PROVIDING RECYCLED WATER FOR CROP IRRIGATION AND OTHER USES IN GILROY, CALIFORNIA

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ABSTRACT

The South County Regional Wastewater Authority (SCRWA) delivers recycled water to local farmers, golf courses and parks throughout the City of Gilroy, California, located approximately 30 miles south of San Jose, California. The SCRWA recently completed an expansion to the tertiary treatment system, which included additional tertiary filter banks, a new storage reservoir, additional pumping capacity, and a new delivery pipe with turnouts.

With the new facilities on-line, the SCRWA recycled water system consists of 6 million gallons per day of firm tertiary filtration capacity, one on-site recycled water storage reservoirs with a total of 3 million gallons of storage, two recycled water delivery pipelines, and four pumping stations.

The new 3 MG reservoir and additional pumping stations at the SCRWA treatment plant are critical in meeting the peak demands of agricultural irrigation. The reservoir enables the treatment plant operators to shave demand peaks and provides the flexibility for the SCRWA to shut down tertiary filters as needed. Having 6 MGD of firm tertiary filter capacity gives the SCRWA the capability of producing enough recycled water to meet existing and future demands.

Interest among potential agricultural recycled water users in the Valley is growing as the price for recycled water becomes competitive with the price of pumping groundwater in the area. Farmers see recycled water as an economical and reliable source for crop irrigation. The SCRWA recycled water system has proven to be an excellent source of high quality water for irrigation of farmlands.

INTRODUCTION

The South County Regional Wastewater Authority (SCRWA) is a joint powers authority between the Cities of Gilroy and Morgan Hill, California, established to treat wastewater for the South Santa Clara County region. The SCRWA owns and operates a conventional secondary wastewater treatment plant and a co-located reclamation facility in Gilroy, California, approximately 30 miles south of San Jose, California, as shown in Figure 1. The two cities are

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predominantly residential communities with a total population served by the SCRWA of approximately 90,000 people.

Agricultural lands surround both communities, and is the predominate landuse for the area. This farming region is known as the Pajaro Valley and is ranked fifth in agriculture production in California. The climate for the valley is semiarid, so water supply is an important issue for farmers in the region. The Pajaro Valley gets most of its water from pumping groundwater and importing water from other parts of California. Recycled water provides a small but growing portion of the water used for agriculture in the region. As the cost of potable and well water increases, the beneficial use of recycled water becomes more evident.

Figure 1. Vicinity Map

The recycled water program at the SCRWA is operated in partnership with the Santa Clara Valley Water District (SCVWD). The SCRWA produces the tertiary treated water at the treatment facility and the SCVWD distributes the water as a wholesaler through its distribution system. Both agencies work together to promote the use of recycled water by agricultural, commercial and industrial users throughout the region.

The SCRWA and the SCVWD recently completed construction of a project to expand the recycled water facilities. The project components included increasing the firm capacity of the tertiary filters from 3 million gallons per day (MGD) to 6 MGD, installing a 3 MG treated water reservoir, two new pump stations, a new 20-inch delivery pipeline, four new irrigation turnouts, and upgrades to the reclamation plant controls systems. These new upgrades provide the SCRWA with the flexibility to better meet the needs of agricultural, commercial and industrial users throughout the system.

This paper will discuss the recycled water program at the SCRWA, including the water reclamation facility with newly constructed improvements, the new storage reservoir, the delivery system including irrigation turnouts, permit requirements including inspection and end user training, and special requirements of agricultural users.

THE SCRWA'S WATER RECLAMATION FACILITY

Facility Description

The SCRWA secondary wastewater treatment plant is an 8.5 MGD conventional facility built in 1994. The plant includes a headworks with bar screens and grit removal followed by pre anoxic tanks for nitrification. Mixed liquor then flows to two oxidation ditches employing mechanical aerators, followed by secondary clarifiers. Secondary effluent is directed to approximately 400 acres of percolation ponds for disposal. Sludge is dewatered using belt presses and used as daily cover at a local landfill.

