Report

Santa Rosa Incremental Recycled Water Program

Laguna Subregional Water Reclamation Facility

IRWP Improvement Master Plan

August 2005

Contents

Acronyms and Abbreviations

ADWF	average daily dry weather flow
BPU	Board of Public Utilities
DHS	California Department of Health Services
FLEWR	Filtration Loading Rate Evaluation for Water Recycling
IRWP	Incremental Recycled Water Program
MG	million gallons
mgd	million gallons per day
NPDES	National Pollutant Discharge Elimination System
TM	technical memoranda or memorandum
UV	ultraviolet

IRWP Improvement Master Plan

Background and Purpose

To plan for increases in future flows to the Laguna Subregional Water Reclamation Facility (Laguna Plant), the Recycled Water Master Plan, prepared as a part of the Incremental Recycled Water Program, identified improvements to the Laguna Plant. The Recycled Water Master Plan also recommended studies that may reduce future facility sizes or defer construction. This report summarizes the findings of a series of technical memoranda (TM) that examined unit processes of the Laguna Plant's liquid process train. The TMs summarized in this memorandum include:

- L-1 – Design Hydrograph Development
- L-2 – Peak Flow Attenuation via Collection System Storage
- L-3 – Headworks Evaluation
- L-4 – Primary Sedimentation Basin Analyses
- L-5 – Filtration and Ultraviolet Expansion
- L-6 – Wet Weather Flow Management

These TMs are presented in their entirety as Appendices A through F, respectively.

Design Flows Summary

Table 1 summarizes the design flows that were developed and used in the studies represented by TMs L-1 through L-6.

TABLE 1
Process Improvements Design Flows
Incremental Recycled Water Program

	Intermediate Improvements Trigger Flow (mgd)	Long-term Improvements Trigger Flow (mgd)
Design Condition, ADWF	21.34	25.9
Peak Diurnal Dry Weather Flow	29	35
Peak Day Flow	83	101
Peak Hour Flow	109	137
Peak Hour Flow with Storage[a]	90	120
Peak Month Flow	47	57

[a]See Appendices A and B regarding additional storage to attenuate peak flows.

Note:

mgd = million gallons per day
ADWF = average daily dry weather flow

TMs L-3, *Headworks Evaluation*, and L-4, *Primary Sedimentation Basin Analyses* (Appendices C and D, respectively), which rely on peak-hour flow for facility sizing, were prepared in advance of TMs L-1, *Design Hydrograph Development*, and L-2, *Peak Flow Attenuation via Collection System Storage* (Appendices A and B, respectively), which assess the effectiveness of providing additional collection system storage to attenuate peak flows received at the Laguna Plant inlet. Flow attenuation could produce the benefit of reducing the size of these facilities.

TMs L-3 and L-4 initially used the **hydrologic model** created by Merritt-Smith Consulting (Feasibility Report, TM 16, 2003) to project peak-hour flows. The peak-hour flow projected by that model is 132 mgd, corresponding to ADWF of 25.9 mgd. TMs L-5, *Filtration and Ultraviolet Expansion*, and L-6, *Wet Weather Flow Management* (Appendices E and F, respectively), rely on peak-day flow projections developed in the hydrologic model, and are unaffected by peak-hour flow projections.

TMs L-1 and L-2 used the **sanitary sewer collection system model** developed as part of the City's Sewer Master Plan to assess the effectiveness of providing additional storage in the collection system, whether inline (within the sewers), or offline (storage reservoirs within the collections system). The hydrologic model and the collection system model produced different, but very close results. Collection system **static modeling** projected a peak-hour flow of 134 mgd, as reported in TM L-1. However, this intermediate value was not used for the analysis. A **dynamic model** of the collection system used for TM L-2 analysis produced a projected peak-hour flow of 137 mgd, corresponding to ADWF of 25.9 mgd.

TM L-2 concludes that significant cost savings can be achieved by providing 17 MG of offline collection system storage. TMs L-3 and L-4 were subsequently revised to indicate that peak-hour flow could be attenuated to 120 mgd at ADWF 25.9 mgd through the addition of 17 MG of storage, as reflected in Table 1.

Recommended Implementation Priorities

Although the precise timing of improvements is uncertain, there are hydraulic improvements that are recommended in the near future and other improvements that follow a logical sequence.

Short-term Improvements

The following discussion is limited to liquid process improvements. Some improvements for solids handling have already been approved and funded by Board of Public Utilities (BPU), and are summarized as shown in Table 2.

