MWH

MEMORANDUM

To: **Darrell Eck, Senior Civil Engineer**

From: **MWH**

Date: **August 6, 2004**

Subject: **Sacramento County Recycled Water Distribution Modeling Study**
Laguna West, Lakeside, Laguna Stonelake, East Franklin and Laguna Ridge

Introduction

This memorandum presents the results of studies performed at the request of the Sacramento County Water Agency (SCWA) and the Sacramento Regional County Sanitation District (SRCSD) to evaluate the existing and new recycled water treatment and distribution systems within the Laguna West/Lakeside/Stonelake (Phase 1) and East Franklin/Laguna Ridge (Phase 2) areas of Zone 40 as shown in **Figure 1**. The results of this study are intended to amend the modeling work contained in the *Zone 40 Recycled Water Master Plan* (HydroScience Engineers, October 2003) (RWMP) and to inform both agencies on needed improvements and operational strategies necessary to meet non-potable water demands within the Phase 1 (existing distribution system) and Phase 2 (proposed and existing distribution system) recycled water planning areas. Through the use of a water distribution model (H20net), existing and proposed pipeline alignments, diameters, and other distribution facilities have been evaluated.

The contents of this memorandum will be incorporated in the Water System Infrastructure Plan (WSIP) for Zone 40 currently under development. The WSIP will frame the results of this study as well as other potential recycled water service areas in the context of a broader SRCSD Recycled Water Program (RWP) in Zone 40.

Brief Background

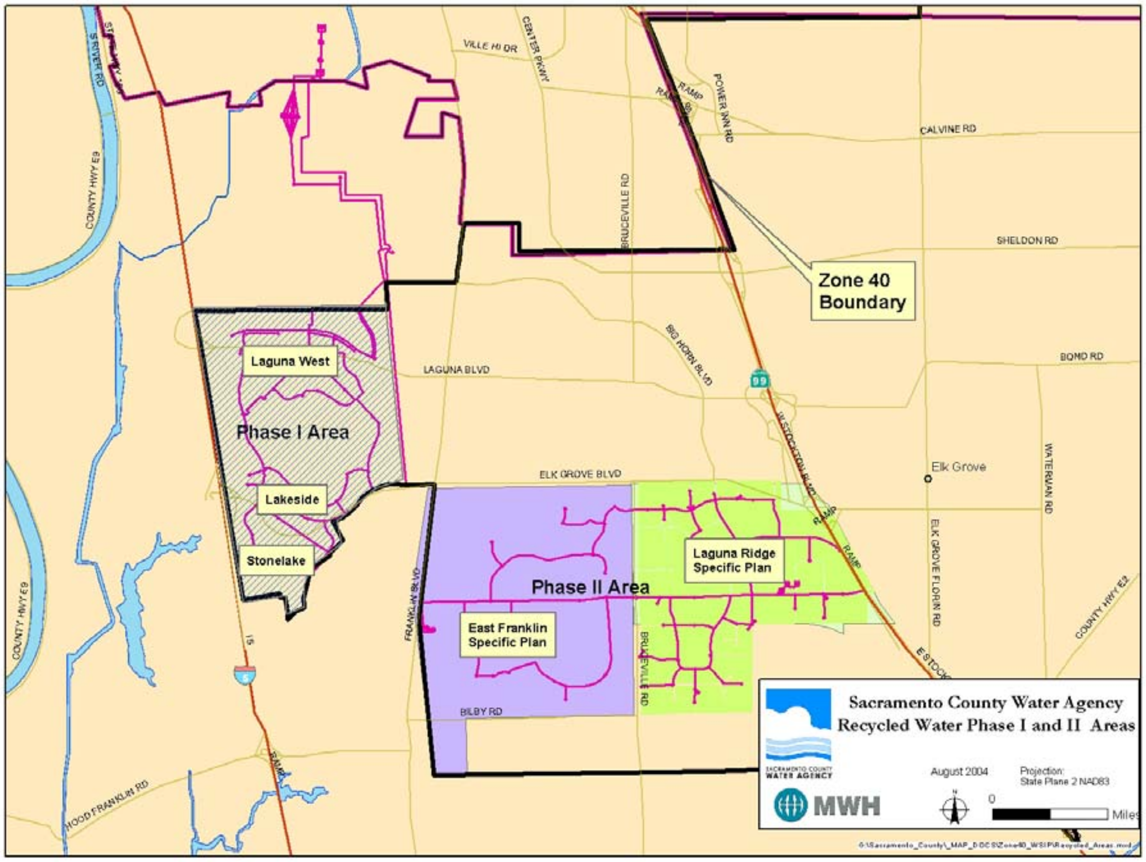
Where it is economically feasible, recycled water is a desirable source of water for outdoor landscape irrigation and other non-potable uses, especially in times of drought when surface water supplies are reduced and the groundwater system is being relied on more heavily to meet potable demands. From SRCSD's perspective, recycled water provides an alternative to discharging treated wastewater into the Sacramento River.

A partnership between SCWA and SRCSD has led to the construction and implementation of Phase 1 of the RWP. The Phase 1 service area consists of on-site uses at the SRCSD Wastewater Treatment Plant complex and non-potable commercial and public landscape areas in the Laguna West, Lakeside, and Laguna Stonelake developments located within the SCWA service area immediately south of SRCSD's facility.

Purpose

This memorandum focuses on the demands and recycled water distribution systems of the Phase 1 and Phase 2 areas shown in **Figure 1**.

Figure 1. Location Map of Recycled Water Studies



Currently, various aspects of the RWP are at different stages of development. For example, Phase 1 conveyance facilities were constructed beginning in 1993 through 2003. Actual delivery of recycled water did not start until completion of the SRCSD tertiary treatment plant in April 2003. Prior to completion of the tertiary treatment plant, source water for the Phase 1 system came from the potable system within the development areas, water from the development lakes, and water from an untreated well. Since the treatment plant came on line, SCWA has experienced extreme high pressures through the SRCSD service pipeline which have caused operational and maintenance concerns on the part of SCWA and reduced customer confidence in the RWP as a whole.

Within the East Franklin Subdivision most of the Phase 2 conveyance facilities have been constructed and are at different stages of acceptance by SCWA for operation. Those portions of the system that are operational are using the potable system as source water. The Laguna Ridge Subdivision Phase 2 conveyance facilities have not been designed. Recycled water supplies for Phase 2 will come from an expansion of the recycled water treatment plant from 5 MGD to 10 MGD to occur sometime in the future (date unknown at this time). Expansion of the treatment plant (including booster pump capacity) and the conveyance pipeline from the treatment plant to the Phase 2 service area tanks has not been designed.

A fundamental assumption in this study is that facilities that have been constructed have no flexibility to change in either size or alignment, and facilities that have been designed have little flexibility to change based on the findings of this work. There are three primary objectives of this study:

Identify the cause of excessively high pressures in the Phase 1 conveyance system and develop a solution.

Verify the adequacy of the preliminary design for the Phase 2 conveyance and storage system.

Design the system to meet SCWA system requirements and minimize operational swings in the output of the SRCSD Recycled Water Treatment Plant.

Recycled Water Demands and Demand Patterns

The HydroScience RWMP identified demands and facilities for both existing and future customers within the Phase 1 and 2 areas. Based on actual operational experience it is apparent that some of the assumptions (i.e., demands and patterns of use) may have been unrealistic. Recycled water demands for Phase 1 and 2 were calculated initially calculated in this study using unit demand factors and irrigated areas taken from the RWMP (Parks = 5.876 gpm/acre and Streetscapes = 6.026 gpm/acre). A summary of the demands is shown in **Table 1** and **Table 2** for each assumed user of recycled water. To evaluate the problem, the demand pattern used in the RWMP was modified. This modification is related to the assumptions that were made on how recycled water customers irrigate; especially, how variations in demands temporally take place based on the size of the park or landscaping being irrigated.

For the evaluation, SRCSD provided actual recorded demand data from two representative days in May 2003. In comparing the shape of the demand curves developed based on actual demands with the original design curves from the RWMP, there was a significant difference. As these curves are used for designing system storage, pumps, and pipe sizes, this difference required a detailed look at what was happening in the field.

Figure 2 is a schematic of sprinkler placement on a plot of land. The schematic assumes a 50 foot radius for each sprinkler and that 2 sprinklers are required to irrigate a 100 foot by 100 foot area. Based on this information and using a flow rate per sprinkler of 11 gpm, irrigation times given in irrigation units were determined for each park and streetscape shown in **Table 1** and **Table 2**. Using the irrigation units, flow diurnal curves were developed for the entire area. **Figure 3** shows how irrigation units are used to calculate the diurnal curve for a service area. Irrigation use patterns show that the majority of large users typically have automatic sprinkler systems that turn on at 11 PM and then cycle through each station so that the entire irrigated area is covered by no later than 7 AM. This pattern causes significant stress on the water system, which will be explained in the following section.

Figure 2. Sprinkler Coverage Over One Irrigation Unit

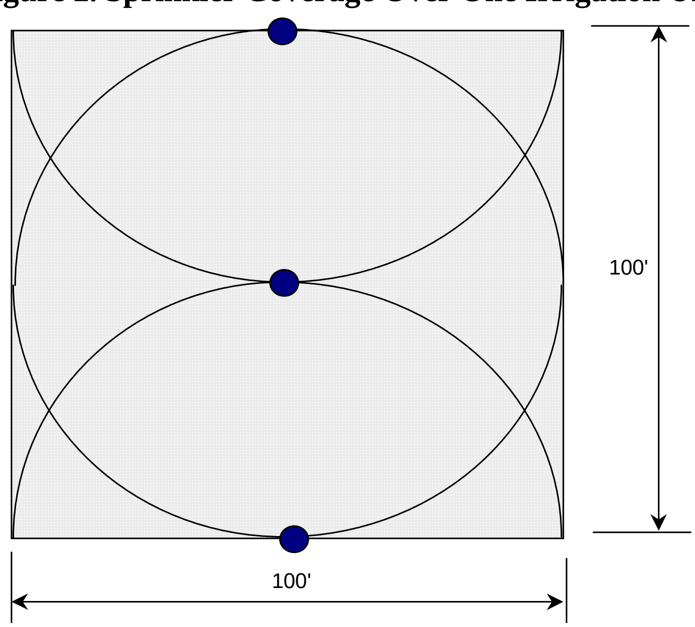


Figure 4 shows four diurnal curves for the Phase 1 area. The two solid lines indicating a lower water demand based on the May 2003 data provided by SRCSD. The two May diurnal curves were used to calibrate the demand model. After calibration (indicated by the dashed line), the demand model was used to increase demands to reflect a maximum day condition. As shown on the graph, the peak of the Maximum Day curve (likely to occur in July or August) is approximately 2000 gpm greater than the May curves. The diurnal characteristics of the curves assume that all recycled water irrigation begins between 9 PM and 11 PM

and ends between 7 AM and 8 AM. It is believed that the schools and parks (the largest customers) begin irrigation at 11 PM, while commercial and industrial landscaping begins anywhere from 9PM to 11PM.

Table 1. Phase 1 Recycled Water Demands

Customer Name	Junction Node	Irrigated Surface Area (acres)	Maximum Day Demand (gpm)	Number of Irrigation Units
SRWTP Customers				
SRWTP Process Water	J-1002		429	
SRWTP Trail of Trees	J-1006		100	
WRP Process Water (SRWTP)	J-1168		315	
Irrigation at New Admin. Bldg. (SRWTP)	J-1002		375	
Subtotal			1,219	
Subtotal (MGD)			1.76	
Laguna West Development				
JVC Commercial	J-1025	2.2	12.9	10
Apple Computers Commercial	J-1011	6.9	40.5	30
Laguna Blvd Streetscape (NE)	J-1011	2.7	16.3	12
Laguna Blvd Streetscape (SE)	J-1033	1.8	10.8	8
Laguna Blvd Streetscape (NW)	J-1020	2.7	16.3	12
Laguna Blvd Streetscape (SW)	J-1023	1.8	10.8	8
Harbour Point Dr. Streetscape (N-1)	J-1070	1.2	7.2	5
Harbour Point Dr. Streetscape (N-2)	J-1015	1.2	7.2	5
Daylor Way Streetscape	J-1082	1	6.0	4
East Lake Dr Streetscape	J-1080	2.5	15.1	11
Bendix Way Streetscape	J-1079	1.1	6.6	5
Town Center Park	J-1012	7.3	42.9	32
Bartholomew Park	J-1013	10	58.8	44
West Lake Dr Streetscape	J-1014	4.9	29.5	21
Gary Lawson Park	J-1086	2.2	12.9	10
Laguna West Commercial 1	J-1021	1.6	9.4	7
Laguna Blvd – Dwight Rd Commercial	J-1031	5.1	30.0	22
Levee	J-1071	3.7	22.3	16
Laguna Blvd I-5 Interchange	J-1021	17	102.4	74
Lawrence Park	J-1041	7.7	45.2	34
Sims Elementary School	J-1081	7.6	44.7	33
Buckminster Dr Streetscape	J-1042	0.9	5.4	4
South Laguna West Park (Lot O)	J-1085	5.3	31.1	23
Laguna West Commercial 2	J-1021	4	23.5	17
Bastona Drive Park	J-1015	5	29.4	22
Subtotal		107.4	637.5	
Subtotal (MGD)			0.9	