Co-located with the secondary treatment facility, the SCRWA reclamation plant was constructed in 1995 and utilizes anthracite media filters to tertiary treat a portion of the secondary effluent to meet California's Title 22 Water Reuse Criteria. The facility also includes a chlorine contact basin, a dechlorination facility, and distribution pumping stations. The original pre-design report for the reclamation facilities recommended a phased construction approach such that expansion would be staged to an ultimate firm capacity of 12 MGD. The configuration at ultimate capacity included 5 filters (each having a 3 MGD capacity), such that 12 MGD reliable capacity can be produced with one filter out of service for backwash or maintenance (MWH, 1992). The original reclamation facility constructed in 1995 included the following facilities:

- Two anthracite granular media filters (reliable capacity of 3 MGD)
- Filter feed pumping facility (reliable capacity of 4 MGD)
- Filter support systems (backwash and chemical feed system)
- Disinfection (chlorine contact basin with 8.5 MGD capacity)
- Southwest Reclamation Pump Station (2 MGD capacity)

As recycled water demands increased, the SCRWA elected to expand the reclamation facility. Initially the objective was to increase the reliable tertiary filtration capacity to 6 MGD by adding one additional anthracite media filter cell. However, based on the paired layout of the existing filters and increased construction costs for a single filter, it was determined that construction of two filters (i.e., providing additional 6 MGD of capacity) was more cost effective. Therefore under the expansion project, the filtration capacity at the SCRWA reclamation facility was expanded by 6 MGD to a total reliable filtration capacity of 9 MGD. However, expansion of the filter support systems and chemical feed systems remains at the target 6 MGD capacity. These facilities can be further expanded during a future plant upgrade project. Construction of the new facilities was completed in 2006. The new reclamation facility constructed in 2006 included the following facilities:

- Two new anthracite granular media filters (additional capacity of 6 MGD)
- Filter feed pumping facility (additional capacity for 2 MGD)
- Filter support systems (additional backwash and chemical feed capacity for 3 MGD)
- Southwest Reclamation Pump Station (additional 2 MGD capacity)
- New Reclaimed Water Pump Station (3 MGD capacity)
- New 1 mile 20-inch South Pipeline for recycled water delivery (includes 4 turnouts)
- New on-site storage reservoir (3 MG)

- New Reservoir Return Pump Station (3 MGD capacity)

The SCRWA facility is shown in Figure 2 below.

