Trabuco Canyon Water District

Final Report

Water, Wastewater and Reclaimed Water Master Plan

December 1999

MONTGOMERY WATSON

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Executive Summary

This section presents a summary of the information included in the rest of this Master Plan Report. The purpose of this Executive Summary is to allow the reader an opportunity to peruse a synopsis of the information included in the remainder of the Report, without requiring a large time investment. The details and background of the information presented in this Section is included in Sections 1 through 8 and in Appendices A through D. This Executive Summary is focussed on the following topics; background of the project, project approach, water, wastewater, and reclaimed water system findings, recommendations, and master plan implementation.

BACKGROUND

The Trabuco Canyon Water District's (District's) previous water and wastewater master plan was done by NBS Lowry in 1992 and identified facilities needed to improve the existing system and provide upgraded service to the central portion of the District. The District requisitioned this Master Plan to provide recommendations for developing the necessary facilities to provide water, wastewater, and reclaimed water services for District customers throughout the District and adjacent planning areas through build-out. A location map of the District is shown in **Figure ES-1**.

The District has a population of approximately 10,300 people and is located in the southeastern portion of Orange County. The District provides sewer service to approximately 3,256 connections located within the District, 1,600 connections in the Irvine Ranch Water District (IRWD), and 233 connections in the Santa Margarita Water District (SMWD). The District provides water service to approximately 3,616 residential households located within the District and 532 households in the IRWD service area. The District provides reclaimed water service to three major users: Dove Canyon golf course, Dove Canyon Master Association (DCMA), and the Robinson Ranch Home Owners Association (HOA).

The District obtains water from a variety of sources including local groundwater wells, State Project water, and inter-ties with other water purveyors. The level of service provided to customers and the quantity of water provided within the District have increased over the years in conjunction with the District's growth.

The District treats a portion of the collected wastewater at the Robinson Ranch Wastewater Treatment Plant (RRWWTP) while the remainder is conveyed to SMWD for treatment at their Chiquita Wastewater Reclamation Plant. A major portion of the District remains unsewered.

The District reclaims the treated wastewater effluent from the RRWWTP by pumping treated and stored flows to the reclaimed water customers. In addition, "recycled" flows, which are stormwater runoff flows, can be pumped from the Dove Canyon Lake to augment treated effluent flows during periods of high demand.

PROJECT APPROACH

The generalized project approach for analyzing each of the systems (water, wastewater, and

Figure ES-1
Location Map

reclaimed water) consists of several stages as follows:

- Review submitted 24 hour extended period simulation (EPS) models of the existing systems. These models will also reflect the average day, maximum day (only for the water and reclaimed water systems), and peak hour operations.
- Evaluate models to determine existing system needs and potential solutions.
- Develop recommendations for the existing system based on model results and other, non-hydraulic system considerations.
- Develop build-out water demands, wastewater generation, and reclaimed water demand estimates.
- Model and evaluate future systems through District build-out conditions to determine future system needs.
- Prepare an existing system and buildout system Capital Improvement Program (CIP) to address both the magnitude and timing of deficiencies in each system.

PROJECTIONS

The timing of future flows (water and reclaimed water demands, as well as wastewater generation) can be estimated by reviewing historical population growth, but is more a function of the phasing of new developments. Historical and projected District population is presented in **Table ES-1**. The District was divided into three Planning Zones, as shown in **Figure ES-2**.

Table ES-1
Historical and Future District Population

Year	Population[1]
1994	7,943
1995	8,886
1996	9,413
1997	10,103
1998	10,282
2010	12,504
Build-out[1]	17,340

Note: 1. Historical data from estimates provided to the District by the Orange County Environmental Management Agency.
2. Estimated to occur at year 2030.

An initial phasing period was used based on including all developments that are currently in progress or that have made it known to the District that they will be developing soon. It was estimated that these developments would be complete by the year 2010. All other properties are anticipated to develop between the year 2010 and Build-Out. The properties estimated to be developed by the year 2010 are listed below for each planning area:

Figure ES-2
District Planning Zones

- **North.** Edgar 4-S Ranch North (Njd), Edgar 4-S Ranch South (Njd), Edgar Panter Ranch (Njd), Lyon (Beazer), Saddleback Meadows, Schefflete (Panter Ranch), South El Toro, Watson, and Zadeh.
- **Central.** Ferber, Hinrichs (Porter), Nursery properties, Porter, and Rose Canyon.
- **South.** None.

Estimates for water and reclaimed water demands, as well as wastewater flows, were made for existing, year 2010, and build-out conditions. A summary of these estimates are presented in **Table ES-2**.

Table ES-2
Estimate of Flows

Year and Area	Average Annual Flow (acre-ft/yr)	Average Daily Flow (mgd)	Maximum Day Flow (mgd)	Peak Hour Flow (mgd)
Existing (1998)				
Potable	1,938	1.73	3.36	8.30
Non-potable	1,669	1.49	3.27	9.81
Total Water	**3,607**	**3.22**	**6.63**	Note 1
Wastewater	**986**	**0.88**	**N/A**	**2.78**
Year 2010				
Potable	2,666	2.38	4.63	11.43
Non-potable	1,848	1.65	3.61	10.83
Total Water	**4,514**	**4.03**	**8.24**	Note 1
Wastewater	**1,411**	**1.26**	**N/A**	**4.00**
Build-out (Year 2030)				
Potable	3,047	2.72	5.30	13.09
Non-potable	2,206	1.97	4.33	12.99
Total Water	**5,253**	**4.69**	**9.63**	Note 1
Wastewater	**1,949**	**1.74**	**N/A**	**5.51**

Note: 1. Peak hour demands for potable and non-potable demands would not occur simultaneously.

WATER SYSTEM FINDINGS

Recommendations are summarized here for both existing and build-out conditions. These recommendations are in the categories of source water, treated water storage, booster pumps, control valves, and pipelines. Pressure zone modifications are not explicitly listed but are recommended through implementation of a combination of the above facilities. Each recommendation is accompanied by a brief explanation of the reason why the recommendation was made. A summary of the recommendations is presented in **Table ES-3**, including the page number in this report where the recommendation was originally made.