Customer Name	Junction Node	Irrigated Surface Area (acres)	Maximum Day Demand (gpm)	Number of Irrigation Units
Lakeside Development				
Lakeside Commercial 1	J-1024	2.1	12.3	9
Four Winds Way Streetscape	J-1063	1.7	10.2	7
Harbour Point Dr. Streetscape (S-1)	J-1024	1.2	7.2	5
Harbour Point Dr. Streetscape (S-2)	J-1043	1.2	7.2	5
Junior High School in Lakeside	J-1078	5.5	32.3	24
Johnson Park	J-1062	16	94.0	70
Lakeside Commercial 2	J-1062	2	11.8	9
Lakeside Recreation Center	J-1061	1.7	10.0	7
Lake Point Dr Streetscape	J-1062	1.5	9.0	7
Maritime Dr Streetscape	J-1077	3.1	18.7	14
Elk Grove Blvd I-5 Interchange	J-1051	16.5	99.4	72
Lakeside Commercial 3	J-1060	3.5	20.6	15
Lakeside Commercial 4	J-1055	0.5	2.9	2
Shorelake Dr Streetscape	J-1054	0.3	1.8	1
Elk Grove Blvd Streetscape	J-1052	10.1	60.9	44
Subtotal		66.9	398.4	
Subtotal (MGD)			0.6	
Laguna Stonelake Development				
Stonelake Commercial (Lot E)	J-1064	2.9	17.0	13
Stonelake Commercial (Near I-5)	J-1050	2.7	15.9	12
North Stonelake Park	J-1088	4.2	24.7	18
Riparian Drive Streetscape (E)	J-1089	1.8	10.8	8
Riparian Drive Streetscape (W)	J-1087	1.8	10.8	8
Taron Drive Streetscape (E-1)	J-1066	1.4	8.4	6
Taron Drive Streetscape (E-2)	J-1076	1.4	8.4	6
Taron Drive Streetscape (W-1)	J-1073	1.4	8.4	6
Taron Drive Streetscape (W-2)	J-1074	1.4	8.4	6
South Stonelake Park 1	J-1075	21.1	124.0	92
Stonelake School	J-1075	6.4	37.6	28
South Stonelake Park 2	J-1074	2.4	14.1	10
Subtotal		49	288.7	
Subtotal (MGD)			0.4	
TOTAL Phase I Recycled Water Demand (gpm)			**2,544**	
TOTAL Phase I Recycled Water Demand (MGD)			**1.91**	

Table 2. Phase 2 Recycled Water Demands

Customer Name	Junction Node	Irrigated Surface Area (acres)	Max Day Demand (gpm)	Number of Irrigation Units
Existing Customers				
Zehnder Park (357-G4)	J-1093	14.8	87	64
Michael Caterino Park (357-G6)	J-1094	2.5	15	11
Womack Park (357-H5)	J-1094	8.3	49	36
Subtotal		26	150	
Subtotal (MGD)			0.22	
East Franklin Development				
East Franklin Streetscapes (Lump Sum)	J-1100	7.4	45	32
	J-1102	7.4	45	32
	J-1142	7.4	45	32
	J-1130	7.4	45	32
	J-1137	7.4	45	32
Neighborhood Park (Jungkeit)	J-1124	2.07	12	9
Neighborhood Park (Cresleigh)	J-1141	5.04	30	22
Elem. School	J-1141	3.57	21	16
Neighborhood Park (Backer)	J-1139	7.92	47	34
Community Commercial (Backer)	J-1142	14.1	83	61
Neighborhood Park (Dunmore)	J-1124	5.84	34	25
Elem. School (Dunmore)	J-1124	6.91	41	30
Neighborhood Commercial (Dunmore)	J-1097	4.74	28	21
Mini Park (Dunmore)	J-1099	0.43	3	2
Community Park (Stathos AKT)	J-1123	26.3	155	115
Elem. School (Stathos AKT)	J-1138	7	41	30
Neighborhood Park (Stathos AKT)	J-1138	2.67	16	12
Continuation School (Bonacci)	J-1128	4.24	25	18
Neighborhood Park (Gilliam)	J-1100	8.01	47	35
Conv. Commercial (Stathos)	J-1100	1.37	8	6
High School (Stathos)	J-1101	46.4	273	202
Sports Park	J-1102	40.3	237	176
Elem School (Machado)	J-1137	6.93	41	30
Neighborhood Park (Machado)	J-1137	9.27	54	40
Elem. School (Stathos)	J-1129	6.89	40	30
Neighborhood Park (Zweck)	J-1129	6.61	39	29
Neighborhood Park (Hoffman)	J-1135	9	53	39
Elem. School (Hoffman)	J-1135	7.6	45	33
Subtotal		270	1,593	
Subtotal (MGD)			2.29	

Customer Name	Junction Node	Irrigated Surface Area (acres)	Max Day Demand (gpm)	Number of Irrigation Units
Laguna Ridge Development				
Shopping Center	J-1143	17.10	100	74
Shopping Center	J-1170	8.05	47	35
Civic Center	J-1171	11.10	65	48
Shopping Center	J-1172	10.15	60	44
Shopping Center	J-1173	2.70	16	12
Industrial/Office Park (north)	J-1174	7.60	45	33
Shopping Center	J-1174	3.50	21	15
Neighhood Park (north)	J-1178	9.00	53	39
Elementary School	J-1179	7.00	41	30
High School	J-1160	53.20	313	232
Commercial/Mixed Use	J-1184	4.10	24	18
Community Park	J-1153	32.13	189	140
Elem. School (east)	J-1153-2	7.00	41	30
Commercial/Mixed Use (3)	J-1176	11.30	66	49
Neighborhood Park (south)	J-1155	9.00	53	39
Elem. School (south)	J-1155	7.00	41	30
Shopping Center (northwest)	J-1144	5.25	31	23
Local Park (1)	J-1143	1.80	11	8
Neighborhood Park (east)	J-1162	43.56	256	190
Local Park (east)	J-1153	3.60	21	16
Shopping Center (west)	J-1103	6.95	41	30
Industrial/Office Park (north)	J-1172	2.50	15	11
Commercial/Mixed Use	J-1173	2.15	13	9
Local Park	J-1175	3.60	21	16
Office Park	J-1184	8.80	52	38
Commercial/Mixed Use	J-1176	0.80	5	3
Shopping Center	J-1159	7.00	41	30
Shopping Center	J-1159	2.00	12	9
Streetscapes	J-1159	11.70	71	51
Local Park	J1169	2.88	17	13
Community Park	J-1104	17.91	105	78
Local Park	J-1146	2.43	14	11
Local Park	J1173	2.70	16	12
Streetscapes	J1173	23.97	144	104
Streetscapes	J1154	5.03	30	22
Streetscapes	J1176	5.00	30	22
Local Park	J1182	2.52	15	11
Local Park	J1183	2.88	17	13
Neigborhood Park	J1184	6.30	37	27
Local Park	J1185	2.70	16	12
Streetscapes	J1186	4.10	25	18
Streetscapes	J1180	0.70	4	3
Streetscapes	J1181	0.70	4	3

Customer Name	Junction Node	Irrigated Surface Area (acres)	Max Day Demand (gpm)	Number of Irrigation Units
Streetscapes	J1187	2.30	14	10
Streetscapes	J1188	2.30	14	10
Streetscapes	J1189	1.80	11	8
Streetscapes	J1190	2.92	18	13
AutoMall	J1191	2.00	12	9
Multi-Family Residential	J-R1191	0.70	4	3
Multi-Family Residential	J-R1192	0.48	3	2
Multi-Family Residential	J-R1193	0.63	4	3
Multi-Family Residential	J-R1194	0.73	4	3
Multi-Family Residential	J-R1195	0.59	3	3
Multi-Family Residential	J-R1196	0.50	3	2
Multi-Family Residential	J-R1197	0.50	3	2
Multi-Family Residential	J-R1198	0.50	3	2
Multi-Family Residential	J-R1199	0.40	2	2
Multi-Family Residential	J-R1201	0.58	3	3
Multi-Family Residential	J-R1202	0.19	1	1
Multi-Family Residential	J-R1203	0.59	3	3
Multi-Family Residential	J-R1204	0.65	4	3
Multi-Family Residential	J-R1205	0.80	5	3
Local Park	J-1210	1.80	11	8
WTF Laguna Ridge	J-1211	2.96	17	13
WTF Poppy Ridge	J-1212	3.12	18	14
Local Park	J-1213	1.80	11	8
Subtotal		408	2,408	
Subtotal (MGD)			3.47	
Total Phase II Recycled Water Demand (gpm)			**4,152**	
Total Phase II Recycled Water Demand (MGD)			**5.98**	

Figure 3. Formation of Diurnal Curve Using Irrigation Units

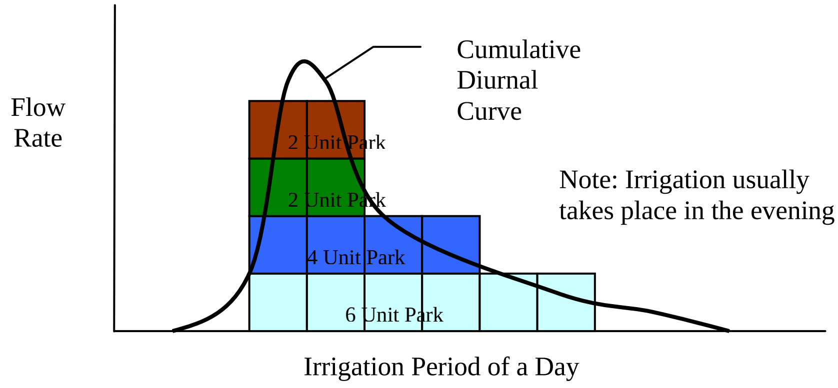
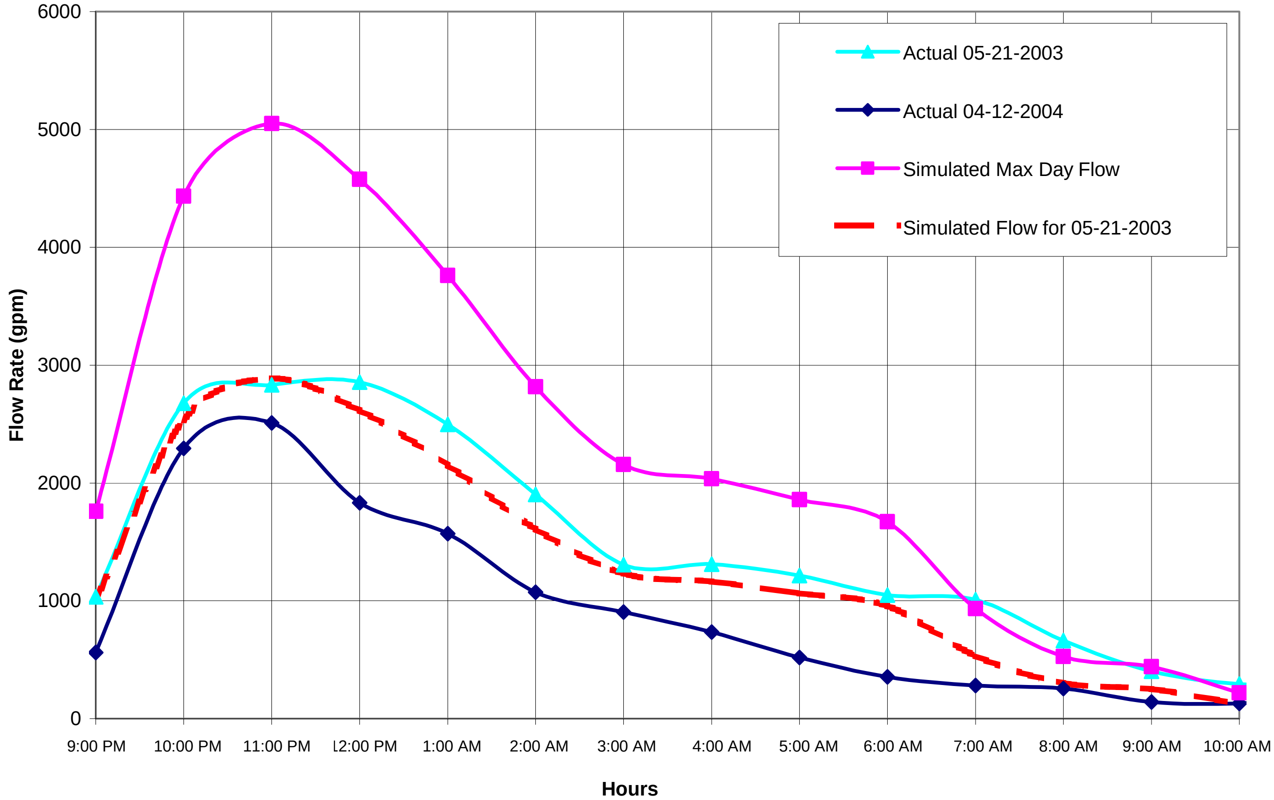


Figure 4: Flow Diurnal Curve for Phase I area



Modeling Methodology

The modeling methodology used in this study is similar to the design of a potable water system. The only requirement that does not need to be met in relationship to capacity is fire flow. Other parameters such as system pressures, pipe velocities, and storage requirements are similar to insure proper operation and maintenance, adequate level of service to the customer, and infrastructure longevity. Modeling assumptions are as follows:

System pressure requirements are between 40 pounds per square inch (psi) and 80 psi.

System storage should allow for the continuous operation (at a constant rate of flow) of the recycled water treatment plant and have sufficient storage to meet peak hour demands during maximum day conditions.

Pipe velocities should not exceed 6 feet per second.