Lining West College Overflow Pond

As noted in TM L-2, lining this pond and constructing other associated improvements would facilitate diversion of wet weather flow and thereby reduce future estimated flows from a peak-hour flow of approximately 137 mgd to 120 mgd. In the near term, it would reduce peak-hour flow from approximately 109 to 90 mgd. Because the capacity of the existing headworks is 90 mgd, this will delay the need for new headworks in the near term.

These improvements will also remove some pressure on emergency power capacity. The estimated cost for these improvements is $4.3 million.

TABLE 2
Short-term Solids Handling Improvements
Incremental Recycled Water Program

	Estimated Cost, $ millions				
Year	**2004**	**2005**	**2006**	**Future**	**Total**
Recommended Improvement					
Solids Handling and Treatment[a]					
Thickening					
Digestion		0.5		1.6	2.1
Dewatering		1.7			1.7
Composting	0.8			1.8	2.6
Land Application	2.5		0.2		2.7
Total	3.3	2.2	0.2	3.4	9.1

[a]Improvements already funded.

Source: Biosolids Program Phase 2 – Brown & Caldwell, July 2003

Screenings Washers/Conveyors Improvements

As described in TM L-3, replacing the screens and conveyors will improve reliability and extend the life of the existing headworks. The estimated cost for these improvements is $2.0 million.

Rehabilitate Primary Sedimentation Basins

It is recommended that high priority be given to making improvements, including demolishing existing and installing new finger baffles in each of the eight basins, and replacing the effluent launders. These improvements will provide better flow distribution and prevent solids scouring in the sludge hoppers. The City may wish to consider replacing the scum removal system at the same time. Estimated cost is $300,000.

Without chemically enhanced primary treatment, two new primary sedimentation basins could be an immediate need. It is recommended that the City consider implementing the rehabilitation measures listed above, implementing chemically enhanced (ferrous chloride plus polymer) primary treatment during wet weather, and monitoring performance or perform stress testing to determine if construction of these basins could be deferred.

Power Master Plan and Emergency Power

Emergency power during extreme wet weather events is currently an issue. A request for proposals is currently underway to retain expertise in developing a Power Master Plan. To plan for the long-term, the plant power system should be examined as a whole, considering the following issues:

- The existing cogeneration units may be approaching the end of their useful lives.
- There are air quality permitting issues with the existing diesel generators.

- The City has committed to reduce greenhouse gases, which would favor alternative energy sources.
- Future demands could push beyond current utility supply.

Therefore, it is recommended that plant power be evaluated as a Power Master Plan. Estimated cost is $200,000.

The Power Master Plan will also include recommendations for emergency power improvements. The cost of other improvements that might be recommended in the Power Master Plan is unknown at this time. For program planning purposes, a total of $15.3 million has been included in the cost estimate.

Filtration and Disinfection

Discussions are ongoing with the California Department of Health Services (DHS) regarding both filtration and disinfection. Changes in filtration requirements are anticipated following the Filtration Loading Rate Evaluation for Water Recycling (FLEWR) studies. The City is an active participant in the studies, which will be completed in 2006. For program planning and cost estimating purposes, 30 mgd of new microfiltration membranes are included at an estimated cost of $28 million.

Possible changes in disinfection requirements are being reviewed by DHS as part of the National Pollutant Discharge Elimination System (NPDES) permit renewal process currently underway. Depending on the outcome of discussions regarding disinfection, the City could be issued a compliance schedule in its new permit. Potential cost of two additional UV channels and equipment is $12 million. The cost of associated plant hydraulic improvements is estimated to be $1 million.

Intermediate-term Improvements

Intermediate-term improvements will be required to provide capacity beyond peak-hour flows of 90 mgd (assuming additional flow equalization at West College), but do not necessarily provide full capacity to 2020 (25.9 mgd ADWF, 120 mgd peak-hour).

Build New Headworks and Primary Sedimentation Basins

Beyond the peak-hour flow of 90 mgd, a new headworks will be required. A new headworks would be constructed at the north end of the plant in accordance with Revised Alternative 1 described in TM L-4, including influent pumping, screening, grit removal, and sedimentation. The new headworks would become the "duty" headworks, and the existing headworks would be used for wet weather flows that exceed 30 mgd. Flows from Rohnert Park and Cotati would flow through the existing headworks year-round. Flow would be routed through a pipeline from the three new primary sedimentation basins to the secondary system in the main plant. Approximate cost of the new headworks is $11.4 million. This cost was estimated assuming that chemically assisted treatment would continue to be used during wet weather at the existing headworks; otherwise, two additional basins and appurtenances would be needed at the main plant at a cost of approximately $7.1 million. Improvements to the primary sludge pump station are expected to cost an additional $1.1 million.