Table ES-3
Recommended Water System Improvements

Facility Description	Recommendation		Comment	Page
	Existing	Build-Out		
Source Water				
Construct DWTP Backwash Storage Tank	0.18 MG		Minimizes distribution system impacts during filter backwash	4-29
Baffle DWTP Clearwell	0.1 MG		Increases disinfection CT credit	4-29
Improve DWTP Disinfection System	Note 2		Compliance with Disinfection/ Disinfectant Byproducts Rule	4-29
Construct Treatment for Rose and Lang Wells[3]	1.6 mgd		Compliance with Surface Water Treatment Rule	4-29
DWTP Booster Pump	300 hp	None	Spare pump and motor for redundancy	5-32
P T Booster Pump	None	100 hp	Spare pump and motor for redundancy	5-41
Treated Water Storage				
Harris Grade Site	2.61 MG	None	For Ex. System Needs[4]	5-35
Harris Grade No. 2	Various	None	Recoat, EQ-proof, and OSHA ladder[4]	5-40
Upper Harris Grade Site	None	3.00 MG		5-42
Rose Canyon	Various	None	Recoat, EQ-proof, and OSHA ladder	5-40
Cooks	Various	None	Recoat, EQ-proof, and OSHA ladder	5-40
Booster Pump				
Rose Canyon Diesel Generator	100 hp	None	Fire protection for Joplin	5-37
Canyon Creek Fire Pump	300 hp	None	At build-out, entire zone can be served by Upper Harris Grade zone.	5-36
Robinson Ranch	30 hp	None	Additional 5 hp added now for build-out	5-37, 5-46
Upper Harris Grade	None	50 hp	Supply new Upper Harris Grade Reservoir	5-46
Control Valve				
Harris Grade to Trabuco Oaks	8-in	None	Fire Protection	5-38
Pipeline				
Mountain View Rd, 8-in.	800 ft.	None	Fire Protection.	5-38
Santiago Canyon Rd, 12-in.	None	2,300 ft.	Required for Fire Protection	5-48
Via Del Lago St., 8-in.	510 ft.	None	High Country Zone modification between Weeping Willow St. and Via Del La Luz	5-32
Via Del Lago St., 8-in.	640 ft.	None	High Country Zone modification; Via Del La Luz to Via Del Sol.	5-32
Booster Station piping, 8-in	None	400 ft.	Suction and discharge; UHG zone.	5-46
Live Oak Canyon Rd, 8-in	None	1,700 ft.	Edgar 4-S to Truck Trail; UHG zone.	5-46
Live Oak Canyon Rd, 8-in	None	2,740 ft.	Truck Trail to Canyon Cr.; UHG zone.	5-46
Hamilton Truck Trail, 8-in	None	5,300 ft.	Live Oak to Trabuco Oak; UHG zone.	5-46
Easement, 8-in	None	1,160 ft.	Live Oak to UHG Res.; UHG zone.	5-46
Easement, 8-in	None	2,500 ft.	UHG Res. to Canyon Cr.; UHG zone.	5-46
Canyon Creek Prop., 8-in	None	3,050 ft.	On Canyon Cr. Property; UHG zone.	5-46

Note:
1. EQ = Earthquake.
2. Need for new disinfection system to be based on a detailed evaluation of DWTP.
3. Final recommendation to be based on feasibility study.
4. Alternatively, Harris Grade No. 2 could be demolished and a 3.0 MG reservoir installed.

Figure ES-3
Recommended Water System Improvements

11 x 17

In some instances, a recommendation is made for the existing system and is overridden by a recommendation for the build-out system. This is due to the desire to make improvements to the system based on a global understanding of ultimate requirements. A graphical presentation of recommended system improvement locations is presented in **Figure ES-3**.

WASTEWATER SYSTEM FINDINGS

This section recommended a number of improvements to the District's wastewater system. **Table ES-4** presents a summary of the recommended wastewater improvements along with the recommended capacity and a brief explanation for the improvement. The page number of this section where the recommendation is discussed is also included. **Figure ES-4** presents the location of the proposed improvements and categorizes them between existing and future needs.

Table ES-4
Recommended Wastewater System Improvements

Description	Recommendation		Comment	Page
	Existing	Build-out		
RRWWTP				
Title 22 Improvements	Various		Upgrade existing plant	6-23 – 6-24
Plant Expansion		0.5 mgd	Meets future flows	6-39
Sewer Lift Stations (SLS)				
Golf Club	x		Pressure grout cracks	6-17
Via Alegre	x		Corrosion and odor control	6-17
Heritage	x		Pressure grout cracks, verify standby pump	6-17
Live Oak		200 hp	Serves Central System	6-29
Nursery		200 hp	Serves Central System	6-29
Gravity Sewers				
North System				
Live Oak Canyon Rd., 8-in.		4,500 ft	Flows to El Toro system	6-29
Central System No. 1				
Live Oak Canyon Rd., 8-in		12,500 ft	Flows to Live Oak SLS	6-29
Central System No. 2				
T.O. Dr./Hamilton Truck Tr., 8-in.		9,900 ft	Serves Trabuco Oaks area	6-29
Rose Canyon Rd., 8-in		9,900 ft	Serves Rose Canyon area	6-29
Trabuco Creek Rd., 8-in		11,100 ft	Flows to Live Oak SLS	6-29
Trabuco Canyon Rd., 8-in		3,300 ft	Flows to Live Oak SLS	6-29
Trabuco Canyon Rd., 10-in		900 ft	Flows to Live Oak SLS	6-29
Trabuco Canyon Rd., 12-in		4,900 ft	Flows to Live Oak SLS	6-29
Adkinson Ln., 8-in		500 ft	Local laterals	6-30
Sycamore Dr., 8-in		2,200 ft	Local laterals	6-30
Mountain View Rd., 8-in		2,000 ft	Local laterals	6-30
Flanagan Rd., 8-in		2,000 ft	Local laterals	6-30
Hunky Dorie Ln., 8-in		2,000 ft	Local laterals	6-30
Lambrose Canyon Rd., 8-in		3,200 ft	Local laterals	6-30
Force Mains				
Trabuco Canyon Rd., 10-in		15,800 ft	Flows to RRWWTP	6-30

Note: 1. Page listed is in Section 6.

RECLAIMED WATER SYSTEM FINDINGS

Reclaimed water is planned to be served to the South planning area and to the nursery property. In addition to new pipelines necessary to serve existing customers, a new pressure zone is recommended in Upper Robinson Ranch. To serve the potential customers in this new pressure zone, it is necessary to add a new booster station, PRS, and pipelines. Two new pumps are recommended and these pumps would obtain suction from the discharge of the DCIPS, similar to the existing RRIPS, and would provide water to the Upper Robinson Ranch pressure zone. The pumps would each provide 710 gpm and would need to be approximately 75 hp. In addition, a PRS is recommended in Robinson Ranch Road for pressure relief and for redundancy. Finally, additional pipelines are recommended as summarized in **Table ES-5** and as shown in **Figure ES-5**.

Table ES-5
Recommended Reclaimed Water Pipeline Additions

Location	Diameter (in)	Length (ft)
Robinson Ranch Zone		
Between High Country Dr. and Weeping Willow St.	6	170
Plano Trabuco Rd.	3	1,340
Rancho Cielo Dr.	4	3,030
Via De La Luz	4	970
Property line between Cimmaron Ln. and Mill Stream Rd.	6	2,300
Between property line and Mill Stream Rd.	4	240
Mill Stream Rd.	4	730
Country Hollow Ln.	4	880
Upper Robinson Ranch Zone		
Between new Pump Station and Brookseed Dr.	10	2,730
Brookseed Dr., from end of cul-de-sac to Sentinel Dr.	8	1,430
Sentinel Dr., between Brookseed Dr. and Robinson Ranch Rd.	8	1,200
Robinson Ranch Rd., between Sentinel Dr. and Raintree Ln.	8	1,660
Robinson Ranch Rd., between Raintree Ln. and Shadow Rock Ln.	6	700
Raintree Ln., between Robinson Ranch and Porter Ranch Rds.	8	1,690
Porter Ranch Rd., between Shadow Rock Ln. and Quicksilver Dr.	6	1,800
Quicksilver Dr., between Porter Ranch Rd. and Shadow Rock Ln.	6	310
Shadow Rock Ln., between Quicksilver Dr. and Robinson Ranch Rd.	6	1,060
Total		**22,240**

Figure ES-4
Recommended Wastewater System Improvements

11x17

Figure ES-5
Recommended Reclaimed Water System Improvements

RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

It is of critical importance that the District be able to phase the recommended improvements in a manner that is tied to development. If development occurred exactly as desired for smooth implementation of recommended facilities, then all of the developments that benefit from a particular improvement would come on-line simultaneously. What is more likely to happen is that development will occur in sporadic locations, driven by rationale outside of District control. This type of development pattern is typical and the goal is to provide the District with a method of responding to this development, in as economical of a fashion as possible.

