CITY OF RIVERSIDE

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Recycled Water Phase I Feasibility Study and Citywide Master Plan

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SEPTEMBER2003

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September 5, 2003

Mr. Kevin Milligan, P.E.
Principal Water Engineer
Riverside Public Utilities
City of Riverside
3900 Main Street
Riverside, CA 92522

Subject: Recycled Water Phase 1 – Feasibility Study and Citywide Master Plan

Dear Mr. Milligan:

Parsons is pleased to submit ten (10) copies of the Recycled Water Phase I – Feasibility Study and Citywide Master Plan to the City of Riverside. Ten (10) copies of CD ROMs for the report are also submitted for your use.

We greatly appreciate the contribution from the City of Riverside's staff in completing this report, which provides details of the planning effort for the implementation of the Phase I Water Recycling Project and future water recycling projects.

Please feel free to call me at (626) 440-6263 if you have any questions.

Respectfully,

Surendra K. Thakral, P.E., DEE
Vice President – Water and Infrastructure, Inc.

Enclosure

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This executive summary presents a brief summary of the **Recycled Water Phase I Feasibility Study and Citywide Master Plan** for the City of Riverside (City).

PROJECT BACKGROUND

The City objectives include optimizing the use of recycled water from the Regional Water Quality Control Plant (RWQCP) for various non-potable applications.

The 1992 Recycling Master Plan focused on recycled water quantity and quality evaluation, recycled water use options, market assessment, development of a core distribution system, and excess recycle management. Although the City has not formally adopted and implemented this master plan, it has gradually increased the use of recycled water around the RWQCP on a case-by-case basis.

PURPOSE OF STUDY

This study has been conducted to assist the City in evaluating the cost effectiveness and benefits of using recycled water for landscape irrigation, agricultural irrigation, groundwater recharge, and commercial and industrial purposes. It updates the 1992 Recycling Master Plan with an economic analysis of the development and phased implementation of recycled water systems for non-potable water users throughout the City as well as the Jurupa Community Water District.

The specific purposes of this study included developing a more detailed plan for the Phase I Water Recycling Project and updating the City-wide Water Recycling Master Plan to validate the future demands and capital outlay.

RECYCLED WATER QUALITY CRITERIA AND REGULATIONS

California recognizes the importance of recycling water to meet overall water demand, as backed by Resolution No. 77-1, State Board's Policy with Respect to Water Reclamation in California, and specifically addressed in the California Water Code, Sections 13575 and 13577. As California's demand for water continues to increase, so will the necessity to recycle wastewater effluent from water reclamation facilities throughout the state. The Department of Health Services (DHS) establishes water quality standards and treatment reliability criteria for water recycling under Title 22, Chapter 4, of the California Code of Regulations (Title 22), and in Title 17, Division 1, Chapter 5, Group 4, Article 1, and Section 7604 (Title 17). Requirements for recycled water use in California, not described in Title 22, are considered and approved by DHS on a case-by-case basis.

Title 22 sets bacteriological water quality standards based on the expected degree of public contact with recycled water.

- For water reuse applications with a high potential for the public to come in contact with the recycled water, Title 22 requires disinfected tertiary treatment.

- For applications with lower potential for public contact, Title 22 requires three levels of secondary treatment, differing by the amount of disinfection required.

In addition to establishing recycled water quality standards, Title 22 specifies the reliability and redundancy of each recycled water treatment and use operation.

Title 17 provides protection against cross-connections between potable water systems and recycled water systems.

RECYCLED WATER QUALITY AND QUANTITY

The RWQCP, a municipal wastewater treatment plant operated by the City, is located on a 121-acre site at 5950 Acorn Street, south of the Santa Ana River, near the intersection of Van Buren Boulevard and Jurupa Avenue. The City completed construction of the first phase of the Hidden Valley Wetlands Enhancement Project (HVWEP) in March 1995. The HVWEP has been expanded to include an educational pond and other ponds. Approximately 100 acres of constructed wetlands are being used for additional wastewater treatment (nitrogen removal) from the RWQCP final effluent.

The RWQCP is currently producing about 32 mgd of recycled water on an annual average basis, while it is designed and permitted to produce up to 40 mgd of recycled water. The RWQCP is master planned for an ultimate capacity of 60 mgd. Thus, with the growth in population, the availability of recycled water is likely to go up to 40 mgd in the near future and 60 mgd ultimately.

Considering the City's obligations associated with the Prado Settlement (maximum 13.38 mgd) and potential evaporation losses at the HVWEP (about 0.5 mgd), about 18 mgd on annual average basis is available for the non-potable water uses discussed in Section 4 of this master plan.

Considering the projected population growth in the RWQCP service area, including population growth in the City, Jurupa, Rubidoux, and Edgemont, recycled water availability is likely to grow with time. However, to be conservative, this master plan has considered only 19 mgd to be available for non-potable water uses.

RECYCLED WATER MARKET ANALYSIS

Table EX-1 below summarizes the City's total non-potable reuse potential. Approximately 20,400 AFY (18 mgd annual average) of recycled water demand can be reasonably anticipated within the City limits and in the vicinity. Preliminary supply and demand analysis indicates that the 32 mgd of recycled water produced from the RWQCP will meet annual average demands. Storage facilities will be required to meet the peak monthly/daily/hourly demands.

Due to the speculative nature of current arrangements between the City and neighboring cities, this report assumes all required water will be available from the RWQCP. No arrangement for potable water supply supplement is investigated, although minimally a potable water supply hookup will be required for emergencies.

This estimated market does not include demands within the City's 15,000-acre southerly sphere of influence.

Table EX-1
Recycled Water Average Annual Demand
Assessment of Direct Non-potable Reuse Market

	User Code	Category	Reuse Potential (AFY) Existing Establishment		Future Establishment
A.	**Within the City Limts/School Districts**				
	Landscape Irrigagation				
	100	Cemeteries	253		
	200	Colleges/Universities/Schools	2,256		176
	300	Golf Courses	1,335		400
	400	Parks	1,744		895
	500	Miscellaneous	268		270
	600	Freeway Irrigation and City Greenbelts	793		100
	800	Industrial - Landscape Irrigation	422		
			7,070		
		Minor Potential Users	1,000		
		Subtotal - Landscape Irrigation	**8,070**		**1,841**
	Industrial Process/Commercial				
	700	Commercial	500		300
	900	Industrial - Processes	86		850
		Subtotal - Industrial Process/Commercial	**586**		**1,150**
Total Within City Limits			**8,656**		**2,991**
Total Existing and Future			**11,700**	**AFY**	
B.	**Additional Users Along City's Notherly Boundary**		**1,310**	**AFY**	
C.	**Potential User's Along City's Southerly Boundary**		**1,360**	**AFY**	
D.	**Potential Gage Canal Agricultural Irrigation Usage**		**6,000**	**AFY**	
E.	**Grand Total (A + B + C + D)**		**20,370**	**AFY**	
		Say	**20,400**	**AFY**	

CITYWIDE RECYCLED WATER MASTER PLAN

The City recycled water core distribution systems, for users identified in Section 4, will provide recycled water to users throughout the City, JCSD and users located in southerly boundaries in the Western Municipal Water District (WMWD). The core system provides an estimate of the pipe sizes and footage, pipeline alignments, reservoirs and pump stations to supply recycled water and to provide the basis for the conceptual cost estimates.

The total estimated capital cost for the citywide distribution system is approximately $64,670,000. As detailed in Section 5, the capital cost can be financed according to different scenarios. The monthly capital and O&M costs to the City for the various financing scenarios are listed in **Table 5-7** through **Table 5-10** of Section 5. With a potential reuse of 20,400 AFY, as described in Section 4, the cost for reclaimed water production ranges from $264/AFY to $409/AFY, depending on the financing option as summarized in **Table EX-2** below.

Table EX-2
Summary of Alternative Pricing Options for
Citywide Recycled Water Production Cost

Item No.	Description of Preliminary Project Cost	Recycled Water Production Cost ($/AF/Y)
1.	City Funds - No Grants and/or Loans	309
2.	City Funds (75%) and Grant (25%)	244
3.	City Funds (25%) and SRF Loan (75%)	263
4.	Grant (25%) and SRF Loan (75%)	197

PHASE 1 – WATER RECYCLING PROJECT

Section 6 describes the Phase I – Water Recycling Project. The Phase I Project is restricted to about a 3-mile radius around the City's RWQCP. This 3-mile radius includes major potential users within the City, Jurupa Community Service District (JCSD) and Rubidoux Community Service District (RCSD). Two alternatives, with two sub-alternatives each, were identified, surveyed and evaluated for the development of Phase I – Water Recycling Project. These alternatives include:

- **Alternative 1a** – System designed with no citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue.
- **Alternative 1b** – System designed with citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue.
- **Alternative 2a** – System designed with no citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.
- **Alternative 2b** – System designed with citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.

A detailed presentation of the above alternatives, along with their associated costs under different financing scenarios, is given in Section 6 **(Table 6-3 through Table 6-36**). To summarize, the total Phase I project cost will include miscellaneous water resources costs, the incremental costs associated with upgrading the City RWQCP system, and distribution costs within the City. **Table 6-37** (reproduced below as **Table EX-3**) presents the combined capital and operation and maintenance costs for the different alternatives assessed for the project. It is observed that the water production cost for a system designed to meet only Phase I demand is lower than that for a system designed to meet citywide demand. Considering that the typical water production cost in Southern California ranges between $300/AFY to $700/AFY, the feasible Phase I recycled water system alternatives are:

- Alternative 1a – with or without grant and loan.
- Alternative 1b – only with grant and loan.
- Alternative 2a – with or without grant and loan.
- Alternative 2b – with or without grant and loan.

POTENTIAL FUNDING SOURCES

A variety of funding alternatives could be used to funding the projects developed under this master plan. The standard practice for water recycling projects such as this one relies on California SRF loans, Proposition 13 grants, water system cash reserves, and, as required, long-term debt. The availability of water system cash reserves, or relatively short-term loans from the City, with repayment at interest from the water sales, is an important financing resource. The City would like to explore grants under the federal funds, Propositions 50 and 13 grants, and SRF loan. It is obvious that some kind of innovative project funding approach is needed for the economical viability of the City's water recycling project.

The Project Recommendations and Implementation Plan (Section 8) of this master plan evaluates the potential project alternatives under the following economical scenarios:

- No grant and SRF (City' own financing)
- Only 25% Proposition 13 grants

- Combination of propositions 13 and low interest rate SRF loan for 75 percent of project cost

PROJECT RECOMMENDATIONS AND IMPLEMENTATION PLAN

The Citywide Project and the two alternatives for the Phase I Project evaluated in this report vary considerably in cost. However, they have similar features, including serving all the major potential users and providing flexibility of phased implementation. The Phase 1 Project has a potential recycled water reuse of approximately 1,870 AFY. The Citywide project has a significant number of potential recycled water users with an estimated demand of 12,400 AFY.

As the initial phase of a water recycling system, Parsons recommends the implementation of Alternative 1a or 2a. Alternatives 1a and 2a have the lowest overall cost per acre-foot compared to other alternatives with SRF loan and 25% grant. The estimated production cost of Alternative 1a is $360/AFY and Alternative 2a is $362/AFY.

Implementation of a recycled water program must consider many issues before design and construction programs are initiated. These issues must be resolved or addressed before final project feasibility and scope can be accurately determined. The following proposed implementation sequence provides a directive for effective implementation of the water recycling program in conjunction with the City's overall objectives. All of these tasks should be completed prior to project design.

- **Water Quality Issues**
- **Water Recycling Ordinance**
- **Recycled Water Supply**
- **Agreement with JCSD and neighboring Cities**
- **Users Agreement**
- **Environnemental Documentation**
- **Loan Application**
- **Engineering Report (Title 22 Report)**
- **Public Information Program**
- **Conversion Costs**
- **Reliability and Public Health Protection**
- **Groundwater Recharge Issues**

Table EX-3
Summary of Alternative Pricing Options

Alternatives		Riverside Potential Reuse (AFY)	Pipe Length (LF)	Approximate Capital Cost	Water Production Cost				
					Option 1 ($/AFY)	Option 2 ($/AFY)	Option 3 ($/AFY)	Option 4 ($/AFY)	Option 5 ($/AFY)
1 - JCSD, City of Riverside Users up to Arlington Ave.									
A.	System to meet phase I demand only	1,100	31,104	$6,297,000	550	439	470	360	276
B.	System to meet Citywide demand also	1,100	31,104	$7,904,000	651	513	552	413	308
	Difference (A - B)			$1,607,000	$101	$74	$82	$53	$32
2 - JCSD, City of Riverside Users up to Arlington Ave., Adams St. & Magnolia Ave.									
A.	System to meet phase I demand only	1,500	47,026	$9,368,000	569	448	482	362	270
B.	System to meet Citywide demand also	1,500	47,026	$9,961,000	594	466	502	374	277
	Difference (A - B)			$593,000	$26	$18	$20	$13	$7

Option 1: City Funds - No Grants and/or Loans
Option 2: City Funds (75%) and Grant (25%)
Option 3: City Funds (25%) and SRF Loan (75%)
Option 4: Grant (25%) and SRF Loan (75%)
Option 5: Grant (50%) and SRF Loan (50%)

SECTION 1
INTRODUCTION

Water is always in short supply in southern California and the need for water is expected to grow, driven by increasing population, need for protection of the Delta, and continued industrialization. Increased conservation efforts will slow but not stop this growth in demand. In fact, the California Department of Water Resources has predicted chronic water shortages by the year 2020.

As water demands and environmental needs grow, water recycling provides an additional viable source that will play a greater role in California's overall water supply. Using drought-proof recycled water reduces dependence on freshwater for uses such as landscape irrigation, dust control and industrial cooling; thus reserving the best and purest source of water for public drinking water. Water recycling can help conserve and sustainably manage California's vital water resources.

The City of Riverside's objectives include optimizing use of recycled water from the Regional Water Quality Control Plant (RWQCP) for various non potable uses.

1.1 PROJECT BACKGROUND

The City of Riverside (City) 1992 Reclamation Report (1992 Recycling Master Plan) focused on recycled water quantity and quality evaluation, recycled water use options, market assessment, development of a core distribution system, and excess recycle management.

Although, the City has not formally adopted and implemented the water recycling master plan, it has gradually increased the use of recycled water around the RWQCP on a case-by-case basis.

Users that have made the switch to recycled water include Van Buren Golf Course (Sky Links Executive Golf Course), Toro Manufacturing and Urban Forest. However, several types of non-potable water users that do not require potable water, such as landscape irrigation, commercial and industrial consumers are still using high quality potable water. No formal effort has been made to convince these users to use non-potable water.

While water recycling is a sustainable approach and has been cost-effective in other communities, the treatment of wastewater (no extra cost in this case) for reuse and the installation of distribution systems can be initially expensive compared to water supply alternatives such as ground water or imported water. Considering this situation, the Metropolitan Water District, the California State and Federal governments, have several financial support incentive programs to promote and make water recycling projects more cost effective and viable for a variety of purposes.

1.2 PURPOSE

This study has been conducted to assist the City in evaluating the cost effectiveness and benefits of using recycled water for landscape irrigation, agricultural irrigation, groundwater recharge, commercial and industrial purposes. It updates the 1992 Recycling Master Plan with an economic analysis of the development and phased implementation of recycled water systems for non-potable water users throughout the City as well as Jurupa Community Service District.

The specific purposes of this study included developing a more detailed plan for the Phase I Water Recycling Project and updating the City-wide Water Recycling Master Plan to validate the future demands as well as capital outlay.

1.3 PROJECT ORGANIZATION

This master plan report is organized into the following 8 sections and relevant appendices.

SECTIONS

Section 1 – Introduction

Section 2 – Recycled Water Quality Criteria and Regulations

Section 3 – Recycled Water Quality and Quantity

Section 4 – Recycled Water Market Analysis

Section 5 – Citywide Recycled Water System

Section 6 – Phase I – Water Recycling Project

Section 7 – Potential Funding Sources

Section 8 – Project Recommendation and Implementation Plan

APPENDICES:

Appendix A: 001 NPDES Permit

Appendix B: Prado Agreement

Appendix C: Hydraulic Modeling Results

Appendix D: Water Recycling Funding Guidelines

Appendix E: Prop 50 Funding Forms

SECTION 2

RECYCLED WATER QUALITY CRITERIA AND REGULATIONS

2.1 RECYCLED WATER QUALITY CRITERIA

Water reclamation and reuse criteria are principally directed at health and environmental protection and typically address wastewater treatment, recycled water quality, treatment reliability, distribution systems, and use area controls.

There are no federal regulations governing water reclamation and reuse in the U.S.; the regulatory burden rests with the individual states. The criteria vary among the states that have developed regulations. California's regulations (Title 22 and Title 17) are briefly discussed in this section. The U.S. Environmental Protection Agency (EPA) published guidelines in 1992 that are intended to provide guidance to states that have not developed their own criteria or guidelines.

Water quality criteria are based on a variety of considerations, including the following:

- ***Public health protection***: Recycled water should be safe for the intended use. Most existing water reuse regulations are directed at public health protection.
- ***Use requirements***: Many agricultural, industrial and other applications have specific physical and chemical water quality requirements that are not related to health considerations. Water quality requirements not associated with public health or environmental protection are seldom included in water reuse criteria by regulatory agencies.
- ***Irrigation effects***: The effect of individual constituents or parameters on crops or other vegetation, soil, and groundwater or other receiving water affects the water quality requirements. User water quality concerns often fall outside the scope of regulatory responsibility.
- ***Environmental considerations:*** The natural flora and fauna in and around recycled water use areas and the recycled water should not adversely impact receiving waters**.**
- ***Aesthetics***: For high level uses, e.g. urban irrigation and toilet flushing, the recycled water should be no different in appearance than potable water, i.e., clear, colorless, and odorless. For recreational impoundments, recycled water should not promote algal growth.
- ***Economics and Political realities:*** Regulatory decisions regarding water reclamation and reuse are influenced by public policy, technical feasibility, and economics.

2.2 RECYCLED WATER ACCEPTABILITY ISSUES

The acceptability of recycled water for any particular use is dependent on the physical, chemical, and microbiological quality of the water. Factors that affect the quality of

recycled water include source water quality, wastewater treatment processes and treatment effectiveness, treatment reliability, and distribution system design and operation. Local considerations include:

- Industrial wastes discharged to municipal sewerage systems can introduce chemical constituents that may adversely affect biological wastewater treatment processes and subsequent recycled water quality. California requires implementation of **industrial source control programs** to limit the input of chemical constituents that may adversely affect biological treatment processes and subsequent acceptability of the water for specific uses.
- Assurance of **treatment reliability** is an obvious, yet sometimes overlooked, quality control measure.
- **Distribution system design and operation** is important to ensure that the recycled water is not degraded before use and not subject to misuse.
- Open storage may result in water quality degradation by microorganisms, algae, or particulate matter, and may cause objectionable odor or color in the recycled water.

Making recycled water suitable and safe for reuse applications is achieved by eliminating or reducing the concentrations of microbial and chemical constituents of concern through wastewater treatment and/or by limiting public or worker exposure to the water via design and operational controls.

Toxic, and Microbial Constituents

The presence of toxic chemicals and microbial pathogens in wastewater creates the potential for adverse health effects where there is contact, inhalation, or ingestion of chemical or microbiological constituents of health concern.

The potential transmission of infectious disease by pathogenic agents is the most common concern associated with non-potable reuse of treated municipal wastewater. The principal infectious agents that may be found in raw municipal wastewater can be classified into three broad groups: bacteria; parasites (protozoa and helminths); and viruses. Excluding the use of raw sewage or primary effluent on sewage farms in the late 19th century, there have not been any confirmed cases of infectious disease resulting from recycled water use in the U.S.

Organic Constituents

Health effects related to the presence of organic constituents are of primary concern with regard to potable reuse. Both organic and inorganic constituents must be considered where recycled water is utilized for food crop irrigation, where recycled water from irrigation or other beneficial uses reaches potable groundwater supplies, or where organics may bio-accumulate in the food chain, e.g., in fish-rearing ponds.

The effect of organic constituents in recycled water used for crop irrigation may warrant attention if industrial wastes contribute a significant fraction to the wastewater.

Chemical Constituents and Physical Parameters

The chemical constituents potentially present in municipal wastewater generally are not a major health concern for urban uses of recycled water but may affect the acceptability of the water for uses such as food crop irrigation, industrial applications, and indirect potable reuse. Chemical constituents may be of concern when recycled water percolates into potable groundwater aquifers because of irrigation, groundwater recharge, or other uses.

Effects of physical parameters, e.g. pH, color, temperature, and particulate matter, and chemical constituents, e.g. chlorides, sodium, and heavy metals, are well known, and recommended limits have been established for many constituents.

2.3 WATER QUALITY CONSIDERATIONS FOR REUSE APPLICATIONS

2.3.1 Irrigation – Landscape and Agricultural

Both agricultural and landscape irrigation with recycled water are well accepted and widely practiced in the U.S. The water quality requirements and operational controls placed on the system depend on the area being irrigated, its location relative to populated areas, and the extent of public access or use of the grounds. The chemical composition of recycled water that has received secondary or higher levels of treatment, although highly variable, normally meets existing guidelines for landscape and agricultural irrigation use.

The recycled water available at the RWQCP goes through advanced treatment (tertiary filtration, chlorination and dechlorination) and meets existing guidelines for irrigation use.

Landscape Irrigation

Landscape irrigation involves the irrigation of golf courses, parks, cemeteries, school grounds, freeway medians, residential lawns, and similar areas. The concern for pathogenic microorganisms is somewhat different than for agricultural irrigation in that landscape irrigation frequently takes place in urban areas where the likelihood of human contact is higher and control over the use of the recycled water is more critical.

Agricultural Irrigation

The mechanism of potential food contamination from irrigation with recycled water includes:

- Physical contamination, where evaporation and repeated application may result in a buildup of contaminants on crops;
- Uptake through the roots from the applied water or the soil; and
- Foliar uptake.

Spray irrigation of food crops that grow above the ground surface requires more stringent requirements than surface irrigation because of the direct contact between the recycled water and the crops. Surface irrigation of root crops, such as carrots, beets, and onions also results in direct contact between the crop and recycled water; hence, irrigation of those and similar root crops should be subject to the same requirements.

Organisms contaminating food crops remain viable on the food surface unless they succumb to desiccation, exposure to sunlight, starvation, or action of other organisms or chemical agents. The reliability and completeness of pathogen inactivation by these mechanisms are questionable. Therefore, recycled water that is essentially free of measurable levels of pathogens is typically required for the spray irrigation of all crops that are eaten or sold raw.

Trace elements in recycled water normally occur in low concentrations that are not hazardous, but some are toxic at elevated concentrations. Some constituents are known to accumulate in particular crops, thus presenting potential health hazards to both grazing animals and/or humans.

2.3.2 Dual Systems

Although use of recycled water inside buildings for toilet and urinal flushing or for fire protection does not result in frequent human contact with the water, regulatory agencies usually require that the recycled water be essentially pathogen-free to reduce health hazards upon inadvertent cross-connection to potable water systems.

Areas that use both potable and recycled water are usually required to have backflow prevention devices on the potable water supply line to each site to reduce the potential of contaminating the potable drinking water system in the event of an inadvertent cross-connection.
Currently recycled water for toilet or urinal flushing or for fire protection is not allowed in single family residential dwellings.

2.3.3 Industrial Reuse

The suitability of recycled water for industrial processes depends on the particular use. Recycled water is used in the manufacture cooling and a wide variety of paper products, ranging from kraft pulp newsprint to high quality paper for stationery and wrappings. Additional site specific treatment beyond the Title 22 Requirements might be required on a particular use.

Use of recycled water in industrial or commercial facilities where the waste flow is returned to the municipal sewer system could increase the TDS load at the municipal treatment plant. The effect of this additional load should be analyzed on a case-by-case basis.

2.3.4 Recreational and Environmental Uses

Impoundments may serve a variety of functions from aesthetic non-contact uses to boating, fishing, and swimming. The level of treatment required will vary with the intended use of the water. Water quality requirements and thus required treatment levels increase as the potential for human contact increases. Typical quality requirements include:

- The appearance of the recycled water is important when it is used for impoundments, and treatment for nutrient removal may be required. Without nutrient control, there is a potential for algae blooms, resulting in odors, an unsightly appearance, and eutrophic conditions.

- Recycled water used for recreational impoundments where fishing and boating are allowed should not contain high levels of pathogenic microorganisms or heavy metals that accumulate in fish to levels that present health hazards to the consumers of the fish.
- For use in nonrestricted recreational impoundments where full-body contact with the water is allowed, the water should be microbiologically safe, colorless, and non-irritating to eyes and skin.

2.3.5 Groundwater Recharge – Spreading and Injection

The purposes of groundwater recharge using recycled water include establishing saltwater intrusion barriers in coastal aquifers, providing soil-aquifer treatment (SAT) for future reuse, providing storage of recycled water, controlling or preventing ground subsidence, and augmenting potable or non-potable aquifers. The two principal means of recharging groundwater basins with recycled water are surface spreading and injection.

Surface Spreading

Where surface spreading of recycled water is used to augment potable groundwater supplies, tertiary treatment, i.e., secondary treatment followed by filtration and disinfection, or advanced wastewater treatment processes may be needed and in some cases required by regulatory agencies to assure that the recharged water does not contain pathogens or health-significant levels of chemical constituents.

Injection

Injection involves pumping recycled water directly into the groundwater zone, which is usually a confined aquifer. Injection requires water of higher quality than surface spreading:

- To prevent clogging of injection equipment
- Because of the absence of soil matrix treatment afforded by surface spreading, and,
- More importantly, to have the injection water meet drinking water standards or match or exceed the quality of the groundwater into which it is injected.

Treatment processes beyond secondary treatment that may be used before injection include chemical coagulation/clarification, filtration, air stripping, ion exchange, granular activated carbon, reverse osmosis or other membrane processes, and disinfection.

2.4 U.S. EPA WATER REUSE GUIDELINES

The U.S. Environmental Protection Agency, in conjunction with the U.S. Agency for International Development, published *Guidelines for Water Reuse* in 1992 (Ref. EPA/625/R-92/004). The primary purpose of the document is to provide guidelines, with supporting information, for utilities and regulatory agencies in the U.S., particularly in states where standards do not exist or are being revised or expanded. California's comprehensive standards are discussed later in this section.

The guidelines address all of the important aspects of water reuse including recommended treatment processes, recycled water quality limits, monitoring frequencies, setback distances, and other controls for various water reuse applications. The guidelines address water reclamation and reuse for nonpotable applications as well as indirect potable reuse by groundwater recharge and augmentation of surface water sources of supply.

