf of distribution piping with an additional 20,000 lf under construction at this time. There is a storage capacity of approximately 100,000 gallons within the system currently. The City is currently following a Reclaimed Water Master Plan that includes plans to ultimately expand the distribution piping to over 250,000 lf and to include storage of over 3 MGD, spread throughout the system.

There are currently 16 reclaimed water customers in the City of Franklin. The Vanderbilt Legends Club of Tennessee, a large mixed-use development, two high schools, three local merchants, eight residential single-family units and one landscape company make up the list of current customers. These customers represent an average daily use of 500,000 gallons per day, with normal peak demands approaching 2.5 MGD. Although many of these customers use little or no water in the winter months, in the summer the City has delivered in excess of 3 MGD to these customers. The State of Tennessee has begun requiring permits to withdraw water from waters of the State. This has affected surrounding businesses that have historically withdrawn water for irrigation. These include golf courses, landscape companies, nurseries, and other large water users, including water utilities. It is anticipated that the state will consider some uses of higher value than others. For this reason, the cheaper, readily available reclaimed water from the Franklin system has become attractive to those who might not have used it in the past.

The City Reclaimed Water Master Plan has identified major users and projected uses from these customers for the near future. They include four additional golf courses, public parks, median and open areas, industrial and commercial users, and additional residential and office development. It is anticipated that these users represent an average demand of 6 MGD of use in the summer, with peak use approaching 10 MGD. These near-term potential users have been identified as being in relatively close proximity to existing reclaimed water distribution lines and can be connected to the system with minimal effort.

#### MURFREESBORO, TENNESSEE

The City of Murfreesboro currently boasts a population of over 100,000 residents. The effluent water reuse system was initially started as a plant water system at the for the wastewater plant. The Wastewater Facilities Plan Update in 2002 identified the repurified water system as a tool that could be used to assist the City in overcoming the limited capacity of the receiving stream to assimilate treated wastewater. The City began the design of the effluent water reuse system in 2002, and they purchased two farms with a total acreage of over 600 acres for dedicated disposal of treated wastewater. As an additional benefit of installing the distribution system piping to the disposal sites, the City has been able to offer reclaimed or repurified water to industrial and commercial customers along the routes of those lines.

In contrast to the City of Franklin's system, the Murfreesboro system was expanded and developed more fully to specifically accommodate the disposal of treated effluent. The rate of growth in the City's sewer service area has been phenomenal, and the City has made determined efforts to stay ahead of the growth curve in its ability to collect and treat wastewater from the newly developed areas. The receiving stream, with its limited additional capacity to handle even highly treated wastewater effluent, provided little opportunity in the way of future capacity for the wastewater system. The substantial commitment made when the City purchased dedicated disposal sites represents a significant step to ensure adequate wastewater treatment and disposal for additional growth. It is anticipated that the disposal site will be able to accommodate flow representing in excess of 20,000 new homes with no additional discharge planned for the receiving stream.

Supplying reclaimed water to the public for irrigation and industrial uses is also finding its way into the operational scheme of the Murfreesboro repurified system. The City has set a rate on the purchase and use of reclaimed water of \$0.05 per 100 cu ft (\$0.07 per 1,000 gallons) for residential and industrial use. The State allows unrestricted use for non-potable, non-contact uses for the Murfreesboro system at this time. Compared to the potable water rate of \$2.74 per 100 cu ft (\$3.66 per 1,000 gallons), repurified water presents a significant cost savings and incentive for use.

The reclaimed water delivery system has a current capacity of 7 MGD with provisions to increase pumping capacity as demands require. There are approximately 85,000 lf of distribution line in place with storage of over 500,000 gallons. The City projects a future capacity of 16 MGD, distribution piping of over 250,000 lf and a storage capacity of approximately 5 million gallons. Existing users in the Murfreesboro reclaimed water system include one golf course, a hospital that uses the water for the cooling system, a residential office development and a large soccer complex, which uses repurified water for irrigation. The system currently supplies an average daily flow in excess of 1,500,000 gallons per day and a peak flow of 3,500,000 gallons per day to its existing customers. The City has anticipated that, due to the location of existing distribution piping, many additional users in close proximity to these lines can be served with a minimum amount of new line having to be installed. These would include three additional golf course locations, public parks, medians and open areas, industrial/commercial users, educational and institutional users, and other residential development. The Murfreesboro system anticipates flows in the future to range from an average of 8 MGD to peak use approaching 14 MGD.

## WATERSHED PROTECTION

These two cities have found that there are many benefits to developing and operating a reclaimed water system. They include the protection of the watershed by decreasing the amount of raw water diverted from the Harpeth River and the Stones River and their tributaries for drinking water purposes. The reclaimed systems also allow for a significantly decreased discharge from the cities' wastewater treatment systems into sensitive rivers and streams. By developing a reclaimed water system in these cities, city leaders have provided one way to accommodate a portion of the anticipated growth. These efforts result in an increase in the water available for irrigation and industrial uses without depleting precious raw water resources. They find that this reduces the demand for potable water, prolonging the life of the City's water system components. Reuse water also provides a cost savings for customers who can purchase reclaimed water for appropriate uses at a lower cost than potable water. These municipalities are able to ensure that their customers who are connected to the reclaimed water systems are not required to restrict their non-potable water use during dry periods. Last summer, the City of Franklin was under restricted potable water use for approximately nine weeks due to the drought conditions. However, reclaimed water was available during the entire summer for irrigation.