Add One Secondary Clarifier

One new secondary clarifier was originally thought to be an immediate need as described in Feasibility Report TM 3, *Capacity Analysis*. However, the subsequent aeration basin upgrades, coupled with operational modifications, should enable the City to delay this improvement. It is recommended that plant staff monitor this situation and report any deterioration to below acceptable performance. Potential cost, including associated sludge pumping, is estimated to be $4.0 million.

Long-term Improvements

Build New Sedimentation Basins

Two new sedimentation basins will be required to provide hydraulic capacity of 120 mgd peak-hour flow. Estimated cost is $6.3 million, including additional improvements to the primary sludge pump station.

Build New Aeration Basins and Secondary Clarifiers

Two new aeration basins and two new secondary clarifiers, with associated sludge pumping, are recommended to be constructed at the north site to provide a full secondary treatment train for 30 mgd, as described in Feasibility Report TM 3, *Capacity Analysis*. Estimated cost is $17.9 million.

Expand UV Disinfection and Filtration

It is expected that 5 mgd of microfiltration capacity and one additional UV basin will be required to provide full capacity to treat flows associated with 25.9 mgd ADWF. Estimated cost is $11.0 million.

Expand Emergency Power

Additional emergency power supply is recommended to power the long-term expansion facilities. Estimated cost is $3.3 million.

Expand Solids Handling

In accordance with the Biosolids Program, additional digestion and dewatering capacity is recommended to treat flows that exceed the current plant capacity. Estimated cost is $2 million for digestion and $4.3 million for dewatering (source: Brown & Caldwell).

Implementation Plan

A summary of plant improvements and relative timing is shown in Table 3. This table is subject to a number of variables related to both timing and facilities implemented. Potential permit requirements, outcome of the FLEWR studies, outcome of the Power Master Plan, improvements in technology, and ongoing discussions with DHS will likely change the construction plan over the next 15 years. This table does not include the cost of discharge improvements, permitting studies, or participation in FLEWR, which the City is pursuing on a parallel path.

Flow Trends

When the Incremental Recycled Water Program (IRWP) began in 2001, future flow projections were made for the Subregional System ADWF. Those projections were reflected in Feasibility Report TM 1, *Future Flows.* As shown on Figure 1, it was estimated that current permitted flow of 21.3 mgd ADWF would be reached in approximately 2010. These projections are shown as the top line on Figure 1.

However, flows have developed more slowly than originally anticipated. Possible reasons for this trend were examined, first checking the City's ongoing water conservation program. Although this program has been very successful, City staff indicate that most indoor water savings were realized by 2001. In the future, greater savings will be made through outdoor water conservation, which does not affect Laguna Plant flow. However, in TM 2 of the Feasibility Report, *Indoor Water Conservation*, it was assumed that an additional savings of 300 million gallons (MG) annually was possible, half from Santa Rosa and half from the other Subregional Partners. This equates to 0.8 mgd.

A correlation was sought between total annual rainfall or local groundwater levels with average daily dry weather flow; there was no apparent correlation.

Population and employment trends for the period in question also were researched. From 2000 through 2003, population continued to increase, although more slowly than previous years. Since 2000, the City of Santa Rosa's population has increased at an annual rate of about 1.3 percent. In contrast, dry weather flows were projected to increase at a rate of 1.8 percent annually between 2000 and 2020 based on population data from the general plans of the affected communities.

Employment data are available only for Sonoma County as a whole, but should be representative for the Subregional System partners. Employment is customarily reported as full-time positions. Therefore, part-time positions, temporary positions, and contract hires are not generally reported. The recent employment trend for the Subregional System, however, is expected to mirror the general trend for the County. After peaking during the first quarter of 2001, employment in the County has declined every month since. According to Sonoma State University, Sonoma County has lost 13,300 jobs since hitting its peak. As reported by the *Santa Rosa Press Democrat* (September 19, 2004), Sonoma County experienced its first gain of 100 jobs during August 2004. Additionally, a downturn in tourism began in spring 2001, although the decline is slight. The wine industry has likewise experienced a downturn, but its influence on wastewater flow is less clear.