The treatment processes and recycled water quality limits recommended in the guidelines for various recycled water applications are presented in **Table 2-1**. Both recycled water quality limits and wastewater treatment unit processes are recommended for the following reasons:

(1) Water quality criteria involving surrogate parameters alone do not adequately characterize recycled water quality;

(2) A combination of treatment and quality requirements known to produce recycled water of acceptable quality obviates the need to monitor the finished water for certain constituents;

(3) Expensive, time-consuming, and in some cases, questionable monitoring for pathogenic microorganisms is eliminated without compromising health protection; and

(4) Treatment reliability is enhanced**.**

The guidelines suggest that, regardless of the type of recycled water use, some level of disinfection should be provided to avoid adverse health consequences from inadvertent contact or accidental or intentional misuse of a water reuse system.

Table 2-1
U.S. EPA Guidelines for Water Reuse
(Applicable to the States not having their own standards)

Type of Use	Treatment	Recycled Water Quality
Urban uses, Food crops eaten raw, Recreational impoundments	• Secondary • Filtration • Disinfection	• pH = 6-9 • 10 mg/L NO3-N • 2NTU[a] • No detectable fecal coli/l00 mL[b] • 1 mg/L Cl_2 residual[c]
Restricted access area irrigation, Processed food crops, Nonfood crops, Aesthetic impoundments, Construction uses, Industrial cooling[d], Environmental reuse	• Secondary • Disinfection	• pH = 6-9 • 30 mg/L BOD • 30mg/L SS • 200 fecal coli/l00 mL[e] • 1 mg/L Cl_2 residual[c]
Groundwater recharge of nonpotable aquifers by spreading	• Site specific & use dependent • Primary (minimum)	• Site specific & use dependent
Groundwater recharge of nonpotable aquifers by injection	• Site specific & use dependent • Secondary (minimum)	• Site specific & use dependent
Groundwater recharge of potable aquifers by spreading	• Site specific • Secondary & Disinfection (minimum)	• Site specific • Meet drinking water standards after percolation through vadose zone
Groundwater recharge of potable aquifers by injection, Augmentation of surface supplies	• Includes the following: • Secondary • Filtration • Disinfection • Advanced wastewater treatment	• Includes the following: • pH = 6-8.5 • 2NTU[a] • No detectable fecal coli/100mL[b] • 1 mg/L Cl_2 residual[c] • Meet drinking water standards

[a] Should be met prior to disinfection. Average based on a 24-hour time period. Turbidity should not exceed *5* NTU at any time.
[b] Based on 7-day median value. Should not exceed 14 fecal coli/l00 mL in any sample.
[c] After a minimum contact time of 30 minutes.
[d] Re-circulating cooling towers.
[e] Based on 7-day median value. Should not exceed 800 fecal coli/l00 mL in any sample.
Source: Adapted from [31].

2.5 REGIONAL BOARD/LOCAL REQUIREMENTS

In California, nine Regional Boards oversee the federal clean water regulations and implement the federal National Pollutant Discharge Elimination System (NPDES) program. NPDES permit requirements related to wastewater treatment and discharges to the Santa Ana River are discussed briefly in Section 3.

The Regional Board authority to protect Waters of the State is stated in the Porter-Cologne Water Quality Act of 1969. In protecting Waters of the State, each of the 9 Regional Boards (which are territorially divided by drainage basins) develop and adopt water quality control plans (basin plans) whereby beneficial uses of waters in the respective drainage basins are established, and water quality objectives are also established to protect such beneficial uses. The Regional Boards issue NPDES permits and waste discharge requirements consistent with protection of the beneficial uses in the respective basin plan, as well as compliant with federal clean water standards.

The Regional Board adopted the Water Quality Control Plan Report, Santa Ana Region (Basin Plan) on March 11, 1994 and became effective on January 24, 1995. The Basin Plan sets forth requirements for adequate water quality planning, implementation, management, and enforcement practices. It provides a definitive program to preserve and enhance both surface water and groundwater quality in the basin.

2.5.1 Groundwater Recharge Objectives

Groundwater recharge of treated wastewater is handled in a similar manner to water reuse, although the limits and the amount of flow that is affected are different.

The Basin Plan establishes water quality objectives necessary to protect the beneficial uses of receiving waters, including groundwater, inland surface water and coastal water. Currently, the Basin Plan objectives dictate that the wastewater reaching the groundwater table must not exceed a TIN (Total Inorganic Nitrogen) concentration of 10 mg/L.

The draft Groundwater Recharge Reuse Guidelines (GRRG) currently promulgated by the DHS (Department of Health Services) stipulate a total nitrogen concentration range between 1 and 10 mg/L for the recharge water. The DHS is currently considering adoption of an exact limit for total nitrogen but is unsure what total nitrogen limit in recharge water is necessary to assure that the nitrate standard will not be exceeded due to any groundwater recharge projects. Nevertheless, the DHS recognizes and may allow TIN treatment and removal through the soil column. The result is that recycled water used for groundwater recharge could contain higher concentrations of TIN.

The Basin Plan, 1995 lists the groundwater and inland surface water beneficial uses by hydrographic subunit (HSU) as shown in **Table 2-2** with regulated parameters for total dissolved solids, hardness, sodium, chloride and sulfate.

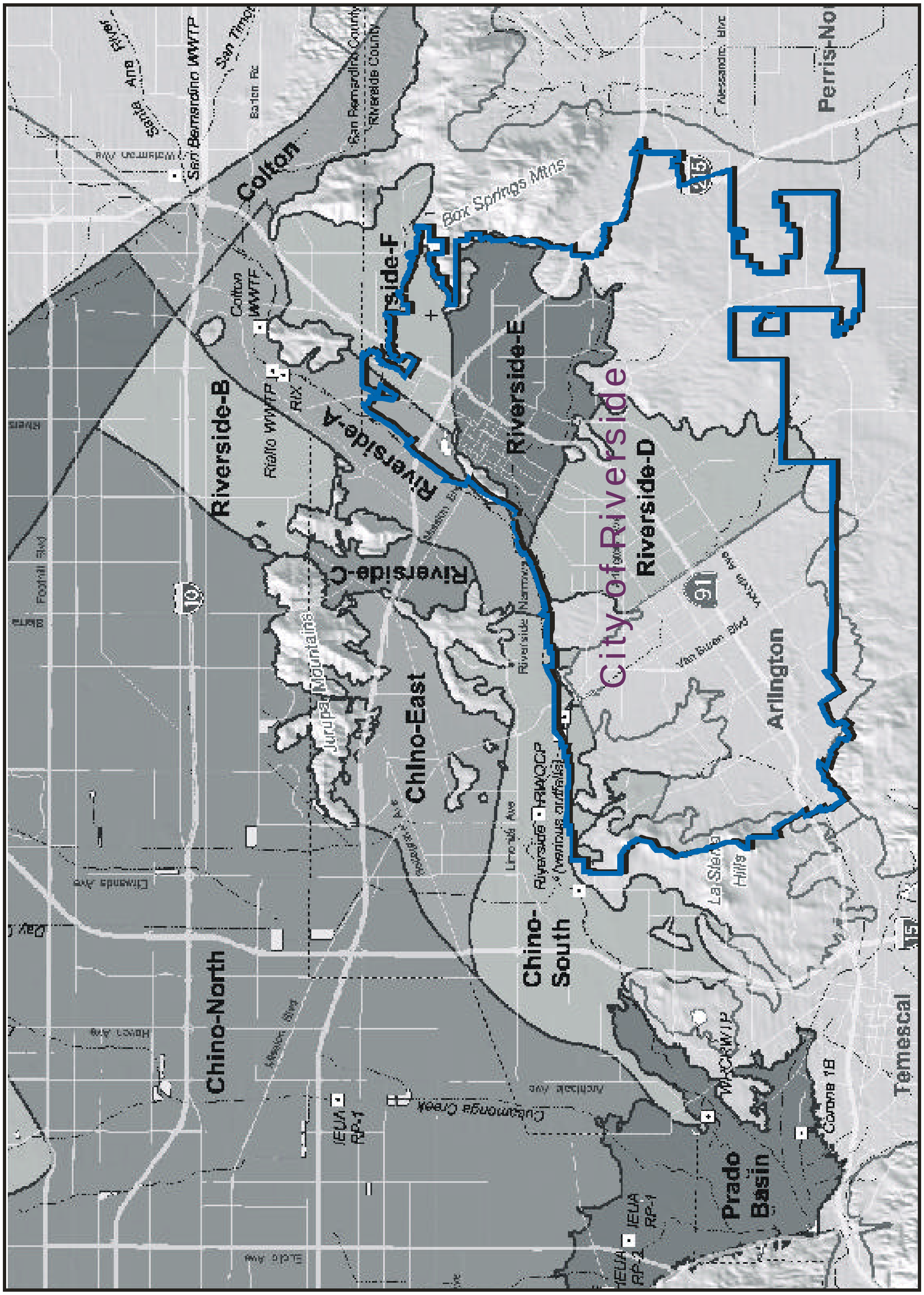
Table 2-2
RWQCP Sub Basins Ground Water Quality Objectives

Groundwater Supply Sub-basins	TDS	Hardness	Sodium Na	Chloride Cl	NO_3-N	Sulfate SO_4	Hydrologic Unit	
							Primary	Secondary
Arlington	1050	500	125	180	20	160	801.26	801.25
Bunker Hill I	260	190	15	10	1	45	801.51	-
Bunker Hill II	290	190	30	20	5	62	801.52	-
Bunker Hill Pressure	300	160	30	20	1	62	801.52	-
Riverside I	490	270	50	50	4	85	801.27	-
Riverside I	650	360	70	85	10	100	801.27	-
Riverside I	990	500	125	170	20	135	801.27	-

(Ref: Santa Ana Region Basin Plan, 1995)

Basin Plan Revision and New Groundwater Recharge Requirements

The Regional Water Quality Control Board (RWQCB) is scheduled to finalize a revision to the basin plan in the first quarter of 2004. The revision will include new groundwater basin boundaries and associated objectives for nitrate nitrogen and TDS. The proposed changes may limit the uses of reclaimed water in some areas due to water quality limitations. Under the proposed amendment, the City will overlay six different groundwater management zones (eight zones if the Jurupa and Rubidoux Community Services Districts are included). **Figure 2-1** overlays the City boundaries over the latest proposed groundwater management zones. Each of these zones will have specific groundwater objectives for TDS and nitrate nitrogen. Specific reclamation proposals will need to be assessed based on the type and location of the proposed activity after the revisions are finalized. **Table 2-3** summarizes the Water Quality Objectives associated with TDS and N03-N.



Source: Modified fromWildermuth Environmental, Inc.

Figure 2-1 – Groundwater Management Zone Boundaries and City of Riverside Boundary

Table 2-3
Revised Water Quality Objectives
(Likely to be adopted by RWQCB in few months)

Groundwater Subbasins Management Zones	Water Quality objective (mg/L)		HYDROLOGIC UNIT	
	TDS	NO_3-N	Primary	Secondary
SAN JACINTO RIVER BASIN				
Garner Valley*	300	2.0	802.22	
Idyllwild Area**	--	--	802.22	802.21
Canyon	230	2.5	802.21	
Hemet - South	730	4.1	802.15	802.21
Lakeview - Hemet North	520	1.8	802.14	802.15
Menifee	1020	2.8	802.13	
Perris North	570	5.2	802.11	
Perris South	1260	2.5	802.11	802.12, 802.13
San Jacinto - Lower	520	1.0	802.21	
San Jacinto - Upper	320	1.4	802.21	802.23
LOWER SANTA ANA RIVER BASIN				
La Habra**	--	--	845.62	
Santiago**	--	--	801.12	
Orange	580	3.4	801.11	801.13, 845.61, 801.14
Irvine**	910	5.9	801.11	
UPPER SANTA ANA RIVER BASIN				
Big Bear Valley	220	5.0	801.71	801.73
Beaumont "maximum benefit"++	340	5.0	801.62	801.63, 801.69
Beaumont "antidegradation"++	230	1.5	801.62	801.63, 801.69
Bunker Hill - A	310	2.7	801.51	801.52
Bunker Hill - B	330	7.3	801.52	801.53, 801.54, 801.57, 801.58
Colton	410	2.7	801.44	801.45
Chino - North "maximum benefit"++	420	5.0	801.21	481.21, 481.23, 481.22, 801.21, 801.23, 801.24, 801.27
Chino 1 - "antidegradation"++	290	4.9	802.21	481.21
Chino 2 - "antidegradation"++	260	2.9	802.21	
Chino 3 - "antidegradation"++	260	3.5	802.21	
Chino - East	730	10.0	802.21	801.27
Chino - South	680	4.2	802.21	801.26
Cucamonga "maximum benefit"++	420	5.0	801.24	801.21
Cucamonga "antidegradation"++	210	2.4	801.24	801.21
Lytle	260	1.5	801.41	801.42
Rialto	230	2.0	801.41	801.42
San Timoteo "maximum benefit"++	370	5.0	801.62	
San Timoteo "antidegradation"++	300	2.7	801.62	
Yucaipa "maxium benefit"++	370	5.0	801.61	
Yucaipa "antidegradation"++	320	4.2	801.61	
MIDDLE SANTA ANA RIVER BASIN				
Arlington	980	10.0	801.26	
Bedford**	--	--	801.32	
Coldwater	380	1.5	801.31	
Elsinore	480	1.0	802.31	
Lee Lake**	--	--	801.34	
Riverside - A	560	6.2	801.27	
Riverside - B	290	7.6	801.27	
Riverside - C	680	8.3	801.27	
Riverside - D	810	10.0	801.27	
Riverside - E	720	10.0	801.27	
Riverside - F	660	9.5	801.27	
Temescal	770	10.0	801.25	

* Additional objectives for Garner Valley: Hardness 100 mg/L; Sodium 65 mg/L; Chloride 30 mg/L; Sulfate 40

** Numeric objectives not established; narrative objectives apply

++ "maximum benefit" objectives apply unless Regional Board determines that lowering of water quality is no of maximum benefit to the people of the state; "antidegradation" objectives then would apply.

Groundwater recharge is a potential year-round use of recycled water in the area. This alternative must consider Title 22 guidelines such as required times (12 months) prior to withdrawal, blending ratios (20% recycled water, 80% natural groundwater), and setback requirements (injection/recharge points one mile away from potable wells). Total organic carbon concentrations must also be met, and the recharge of groundwater would likely require demineralization prior to injection/recharge to meet these.

The use of recycled water (RWQCP effluent), ranging TDS ranges between 515 to 540 mg/L, may not allowed to be used in certain groundwater management zones (sub basins which out demonstration to the RWQCB that it will not degrade the ground water quality. Under similar conditions, the RWQCB has required Salt Balance Study by qualified professional to demonstrate no impact on the ground water. This master planning efforts considers that the City will be eventually able to use the RWQCP effluent for the potential users located in these sub basins, thus such users are not precluded from this study.

Groundwater modeling would be required to determine impacts to and protection of beneficial guidelines. Long-term groundwater monitoring would likely be required as part of the alternative. Groundwater recharge would be the ideal alternative to compensate for the wide variation in recycled water availability at the RWQCP. When agricultural and turf irrigation demands are lowest (winter time), recharge of the groundwater can be implemented to its fullest extent, and it can be minimized during summer months when demands are high.

2.6 CALIFORNIA WATER RECYCLING AND REUSE CRITERIA

2.6.1 Treatment Requirements

The California Department of Health Services (DHS) has determined that recycled water should be essentially free of pathogenic organisms. DHS specifies treatment processes (secondary treatment, filtration, and disinfection), operational requirements (filtration rates, chlorine contact time, etc.), and water quality parameters (turbidity and coliform organisms) that have been demonstrated to result in the production of water of the desired quality.

2.6.2 Water Quality Monitoring

Water quality monitoring is a very prominent issue during development of reuse standards or guidelines. Monitoring decisions include selection of water quality parameters, numerical limits, sampling frequency, and the monitoring compliance point. Important issues include the need to monitor for viruses and the appropriate parameter for measurement of particulates. It would be impractical to monitor recycled water for all of the toxic chemicals and pathogenic organisms of concern, and surrogate parameters are universally accepted.

The state of California has comprehensive regulations (Title 22 and Title 17 Requirements) and prescribes requirements according to the end use of the water. The California reuse criteria include requirements for treatment reliability that address standby power supplies, alarm systems, multiple or standby treatment process units, emergency storage or disposal of inadequately treated wastewater, elimination of

treatment process bypassing, monitoring devices and automatic controllers, and flexibility of design.

California is in the process of revising its comprehensive regulations and reuse criteria. The most recent draft criteria are presented in **Table 2-4** (non-potable reuse) and **Table 2-5** (potable reuse via groundwater recharge).

Table 2-4
California Treatment and Quality Criteria[a] for Nonpotable Uses of Recycled Water (1)

Type of Use	Total Coliform Limits [b]	Treatment Required
Irrigation of fodder, fiber, & seed crops, orchards and vineyards[c], and processed food crops; Flushing sanitary sewers	None required	Secondary
Irrigation of pasture for milking animals, landscape areas[d], omamental nursery stock, and sod farms; Landscape impoundments; Industrial or commercial cooling water where no mist is created; Nonstructural fire fighting; Industrial boiler feed; Soil compaction; Dust control; Cleaning roads, sidewalks, and outdoor areas	23/100 mL	Secondary & disinfection
Surface irrigation of food crops; restricted landscape impoundments	2.2/100 mL	Secondary & disinfection
Irrigation of food crops[e] and open access landscape areas[f] Nonrestricted recreational impoundments; Toilet and urinal flushing; Industrial process water; Decorative fountains; Commercial laundries; Snow making; Structural fire fighting; Industrial or commercial cooling where mist is created	2.2/100 mL	Secondary Coagulation[g], filtration[h], & disinfection

[a] Includes proposed revisions.
[b] Based on running 7-day median.
[c] No contact between recycled water and edible portion of crop.
[d] Cemeteries, freeway landscaping, restricted access golf courses, and other controlled access irrigation areas.
[e] Contact between recycled water and edible portion of crop; includes edible root crops.
[f] Parks, playgrounds, schoolyards, residential landscaping, unrestricted access golf courses, and other uncontrolled access irrigation areas.
[g] Not required if the turbidity of the influent to the filters does not exceed 5 NTU more than 5 percent of the time.
[h] The turbidity of filtered effluent cannot exceed a daily average of 2 nephelometric turbidity units (NTU).
(1) *Source Reference: (State of California. 1998. Draft Water Recycling Criteria. California Department of Health Services, Drinking Water Program, Sacramento, California)*

Table 2-5
Proposed California Groundwater Recharge Criteria (1)

Treatment and Recharge Site Requirements	Project Category[a] I	II	III
Required treatment			
Secondary	X[b]	X	X
Filtration	X	X	X
Disinfection	X	X	X
Organics removal	X		X
Water Quality Limits	Drinking water standards except nitrogen, 10 mg/L total nitrogen, & 1 mg/L TOC of wastewater origin in extracted water		
Maximum allowable recycled water in extracted well water (%)	50	20	50
Depth to groundwater at initial percolation rate of:			
<0.5 cmlmin (<0.2 in/min)	3 m (10 ft)	3 m (10 ft)	n.a.[c]
<0.8 cm/min (<0.3 in/min)	6 m (20 ft)	6 m (20 ft)	n.a.[c]
Minimum retention time underground (months)	6	6	12
Horizontal separation	150m (500 ft)	150m (500 ft)	600m (2000 ft)

[a] Categories I and II, are for surface spreading projects. Category III is for injection projects.
[b] X means that the treatment process is required.
[c] Not applicable.
[d] From edge of recharge operation to the nearest potable water supply well.

(1) *Source: Reference (State of California. 1999. Draft Proposed Groundwater Recharge Regulation. California Department of Health Services, Division of Drinking Water, Sacramento, California)*

2.7 TITLE 22 CRITERIA - DEPARTMENT OF HEALTH AND SAFETY

California recognizes the importance of recycling water to meet the overall water demand, as backed by Resolution No. 77-1, State Board's Policy with Respect to Water Reclamation in California, and specifically addressed in the California Water Code, Sections 13575 and 13577. As California's demand for water continues to increase, so will the demand for and the necessity to recycle wastewater effluent from water reclamation facilities throughout the state.

The DHS establishes water quality standards and treatment reliability criteria for water recycling under Title 22, Chapter 4, of the California Code of Regulations (Title 22), and in Title 17, Division 1, Chapter 5, Group 4, Article 1, and Section 7604 (Title 17). Requirements for recycled water use in California, not described in Title 22, are considered and approved by DHS on a case-by-case basis.

Title 22 sets bacteriological water quality standards based on the expected degree of public contact with recycled water.

For water reuse applications with a high potential for the public to come in contact with the recycled water, Title 22 requires disinfected tertiary treatment.

For applications with lower potential for public contact, Title 22 requires three levels of secondary treatment, differing by the amount of disinfection required.
In addition to establishing recycled water quality standards, Title 22 specifies the reliability and redundancy for each recycled water treatment and use operation.

Title 17 provides protection against cross-connections between potable water systems and recycled water systems.

2.7.1 Proposed Title 22 Regulations Changes

California DHS issued the latest versions of both Title 17 and 22 on August 30, 1999 for public comment prior to formal adoption. The significant pending changes to Title 22 tertiary water treatment standards are with respect to the disinfection and filtration processes. These proposed changes are described as follows:

Section 60301.230, Disinfected Tertiary Recycled Water.

The chlorine disinfection process to achieve a 2.2 MPN (Maximum Probable Number) would require a "CT" (chlorine dosage times time, milligrams-minutes/liter) of not less than 450 at all times with a modal contact time of at least 90 minutes, based on peak dry weather flow. The current criterion requires a 2 hour detention time at plant maximum flow rate.

The combined disinfection/filtration process must also achieve 99.999 percent removal of the plaque-forming units of F-specific bacteriophage MS2, or polio virus in the recycled water. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration. This proposed requirement allows alternative disinfection processes, in combination with conventional filtration (chemical coagulation, clarification prior to filtration) and direct filtration alternatives that reliably meet the virus removal criteria.

Section 60301.320, Filtered Wastewater.

The filtration requirement recognizes direct filtration as an acceptable alternative, and now lists microfiltration, ultrafiltration, nanofiltration and reverse osmosis as alternative means of filtration.

2.7.2 Key Title 22 Requirements

2.7.2.1 Water Recycling Potential Uses Requirements (Title 22 – Article 3)

A. Use of Recycled Water for Irrigation (*Ref. Title 22 Code Section - §60304*)

(a) Recycled water used for the surface irrigation of the following shall be a disinfected tertiary recycled water, except that for filtration pursuant to Section 60301.320(a) coagulation need not be used as part of the treatment process provided that the filter effluent turbidity does not exceed 2 NTU, the turbidity of the influent to the filters is

continuously measured, the influent turbidity does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU, and that there is the capability to automatically activate chemical addition or divert the wastewater should the filter influent turbidity exceed 5 NTU for more than 15 minutes:

(1) Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop,

(2) Parks and playgrounds,

(3) School yards,

(4) Residential landscaping,

(5) Unrestricted access golf courses, and

(6) Any other irrigation use not specified in this section and not prohibited by other sections of the California Code of Regulations.

(b) Recycled water used for the surface irrigation of food crops where the edible portion is produced above ground and not contacted by the recycled water shall be at least disinfected secondary-2.2 recycled water.

(c) Recycled water used for the surface irrigation of the following shall be at least disinfected secondary-23 recycled water:

(1) Cemeteries,

(2) Freeway landscaping,

(3) Restricted access golf courses,

(4) Ornamental nursery stock and sod farms where access by the general public is not restricted,

(5) Pasture for animals producing milk for human consumption, and

(6) Any nonedible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground or school yard

(d) Recycled wastewater used for the surface irrigation of the following shall be at least undisinfected secondary recycled water:

(1) Orchards where the recycled water does not come into contact with the edible portion of the crop,

(2) Vineyards where the recycled water does not come into contact with the edible portion of the crop,

(3) Non food-bearing trees (Christmas tree farms are included in this category provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting or allowing access by the general public),

(4) Fodder and fiber crops and pasture for animals not producing milk for human consumption,

(5) Seed crops not eaten by humans,

(6) Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans, and

(7) Ornamental nursery stock and sod farms provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting, retail sale, or allowing access by the general public.

(e) No recycled water used for irrigation, or soil that has been irrigated with recycled water, shall come into contact with the edible portion of food crops eaten raw by humans unless the recycled water complies with subsection (a).

B. Use of Recycled Water for Impoundments (*Ref. Title 22 Code Section - §60305*)

(a) Except as provided in subsection (b), recycled water used as a source of water supply for nonrestricted recreational impoundments shall be disinfected tertiary recycled water that has been subjected to conventional treatment.

(b) Disinfected tertiary recycled water that has not received conventional treatment may be used for nonrestricted recreational impoundments provided the recycled water is monitored for the presence of pathogenic organisms in accordance with the following:

(1) During the first 12 months of operation and use the recycled water shall be sampled and analyzed monthly for Giardia, enteric viruses, and Cryptosporidium. Following the first 12 months of use, the recycled water shall be sampled and analyzed quarterly for Giardia, enteric viruses, and Cryptosporidium. The ongoing monitoring may be discontinued after the first two years of operation with the approval of the department. This monitoring shall be in addition to the monitoring set forth in section 60321.

(2) The samples shall be taken at a point following disinfection and prior to the point where the recycled water enters the use impoundment. The samples shall be analyzed by an approved laboratory and the results submitted quarterly to the regulatory agency.

(c) The total coliform bacteria concentrations in recycled water used for nonrestricted recreational impoundments, measured at a point between the disinfection process and the point of entry to the use impoundment, shall comply with the criteria specified in section 60301.230 (b) for disinfected tertiary recycled water.

(d) Recycled water used as a source of supply for restricted recreational impoundments and for any publicly accessible impoundments at fish hatcheries shall be at least disinfected secondary-2.2 recycled water.

(e) Recycled water used as a source of supply for landscape impoundments that do not utilize decorative fountains shall be at least disinfected secondary-23 recycled water.

C. Use of Recycled Water for Cooling (*Ref. Title 22 Code Section - §60306*)

(a) Recycled water used for industrial or commercial cooling or air conditioning that involves the use of a cooling tower, evaporative condenser, spraying or any mechanism that creates a mist shall be a disinfected tertiary recycled water.