Parcels already identified for short-term development have been listed and graphically represented on **Figure 2-3**. Development typically occurs in clusters. One explanation for this is that when the District constructs the improvements necessary to support particular parcels, it is easier for neighboring parcels to develop because they would then have access to water, wastewater, and, in some cases, reclaimed water service. Another way of looking at this is that the phasing of water, wastewater, and reclaimed water facilities must occur in conjunction with each other as any area that needs one service, typically needs the others. This understanding of development patterns was utilized to develop the anticipated order of facility recommendations listed in the CIP.

As detailed in Sections 4, 5, 6, and 7, improvements have been recommended for both existing and build-out conditions for the water, wastewater, and reclaimed water systems, respectively. Both our understanding of the system's existing needs and conversations with District staff regarding the recommended improvements indicated that many of the recommended improvements are necessary "as soon as possible". In addition, some capital improvements may be done in-house by District staff as time and resources become available.

The CIP has been developed in three phases. The first phase covers for existing needs through the next six years (Year 2000-2005 Existing CIP). The second phase covers new development expected by 2010 (Year 2000-2010 Future CIP), and for the remainder of new development to build-out (Year 2011 to Build-Out Future CIP). These CIPs are presented in **Tables ES-6** through **ES-8** and are summarized in **Table ES-9**.

Figure ES-6 presents a chart of annual expenditures for each of the three systems. This chart assumes uniform annual expenditures for each of the CIP stages. Actual annual expenditures would be a function of development trends and District funding capabilities.

The trigger point for implementing a given system improvement is a developer's request for service from the District. This request starts a review process by the District to determine if the existing facilities are adequate to provide service. If the existing facilities are inadequate to meet the needs of the development, then design and construction of the propose facilities would commence. When development occurs at different time periods or in a different order than assumed in Section 2, the timing for construction of recommended improvements accelerate or decelerate. Furthermore, if additional parcels along a different gravity sewer begin the development process, then they should be reviewed with respect to dates anticipated for scheduled gravity sewers. The District should use this master plan as a guide in determining what facilities must be constructed and paid for by an individual developer or group of developers.

Table ES-6
Year 2000-2005 Existing CIP

Description	Size/Capacity	Total Cost[1]
WATER		
Construct DWTP Backwash Storage Tank	0.18 MG	$ 270,000
Construct Baffled Clearwell at DWTP	0.1 MG	190,000
Improve DWTP Disinfection System[2]	Lump sum	20,000
Spare Pump and Motor at DWTP	300 hp	50,000
Construct Microfiltration Plant for Rose and Lang Wells	1.6 mgd	3,660,000
Construct New Reservoir at Harris Grade Site	3.0 MG	1,530,000
Demolish: Harris Grade Reservoir No. 2	Lump sum	20,000
Recoat, EQ-proof, install OSHA ladder: Rose Canyon Reservoir	Lump sum	130,000
Recoat, EQ-proof, install OSHA ladder: Cooks Reservoir	Lump sum	70,000
Install Canyon Creek Fire Pump	150 hp	320,000
Install Rose Canyon Pump Station Generator	200 kW	50,000
Install 8-in pipe in Mountain View Rd.	800 feet	110,000
Install 8-in pipe in Via Del Lago St.	500 feet	70,000
Install 8-in pipe in Via Del Lago St.	600 feet	90,000
Year 2000 Water Subtotal		**$6,580,000**
WASTEWATER		
Implement RRWWTP Title 22 Improvements	See Table 6-5	1,040,000
Construct Additional Reclaimed Reservoir Storage[3]	90 ac-ft	4,500,000
Pressure grout cracks at Golf Club Sewer Lift Station	Lump sum	30,000
Implement corrosion and odor control improvements at Via Alegre Sewer Lift Station	Lump sum	100,000
Pressure grout cracks at Heritage Sewer Lift Station	Lump sum	30,000
Install standby generator in Heritage Sewer Lift Station	150 kW	40,000
Year 2000 Wastewater Subtotal		**$5,740,000**
RECLAIMED WATER		
Install Upper Robinson Ranch Irrigation Booster Sta.	150 hp	600,000
Install Robinson Ranch Rd. PRS	Lump sum	130,000
Install 6-in pipe in High Country/Weeping Willow	170 ft	20,000
Install 3-in pipe in Plano Trabuco Rd.	1,340 ft	100,000
Install 4-in pipe in Rancho Cielo Dr.	3,030 ft	280,000
Install 4-in pipe in Via De La Luz	970 ft	90,000
Install 6-in pipe down property line	2,300 ft	200,000
Install 4-in pipe in Property line to Mill Stream Rd.	240 ft	30,000
Install 4-in pipe in Mill Stream Rd.	730 ft	70,000
Install 4-in pipe in Country Hollow Ln.	880 ft	80,000
Install 10-in pipe from New PS to Brookseed Dr.	2,730 ft	240,000

Table ES-6
Year 2000-2005 Existing CIP
(Continued)

Description	Size/Capacity	Total Cost[1]
Install 8-in pipe in Brookseed Dr.	1,430 ft	140,000
Install 8-in pipe in Sentinel Dr.	1,200 ft	120,000
Install 8-in pipe in Robinson Ranch Rd.	1,660 ft	160,000
Install 6-in pipe in Robinson Ranch Rd.	700 ft	70,000
Install 8-in pipe in Raintree Ln.	1,690 ft	170,000
Install 6-in pipe in Porter Ranch Rd.	1,800 ft	160,000
Install 6-in pipe in Quicksilver Dr.	310 ft	40,000
Install 6-in pipe in Shadow Rock Ln.	1,060 ft	100,000
Year 2000 Reclaimed Water Subtotal		**$960,000**
Year 2000 Improvements Total		**$15,120,000**

Note: 1. All costs rounded to next higher ten thousand dollars.
2. Need for new disinfection system to be based on a detailed plant evaluation.
3. Cost is based on order of magnitude estimate for a roller-compacted concrete dam across canyon near the RRWWTP. A detailed site evaluation is required to better define this estimate.

Many of the parcels that are expected to develop will also require on-site water, sewer or reclaimed water facilities to serve the individual tract. In this case, it is recommended that the developer (or developers) fund the preparation of a subarea master plan. The subarea master plan would define the specific facilities needed to meet the on-site facility needs and identify the points of connection to the District's facilities. If several parcels develop simultaneously, the subarea master plan could identify those facilities that could jointly serve all of the parcels (such as booster pumps, reservoirs, etc.)

There is no way to link recommended improvements to the number of connections or the District's population, because the important information is knowing exactly where in the District each developing parcel is located. The one exception to this is the expansion of the RRWWTP, which should be implemented based on the anticipated amount of wastewater being generated. The average wastewater flow at the RRWWTP in year 2010 will be 0.92 mgd based on development of properties shown in **Figure 2-3.** will be 0.92 mgd This flow exceeds the current treatment plant capacity of 0.85 mgd. The RRWWTP expansion, as described in Section 6, can be performed in a modular fashion. It is recommended that a pre-design of the expansion be conducted in the near future so that proper staging of expansion components can take place at the appropriate time.

