

RECLAIMED WATER – IS IT FOR EVERYONE?

*Tom Clark, Tucson Water, Tucson, AZ
Karen Dotson, Tucson Water, Tucson, AZ*

Abstract

When you live in the desert where drinking water supplies are scarce, every site with the potential to use reclaimed water should use it. Right? When reclaimed water is matched with the right customers, there is an unbeatable partnership – customers save money because of the lower cost of the water, turf and landscaping benefit from the nutrients in the water, and the community saves potable water for drinking. Reclaimed water and the wrong customer is a recipe for unhappiness.

The presentation looks at two residential neighborhoods that are served reclaimed water by Tucson Water. One is an older, well-established area with large lots and extensive turf and vegetated areas. The other neighborhood is new with small lots and minimal landscaping.

Tucson, A Water Conscious Community

Tucson, located in the Sonoran Desert, receives only 11 inches of rain a year and has no local surface water supply. As a result, Tucson has always been a water-conscious community. The Tucson area is growing rapidly, at a rate of 2.5 to 3 percent annually. Today Tucson Water is delivering its customers groundwater and Colorado River water from the Central Arizona Project that has been recharged and recovered.

Tucson's reclaimed water system is unique in several ways. Rather than a means to dispose of treated wastewater, it is an important and growing water supply for this desert community. Wastewater is the only supply that will continue to grow as the population increases. Therefore, reclaimed water plays an increasingly important role in the water supply picture. The City has committed to the increasing the use of effluent as part of its long-range water supply plan. This commitment anticipates that effluent for non-potable reuse will be eight (8) percent of the total water through the year 2050.

A Regional Overview

The City owns and operates a municipal water utility, Tucson Water, which provides potable and reclaimed water service in the Tucson metropolitan area. Tucson Water serves potable water to over 690,000 people, about 80 percent of the metropolitan population. In 2003, the utility delivered approximately 109,700 acre-feet of potable water and 11,500 acre-feet of reclaimed water. In the Tucson region, the combined annual municipal, agricultural, and mining groundwater pumpage is nearly three and a half times greater than the rate of replenishment of the aquifer.

Pima County owns and operates the regional wastewater collection system and treatment facilities. An intergovernmental agreement between the City and the County provides the City with the right to use about half of the 68,000 acre-feet (calendar year 2003) of secondary effluent produced at the two regional treatment plants. Today, this secondary effluent is used in the reclaimed system and the remainder is used to irrigate two other golf courses or is discharged into the Santa Cruz River, under an NPDES Permit, where it recharges the aquifer.

Tucson's Reclaimed Water System

Since the first customer (a golf course located at the end of a 10-mile pipeline) received reclaimed water in 1984, more than 100 more miles of pipe have been added to the system. Reclaimed water is produced in two ways: at a filtration plant and through recharge and recovery. The filtration plant further treats secondary effluent from one of the County's wastewater plants and is permitted to produce up to 10 MGD.

Reclaimed water is also produced at two recharge and recovery facilities: the Sweetwater Recharge and Recovery Facility located south of the filtration plant and the Santa Cruz River. The Sweetwater facility consists of eight constructed basins which are used to recharge secondary effluent. It is operated under an aquifer protection permit that allows 6,500 acre-feet of treated wastewater to be recharged and recovered annually. A constructed wetlands is also part of the Sweetwater facility. The wetlands was designed to treat the backwash water from the filters and is also used as a public environmental amenity

The Santa Cruz River facility is a "managed in-channel" project. Secondary effluent produced at the County's wastewater treatment plants is discharged into the river and "stored water credits" earned.

The recovered water is a very good quality, less than one NTU turbidity with nitrogen levels below the 10mg/L drinking water standard. This low nitrogen level is significant because the secondary effluent produced by the County is not denitrified and is typically in the 27 mg/L range. Recovered water from the recharge facilities is blended with water produced at the filtration plant to produce water that meets Tucson's Reuse Permit requirements. The amount of recovered water blended with the filtered water varies daily based on total system demand and the quality of the filtered water. In 2003, the blend was about 25 percent filtered water and 75 percent recovered water.

Customer Characteristics

In calendar year 2003, 11, 500 acre-feet of reclaimed water was delivered to nearly 600 customers. Sixty-three percent of this water was delivered to fourteen golf courses. Another 18 percent was delivered to parks. The remainder was delivered to schools (10 percent), single family (2.6 percent), agriculture (2.6 percent), commercial (1.2 percent), multi-family (0.4 percent), and street landscape (2.5 percent).

Although reclaimed water deliveries have increased by nearly 50 percent since 1995, the percentage of deliveries in each customer category has remained relatively constant except in the single-family group, which has had the highest increase. This can be attributed to increased public awareness of the availability of reclaimed water and a model environmental community which includes reclaimed water service to each home.

All of the City-owned golf courses are irrigated with reclaimed water or secondary effluent. The City has a policy that all new golf courses and turf facilities over 10 acres use reclaimed water. Pima County also has a policy requiring reclaimed water use.