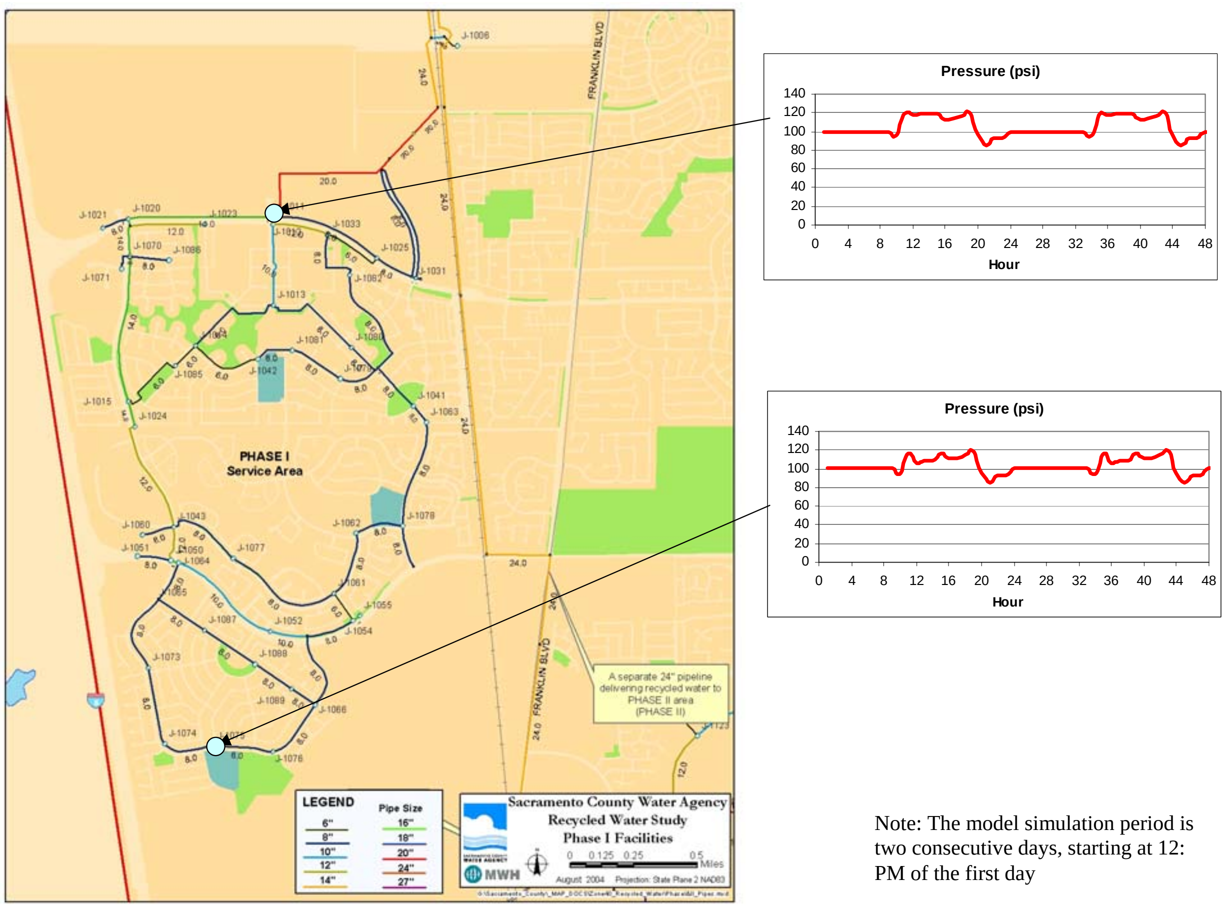
Modeling Results

The modeling results shown in **Figure 5**, **Figure 6**, and **Figure 7** include distribution systems of the Phase 1 and Phase 2 facilities. These maps include existing and proposed pipe and storage tank sizes, their locations, as well as assumed locations of model demand nodes and/or irrigation areas, where applicable. These maps also present pressures within the service area. The pressure hydrographs indicate how the system performs over the simulation period. As mentioned above, SCWA desires to have pipe pressures between 40 psi and 80 psi.

Phase 1 Results

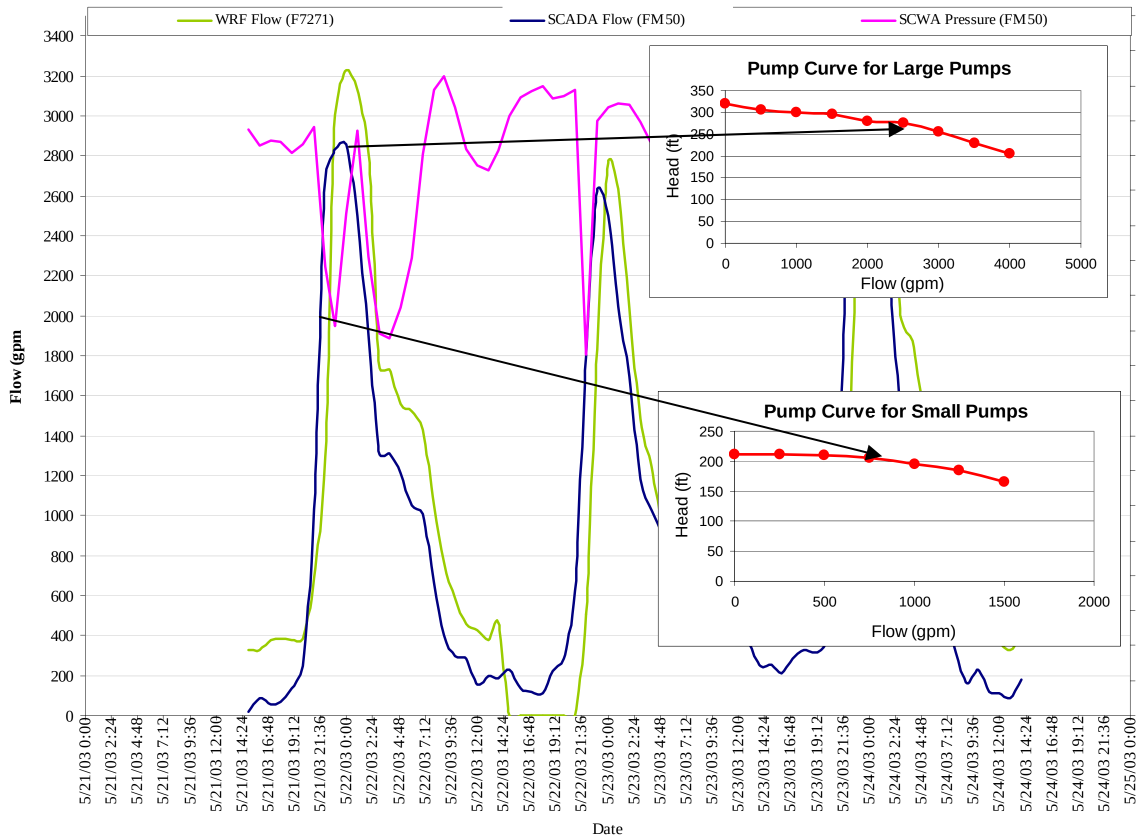
Figure 5 represents the existing system and highlights areas of high pressure concern in both the north and south portion of the distribution system. These pressure problems are associated with the pumps at SRCSD's recycled water treatment plant and the lack of adequate storage, or boosting capacity, in the southern reaches of the system. Modeling results indicate that both locations regularly experience operating pressures in excess of 100 psi. SRCSD's pump curves are illustrated in **Figure 6**. From this figure, the head, in feet, provided by the pumps is based on the system curve (what the pump experiences when pushing water into the system). There are two small pumps and two large pumps operating at the recycled water treatment plant. According to the large pump curve, the large pump provides approximately 275 feet of head during high flow conditions. This corresponds to a source pressure of approximately 120 psi.

Figure 5. Phase 1 – Existing Condition with a Calibrated Demand Pattern



Note: The model simulation period is two consecutive days, starting at 12: PM of the first day

Figure 6. Pump Curve Operations



Step 1: Install Pressure Reducing Valve

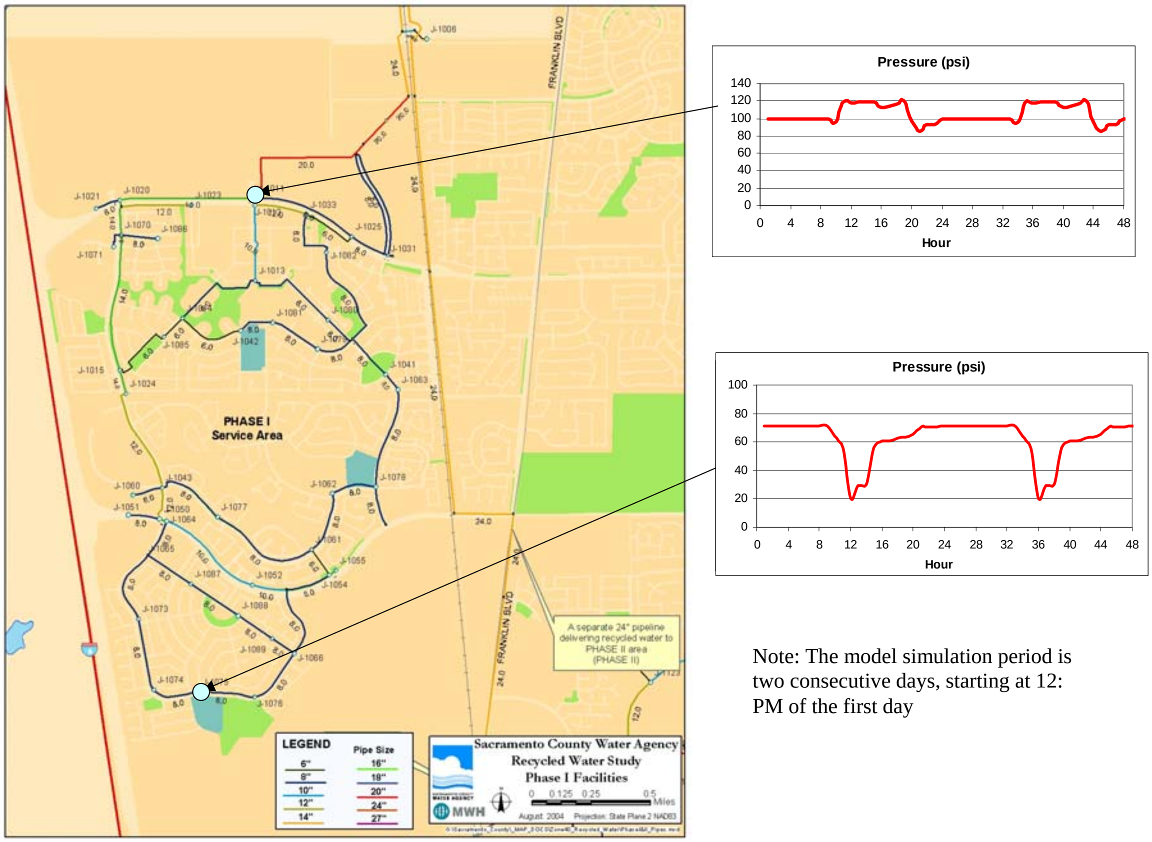
Figure 7 presents the same distribution map of the existing Phase 1 facilities and includes the installation of a pressure reducing valve (PRV) set at 80 psi. The PRV resolves the high pressure problem by keeping maximum pressure at 80 psi. However, minimum pressures drops to 25 psi during peak hour, which is too low.

Looking at the difference between the two hydrograph figures in **Figure 7** at peak hour conditions) the amount of head loss between the source of supply to the north and the service furthest to the south is 50si. This means that if the source pressure were decreased to 70 si, the service pressure to the south would be 20 psi (the difference between 70 psi and 20 pi), producing a below standard level of service. Steps to reduce pressures and maintain adequate level of service are provided below.

Step 2: Begin Customer Education Program on Irrigation Practices

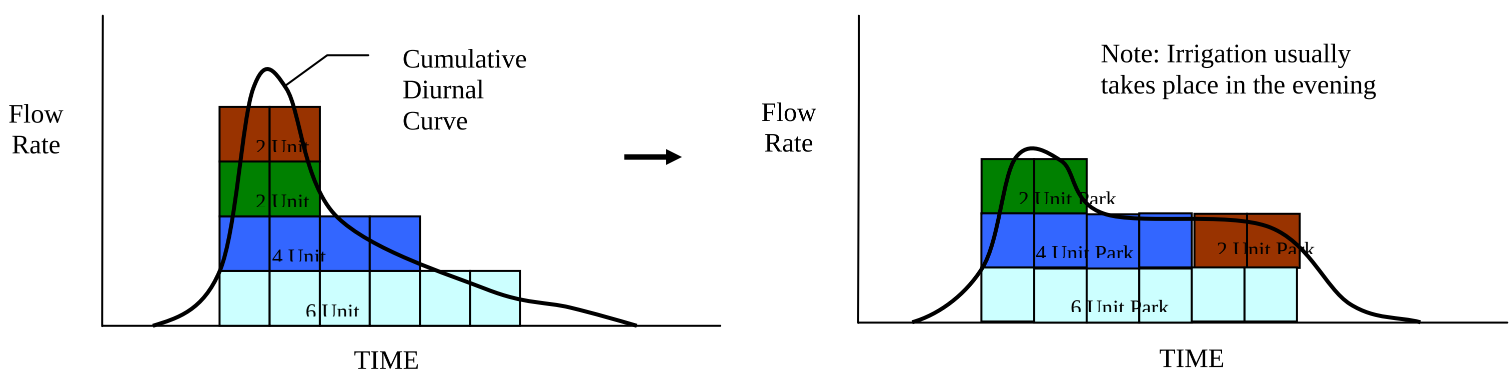
As shown in **Figure 3,** the diurnal pattern of the system has a very high peak hour flow due to the irrigation scheduling practices of the larger customers. Through education, these customers can reduce this peak flow (which in turn reduces the head loss in the system) and increase system pressures to the south. An example of this is having smaller parks move off of peak hours as shown in **Figure 8**. This figure shows that individual parks can meet their irrigation unit requirement and at the same time reduce peak demand.