Table ES-7
Year 2000-2010 Future CIP

Description	Size/Capacity	Total Cost[1]
WATER		
Construct Upper Harris Grade Reservoir	3.0 MG	1,530,000
Construct Upper Harris Grade Booster Station	50 hp	250,000
Install 12-in pipe in Santiago Canyon Rd.	2,300 feet	330,000
Install 8-in Upper Harris Grade BS piping	400 feet	60,000
Install 8-in pipe in Live Oak Canyon Rd.	1,700 feet	170,000
Install 8-in pipe in Live Oak Canyon Rd.	2,700 feet	260,000
Install 8-in pipe in Hamilton Truck Trail	5,300 feet	510,000
Install 8-in pipe in Upper Harris Grade Easement	1,200 feet	120,000
Install 8-in pipe in Upper Harris Grade Easement	2,500 feet	240,000
Install 8-in pipe in Canyon Creek Property	3,100 feet	300,000
Year 2010 Water Subtotal		**$3,770,000**
WASTEWATER		
Expand RRWWTP	0.5 mgd	6,440,000
Construct Additional Reclaimed Reservoir Storage[2]	130 ac-ft	6,500,000
Install Live Oak Sewer Lift Station	200 hp	1,620,000
Install Nursery Sewer Lift Station	200 hp	1,620,000
Install 8-in gravity pipe in Live Oak Canyon Rd.	4,500 feet	950,000
Install 8-in gravity pipe in Live Oak Canyon Rd.	12,500 feet	2,630,000
Install 8-in gravity pipe in Rose Canyon Rd.	4,500 feet	860,000
Install 8-in gravity pipe in Trabuco Creek Rd.	11,100 feet	2,110,000
Install 8-in gravity pipe in Trabuco Canyon Rd.	3,300 feet	630,000
Install 10-in gravity pipe in Trabuco Canyon Rd.	900 feet	190,000
Install 12-in gravity pipe in Trabuco Canyon Rd.	4,900 feet	1,160,000
Install 8-in gravity pipe in Hunky Dorie Ln.	2,000 feet	380,000
Install 8-in gravity pipe in Lambrose Canyon Rd.	3,200 feet	610,000
Install 10-in force main in Trabuco Canyon Rd.	15,800 feet	2,690,000
Additional Localized Facilities[3]	Lump sum	2,170,000
Year 2010 Wastewater Subtotal		**$30,560,000**
Year 2010 Improvements Total[4]		**$34,330,000**

Note:
1. All costs rounded to next higher ten thousand dollars.
2. Cost is based on order of magnitude estimate for a roller-compacted concrete dam across canyon near the RRWWTP. A detailed site evaluation is required to better define this estimate.
3. An allowance of 15 percent of the collection system cost is included for special construction such as local lift stations and creek crossing. The allowance does not include sewer lines serving individual streets and homes.
4. No reclaimed water system improvements are recommended for this time period.

Table ES-8
Year 2011 to Build-Out Future CIP

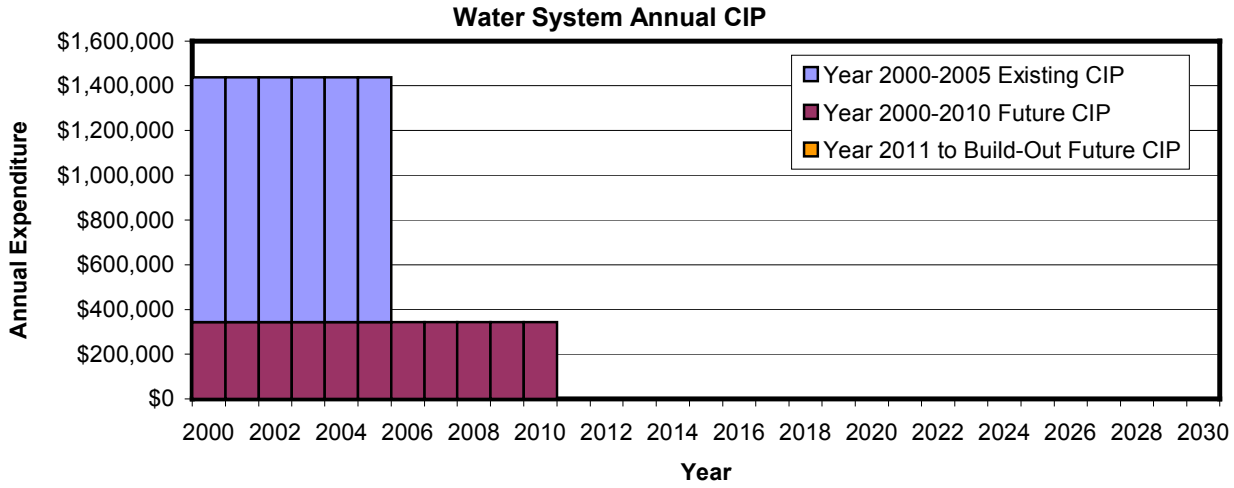
Description	Size/Capacity	Total Cost[1]
WATER		
Upgrade Plano/Trabuco Booster Pump Station	120 hp	30,000
Year 2020 Water Subtotal		**$30,000**
WASTEWATER		
Install 8-in gravity pipe in T.O. Dr./Hamilton Truck Tr.	9,900 feet	1,890,000
Install 8-in gravity pipe in Rose Canyon Rd.	5,400 feet	1,030,000
Install 8-in gravity pipe in Adkinson Ln.	500 feet	100,000
Install 8-in gravity pipe in Sycamore Dr.	2,200 feet	420,000
Install 8-in gravity pipe in Mountain View Rd.	2,000 feet	380,000
Install 8-in gravity pipe in Flanagan Rd.	2,000 feet	380,000
Additional Localized Facilities[2]	N/A	440,000
Year 2020 Wastewater Subtotal		**$4,640,000**
Year 2020 Improvements Total[3]		**$4,670,000**

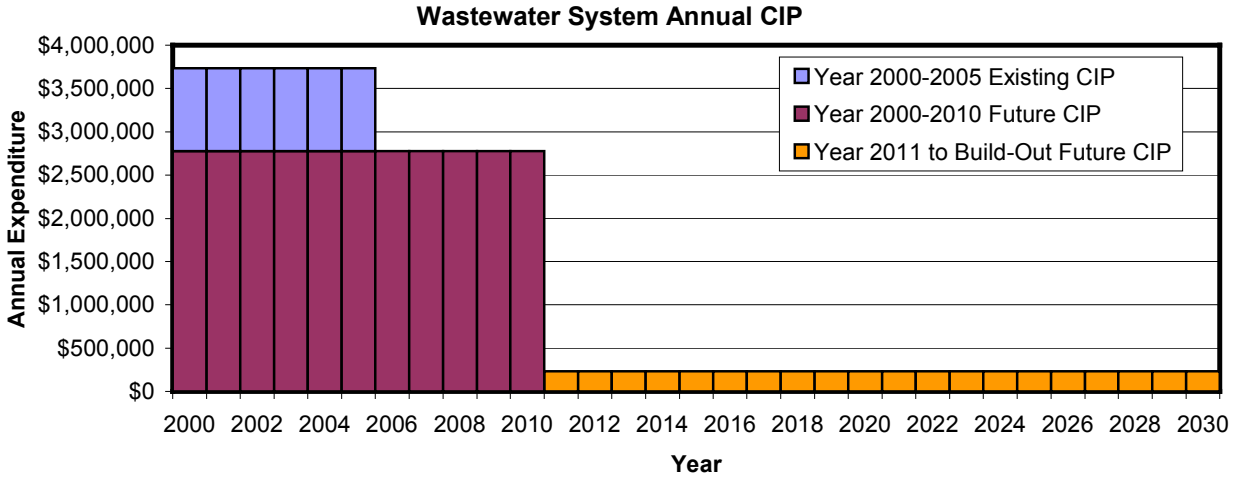
Note: 1. All costs rounded to next higher ten thousand dollars.
2. An allowance of 15 percent of the collection system cost is included for special construction such as local lift stations and creek crossing. The allowance does not include sewer lines serving individual streets and homes.
3. No reclaimed water system improvements are recommended for this time period.