TABLE 3
Laguna Plant Process Improvements Implementation Plan
Incremental Recycled Water Program

Recommended Improvement	Short-term ($ million)						Intermediate ($ million)			Long-term ($ million)			Improvements Subtotal ($ million)
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
Preliminary Treatment													
West College Pond Lining			4.3										**4.3**
Headworks			2.0					11.4					**13.4**
Primary Treatment													
Primary Clarifiers[a] and Return Pipe		0.3						7.1				6.0	**13.4**
Primary Sludge Pump Station								1.1				0.3	**1.4**
Primary Sedimentation Basin Retrofit			0.3										**0.3**
Secondary Treatment													
Aeration Basins										5.4	5.4		**10.8**
Secondary Clarifiers							4.0			3.4	3.4		**10.8**
RAS/WAS Pumping										0.3			**0.3**
Tertiary Treatment													
Filtration[b]					14.0	14.0				5.0			**33.0**
UV Disinfection					6.0	6.0				6.0			**18.0**
Hydraulic Improvements				1.0									**1.0**
Solids Handling and Treatment[c]													
Thickening													
Digestion		*0.5*		*1.6*						2.0			**2.0**
Dewatering		*1.7*								4.3			**4.3**
Composting	*0.8*			*1.8*									
Land Application	*2.5*		*0.2*										
Power Generation		0.2		5.9	5.9					3.3			**15.3**
Subtotal by Year ($ million)	0.0	0.5	6.6	6.9	25.9	20.0	4.0	19.6	0.0	29.7	8.8	6.3	**$128.0**

[a]Optimistic assumption based upon implementation of primary clarifier modifications; needs to be verified by field testing.

[b]Assumes 30 mgd of membrane filters, expandable to 35 mgd in 2010; results could change based on the outcome of FLEWR.

[c]Estimates from Final Biosolids Program, Phase II, Brown & Caldwell; italics not included in totals – financing already obtained.

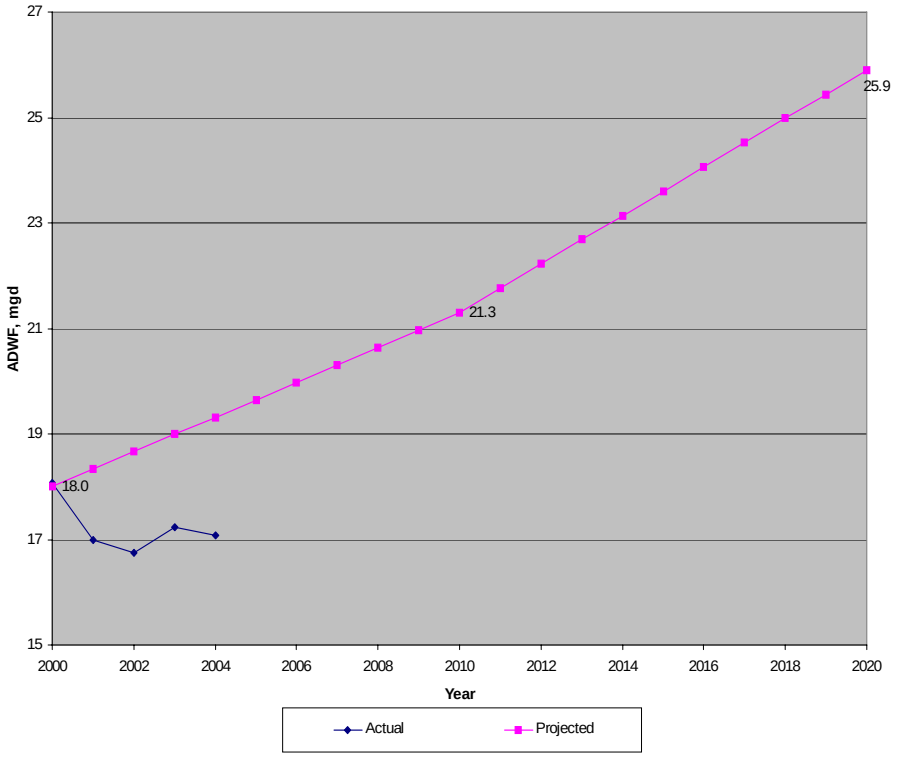
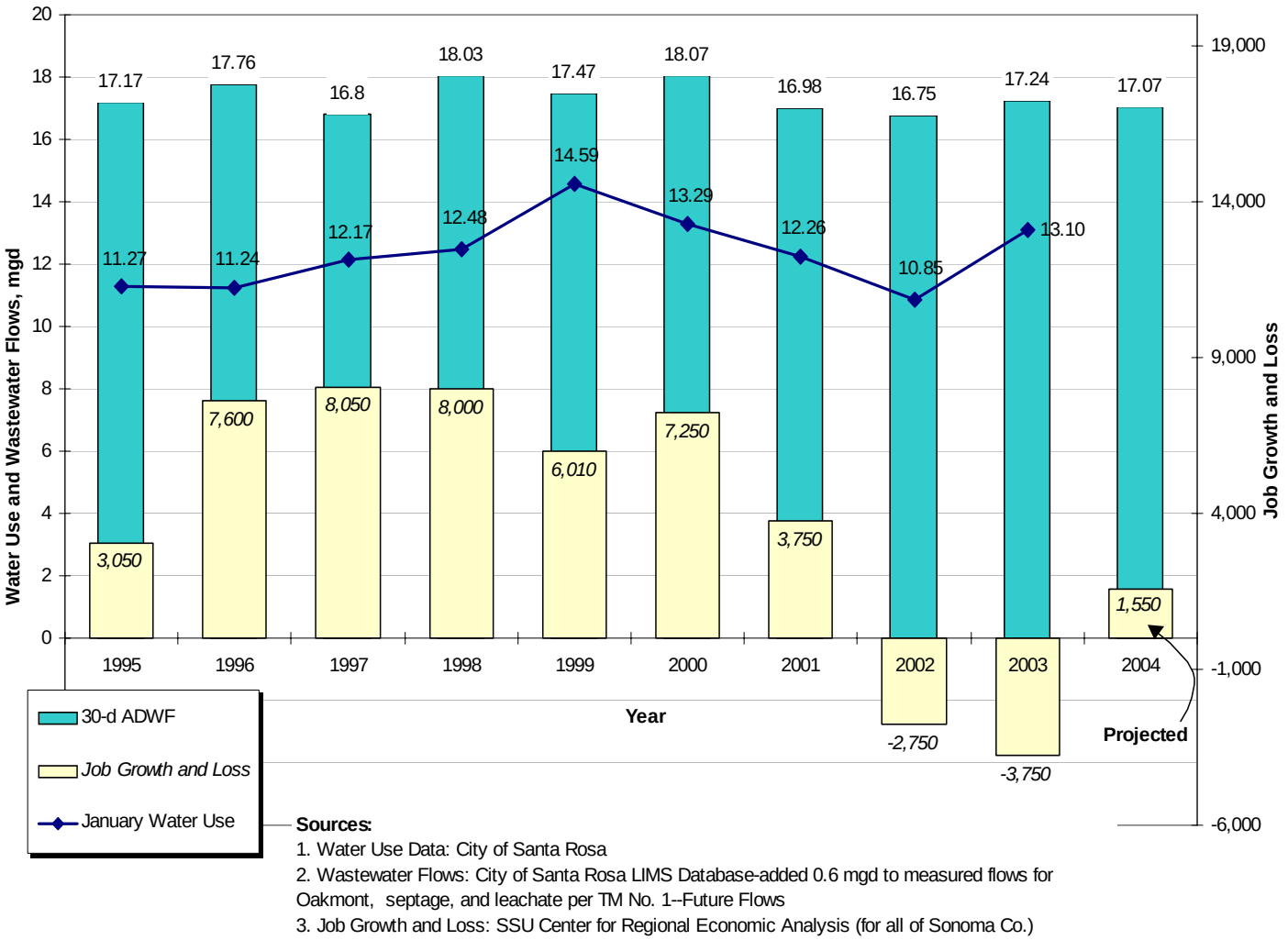