(b) Use of recycled water for industrial or commercial cooling or air conditioning that does not involve the use of a cooling tower, evaporative condenser, spraying, or any mechanism that creates a mist shall be at least disinfected secondary-23 recycled water.

(c) Whenever a cooling system, using recycled water in conjunction with an air conditioning facility, utilizes a cooling tower or otherwise creates a mist that could come into contact with employees or members of the public, the cooling system shall comply with the following:

(1) A drift eliminator shall be used whenever the cooling system is in operation.

(2) A chlorine, or other, biocide shall be used to treat the cooling system recirculating water to minimize the growth of Legionella and other micro-organisms.

D. Use of Recycled Water for Other Purposes. (*Ref. Title 22 Code Section - §60307*)

(a) Recycled water used for the following shall be disinfected tertiary recycled water, except that for filtration being provided pursuant to Section 60301.320(a) coagulation need not be used as part of the treatment process provided that the filter effluent turbidity does not exceed 2 NTU, the turbidity of the influent to the filters is continuously measured, the influent turbidity does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU, and that there is the capability to automatically activate chemical addition or divert the wastewater should the filter influent turbidity exceed 5 NTU for more than 15 minutes:

(1) Flushing toilets and urinals,

(2) Priming drain traps,

(3) Industrial process water that may come into contact with workers,

(4) Structural fire fighting,

(5) Decorative fountains,

(6) Commercial laundries,

(7) Consolidation of backfill around potable water pipelines,

(8) Artificial snow making for commercial outdoor use, and

(9) Commercial car washes, including hand washes if the recycled water is not heated, where the general public is excluded from the washing process.

(b) Recycled water used for the following uses shall be at least disinfected secondary-23 recycled water:

(1) Industrial boiler feed,

(2) Nonstructural fire fighting,

(3) Backfill consolidation around nonpotable piping,

(4) Soil compaction,

(5) Mixing concrete,

(6) Dust control on roads and streets,

(7) Cleaning roads, sidewalks and outdoor work areas and

(8) Industrial process water that will not come into contact with workers.

(c) Recycled water used for flushing sanitary sewers shall be at least undisinfected secondary recycled water.

2.7.2.2 Recycled Water Use Area Requirements (Title 22 -Article 4)

(a) No irrigation with disinfected tertiary recycled water shall take place within 50 feet of any domestic water supply well unless all of the following conditions have been met:

(1) A geological investigation demonstrates that an aquitard exists at the well between the uppermost aquifer being drawn from and the ground surface.

(2) The well contains an annular seal that extends from the surface into the aquitard.

(3) The well is housed to prevent any recycled water spray from coming into contact with the wellhead facilities.

(4) The ground surface immediately around the wellhead is contoured to allow surface water to drain away from the well.

(5) The owner of the well approves of the elimination of the buffer zone requirement.

(b) No impoundment of disinfected tertiary recycled water shall occur within 100 feet of any domestic water supply well.

(c) No irrigation with, or impoundment of, disinfected secondary-2.2 or disinfected secondary-23 recycled water shall take place within 100 feet of any domestic water supply well.

(d) No irrigation with, or impoundment of, undisinfected secondary recycled water shall take place within 150 feet of any domestic water supply well.

(e) Any use of recycled water shall comply with the following:

(1) Any irrigation runoff shall be confined to the recycled water use area, unless the runoff does not pose a public health threat and is authorized by the regulatory agency.

(2) Spray, mist, or runoff shall not enter dwellings, designated outdoor eating areas, or food handling facilities.

(3) Drinking water fountains shall be protected against contact with recycled water spray, mist, or runoff.

(f) No spray irrigation of any recycled water, other than disinfected tertiary recycled water, shall take place within 100 feet of a residence or a place where public exposure could be similar to that of a park, playground, or school yard.

(g) All use areas where recycled water is used that are accessible to the public shall be posted with signs that are visible to the public, in a size no less than 4 inches high by 8 inches wide, that include the following wording: “RECYCLED WATER - DO NOT DRINK”. Each sign shall display an international symbol similar to that shown in figure 60310-A. The Department may accept alternative signage and wording, or an

educational program, provided the applicant demonstrates to the Department that the alternative approach will assure an equivalent degree of public notification.

(h) Except as allowed under section 7604 of title 17, California Code of Regulations, no physical connection shall be made or allowed to exist between any recycled water system and any separate system conveying potable water.

(i) The portions of the recycled water piping system that are in areas subject to access by the general public shall not include any hose bibs. Only quick couplers that differ from those used on the potable water system shall be used on the portions of the recycled water piping system in areas subject to public access.

2.7.2.3 Dual Plumbed Recycled Water Systems Requirements (Title 22 - Article 5)

(a) No person other than a recycled water agency shall deliver recycled water to a dual-plumbed facility.

(b) No recycled water agency shall deliver recycled water for any internal use to any individually-owned residential units including free-standing structures, multiplexes, or condominiums.

(c) No recycled water agency shall deliver recycled water for internal use except for fire suppression systems, to any facility that produces or processes food products or beverages. For purposes of this Subsection, cafeterias or snack bars in a facility whose primary function does not involve the production or processing of foods or beverages are not considered facilities that produce or process foods or beverages.

(d) No recycled water agency shall deliver recycled water to a facility using a dual plumbed system unless the report required pursuant to section 13522.5 of the Water Code, and which meets the requirements set forth in section 60314, has been submitted to, and approved by, the regulatory agency.

2.7.2.4 Groundwater Recharge. (Title 22- Article 5)

Reclaimed water used for groundwater recharge of domestic water supply aquifers by surface spreading shall be at all times of a quality that fully protects public health. The State Department of Health Services' recommendations to the Regional Water Quality Control Boards for proposed groundwater recharge projects and for expansion of existing projects will be made on an individual case basis where the use of reclaimed water involves a potential risk to public health.

(a) The State Department of Health Services' recommendations will be based on all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal.

(b) The State Department of Health Services will hold a public hearing prior to making the final determination regarding the public health aspects of each groundwater recharge project. Final recommendations will be submitted to the Regional Water Quality Control Board in an expeditious manner.

2.8 TITLE 17 REQUIREMENTS

Title 17 of the California Administrative Code establishes regulations relating to cross-connections of potable and non-potable water systems to ensure safety of public health. The regulations require a cross-connection control program whereby the public water supply is protected from contamination.

In effect, the requirements state that connections to a domestic water system must be isolated from the recycled water main by an air gap, a reduced pressure principle device or a double check valve assembly. Title 17 regulations disallow direct connection between any system or facility delivering recycled water and the domestic water system.

2.8.1 Protection of Water System (Title 17- Article 2)

2.8.1.1 Approval of Backflow Preventers (*Ref. Title 17 Code Section* 7601)

(a) Air-gap Separation. An Air-gap separation (AG) shall be at least double the diameter of the supply pipe, measured vertically from the flood rim of the receiving vessel to the supply pipe; however, in no case shall this separation be less than one inch.

(b) Double Check Valve Assembly. A required double check valve assembly (DC) shall, as a minimum, conform to the AWWA Standard C506-78 (R83) adopted on January 28, 1978 for Double Check Valve Type Backflow Preventive Devices which is herein incorporated by reference.

(c) Reduced Pressure Principle Backflow Prevention Device. A required reduced pressure principle backflow prevention device (RP) shall, as a minimum, conform to the AWWA Standard C506-78 (R83) adopted on January 28, 1978 for Reduced Pressure Principle Type Backflow Prevention Devices which is herein incorporated by reference.

2.8.1.2 Location of Backflow Preventers (*Ref. Title 17 Code Section* 7603)

(a) Air-gap Separation. An air-gap separation shall be located as close as practical to the user's connection and all piping between the user's connection and the receiving tank shall be entirely visible unless otherwise approved in writing by the water supplier and the health agency.

(b) Double Check Valve Assembly. A double check valve assembly shall be located as close as practical to the user's connection and shall be installed above grade, if possible, and in a manner where it is readily accessible for testing and maintenance.

(c) Reduced Pressure Principle Backflow Prevention Device. A reduced pressure principle backflow prevention device shall be located as close as practical to the user's connection and shall be installed a minimum of twelve inches (12”) above grade and not more than thirty-six inches (36”) above grade measured from the bottom of the device and with a minimum of twelve inches (12”) side clearance.

2.8.1.3 Type of Protection Required (*Ref. Title 17 Code Section* 7604)

The type of protection that shall be provided to prevent backflow into the public water supply shall be commensurate with the degree of hazard that exists on the consumer's

premises. The type of protective device that may be required (listed in an increasing level of protection) includes: Double Check Valve Assembly-(DC), Reduced Pressure Principle Backflow Prevention Device-(RP), and an Air-gap Separation-(AG). The water user may choose a higher level of protection than required by the water supplier. The minimum types of backflow protection required to protect the public water supply, at the water user's connection to premises with various degrees of hazard are given in Table 1. Situations which are not covered in Table 1 shall be evaluated on a case-by-case basis and the appropriate backflow protection shall be determined by the water supplier or health agency.

SECTION 3
RECYCLED WATER QUALITY AND QUANTITY

This section describes the City's Regional Water Quality Control Plant (RWQCP) ownership, effluent quantity and quality, basin quality objectives, comparison between RWQCP final effluent and recycled water regulatory requirements.

3.1 REGIONAL WATER QUALITY CONTROL PLANT

RWQCP is a municipal wastewater treatment plant operated by the City. The plant is located on a 121 acre site at 5950 Acorn Street in the City, south of the Santa Ana River, near the intersection of Van Buren Boulevard and Jurupa Avenue. It started operation in 1946 as a small primary treatment plant and has gone through several major upgrades. The RWQCP is currently designed and permitted to treat 40 million gallons per day (mgd) of wastewater.

The City completed construction of the first phase of the Hidden Valley Wetlands Enhancement Project (HVWEP) in March 1995. The HVWEP has been expanded to include an educational pond and other ponds. Approximately 100 acres of constructed wetlands are being used for additional wastewater treatment (nitrogen removal) from the RWQCP final effluent.

Process Description

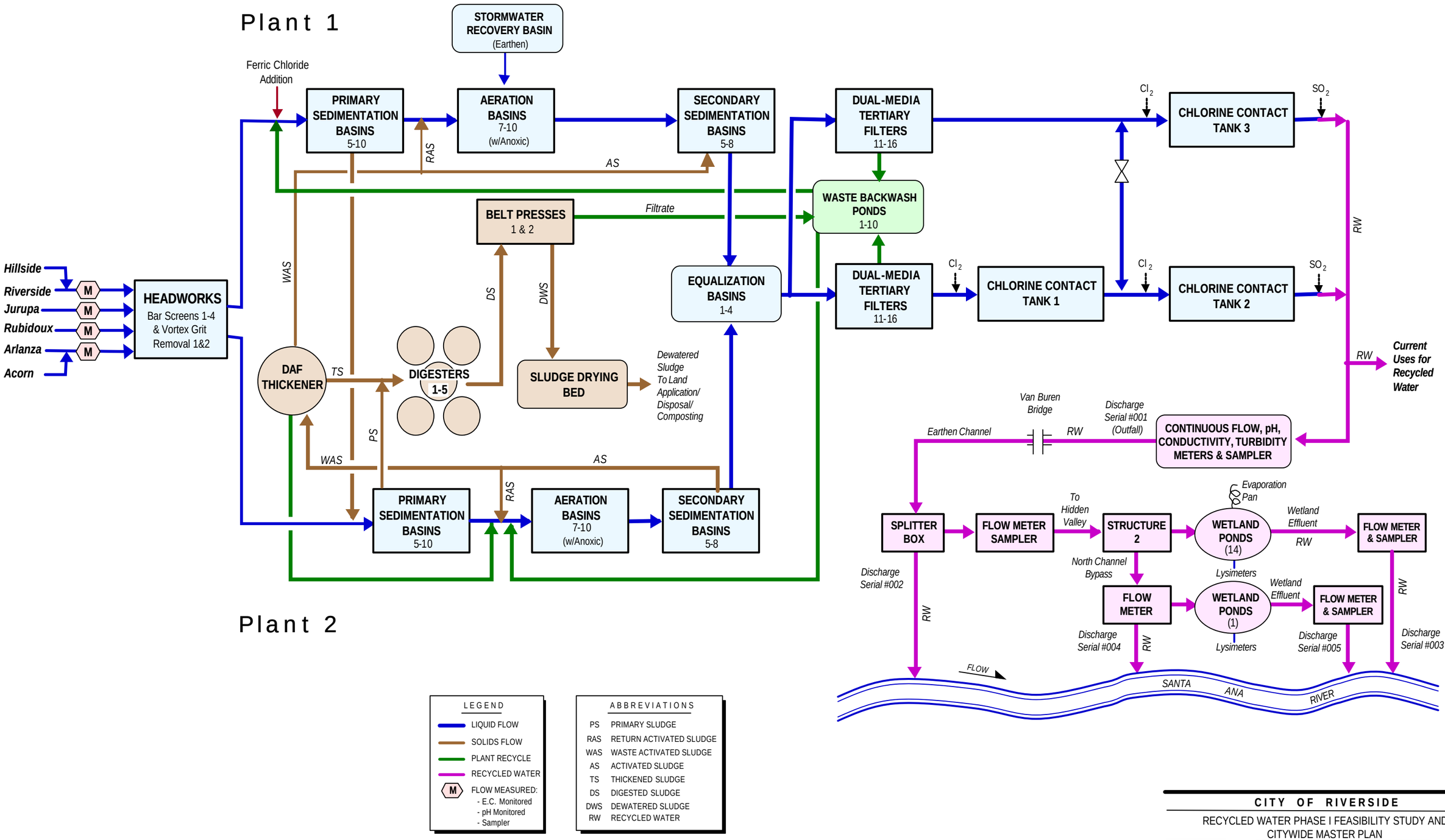
The RWQCP treats wastewater from the following agencies that have contractual agreements with the City: Jurupa Community Services District (JCSD), Rubidoux Community Services District (RCSD), Western Municipal Water District (WMWD) and Edgemont Community Services District (ECSD).

Influents to the RWQCP are metered at a common headworks structure consisting of bar screens and vortex grit removal (Pista Grit System). Effluent from the headworks is proportionately channeled to Plant 1 and Plant 2 consisting of primary clarifiers, aeration tanks, and secondary clarifiers.

Plant 1 and 2 flows are combined in equalization basins prior to tertiary treatment. Tertiary treatment consists of a chemical feed system, dual media filtration (16 filters), chlorination (3 chlorine contact tanks), and dechlorination by sulfur dioxide (SO_2).

The RWQCP discharges tertiary treated wastewater to Reach 3 of the Santa Ana River. Final effluent is conveyed through an earthen channel in the Santa Ana River basin to the HVWEP. Partial flow of approximately 19 mgd is discharged to the Santa Ana River just before the HVWEP; about 13 mgd of flow is directed through the HVWEP for further nitrogen removal.

A schematic diagram of the treatment process of the City's RWQCP is shown in **Figure 3-1**.



CITY OF RIVERSIDE

RECYCLED WATER PHASE I FEASIBILITY STUDY AND CITYWIDE MASTER PLAN

Figure 3-1 Riverside Water Quality Control Plant Process Flow Schematic

3.2 SANTA ANA RIVER DISCHARGE/NPDES PERMIT REQUIREMENTS

The Santa Ana River is an effluent dominated natural stream that provides water for recreation and for aquatic and wildlife habitat. River flows are also a significant source of groundwater recharge (approximately 70% of total recharge) in the lower basin, which provides domestic supplies for more than two million people.

The National Pollution Discharge Elimination System (NPDES) permit for discharge into Santa Ana River requires secondary treatment, virus control, in-line coagulation and filtration and improved disinfection (or their equivalents) for all wastewater discharges in order to protect the health of the people who used the Santa Ana River for contact recreation. Control of inorganic nitrogen levels in discharged water is also required to protect the aquatic habitat from un-ionized ammonia toxicity and to manage nitrate levels in groundwater for subsequent municipal uses. Control on residual chlorine levels in discharges is also a requirement of the NPDES permit.

3.2.1 Current NPDES Permit Requirements

The tertiary effluent from RWQCP is discharged into Santa Ana River at two discharge points – before and after the HVWEP. Both discharges are regulated by the recently adopted (January 2001) Santa Ana Regional Water Quality Control Board (RWQCB) Order No. 01-3 replacing Order No. 95-18, NPDES No. CA0105350. This Order is based on the plant's current design rating of 40 mgd ADWF. Copy of the referred NPDES permit is enclosed, as **Appendix A.** Effluent quality standards require tertiary treatment with filters and disinfection equivalent to Title 22 requirements for recycled water, due to the use of receiving waters for water contact recreation.

A summary of the main effluent quality limits is provided in **Table 3-1.**

3.2.2 Future NPDES Permit Requirements

The TIN limits at RWQCP are expected to be reduced to perhaps as low as 8 to 10 mg/L at the conclusion of the Santa Ana River TIN/TDS Study in the near future. Section 2.5 "Regional Board/Local Requirements" of this report discussed more in detail current status of the TIN/TDS study and anticipated TDS and NO3-N limits for groundwater subbasins.

Irrigation with recycled water must be performed in a manner that will ensure the groundwater quality objectives for TIN are met. The City of Riverside as the applicant must demonstrate that the application rates for recycled water do not exceed the plant nitrogen uptake. This will prevent nitrogen from migrating to the groundwater.

Table 3-1
Summary of Key NPDES Effluent Requirements

Parameter	Weekly Average	Monthly Average	Annual Average	Daily Max.	Notes
BOD	30 mg/L	20 mg/L	-	-	
TSS	30 mg/L	20 mg/L	-	-	
NH_4-N	-	5.0 mg/L	-	-	
Chlorine Residual	-	-	-	0.1 mg/L	Instantaneous max, ceiling 2 mg/L
TIN	-	-	10 mg/L 13 mg/L	-	For flow > 38 MGD For flow < 38 MGD
TDS	-	-	650 mg/L	-	250 mg/L incremental limit
Turbidity	-	-	-	-	Daily avg. 2 NTU 5 NTU for 5% of the time during any 24 hours
Coliform	< 2.2 MPN	-	-	-	Max. 23 MPN, once per mo.
pH	-	-	-	6.5-8.5	99% compliance
- not specified					

3.3 RECYCLED WATER - QUANTITY AND AVAILABILITY

3.3.1 Current And Future Availability Of Recycled Water

The RWQCP is currently producing about 32 mgd of recycled water on an annual average basis, while it is designed and permitted to produce up to 40 mgd of recycled water. The RWQCP is master planed for ultimate capacity of 60 mgd. Thus, with the growth in population, the availability of recycled water is likely to go up to 40 mgd in the near future and 60 mgd ultimately.

3.3.2 Santa Ana River Flow Contribution Requirements – Prado Dam Settlement

In support of the Prado Settlement, an agreement between the Western Municipal Water District (WMWD) and the City on November 30 1968, obligated an annual discharge of 15,5250 acre feet (13.38 mgd) from the RWQCP for maintenance of base flows at the Prado Dam. The volume may be slightly reduced by quality and credit adjustments.

The City delivers more effluent than is required under this agreement. It may, in any given year, reduce its adjusted contribution by the amount of such excess deliveries, but in no event shall the City's adjusted contribution be less than 13,420 AFY (11.78 mgd on annual average basis).

However, if the minimum obligations under the Prado Settlement are lowered to 34,000 AFY, then the 13,420 AFY shall be reduced to 12,420 AFY (10.88 mgd on annual average basis). Please note that the City has the option to discharge more during rainy days than during peak demand days.

A copy of the referenced agreement is provided in **Appendix B.**

3.3.3 Hidden Valley Wetlands Enhancement Project

The HVWEP consisting of several unlined wetlands ponds, Treats about 13 mgd of the RWQCP final effluent for further nitrogen removal. Nitrogen is removed by plant uptake. About 3 mgd of water is lost to evaporation and seepage. Therefore, about 10 mgd of the wetlands final effluent joins the Santa Ana River through surface flow. The City could pump this water for non-potable uses, but may prefer to leave it in the Santa Ana River to meet obligations related to Prado Settlement.

3.3.4 Recycled Water Availability for Non-Potable Uses

In summary, currently about 32 mgd of recycled water is available for both non-potable uses and ground water recharge.

Considering the City's obligations associated with the Prado Settlement (maximum 13.38 mgd) and potential losses at the HVWEP (about 3 mgd), about 16 mgd on annual average basis is available for the non-potable water uses discussed in the following section of this master plan.

Considering the projected population growth in the RWQCP service area, including population growth in the City, Jurupa, Rubidox, and Edgemont communities, the recycled water availability is likely to grow with time. However, to be conservative this master plan has considered only 16 mgd available for non-potable water uses.

3.4 RWQCP EFFLUENT (RECYCLED WATER) QUALITY

The RWQCP produces high quality effluent, which consistently exceeds the Title 22 requirements. The final effluent is being used for water recycling and is suitable for additional recycled water uses.

Tables 3-2 through 3-5 summarize the major effluent quality parameters.

Table 3-2
2001 Annual Summary of Suspended Solids, BOD & COD Effluent Monitoring Data (1)

Parameter:	SusSolids	SusSolids	SusSolids	SusSolids	SusSolids	BOD	BOD	BOD	BOD	BOD	COD
Units:	mg/l	mg/l	lbs/day	lbs/day	% red	mg/l	mg/l	lbs/day	lbs/day	% red	mg/l
Limits	20	30	6,672	10,008	85	20	30	6,672	10,008	85	
	avg mnth	avg wkly	avg mnth	avg wkly		avg mnth	avg wkly	avg mnth	avg wkly		
Month	**MONTHLY AVERAGES**										
January	<2	<2	282	283	99.5	<2	<2	454	719	99.2	16
February	<2	<2	<533	<533	99.5	<2	<2	<533	<533	99.3	17
March	<2	<2	<533	<533	99.1	<2	<2	<533	<533	99.1	17
April	<2	<2	<533	<533	99.3	<2	<2	<533	<533	99.1	17
May	<2	<2	661	674	98.8	<2	<2	432	426	98.9	21
June	2	<2	609	553	98.9	2	<2	511	448	99.1	*
July	5	5	1225	1275	98.0	3	3	715	746	98.7	*
August	<2	<2	<518	<518	99.2	<2	<2	<518	<518	99.0	*
September	<2	<2	<568	<568	99.5	<2	<2	<568	<568	99.3	*
October	<2	<2	<576	<576	99.6	<2	<2	<576	<576	99.4	*
November	<2	<2	<572	<572	99.6	<2	<2	<572	<572	99.4	*
December	<2	<2	<564	<564	99.7	<2	<2	<564	<564	99.1	*
	ANNUAL SUMMARY										
Min	2	<2	0	37	95	<2	<2	241	264	98.2	10
Max	10	3	2,590	885	100	4	3	1,058	787	100.0	40
Avg	2.5	1	346	346	99.4	1.9	1.2	451	446	99.2	17
Violations	0	0	0	0	0	0	0	0	0	0	0

(1) Ref: RWQCP 2001 Annual Report

Table 3-2 (Continued)
2001 Annual Summary of Suspended Solids, BOD & COD Effluent Monitoring Data [1]

Parameter:	Flow	ECond	pH	pH	Cl2 Res	Turbidity	Turbidity	Coliform	Coliform	NH_3-N
Units:	MGD	µmhos/cm	SU	SU	mg/l	NTU	NTU	MPN	MPN	mg/l
Limits					0.1 max		>5	2.2		5
		mnthly avg	6.5 min	8.5 max	[99%]	2	[5%]	7D med max	23 max	avg mnthly
Month	**MONTHLY AVERAGES & MINIMUMS/MAXIMUMS OF pH & COLIFORM**									
January	**32.11**	**928**	**6.57**	**7.23**	**<.01**	**0.88**	**0**	**<2**	**4**	**0.20**
February	**32.84**	**920**	**6.71**	**7.17**	**<.01**	**0.63**	**0**	**<2**	**2**	**0.20**
March	**32.60**	**929**	**6.71**	**7.10**	**<.01**	**0.68**	**0**	**<2**	**23**	**0.20**
April	**31.78**	**923**	**6.68**	**8.32**	**<.01**	**0.77**	**0**	**<2**	**4**	**0.20**
May	**31.24**	**937**	**6.71**	**7.13**	**<.01**	**0.57**	**0**	**<2**	**2**	**0.30**
June	**31.21**	**921**	**6.76**	**7.27**	**<.01**	**0.50**	**0**	**<2**	**13**	**0.30**
July	**31.17**	**924**	**6.50**	**7.21**	**<.01**	**0.63**	**0**	**<2**	**2**	**0.13**
August	**31.05**	**919**	**6.84**	**7.24**	**<.01**	**0.45**	**0**	**<2**	**2**	**0.38**
September	**31.83**	**922**	**6.51**	**7.48**	**<.01**	**0.46**	**0**	**<2**	**2**	**0.60**
October	**32.46**	**917**	**6.62**	**7.16**	**<.01**	**0.46**	**0**	**<2**	**2**	**0.30**
November	**32.45**	**926**	**6.50**	**7.50**	**<.01**	**0.54**	**0**	**<2**	**23**	**0.38**
December	**31.60**	**960**	**6.50**	**7.00**	**<.01**	**0.76**	**0**	**<2**	**2**	**1.10**
	ANNUAL SUMMARY									
Min	**23.52**	**659**	**6.41**	**6.61**	**<.01**	**0.29**	**0**	**<2**	**2**	**<0.1**
Max	**38.96**	**990**	**7.36**	**8.32**	**1.88**	**1.52**	**0**	**2**	**23**	**3.9**
Avg	**31.85**	**928**	**6.82**	**7.03**	**0.02**	**0.61**	**0**	**<2**	**<2**	**0.08**
Tot	**11,626.23**									
Violations	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

(1) Ref: RWQCP 2001 Annual Report

Table 3-3
Potable Water - Weighted Average Constituent Concentrations (1)

12 MONTH AVE. DATA				1 MONTH AVERAGE DATA						
DATE	POTABLE WATER TDS	EFFLUENT TDS	INCREMENT	TDS	Cl	SO_4	HARD	Na	NO_3	B
01/01	331	531	200	322	30	54.1	176	37	20.5	0.084
02/01	332	524	192	340	33	56.4	187	40	22.6	0.083
03/01	332	518	186	327	31	55.4	179	39	20.4	0.083
04/01	329	515	186	317	29	56.6	179	38	20.4	0.078
05/01	330	515	185	328	30	54.1	189	40	23.0	0.080
06/01	329	516	186	326	31	53.2	188	38	23.3	0.085
07/01	329	513	184	326	31	52.9	187	39	23.5	0.079
08/01	329	518	189	328	31	53.4	190	39	23.8	0.078
09/01	329	521	192	332	31	54.6	189	39	23.1	0.078
10/01	330	524	194	334	31	54.2	189	39	23.2	0.077
11/01	330	527	197	328	30	57.3	183	39	21.5	0.081
12/01	328	532	204	332	32	57.8	185	41	20.3	0.082