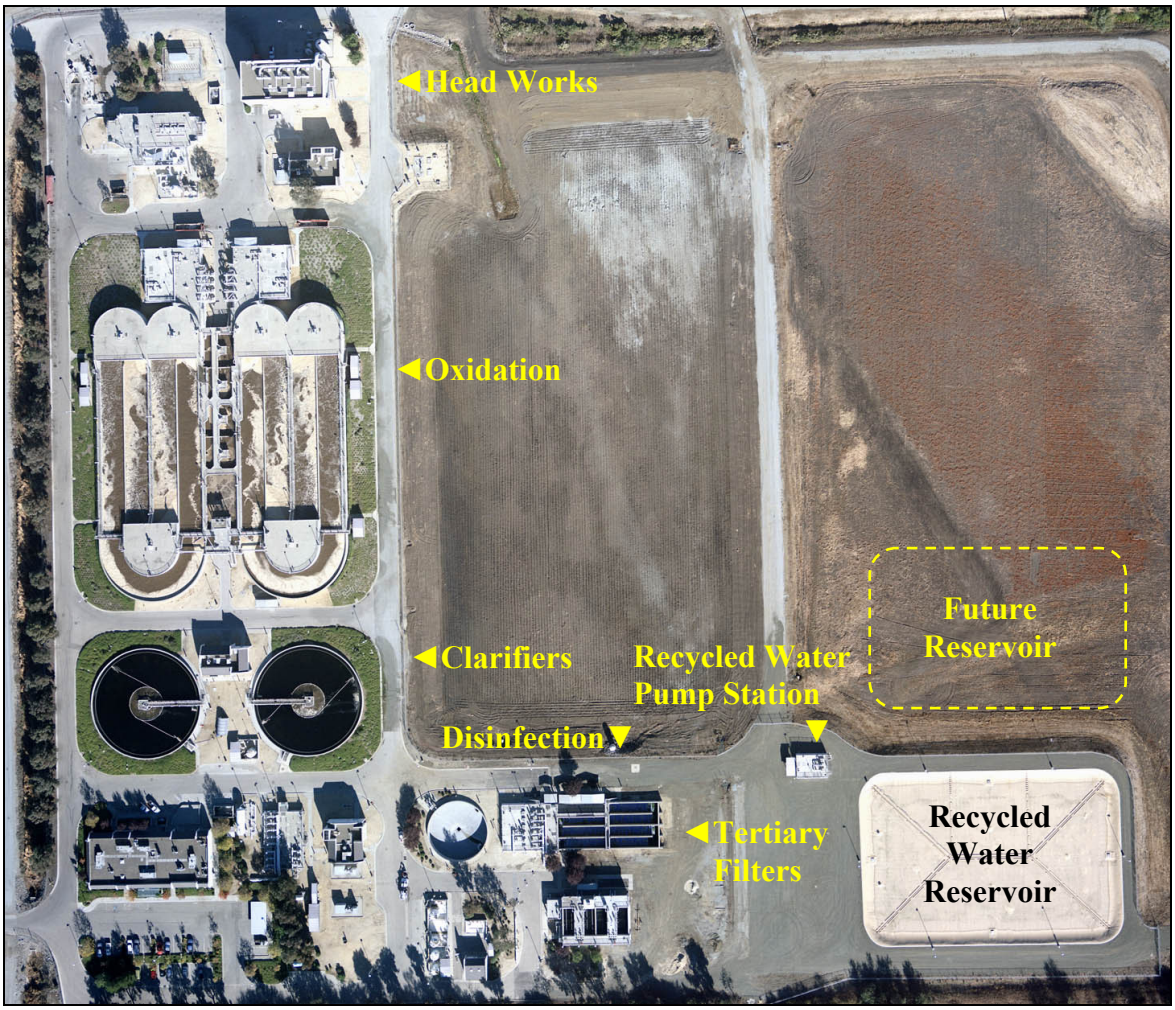

Figure 2. SCRWA Facility

Planned Facility Improvements

The SCRWA is currently in the process of designing a new ultraviolet (UV) disinfection facility to disinfect tertiary treated water for recycled water delivery during the summer months and discharge to the Pajaro River during the winter months. The UV facility will be constructed in 2008 and have an initial capacity of 4.5 MGD, with accommodations to expand to 13 MGD. The UV facility will provide disinfection of the tertiary treated water using the latest proven technology while eliminating disinfection bi-products related to chlorination such as dibromochloromethane ($CHBr_2Cl$) and bromodichloromethane ($CHBrCl_2$). Although these chlorination bi-products are not known to cause adverse health effects in people, animal studies show that high concentrations can damage the liver and kidneys and affect the brain (ATSDR 1999).

The SCRWA is also in the process of extending the South Pipeline an additional 2 miles to provide recycled water to farmers south of the Facility during the summer months and for discharge of tertiary treated water to the Pajaro River during the winter months. Four to six new turnouts will be installed along the new pipeline reach to provide water to new users. The pipeline with new turnouts will be constructed in 2008.

The SCRWA maintains a continuous improvement program at the facility. They are diligent in evaluating all of the latest treatment technologies and consulting with experts in the field of water treatment, civil/mechanical engineering and operations and maintenance specialists.

THE SCRWA'S ON-SITE STORAGE RESERVOIR

Reservoir Design

As part of the Filter Expansion Project constructed in 2006, the SCRWA constructed a new 3 MG on-site storage reservoir to provide additional flexibility and reliability for their recycled water delivery system. To be consistent with the capacity of the tertiary treatment facilities, provisions were made for 6 MG of recycled water storage. A two-cell, 6-MG storage reservoir was designed, but only one, 3 MG cell will be constructed as a part of the Filter Expansion Project. The second cell will be constructed when recycled water demands increase enough to necessitate more storage capacity (see Figure 1).