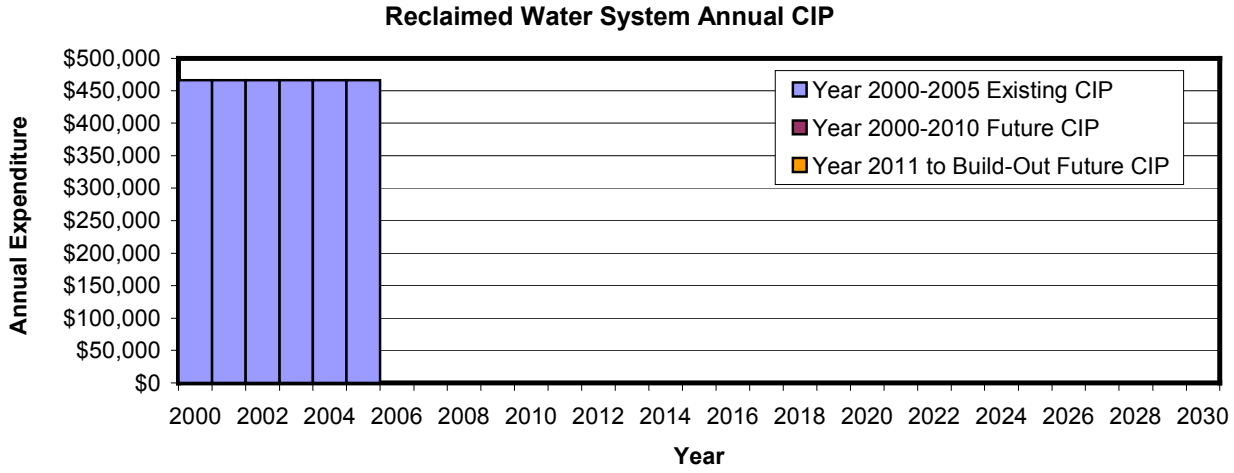
Table ES-9
Summary of Recommended CIP Costs

Description	Total Cost ($)
Year 2000-2005 Existing CIP	
Water	$6,580,000
Wastewater	5,740,000
Reclaimed Water	2,800,000
Subtotal	**$15,120,000**
Year 2000-2010 Future CIP	
Water	3,770,000
Wastewater	30,560,000
Subtotal	**$34,330,000**
Year 2011 to Build-Out Future CIP	
Water	30,000
Wastewater	4,640,000
Subtotal	**$4,670,000**
Grand Total	**$54,120,000**

Figure ES-6
Proposed Capital Improvement Program Expenditures







ADDITIONAL INVESTIGATIONS AND ON-GOING PROGRAMS

There are several specific investigations that have been recommended in this master plan update. These investigations include:

- Preparation of a reclaimed water seasonal storage reservoir site evaluation study
- Preparation of a pre-design study for modifications to the RRWWTP
- Evaluation of wastewater flows from IRWD into the District's Portola Hills sewers
- Evaluation of changing billing/accounting from being based on the number EDUs (number of water fixtures) to being based on the size of the service connection
- Preparation of a study to evaluate the feasibility of treating the Rose Canyon and Lang wells
- Evaluation of the District's capabilities of meeting the new Disinfectants/Disinfection By-products Rule.

The District should also continue a number of on-going programs including but not limited to:

- Updating and maintaining all District atlas sheets
- Maintaining and replacing defective water and reclaimed water meters
- Maintaining all District facilities to ensure reliable operations

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Section 1
Introduction

This introduction provides a project overview and an outline of the Water, Wastewater, and Reclaimed Water Master Plan (Master Plan). In addition, this Section also provides a brief background of the Trabuco Canyon Water District (District) and the reasons for this Master Plan, a discussion of the project objectives, the scope of work and the approach taken, a description of the report sections to follow, and a listing of abbreviations and definitions used in this report.

PROJECT BACKGROUND

The District's previous water and wastewater master plan was done by NBS Lowry in 1992 and identified facilities needed to improve the existing system and provide upgraded service to the central portion of the District. The District requisitioned this Master Plan to provide recommendations for developing the necessary facilities to provide water, wastewater, and reclaimed water services for District customers throughout the District and adjacent planning areas through build-out.

The District provides sewer service to approximately 3,256 connections located within the District, 1,600 connections in the Irvine Ranch Water District (IRWD), and 233 connections in the Santa Margarita Water District (SMWD). These connections have been input to the model; however, as discussed in Section 2, a counting of parcels within the Robinson Ranch and Dove Canyon areas indicated 2,624 potential residential connections compared to model input connections totaling 2,649. In terms of completing the sewer system analysis and finalizing recommendations for this Master Plan, this difference is not considered significant, and the values for numbers of 2,649 connections already entered in the model by the District will be used throughout the remainder of this report. The District provides water service to approximately 3,616 residential households located within the District and 532 households in the IRWD. The District provides reclaimed water service to three major users: Dove Canyon golf course, Dove Canyon Master Association (DCMA), and the Robinson Ranch HOA.

The District obtains water from a variety of sources including groundwater wells, State Project water, and inter-ties with other water purveyors. The level of service provided to customers and the quantity of water provided within the District have increased over the years in conjunction with the District's growth.

The District treats a portion of the collected wastewater at the Robinson Ranch Wastewater Treatment Plant (RRWWTP) while the remainder is conveyed to SMWD for treatment at their Chiquita Wastewater Reclamation Plant. A major portion of the District remains unsewered.

The District reclaims the treated wastewater effluent from the RRWWTP by pumping treated and stored flows to the reclaimed water customers. In addition, "recycled" flows, which are stormwater runoff flows, can be pumped from the Dove Canyon Lake to augment treated effluent flows during periods of high demand.

STUDY AND PLANNING AREA

The District is located in the central portion of Orange County and has a January, 1998 population of approximately 10,300 people, based on census data provided to the District on an annual basis from the Orange County Environmental Management Agency (OCEMA). In addition to property located within the District boundaries, this Master Plan also incorporates analysis and recommendations for four currently undeveloped parcels located adjacent to the District's northeast boundary that can not physically be served by any other agency. The general location of the District, and the specific District boundaries, are shown graphically in **Figures 1-1** and **1-2**, respectively.

AUTHORIZATION

This Master Plan has been developed in accordance with an agreement between the District and Montgomery Watson dated January 29, 1998.