Tale of Two Neighborhoods

In the initial planning of the reclaimed water system in the early 1980's, Tucson Water did not plan to provide single family residential service. However, in 1994 a neighborhood with lots of one acre and larger and high outdoor water use approached Tucson Water about including reclaimed water lines as part of the improvement district they were forming to bring sewer service to the neighborhood. Because this neighborhood, which will be referred to as Neighborhood A, had the highest per capital water use of any Tucson neighborhood, the utility agreed to install reclaimed water lines in the residential streets at no cost to the property owners. Residents would be responsible for the cost of the reclaimed meter and any onsite improvements that might be required to accept reclaimed water. The decision of whether to connect to the reclaimed system was left to the property owners. In the first year, nine properties connected to the system. Each year additional properties are connected and today 131 homes (38%) in the neighborhood are connected.

In the mid-1990's, a group of local developers were planning Tucson's first "sustainable" community. This community, referred to in this paper as Neighborhood B, was to be a model of energy efficient design and technologies, including solar energy, water harvesting, xeriscape, and reclaimed water use. The lots in this neighborhood are small, 5,000–10,000 square feet, with minimal turf and landscaping. The Covenants, Conditions, and Restrictions (CC&R's) recorded by the developers of Neighborhood B require that all outdoor watering be with reclaimed water. In 1998 the first home was connected to the reclaimed water system. Today 235 homes use reclaimed water.

Table 1 illustrates the reclaimed and potable water use for each of the neighborhoods. It is interesting that the total water use for Neighborhood B only averages 8.8 Ccfs/ month, compared to the 12.0 Ccf/mo system-wide residential average, while total water use in neighborhood A is 76.2 Ccfs/mo.

Reclaimed water use in Neighborhood B is about 60% (this is the typical percentage of outdoor water use in Tucson) of the total water use, while reclaimed water use in Neighborhood A is 82% of the total water use.

Water Rates and Savings

Since Tucson Water began delivering reclaimed water in 1984, it has been the Mayor and Council's policy that reclaimed would cost less than potable water as an incentive for Tucson Water customers with uses suitable for reclaimed water to convert. The reclaimed water rates currently recover about 70% of the cost of service, with the remaining 30% paid for by the potable water customers through their water rates. Although a few customers convert to reclaimed water because "it's the right thing to do", most convert because of the potential savings.

Potable water is billed based on an inclining block system with the lowest block (0-15 Ccf) costing \$1.03 and the highest block (over 45 Ccf) costing \$6.97 Ccf. Reclaimed water is sold at a flat rate of \$1.31/Ccf.

Figures 1 and 2 illustrate the rate blocks of the average customer's water use in each neighborhood. Note that all of the water use in Neighborhood B falls within the first (and least expensive) rate block. The average customer in Neighborhood A has a significant volume of use in the highest rate block. Given these usage patterns, the saving potential for converting to reclaimed water is different in each neighborhood.

Table 2 shows that even the low water use customer in Neighborhood A will see an annual savings from converting to reclaimed water and the high volume customer will have a significant annual savings. In contrast, as seen in Table 3, in Neighborhood B, it will actually cost low and average volume customers more to use reclaimed water than it would to use potable water.

Customer Satisfaction

Based on customer calls to the utility and number of requests to have reclaimed water service discontinued, it can be concluded that there is a strong relationship between customer satisfaction, the volume of reclaimed water used and the amount of money saved. In Neighborhood A, no reclaimed water services have been discontinued at the customer's request. The reclaimed water signs that Tucson Water requires to be posted at the entrance to every property having reclaimed water are a source of pride and identity in this neighborhood.

In contrast, in Neighborhood B an increasing of customers are requesting to have their reclaimed water meters removed and opting for landscaping that requires no supplemental watering. The second and third phases of Neighborhood B which are now being developed have dropped the requirement of reclaimed water use at individual houses and will use reclaimed water only for the street medians and common area. The reclaimed water signs are a continued source of friction between the customers and Tucson Water. Several customers are at risk of having their reclaimed service discontinued for failure to leave the sign in place.

Time Is Money

Reclaimed water requires more one-on-one customer contact than potable water. Sites must be inspected before reclaimed water service is initiated and periodic inspections afterwards are required to assure that the water is being used safely and in compliance with all of the State and local regulations. Also all potable services at sites with reclaimed water require backflow protection.

In Neighborhood A, inspections are quick and routine. Placement of the reclaimed water signs is non-controversial and the lot size and configuration makes it easy to place the backflow prevention assembly close to the potable water meter. In neighborhood B, an inspector may have to go to the same site several times. Correct placement of the backflow prevention assembly is difficult because the lots are so small. Reclaimed water signage is a persistent problem; residents remove them because they feel they are unsightly. The backflow prevention/reclaimed water inspector for the zone that included Neighborhood B spends nearly 75% of his time with Neighborhood B.