The reservoir site was graded to raise the water surface elevation to 162.5 feet. This prevented the overflow of the pond. The reservoir has a Hypalon® membrane liner and floating cover. The cover design is illustrated in Figure 3, and an as-built photo is provided in Figure 4. The design criteria for this new recycled water storage reservoir are summarized in Table 1.

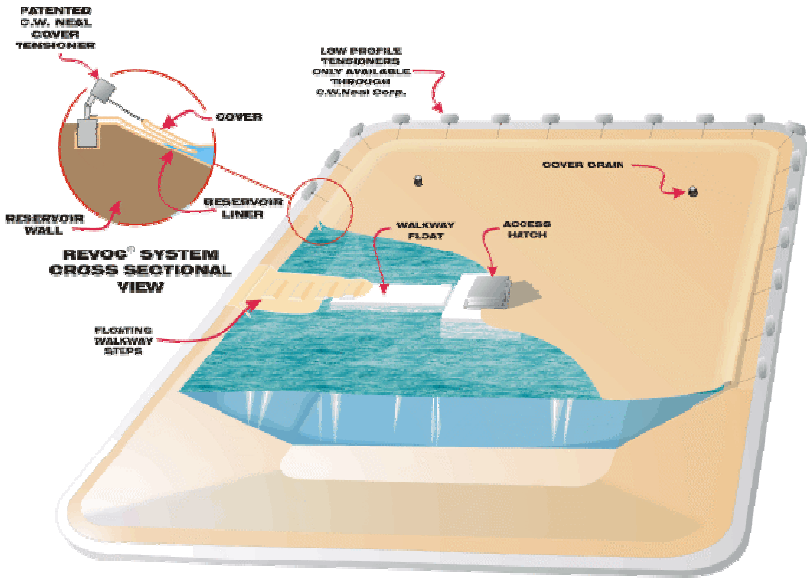

Figure 3. Schematic of Hypalon® Membrane Liner and Floating Cover System (CW Neal 2007)

Figure 4. Photograph of Final Constructed Reservoir

Table 1. Design Criteria for New Recycled Water Storage Reservoir

Storage capacity	6 MG
Total number of cells	2
Number of cells constructed	1
Total pond depth	14.5 ft
Freeboard height	2 ft
Maximum water depth	12.5 ft
Minimum water depth	1 ft
Footprint (each cell)	41,000 ft^2
Lining	Hypalon membrane
Cover	Hypalon floating cover

Reservoir Operation

A new Reservoir Return Pump Station facilitates two-way transport of recycled water in and out of the reservoir. In one direction, recycled water is transported from the chlorine contact basin to the new recycled water reservoir, via a new 30-inch fill line. In the other direction, recycled water from the same reservoir is transported, via a new 30-inch withdraw line, to the Reservoir Return Pump Station that pumps to the Reclaimed Water Pump Station wet well for conveyance to end users. Table 2 provides a summary of the design criteria for the new Reservoir Return Pump Station.

Table 2. Design Criteria for New Reservoir Return Pump Station

Number of units (b/o), total	4
Number of units, standby	1
Number of units, installed	2
Type	Vertical Turbine
Capacity, each unit	2100 gpm (3 mgd)
TDH	14 ft
Motor Size (each)	15 HP

The new on-site reservoir is used to store water during periods of low demand and deliver additional water during periods of high demand (higher than the flow out of the filters). The reservoir gives the SCRWA flexibility to deliver recycled water at high rates on-demand, and increases the reliability of the recycled water supply by providing storage reserves in case of a reclamation plant shut-down.

The reservoir is crucial in the delivery of water to agricultural users throughout the recycled water delivery system. Agricultural users in the Pajaro Valley arid climate tend to require large quantities of water on-demand and cannot be without water for extended periods of time during the growing season. The reservoir allows the SCRWA to balance the peaks of high volume on-demand water use and provide farmers with a reliable source of clean water throughout the growing season.