(1) Ref: RWQCP 2001 Annual Report

Table 3-4
RWQCP Effluent Monitoring Part I

Constituent	12-month Avg-Limit (mg/l)	12-month Average (mg/l)	# Exceeded	12-month Avg Emission Rate Limit (lbs/day)	12-month Avg Emission Rate Value (lbs/day)
Total Filtrable Residue	650	531	0	216,840	140,629
Total Hardness	275	207	0	91,740	54,797
Chloride	140	88	0	46,704	23,342
Sodium	110	91	0	36,696	24,370
Sulfate	125	85	0	41,700	21,718
Boron	0.75	0.4	0	250	103
Fluoride	1	0.4	0	334	121
Barium	1	0.02	0	334	6
Iron	0.3	<0.10	0	100	<27
Manganese	0.05	<0.02	0	17	<5
Total Inorganic Nitrogen ***(Note 1)***	13	10.1	0	5,004	2,690

Table 3-5
RWQCP Effluent Monitoring on Part II

	Max Daily Limit (µg/l)	Max Daily Value (µg/l)	# Exceeded	Avg Monthly Limit (µg/l)	Avg Monthly Value (µg/l)	# Exceeded
Chromium (VI) *	16	<15	0	11	<15	0
Mercury	2.4	<0.5	0			
Selenium	20	<14	0	5	<14	0
Silver	13.1	<16	0			
Total Recoverable Cadmium	19	<15	0	4.4	<15	0
Total Recoverable Copper	84	22	0	53	19	0
Total Recoverable Lead	1040	<26	0	77	<26	0

	Daily Mass Rate Limit (lbs/day)	Max Daily Mass Rate (lbs/day)	# Exceeded	Avg Monthly Mass Rate Limit (lbs/day)	Avg Monthly Mass Rate (lbs/day)	# Exceeded
Chromium (VI) *	5	<3.8	0	4	<3.8	0
Mercury	0.8	<0.2	0			
Selenium	7	<3.6	0	2	<3.6	0
Silver	4	<4	0			
Total Recoverable Cadmium	6	<3.8	0	1	<3.8	0
Total Recoverable Copper	28	6	0	18	5	0
Total Recoverable Lead	347	<6.6	0	26	<6.6	0

Table 3-6
Effluent Monitoring on January 16, 2001

	Sample Date	Monthly Average (mg/l)	Daily Max (mg/l)	Sample Type
Total Organic Carbon	01/16/2001	7.7		Comp
Carbonate	01/16/2001	0		Comp
Bicarbonate	01/16/2001	150		Comp
Calcium	*		64	Comp
Magnesium	*		11.7	Comp
Specific Cond. in umhos/cm	CONTINUOUS	928	952	Cont
Ammonia nitrogen	*	0.2	Limit = 5.0 mg/l monthly avg	Grab

Table 3-7
Influent Monitoring on January 16, 2001

	Monthly Average		Daily Max		Daily Min	
Ammonia Nitrogen		mg/l	28.1	mg/l		
Total Inorganic N		mg/l	27.3	mg/l		
TDS	579	mg/l		mg/l		
Specific Conductivity	1163	umhos/cm	1242	umhos/cm		
pH			8.92	S.U.s	6.13	S.U.s

SECTION 4
RECYCLED WATER MARKET ANALYSIS

City of Riverside (City) prepared a Technical Memorandum on Water Reclamation (TM-2 of the 1992 Master Plan Update) in 1992 to establish the framework for a water recycling system. This section updates the recycled water market survey and assessment (Chapter 4 of TM-2) and includes any changes in demand, and addition/ deletion of potential users. The market analysis focuses on major potential users and their potential contribution to the Phase I project distribution system. The market assessment results will become the basis for the development of this report.

4.1 EXISTING RECYCLED WATER USES

The City currently serves recycled water from the Regional Water Quality Control Plant (RWQCP) to the following three existing users for landscape irrigation:

- Van Buren Golf Center (Sky Link Executive Golf Course)
- Toro Manufacturing Company
- Urban Forest

Table 4-1 summarizes the existing recycled water consumption (November 2001 data) and presents the estimated demands of these users. The estimated demands are approximately 290 acre-feet per year (AFY). The recycled water utilization by these users is anticipated to be stable and should not vary too much in the future. These existing users installed their own pipeline distribution system. The Van Buren Golf Center currently pays about $80/AF for golf course irrigation with recycled water. The Urban Forest irrigates landscape median twice a week on Van Buren/Jurupa (just before the Van Buren Bridge) therefore is not charged for recycled water usage. Toro Manufacturing Company uses recycled water for industrial processing and pays a lower rate of $6/AF.

Table 4-1
City of Riverside Existing Recycled Water Reuse
Recycled Water Usage in November 2001(1)

Facility	Maximum (gpd)	Minimum (gpd)	Average (gpd)	Estimated Demand (AFY)
Van Buren Golf Center (Sky Link Executive Golf Course)	335,000	14,000	173,373	195
Urban Forest	4,550	0	921	25(3)
Toro Manufacturing Company	---	---	62,488 (2)	70

(1) Information is from the RWQCP
(2) Estimated value based on telecom with Toro Manufacturing staff
(3) Including Van Buren Median & Frontage usage

4.2 POTENTIAL RECYCLED WATER USES

The Title 22 effluent produced from the RWQCP is suitable for a variety of reuses, including the following:

Landscape Irrigation

- Parks and recreation centers
- School yards and athletic fields
- Freeway medians and street median strips
- Golf courses
- Churches and cemeteries
- Areas around residential/commercial/industrial developments

Recreational Uses –

- Recreational impoundments
- Ornamental landscape uses and decorative water features (e.g. fountains, reflecting pools, waterfalls, etc.)

Agricultural Uses –

- Food crops
- Harvested feed, fiber and seed
- Orchards and vineyards
- Pasture, nursery and sod, etc.

Industrial/Commercial Uses –

- Industrial process water
- Cooling water
- Vehicle/window washing
- Mixing water for pesticides, herbicides, liquid fertilizers, etc.
- Dust control
- Concrete production
- Fire protection
- Other miscellaneous uses

There are many other potential uses for recycled water, as outlined in the Title 22 guidelines (**Table 4-2**). Many of the identified alternative uses are more occasional or intermittent in nature, such as dust control, fire fighting, flushing sewers, for example. Some uses can provide constant demands throughout the year, such as toilet flushing and groundwater recharge, if feasible for implementation.

Table 4-2

Recycled Water Uses Allowed* In California

This summary is prepared for WateReuse Association, from the December 2, 2000, Title-22 adopted Water Recycling Criteria, and supersedes all earlier versions.

Use of Recycled Water	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Irrigation of:				
Food crops where recycled water contacts the edible portion of the crop, including all root crops	Allowed	Not allowed	Not allowed	Not allowed
Parks and playgrounds	Allowed	Not allowed	Not allowed	Not allowed
School yards	Allowed	Not allowed	Not allowed	Not allowed
Residential landscaping	Allowed	Not allowed	Not allowed	Not allowed
Unrestricted-access golf courses	Allowed	Not allowed	Not allowed	Not allowed
Any other irrigation uses not prohibited by other provisions of the California Code of Regulations	Allowed	Not allowed	Not allowed	Not allowed
Food crops, surface-irrigated, above-ground edible portion, and not contacted by recycled water	Allowed	Allowed	Not allowed	Not allowed
Cemeteries	Allowed	Allowed	Allowed	Not allowed
Freeway landscaping	Allowed	Allowed	Allowed	Not allowed
Restricted-access golf courses	Allowed	Allowed	Allowed	Not allowed
Ornamental nursery stock and sod farms with unrestricted public access	Allowed	Allowed	Allowed	Not allowed
Pasture for milk animals for human consumption	Allowed	Allowed	Allowed	Not allowed
Nonedible vegetation with access control to prevent use as a park, playground or school yard	Allowed	Allowed	Allowed	Not allowed
Orchards with no contact between edible portion and recycled water	Allowed	Allowed	Allowed	Allowed
Vineyards with no contact between edible portion and recycled water	Allowed	Allowed	Allowed	Allowed
Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest	Allowed	Allowed	Allowed	Allowed
Fodder and fiber crops and pasture for animals not producing milk for human consumption	Allowed	Allowed	Allowed	Allowed
Seed crops not eaten by humans	Allowed	Allowed	Allowed	Allowed
Food crops undergoing commercial pathogen-destroying processing before consumption by humans	Allowed	Allowed	Allowed	Allowed
Ornamental nursery stock, sod farms not irrigated less than 14 day before harvest	Allowed	Allowed	Allowed	Allowed
Supply for impoundment:				
Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms	Allowed**	Not allowed	Not allowed	Not allowed
Restricted recreational impoundments and publicly accessible fish hatcheries	Allowed	Allowed	Not allowed	Not allowed
Landscape impoundments without decorative fountains	Allowed	Allowed	Allowed	Not allowed
Supply for cooling or air conditioning:				
Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist	Allowed***	Not allowed	Not allowed	Not allowed
Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist	Allowed	Allowed	Allowed	Not allowed

WateReuse Association 1 (916) 442-2746 www.watereuse.org/h2o

Table 4-2 (Continued)

Recycled Water Uses Allowed* In California

This summary is prepared for WateReuse Association, from the December 2, 2000, Title-22 adopted Water Recycling Criteria, and supersedes all earlier versions

Use of Recycled Water	Treatment Level			
	Disinfected Tertiary Recycled Water	Disinfected Secondary-2.2 Recycled Water	Disinfected Secondary-23 Recycled Water	Undisinfected Secondary Recycled Water
Other uses:				
Groundwater Recharge	**Allowed** under special case-by-case permits by RWQCBs****			
Flushing toilets and urinals	**Allowed**	Not allowed	Not allowed	Not allowed
Priming drain traps	**Allowed**	Not allowed	Not allowed	Not allowed
Industrial process water that may contact workers	**Allowed**	Not allowed	Not allowed	Not allowed
Structural fire fighting	**Allowed**	Not allowed	Not allowed	Not allowed
Decorative fountains	**Allowed**	Not allowed	Not allowed	Not allowed
Commercial laundries	**Allowed**	Not allowed	Not allowed	Not allowed
Consolidation of backfill material around potable water pipelines	**Allowed**	Not allowed	Not allowed	Not allowed
Artificial snow making for commercial outdoor uses	**Allowed**	Not allowed	Not allowed	Not allowed
Commercial car washes, not heating the water, excluding the general public from washing process	**Allowed**	Not allowed	Not allowed	Not allowed
Industrial process water that will not come into contact with workers	**Allowed**	**Allowed**	**Allowed**	Not allowed
Industrial boiler feed	**Allowed**	**Allowed**	**Allowed**	Not allowed
Nonstructural fire fighting	**Allowed**	**Allowed**	**Allowed**	Not allowed
Backfill consolidation around nonpotable piping	**Allowed**	**Allowed**	**Allowed**	Not allowed
Soil compaction	**Allowed**	**Allowed**	**Allowed**	Not allowed
Mixing concrete	**Allowed**	**Allowed**	**Allowed**	Not allowed
Dust control on roads and streets	**Allowed**	**Allowed**	**Allowed**	Not allowed
Cleaning roads, sidewalks and outdoor work areas	**Allowed**	**Allowed**	**Allowed**	Not allowed
Flushing sanitary sewers	**Allowed**	**Allowed**	**Allowed**	**Allowed**

* Refer to the full text of the December 2, 2000 version of Title-22: California Water Recycling Criteria. This chart is only an informal summary of the uses allowed in this version.

The complete and final 12/02/2000 version of the adopted criteria can be downloaded from : <http://www.dhs.ca.gov/ps/ddwem/publications/Regulations/recycling/rw_index.htm>

** With "conventional tertiary treatment". Additional monitoring for two years or more is necessary with direct filtration.

*** Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

**** Refer to Groundwater Recharge Guidelines, available from the California Department of Health Services.

Prepared by Bahman Sheikh and edited by EBMUD Office of Water Recycling, who acknowledge this is a summary and not the formal version of the regulations referenced above.

WateReuse Association 2 (916) 442-2746 www.watereuse.org/h2o

Toilet flushing with recycled water is becoming more prevalent in Southern California (e.g. Irvine Ranch Water District). However, dual plumbing with cross-connection prevention and backflow protection devices would be required to protect potable water. Therefore, this is generally implemented for new buildings. Retrofitting existing facilities for dual plumbing is costly and cumbersome. Similarly, it would require extensive geotechnical investigation to determine the feasibility of groundwater recharge projects. For the purpose of this study, only landscape irrigation, agricultural irrigation, recreational, commercial and industrial uses will be addressed in the market survey and assessment.

4.3 MARKET SURVEY

The market survey compiled for this project consist of major potential users within Phase I project boundary, which includes a 70 percent probability capture of the City users, as well as users in Jurupa Community Service District (JCSD) and Rubidoux Community Service District (RCSD) that are located around the City boundaries, as shown on **Figure 4-1**.

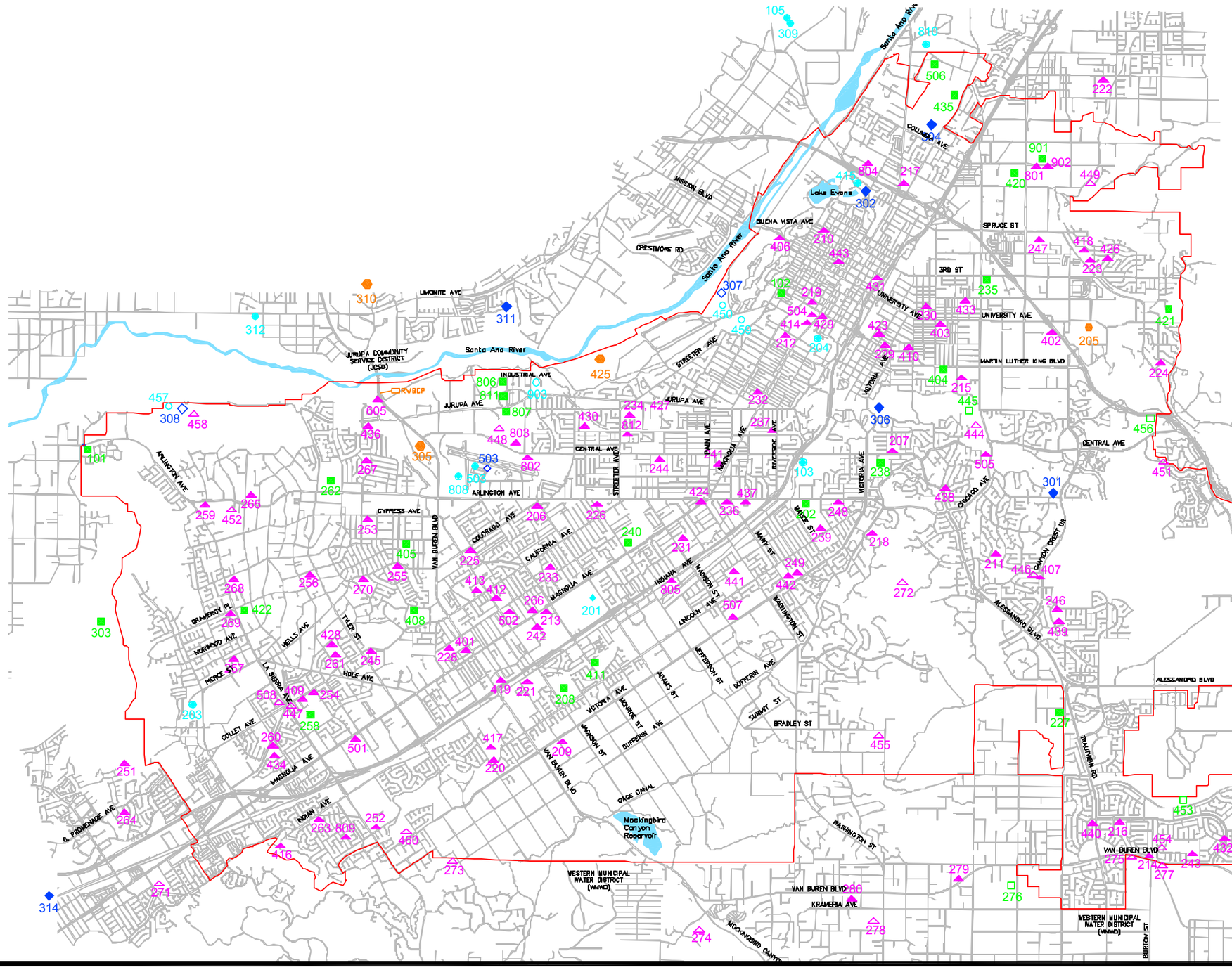
The City dictates that the market survey be limited within a two-mile radius of the RWQCP for the Phase I Feasibility Study. The major potential recycled water users were identified and compiled using information contained in the City's 1992 Master Plan Update TM-2, Thomas Bros. Maps, JCSD Indian Hills Water Recycling Project Report and field survey by Parsons.

Letters and questionnaire forms were sent to existing and potential recycled water users within the City to gather information to update projected demands and assess degree of future customer interest. It was anticipated that these identified users would have the most interest in the distribution systems developed in this study.

4.3.1 Classification of Potential Users

The market survey and assessment focuses on the users, which will significantly impact the recycled water distribution system alignment and project economic feasibility. In order to quantify and organize total potential demands, the users have been categorized as follows:

- **Major Potential Users.** Major users have a potential recycled water demand of 10 AFY or more. These users are the focus of the market survey since they represent the majority of potential reuse and dictate the alignment of the distribution system. Major potential users are further distinguished as existing or future consumers.
    - **Existing Facilities.** These users include facilities that are either currently in place or will be in business in the near-term. Near-term denotes facilities scheduled for development and water connection in the next five years. These facilities are typically in a construction or final planning stage.
    - **Future/Planned Facilities.** Accordingly, these users denote facilities in the preliminary or conceptual planning stage. Facility development will not occur in the next five years.



LEGEND

User Symbol Existing Facility	User Symbol Future Facility	Potential Reuse (Acre Feet / Year)
▲	△	10 – 49
■	□	50 – 99
●	○	100 – 199
◆	◇	200 – 399
⬢	⬡	400 Plus
		City of Riverside Boundary

GRAPHIC SCALE

0 6000' 12000'

SCALE: 1" = 6000'

N

FIGURE 4-1 POTENTIAL RECYCLED WATER USERS

CITY OF RIVERSIDE

RECYCLED WATER PHASE I FEASIBILITY STUDY AND CITYWIDE MASTER PLAN

SEPTEMBER 2003

- **Minor Potential Users.** Minor users include users with a potential recycled water demand less than 10 AFY. Minor users include small parks and schoolyards and small residential, commercial, and industrial landscape irrigation areas. Since minor users are prevalent throughout the City, they do not influence the alignment of the recycled water distribution system and are not specifically identified in this market survey. Furthermore, it may not be economically feasible to serve many minor users due to remoteness from major reuse areas or prohibitive on-site repiping costs for small industrial users. While minor industrial users are not included in the market assessment, some minor irrigation users near main recycled water transmission lines can be served. Therefore, the Market Assessment section of this chapter incorporates some potential minor irrigation consumption when assessing market demands.

4.3.2 Survey of Major Potential Users

A comprehensive market survey was conducted throughout the City to identify the potential major recycled water users. Many potential users were contacted to verify water consumption, estimate potential reuse, and assess the general sentiment on water recycling. As mentioned earlier, market survey was focused on the major users who could have a significant effect on distribution system alignment and project economics. The market survey involved data collection from the following categories:

Landscape Irrigation. This irrigation market includes cemeteries, universities, colleges, schools, golf courses, parks, hospitals, airports, sports complex, nursery, greenbelts, commercial, commercial and industrial users. An initial database of potential users was developed from the City's 1992 Master Plan Update (TM-2). The following sources provided information to update and expand user base and estimate potential demands:

- City of Riverside – Park & Recreation, Public Works, Public Utilities, and Planning Departments
- Riverside and Alvord Unified School Districts
- Contacts with major potential users
- Various reports
- City maps and Thomas Brothers Map Guide

Selected agencies representing cemeteries, universities, colleges, schools, parks, golf courses, hospitals, and industries were contacted to obtain information about their current water use and future potential recycled water uses.

Agricultural Irrigation. No market survey was conducted for the agricultural users. The City has substantial agricultural acreage, primarily orange groves, which are presently served by the Gage Canal, Riverside Canal and some potable wells. These users are ideal candidates for recycled water. The water pumped from various wells to the canal is currently distributed to agricultural users by Gage Canal Company at a relatively low rate. It may be the City's best interest to replace the potable quality water in the Gage Canal with recycled water to serve these sites in the future.

Agricultural irrigation is included in this market assessment for potential recycled water demand but is not considered for the development of the core distribution system and cost analysis.

Industrial. Several industries were contacted to obtain their potential interest in using recycled water for irrigation and/or processing water. Additional input from the RWQCP's Compliance and Monitoring Group was also obtained to update the reuse potential of those industries previously identified on the 1992 list.

Commercial. No specific information was available on potential commercial reuse. An estimate was generated for the market assessment based on the City's 1992 Master Plan Update, field survey, and previous experience.

4.3.3 User Codes and Classifications

Each major potential user was allocated a unique code number with the first digit corresponding to the type of facility (golf course, park, industry, etc.). Major potential users are categorized as shown in **Table 4-3** below.

Table 4-3
Potential Recycled Water User Code and Classification

Code	Description of Users
100 Series	Cemeteries
200 Series	Colleges, Universities, Schools
300 Series	Golf Courses
400 Series	Parks
500 Series	Miscellaneous (airport, nurseries, etc.)
600 Series	Freeway Irrigation and City Greenbelts
700 Series	Commercial
800 Series	Industrial - Landscape Irrigation
900 Series	Industrial - Process

Larger users are located and represented symbolically on the map figures of this report based on their potential reuse, as shown in **Table 4-4**.

Table 4-4
Symbolical Representation

Symbol	Potential Recylced Water Users (Acre Feet/Year)
▲	10 - 49
■	50 - 99
●	100 - 199
◆	200 - 399
⬢	400 or more

The potential users who currently exist or will be in business within the next 5 years are identified with solid colored symbols while future facilities are represented with hollow symbols. This procedure identifies general growth areas and facilitates distribution system layout, phasing and extensions.

4.4 MARKET ASSESSMENT

Data gathered in the market survey included existing and major potential recycled water users, type of recycled water use, specific water quality requirements, estimated demands and schedule of water usage for irrigated areas.

The following were steps undertaken to assess potential recycled water users market for the Phase I Project:

1. Evaluated several alternatives and identified Phase I project boundary based on major potential recycled water users around the vicinity of RWQCP.
2. Sent letters and recycled water user survey forms to potential users to verify and update demands.
3. Conducted field investigations within Phase I project boundary to ensure accuracy in demands of identified major potential users.
4. Developed understanding for on-site conversion needs from potable to recycled water.
5. Performed economical analysis on various alternatives to identify the most cost effective recommendation for the project.

4.4.1 Average Annual Demand

Tables 4-5, 4-6 and 4-7 summarize the average annual demand for the potential major recycled water users within the City, and along the northerly and southerly boundaries, respectively. Their ID code number, acreage (if available) and potential reuse volume are also included in these tables. Note that some of the schools within the Riverside and Alvord Unified School Districts are located outside of City limit (see Figure 4-1) but are grouped together with the other schools in Table 4-5.

The potential landscape irrigation demands are based on actual water consumption data if available. Otherwise, demand is calculated as 2.5 AFY per irrigated acre based on the findings of previous area studies. This multiplier was previously verified by an investigation of water consumption by the City Parks and Recreation Department.

The potential commercial reuse demand is an estimated value. The potential industrial demands are based on actual consumption data provided by the water utilities department. Location of these potential users can be found on Figure 4-1.

4.4.2 Potential User Demands by Category Within the City

Cemeteries. Three cemeteries within the City were identified and assessed with an estimated total potential demand of 253 AFY. Crestlawn Memorial Park currently uses non-potable ground water for irrigation.