Figure 7. Phase I Improvement Alternative – PRV Only (Max Day Demand)



Note: The model simulation period is two consecutive days, starting at 12: PM of the first day

Figure 8. Moving Irrigation to Off-Peak Hours



Step 3: Install Peaking Facilities in South Portion of Phase 1

The installation of a PRV in Step 1 creates low pressure conditions in the southern portion of the distribution system. This low pressure condition should improve with the change in irrigation practices described in Step 2. However, for increased reliability, an additional supply and peaking facility are recommended for the southern portion of the system. After discussions with SCWA staff, it appears that the most reasonable way of providing these facilities would be through the potable system. The Lakeside groundwater treatment facility could provide water through an air gap (or other positive separation device) to a small tank which would then be pumped into the recycled water system. **Figure 9** shows the Phase 1 distribution system including the peaking facility. Minimum pressures in the south increase to 50 psi when the peaking facility is added to the system.

Phase 2 Results

Figure 10 represents the Phase 2 distribution system based on Maximum Day demands and shows updated pipeline and storage requirements. Operational and design requirements are provided below:

1. **Delivery of recycled water to East Franklin recycled storage reservoirs** – Unlike the Phase 1 system where service level pressures and demands are met from booster pumps owned and operated by the SRCSD; recycled water would be delivered to the Phase 2 system via low head pumps and a wholesale pipeline that would discharge to the 3.0 MG storage tank situated at the Franklin WTP site. Zone 40 will be responsible for wholesale pipeline and the facilities after the 20-inch pipeline including the storage and booster pumps necessary to deliver the recycled water to the distribution system.

2. **Use of in-system storage and booster pumps** – Phase 2 proposes recycled water storage at both the East Franklin and Laguna Ridge Water Treatment Plants.

3. **Consideration of existing installed pipelines** – To date, installation of recycled water pipeline (purple pipe) has taken place west of Bruceville Road in the East Franklin development area. For the purpose of this study it is assumed that previously installed pipe will not be modified or paralleled with additional pipe to increase capacity. As a result, storage operations become critical to the systems ability to maintain adequate supply and pressure during peak periods. Storage operations are explained in **Figure 10**. If the service area of the Phase 2 system is expanded to serve areas outside the existing Phase 2 service area, some paralleling of existing pipes may become necessary.

Storage Operations

The graphs in **Figure 10** are read from top to bottom and left to right. A detailed description of each of these graphs is provided below. The time units begin at 12 noon and extend for a 48 hour period. A more detailed map of the distribution system is provided as an attachment to this memorandum.

Flow from SRCSD Recycled Water Treatment Plant – This graph indicates the flow out of the recycled water treatment plant clear well and low head pump station to the East Franklin recycled water storage reservoir. You can see from this graph that the outflow rate is constant, this provides the best and most efficient use of the Recycled Water Treatment Plant.

East Franklin Pump Operations – Pump operations are dictated by time of demand and the pump curves assigned to each pump. The flow hydrograph shows irrigation periods and the fill periods for the Laguna Ridge tank. The tank's fill period occurs during the non-irrigation period. The fill rate is determined by the time of day and the flow rate through the existing transmission pipe in New Poppy Ridge Road. The flow hydrograph shows that the fill rate of the Laguna Ridge tank is 2,500 gpm and the fill period is from 12:00 noon to 7:00 PM.

East Franklin Tank Levels – This graph indicates the percent full of the 3.0 MG storage tank at the East Franklin water treatment plant site. The pattern of fill and release is typical of a storage tank with the exception of the small fill and release cycle occurring during the off-peak period to fill the 2.0 MG tank at the Laguna Ridge water treatment plant. This operation uses capacity in the conveyance system when no irrigation is taking place to fill the Laguna Ridge tank.

East Franklin System Pressures – System pressures are maintained at the design requirements through appropriate pump curves and adequate storage. Pressures at the East Franklin tank fluctuate between 60 and 75 psi.

Laguna Ridge Tank Levels – This graph indicates a typical storage and release pattern of a tank throughout the simulation period. The storage capacity of the Laguna Ridge Tank is 2.0 MG. For the normal and average day conditions, the tank is filled with recycled water from the East Franklin Tank during off-peak hours and boosted out to the system during irrigation hours. In the hottest days of summer, the supply of recycled water may not be adequate to meet the system irrigation demand at an acceptable service pressure. As a result, a groundwater well may be required as a peaking facility to fill the tank during peak hours for extreme hot day conditions.

Laguna Ridge Pump Operations – During the irrigation period water is pumped out of the Laguna Ridge tank to meet system demands and to help maintain system pressure. Variable speed pumps are required to provide the flexibility to control water releases and pressure fluctuations.

Laguna Ridge System Pressures – This graph shows the pressure fluctuation at the east end of Whitelock Parkway. The system pressures within the Laguna Ridge portion of the system is maintained between 40 and 70 psi.

Figure 9. Phase I Improvement Alternative – PRV and Peaking Facilities

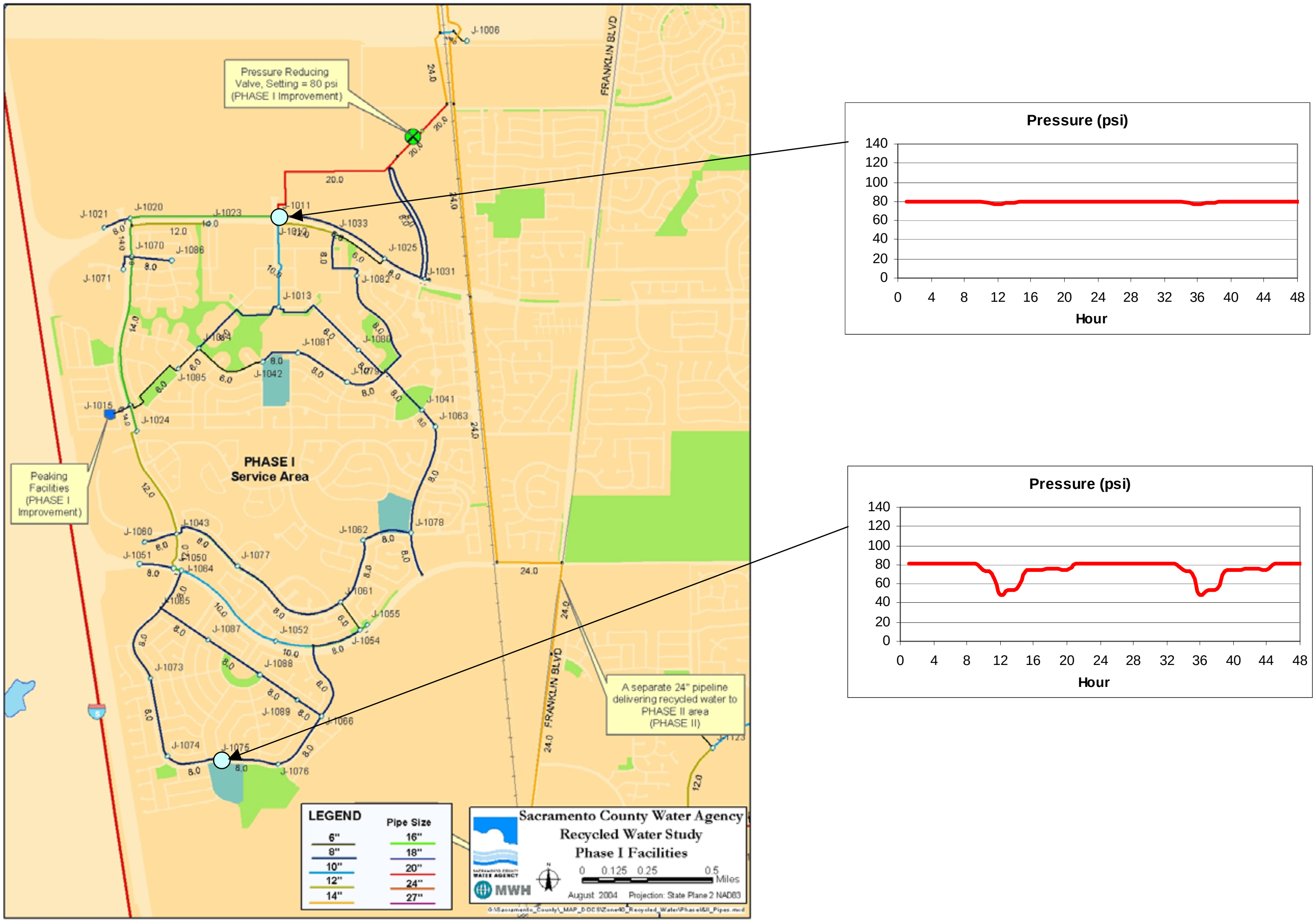
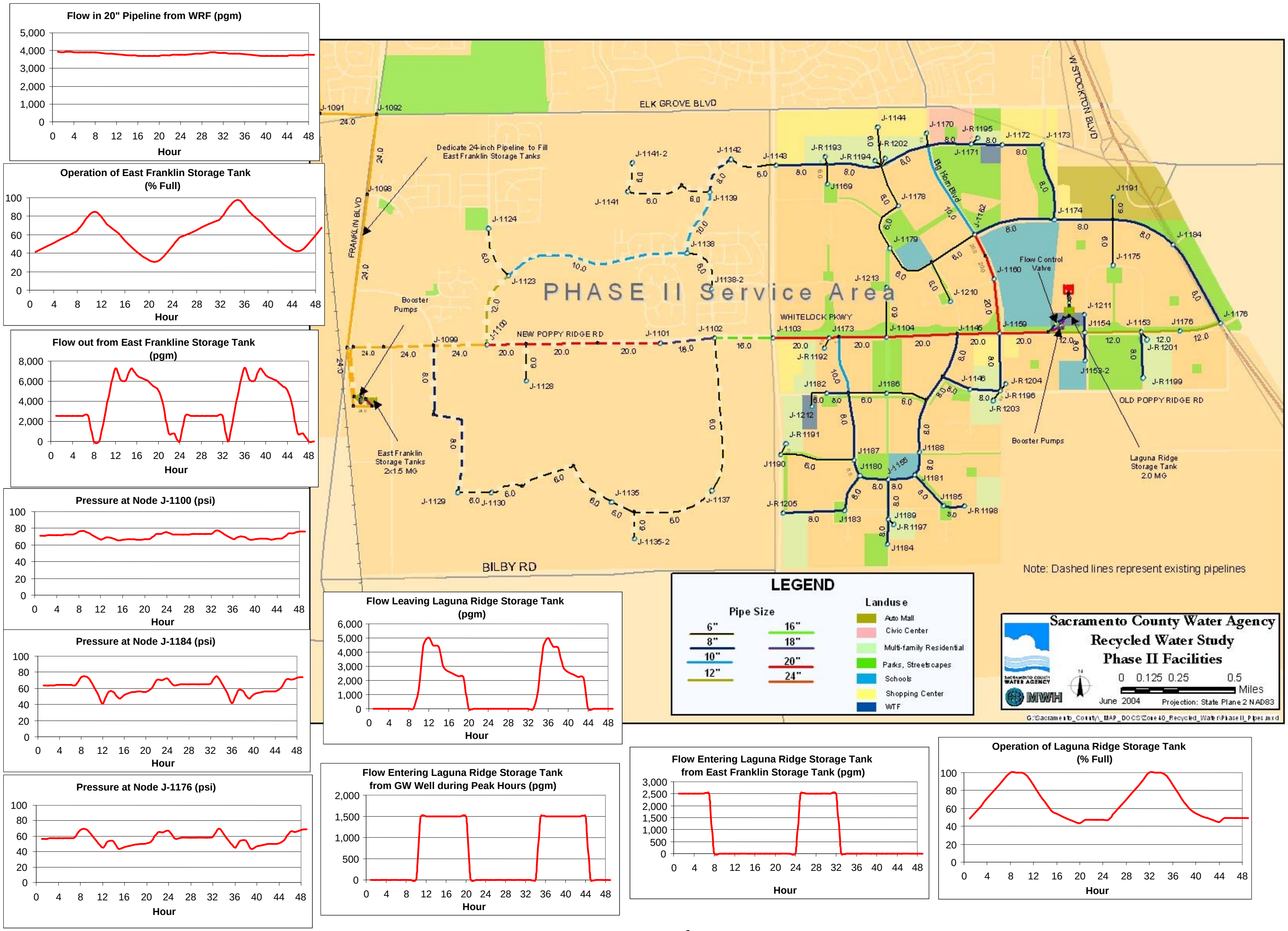


Figure 10. Phase 2 Water Demands and Proposed Distribution System Requirements



Cost Estimate for New Phase 2 Facilities.

Costs associated with the Phase 2 recycled water facilities are currently being recovered through a special fee program assessed by SCWA over the East Franklin and Laguna Ridge Development areas. This fee assesses every equivalent dwelling unit (edu) $596 and is based on costs developed in the original LSPFFP. The total Phase 2 cost used in the LSPFFP study included the SRCSD Recycled Water Treatment Plant expansion and wholesale pipeline and totaled $43.6 M. With the revised facility requirements indicated in this study, a re-examination of the original cost estimate is required. Any overage in cost as a result of this study is assumed to spread over all of Zone 40.