NEW RECLAMATION PUMP STATION AND DELIVERY SYSTEM

The new Reclaimed Water Pump Station pumps water to agricultural lands south of the SCRWA reclamation facility. The pump station can pull water from two sources: 1) the chlorine contact chamber effluent; and 2) the reservoir storage water provided by the Reservoir Return Pump Station. A schematic of the reclaimed water treatment storage and delivery system is shown in Figure 5.

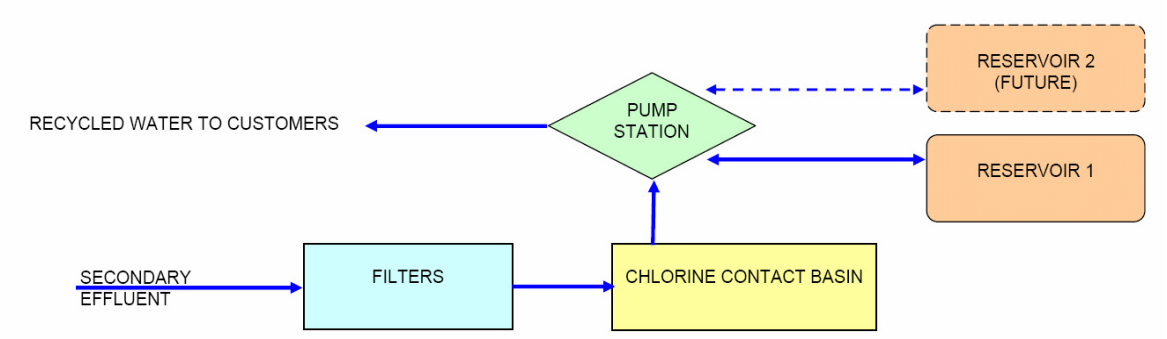

Figure 5. Treatment, Storage and Delivery Schematic

The Reclaimed Water Pump Station utilizes the new 20-inch South Pipeline to deliver recycled water for irrigation. The pump station includes 2 vertical turbine pumps run on variable frequency drives in a lead/lag configuration to deliver water to recycled water users at 80 psi. The pumps pump against a pressure sustaining valve to regulate pressure in the South Pipeline. This pumping configuration provides agricultural users with recycled water at a constant pressure for irrigation of crops. Design Criteria for the pump station are provided in Table 3.

Table 3. Design Criteria for New Recycled Water Pump Station

Number of units (b/o), total	3
Number of units, standby	0
Number of units, installed	2
Type	Vertical Turbine
Capacity, each unit	2100 gpm (3 mgd)
TDH	170 ft
Motor size (each)	125 HP

Though there are some agricultural users and potential users located off of the 12-inch Southwest Reclamation Pump Station recycled water pipeline, the Reclaimed Water Pump Station and South Pipeline provide recycled water to the majority of the SCRWA's agricultural users. Extension of the South Pipeline to the Pajaro River will deliver recycled water to many more agricultural users in the Pajaro Valley.

The constructed portion of the South Pipeline includes four connection points (turnouts) for agricultural users to hook up irrigation systems along the pipeline. An additional four more turnouts are planned when the pipeline is extended. The turnouts are approximately 1000 feet apart and are evenly spaced along the alignment. The turnouts contain protection devices including check valves and pressure regulators to insure no contamination of the recycled water. The turnouts have a standard blind flange for agricultural users to easily connect their existing irrigation equipment. Each of the turnouts is properly painted and marked in English and Spanish to notify users of the product. A photograph of a turnout on the South Pipeline is shown in Figure 6.

Figure 6. Irrigation Turnout on the South Pipeline

THE SCRWA'S WATER RECLAMATION FACILITY PERFORMANCE

Clean Water Treatment Process

Clean water produced at the SCRWA follows criteria of the California Regional Water Quality Control Board and the California Department of Health Services. These regulatory agencies set

treatment standards for wastewater treatment and recycled water use respectively. Specifically, California's Title 22 sets water reuse criteria, and is listed in Table 4 (CDHS 2001).