Steps that have been taken in implementing the reclaimed water system in these municipalities include evaluating the existing potable water system customers by demand and location. Water records identify customers according to their business category and total water use, and the Cities were able to install reclaimed water distribution piping in areas that would provide the greatest benefit to the system at the least cost. The cities were also able to evaluate the reclaimed water treatment levels required for potential customers by completing telephone interviews and

researching industrial standards. Existing wastewater treatment plant performance was evaluated and compared to the treatment level required for the uses that each type of customer would need. Wastewater treatment processes were changed or modified where required in order to provide the adequate level of treatment necessary for the reclaimed water supply. These steps were completed in order to evaluate the potential demand for reclaimed water and then to plan the distribution system and high service pumps in order to deliver water to the potential customers that were identified.

Each city had discussions with the regulatory agencies responsible for their various operations. They developed cost-rate models for the recovery of costs associated with the reclaimed water system. While no separate utility has been set up for the operation of these reclaimed systems, the systems do operate as separate entities to some extent. The model each municipality chose to follow was to start with a small distribution loop and concentrate on delivery of reclaimed water to the largest users. By ensuring that large users were supplied water, then residential units and smaller commercial/industrial users that lay along the route of the distribution system could be identified and developed as additional customers. Finally, each municipality recognized the necessity to implement a public awareness program addressing reclaimed water.

## PUBLIC AWARENESS PROGRAM

Reclaimed water system providers, especially municipalities and public entities, should be aware of the importance of a public awareness program to supplement the roll-out of any new reclaimed water program. The absence of a public awareness program can be a prescription for failure. Municipalities must realize that if they do not shape the communication process and provide for the free exchange of information, someone else will do so. Integral to a public awareness program should be three goals: To inform, to communicate and to educate the public or the potential customers. The provider must inform the public that the program exists; that reclaimed water is available for their use. They must communicate to the public the important aspects of the development of the program and how the product is to be delivered for use to each customer. The desired outcome of the public awareness program should be to create and maintain a partnership with the community. The program should improve levels of confidence and trust between the public and the treatment provider. One would like to think that in the long run, this will result in the acceptance of the product by the community as well as providing long-term support for the reclaimed water program.

When introducing a new concept, such as a reclaimed water system to the public, one must be aware that there are certain aspects that can, if given an opportunity, quickly turn public opinion against a project. One such issue is fear of the unknown, usually caused by lack of information. It is natural behavior for humans to fear what we do not know. The lack of information usually contributes to confusion about an issue, fueling rumor and misinformation about a program such as reclaimed water. These human conditions, when combined, can serve to foster public mistrust of most any new public program.

What might be the public's concerns over a newly introduced reclaimed water program? They will normally take the form of questions that address safety and expense. People will want to know if reclaimed water is a safe product. They will be concerned for how a reclaimed water program will affect water rates and taxes as well as whether a system such as this will require construction or cause inconveniences to their everyday lives. Most will want to know whether the technology is reliable and proven successful over time.

A good public relations program should have as one of its major focuses good communications. In order to gain community acceptance and support, the management of a system must commit to be open, honest, consistent and clear in their message. Leadership must make a commitment to be responsible to public opinion and to make this an on-going effort that will not end as soon as the system is rolled out. The key audiences to a public awareness program should be, of course, the public, but also the press and stake holders that both support and oppose the reclaimed water system. To a great extent, individuals become supporters or opponents dependent upon how well the message is first communicated.

In laying the foundation for the public awareness program, leaders will want to do sufficient research. Identification and inclusion of project experts and third-party resources may prove helpful. Then identification of all the stake holders and the opinion leaders within each group will bring about a healthy exchange of views that can ensure that all issues are addressed. It is very important to develop a clear, consistent message that will be delivered to all parties involved.

When communicating with the public, a reclaimed water provider may wish to hold small group meetings or to present to larger community groups. It is not uncommon to publish newsletters or websites with the information that the provider wishes to convey. E-mail updates, bill inserts or government access television are all important tools when trying to deliver a message about a new product. Public participation and feedback is important in a public relations program. The provider will want to provide some method by which the public can respond with questions and concerns. This process might best be developed as a hot line, an on-line form for comment on a website, comment cards that are handed out at public meetings, or possibly forming a citizens' advisory group to participate in the development of the program. Whether communicating with the public, the press or other stake holders, the keys to success are the same: to provide quick, candid answers and to always be clear and consistent in your communications.

For those wishing to develop their own reclaimed water program, the benefits are many. A full-service utility is able to provide irrigation and process water at lower cost than potable water. While preserving and extending the raw water supply for potable purposes, a previously untapped resource can be used to great benefit. The following path forward is suggested as a basic framework for creating a reclaimed water program.

- Adopt a Mission Statement.
- Initiate a Public Awareness Program.
- Recommend to the regulating authorities a rate methodology and the requirements for an ordinance that would require mandatory use of reclaimed water for certain types of customers.
- Review and adopt policies, procedures and regulations for reclaimed water.
- In areas where this does not already take place, investigate restricting water withdrawal from the waters of the State for non-potable use in areas where reclaimed water might be available in the future.
- Complete and submit a Water Reclamation System Master Plan to the State regulatory authority for approval. Resolve possible jurisdiction issues.
- Begin construction of reclaimed water facilities that will provide the greatest benefit to the system at the lowest cost, and develop managerial or accounting systems to account for the reclaimed water utility.