The cost estimate includes new pipes, storage tanks, and pump stations. These include pipelines in Laguna Ridge, the 24" pipeline from SRCSD Recycled Water Treatment Plant to East Franklin, the East Franklin Storage Reservoir and Pump Station, and the Laguna Ridge Storage Reservoir and Pump Station. These costs are summarized in **Table 3**. The methodology for apportioning costs assumes that the Zone 40 will be paying for the pumps located on SRCSD property and the 24-inch pipeline that feeds the East Franklin storage reservoir. The remaining cost will be paid through the existing $596/edu recycled water fee program, and, as mentioned above, any additional incremental cost not covered by the recycled water fee program is spread through the Zone 40 fee program. This is done to maintain equity in the Phase 2 area.

The assumed number of units remaining in the Laguna Ridge Development area is based on the revised land use diagram approved by the City of Elk Grove. Based on the revised land use approximately 8,000 equivalent dwelling units include residential and the equivalent dwelling unit factor for commercial. **Table 3** indicates a short fall of approximately **$11.36M** that will need to be funded through the Zone 40 Development and User Fee Program. An update to the Zone 40 fee program to include these costs will be done with the on-going Zone 40 Water System Infrastructure Plan due for completion in early 2005.

Table 3. Summary of Costs of Laguna Ridge System

Pump Costs

Pump #	Description	Quantity	Design Head (ft)	Design Flow (gpm)	Hp	Unit Cost ($/hp)	Capital Cost ($1,000)	Engineering	Contingency	Cost for Each Pump Station ($1,000)
1	Low-head pump delivering water from WRF to East Franklin Storage Tank	3	100	2,000	50.6	809.6	122.8	20%	15%	$165.8
2	Pumps at East Franklin Storage Tank	6	155	2,000	78.4	809.6	380.7	20%	15%	$513.9
3	Pumps at Laguna Ridge Storage Tank	2	135	1,500	51.2	809.6	82.9	20%	15%	$111.9
Total Pump Cost										**$791.5**

Storage Tank Costs

No.	Description	Storage (MG)	Unit Cost ($1,000/ MG)	Capital Cost ($1,000)	Engineering	Contingency	Cost ($1,000)
1	East Franklin Storage Tank	3	578	1,735	20%	15%	$2,342
1	Laguna Ridge Tank	2	578	1,157	20%	15%	$1,561
Total Storage Tank Cost							**$3,904**

Pipelines

Length	Description	Diameter	Unit Cost ($/linear foot)	Unit Cost ($1,000)	Engineering & Environmental	Construction Contingency	Cost ($1,000)
25,000	Pipeline	24	$120.00	$ 3,000	20%	15%	$ 6,600
8,823	Pipeline	20	$113.60	$ 1,002	20%	15%	$ 2,205
4,038	Pipeline	12	$40.50	$ 164	20%	15%	$ 360
3,688	Pipeline	10	$33.70	$ 124	20%	15%	$ 273
33,571	Pipeline	8	$27.00	$ 906	20%	15%	$ 1,994
11,572	Pipeline	6	$20.20	$ 234	20%	15%	$ 514
Total Pipline Cost							**$ 11,432**
Expected Existing Fee Program Revenue							$ (4,768)
Total Unfunded Capital Cost (including Pumps and Tanks)							**$ 11,360**

Note: Unit Costs for pipelines are taken from the SCWA Ordinance 18, Schedule C and may not truly reflect the actual cost of construction.

Recommendations/Conclusions

A summary of the objectives and the recommendations/conclusions of this memorandum is provided below.

Identify the source of high pressure problems in the Phase 1 conveyance system and identify a solution. The problem in the Phase 1 system is twofold: 1) inadequate peaking capacity at the far reaches of the system, and 2) inappropriate pumps for the demand requirements of the system. Recommendations have been provided in the sections above to remedy this situation.

Verify the adequacy of the existing and preliminary design of the Phase 2 conveyance and storage system. A complete analysis was performed on the Phase 2 portion of the study. From this work, a recommendation of pipe sizes, storage tanks, and pump characteristics have been provided.

Evaluate and modify, if necessary, the system to meet SCWA system requirements and minimize operational swings in the output of the SRCSD Recycled Water Treatment Plant. SRCSD's Recycled Water Treatment Plant will operate at a fixed speed once Phase 2 is on-line.

Identify the cost of all new facilities for possible finance strategy to be implemented through SCWA and SRCSD. Costs have been identified and the allocations to be paid for by the existing Recycled Water Fee Program, and the Zone 40 Fee Program are identified.

Discussion Paper on Feasibility on Use of Recycled Water in the North Vineyard Station Specific Plan/Florin Station Community Plan Area

Introduction

The Sacramento County Water Agency (SCWA), at the request of the Sacramento Regional County Sanitation District (SRCSD), has prepared this discussion paper to evaluate the feasibility of implementing a recycled water use program in the proposed new growth areas of the North Vineyard Station Specific Plan and Florin-Vineyard Community Plan areas as shown in **Figure 1**. SCWA Zone 41 is the designated retail water provider for these new growth areas. SCWA Zone 40 is responsible for the development of new water supplies which can include entering into wholesale agreements with other water supply agencies such as the City of Sacramento for surface water or the SRCSD for recycled water. In the case of recycled water, a wholesale agreement is currently in place between Zone 41 and the SRCSD for service in the Laguna West and Lakeside development areas. Under this agreement, SCWA purchases water from SRCSD delivered to a specified metering point, conveys this water to the customer or to a storage location, and then retails the water "on-demand" to its customers. The cost of the water is dictated by provisions of the wholesale agreement plus the cost to construct, operate, and maintain the recycled water distribution system.

Purpose

This paper quantifies the facilities necessary to convey and retail recycled water from a single source of supply located adjacent to the study area. Two levels of implementation are considered. The first examines implementation that includes all potential large recycled water users such as institutional (e.g., schools), parks, and public landscape corridors. This level of implementation assumes that a minimal amount of the above type of outdoor irrigation demands will be met through the potable water system. The second level of implementation considers full use of recycled water to meet all outdoor irrigation requirements including single family homes.

This paper provides a brief summary of the findings of the technical work completed to evaluate the two levels of implementation and develops a cost estimate for each.

Study Area Land Use and Water Demands

This section provides the land use and water demand information related to the project area. This information is necessary to develop the infrastructure requirements necessary to provide recycled water to meet the projected water demands.

Project Land Use

The study area is approximately 1,440 acres in size and is roughly bounded by Gerber Road on the South, Elk Grove-Florin Road on the west, Elder Creek Road on the north, and Bradshaw Road on the east. The proposed land use within the study area contains a predominance of residential land uses with a lesser presence of commercial and active industrial uses. The breakdown in land uses are provided in **Table 1** for residential land uses and **Table 2** for commercial and industrial land uses.

Figure 1. Project Location Map

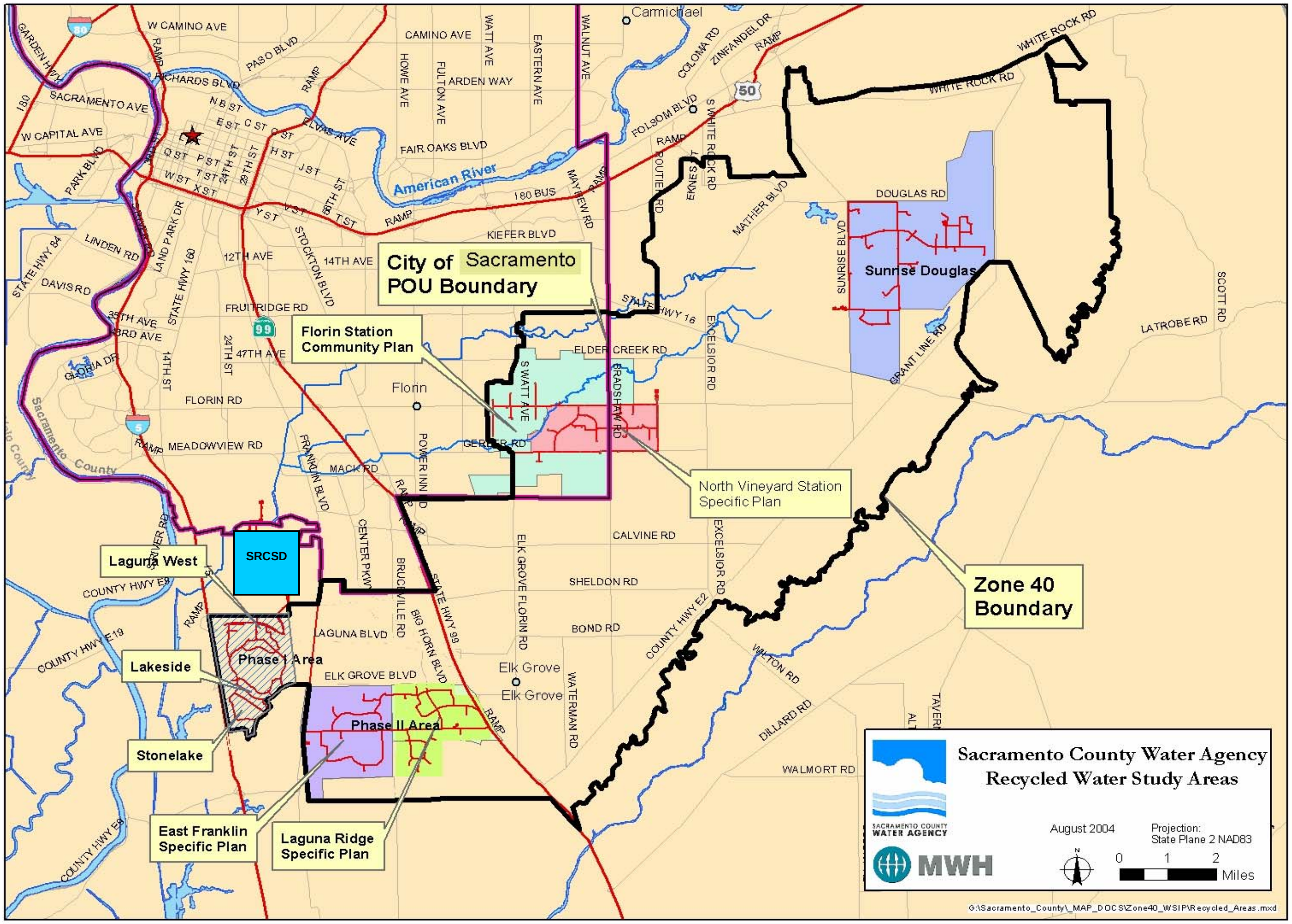


Table 1. Residential Land Uses and Non-Potable Demand

Land use	Density Range (EDU/acre)	Density Fixed Count (EDU/acre)	Area (acres)		Dwelling Units	Annual Avg (AF/year)	Maximum Day (MGD)	Peak Hour (gpm)
			net	gross				
Multi-Family Residential	12 to 22	18 (net)	37.7	40	679	60	0.05	74
Medium Density Residential	7 to 12	10 (net)	20.7	21	207	32	0.03	40
Single Family Residential	4 to 7	6 (gross)		224	1,342	336	0.30	416
Single Family Residential	3 to 5	5 (gross)		589	2,944	883	0.79	1,095
Single Family Residential	1 to 3	2 (gross)		282	560	423	0.38	524
Existing Residential				6	13	9	0.01	11
Total				**1,161**	**5,745**	**1,742**	**1.56**	**2,160**

Table 2. Commercial and Industrial Land Uses and Non-Potable Demand

Land use	Total Area (acres)	Total Average Annual Water Demand (AF/year)	Non-potable Water Use Area (acres)	Non-Potable Average Annual Water Demand (AF/year)	Non-Potable Maximum Day Irrigation Demand (MGD)	Non-Potable Peak Hour Unit Demand (gpm/Acre)	Non-Potable Water Peak Hour Demand (gpm)
PARKS	124	408	111	367	0.94	12	653
GOLF COURSE	20	65	20	65	0.17	6	116
SCHOOLS	60	198	42	139	0.35	12	246
STREETSCAPES	23	76	23	76	0.20	6	139
COMMERCIAL	50	165	25	83	0.20	6	142
Total	**276**	**912**	**221**	**730**	**1.87**	**41**	**1,296**

Recycled Water Demands

Recycled water demands are developed based on the area requiring irrigation, the amount of evapotranspiration that occurs in the area, and the rate of water application from a typical irrigation system. There are three water demand numbers of interest. The first is the annual water demand or how much water is used over a given year. The second is the maximum day demand, which is typically the amount of water that will need to come from the source supply or recycled water treatment plant. Lastly, there is an interest in the peak hour demand for sizing system facilities including storage, pumps, and transmission pipelines.

Table 1 indicates the average, maximum day and peak hour demands for residential non-potable uses. In this table it was assumed that on average approximately 50% of the water use by a single family home is used outdoors (average annual consumption of residential areas is assumed to be 3.0 AF/acre/year).

Smaller lot homes will likely use less water outdoors compared to indoor use and larger lot homes, typically with large landscaped yards, will likely use more water outdoors than indoors. What is shown is assumed to be an average. The peaking factor used to achieve a maximum day demand is assumed to be 2 times the average annual demand. The peak hour demand is assumed to be 2 times the maximum day demand.

Table 2 presents the recycled water demands for commercial and public landscape uses. Water demand assumptions in these examples is based on the irrigated area and the assumed application rate based on the number of assumed sprinkler heads per acre of land. The first two columns of **Table 2** indicate the total area and total average annual water demand based on a demand factor of 3.0 AF/acre/year. The total demand is indicated for reference when looking at full implementation of recycled water demand. Under the limited use implementation scenario, only those areas that have significant demand and can be reached by the distribution system at a reasonable cost are used. The remaining columns of **Table 2** present the limited use implementation demands. Under the limited use scenario, 221 acres of a possible 271 acres are provided recycled water service. The total demand of 1.87 MGD indicates the size of treatment plant facility. The peak hour demand of approximately 1,300 gpm is the demand used for designing the recycled water distribution system in the following section.