DATA SOURCES

Many reports, studies, and other sources of information were supplied by the District for the preparation of this Master Plan. This material was obtained from sources such as the Planning, Engineering, and Finance departments within the District, California Department of Health Services (DHS), Los Angeles County, Southern California Association of Governments (SCAG), Insurance Services Organization (ISO), and others. Pertinent materials included water, wastewater, and reclaimed water system maps and computer models; aerial maps; planning information; historical billing, production, and other records; and detailed facility information. Numerous meetings were held with District staff and with representatives from agencies with information pertaining to the District's operations. In addition, extended interactions were held with the District's operational staff during the evaluation of existing facilities, model evaluation, and model calibration stages to utilize their knowledge and information.

PROJECT APPROACH

The generalized project approach for each of the systems (water, wastewater, and reclaimed water) consists of several stages as follows:

- Review submitted 24 hour extended period simulation (EPS) models of the existing systems. These models will also reflect the average day, maximum day (only for the water and reclaimed water systems), and peak hour operations.
- Evaluate models to determine existing system needs and potential solutions.
- Develop recommendations for the existing system based on model results and other, non-hydraulic system considerations.
- Develop build-out water demands, wastewater generation, and reclaimed water demand estimates.
- Model and evaluate future systems through District build-out conditions to determine future system needs.

Figure 1-1
Vicinity Map

Figure 1-2
Location Map

- Prepare an existing system and buildout system Capital Improvement Program (CIP) to address both the magnitude and timing of deficiencies in each system.

OBJECTIVES AND SCOPE OF WORK

The primary objective of the District with respect to water, wastewater, and reclaimed water can be summarize as follows:

> "To provide the highest degree of performance and reliability that is necessary to furnish cost-effective and fiscally responsible services."

This Master Plan has been developed to assist the District in achieving this overall objective, and the primary steps, which mirror the approach given above, are:

- Evaluate the existing system with respect to the current and future needs.
- Identify the anticipated year for build-out and develop recommendations for improvements necessary to serve the District's needs through build-out.

The Scope of Work for this Master Plan includes the following tasks.

1. Collect and review background data.

2. Perform a field investigation of major existing system facilities to determine their adequacy for existing and future use.

3. Evaluate current water supplies from reliability, quantity, and quality perspectives and recommend any necessary improvements.

4. Develop water demand, sewer generation, and reclaimed water demand projections through build-out.

5. Develop water system criteria including maximum pipeline velocities, minimal fire flow residual pressures, minimum and maximum allowable system pressures, minimum allowable storage volumes for emergency, operational, and fire fighting purposes, and minimum emergency power requirements.

6. Develop wastewater system criteria including peaking factors, minimum and maximum pipeline and force main velocities, minimum pipe slopes, and pipeline sizing criteria.

7. Develop reclaimed water system criteria including maximum pipeline velocities, minimum and maximum allowable system pressures, and both operational and seasonal storage requirements.

8. Evaluate existing system performance through the calibration of 24 hour EPS, computer-based hydraulic models for the water, wastewater, and reclaimed water systems.

9. Identify, and determine costs for, needed facilities for the existing system.

10. Evaluate and identify future system needs utilizing previously determined information and the computer hydraulic models.

11. Develop a CIP for recommended existing and future system improvements, including phasing of all improvements.

12. Develop a detailed color map showing all existing and recommended facilities, by phase.

13. Develop a Master Plan Report summarizing all of the findings and recommendations.

REPORT OUTLINE

This Master Plan consists of seven sections with the contents of the remaining seven sections being:

Section 2 – Projected Land Uses, Population, and Flows. This section details the types of land uses including current and ultimate build-out level of development. The presentation of the land uses includes evaluation of population projections and assignment of Equivalent Dwelling Units (EDUs) to population and land use type. In addition, existing water demands and sewage flow rates taken from historical records are summarized.

Section 3 – Future System Alternatives and Selection. The District has several planning alternatives that could be implemented to meet future needs. Each alternative defines a different approach for meeting the future water supply and wastewater treatment and disposal needs of the District's customers. The purpose of this section is to define and evaluate alternative systems and to select a preferred approach. This preferred alternative is used to define the future facilities requirements of the District.

Section 4 - Water Sources. District water sources are evaluated with respect to the quantity of water available both now and in the future, and how these quantities compare with the water needed. A comparison of water currently available through existing contracts against existing and future demands is made to determine the need for additional source water. An evaluation of the adequacy of existing source water treatment facilities plus any treated water obtained from outside the District, compared to system demands, is made for both existing and future conditions. In addition, water production and consumption records are compared to determine unaccounted for water.

Section 5 – Water System. The evaluation of, and recommendations for, the water system are presented. This includes identification and evaluation of water sources, evaluation of the existing distribution system, presentation of modeling methodology and calibration, and evaluation of the future system.

Section 6 – Wastewater System. The evaluation of, and recommendations for, the wastewater system are presented. This includes evaluation of the existing sewer collection system and treatment plant, presentation of modeling methodology and calibration, and evaluation of the future system.

Section 7 – Reclaimed Water System. The evaluation of, and recommendations for, the reclaimed water system are presented. This includes evaluation of the existing distribution system, potential demands, and the future system, as well as presentation of the modeling methodology and calibration results.

Section 8 – Capital Improvement Program. The presentation of the CIP for each part of the Master Plan includes the phasing of facilities for both existing and future needs, the allocation of costs, and sensitivity analyses of development timing. In addition, environmental review requirements and guidelines for updating the Master Plan are provided.

Appendix A – References

Appendix B – Summary of Current and Future Drinking Water Regulations

Appendix C – Water System Model Calibration

Appendix D – Detailed Cost Tables

LIST OF ABBREVIATIONS

To conserve space and improve readability, abbreviations have been used in this report. Each abbreviation has been spelled out in the text the first time it is used. Subsequent uses of the term are usually identified by their abbreviation. The abbreviations used are shown in **Table 1-1**.

Table 1-1
Abbreviations

Abbreviation	Explanation
ac	Acre
AAD	Annual Average Day
AB	Assembly Bill
AC	Asbestos-cement
ACP	Asbestos Cement Pipe
AD	Average Day
AF	Acre-feet
AFY	Acre-feet Per Year
ADD	Average Day Demand
ADWF	Average Dry Weather Flows
AMP	Allen-McColloch Pipeline
AMCL	Alternate Maximum Contaminant Levels
AMR	Annual Monitoring Report
AWWA	American Water Works Association
BMP	Best Management Practices

Table 1-1
Abbreviations
(continued)

Abbreviation	Explanation
CAD	Computer Aided Drafting
CAP	Cryptosporidium Action Plan
CCR	Consumer Confidence Reports
CDC	Centers for Disease Control and Prevention
CEQA	California Environmental Quality Act
cfs	Cubic Feet Per Second
CIP	Capital Improvement Program
CPA	Central Pool Augmentation
DBCP	Dibromochloropropane
D/DBPs	Disinfectants/Disinfectant By-products
DCIPS	Dove Canyon Irrigation Pump Station
DCMA	Dove Canyon Master Association
DHS	California Department of Health Services
DIP	Ductile Iron Pipe
District	Trabuco Canyon Water District
DOF	California Department of Finance
DMP	Development Monitoring Program
DPR	California Department of Parks and Recreation
du	Dwelling Unit
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment and Protection
DWTP	Dimension Water Treatment Plant
EA&L	Engineering, Administration, and Legal
EDU	Equivalent Dwelling Unit
EIR	Environmental Impact Report
EPA	United States Environmental Protection Agency
EPS	Extended Period Simulation
ERDU	Equivalent Residential Dwelling Unit
ET	Evapotranspiration
ETWD	El Toro Water District
fps	Feet Per Second
ft	Feet
FTSP	Foothill Trabuco Specific Plan
FY	Fiscal Year
gpcd	Gallons Per Capita Day