FIGURE 1
Average Dry Weather Flow Projections
Incremental Recycled Water Program

The City of Santa Rosa does not directly meter wastewater from most commercial and industrial establishments, which could be used to verify the effects of employment on flows. Therefore, a surrogate measurement was sought. City of Santa Rosa commercial non-irrigation water consumption data were used as the surrogate. These data were collected and compared to Laguna Plant ADWF. ADWF represents the 30 consecutive days of lowest plant flow. Results of this comparison, as well as employment trends, are shown on Figure 2.

As illustrated by Figure 2, the surrogate employment measurement follows the same downward trend as ADWF at the Laguna Plant. While data are limited, it appears that additional water conservation, slow population growth, job loss, and a general downturn in the economy provide some confirmation of the dry weather flow trends observed over the last several years. It should be noted, however, that this trend is reversible with economic recovery. Because flow projections are so sensitive to population demographics and the economy, the City should continue to monitor these trends and adjust the implementation schedule for improvements as needed.



Sources:
1. Water Use Data: City of Santa Rosa
2. Wastewater Flows: City of Santa Rosa LIMS Database-added 0.6 mgd to measured flows for Oakmont, septage, and leachate per TM No. 1--Future Flows
3. Job Growth and Loss: SSU Center for Regional Economic Analysis (for all of Sonoma Co.)

FIGURE 2
Comparison of Santa Rosa Wet-Weather Commercial and Non-Irrigation Water Use, Dry-Weather Wastewater Flows, with Job Growth and Loss
Incremental Recycled Water Program