Recycled Water Distribution System

This section briefly describes the recycled water distribution system design and methodology. The intent of the design is not to provide a detailed plan for purposes of designing or constructing a distribution system; rather, the purpose is to develop, at a feasibility study level, the approximate system requirements to base an initial cost estimate for implementing a program for limited use of recycled water within the project area.

Design Methodology

The design assumptions used in this study are similar to those accepted by SCWA in the design of the Phase 1 and Phase 2 recycled water service areas in the Laguna and East Franklin/Laguna Ridge development areas, respectively. Computer modeling was completed using H2Onet applying an extended period simulation over a 48 hour period. Recycled water demands are assumed to take place within the timeframe between 10 PM and 7 AM. Based on this method of design the distribution system in **Figure 2** identifies the needed storage, pumping, and pipe system to meet peak hour demands under the limited use implementation scenario. Pressures in the system during peak hour conditions are designed to not fall below 45 pounds per square inch (PSI).

Practical Implementation Scenario

The source of water is assumed to originate from a future SRCSD scalping plant that will treat wastewater from a regional interceptor pipeline to Title 22 standards to maintain a constant head in RES1 located at the northeast corner of the project area. From this constant head source of supply, a 1.5 MG storage tank is constructed to allow for peaking capacity in the system near the source. From the storage tank a 24-inch transmission pipeline travels south on the Vineyard Road extension to a point where it turns west into the project area. The pipeline continues west and then north to loop into the distribution pipeline in Florin Road where it continues to travel as a 12-inch main to the western boundary of the project. Three 6-inch to 8-inch distribution mains travel east-west to serve the majority of recycled water customers along Gerber and Florin Roads.

Figure 2. Recycled Water Distribution System Limited Use Implementation Scenario

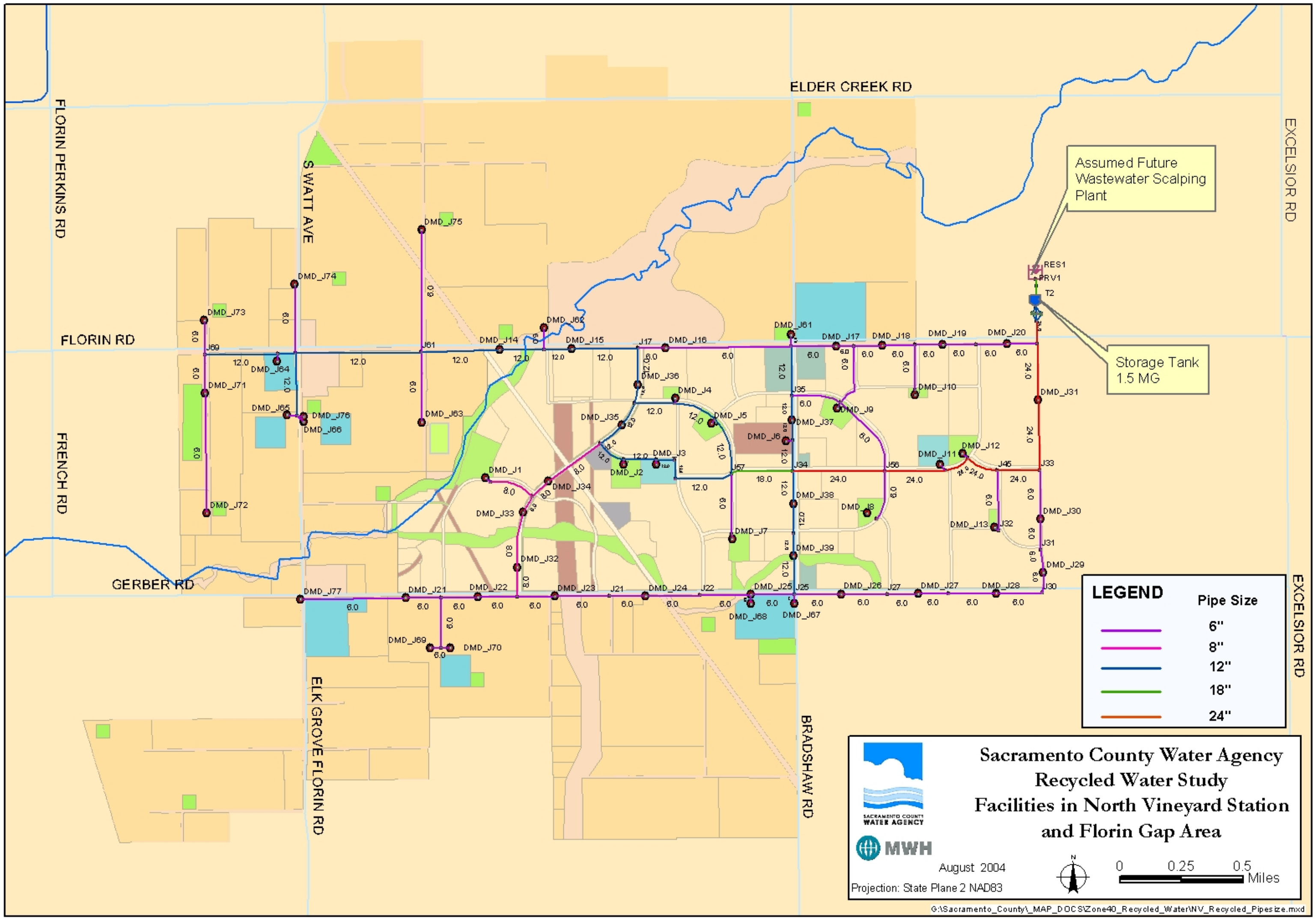


Table 3. Estimate Capital Costs for Limited Use Implementation Scenario

Pumps

Pump #	Description	Quantity	Design Head (ft)	Design Flow (gpm)	Hp	Unit Cost ($/hp)	Capital Cost ($1,000)	Engineering & Environmental	Construction Contingency	Cost for Each Pump Station ($1,000)
1	Pumps at Recycled Water Storage Tank in North Vineyard Station	4	165	1,500	63	$1,000	$250	15%	25%	$350
Total										**$350**

Storage Tanks

No.	Description	Storage (MG)	Unit Cost ($1,000/MG)	Capital Cost ($1,000)	Engineering & Environmental	Construction Contingency	Cost ($1,000)
1	Recycled Water Storage Tank in North Vineyard Station	1.5	$500	$750	15%	25%	$1,050
Total							**$1,050**

Pipelines

Length (feet)	Description	Diameter	Unit Cost ($/inch-dia/linear foot)	Capital Cost ($1,000)	Engineering & Environmental	Construction Contingency	Cost ($1,000)
8,661.6	Pipeline	24	$ 8.75	$ 1,819	15%	25%	$ 2,547
1,956.2	Pipeline	18	$ 6.25	$ 220	15%	25%	$ 308
25,791.2	Pipeline	12	$ 6.25	$ 1,934	15%	25%	$ 2,708
5,086.2	Pipeline	8	$ 5.00	$ 203	15%	25%	$ 285
49,901.1	Pipeline	6	$ 5.00	$ 1,497	15%	25%	$ 2,096
Total							**$7,943**

Total Capital Cost **$ 9.34 Million**

Estimated Project Costs

The quantities of pipeline and other infrastructure is provided in **Table 3** above. Unit costs are based on studies recently completed in the Sacramento area and represent feasibility study level of confidence. The total estimated capital cost of the limited use implementation scenario is **$9.34 Million**. There are several methods of normalizing this cost to a unit cost that can be compared with other water supplies. The first is a unit cost based on dollars per acre-foot of water, the second is on dollars per acre of developed land, and the third is dollars per equivalent dwelling unit. **Table 4** presents these normalized costs. The $/AF cost of $756/AF assumes that the total capital cost ($9.34 M) is amortized over a 40 year period at 5.5% effective interest. Currently, the typical cost for new supplies of surface water is anywhere from $250/AF to $500/AF, depending on the cost of water and infrastructure necessary to get it to the customer. Groundwater costs are typically below $300/AF assuming arsenic treatment technologies are implemented. A final method of viewing the cost of recycled water is if the cost were spread over the entire Zone 40 service area and paid through development fees and user fees. The determination of this cost requires the use of Zone 40's financial model that incorporates the entire capital improvement program to 2030 build-out. This effort will be completed as part of the Zone 40 WSIP.

Table 4. Unit Cost of Water for Limited Use Implementation Scenario

Unit Cost Basis	Units	Total Number of Units	Unit Cost
($/AF)	Acre-feet of water	730	$ 756
($/acre)	Project acres	1440	$ 6,489
($/Equivalent Dwelling Unit)	Equivalent Dwelling Units	7200	$ 1,298

The avoided cost of not having to construct additional potable water system capacity as a result of the recycled water system is not considered to be significant. This is a result of fire flow requirements being a controlling factor on transmission mains and storage design.

Full Use Implementation Scenario

Under the full use implementation scenario it is assumed that recycled water would be provided to all residential and commercial areas. The ability to implement such a scenario is considered to be challenging given current regulatory agency and public concerns. These concerns stem from having a recycled water system that may be susceptible to public contact in private backyards, and the difficulty of ensuring no cross connections with the potable system once the recycled water supply is on private property. However, under the scope of this study, there is the need to develop an estimated cost of a full use implementation scenario for comparison purposes with the limited use implementation scenario.

The approach taken to develop this scenario requires some broad assumptions related to system requirements necessary to serve residential areas. No modeling is performed under this scenario; rather, an incremental cost is added to the limited use implementation scenario to increase the capacity of that system to serve residential demands. To allow for a simple addition to the limited use implementation scenario, it is assumed that, through education and enforcement, irrigation can be spread uniformly over the irrigation timeframe (10 pm to 7 am). This modification in the irrigation pattern will limit the need for additional expansion of the limited use implementation scenario pipelines. The treatment plant and storage reservoir will be the only facilities that will be upsized as a result of the added demand.

For recycled water distribution pipe construction within residential rights-of-way, it is assumed that every acre of developed land will have approximately 450 linear feet (LF) of roadway and pipeline. This is based on the assumption that for every acre of developed land, 35 percent of the land is dedicated to roadway with a nominal width of 35 feet. The minimum pipe size in residential streets is 6-inches. With 1161 acres of residential area, approximately 500,000 LF of 6-inch pipeline will be required.

The average annual demand for the full use implementation scenario increases by 1,742 AF/year over the limited use scenario according the **Table 1**. This results in 1.56 MGD of maximum day capacity and 2,160 gpm of peak hour capacity. The incremental volume in storage needed for peak hour (for 6 hours) demands is 0.9 MG rounded up 1.0 MG. It is assumed that this tank would be located somewhere in the far reaches of the system and would fill during the off-peak periods through the transmission system constructed under the limited use implementation scenario. The total incremental cost for the storage and distribution mains is calculated to be $0.7M and $21.2M, respectively. The same normalized cost comparison is provided in **Table 5**. The unit cost of water in $/AF is about the same as that shown in **Table 4**, indicating that the cost of serving residential properties does not increase the total cost of providing recycled water based on the additional supply of water that it provides. However, the cost is still greater than 100 percent higher than other costs of water at this time.

Table 5. Unit Cost of Water for Full Use Implementation Scenario

Unit Cost Basis	Units	Total Number of Units	Unit Cost
($/AF)	Acre-feet of water	1742	$ 744
($/acre)	Project acres	1440	$ 15,237
($/Equivalent Dwelling Unit)	Equivalent Dwelling Units	7200	$ 3,047

Conclusions/Recommendations:

As stated in the Purpose section of this paper the objective of this study was to quantify, to a feasibility level of effort, two scenarios of recycled water use in the North Vineyard Station Specific Plan area and the Florin-Vineyard Community Plan area in terms of facilities needed and associated costs. Based on the comparatively high unit cost of recycled water identified in this study, a recommendation by SCWA on the feasibility of implementing either scenario cannot be asserted at this time. What the findings do indicate, however, is that additional work is necessary to address questions that, when answered, may lead to a positive recommendation. These questions are stated below:

1. **What would be the level of financial participation by the SRCSD?** The study assumes that SRCSD will provide the source of supply up to the maximum day demand of the study area, and that SCWA will pay for and operate the storage and distribution components. There are clear benefits to implementing recycled water programs in the county in terms of providing a new source of supply of water. The question of who pays is an important one, especially when SRCSD is looking at potentially higher costs for enhanced treatment in the event discharge requirements to the Sacramento River are tightened by the regulatory agencies. It seems appropriate that SRCSD and SCWA pay proportionally based on the level of benefit to each agency. It is recommended that this be evaluated as part of the SRCSD Recycled Water Master Plan that is currently underway.

2. **What is the timing/phasing of the SRCSD recycled water supply facilities?** If the timing of the SRCSD facilities is determined to be phased long after the installation of the storage and conveyance infrastructure, it may be cost-effective for SRCSD to invest in the construction of said infrastructure and, through agreement, have SCWA pay for the facilities at the time supplies are provided. This

approach will likely place recycled water in a competitive cost advantage with other supplies at the time; especially if growth beyond the current Zone 40 Master Plan 2030 study boundary is being contemplated. It is recommended that this be evaluated as part of the SRCSD Recycled Water Master Plan that is currently underway.