Table 1-1
Abbreviations
(continued)

Abbreviation	Explanation
GIS	Geographical Information System
gpd	Gallons Per Day
gpm	Gallons Per Minute
GWI	Groundwater Infiltration
GWR	Groundwater Rule
HAAs	Haloacetic Acids
HGL	Hydraulic Grade Line
hp	Horsepower
HPC	Heterotrophic Plate Count
ICR	Information Collection Rule
IESWTR	Interim Enhanced Surface Water Treatment Rule
in	Inches
IOCs	Inorganic Chemicals
IRWD	Irvine Ranch Water District
IRP	Integrated Water Resources Plan
ISO	Insurance Services Organization
LACSD	Los Angeles County Sanitation Districts
LAFCO	Local Agency Formation Commission
LAWD	Los Alisos Water District
LCR	Lead and Copper Rule
LP	Linear Programming
LPA	Local Primacy Agency
Master Plan	Water, Wastewater, and Reclaimed Water Master Plan
MBAs	Foaming Agents
MCLs	Maximum Contaminant Levels
MD	Maximum Day
MDD	Maximum Day Demand
Metropolitan	Metropolitan Water District
MG	Million Gallons
mgd	Million Gallons Per Day
MIBK	Methyl Isobutyl Ketone
MOU	Memorandum of Understanding
MRDLs	Maximum Residual Disinfectant Levels
MTBE	Methyl-tertiary-butyl ether
MW	Montgomery Watson

Table 1-1
Abbreviations
(continued)

Abbreviation	Explanation
MWDOC	Municipal Water District of Orange County
NPDWR	National Primary Drinking Water Regulations
NRC	National Research Council
O&M	Operation and Maintenance
OCEMA	Orange County Environmental Management Agency
OCFA	Orange County Fire Authority
OCWD	Orange County Water District
PCB	Polychlorinated biphenyl
pCi/l	Picocuries Per Liter
PDWF	Peak Dry Weather Flow
PH	Peak Hour
PHD	Peak Hour Demand
PHGs	Public Health Goals
PQL	Practical Quantitation Level
PRSs	Pressure Regulating Stations
PRV	Pressure Regulating Valve
psi	Pounds Per Square Inch
PVC	Polyvinyl Chloride Pipe
PWWF	Peak Wet Weather Flows
RDU	Residential Dwelling Unit
RMP	Risk Management Plan
RRIPS	Robinson Ranch Irrigation Pump Station (RRIPS
RRWWTP	Robinson Ranch Wastewater Treatment Plant
RWD	Report of Waste Discharge
RWQCB	Regional Water Quality Control Board
RWSR	Reclaimed Water Storage Reservoir
SAC	Santiago Aqueduct Commission
SBR	Sequencing Batch Reactor
SCADA	Supervisory Control and Data Acquisition
SCAG	Southern California Association of Governments
SCE	Southern California Edison
SCP	South County Pipeline
SCWD	Santiago County Water District

Table 1-1
Abbreviations
(continued)

Abbreviation	Explanation
SDWA	Safe Drinking Water Act
sf	Square Feet
SMWD	Santa Margarita Water District
SOCRA	South Orange County Reclamation Authority
SOCs	Synthetic Organic Chemicals
SWAP	Source Water Assessment Program
SWRCB	State Water Resources Control Board
SWTR	Surface Water Treatment Rule
TCWD	Trabuco Canyon Water District
TCR	Total Coliform Rule
TDH	Total Dynamic Head
TDS	Total Dissolved Solids
THM	Trihalomethanes
UAF	Unaccounted For
UHG	Upper Harris Grade
US	Upper Schwendeman
USGS	United States Geological Survey
VOCs	Volatile Organic Chemicals
WSP	Welded Steel Pipe

Section 2
Projected Land Uses, Population, and Flows

This section provides an analysis of ultimate (build-out) land use characteristics within the District. These build-out land uses, along with estimates of the anticipated number of dwelling units at build-out, are used to project when build-out conditions are expected to occur, the anticipated build-out population, and the estimated build-out water, wastewater, and reclaimed water flows. This section also provides an analysis of historical data, including population and water, wastewater, and reclaimed water flows to establish existing water, wastewater, and reclaimed water requirements.

Water use patterns, including annual, monthly, and daily, are evaluated, and peaking factors are developed for maximum day and peak hour water uses. Wastewater generation rates and flows for annual, monthly, and daily values are summarized. In addition, wastewater peaking factors are developed for maximum month and peak hour conditions. Reclaimed water demands, including annual, monthly, and daily, are evaluated, and peaking factors are developed for maximum day water uses.

LAND USE PLANS

The basis for water demand and wastewater flow projections is adopted land use plans for the District area.

Planning Areas

The District includes several planning areas, the largest of which is the Foothill/Trabuco Specific Plan (FTSP) area. The FTSP was adopted by the County of Orange in 1991. This area is geographically the largest planning area in the District covering approximately 70 percent of the District's area. There are three sub-areas identified within the FTSP: Upper Aliso in the northwest, Trabuco Canyon centrally, and Plano Trabuco in the southeast. The next largest planning areas are the Dove Canyon, Robinson Ranch, and Portola Hills developments. Both Dove Canyon and Robinson Ranch are located south of the FTSP area and Portola Hills is west of the FTSP area. These three developments are large enough to require the submission of Annual Monitoring Reports (AMR) for Orange County's Development Monitoring Program (DMP). There are six additional areas within the District that are not explicitly covered by specific development plans and that are not required to submit AMRs. Three of these areas, the O'Hill, Brock, and Rancho Cielo areas, are located between the Robinson Ranch and Dove Canyon developments. The final three areas, the Santiago Ranch area outside of the FTSP border, and the Southern California Edison, and South El Toro properties, are located to the west of the FTSP area.

Because the District includes several separate planning areas, the District has been divided into three overall divisions for the purpose of this master plan. These divisions are referred to as

North, Central, and South and are shown in **Figure 2-1**, along with the other referenced planning areas. Each division has distinct characteristics, in addition to distinct geographical boundaries, and are described below:

- **North.** Encompasses the northwest portion of the District, from the eastern edge of the Upper Aliso FTSP boundary westward. This includes the areas of South El Toro, Southern California Edison, the District's portion of Portola Hills, and other areas within the District but west of the FTSP.

- **Central.** Primarily includes the Trabuco Canyon and Plano Trabuco areas of the FTSP and those areas north of Trabuco Creek that are outside the FTSP and the District. The Edgar Sky Ranch and Hinrichs (Porter) properties are included because they are anticipated to be developed by build-out and no other agency would be able to serve them. This area also includes the nurseries located on the south side of Trabuco Creek.

- **South.** Includes the Robinson Ranch, Dove Canyon and adjacent developments within the District.