Table 4. California's Title 22 Criteria for Recycled Water with Granular Media Filtration and Chlorine Disinfection

Maximum filter loading rate	5 gpm/sf
Daily average turbidity	< 2 NTU
24-hour turbidity	< 5 NTU 95% of the time
Maximum turbidity	10 NTU
Contact time (CT)	> 450 mg-min/l
Total coliform (7 day)	< MPN of 2.2 per 100 ml
Total coliform (30 day)	< MPN of 23 per 100 ml

Each treatment plant receives different water quality; therefore treatment processes must be developed site specific. At SCRWA, granular anthracite media filters and disinfection are used to produce tertiary effluent. The SCRWA reclamation facility exceeds the California Title 22 requirements for recycled water treatment using granular media filtration. Table 5 provides a summary of reclamation facility treatment performance from 2003 to present.

Table 5. Reclamation Facility Performance – Summary of Data (MWH 2006a)

Daily average flow winter (November – April) Summer (May – October)	0.25 MGD 1 – 1.5 MGD
Daily maximum flow winter (November – April) Summer (May – October)	2 MGD 3 MGD
Average TSS filter influent	4.5 mg/L
Average TSS filter effluent	<1 mg/L
Daily average influent turbidity	1.4 NTU
Daily average effluent turbidity	0.4 NTU
Daily average effluent BOD	2 mg/l
Daily average effluent nitrate as nitrogen	2.3 mg/l
Daily average effluent dissolved oxygen	5 mg/l
Effluent coliform	2 MPN/100
Average solids loading prior to backwash)	40 pounds

Recycled water is safe to use. Potential health risks associated with the use of recycled water have been well documented nationwide as water recycling projects are implemented and carefully monitored by responsible local health authorities and water quality control agencies. Tertiary recycled water is a highly treated, filtered and disinfected product according to the California Department of Health Services criteria. These standards for recycled water are among the most stringent in the world. No health-related problems have been traced to any of the recycling projects currently operating in California. (SCRWA 2006) As shown in Table 6,

recycled water is at SCRWA is of comparable or better quality than the local shallow groundwater for many constituents.

Table 6. Comparison of SCRWA Recycled Water Quality to Local Groundwater (SCRWA 2006)

Irrigation Water Quality Comparison				
Constituent	Units	SCRWA-SCVWD Recycled Water	Gilroy Muni. Deep Ground Water (Well MW-10)	Gilroy Shallow Ground Water (at SCRWA Facility)
Total Dissolved Solids	mg/L	582	400	650
Boron	mg/L	0.14	0.1	0.35
Calcium	mg/L	43	120	170
Chloride	mg/L	144	33	120
Magnesium	mg/L	27	18	25
Sodium	mg/L	99	37	110
Sulfate	mg/L	57	110	120
Nitrogen:				
Nitrate-Nitrogen	mg/L	2.3	5	10
Nitrite-Nitrogen	mg/L	0.03	2	0.05
ph	Std. Units	7.6	7.3	6.9

Note: Water quality data from 2004-05 period.

Annual Operational Conditions

The historical data indicates that the hydraulic loading rate to the filters varies seasonally. The daily average flow to the filters in the winter months (November through April) is 0.25 MGD, ranging from 0.1 MGD to 2 MGD, and the daily average flow to the filters during summer months (May through October) is between 1 and 1.5 MGD, while the minimum and maximum flows ranged from 0.2 MGD to 3.5 MGD. The SCRWA currently sends the secondary effluent to all four filters, and only takes one off-line during backwash.

With the new 3 MG storage reservoir and new Reclaimed Water Pump Station with variable frequency drives in operation, the erratic water demands of agricultural recycled water users can be accommodated. The performance of the SCRWA reclamation facility has drastically improved with the new facilities on-line. As shown in Figure 7, recycled water demand at the Reclaimed Water Pump Station and South Pipeline reflect the nature of agricultural use of recycled water. Recycled water flow demands of up to 2,200 gpm were seen in spring 2007. Farmers tend to take large quantities of water on-demand for short periods of time. The SCRWA system was designed and is operated to accommodate these demands.