Table 4-5
Recycled Water Average Annual Demand
Major Potential Users within the City/School Districts

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)
	CEMETERIES			
101	Crestlawn Memorial Park	190	35	88
102	Evergreen Memorial Park	25	22	55
103	Olivewood Memorial Park	78	35	110
	SUBTOTAL			**253**
	SCHOOLS			
	Colleges/Universities			
201	California Baptist University	65	23	60
202	California School for the Deaf	90	32	80
203	La Sierra University	--	90	225
204	Riverside Community College	115	40	100
205	University of California Riverside	1,140	320	480
				945
	Riverside Unified School District			
206	Adams Elementary School	8	4	10
207	Alcott Elementary School	10	5	13
208	Arlington High School	47	24	59
209	Bethel Christian High School	20	10	25
210	Bryant Elementary School	3	1	3
211	Castle View Elementary School	12	6	15
212	Central Middle School	21	11	26
213	Chemawa Middle School	21	11	26
214	Earhart Middle School	20	15	38
215	Emerson Elementary School	10	5	13
216	Franklin Elementary School	10	5	13
217	Fremont Elementary School	10	5	13
218	Gage Middle School	18	9	23
219	Grant Elementary School	10	2	5
220	Harrison Elementary School	15	8	19
221	Hawthorne Elementary School	6	3	6
222	Highgrove Elementary School	10	5	13
223	Highland Elementary School	10	5	13
224	Hyatt Elementary School	8	4	10
225	Jackson Elementary School	11	6	14
226	Jefferson Elementary School	10	5	13
227	King High School	50	35	88
228	Liberty Elementary School	6	2	5
229	Lincoln High (Alternative School)	4	2	4
230	Longfellow Elementary School	5	0.3	1
231	Madison Elementary School	10	5	13
232	Magnolia Elementary School	9	5	11
233	Monroe Elementary School	10	5	13
234	Mt View Elementary School	13	7	16
235	North High School	43	22	54
236	Notre Dame High School	20	10	25
237	Pachappa Elementary School	7	3	6

Table 4-5 (Continued)
Recycled Water Average Annual Demand
Major Potential Users within the City/School Districts

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)
238	Poly High School	40	20	50
239	Raincross High/Ed Options Center (Alt. Sch.)	7	1	2
240	Ramona High School	54	27	68
241	Riverside Adult School (Alt. School)	6	1	1
242	Riverside Christian High School	20	10	25
243	Rivera Elementary School	10	1	2
244	Sierra Middle School	20	10	25
245	Sunshine Elementary School	10	0.1	0.3
246	Taft Elementary School	10	5	13
247	University Heights Middle School	18	9	23
248	Victoria Elementary School	6	3	6
249	Washington Elementary School	10	5	13
				833
	Alvord Unified School District			
251	Alvord High School	4	2	5
252	Arizona Intermediate School	20	10	25
253	Arlanza Elementary School	12	6	15
254	Colette Elementary School	10	5	13
255	Foothill Elementary	11	6	14
256	La Granada Elementary	7	4	10
257	La Sierra Academy High School	20	10	25
258	La Sierra High School	46	23	58
259	Loma Vista Intermediate School	22	11	28
260	McAuliffe Elementary School	10	5	13
261	Myra Linn Elementary School	8	4	10
262	Norte Vista High School	47	24	59
263	Orrenmaa Elementary School	10	5	13
264	Promenade Elementary School	10	5	13
265	Rosemary Kennedy Elementary School	10	5	13
266	Sherman Indian High School	85	40	100
267	Terrace Elementary School	10	5	13
268	Twinhill Elementary School	11	6	14
269	Valley View Elementary School	10	5	13
270	Wells Intermediate School	20	10	25
				478
	SUBTOTAL			**2,256**
	Future Schools			
271	Ysmael Village Elementary School	--	6	15
272	Alessandro Heights Elem School	10	5	13
273	Lake Hills Elementary School	10	5	13
274	Mockingbird Canyon Elementary	10	5	13

Table 4-5 (Continued)
Recycled Water Average Annual Demand
Major Potential Users within the City/School Districts

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)
275	Orangecrest 2 Elementary School	12	6	15
276	Orangecrest High School	54	27	68
277	Orangecrest Middle School	21	11	26
278	South Woodcrest Elem School	10	5	13
	SUBTOTAL			**176**
	GOLF COURSES			
301	Canyon Crest Country Club	152	120	300
302	Fairmount Park Golf Course	100	80	200
303	Ingalls	35	30	75
304	Riverside Golf Club	108	86	215
305	Van Buren Golf Center (Sky Links Golf Course)	--	--	195
306	Victoria Club	120	100	350
	SUBTOTAL			**1,335**
	Future Golf Courses			
307	Tequesquite Landfill Golf Course	100	80	200
308	Rancho La Sierra	100	80	200
	SUBTOTAL			**400**
400	**PARKS**			
401	Arlington	4	4	10
402	Bergamont	5	2	6
403	Bobby Bonds Park/Cesar Chavez Ctr.	15	15	38
404	Bordwell Park/Stratton Center	23	23	58
405	Bryant, John/Aelanza Center	22	22	55
406	Carlson	1.8	1.4	4
407	Castleview	26.6	1.25	3
408	Castleview Park Site	27	27	68
409	Collett	6	4	9
410	Dario Vasquez	1.8	1.03	3
411	Don Derr Park	24	24	61
412	Don Jones	6	6	15
413	Don Lorenzi Sport Camp	9	9	22
414	Evans, Samuel C.	12	12	30
415	Fairmount	165	70	175
416	Frost Reservoir	10	10	25
417	Harrison	6	6	15
418	Highland	7	7	17
419	Hunt Park/ Renck Center	14	14	35
420	Hunter	36	26	65
421	Islander	28	24	60
422	La Sierra Park / La Sierra Center	28	28	70
423	Lincoln	4	3	7

Table 4-5 (Continued)
Recycled Water Average Annual Demand
Major Potential Users within the City/School Districts

Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)
424	Low	1	1	3
425	Martha Mclean Anza Narrows	--	200	500
426	Mount Vernon	8	8	20
427	Mtn. View	6	6	15
428	Myra Linn	9	9	23
429	Newman	0.4	0.4	1
430	Nichols Park / Joyce Jackson Center	17	17	43
431	North	1.4	1.4	4
432	Orange Terrace Community	--	15	38
433	Patterson	5	5	11
434	Rancho Loma	7	6	14
435	Reid Park / Ruth Lewis Center	41	29	73
436	Rutland	9	9	23
437	Shamel	10	10	25
438	Swanson	1	1	2
439	Taft	7	2	4
440	Thundersky	12	10	26
441	Villegas Park / Ysmael Villegas Ctr.	18	18	45
442	Washington	4	4	10
443	White Park / Dales Center	6	6	15
	SUBTOTAL			**1,744**
	Future Parks			
444	Alessandro Heights	10	10	25
445	Andulka	37	37	93
446	Campbell & Golden	10	10	25
447	Challen Hill	34	34	85
448	Hillside Ave	10	10	25
449	Hunter Business	10	10	25
450	Landfill Area Park	40	40	100
451	Lusk Highlander	10	10	25
452	Mitchell Ave	6	6	15
453	Orange Terrace Comm.	21	21	53
454	Orangecrest #2	4	4	10
455	Prenda Reservoir	25	15	38
456	Quail Run	27	27	68
457	Rancho La Sierra	60	60	150
458	River Ranch	10	10	25
459	Tequesquite Arroyo	43	43	108
460	Victoria - Cross	10	10	25
	SUBTOTAL			**895**
	MISCELLANEOUS USES			
501	Kaiser Permanente Hospital	40	12	30
502	Parkview Comm. Hosp. Med. Ctr.	--	5	13

Table 4-5 (Continued)
Recycled Water Average Annual Demand
Major Potential Users within the City/School Districts

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)
503	Riverside Municipal Airport	304	50	125
504	Riv. Community Hospital	--	--	10
505	Teen Challenge International	--	10	25
506	AB Brown Sports Complex	47	24	59
507	Wholesale Nursery	10	3	6
	SUBTOTAL			**268**
	Future Miscellaneous Uses			
503	Riverside Municipal Airport	304	100	250
508	Riverside Pkwy @ La Sierra University	--	--	20
	SUBTOTAL			**270**
	GREENBELTS			
601	Caltrans Hwy 60 (2 Mi)	--	--	71
602	Caltrans Hwy 215 (2 Mi)	--	--	71
603	Caltrans Hwy 91 (12 Mi)	--	--	213
604	City Medians	165	165	413
605	Van Buren Median & Frontage (Urban Forest)	-	10	25
	SUBTOTAL			**793**
	Future Greenbelts			
604	City of Medians	40	40	**100**
	COMMERCIAL			
	Existing Commercial Establishments	--	--	**500**
	Future Commercial Establishments	--	--	**300**
	INDUSTRIES - LANDSCAPE IRRIGATION			
801	Bourns, Inc.	--	5	13
802	Caddock Electronics, Inc.	--	--	6
803	Corona College Heights	--	--	6
804	Layton Softwater	--	--	6
805	Progressive Wheel	--	--	6
806	Toro Irrigation (Manufacturing Company)	--	--	70
807	Dow Jones & Company, Inc.	--	--	50
808	Airport Industrial Area	--	--	100
809	La Sierra Industrial Area	--	5	13
810	Hunter Park Industrial Area	--	50	125
811	Residential Industrial Area	--	5	13
812	Presidential Industrial Area		6	15
	SUBTOTAL			**422**
	INDUSTRIES - PROCESS			
901	Alumax Mill	--	--	74
902	Bourns	--	--	12
	SUBTOTAL			**86**

Table 4-5 (Continued)
Recycled Water Average Annual Demand
Major Potential Users within the City/School Districts

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)
	Future Industries - Process			
903	400 MW Power Plant (planned by PUD)	--	--	150
	Other future industries	--	--	700
	SUBTOTAL			**850**
	MINOR POTENTIAL REUSE			
	City Total	--	--	**1,000**
	SUMMARY OF POTENTIAL USES			
	Existing			
	Landscape Irrigation			6,648
	Industrial Process/Commercial			1,008
	Minor			1,000
	SUBTOTAL			**8,656**
	Future Establishments			
	Landscape Irrigation			1,841
	Industrial Process/Commercial			1,150
	SUBTOTAL			**2,991**
	GRAND TOTAL			**11,647**
			Say	**11,700**

Table 4-6
Recycled Water Average Annual Demand
Major Potential Users Along City's Northerly Boundary

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)	Status*
	AREA GOLF COURSES				
309	El Rivino Country Club	90	72	180	Existing
310	India Hills Golf Course**	--	–	600	Existing
311	Jurupa Hills Country Club	110	88	220	Existing
312	Paradise Knolls Golf Course	70	56	140	Existing
	SUBTOTAL			**1,140**	
	AREA PARKS				
461	Havenview Park No. 1**	35	30	12	Existing
462	Havenview Park No. 2**	35	30	15	Existing
	SUBTOTAL			**27**	
	MISCELLANEOUS				
509	EDA Streetscape East of Camino Real & Limonite	--	–	36	Existing
510	JUSD (Linares)**	--	–	27	Existing
511	NE Corner Limonite and Clay**	--	–	9	Existing
512	W. Side Camino Real**	--	–	8	Existing
513	Camino Real South of Lamonite**	--	–	0.1	Existing
	SUBTOTAL			**80**	
	INDUSTRIES				
903	Northwest Pipe Company	--	6	25	Existing
904	Robertson Ready Mix	--	–	35	Existing
	SUBTOTAL			**60**	
	TOTAL			**1,307**	
			Say	**1,310**	

* Only existing potential users were assessed outside the City limits
** JCSD Indian Hills Water Recycling Project

Table 4-7
Average Annual Demand
Major Potential Users Along City's Southerly Boundary

ID Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)	Status*
1. USERS CURRENTLY SERVED BY GAGE CANAL AND/OR RIVERSIDE CANAL					
	AREA CEMETERIES				
104	Riverside National Cemetery	740	280	700	Existing
	SUBTOTAL			**700**	
200	**AREA SCHOOLS**				
279	Woodcrest Christian High School	20	10	25	Existing
280	Woodcrest Elementary School	10	2	4	Existing
	SUBTOTAL			**29**	
300	**AREA GOLF COURSES**				
313	March AFB Golf Course	90	72	180	Existing
	SUBTOTAL			**180**	
500	**MISCELLANEOUS**				
514	March Air Force Base	--	6	15	Existing
	SUBTOTAL			**15**	
600	**GREENBELTS**				
606	March Air Force Base	--	6	**15**	Existing
	TOTAL			**939**	
2. USERS CURRENTLY SERVED BY POTABLE WATER					
	AREA CEMETERIES				
105	Green Acres Memorial Gardens	85	55	138	Existing
	SUBTOTAL			**138**	
300	**AREA GOLF COURSES**				
314	Cresta Verde Golf Course	140	112	280	Existing
	SUBTOTAL			**280**	
	TOTAL			**418**	
	GRAND TOTAL			**1,360**	

* Only existing potential reuse was assessed outside the City limits

Schools. Five colleges/universities and two school districts were surveyed. La Sierra University has its own well. Irrigated areas for all schools were identified and assessed at 2.5 AFY per acre. The reuse potential for the colleges/universities totals 945 AFY for landscape irrigation. Existing major elementary, intermediate, and high schools have been assessed at 1,311 AFY. Future schools add another 176 AFY.

Four schools under this category has a recycled water demand equal to or greater than 100 AFY, including La Sierra University (225 AFY), Riverside Community College (100 AFY), University of California Riverside (480 AFY), and Sherman Indian High School (100 AFY).

Golf Courses. Six existing area golf courses were assessed at a total potential recycled water demand of 1,335 AFY. These existing golf courses include Canyon Crest, Fairmount Park, Ingalls, Riverside, Van Buren (Sky Links) and Victoria courses. An additional potential demand of 400 AFY is identified for two future golf courses, the Tequesquite Landfill Golf Course and Rancho La Sierra Golf Course. The Van Buren golf course is one of the three existing recycled water users in the City. All except one golf course have a demand close to or greater than 200 AFY.

Minimal amount of water is currently purchased from the City because the majority of these golf courses have their own wells. However, these potential users are still considered and are included in this market assessment.

Parks/Recreational Areas. Forty-three existing major parks/recreational areas have a total reuse potential of 1,744 AFY with an additional 895 AFY for future parks. Seventeen future major parks were identified within the City with a total area of 357 acres. Fifteen of the seventeen future parks are planned with an area larger than 10 acres. It should be noted that parks can have acreage less than 5 AFY and could be served recycled water economically.

Five of the parks/recreational areas were identified with a recycled water demand exceeding 100 AFY, including Fairmount, Martha Mclean Anza Narrows, Landfill Area Par, Rancho La Sierra, and Tequesquite Arroyo.

Miscellaneous Irrigation. This category includes irrigation at hospitals, airport, sports complex and nursery grounds. The major reuse potential in this group is Riverside Municipal Airport, which has an existing reuse demand of 125 AFY and a future demand of 250 AFY. The total potential reuse demand for this category is 268 AFY for existing facilities and 270 AFY for future facilities.

Greenbelts and Freeway Irrigation. Approximately 355 AFY is assessed for irrigating the three freeways that traverse through the City (i.e. Hwy 60, Hwy 215, and Hwy 91). The recycled water demands for irrigating the city medians are estimated to be 438 AFY for the existing facilities and 100 AFY for future facilities.

Commercial. The potential commercial users were not surveyed for recycled water use. A total estimate of 800 AFY for total commercial reuse was generated based on the City's 1992 Master Plan Update, field survey, and previous experience.

Industries Landscape Irrigation. The primary users in this group are various industries and the future 400 MW power plant planned by the City of Riverside Public

Utility Department. The user base identified a total potential users demand of 422 AFY for existing facilities and 850 AFY for future facilities.

Industries Process. Two industries in this category were identified with a total recycled water demand of 86 AFY.

Minor Potential Reuse. The minor potential reuse assessment represents a fragment of the minor nonpotable market in the City. Minor users include small greenbelts, parks, schoolyards, residential, commercial and industrial landscape irrigation areas. The minor reuse potential has been assessed at 1,000 AFY.

Agricultural Irrigation. The City owns the Gage Transmission System, which is operated by the Gage Canal Company. The present capacity of the system, as reported by the City, is approximately 30,000 gpm (43 mgd). The City owns 19000 gpm of this capacity.

Gage Canal gets 24,000 gpm from Gage well system and 6,000 gpm from the City potable wells. Out of 24,000 gpm from Gage wells, the City is stockholder for 13,000 gpm and Gage Canal Company for 11,000 gpm. Out of 11,000 gpm, the City trades with the Gage Canal for 5,400 gpm for potable uses and provides 25 percent more from the Riverside Canal system in the down stream.

The total length of the Gage Canal transmission system is approximately 54,300 linear feet. In the upper reach of the Gage Transmission Pipeline (approximately 6,500 linear feet) the pipeline increases in diameter from 24 to 30, 36, 42 and 48 inches. The remainder of the transmission pipeline varies in diameter from 48 to 60 inches. At the terminal point of the pipeline (Linden Street), a 36-inch diameter pipeline delivers potable water to the Linden and Evans Reservoirs.. Given the City's share of the Gage Canal Company and water exchange agreements, the City's continuous delivery of domestic water to the Linden and Evans reservoirs is approximately 24,400 gpm (35.6 mgd). Typically, for a period of two months in the winter, the lower Gage Canal system is taken out of service for maintenance and the entire Gage transmission capacity is available for use by the City of Riverside. All deliveries up to 27,000 gpm (39 mgd) flow by gravity through a 36-inch-diameter pipeline, which connects the turnout on Linden Street to the Linden and Evans reservoirs.

The lower reaches of the Gage Transmission system, which is used exclusively for agricultural irrigation, could be of use for excess recycled water. This utilization would reduce the amount of groundwater pumping required for irrigation.

The City operates a second canal, the Riverside Water Company Canal, that is used for irrigation water conveyance and storm water control. Non-potable wells in the Colton and Riverside groundwater basins are pumped to provide the exchange water with the Gage Canal Company, and to meet irrigation conveyance and delivery obligations with other agencies.

"Approximately 8,000 AFY of non-potable water is delivered to the Gage Canal Company through a pumping system on the Riverside Canal. An additional 6,000 AFY may be delivered to Western Municipal Water District under the terms of a 2003

agreement. In addition the Riverside Canal conveys water produced on behalf of San Bernardino Valley Municipal Water District for delivery to Orange County Water District, and water produced for delivery to Elsinore Valley Municipal Water District (the so-called Temescal Water rights)."

The agricultural demand currently met through the use of non-potable water represents a large potential market for recycled water, perhaps as much as 30,000 AFY. However, the non-potable water supply is cheap and easily accessible. Furthermore, there are a number of institutional issues related to the delivery of recycled water to these other agencies. However, the feasibility and cost effectiveness of this recycling opportunity should be explored in detail.

For the purpose of this study, the agricultural users are included in the market assessment as potential users but not considered for development of the core distribution system and cost analysis. The impact of future development in the agricultural areas must be considered as it affects water reuse.

4.4.3 Potential Recycled Water Demands Along City's Northerly Boundary

A study was done by the JCSD entitled Indian Hills Water Recycling Project which provided the potential user demand for both JCSD and RCSD. This report consists of areas currently using potable water and proposed new areas of reuse. Approximately 1,310 AFY is predicted by JCSD for potential reuse of recycled water for golf course irrigation (4 courses), park irrigation, industrial use, and other miscellaneous uses. **Table 4-6** provides detailed information of these potential users along the City's northerly boundary.

4.4.4 Additional Recycled Water Demands Along City's Southerly Boundary

The City may consider selling recycled water to downstream users (e.g. Norco, Rancho La Sierra, etc.) in the future. Among the potential water recycling opportunities along the City's southerly boundary, there are some existing users currently receiving water from either Gage Canal or Riverside Canal. Approximately 940 AFY of recycled water demand is expected from these potential users.

In addition to the above potential users currently served by the Gage Canal/Riverside Canal, other users along the City's southerly boundary currently served by potable water were also identified with a total potential recycled water demand of 440 AFY. Nearly all of the identified demands are for irrigation. **Table 4-7** provides detailed information of these potential users along the City's southerly boundary.

4.5 PEAKING FACTORS

Recycling water user demands typically vary on a monthly, daily, and hourly basis. A typical irrigation demand curve is depicted in **Figure 4-2**. Peaking factors used for the hydraulic modeling are described under Section 5.3 of this report.

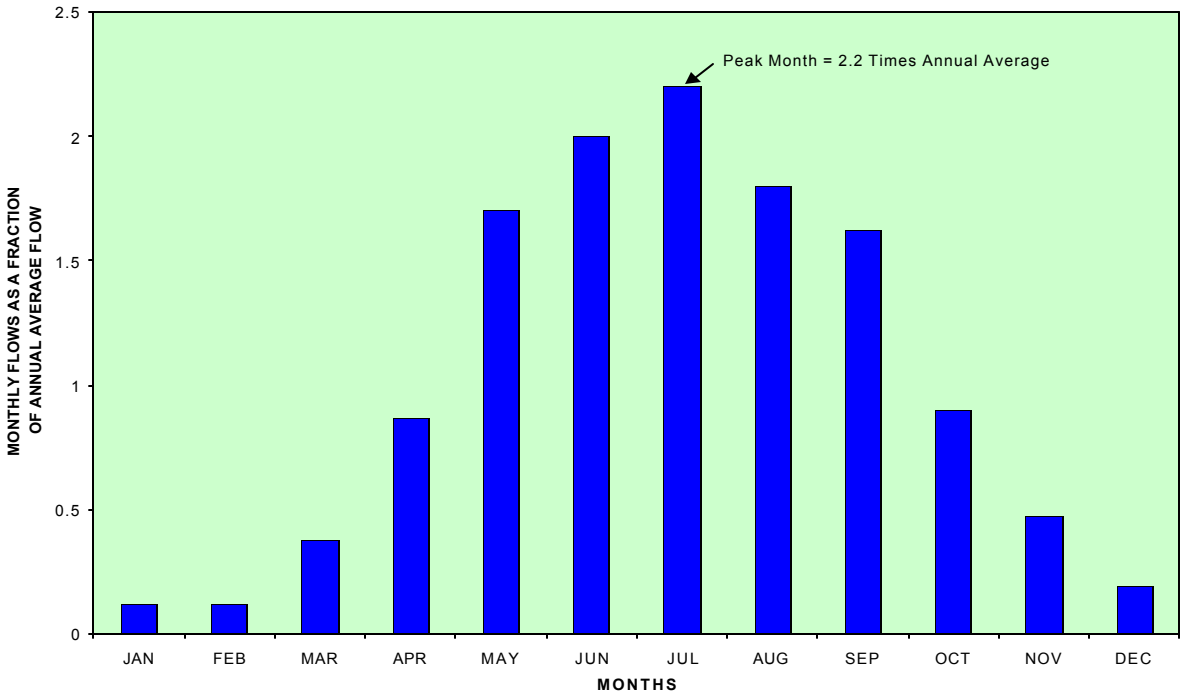


Figure 4-2
Typical Monthly Irrigation Demand

The peaking factors terminology normally used is discussed below.

- **Maximum Month Demand (MMD).** Demand is greatest during the months with low precipitation. MMD varies greatly in most arid regions due to climate changes and evapo-transpiration rates from winter to summer. MMD is important to consider for availability of plant effluent for various customers, and seasonal storage requirements. .
- **Maximum Day Demand (MDD).** MDD is important in determining on-site or off-site storage requirements to meet the demands, and available recycled water for delivery to customers. The peaking factor for MDD is generally depicted as a ratio of the MDD to the MMD.
- **Peak Hour Demand (PHD).** PHD is important in determining proper distribution system sizing (pipelines and pumping requirements). With recycled water irrigation for landscape irrigation, demands and irrigation schedules are generally restricted to nighttime irrigation, an 8- to 10-hour irrigation "window". Due to this restriction, PHD for recycled water systems is typically high compared to that for potable water systems. PHD for recycled water systems range from 1.5 to 3.0 times the MDD.

4.6 SUMMARY

Table 4-8 summarizes the City's total non potable reuse potential. Approximately 20,400 AFY of recycled water demand can be reasonably anticipated within the City limits and in the vicinity. By category, the potential reuse of recycled water for irrigation totals 12,600 AFY; the industrial process/commercial reuse is assessed at 1,800 AFY. The reuse potential for agricultural irrigation is conservatively estimated at 6,000 AFY through the replacement of pumped non-potable groundwater with recycled water in the Gage and Riverside canals.

Preliminary supply and demand analysis indicates that the 32 mgd of recycled water produced from the RWQCP would meet annual average demands. Storage facilities would be required to meet the peak monthly/daily/hourly demands.

Due to the speculative nature of current arrangements between the City of Riverside and neighboring cities, this report assumes all required water would be available from the RWQCP. No arrangement for potable water supply supplement is investigated, although minimally a potable water supply hookup will be required for emergencies.

This estimated market does not include demands within the City's 15,000 acre southerly sphere of influence.

Table 4-8
Recycled Water Average Annual Demand
Assessment of Direct Nonpotable Reuse Market

	User Code	Category	Reuse Potential (AFY) Existing Establishment		Future Establishment
A.	**Within the City Limts/School Districts**				
	Landscape Irrigagation				
	100	Cemeteries	253		
	200	Colleges/Universities/Schools	2,256		176
	300	Golf Courses	1,335		400
	400	Parks	1,744		895
	500	Miscellaneous	268		270
	600	Freeway Irrigation and City Greenbelts	793		100
	800	Industrial - Landscape Irrigation	422		
		Subtotal	7,070		
		Minor Potential Users	1,000		
		Subtotal - Landscape Irrigation	**8,070**		**1,841**
	Industrial Process/Commercial				
	700	Commercial	500		300
	900	Industrial - Processes	86		850
		Subtotal - Industrial Process/Commercial	**586**		**1,150**
Total Within City Limits			**8,656**		**2,991**
Total Existing and Future			**11,700**	**AFY**	
B.	**Additional Users Along City's Notherly Boundary**		**1,310**	**AFY**	
C.	**Potential User's Along City's Southerly Boundary**		**1,360**	**AFY**	
D.	**Potential Agricultural Irrigation Usage**		**6,000**	**AFY**	
E.	**Grand Total (A + B + C + D)**		**20,370**	**AFY**	
		Say	**20,400**	**AFY**	
	Jurupa Community Water District		**770**	**AFY**	**(Ref. Table 6.1)**

SECTION 5
CITYWIDE RECYCLED WATER SYSTEM

5.1 GENERAL PROJECT DESCRIPTION

The purpose of the Citywide Recycled Water Master Plan is to update the 1992 Water Reclamation Master Plan Technical Memorandum No. 2: Water Reclamation for the Regional Water Quality Control Plant Master Plan report prepared by Montgomery Watson.

This chapter discusses the City of Riverside (City) recycled water core distribution systems for users identified in Section 4. This system will provide recycled water to users throughout the City, JCSD and uses located in southerly boundaries in the Western Municipal Water District (WMWD). The core system provides an estimate of pipe sizes and footage, pipeline alignments, reservoirs and pump stations, to supply recycled water and to provide the basis for the conceptual cost estimates.

5.2 PIPELINE ALIGNMENT

The purpose of the core system alignment is not to set the specific route for the distribution system, but to identify a possible alignment, which will serve the largest users and user clusters. Site constraints such as existing water and sewer lines, traffic, and utilities may revise the proposed alignments and must be investigated during pre-design phase. The primary alignment in **Figure 5-1** is effective in the planning stage to present the reuse concept, model the system, and develop project economics.

The alignment is sensitive to the location of the largest users and clusters of users. The pipeline lengths used in the proposed system are approximate and will need to be verified during pre-design phase. Service distribution lines from the core system to each user are not included in the estimates.

The service area of the core distribution system incorporates the total potential reuse of about 20,400 AFY as detailed in Table 4-8 Section 4.

5.3 HYDRAULIC MODEL

The hydraulic model geometry and physical characteristics for the City's Recycled Water System was developed using H_2ONET v3.1 software, which includes a 24-hour simulation and performance analysis. Water demand data from potential users developed from market survey analysis in Section 4 was used to develop the proposed demands for the recycled water distribution system model.

The hydraulic model geometry and physical characteristics of the distribution system includes pipes (length, diameter, Hazen-Williams friction C-factor), pumps (hydraulic head, pump characteristic curve), and storage facilities. GIS files provided by the City were used as the basis to develop the model geometry. **Figure 5-1** presents a schematic of the transmission pipelines throughout the City.