Discussion Paper
Feasibility on the Use of Recycled Water In the Rio del Oro/Sunrise Douglas Community Plan Area

Introduction

The Sacramento County Water Agency (SCWA), at the request of the Sacramento Regional County Sanitation District (SRCSD), has prepared this discussion paper to evaluate the feasibility of implementing a recycled water use program in the Sunrise Douglas Community Plan area as shown in **Figure 1**. SCWA Zone 41 is the designated retail water provider for this new growth area. SCWA Zone 40 is responsible for the development of new water supplies which can include entering into wholesale agreements with other agencies such as SRCSD for recycled water. Currently, a wholesale agreement is in place between Zone 41 and SRCSD for service in the Laguna West/Lakeside/Stonelake and East Franklin/Laguna Ridge development areas. Under this agreement, SCWA purchases water from SRCSD delivered to a specified metering point, conveys this water to the customer or to a storage location, and then retails the water "on-demand" to its customers. The cost of the water is dictated by provisions of the wholesale agreement plus the cost to construct, operate, and maintain the recycled water distribution system.

Purpose

This paper quantifies the facilities necessary to convey and retail recycled water from a single source of supply located adjacent to the study area. Two levels of implementation are considered. The first level includes all potential large recycled water users such as institutional (e.g., schools), parks, and public landscape corridors. This level also assumes that a minimal amount of the above type of outdoor irrigation demands will be met through the potable water system. The second level considers full use of recycled water to meet all outdoor irrigation requirements including single family homes.

This paper provides an evaluation and brief summary of the findings for the two levels of implementation and develops a feasibility level cost estimate for each.

Study Area Land Use and Water Demands

This section provides the land use and water demand information related to the project area. This information is necessary to develop the infrastructure requirements necessary to provide recycled water to meet the projected water demands.

Project Land Use

The study area is approximately 3,884 acres in size and is roughly bounded by Kiefer Road on the South, Grantline Road on the east, Sunrise Boulevard on the west, and the Douglas Road on the north. The proposed land use within the study area is predominantly residential with lesser amounts of commercial and active industrial. A breakdown of the land uses are provided in **Table 1** for residential and **Table 2** for commercial and industrial.

Figure 1. Project Location Map

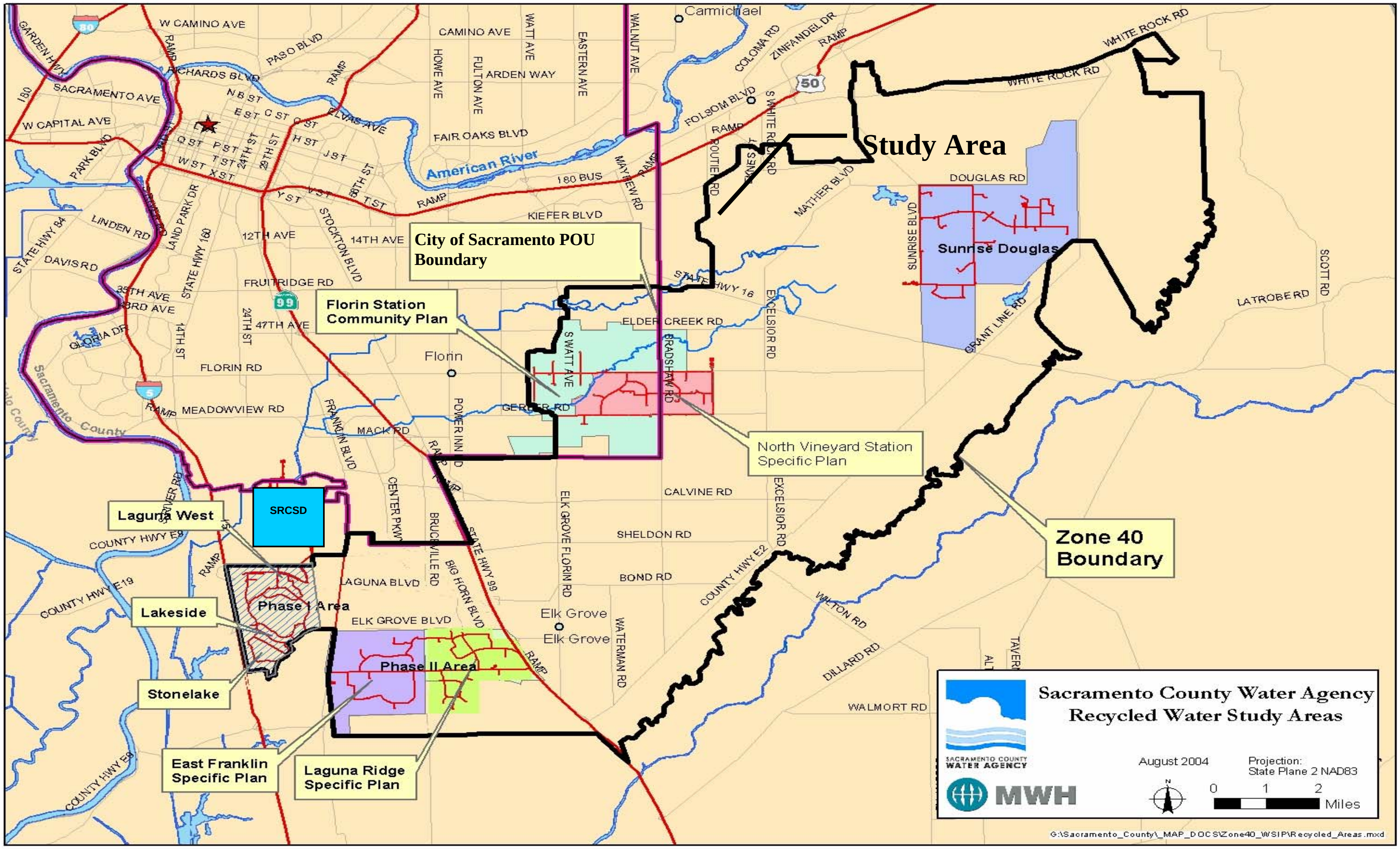


Table 1. Residential Land Uses and Non-Potable Demand

Land Use	Area (acres)	Unit Water Demand Factor (AF/acre/year)	Water Demand (AF/year)	Maximum Day (MGD)	Peak Hour (gpm)
Rural Estates	-	1.33	-	-	0
Single Family	710	2.89	2,052	1.83	2,638
Multi-Family - Low Density	171	3.7	633	0.56	813
Multi-Family - High Density	41	4.12	169	0.15	217
Total	**922**	**11**	**2,854**	**3**	**3,669**

Table 2. Commercial and Industrial Land Uses and Non-Potable Demand

Anatolia						
Land Use	Demand Node	Total Area (acres)	Non-potable Water Use Area (acres)	Peak Day Unit Demand (gpm/AC)	Non-potable Water Peak Demand (gpm)	Maximum Daily Irrigation Demand Volume (MGD)
Park	DMD100	6.74	6.07	5.876	36	0.05
School	DMD101	11.00	7.70	5.876	45	0.07
Park	DMD104	4.01	3.61	5.876	21	0.03
Park	DMD105	5.65	5.09	5.876	30	0.04
School	DMD106	10.97	7.68	5.876	45	0.06
Park	DMD107	5.61	5.05	5.876	30	0.04
Park	DMD164	23.00	20.70	5.876	122	0.18
Streetscapes	DMD160	7.60	7.60	6.026	46	0.07
Streetscapes	DMD162	3.67	3.67	6.026	22	0.03
Streetscapes	DMD165	4.90	4.90	7.026	34	0.05
Subtotal		**83.15**	**72.06**		**431**	**0.62**
SD2 Village						
Land Use	Demand Node	Total Area (acres)	Non-potable Water Use Area (acres)	Peak Day Unit Demand (gpm/AC)	Non-potable Water Peak Demand (gpm)	Maximum Daily Irrigation Demand Volume (MGD)
Park	DMD108	3.30	2.97	5.876	17	0.03
Park	DMD109	11.03	9.92	5.876	58	0.08
School	DMD110	10.36	7.25	5.876	43	0.06
Park	DMD111	6.22	5.60	5.876	33	0.05
Subtotal		**30.91**	**25.75**		**151**	**0.22**
Sunridge 250, Cresleigh Homes, Sunridge Park						
Sunridge Village, SD2 Village H						

Land Use	Demand Node	Total Area (acres)	Non-potable Water Use Area (acres)	Peak Day Unit Demand (gpm/AC)	Non-potable Water Peak Demand (gpm)	Maximum Daily Irrigation Demand Volume (MGD)
Detention/Water Quality Basin	DMD103	16.29	16.29	5.876	96	0.14
Park	DMD112	4.91	4.42	5.876	26	0.04
School	DMD113	9.92	6.94	5.876	41	0.06
Park	DMD117	11.35	10.21	5.876	60	0.09
Park	DMD114	4.14	3.73	5.876	22	0.03
Park	DMD115	3.77	3.39	5.876	20	0.03
Park	DMD116	15.31	13.78	5.876	81	0.12
Park	DMD118	5.63	5.07	5.876	30	0.04
School	DMD119	10.74	7.52	5.876	44	0.06
Park	DMD120	3.73	3.36	5.876	20	0.03
Park	DMD121	24.89	22.40	5.876	132	0.19
Park	DMD122	19.10	17.19	5.876	101	0.15
Subtotal		**129.78**	**114.30**		**672**	**0.97**
East Z40 Pressure Zone						
Land Use	Demand Node	Total Area (acres)	Non-potable Water Use Area (acres)	Peak Day Unit Demand (gpm/AC)	Non-potable Water Peak Demand (gpm)	Maximum Daily Irrigation Demand Volume (MGD)
School	DMD125	10.797	7.56	5.876	44	0.06
Park	DMD126	9.809	8.83	5.876	52	0.07
Park	DMD127	9.742	8.77	5.876	52	0.07
Park	DMD128	5.366	4.83	5.876	28	0.04
Park	DMD129	10.44	9.40	5.876	55	0.08
Subtotal		**46.15**	**39.38**		**231**	**0.33**
Total		**290**	**251**		**1,485**	**1.03**

Recycled Water Demands

Recycled water demands are developed based on the area requiring irrigation, the amount of evapotranspiration that occurs in the area, and the rate of water application from a typical irrigation system. There are three water demand numbers of interest. The first is the annual water demand or how much water is used over a given year. The second is the maximum day demand, which is typically the amount of water that will need to come from the source supply or recycled water treatment plant. Lastly, there is peak hour demand for sizing system facilities including storage, pumps, and transmission pipelines.

Table 1 indicates the average, maximum day and peak hour demands for residential non-potable uses. In this table it was assumed that on average approximately 50% of the water use by a single family home is used outdoors (average annual consumption of residential areas is assumed to be 3.0 AF/acre/year).

Smaller lot homes will likely use less water outdoors compared to indoor use and larger lot homes, typically with large landscaped yards, will likely use more water outdoors than indoors. What is shown is assumed to be an average. The peaking factor used to achieve a maximum day demand is assumed to be 2 times the average annual demand. The peak hour demand is assumed to be 2 times the maximum day demand.

Table 2 presents recycled water demands for commercial and public landscape uses. Water demand assumptions in these examples are based on the irrigated area and the assumed application rate based on the number of assumed sprinkler heads per acre of land. The first two columns of **Table 2** indicate the total area and total average annual water demand based on a demand factor of 3.0 AF/acre/year. The total demand is indicated for reference when looking at full implementation of recycled water demand. Under the limited use implementation scenario, only those areas that have significant demand and can be reached by the distribution system at a reasonable cost are used. The remaining columns of **Table 2** present the limited use implementation demands. Under the limited use scenario, 251 acres of a possible 290 acres are provided recycled water service. The total demand of 1.03 MGD indicates the size of treatment plant facility. The peak hour demand of approximately 1,500 gpm is the demand used for designing the recycled water distribution system in the following section.

Recycled Water Distribution System

This section briefly describes the recycled water distribution system design and methodology. The intent of the design is not to provide a detailed plan for purposes of designing or constructing a distribution system; rather, the purpose is to develop, at a feasibility study level, the approximate system requirements to base an initial cost estimate for implementing a recycled water program within the project area.