Most of the agricultural irrigation systems on the south pipeline use full circle impact sprinklers, requiring a working pressure between 40 and 80 psi. Each sprinkler head is capable of delivering flows between 20 and 100 gpm, depending on the make and model. Farmers can be using 50 to 100 sprinkler heads each time they irrigate their field, so demand is very high during periods of use. The SCRWA treatment and delivery system is designed to accommodate these

agricultural demands, and as such, demand for the SCRWA's recycled water among the agricultural community is growing.

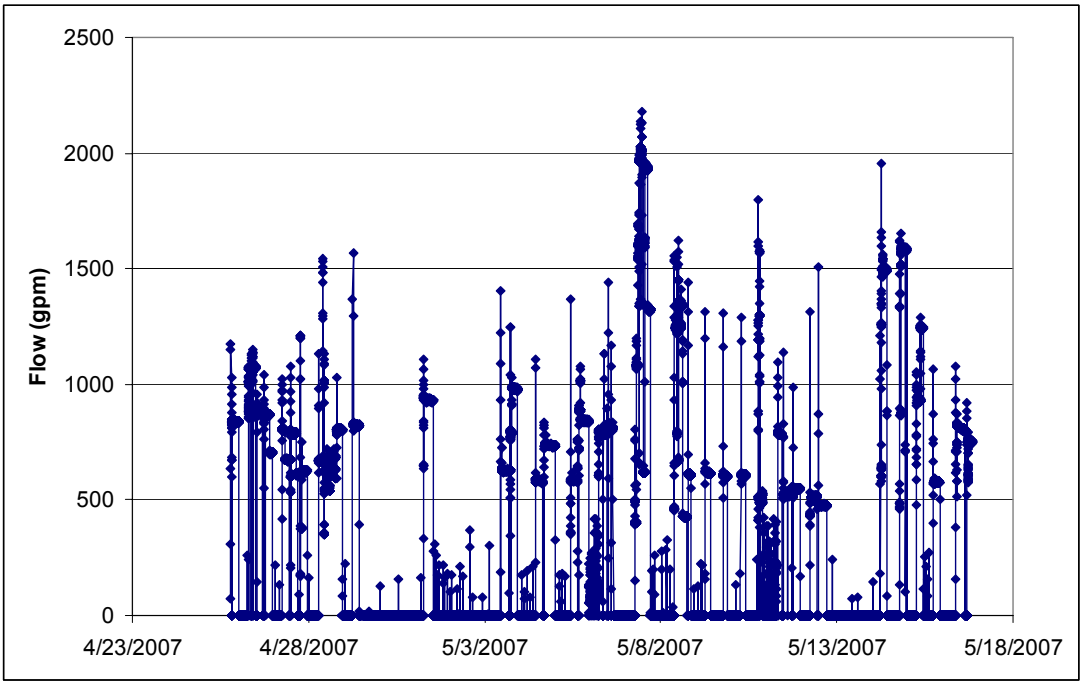

Figure 7. Recycled Water Demand at the South Pipeline
April 25 – May 16, 2007

RECYCLED WATER USE PERMITS AND TRAINING

In accordance with the SCRWA's Waste Discharge Requirements and California Title 22 regulations, all recycled water users must designate a "Site Supervisor" and the Site Supervisor is required to attend annual training sessions at the SCRWA. The Site Supervisor is the responsible party for sharing recycled water use requirements through their organization and is the keeper of all necessary documentation (CRWQCB 2004).

It is essential for Site Supervisors to provide training to agricultural workers on the importance of recycled water safety and proper use of the water. Due to the nature of their work, agricultural workers are often exposed to recycled water, and need to understand safety precautions that should be followed when using the product. The SCRWA provides Site Supervisors with a Site Supervisor Training Manual to share with workers and requires that Site Supervisors educate their workers on the proper uses of recycled water. The cover of the Training Manual is shown in Figure 5.

Proper documentation is the most important issue for the Site Supervisor, especially for agricultural users. Should a contamination issue arise, it will be imperative to confirm the configuration of the irrigation system (piping layout), maintenance and testing activities and the proper training and notification of all employees.

In addition to Site Supervisor training, the SCRWA visits all recycled water user facilities to inspect the connections and confirm separation from any other water systems. Site inspections are performed annually prior the renewal of the recycled water use permits. An example of a recycled water inspection is provided in Figure 8.