Conclusion

While it is true that in the desert “every drop counts”, consideration should be given on a case-by-case basis to the appropriateness of reclaimed water use. Factors to consider in deciding whether reclaimed water is appropriate could include:

- What is the goal of reuse, conservation or disposal of effluent?
- Volume of water that could be saved by to reclaimed water
- Probable customer satisfaction with reclaimed water
- Utility infrastructure costs to deliver reclaimed water
- Utility staff time required to assure that reclaimed water is used safely and in compliance with all of the State and local regulations
- Whether other ways to conserve drinking water, i.e. xeriscape or water harvesting, might be more cost-effective and acceptable to the customer

Table 1. Water Usage Per Service for 2003 in Ccf

Month	Neighborhood A			Neighborhood B			All Residential Water Customers
	Potable	Reclaimed	Total	Potable	Reclaimed	Total	
January	13.1	38.1	51.2	4.96	1.96	6.9	9.8
February	10.9	35.7	46.6	4.89	2.36	7.3	9.0
March	10.2	30.7	41.0	4.93	2.18	7.1	8.8
April	12.6	37.9	50.5	5.71	3.07	8.8	10.6
May	14.1	58.4	72.5	5.57	4.57	10.1	13.6
June	16.8	82.2	98.9	4.96	4.50	9.5	14.8
July	18.7	107.3	126.0	5.36	5.61	11.0	16.9
August	13.2	92.5	105.7	4.75	4.32	9.1	14.3
September	14.3	82.6	96.8	5.14	4.93	10.1	13.1
October	12.4	64.0	76.4	4.96	4.50	9.5	12.3
November	12.5	75.4	87.9	4.50	3.43	7.9	11.3
December	11.2	49.7	60.9	5.04	3.04	8.1	10.1
Monthly Average	13.3	62.9	76.2	5.07	3.71	8.8	12.0

Note: The data for Neighborhoods A and B are for those customers using reclaimed water.

Table 2. Potential Customer Savings in Neighborhood A

Water User Type	Annual Water Usage in Ccf			Annual Savings*
	Reclaimed	Potable	Total	
Low User	299	73	372	\$ 482
Average User	526	324	850	\$ 2,797
High User	1988	281	2269	\$ 11,383

* Includes taxes, backflow prevention assembly annual test and sewer user fees.

Table 3. Potential Customer Savings in Neighborhood B

Water User Type	Annual Water Usage in Ccf			Annual Savings*
	Reclaimed	Potable	Total	
Low User	13	28	41	\$ (79)
Average User	39	70	109	\$ (44)
High User	105	135	240	\$ 171

* Includes taxes, backflow prevention assembly annual test and sewer user fees.

Figure 1. Volume in Inclining Rate Blocks for Average Customer in Neighborhood A

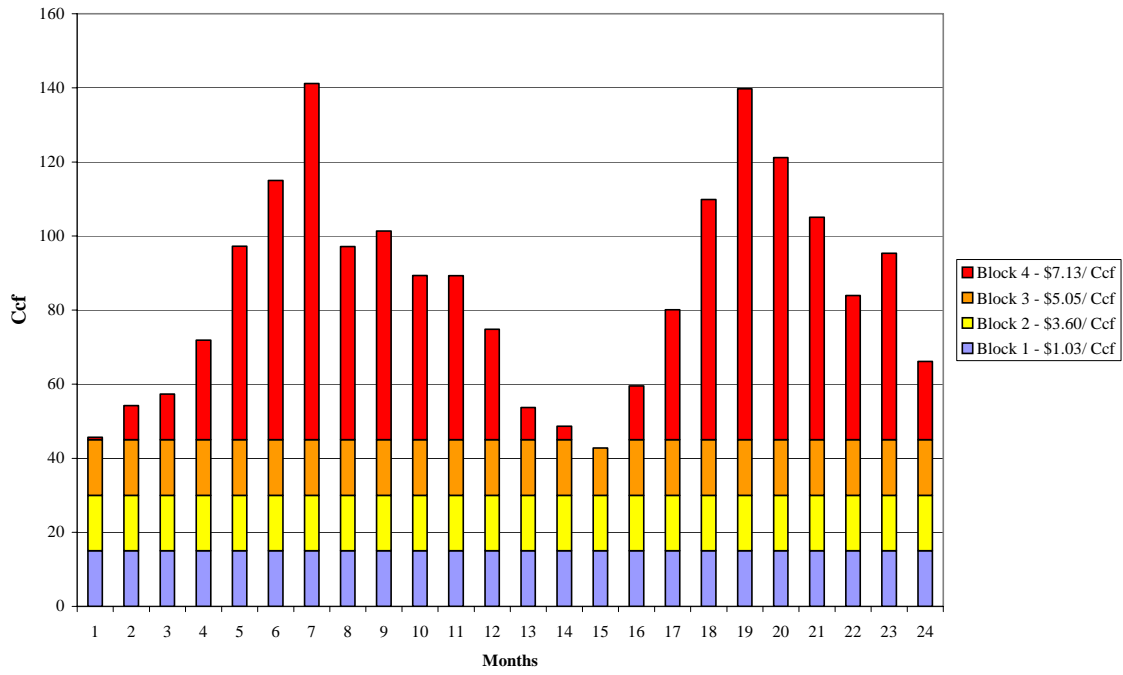


Figure 2. Volume in Inclining Rate Blocks for Average Customer in Neighborhood B