Preliminary pipes were sized based on hydraulic criteria of having friction loss less than 12-ft per 1000-ft of pipe and a velocity at peak flow of less than 10ft/sec. Estimated pressures at the nodes were calculated based on Hazen Williams equation for head loss in the pipe including the elevation difference between nodes of pipe segments. Booster pumps are incorporated when the downstream demand node pressures were less than 50 psi.

Design Criteria

Peaking factors have been established to account for monthly, daily and hourly variations in demand due to fluctuations in irrigation demands. Generally the average maximum day to yearly average day demand factor is approximately 2.5 for water recycling systems.

The peak hour to the yearly average day varies considerably depending on the type of water use. Industrial process demands are generally constant.

As a basis for design for the hydraulic model, the following peaking factors for irrigation demands were used:

- Golf Courses → 5.0
- Schools, Parks and Cemeteries → 3.0
- Industrial → 2.5

Peak hourly demands for golf courses is based on the assumption that irrigation operation will be four hours per day between midnight and 4:00 am, while for schools, parks, cemeteries and other irrigation users, an eight hour per day irrigation operation between the hours of 10:00 p.m. and 6:00 a.m. It should be noted that if golf courses incorporate water hazards (lakes) the peaking factor would be 1.0. The assumption is that recycled water can be delivered to a water hazard at a constant rate 24 hours of the day. At such time when irrigation demands are required, the water source will be the water hazards. The distribution system is designed to deliver the peak hourly demand while maintaining a minimum system pressure of 50 psi and a maximum pressure of 120 psi. Maximum pipeline velocities were maintained at 10 ft/sec or less.

Modeling Results

The following is a summary of the modeling results for each supply alternative as required to meet system demands anticipated in the citywide master plan.

- ***Pipelines.*** **Table 5-1** summarizes the pertinent pipeline characteristics for the core distribution system including length and diameter of each pipe section. **Figure 5-1** shows schematic of the hydraulic model.
- ***Junction Nodes.*** **Table 5-2** summarizes the pertinent junction node characteristics for the core distribution system.

Table 5-1
Pipe Sizes for Citywide System

Pipe#	Length (ft)	Pipe Size (in)
1	2020	30
3	6114	18
5	5629	30
7	7691	24
9	8145	12
11	10242	12
13	3521	12
17	10885	12
19	6160	24
21	5449	24
23	6868	24
25	3516	18
27	6089	24
29	4696	12
31	10155	12
33	10876	24
35	2617	24
41	11898	24
45	12737	12
47	2609	24
49	2644	24
51	7649	12
59	5850	24
61	5649	24
71	8169	12
73	7182	24
75	1000	24
77	3385	12
81	8198	12
83	3775	24
85	6866	24
87	9180	24
89	8661	24
91	2686	24
93	3806	24
97	14708	12
99	3096	12
101	5292	12
105	8509	24
107	6039	24
109	3088	24
111	8604	12

City of Riverside

Citywide Water Recycling Master Plan

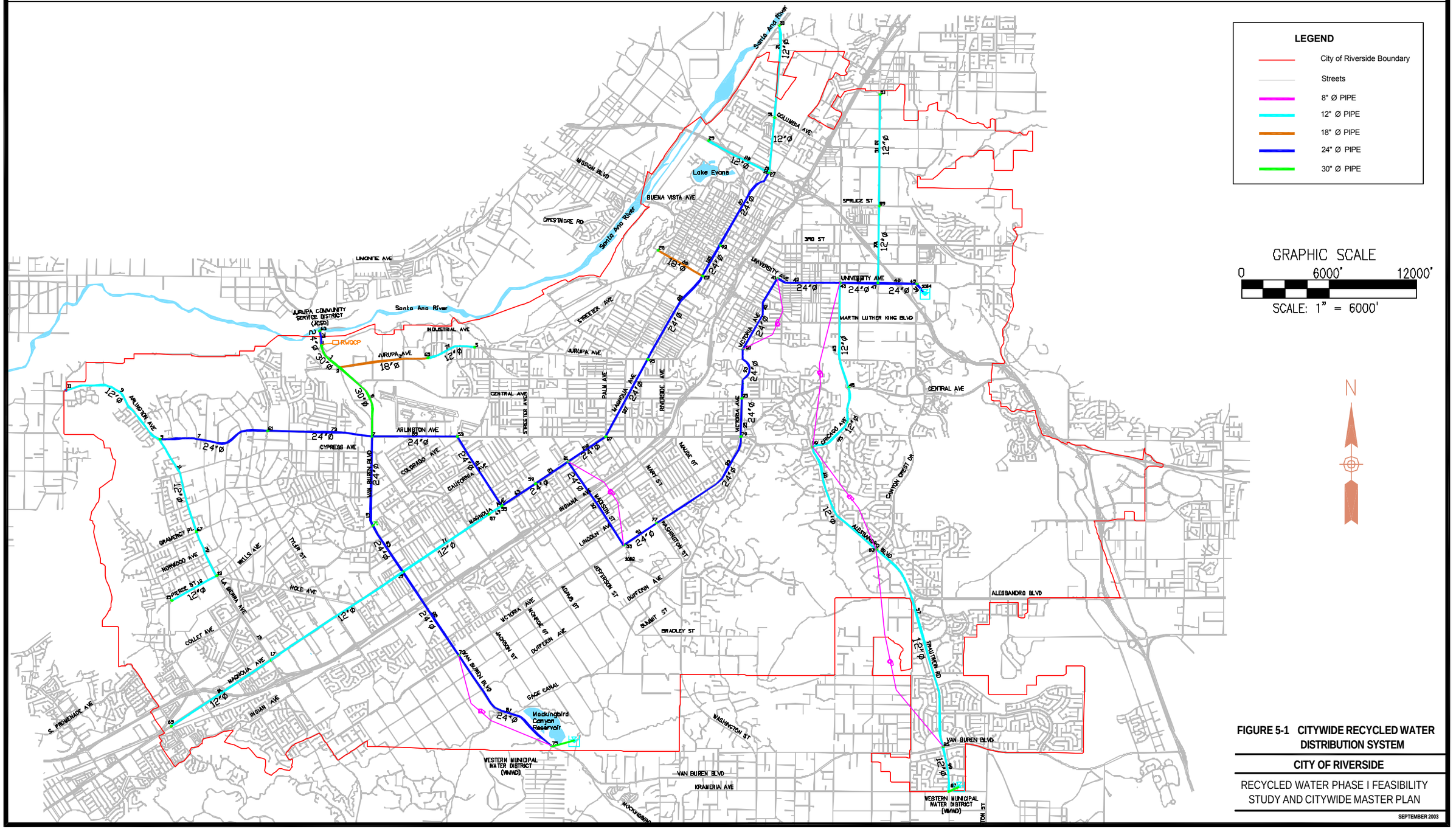


FIGURE 5-1 CITYWIDE RECYCLED WATER DISTRIBUTION SYSTEM

CITY OF RIVERSIDE

RECYCLED WATER PHASE I FEASIBILITY STUDY AND CITYWIDE MASTER PLAN

SEPTEMBER 2003

Table 5-2
Junction Node Characteristics for Citywide System

Node#	Average Day Demand (gpm)	Peak Hour Demand (gpm)
3	30	89
5	911	2950
7	416	1458
9	146	661
11	398	1666
13	66	199
15	248	744
17	250	777
19	35	105
21	42	126
23	107	320
25	294	1129
29	244	981
31	292	1105
33	44	129
35	107	322
43	39	117
49	733	2198
51	125	348
53	14	43
57	181	561
61	166	720
63	896	4478
65	310	1148
69	194	928
71	123	369
72	111	333
75	19	56
77	38	113
79	77	231
81	217	1085
83	48	145
85	232	697
87	580	1962
89	79	236
93	13	40
95	11	32
97	49	147
99	320	1332

- ***Storage Facilities.*** Assuming an eight-hour irrigation period, sixteen hours of peak day storage is required. With a peak hourly demand of 25,600 gpm, about 7 million gallons of operational storage are required.

  The recommended location for these storage facilities is at the University of California, Riverside and at the service boundary between the City of Riverside and Western Municipal Water District.

- **Pumping Station.** Seven booster-pumping stations are required for the core distribution system to operate on a 24 hours continuous basis, see **Table 5-3**.

Table 5-3
Estimate Size for Booster Pump Station

Pump Location	Average Flow (gpm)	Required Head (ft)	HP
RWQCP to system	7300	277	730
Van Buren Blvd. between Victoria Ave. and Mockingbird reservoir	3000	198	215
Madison St. between Magnolia Ave. and Victoria Ave.	4000	107	155
Victoria Ave. between Central Ave. and University Ave.	4000	70	100
Chicago Ave. between Central Ave. and Arlington Ave.	1000	180	65
Alessandro Blvd. between Arlington Ave. and E Alessandro Blvd.	1000	370	135
Alessandro Blvd. between E Alessandro Blvd. and Van Buren Blvd.	1000	160	60
Total			**1460**

5.4 DISTRIBUTION SYSTEM COST ANALYSIS

In order to assess overall project cost and economics, it is necessary to discuss the project components and estimated construction costs. The estimates consider normal engineering design, construction, and construction management costs with moderate utilities interference. Costs for right-of-way and property acquisition are not included. Additionally, other related costs for legal counsel, administrative overhead, public awareness programs, coordinate with the Regional Board or Department of Health Services are not included. Costs are presented in current dollars with an *Engineering News-Record* (ENR) index of 7228 for November 2002 for the Los Angeles area. See **Table 5-5** for a complete list of cost assumptions.

Table 5-4 summarizes the preliminary capital costs associated with pipe sizes and lengths. The capital cost for citywide pipe system is approximately $64,670,000. Lateral distribution piping to individual users is not included in this conceptual plan, and therefore, no cost estimates were included for the distribution pipes. Each user will generally require on-site conversion. Consideration should be given to requiring new development to install irrigation systems to meet AWWA and DHS standards for recycled water use.

A total of six booster pump stations are anticipated for the citywide master plan. The capacity of the booster stations will range from 1,000 gpm to 4,000 gpm. The estimated capital cost for the six booster pump stations is $2,520,000. An additional booster pump station at the RWQCP will be required and is estimated to have a firm capacity

of approximately 7,300 gpm. The estimated capital cost for the RWQCP booster pump station is $1,314,000.

Storage tanks are needed to provide supply to the distribution system during peak demand periods and storage during off peak times such that the booster pump stations can operate at an efficient rate. It is anticipated that three storage reservoirs will be required with a total storage capacity of approximately 7 million gallons. The estimated construction cost for the three storage reservoirs is approximately $5,600,000, not including land acquisitions.

Table 5-4
Citywide System Preliminary Capital Cost Analysis

System Description	Quantity	Total Cost
1 RWQCP Facilities		
a. Booster Pump Station (including disinfection & Misc. Structures)	7,300 gpm	$1,314,000
2 Transmission Pumps		
a. 1000 gpm Booster Pump Station (3 ea.)	3,000 gpm	$540,000
b. 3000 gpm Booster Pump Station (1 ea.)	3,000 gpm	$540,000
c. 4000 gpm Booster Pump Station (2 ea.)	8,000 gpm	$1,440,000
Tansmission Pumps Subtotal	14,000 gpm	$2,520,000
3 Transmission Pipelines		
a. 12" Transmission Pipelines	119,483 LF	$10,036,572
b. 18" Transmission Pipelines	9,630 LF	$1,213,380
c. 24" Transmission Pipelines	135,191 LF	$22,712,088
d. 30" Transmission Pipelines	7,649 LF	$1,606,290
Tansmission Pipeline Subtotal	272,000 LF	$35,570,000
4 Reservoir Storage		
a. 3 MG Reservoir (2 ea.)	6 MG	$4,800,000
b. 1 MG Reservoir (2 ea.)	1 MG	$800,000
Reservoir Storage Subtotal	7 MG	$5,600,000
5 Provision for On-Site Conversion @ Average $10,000/Each Site	186 Ea	$1,860,000
Total Estimated Cost		**$46,864,000**
Contigency @ 20%		**$9,372,800**
Engineering, Legal and Administration @ 15%		**$8,435,520**
Total Estimated Project Cost		**$64,672,320**
say		**$64,670,000**

Note:
- The estimate is based on year 2002 costs at an ENR Construction cost index of 7228 for the Los Angeles area for November 2002.
- It is assumed that the pipeline will be installed in existing City easements and/or public rights-of-way such as public streets.
- It is assumed that equalization basin at RWQCP is already in existence.
- Above estimates do not include financing cost.

5.5 COST CRITERIA

Table 5-5
Citywide System Cost Criteria for Capital Cost Estimate

Item	Cost Factor
Pipeline Construction	$7/ft-in dia
Onsite conversion	$10,000/each
Storage Tanks	$0.80/gal
Booster Pump Station (including disinfection & miscellaneous structures)	$180/gpm
Engineering, Legal & Construction Administration	15% of total estimated cost
Construction Contingency	20% of total estimated cost

5.6 OPERATION COST ESTIMATE AND FINANCING ALTERNATIVES

Operation and maintenance costs include the annual maintenance costs for pipelines, power, labor and pump station repairs. These costs were estimated as a percentage of construction cost. It was assumed that JCSD would share proportion of the costs for power, O & M and miscellaneous costs with the City. **Table 5-6** summarizes the cost criteria used to estimate the operation and maintenance cost as well as total annual costs.

Table 5-6
Cost Criteria for Annual Cost Estimates

Item	Cost Factor
Maintenance	
Pipelines	(Capital Expenditure) - (25% Grant x Capital Cost) (Capital Expenditure) - (75% SRF Loan x Capital Cost)
Reservoirs	None
Operation	
Power	$0.10/KWH
Treatment	None
Capitalization	5.5% Interest (City's loan) 2.4% Interest (SRF Loan) 20 Years Recovery Period

Total annual costs are based on the amortized construction cost plus the annual operation and maintenance cost. Capital costs are amortized based on 5.5 percent interest and a 20-year recovery period. in **Tables 5-7** through **Table 5-10** show the O&M cost assessed for the different alternatives.

Table 5-7
Citywide System Preliminary Cost Estimate

City Funds - No Grants and/or Loans

Item Description	Total Cost	City of Riverside Share
1. Annuity on Loan	$445,000 /month	$445,000 /month
2. Operations and Maintenance		
a. Power Cost	$27,000 /month	$26,000 /month
b. Operation and Maintenance Cost [(a)]	$50,000 /month	$45,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$10,000 /month	$9,500 /month
Total		**$525,500 /month***
Recycled Water Production Cost for City of Riverside (20,400 AFY)		**$309 /AFY**

Note:
(a) 5 additional persons full time, City of Riverside share 4.5 persons time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 5-8
City Funds (75%) and Grant (25%)

Item Description	Total Cost	City of Riverside Share
1. Annuity on Loan	$334,000 /month	$334,000 /month
2. Operation and Maintenance Cost		
a. Power Cost	$27,000 /month	$26,000 /month
b. Operation and Maintenance Cost [(a)]	$50,000 /month	$45,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$10,000 /month	$9,500 /month
Total		**$414,500 /month***
Recycled Water Production Cost for City of Riverside (20,400 AFY)		**$244 /AFY**

Note:
(a) 5 additional persons full time, City of Riverside share 4.5 persons time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 5-9
City Funds (25%) SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Capital Cost		
a. City Fund	$112,000 /month	$112,000 /month
b. SRF Loan	$255,000 /month	$255,000 /month
2. Operation and Maintenance Cost		
a. Power Cost	$27,000 /month	$26,000 /month
b. Operation and Maintenance Cost [(a)]	$50,000 /month	$45,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$10,000 /month	$9,500 /month
Total		**$447,500 /month***
Recycled Water Production Cost for City of Riverside (20,400 AFY)		**$263 /AFY**

Note:
(a) 5 additional persons full time, City of Riverside share 4.5 persons time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 5-10
Grant (25%) and SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity on Loan	$255,000 /month	$255,000 /month
2. Operation and Maintenance Cost		
a. Power Cost	$27,000 /month	$26,000 /month
b. Operation and Maintenance Cost [(a)]	$50,000 /month	$45,000 /month
3. Miscellaneous Costs	$10,000 /month	$9,500 /month
Total		**$335,500 /month***
Recycled Water Production Cost for City of Riverside (20,400 AFY)		**$197 /AFY**

Note:
(a) 5 additional persons full time, City of Riverside share 4.5 persons time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

5.7 SUMMARY

Total estimated capital cost for the citywide distribution system is approximately $64,670,000. This capital cost can be financed monthly by different alternatives, together with O&M cost the monthly costs to the city are listed in **Table 5-7** through **Table 5-10**. With a potential reuse of 20,400 AFY as detailed in Section 4, the cost for reclaimed water production ranks from $197/AFY to $309/AFY depending on the financing option as summarized in **Table 5-11** below. Cost of water production for citywide system is lower than system that is limited to Phase I users only. Compare to a typical production cost range of $300/AFY to $700/AFY in Southern California, the recycled water system therefore is feasible.

Table 5-11
Summary of Alternative Pricing Options for Citywide Water Production Cost

Item No.	Description of Preliminary Project Cost	Recycled Water Production Cost ($/AF/Y)
1.	City Funds - No Grants and/or Loans	309
2.	City Funds (75%) and Grant (25%)	244
3.	City Funds (25%) and SRF Loan (75%)	263
4.	Grant (25%) and SRF Loan (75%)	197

SECTION 6

PHASE 1 – WATER RECYCLING PROJECT

This section presents Phase I – Water Recycling Project including project boundary, current and potential users of recycled water from within the City of Riverside (City), outside the City, the criteria and basis for the hydraulic modeling, preliminary costs and economic analysis.

6.1 DEFINITION AND CRITERIA

Recycled Water Phase I Feasibility Study is an economical analysis to be used in the development and implementation of recycled water within the City of Riverside focusing on its funding, regulatory compliance, constructability, operability and expandability. Phase I Project is restricted to about 2-mile radius around the city's RWQCP. This 2-mile radius includes major potential users within the City, Jurupa Community Service District (JCSD) and Rubidoux Community Service District (RCSD).

6.2 ALTERNATIVES

Two alternatives were identified, surveyed and evaluated for the development of Phase I – Water Recycling Project. These alternatives include:

- Alternative 1 – JCSD, City of Riverside Users up to Arlington Avenue; and
- Alternative 2 – JCSD, City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.

6.2.1 Alternative 1

Alternative 1, would supply recycled water to major potential users located along:

- Van Buren Boulevard between Jurupa Avenue and Arlington Avenue;
- Jurupa Avenue between Van Buren Boulevard and Florence Street;
- Arlington Avenue between Van Buren Boulevard and Tyler Street; and
- Arlington Avenue between Van Buren Boulevard and Adams Street

The service area for Alternative 1 incorporates the total potential reuse of about 1,870 AFY as shown in **Table 6-1.**

6.2.2 Alternative 2

Alternative 2, would supply recycled water to major potential users located along:

- Van Buren Boulevard between Jurupa Avenue and Arlington Avenue;
- Jurupa Avenue between Van Buren Boulevard and Florence Street;
- Arlington Avenue between Van Buren Boulevard and Adams Street;
- Adams Street between Arlington Avenue and Magnolia Avenue;
- Magnolia Avenue between Adams Street and Verde Street; and
- Magnolia Avenue between Adams Street and Wayne Center

The service area for Alternative 2 incorporates the total potential reuse of about 2,270 AFY as shown in **Table 6-2.**

Table 6-1
Alternative 1 – JCSD, City of Riverside Users up to Arlington Avenue

Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)	
A	**JURUPA COMMUNITY SERVICE DISTRICT USERS**				
-	**AREAS CURRENTLY USING POTABLE WATER**				
-	Havenview Park No. 1	--	--	12	
-	Havenview Park No. 2	--	--	15	
-	JUSD (Linares)	--	--	27	
-	NE Corner Limonite and Clay	--	--	9	
-	W. Side Camino Real	--	--	8	
-	Camino Real South of Lamonite	--	--	<1	
	PROPOSED NEW AREAS OF REUSE				
-	Plant 2 (Indian Hills Golf Course)	--	--	600	
-	EDA Streetscape East of Camino Real & Limonite (Rubidioux Community Services District Area)	--	--	36	
	SUBTOTAL			**707**	*
	INDUSTRIES				
-	Robertson Ready Mix	--	--	25	
-	Northwest Pipe Company	--	--	35	
	SUBTOTAL			**60**	
	JCSD USERS SUBTOTAL			**767**	
			Say	**770**	**AFY**
B	**CITY OF RIVERSIDE USERS**				
200	**SCHOOLS**				
206	Adams Elementary School	8	4	10	
226	Jefferson Elementary School	10	5	13	
262	Norte Vista High School	47	24	59	
267	Terrace Elementary School	10	5	13	
	SUBTOTAL			**95**	
300	**GOLF COURSES**				
305	Van Buren Golf Center (Sky Links Executive Golf Course)	--	--	195	
	SUBTOTAL			**195**	
400	**PARKS**				
425	Martha McLean Anza Narrows	--	200	500	**
436	Rutland	9	9	23	
448	Hillside Ave (Future)	10	10	25	
	SUBTOTAL			**548**	

Table 6-1 (cont.)
Alternative 1 – JCSD, City of Riverside Users up to Arlington Avenue

500	**MISCELLANEOUS**				
503	Riverside Municipal Airport	304	50	125	
503	Riverside Municipal Airport (Future)	304	100	250	
605	Van Buren Median and Frontage (Urban Forest)	--	10	25	
	SUBTOTAL			**400**	
800	**INDUSTRIES - LANDSCAPE IRRIGATION AND POWER PLANT**				
806	Toro Irrigation (Manufacturing Company)	--	--	70	
807	Dow Jones & Company, Inc.	--	--	50	
903	400 MW Power Plant (planned by PUD in the near future)	--	--	150	**
	SUBTOTAL			**270**	
	CITY OF RIVERSIDE SUBTOTAL			**1,508**	**AFY**
	PROBABILITY OF CAPTURE - CITY OF RIVERSIDE (Approx. 70%)			**1,056**	**AFY**
			Say	**1,100**	**AFY**
	TOTAL USERS (CITY OF RIVERSIDE & JCSD)			**1,870**	**AFY**

Note:
* From JCSD Indian Hill Water Recycling Project Report
** Estimated per information provided by the City of Riverside Public Utility Department

Table 6-2
Alt. 2 – JCSD, City of Riverside Users up to North of Freeway 91 on Magnolia Ave. between Madison and Van Buren

Code	Potential Users	Total Acres	Irrigation Acres	Reuse Potential (AFY)	
A	**JURUPA COMMUNITY SERVICE DISTRICT USERS**				
-	**AREAS CURRENTLY USING POTABLE WATER**				
-	Havenview Park No. 1	--	--	12	
-	Havenview Park No. 2	--	--	15	
-	JUSD (Linares)	--	--	27	
-	NE Corner Limonite and Clay	--	--	9	
-	W. Side Camino Real	--	--	8	
-	Camino Real South of Lamonite	--	--	<1	
	PROPOSED NEW AREAS OF REUSE				
-	Plant 2 (Indian Hills Golf Course)	--	--	600	
-	EDA Streetscape East of Camino Real & Limonite (Rubidoux Community Services District Area)	--	--	36	
	SUBTOTAL			**707**	*
	INDUSTRIES				
-	Robertson Ready Mix	--	--	25	
-	Northwest Pipe Company	--	--	35	
	SUBTOTAL			**60**	
	JCSD USERS SUBTOTAL			**767**	
			Say	**770**	**AFY**
B	**CITY OF RIVERSIDE USERS**				
200	**SCHOOLS**				
201	Cal Baptist University	65	40	60	
206	Adams Elementary School	8	4	10	
213	Chemawa Middle School	21	11	26	
225	Jackson Elementary School			14	
226	Jefferson Elementary School	10	5	13	
228	Liberty Elementary School			5	
231	Madison Elementary School			13	
236	Notre Dame Elementary School			25	
240	Ramona High School	54	27	68	
242	Riverside Christain High School	20	10	25	
266	Sherman Indian High School	85	40	100	
	SUBTOTAL			**359**	

Table 6-2 (cont.)
Alt. 2 – JCSD, City of Riverside Users up to Arlington Ave., Adams St. & Magnolia Ave.