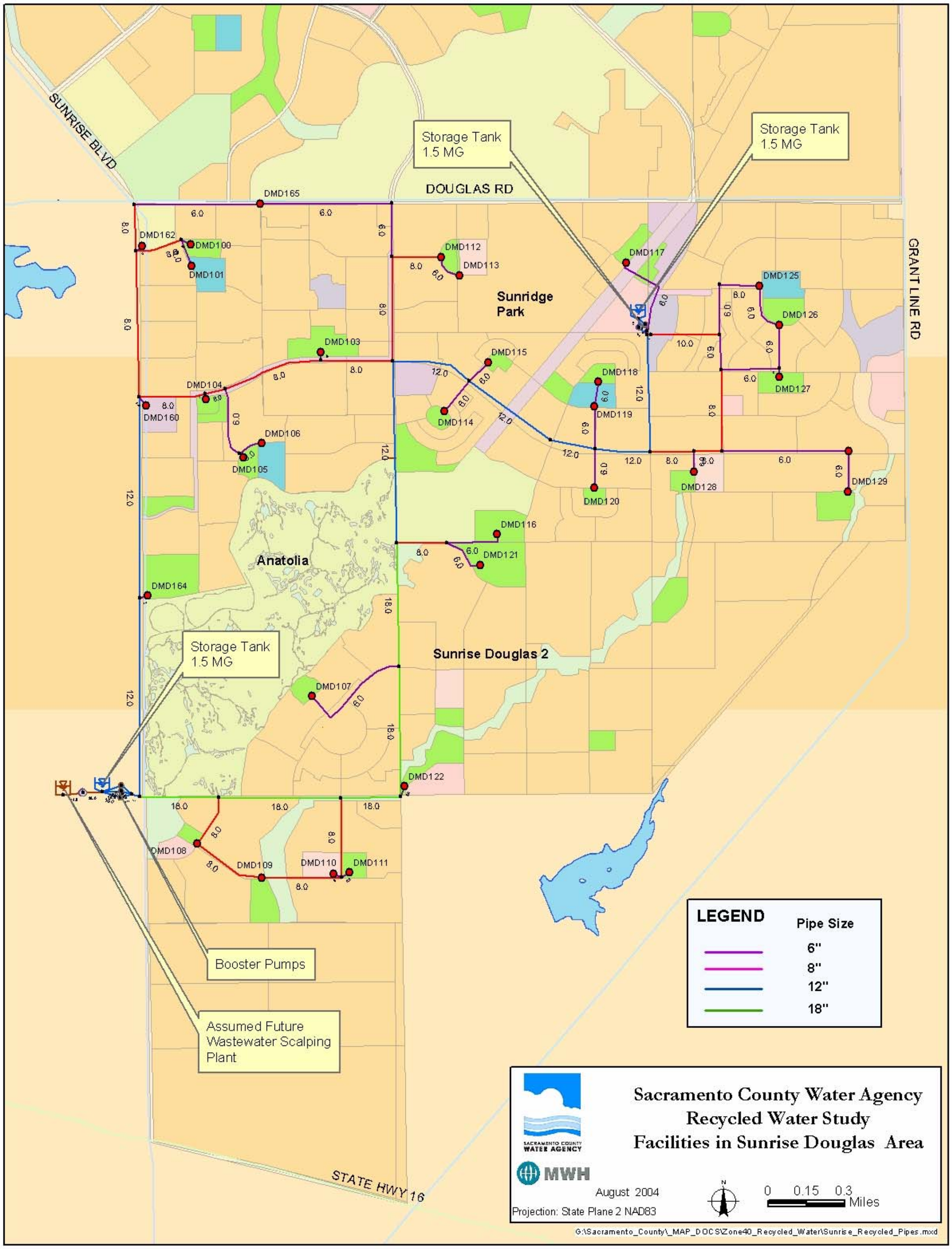
Design Methodology

The design assumptions used in this study are similar to those accepted by SCWA in the design of the Phase 1 and Phase 2 recycled water service areas in the Laguna West/Lakeside/Stonelake and East Franklin/Laguna Ridge development areas, respectively. Computer modeling was completed using H2Onet applying an extended period simulation over a 48 hour period. Recycled water demands are assumed to take place within the timeframe between 10 PM and 7 AM. Based on this method of design the distribution system in **Figure 2** identifies the needed storage, pumping, and pipe system to meet peak hour demands under the limited use implementation scenario. Pressures in the system during peak hour conditions are designed to not fall below 45 pounds per square inch (PSI).

Practical Implementation Scenario

The source of water is assumed to originate from a future SRCSD scalping plant that will treat wastewater from a regional interceptor pipeline to Title 22 standards and maintain a constant head in RES1 located at the southwest corner of the project at Kiefer Road and Sunrise Boulevard. This site is also a potential site for a treated water reservoir as identified in the Sunrise Corridor/Mather/Sunrise Douglas Water System Infrastructure Plan (MWH, April 2004). From this constant head source of supply, a 1.5 MG storage tank is constructed to allow for peaking capacity in the system near the source, and a second 1.5 MG storage tank is necessary in the upper pressure zone area in the northeast. From the lower pressure zone storage tank a 16-inch and 12-inch transmission pipeline network moves the water north and east to higher elevations in the northeast portion of the study area. The pipeline system loops in the lower elevation areas for circulation and stability in the system in the lower pressure zone. A 12-inch pipeline feeds the upper pressure zone storage tank. Booster pumps feed a smaller looped system to reach a practical level of service to recycled water customers.

Figure 2. Recycled Water Distribution System Limited Use Implementation Scenario



Pumps

Pump #	Description	Quantity	Design Head (ft)	Design Flow (gpm)	Hp	Unit Cost ($/hp)	Capital Cost ($1,000)	Engineering & Environmental	Construction Contingency	Total Cost
1	Pumps at Recycled Water Storage Tank in Southwest portion of the study area	4	175	1,500	66	1,000	265	15%	25%	372
2	Pumps at Recycled Water Storage Tank in Northeast portion of the study area	2	165	1,000	42	1,000	83	15%	25%	117
Total										**$488**

Storage Tanks

No.	Description	Storage (MG)	Unit Cost ($1,000/MG)	Capital Cost ($1,000)	Engineering & Environmental	Construction Contingency	Cost ($1,000)
1	Recycled Water Storage Tank in Southwest portion of the study area	1.5	500	750	15%	25%	1,050
2	Recycled Water Storage Tank in Northeast portion of the study area	1.5	500	750	15%	25%	1,050
Total							**$2,100**

Pipelines

Length (feet)	Description	Diameter	Unit Cost ($/inch-dia/linear foot)	Capital Cost ($1,000)	Engineering & Environmental	Construction Contingency	Cost ($1,000)
10,700	Pipeline	18	$ 6.25	$ 1,204	15%	25%	$ 1,685
2,962	Pipeline	16	$ 6.25	$ 296	15%	25%	$ 415
20,413	Pipeline	12	$ 6.25	$ 1,531	15%	25%	$ 2,143
23,825	Pipeline	8	$ 5.00	$ 953	15%	25%	$ 1,334
31,572	Pipeline	6	$ 5.00	$ 947	15%	25%	$ 1,326
Total							**$ 6,903**

Total Capital Cost

$ 9.49

Estimated Project Costs

The quantities of pipeline and other infrastructure are provided in **Table 3**. Unit costs are based on studies recently completed in the Sacramento area and represent feasibility study level of confidence. The total estimated capital cost of the limited use implementation scenario is **$9.49 Million**. There are several methods of normalizing this cost to a unit cost that can be compared with other water supplies. The first is a unit cost based on dollars per acre-foot of water, the second is on dollars per acre of developed land, and the third is dollars per equivalent dwelling unit. **Table 4** presents these normalized costs. The $/AF cost of **$756/AF** assumes that the total capital cost **($9.49 M)** is amortized over a 40 year period at 5.5% effective interest. Currently, the typical cost for new supplies of surface water is anywhere from $250/AF to $500/AF, depending on the cost of water and infrastructure necessary to get it to the customer. Groundwater costs are typically below $300/AF assuming arsenic treatment technologies are implemented. A final method of viewing the cost of recycled water is if the cost were spread over the entire Zone 40 service area and paid through development fees and user fees. The determination of this cost requires the use of Zone 40's financial model that incorporates the entire capital improvement program to 2030 build-out. This effort will be completed as part of the Zone 40 WSIP.

Table 4. Unit Cost of Water for Limited Use Implementation Scenario

Unit Cost Basis	Units	Total Number of Units	Unit Cost
($/AF)	Acre-feet of water	828	$ 677
($/acre)	Project acres	3,884	$ 144
($/Equivalent Dwelling Unit)	Equivalent Dwelling Units	8,750	$ 1,085

The avoided cost of not having to construct additional potable water system capacity as a result of the recycled water system is not considered to be significant. This is a result of fire flow requirements being a controlling factor on transmission mains and storage design.

Full Use Implementation Scenario

Under the full use implementation scenario it is assumed that recycled water would be provided to all residential and commercial areas. The ability to implement such a scenario is considered to be challenging given current regulatory agency and public concerns. These concerns stem from having a recycled water system that may be susceptible to public contact in private backyards, and the difficulty of ensuring no cross connections with the potable system once the recycled water supply is on private property. However, under the scope of this study, there is the need to develop an estimated cost of a full use implementation scenario for comparison purposes with the limited use implementation scenario.

The approach taken to develop this scenario requires some broad assumptions related to system requirements necessary to serve residential areas. No modeling is performed under this scenario; rather, an incremental cost is added to the limited use implementation scenario to increase the capacity of that system to serve residential demands. To allow for a simple addition to the limited use implementation scenario, it is assumed that, through education and enforcement, irrigation can be spread uniformly over the irrigation timeframe (10 pm to 7 am). This modification in the irrigation pattern will limit the need for additional expansion of the limited use implementation scenario pipelines. The treatment plant and storage reservoir will be the only facilities that will be upsized as a result of the added demand.

For recycled water distribution pipe construction within residential rights-of-way, it is assumed that every acre of developed land will have approximately 450 linear feet (LF) of roadway and pipeline. This is based on the assumption that for every acre of developed land, 35 percent of the land is dedicated to roadway with a nominal width of 35 feet. The minimum pipe size in residential streets is 6-inches. With 1161 acres of residential area, approximately 3.8 Million LF of 6-inch pipeline will be required.

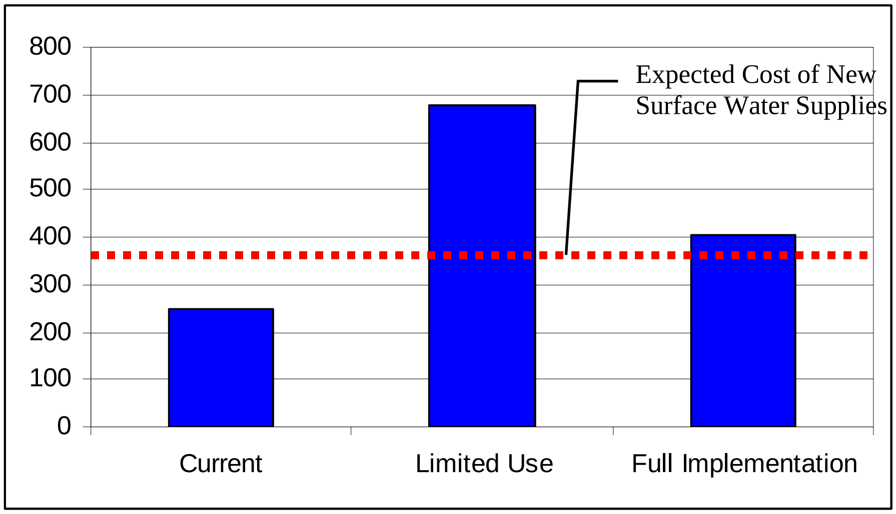
The average annual demand for the full use implementation scenario increases by **5,775 AF/year** over the limited use scenario according the **Table 1**. This results in **10 MGD** of maximum day capacity and **14,851 gpm** of peak hour capacity. The incremental volume needed for peak hour (for 6 hours) demands is **5.5 MG**. It is assumed that there would be two to four tanks one for the upper and one for the lower pressure zones. The optimum location is somewhere in the far reaches of the system and would fill during the off-peak periods through the transmission system constructed under the limited use implementation scenario. The total incremental cost for the storage and distribution mains is calculated to be **$32M** and **$5.34M**, respectively. This does not include booster pumps assuming some economies from the limited use scenario. The same normalized cost comparison is provided in **Table 5**. The unit cost of water in $/AF is about the same as that shown in **Table 4**, indicating that the cost of serving residential properties does not increase (it in fact decreases) the total cost of providing recycled water based on the additional supply of water that it provides. However, the cost is still greater than 100 percent higher than other costs of water at this time.

A summary graph provided in **Figure 3** indicates the current price of water for Zone 40 from groundwater and surface water sources of supply, those contemplated in this study, and those surface water supplies that would be expected in the near term future. From this graph, the full implementation scenario may be cost effective; however, there is a public health perception that would need to be overcome. The larger volume of a total of 12 MGD is also an issue for the SRCSD to respond to in their on-going master plan effort for recycled water.

Table 5. Unit Cost of Water for Full Use Implementation Scenario

Unit Cost Basis	Units	Total Number of Units	Unit Cost
($/AF)	Acre-feet of water	6,603	$ 406
($/acre)	Project acres	3,884	$ 11,678
($/Equivalent Dwelling Unit)	Equivalent Dwelling Units	8,750	$ 5,184

Figure 3. Price of Water Comparison



Conclusions/Recommendations:

As stated in the Purpose section of this paper, the objective of this study was to quantify, to a feasibility level of effort, two scenarios for recycled water use in the Sunrise Douglas Community Plan Area in terms of facilities needed and associated costs. Based on the comparatively high unit cost of recycled water identified in this study, a recommendation by SCWA on the feasibility of implementing either scenario cannot be asserted at this time. What the findings do indicate, however, is that additional work is necessary to address questions that, when answered, may lead to a positive recommendation. These questions are stated below:

1. **What would be the level of financial participation by the SRCSD?** The study assumes that SRCSD will provide the source of supply up to the maximum day demand of the study area, and that SCWA will pay for and operate the storage and distribution components. There are clear benefits to implementing recycled water programs in the county in terms of providing a new source of supply of water. The question of who pays is an important one, especially when SRCSD is looking at potentially higher costs for enhanced treatment in the event discharge requirements to the Sacramento River are tightened by the regulatory agencies. It seems appropriate that SRCSD and SCWA pay proportionally based on the level of benefit to each agency. It is recommended that this be evaluated as part of the SRCSD Recycled Water Master Plan that is currently underway.

2. **What is the timing/phasing of the SRCSD recycled water supply facilities?** If the timing of the SRCSD facilities is determined to be phased long after the installation of the storage and conveyance infrastructure, it may be cost-effective for SRCSD to invest in the construction of said infrastructure and, through agreement, have SCWA pay for the facilities at the time supplies are provided. This approach will likely place recycled water in a competitive cost advantage with other supplies at the time; especially if growth beyond the current Zone 40 Water Supply Master Plan 2030 study boundary is being contemplated. It is recommended that this be evaluated as part of the SRCSD Recycled Water Master Plan that is currently underway.