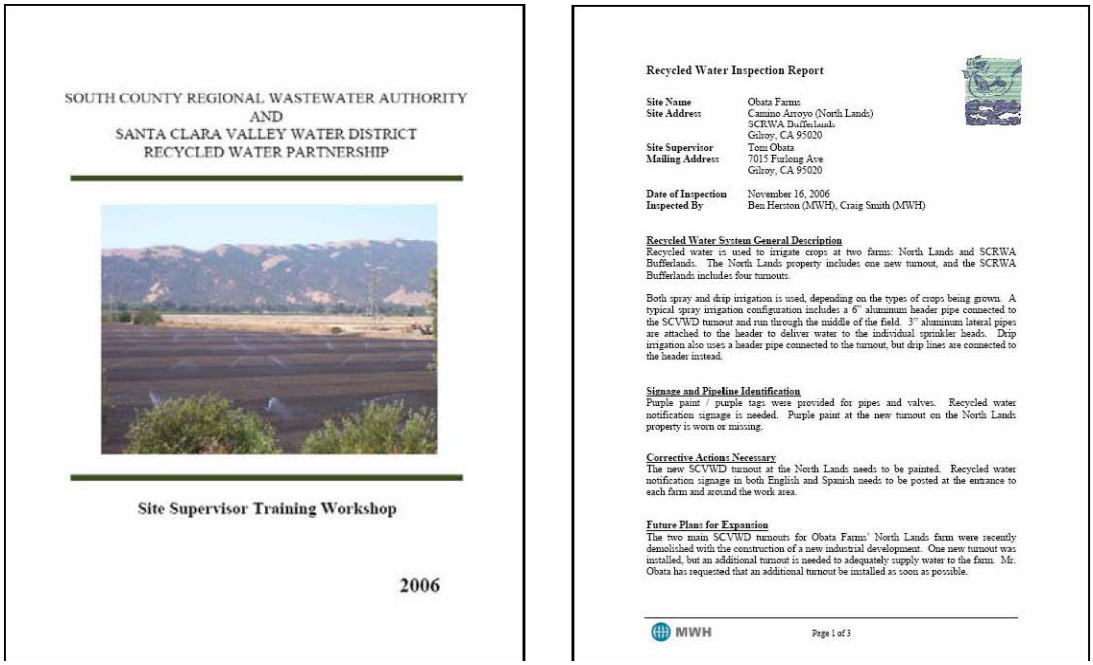

Figure 8. Cover page from Recycled Water Users Training Handbook (MWH 2006b) and Sample Recycled Water Inspection Report

CONCLUSIONS

Through good planning, design and operations, the SCRWA has developed a recycled water program that can accommodate commercial, industrial and agricultural users. Agricultural users of the system have different requirements than commercial and industrial users, as their use is more seasonal and often requires high volumes of water on-demand. These users require high quality water delivered through a versatile storage and delivery system. The SCRWA is able to meet these agricultural demands by providing recycled water that exceeds California's Title 22 standards and is delivered by a versatile pumping station with variable frequency drives, a pipeline and turnouts with pressure sustaining valves and a storage reservoir to shave demand peaks. In addition, the SCRWA provides training to users and inspection of the users systems to ensure the recycled water is being used properly and there is no contamination of the recycled water.

While some consumers are enthusiastic about the use of recycled water, other consumers are concerned about food safety and water-borne diseases. This is understandable due to recent instances of vegetable contamination in California. However, no farms using recycled water have

been identified as producing contaminated food. This is in large part to the good records kept by treatment facilities and their customers. The SCRWA and its agricultural customers follow strict and well established guidelines set by the California Department of Health Services to insure a quality product is being used in the field at all times.

California is an arid environment with a growing population and limited water resources. It is good public policy to develop recycled water as an alternative water resource. In time and with good practice, more consumers will realize the beneficial uses of recycled water. When the next drought hits California, as it surely will, SCRWA and other recycled water purveyors will help the local communities meet commercial, agricultural and residential water demands through smart use of valuable resources.

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