300	**GOLF COURSES**				
305	Van Buren Golf Center (Sky Links Executive Golf Course)	--	--	195	
	SUBTOTAL			**195**	
400	**PARKS**				
401	Arlington			10	
412	Don Jones			15	
413	Don Lorenzi Sport Camp			22	
424	Low			3	
425	Martha McLean Anza Narrows	--	200	500	**
436	Rutland	9	9	23	
437	Shamel			25	
448	Hillside Ave (Future)	10	10	25	
	SUBTOTAL			**623**	
500	**MISCELLANEOUS**				
502	Parkview Comm. Hosp. Med.Ctr.			13	
503	Riverside Municipal Airport	304	50	125	
503	Riverside Municipal Airport (Future)	304	100	250	
605	Van Buren Median and Frontage (Urban Forest)	--	10	25	
	SUBTOTAL			**413**	
800	**INDUSTRIES - LANDSCAPE IRRIGATION AND POWER PLANT**				
806	Toro Irrigation (Manufacturing Company)	--	--	70	
807	Dow Jones & Company, Inc.	--	--	50	
903	400 MW Power Plant (planned by PUD in the near future)	--	--	150	**
	SUBTOTAL			**270**	
C	**CALTRANS**				
C-2	3440 ADAMS			**23.2**	
C-7	3440 JACKSON			**24.0**	
C-8	3440 JEFFERSON			**14.7**	
C-10	3440 MADISON			**23.0**	
C-11	3440 MONROE			**9.9**	
C-14	3440 VAN BUREN			**34.7**	
	SUBTOTAL			**129.6**	**AFY**
	CITY OF RIVERSIDE SUBTOTAL			**1,990**	**AFY**
	PROBABILITY OF CAPTURE - CITY OF RIVERSIDE			**1,432**	**AFY**
	(Capture Probability is assumed 70% except for above CALTRANS data for which it is 100%)		**Say**	**1,500**	**AFY**
	TOTAL USERS (CITY OF RIVERSIDE & JCSD)			**2,270**	**AFY**

Note:
* From JCSD Indian Hill Water Recycling Project Report
** Estimated per information provided by the City of Riverside Public Utility Department

6.3 ALIGNMENTS

Several alignments for the Phase I Project distribution system were considered. These alternatives were reviewed to consider relative advantages based on field investigations, traffic conditions, existing utilities and input from City staff. A summary of the approximate footage for each alternative is shown in **Tables 6-3 and 6-4.**

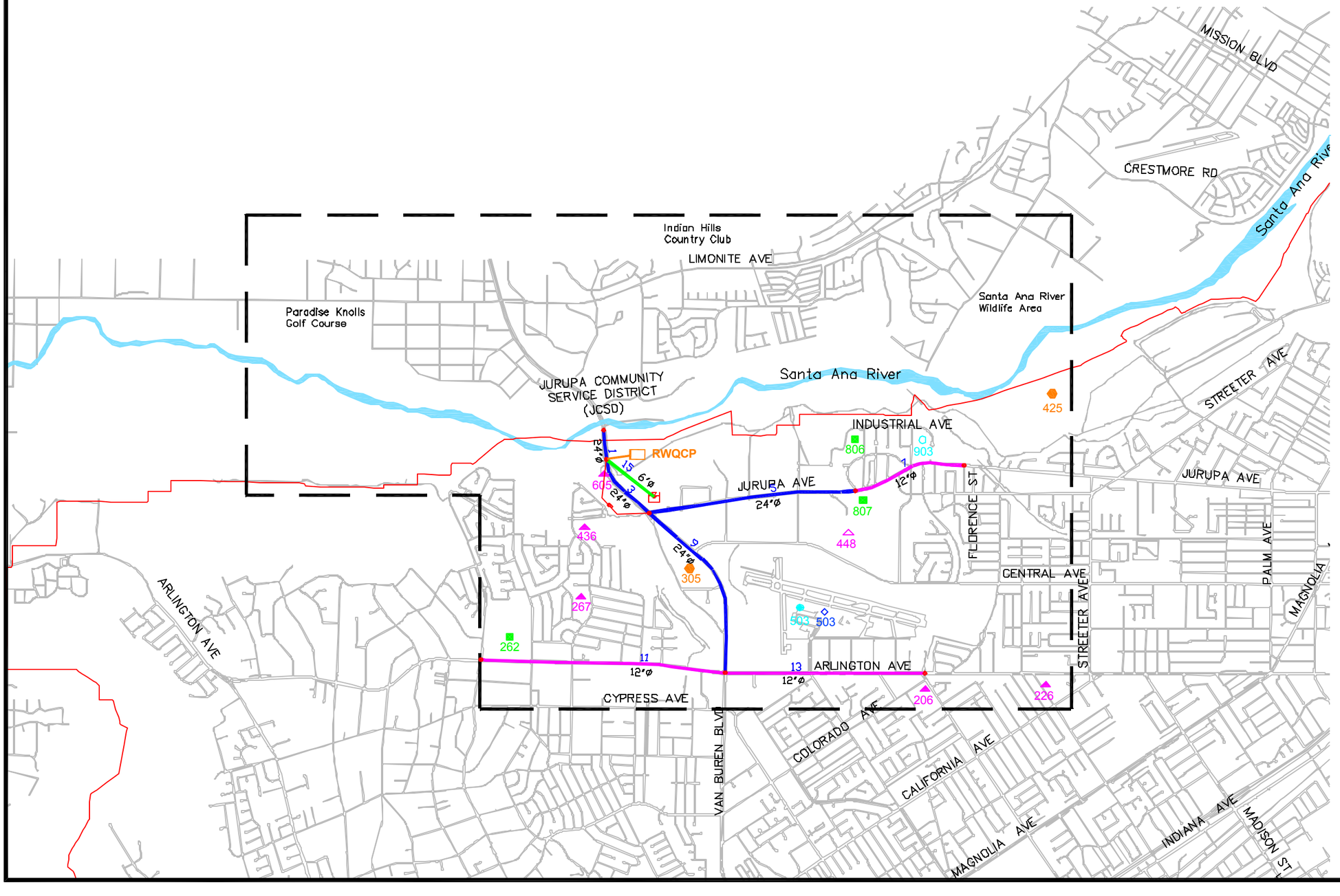
It is necessary to consider both economic and non-economic factors in the evaluation of each alternative alignment. Economic considerations include capital costs and constructability. Non-economic factors include community impact, traffic disruption, utility conflicts, easement/ROW requirements and permits, if required.

6.4 HYDRAULIC MODEL

The hydraulic model for the Phase I project was developed using H_2ONET v3.1 software, which included a 24-hour simulation and performance analysis. Water demand data of potential users was developed from a market survey analysis discussed in Section 4.

The hydraulic model geometry and physical characteristics of the distribution system include pipes (length, diameter, Hazen-Williams friction C-factor), pumps, and storage facilities. GIS files, provided by the City, were used as the basis to develop the model base maps. **Figures 6-1 and 6-2** present the proposed size of transmission pipelines for Alternatives 1 and 2 respectively.

City of Riverside
Recycled Water Phase I Feasibility Study



LEGEND

User Symbol Existing	User Symbol Future	Potential Reuse (Acre Feet / Year)
▲	△	10 – 49
■	□	50 – 99
●	○	100 – 199
◆	◇	200 – 399
⬢	⬡	400 Plus

- City of Riverside Boundary
- Alternative 1 Boundary
- Streets
- 6"Ø PIPE
- 12" Ø PIPE
- 24" Ø PIPE

N

GRAPHIC SCALE

0 3000' 6000'

SCALE: 1" = 3000'

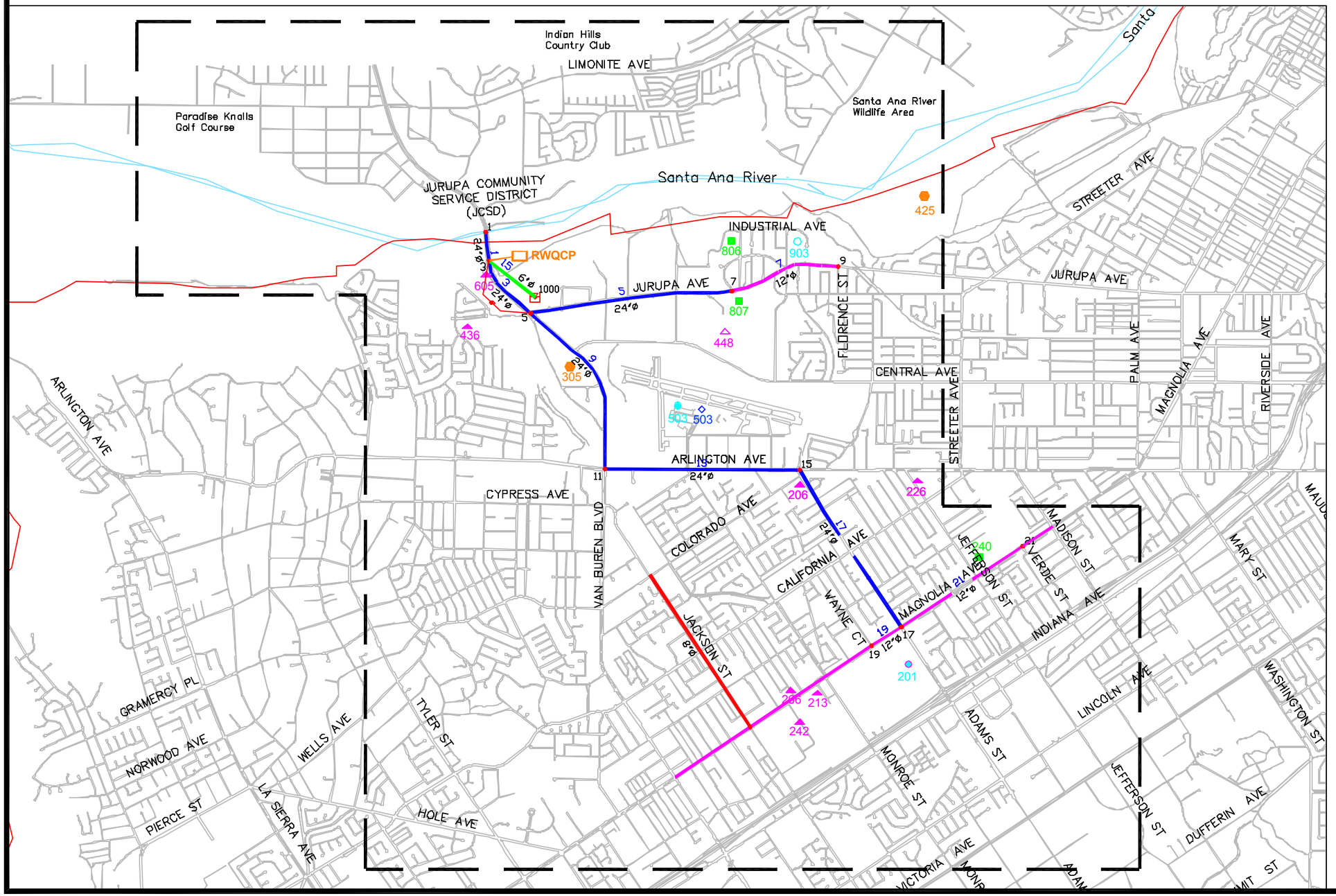
FIGURE 6-1 PHASE 1 - ALTERNATIVE 1

CITY OF RIVERSIDE

RECYCLED WATER PHASE I FEASIBILITY STUDY AND CITYWIDE MASTER PLAN

SEPTEMBER 2003

City of Riverside
Recycled Water Phase I Feasibility Study



LEGEND

User Symbol Existing	User Symbol Future	Potential Reuse (Acre Feet / Year)
▲	△	10 – 49
■	□	50 – 99
⬟	⬠	100 – 199
◆	◇	200 – 399
⬢	⬡	400 Plus

- City of Riverside Boundary
- Alternative 1 Boundary
- Streets
- 6"Ø PIPE
- 8"Ø PIPE
- 12"Ø PIPE
- 24"Ø PIPE

N

GRAPHIC SCALE
0 3000' 6000'
SCALE: 1" = 2000'

FIGURE 6-2 PHASE 1 - ALTERNATIVE 2

CITY OF RIVERSIDE

RECYCLED WATER PHASE I FEASIBILITY STUDY AND CITYWIDE MASTER PLAN

SEPTEMBER 2003

Design Criteria

Peaking factors have been established to account for monthly, daily and hourly variations in demand due to fluctuations in irrigation demands. Generally the average maximum day to yearly average day demand factor is approximately 2.5 for water recycling systems.

The peak hour to the yearly average day varies considerably depending on the type of water use. Industrial process demands are generally constant, but depend upon the hours of operation and on-site storage.

As a basis for design for the hydraulic model, the following peaking factors for irrigation demands were used:

- Golf Courses → 5.0
- Schools, Parks and Cemeteries → 3.0
- Industrial → 2.5

Peak hourly demands for golf courses is based on the assumption that irrigation operation will be four hours per day between midnight and 4:00 am, while for schools, parks, cemeteries and other irrigation users, an eight hour per day irrigation operation between the hours of 10:00 p.m. and 6:00 a.m. It should be noted that if golf courses incorporate water hazards (lakes) the peaking factor would be 1.0. The assumption is that recycled water can be delivered to a water hazard at a constant rate 24 hours of the day. At such time when irrigation demands for golf courses are required, the water source will be from the water hazards. The distribution system is designed to deliver the peak hourly demand while maintaining a minimum system pressure of 50 psi and a maximum pressure of 120 psi. Maximum pipeline velocities were maintained at 10 ft/sec or less.

Modeling Results

The following is a summary of the modeling results for each supply alternative as required to meet system demands anticipated in the Phase I project.

- ***Pipelines.*** **Tables 6-3 and 6-4** summarize the pertinent pipeline characteristics for Alternatives 1 and 2, respectively. The location, length, and proposed pipe diameter of each section are listed.
- ***Storage Facilities.*** The recycled water storage will be from the RWQCP chlorine contact tanks, which will be used as the operational storage for the Phase I Project.
- ***Pumping Station.*** It is anticipated that a booster pumping station will be installed at the chlorine contact tanks. The pumping facility at RWQCP requires a total firm capacity of approximately 6100 gpm. The station would include multiple pumps with one standby pump equal to the largest pump used in operation.

Table 6-3
Pipe Characteristics for Alternative 1a

Pipeline Location	Diameter (in)	Length (ft)
Van Buren Blvd. between City Limits (JCSD) and RWQCP	24	851
Van Buren Blvd. between RWQCP and Arlington Ave.	24	7700
Jurupa Ave. between Van Buren Blvd. and UP Railroad	24	6104
Jurupa Ave. between UP Railroad and Florence St.	12	3382
Arlington Ave. between Van Buren Blvd. and Tyler St.	12	7205
Arlington Ave. between Van Buren Blvd. and Adams St.	12	5862

Table 6-4
Pipe Characteristics for Alternative 2a

Pipeline Location	Diameter (in)	Length (ft)
Van Buren Blvd. between City Limits (JCSD) and RWQCP	24	851
Van Buren Blvd. between RWQCP and Arlington Ave.	24	7700
Jurupa Ave. between Van Buren Blvd. and UP Railroad	24	6104
Jurupa Ave. between UP Railroad and Florence St.	12	3382
Arlington Ave. between Van Buren Blvd. and Adams St.	24	5862
Adams St. between Arlington Ave. and Magnolia Ave.	24	5642
Magnolia Ave. between Adams St. and Van Buren Blvd.	12	7345
Magnolia Ave. between Adams St. and Medison St.	12	4700
Jackson St. between Magnolia Ave. and Colorado Ave.	8	5440

6.5 PHASE I FLEXIBILITY AND EXPANDABILITY

In analyzing the proposed pipe sizing for the Phase I project, consideration is given to determining the required ultimate pipe size when the citywide recycled water system is implemented. This approach, of course, increases the initial costs for the Phase I project due to the installation of larger diameter pipes. However installing the ultimate pipe size during Phase I will avoid the cost of installing parallel pipes when the citywide recycled water system is implemented in the future.

Tables 6-5 and 6-6 summarize the sizes of pipe installed in phase I in order to serve the citywide system. The detail analysis for these pipe sizes is discussed in Section 6, Citywide Recycled Water Master Plan.

Table 6-5
Pipe Characteristics for Alternative 1b
(Enlarged Size to Serve the Citywide System)

Pipeline Location	Diameter (in)	Length (ft)
Van Buren Blvd. between City Limits (JCSD) and RWQCP	24	851
Van Buren Blvd. between RWQCP and Arlington Ave.	30	7700
Jurupa Ave. between Van Buren Blvd. and UP Railroad	18	6104
Jurupa Ave. between UP Railroad and Florence St.	12	3382
Arlington Ave. between Van Buren Blvd. and Tyler St.	24	7205
Arlington Ave. between Van Buren Blvd. and Adams St.	24	5862

Table 6-6
Pipe Characteristics for Alternative 2b
(Enlarged Size to Serve the Citywide System)

Pipeline Location	Diameter (in)	Length (ft)
Van Buren Blvd. between City Limits (JCSD) and RWQCP	24	851
Van Buren Blvd. between RWQCP and Arlington Ave.	30	7700
Jurupa Ave. between Van Buren Blvd. and UP Railroad	18	6104
Jurupa Ave. between UP Railroad and Florence St.	12	3382
Arlington Ave. between Van Buren Blvd. and Adams St.	24	5862
Adams St. between Arlington Ave. and Magnolia Ave.	24	5642
Magnolia Ave. between Adams St. and Van Buren Blvd.	12	7345
Magnolia Ave. between Adams St. and Medison St.	24	4700
Jackson St. between Magnolia Ave. and Colorado Ave.	8	5440

6.6 PRICING CONCEPTS

The commitment of users from the City and JCSD to "buy into" a recycled water system is a factor in determining whether the project is economically feasible. The following items will determine the feasibility to construct a new recycled water system:

- Provide for incremental variable expenses (booster pumps, energy, chemicals) of the water distribution system. These incremental and variable expenses include the variable expenses associated with the RWQCP water treatment facility, booster pumps, the storage option, and transmission pipelines. The transmission pipelines are sized according to the capacity needed for distribution, and therefore the allocation of annual costs associated with financing and maintaining them should be easy to determine and non-controversial.
- Provide for fixed operations and maintenance (O&M) expense associated with water treatment facility, storage option selected, and the distribution system.
- Extent of availability of grants and other subsidies
- Repay fixed debt service (SRF loans and other debt service), and
- Repay cash advances (from other funds) over a predetermined schedule, including a mutually agreed-upon interest rate.

6.7 COMPARING ALTERNATIVE PRICING OPTIONS

Water rate data was collected from the City and evaluated to form the basis for recycled water pricing in the area. The City's potable water rates are summarized as follows:

- During summer, $379/AF ($0.87/100 CF)
- During winter, $292/AF
- Gage Shareholder Customers, $90/AF
- Schools, $350/AF
- Toro Manufacturing Company, $6/AF
- Sky Links Golf Course, $80/AF

As can be seen by these rates, there is a wide variation in rates for water usage provided by the City. Pricing of recycled water can range from a small fraction of the cost of potable water, to as costly as potable water or even more.

6.8 RECYCLED WATER PRODUCTION COST SUMMARY

Tables 6-7 through 6-10 summarize the anticipated recycled water production costs under different funding scenarios for Alternatives 1a and 1b. **Tables 6-11 through 6-36** provides cost criteria, capital and O&M calculations under selected funding scenarios for Alternatives 1a and 1b.

Table 6-7
Phase I Alternative 1a – System Designed with no Citywide Expansion Considerations
Summary of Recycled Water Production Cost Design for the Needs of City of Riverside

Item No.	Description of Preliminary Project Cost	Recycled Water Production Cost ($/AFY)
1.	City Funds - No Grants and/or Loans	550
2.	City Funds (75%) and Grant (25%)	439
3.	City Funds (25%) and SRF Loan (75%)	470
4.	Grant (25%) and SRF Loan (75%)	360
5	Grant (50%) and SRF Loan (50%) & no City Funds	276

Table 6-8
Phase I Alternative 1b – System Designed with Citywide Expansion Considerations
Summary of Recycled Water Production Cost Enlarged for the City of Riverside

Item No.	Description of Preliminary Project Cost	Recycled Water Production Cost ($/AFY)
1.	City Funds - No Grants and/or Loans	651
2.	City Funds (75%) and Grant (25%)	513
3.	City Funds (25%) and SRF Loan (75%)	552
4.	Grant (25%) and SRF Loan (75%)	413
5	Grant (50%) and SRF Loan (50%) & no City Funds	308

Table 6-9
Phase I Alternative 2a – System Designed with no Citywide Expansion Considerations
Summary of Recycled Water Production Cost for the City of Riverside

Item No.	Description of Preliminary Project Cost	Recycled Water Production Cost ($/AFY)
1.	City Funds - No Grants and/or Loans	569
2.	City Funds (75%) and Grant (25%)	448
3.	City Funds (25%) and SRF Loan (75%)	482
4.	Grant (25%) and SRF Loan (75%)	362
5	Grant (50%) and SRF Loan (50%) & no City Funds	270

Table 6-10
Phase I Alternative 2b – System Designed with Citywide Expansion Considerations
Summary of Recycled Water Production Cost Enlarged for the City of Riverside

Item No.	Description of Preliminary Project Cost	Recycled Water Production Cost ($/AFY)
1.	City Funds - No Grants and/or Loans	594
2.	City Funds (75%) and Grant (25%)	466
3.	City Funds (25%) and SRF Loan (75%)	502
4.	Grant (25%) and SRF Loan (75%)	374
5	Grant (50%) and SRF Loan (50%) & no City Funds	277

6.9 CAPITAL COST COMPARISON

Construction costs are estimated on a unit cost basis for each system component including a cost per linear ft for pipeline construction. Unit costs factors are broken down by pipe diameter with different cost factors used for urban and rural construction. Costs for pump stations and reservoirs are based on equations, with estimate cost for pump stations based on pump capacity and reservoir based on capacity.

Miscellaneous costs are included for meters, backflow prevention devices, and stand-by domestic service. Engineering costs and contingency costs are included as a percentage of construction cost. **Table 6-11** summarizes cost criteria used to estimate capital costs.

Table 6-11
Cost Criteria for Capital Cost Estimate

Item	Cost Factor
Pipeline Construction	$7/ft-in dia
Onsite conversion	$10,000/each
Storage Tanks	$0.80/gal
Booster Pump Station (included disinfection & miscellaneous structures)	$180/gpm
Engineering, Legal & Construction Administration	15% of total estimated cost
Construction Contingency	20% of total estimated cost

Preliminary capital and operational costs of two alternatives were estimated in order to determine the unit cost for recycled water. The cost and other criteria will be used to select a recycled water system alternative. The estimate is based on year 2001 costs at an ENR construction cost index of 7228 for the Los Angeles area for November 2002. It is assumed that the pipeline will be installed in existing City easements and/or public rights-of-way such as public streets. It is also assumed that the existing chlorine contact basins will serve as the system storage. The unit cost is based on 20-year bond. Potential savings of $209,856 on capital cost could be realized if using the existing 2,186 LF of 12" pipe from the RWQCP to Van Buren Golf Course.

A summary of the cost estimates for the two alternatives is presented in **Tables 6-12, 6-13, 6-14 and 6-15**. The estimate does not include financing cost. Estimated projected cost for the City of Riverside share includes 59% of Booster Pump Station cost. It is anticipated that the other 41% of Booster Pump Station cost will be paid by JCSD.

Table 6-12
Phase I Alternative 1a - Capital Cost for Transmission System Designed with no Citywide Expansion Considerations

System Description	Quantity	Total Cost
1. RWQCP Facilities		
a. Booster Pump Station (Including disinfection & Misc. Structures)	5,700 gpm	$1,026,000
2. Transmission Pipelines		
b. 12" Transmission Pipeline	16,449 LF	$1,381,716
c. 24" Transmission Pipeline	14,655 LF	$2,462,040
Transmission Pipeline Subtotal	31,104 LF	$3,843,756
3. Provision for On-Site Conversion @ Average $10,000/Each Site	13 Ea	$130,000
Total Estimated Cost		**$4,999,756**
Contingency @20%		**$999,951**
Engineering, legal and Administration @ 15%		**$899,956**
Total Estimated Project Cost		**$6,899,663**
	Say	**$6,900,000**
City of Riverside - Capital Expenditure Share		**$6,296,471 ***
	Say	**$6,297,000**

Note:
- The estimate is based on year 2002 costs at an ENR construction cost index of 7228 for the Los Angeles area for November 2002.
- It is assumed that the pipeline will be installed in existing City easements and/or public rights-of-way such as public streets.
- It is assumed that equalization basin at RWQCP is already in existence.
- Above estimates does not include financing cost.
- Potential savings on Capital Cost could use an existing 12" pipe located within RWQCP to Van Buren Golf Course.
  Estimated footage from RWQCP to Van Buren Golf Course: 2,186 LF
  Estimated Cost Savings: $183,624

* City of Riverside share includes proportion of Booster Pump Station cost.

(a) Potential Project Savings Cost to be deducted from City of Riverside - Capital Expenditure Share

(b) Assumed

Table 6-13
Phase I Alternative 1b - Capital Cost for Transmission System Designed with Citywide Expansion Considerations

System Description	Quantity	Total Cost
1. RWQCP Facilities		
a. Booster Pump Station (Including disinfection & Misc. Structures)	5,700 gpm	$1,026,000
2. Transmission Pipelines		
b. 12" Transmission Pipeline	3,382 LF	$284,088
c. 18" Transmission Pipeline	6,104 LF	$769,104
d. 24" Transmission Pipeline	13,918 LF	$2,338,224
e. 30" Transmission Pipeline	7,700 LF	$1,617,000
Transmission Pipeline Subtotal	31,104 LF	$5,008,416
3. Provision for On-Site Conversion @ Average $10,000/Each Site	13 Ea	$130,000
Total Estimated Cost		**$6,164,416**
Contigency @ 20%		**$1,232,883**
Engineering, Legal and Adminstration @15%		**$1,109,595**
Total Estimated Project Cost		**$8,506,894**
	Say	**$8,507,000**
City of Riverside - Capital Expenditure Share		**$7,903,471 ***
	Say	**$7,904,000**

Note:
- The estimate is based on year 2002 costs at an ENR construction cost index of 7228 for the Los Angeles area for November 2002.
- It is assumed that the pipeline will be installed in existing City easements and/or public rights-of-way such as public streets.
- It is assumed that equalization basin at RWQCP is already in existence.
- Above estimates does not include financing cost.
- Potential savings on Capital Cost could use an existing 12" pipe located within RWQCP to Van Buren Golf Course.

* City of Riverside share includes proportion of Booster Pump Station cost.

(a) Potential Project Savings Cost to be deducted from City of Riverside - Capital Expenditure Share

(b) Assumed

Table 6-14
Phase I Alternative 2a - Capital Cost for Transmission System Designed with no Citywide Expansion Considerations

System Description	Quantity	Total Cost
1. RWQCP Facilities		
a. Booster Pump Station (Including disinfection & Misc. Structures)	6,100 gpm	$1,098,000
2. Transmission Pipelines		
a. 8" Transmission Pipeline	5,440 LF	$304,640
b. 12" Transmission Pipeline	15,427 LF	$1,295,878
c. 24" Transmission Pipeline	26,159 LF	$4,394,628
Transmission Pipeline Subtotal	47,026 LF	$5,995,146
3. Provision for On-Site Conversion @ Average $10,000/Each Site	22 Ea	$220,000
Total Estimated Cost		**$7,313,146**
Contingency @ 20%		**$1,462,629**
Engineering, legal and Administration @ 15%		**$1,316,366**
Total Estimated Project Cost		**$10,092,142**
	Say	**$10,093,000**
City of Riverside - Capital Expenditure Share		**$9,367,449** *
	Say	**$9,368,000**

Note:
- The estimate is based on year 2002 costs at an ENR construction cost index of 7228 for the Los Angeles area for November 2002.
- It is assumed that the pipeline will be installed in existing City easements and/or public rights-of-way such as public streets.
- It is assumed that equalization basin at RWQCP is already in existence.
- Above estimates does not include financing cost.
- Potential savings on Capital Cost could use an existing 12" pipe located within RWQCP to Van Buren Golf Course.
  Estimated footage from RWQCP to Van Buren Golf Course: 2,186 LF
  Estimated Cost Savings: $183,624

* City of Riverside share includes propotion of Booster Pump Station cost.
(a) Potential Project Savings Cost to be deducted from City of Riverside - Capital Expenditure Share
(b) Assumed

Table 6-15
Phase I Alternative 2b - Capital Cost for Transmission System Designed with Citywide Expansion Considerations

System Description	Quantity	Total Cost
1. RWQCP Facilities		
a. Booster Pump Station (Including disinfection & Misc. Structures)	6,100 gpm	$1,098,000
2. Transmission Pipelines		
a. 8" Transmission Pipeline	5,440 LF	$304,640
b. 12" Transmission Pipeline	10,727 LF	$901,068
c. 18" Transmission Pipeline	6,104 LF	$769,104
d. 24" Transmission Pipeline	17,055 LF	$2,865,240
e. 30" Transmission Pipeline	7,700 LF	$1,617,000
Transmission Pipeline Subtotal	47,026 LF	$6,457,052
3. Provision for On-Site Conversion @ Average $10,000/Each Site	13 Ea	$130,000
Total Estimated Cost		**$7,685,052**
Contingency @ 20%		**$1,537,010**
Engineering, legal and Administration @ 15%		**$1,383,309**
Total Estimated Project Cost		**$10,605,372**
	Say	**$10,606,000**
City of Riverside - Capital Expenditure Share		**$9,960,118 ***
	Say	**$9,961,000**

Note:
- The estimate is based on year 2002 costs at an ENR construction cost index of 7228 for the Los Angeles area for November 2002.
- It is assumed that the pipeline will be installed in existing City easements and/or public rights-of-way such as public streets.
- It is assumed that equalization basin at RWQCP is already in existence.
- Above estimates does not include financing cost.
- Potential savings on Capital Cost could use an existing 12" pipe located within RWQCP to Van Buren Golf Course.

* City of Riverside share includes proportion of Booster Pump Station cost.
(a) Potential Project Savings Cost to be deducted from City of Riverside - Capital Expenditure Share
(b) Assumed

6.10 O&M COST COMPARISON

Operation and maintenance costs include the annual maintenance costs for pipelines, power, labor and pump station repairs. These costs were estimated as a percentage of construction cost. It was assumed that JCSD would share proportion of the costs for power, O & M and miscellaneous costs with the City. **Table 6-16** summarizes the cost criteria used to estimate the operation and maintenance cost as well as total annual costs.

Table 6-16
Cost Criteria for Annual Cost Estimates

Item	Cost Factor
Maintenance	
Pipelines	(Capital Expenditure) - (25% Grant x Capital Cost) (Capital Expenditure) - (75% SRF Loan x Capital Cost)
Reservoirs	None
Operation	
Power	$0.10/KWH
Treatment	None
Capitalization	5.5% Interest (City's loan) 2.4% Interest (SRF Loan) 20 Years Recovery Period

Total annual costs are based on the amortized construction cost plus the annual operation and maintenance cost. Capital costs are amortized based on 5.5 percent interest and a 20-year recovery period. **Tables 6-17 through 6-32** show the O & M cost assessed for the different alternatives.

Table 6-17
Alternative 1a – Preliminary Cost Estimate
City Funds – No Grants and/or Loans

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$43,300 /month	$40,600 /month
2. Operations and Maintenance		
a. Power Cost	$9,000 /month	$5,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$50,400 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$550 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-18
Alternative 1a – Preliminary Cost Estimate
City Funds (75%) and Grant (25%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$32,500 /month	$30,400 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,000 /month	$5,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$40,200 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$439 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-19
Alternative 1a – Preliminary Cost Estimate
City Funds (25%) SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan		
a. City Fund	$10,800 /month	$10,100 /month
b. SRF Loan	$24,800 /month	$23,200 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,000 /month	$5,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total **Recycled Water Production Cost for City of Riverside (1,100 AFY)**		**$43,100 /month*** **$470 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-20
Alternative 1a – Preliminary Cost Estimate
Grant (25%) and SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$24,800 /month	$23,200 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,000 /month	$5,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$3,000 /month	$2,500 /month
Total **Recycled Water Production Cost for City of Riverside (1,100 AFY)**		**$33,000 /month*** **$360 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-21
Alternative 1a – Preliminary Cost Estimate
Grant (50%) and SRF Loan (50%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$16,500 /month	$15,500 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,000 /month	$5,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$3,000 /month	$2,500 /month
Total		**$25,300 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$276 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-22
Alternative 1b – Preliminary Cost Estimate
City Funds – No Grants and/or Loans

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$54,400 /month	$50,900 /month
2. Operations and Maintenance		
a. Power Cost	$7,200 /month	$4,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$59,700 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$651 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-23
Alternative 1b – Preliminary Cost Estimate
City Funds (75%) and Grant (25%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$40,800 /month	$38,200 /month
2. Operation and Maintenance Cost		
a. Power Cost	$7,200 /month	$4,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$47,000 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$513 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-24
Alternative 1b – Preliminary Cost Estimate
City Funds (25%) SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan		
a. City Fund	$13,600 /month	$12,700 /month
b. SRF Loan	$31,100 /month	$29,100 /month
2. Operation and Maintenance Cost		
a. Power Cost	$7,200 /month	$4,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$50,600 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$552 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-25
Alternative 1b – Preliminary Cost Estimate
Grant (25%) and SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$31,100 /month	$29,100 /month
2. Operation and Maintenance Cost		
a. Power Cost	$7,200 /month	$4,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$3,000 /month	$2,500 /month
Total		**$37,900 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$413 /AF**

Note:

(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-26
Alternative 1b – Preliminary Cost Estimate
Grant (50%) and SRF Loan (50%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$20,700 /month	$19,400 /month
2. Operation and Maintenance Cost		
a. Power Cost	$7,200 /month	$4,300 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$3,000 /month	$2,500 /month
Total		**$28,200 /month***
Recycled Water Production Cost for City of Riverside (1,100 AFY)		**$308 /AF**

Note:

(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-27
Alternative 2a – Preliminary Cost Estimate
City Funds – No Grants and/or Loans

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$64,500 /month	$60,400 /month
2. Operations and Maintenance		
a. Power Cost	$9,300 /month	$6,200 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$71,100 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$569 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-28
Alternative 2a – Preliminary Cost Estimate
City Funds (75%) and Grant (25%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$48,300 /month	$45,300 /month
2. Operations and Maintenance		
a. Power Cost	$9,300 /month	$6,200 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$56,000 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$448 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-29
Alternative 2a – Preliminary Cost Estimate
City Funds (25%) SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan		
a. City Fund	$16,100 /month	$15,100 /month
b. SRF Loan	$36,900 /month	$34,500 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,300 /month	$6,200 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$3,000 /month	$2,500 /month
Total		**$60,300 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$482 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-30
Alternative 2a – Preliminary Cost Estimate
Grant (25%) and SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$36,900 /month	$34,500 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,300 /month	$6,200 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$3,000 /month	$2,500 /month
Total		**$45,200 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$362 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-31
Alternative 2a – Preliminary Cost Estimate
Grant (50%) and SRF Loan (50%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$24,600 /month	$23,000 /month
2. Operation and Maintenance Cost		
a. Power Cost	$9,300 /month	$6,200 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$3,000 /month	$2,500 /month
Total		**$33,700 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$270 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-32
Alternative 2b – Preliminary Cost Estimate
City Funds – No Grants and/or Loans

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$68,500 /month	$64,200 /month
2. Operations and Maintenance		
a. Power Cost	$8,400 /month	$5,600 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$4,000 /month	$2,500 /month
Total		**$74,300 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$594 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-33
Alternative 2b – Preliminary Cost Estimate
City Funds (75%) and Grant (25%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$51,400 /month	$48,100 /month
2. Operations and Maintenance		
a. Power Cost	$8,400 /month	$5,600 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$4,000 /month	$2,500 /month
Total		**$58,200 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$466 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-34
Alternative 2b– Preliminary Cost Estimate
City Funds (25%) SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan		
a. City Fund	$17,100 /month	$16,000 /month
b. SRF Loan	$39,200 /month	$36,700 /month
2. Operation and Maintenance Cost		
a. Power Cost	$8,400 /month	$5,600 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous, PS Repair & Maintenance Costs	$4,000 /month	$2,500 /month
Total		**$62,800 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$502 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-35
Alternative 2b – Preliminary Cost Estimate
Grant (25%) and SRF Loan (75%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$39,200 /month	$36,700 /month
2. Operation and Maintenance Cost		
a. Power Cost	$8,400 /month	$5,600 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$4,000 /month	$2,500 /month
Total		**$46,800 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$374 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

Table 6-36
Alternative 2b – Preliminary Cost Estimate
Grant (50%) and SRF Loan (50%)

Item Description	Total Cost	City of Riverside Share
1. Annuity of Loan	$26,100 /month	$24,500 /month
2. Operation and Maintenance Cost		
a. Power Cost	$8,400 /month	$5,600 /month
b. Labor Cost [(a)]	$2,500 /month	$2,000 /month
3. Miscellaneous Costs	$4,000 /month	$2,500 /month
Total		**$34,600 /month***
Recycled Water Production Cost for City of Riverside (1,500 AFY)		**$277 /AF**

Note:
(a) 1 person half time

* Assumes JCSD will share proportion of the costs for power, O & M and miscellaneous costs.

6.11 SUMMARY

Section 6 describes the Phase I – Water Recycling Project. The Phase I Project is restricted to about a 3-mile radius around the City's RWQCP. This 3-mile radius includes major potential users within the City, Jurupa Community Service District (JCSD) and Rubidoux Community Service District (RCSD). Two alternatives, with two sub-alternatives each, were identified, surveyed and evaluated for the development of Phase I – Water Recycling Project. These alternatives include:

- Alternative 1a – System designed with no citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue.
- Alternative 1b – System designed with citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue.
- Alternative 2a – System designed with no citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.
- Alternative 2b – System designed with citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.

A detailed presentation of the above alternatives, along with their associated costs under different financing scenarios, is given in Section 6 (**Table 6-3** through **Table 6-36**). To summarize, the total Phase I project cost will include miscellaneous water resources costs, the incremental costs associated with upgrading the City RWQCP system, and distribution costs within the City. **Table 6-37** (shown below) presents the combined capital and operation and maintenance costs for the different alternatives assessed for the project. It is observed that the water production cost for a system designed to meet only Phase I demand is lower than that for a system designed to meet citywide demand. Considering that the typical water production cost in Southern California ranges between $300/AFY to $700/AFY, the feasible Phase I recycled water system alternatives are:

- Alternative 1a – with or without Grant and Loan.
- Alternative 1b – only with Grant and Loan.
- Alternative 2a – with or without Grant and Loan.
- Alternative 2b – with or without Grant and Loan.

Total project cost will include miscellaneous water resources costs, the incremental costs associated with upgrading the City RWQCP system, and distribution costs within the City. **Table 6-37** presents the combined capital and operation and maintenance costs for the different alternatives assessed for the project. It is observed that water production cost for system designed to meet only phase I demand is lower than that for system to meet citywide demand. With a typical water cost ranging between $300/AFY to $700/AFY in Southern California, recycled water system for the city is feasible with Grant and Loan for phase I system that will implement citywide demand and feasible even without Grant and Loan for system that serve water users in phase I only.

Table 6-37
Summary of Alternative Pricing Options

Alternatives		Riverside Potential Reuse (AFY)	Pipe Length (LF)	Approximate Capital Cost	Water Production Cost				
					Option 1 ($/AFY)	Option 2 ($/AFY)	Option 3 ($/AFY)	Option 4 ($/AFY)	Option 5 ($/AFY)
1 - JCSD, City of Riverside Users up to Arlington Ave.									
A.	System to meet phase I demand only	1,100	31,104	$6,297,000	550	439	470	360	276
B.	System to meet Citywide demand also	1,100	31,104	$7,904,000	651	513	552	413	308
	Difference (A - B)			$1,607,000	$101	$74	$82	$53	$32
2 - JCSD, City of Riverside Users up to Arlington Ave., Adams St. & Magnolia Ave.									
A.	System to meet phase I demand only	1,500	47,026	$9,368,000	569	448	482	362	270
B.	System to meet Citywide demand also	1,500	47,026	$9,961,000	594	466	502	374	277
	Difference (A - B)			$593,000	$26	$18	$20	$13	$7

Option 1: City Funds - No Grants and/or Loans
Option 2: City Funds (75%) and Grant (25%)
Option 3: City Funds (25%) and SRF Loan (75%)
Option 4: Grant (25%) and SRF Loan (75%)
Option 5: Grant (50%) and SRF Loan (50%)

The recycled water project will provide benefits for many years after it is completed. There are several ways to finance such a project. Capital items that have a useful life over a long period may be financed over that period or on a "pay-as-you-use" basis. The term of the borrowing should coincide with or be less than the estimated useful life of the improvements if bond market conditions permit and if the debt obligation is within the City's ability to pay.

Majority of projects are financed by a combination of resources and financing techniques. The water recycling projects typically are not cost effective without innovative funding. Some of the more common financing techniques applicable in this case are reviewed here with the objective of finding the least cost method that is reasonable and within the City's ability to pay.

7.1 FUNDING ALTERNATIVES

A variety of funding alternatives as briefly described below could possibly used in for funding the projects developed under this master plan.

Proposition 13 (2000 Bond Law)

The Costa-Machado Water Act of 2000 (AB 1584) was approved by the voters as Proposition 13 on March 7, 2000. This new bond law includes loans and grants for the design and construction of water recycling projects. These are projects that reclaim either municipal wastewater or polluted groundwater. The State Water Resources Control Board (SWRCB) develops the priority list of projects proposed for funding with these grants and loans. The SWRCB administers two funding programs under Proposition 13:

- ***Water Recycling Facilities Planning Grant Program***

  The Water Recycling Facilities Planning Grant Program provides grants up to $75,000 to local public agencies to investigate the feasibility of water recycling and to prepare a facility's plan documenting the analyses and conclusions of the investigation.

- ***Water Recycling Construction Program***

  The Water Recycling Construction Program (formally the Water Recycling Loan Program) provides low-interest loans and grants to local public agencies for the design and construction of water recycling facilities. The types of facilities include wastewater treatment, recycled water storage facilities, pump stations, and recycled water distribution pipelines. A funding application includes a facilities plan to document the need for the project, the alternatives that were analyzed, and the engineering, economic, financial, and institutional feasibility of the proposed facilities.

Funding is provided to projects within the categories of projects that have completed or are in the final stages of facilities planning and that augment the state's water supply or provide other local benefits. A maximum funding amount of combined grant and loan per eligible water recycling project is set as $20 million. A set grant funding to 25 percent of eligible costs, up to $5 million per project with the balance of the eligible project cost to be funded with a low interest loan.

Proposition 13 provides both grants and additional SRF loan funds. 25% of project cost is allocated towards Proposition 13 Grant, while 75% of project cost is allocated towards State Revolving Fund (SRF) Loan with a low interest rate (typically it ranges between 2.8% and 2.4 %). There is no application deadline. The grant is allocated on a first come first serve basis.

Proposition 50

Water Quality, Supply and Safe Drinking Water Projects. Coastal Wetlands Purchase and Protection, State of California

Proposition 50 authorizes $3,440,000,000 general obligation bonds, to be repaid from state's General Fund, to fund a variety of water projects including: specified CALFED Bay-Delta Program projects including urban and agricultural water use efficiency projects; grants and loans to reduce Colorado River water use; purchasing, protecting and restoring coastal wetlands near urban areas; competitive grants for water management and water quality improvement projects; development of river parkways; improved security for state, local and regional water systems; and grants for desalination and drinking water disinfecting projects.

Appendix E provides copy of Proposition 50 and SAWPA Project information Form for Prop 50 potential funding.

Bureau of Reclamation

A bond measure was passed in 1984 authorizing the state to issue $25 million in low-interest loans for water recycling projects, which met certain technical and cost-effective criteria. This fund would be replenished through the repayment of loans drawn from it. Loan repayment was slow and the fund was being quickly depleted and subsequent bond measures were necessary to support the fund.

This program is administered by the SWRCB, Office of Water Recycling. Loan funds are available up to 100 percent of design and construction of water recycling projects. However, no single project may receive more than $5 million. Loans may be for a period of up to 20 years with an interest rate equal to the state's most recent General Obligation Bond sale interest rate.

California State Revolving Fund (SRF) Loans

The Federal Clean Water Act provides for the creation of a State Revolving Fund (SRF) Loan Program capitalized in part by federal funds. Between $150 to $200 million are available each year in this program. This program, which was originally designed to provide funding for high priority wastewater treatment and disposal

projects, was revised in September 1990 to include water recycling projects within its list of eligible projects.

SRF low interest loans are available through the California Department of Water Resources (DWR). With a successful application, DWR will commit funds on a predetermined schedule. California requires repayment of SRF loans at ½ of the interest rate it pays on the immediately preceding sale of its General Obligation Bonds, and therefore these loans are for a very low interest rate, currently at 2.4 percent. The State sells bonds on roughly 2-month intervals. Term for repayment may be from 15 to 20 years. It is thought repayment can be structured with an escalating annual debt service payment (if required) to match a reliable schedule of hook-ups, to track with anticipated cash flow from the project.

City's water recycling project already on the SWQCB priority list. Loans are provided based upon the readiness to construct, project qualification and availability of funds. Terms for a SRF loan are that the maximum repayment period is expected to be 20 years starting with the date on the grant/loan contract.

Other Grants and Loans

Occasionally, federal, state, and/or local grants and loans are available for water recycling projects. Federal funds are mostly available for low-income localities, and it is thought the service area may not qualify. City staff usually provides tracking of the availability and application requirements for locally available grants and loans.

General Obligation Bonds

Proposition 46 passed in 1986 opened the door to financing public facilities through general obligation (G.O.) bonds. G.O. bonds are the most efficient form of long-term financing (other than SRF loans) because the bond issues require neither a reserve fund nor funded interest during construction of the project financed. Costs of issuance are lower because these bonds are easier to structure, review from a legal standpoint, and analyze for credit-worthiness. G.O. bonds are secured by the properties in the City. Costs are generally borne by property owners in proportion to the assessed valuation of their properties. There would be considerable inequity because assessed valuation in many cases would not be representative of the true costs of the property if it had not changed ownership. Property owners throughout the City would in effect subsidize recycled water users. The major difficulty in issuing G.O. bonds is that they need to be approved by a two thirds majority of the voters. Educating the voters about the issues require time and resources. Because of the inequities discussed above, approval of two thirds of the electorate required before the bonds could be sold would be difficult.

Revenue Bonds

Revenue bonds are secured solely by a pledge of revenues. Usually an enterprise's revenues are derived from the facility that the bonds are used to acquire, construct, or improve. There is no obligation on the part of the enterprise to levy assessments for the payment of revenue bond service or for the maintenance and operation of the enterprise that produces the revenues that are pledged to pay bond service.

One measure of revenue bond security is the "coverage" provided. Coverage is the ratio of net revenue to annual bond service requirements. Net revenue is defined as the difference between operating revenues (including interest but not including connections fees) and the operating expenses (not including expenses related to new connections or depreciation). For revenue bonds to be saleable, the issuer normally pledges to maintain net revenue of 1.25 times annual bond service. The marketability of the bonds will be enhanced if it can be shown that the actual coverage provided by the net revenues will exceed the pledged ratio.

In addition, revenue bond buyers demand further safeguards by the establishment of a reserve fund equal to the average or maximum annual bond service. This reserve is normally created from the proceeds of the bond sale. The reserve is maintained for the entire life of the bond issue to meet annual principal and interest requirements in case operating revenues are insufficient for bond service in any given year.

Certificates of Participation (COPs)

This form of financing provides long term financing through a lease, installment sale agreement or loan agreement that is not subject to statutory limitations such as elections, interest rate limits, etc. The parties involved in a COP issue include the public entity (lessee), another public agency such as a redevelopment agency, or parking authority (the lessor) and a trustee. Legal basis for COPs comes from basic laws that allow public entities to enter into lease agreements one year at a time, with the understanding that a public entity cannot obligate future governing bodies to honor a lease agreement. This may result in COPs commanding a higher interest rate than revenue bonds. In other respects COPs are similar to revenue bonds.

Federal Budget Line Item Appropriations

Various large recycled water projects (such as the West Basin MWD Recycled Water Project located in the South Bay area of Los Angeles County) have been funded in part through Federal line item appropriations. This funding alternative is unusual and requires a lengthy lead-time.

7.2 SUMMARY

To summarize, standard practice for water recycling projects such as this one relies on California SRF loans, Proposition 13 grants, water system cash reserves, and, as required, long-term debt. The availability of water system cash reserves, or relatively short-term loans from the City, with repayment at interest from the water sales, is an important financing resource. The City would like to explore grant under the federal funds as discussed, Proposition 13 grants, and SRF loan. It is obvious that some kind of innovative project funding approach is must for the economical viability of the City's water recycling project.

The Section 8 of this master plan evaluates the potential project alternatives under following economical scenarios:

- No grant and SRF (City' own financing)
- Only 25% Proposition 13 grants
- Combination of proposition 13 and low interest rate SRF for the 75 percent of project cost.

Economic analysis based upon 100% grant money is not fair without commitment of full grant.

SECTION 8

PROJECT RECOMMENDATION AND IMPLEMENTATION PLAN

This section describes the recommendations and implementation plan for the Phase I Project and Citywide Water Recycling Master Plan.

The scope of this study included the following issues and topics:

- Recycled water source (City of Riverside, RWQCP), quantity and quality analysis;
- Identify potential direct recycled water users;
- Recycle water demand and supply analysis;
- Development of alternatives for recycled water system alternatives;
- Preliminary cost estimates and cost economics for most viable alternatives;
- Financial, institutional and regulatory issues;
- Recommendation of the most viable alternative; and
- Implementation plan for the recommended alternative.

8.1 CITYWIDE WATER RECYCLING MASTER PLAN

Section 5 describes the ultimate recycled water system to serve users within the City and JCSD and also Western MWD. The citywide project has a significant number of potential recycled water users with an estimated demand of 20,400 AFY. Preliminary capital and operational cost estimates and life-cycle costs for the citywide project were developed. This report will be used as road map to implement phased water recycling projects. A predesign/feasibility study, hydraulic analysis, funding plan, and economic analysis will be required for each phase.

8.2 WATER RECYCLED PHASE I PROJECT

Section 6 examined the following alternatives for developing Phase I - Project within the City and delivery of recycled water to JCSD. Each of these alternatives was also reviewed based on installing the ultimate pipe size required for the citywide water recycling system. The alternatives included:

- **Alternative 1a** – System designed with no citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue.
- **Alternative 1b** – System designed with citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue.
- **Alternative 2a** – System designed with no citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.

- **Alternative 2b** – System designed with citywide expansion considerations for JCSD and City of Riverside Users up to Arlington Avenue, Adams Street and Magnolia Avenue.

Section 6 also provided preliminary capital and operational cost estimates for the two alternatives and cost economics and life-cycle costs for each of the alternatives.

8.2.1 Phase I Project Implementation Recommendations

The following issues will impact the selection of the most viable alternative:

- Most practical and cost-effective;
- Consideration of groundwater recharge during low demand period;
- Refinement of distribution system during predesign; and
- Extent of environmental impacts.

As the initial phase of a water recycling system, Parsons recommends implementing Alternative 1a or 2a with grants and SRF loan. Both alternatives are very close and within the error of margin. Selection of any of these alternatives will depend upon conformation/firming of agreements with users and availability of funds.

8.2.2 Phase I Project Implementation Guidelines

Implementation of a recycled water program must consider many issues before design and construction programs are initiated. These issues must be resolved or addressed before final project feasibility and scope can be accurately determined. The following proposed implementation sequence provides a directive for effective implementation of the water recycling program in conjunction with the City's overall objectives. All of these tasks should be completed prior to project design.

- **Water Quality Issues.** Discuss water quality and groundwater recharge objectives with the RWQCP, especially regarding total dissolved solids (TDS) and nitrogen limitations. This issue is critical to the viability of the project and needs must be definitely resolved prior to implementation of the program.
- **Water Recycling Ordinance.** Consider issuing an ordinance on water recycling and a reuse compliance policy. This ordinance could mandate use of recycled water, and incorporate rules and regulations regarding the use of recycled water pursuant to DHS guidelines.
- **Recycled Water Supply.** Reevaluate the availability of the recycled water supply for the City of Riverside during different periods of the year based on additional information concerning JCSD and Western MWD systems. Consider implementing the project in phases in order to minimize the use of potable water during summer months.

- **Agreement with JCSD and Neighboring Cities.** Develop an agreement with JCSD and neighboring cities. Emphasize the following issues:

  - Recycled water purchase cost
  - JCSD and neighboring Cities system upgrade capital and O&M costs sharing
  - Recycled water sharing during different months of the year
  - Priority for surplus City of Riverside RWQCP water

  In the event of RWQCP expansion, the City should receive priority for all surplus water exceeding the City of Riverside requirements. This will provide an opportunity to serve more users within the City and within neighboring areas including JCSD, Rubidoux CDS, City of Norco, etc.

- **Users Involvement.** Contact all the identified users in order to get "buy-in" to a water recycling system as well as to confirm their demands. Obtain letters of intent from each user.

- **Environmental Documentation.** Prior to implementing the proposed project, the City will have to comply with the requirements of the California Environmental Quality Act (CEQA). An Initial Environmental Study (EIS) would investigate issues such as the potential impacts from the project construction on local traffic, air quality, biological resources, and/or archaeological resources. Operational impacts from project, including impacts to groundwater quality, would also be addressed. If no significant impacts were identified in the EIS, a Negative Declaration could be prepared. Otherwise, an Environmental Impact Report (EIR) will be required in order to fully address and mitigate any significant environmental effects.

- **Grant/Loan Application.** In order to obtain financial assistance from the State or other agencies, specific details of the proposed water recycled project must be provided in the grant/loan application. Due to the large number of grant/loan applicants and the long lag time between the application and granting of various loans, submission of all required information should be in as timely a fashion as feasible. Additionally, for state loans, certification of the required environmental documentation is required prior to an application package being deemed complete.

- **Engineering Report (Title 22 Report).** Title 22, Chapter 3, Article 7, Section 60323 of the California Code of Regulations requires an engineering report to be filed for any project producing or supplying recycled water for direct reuse. The report includes a description of recycled water production, transmission of the recycled water, existing and future users, and the proposed method of administering the recycled water system. Both the Regional Water Quality Control Board and the Department of Health Services review the Title 22 report prior to the Board issuing Water Reclamation Requirements for the project.

- **Public Information Program.** Develop a public information/awareness program in conjunction with the related conservation program.

- **Conversion Costs.** Estimate on-site conversion requirements and costs for each user.
- **Reliability and Public Health Protection.** Consider treatment reliability and public health protection guidelines (Appendix A).
- **Groundwater Recharge.** Evaluate the feasibility of groundwater recharge with recycled water from the RWQCP during low demand periods when up to 15-18 mgd of supply could be available. It may be cost effective for the City to recover recharged water as potable without any further treatment.