Existing Development

The District service area is predominately residential in nature, with some supporting commercial development. Housing densities range from a 14.5 dwelling unit per acre (du/acre) apartment complex in Robinson Ranch to 0.1 du/acre in the outlying areas of the District. Commercial development consists primarily of major supermarkets, drugstores, offices, retail shops, and restaurants serving the local residents. There is no industrial development. No major employment centers exist to draw significant numbers of workers who may reside outside the District. The development characteristics of the District are not expected to change significantly in the future. However, new development is generally anticipated to be less dense than the existing planned community areas of Robinson Ranch, Dove Canyon, and Portola Hills.

Through discussions with the District, it was agreed that several of the existing developments, specifically the Robinson Ranch, Rancho Cielo, Walden, and Dove Canyon areas, have in essence already reached build-out levels of development.

Only a portion of the Portola Hills development is within the District. The District portion of Portola Hills is completely built-out and no additional growth is anticipated. In this area, complete service is provided for wastewater and "mixed" service is provided for water. The "mixed" service designation is given because there is a water service agreement with Irvine Ranch Water District (IRWD) where IRWD provides water to District Portola Hills customers from IRWD water sources, the District performs the billing service for those customers, and then the District then pays IRWD for water consumed in this area minus the costs associated with billing. The District has 532 water connections in this area and this water demand is accounted for in the District's annual billing. In this report, Portola Hills demand is included in total system demands and its IRWD supply is accounted separately in water supplies.

Figure 2-1
District Planning Areas

11x17

Build-Out Land Use

Land use information designates the type of development and the density of development that is anticipated to occur within a specified geographical area. This information is useful for planning purposes as the land uses specified are designated for ultimate development conditions. Therefore, the land use information provides the maximum amount of anticipated development in each location within the District, leading directly to the maximum anticipated population, water and reclaimed water demand, and wastewater generation. Land use information is used in this Master Plan to determine the ultimate build-out conditions for the District.

Maximum Dwelling Units

A summary of the land use within the District under build-out conditions is shown in **Table 2-1**. A typical planning assumption used in these analyses is that any parcel may have its development clustered in the most favorable portion of the parcel. However, the average parcel development will be consistent with the designated land use. The geographical locations of the build-out land uses within the District (future land use map) are shown in **Figure 2-2**.

Table 2-1
Summary of Build-Out Land Use Areas

Land Use Classification	Abbreviation	Acres
10 Ac/du[1]	10	598
4 Ac/du	4	1,573
2 Ac/du	2	1,014
1.00 - 1.99 Ac/du	1	381
Less than 1 Ac/du	LT1	441
Less than 1 Ac/du – outside[2]	LT1-OUT	2,063
Commercial Residential	CR	24
Community Commercial	CC	55
Community Commercial – outside[2]	CC-OUT	22
Open Space/Conservation	OSC	1,659
Public/Quasi-Public Facility	PQF	402
Total		**8,232**

Note: 1. Ac/du = acres per equivalent dwelling unit
2. Outside means outside of the Foothill Trabuco Specific Plan (FTSP).

Several assumptions are made in the analysis of build-out conditions and the subsequent impacts on the future water, wastewater, and reclaimed water systems. These assumptions are consistent with the FTSP and other planning documents for this area and are as follows:

- Existing development will not be redeveloped at higher densities except as allowed by the FTSP and noted on the future land use map (**Figure 2-2**).
- Areas designated as open space or undevelopable on the future land use map will not be developed.

- Potable Water Consumption is equivalent to 459 gallons/connection/day on average.
- Non-Potable Water Consumption is equivalent to 252 gallons/connection/day on average.
- Wastewater Production is equivalent to 270 gallons/connection/day on average.

A summary of the maximum anticipated dwelling units at build-out, separated by planning area, is presented in **Table 2-2**. Two types of dwelling units are presented in **Table 2-2**: residential dwelling units (RDUs) and equivalent residential dwelling units (ERDUs). The residential dwelling units include all water that is billed to residential and apartment billing classifications. The equivalent residential dwelling units include all water billed to the remaining commercial, irrigation, and agricultural billing classifications. Total equivalent dwelling units (EDUs) are the sum of the two classifications.

RDU values come from the FTSP, AMRs, and specific plans. The ERDU value for a non-residential customer is the average water use for 1997 and 1998 divided by the average residential water use of 459 gallons/connection/day. All calculations are done using the monthly billing records for 1997 and 1998. Since 1998 was an unseasonably wet year due to the El Niño phenomenon, 1997 is used as the base year for comparison. Water use by commercial accounts that operated for less than a year are prorated to estimate a full year's water demand.

At build-out, it is anticipated that the two large nurseries in the Plano Trabuco planning area will be converted to residential acreage as specified in the FTSP. This assumption is included in the evaluation of build-out dwelling units.

Foothill/Trabuco Specific Plan Area

The FTSP defines the allowable land uses within its borders. Each parcel within the FTSP has been assigned a maximum number of dwelling units (DUs) that can be developed at build-out conditions. Twenty parcels have been identified as "existing use" indicating that the current use will be continued through build-out with no changes. Maximum anticipated dwelling units for the existing use parcels are determined as described above.

There has been one major change and several minor changes to the anticipated maximum number of dwelling units at build-out in the FTSP area. The Bridlewood property is currently being developed under the name Saddleback Meadows with a maximum of 299 DUs, instead of the originally anticipated 705 DUs. This change is based on action taken by the Orange County Board of Supervisors in December 1998. This change is shown in **Table 2-2** along with other minor adjustments that have occurred since the adoption of the FTSP in 1991.

Other Planning Areas

The maximum dwelling units for residential and apartment areas outside the FTSP are specified in their respective AMRs, specific plans, or zoning maps. In the North, the District's portion of Portola Hills is currently built-out. The Central area is completely covered by the FTSP. In the South, the Robinson Ranch, O'Hill, Walden, Rancho Cielo, and Dove Canyon developments are currently built-out and no more development is anticipated.

Figure 2-2
Future Land Use Map

11x17

Table 2-2
Estimated Build-Out Dwelling Units

Planning Area	Ex. Property Land Use	Land Use (ac/du)	Area (ac)	RDU	ERDU	EDU
North						
Adams	Res. (SFD)	2	7	3	-	3
Austin	Res. (SFD)	1	17	8	-	8
Bass	Res. (SFD)	OSC	1	0	-	0
Carisoza	Res. (SFD)	1	8	4	-	4
Cleveland National Forest-A	Open Space	OSC	117	-	0	0
Cook's Corner[1]	Commercial	CC	9	-	5	5
County of Orange	Open Space	OSC	11	-	0	0
District Portion of Portola Hills	Res. (SFD)	LT1-OUT	75	532	-	532
Edgar 4-S Ranch North (Njd)	Res. (SFD)	4	308	78	-	78
Edgar 4-S Ranch South (Njd)	Res. (SFD)	4	78	19	-	19
Edgar Panter Ranch (Njd)	Res. (SFD)	1	33	21	-	21
Erickson	Res. (SFD)	1	9	5	-	5
Haefele	Res. (SFD)	2	4	1	-	1
Lawrence	Res. Special Use	CR	24	-	1	1
Live Oak-A (Hazard)	Res. (SFD)	1	3	1	-	1
Live Oak-B (Var. Owners)	Res. (SFD)	1	4	5	-	5
Live Oak Limited	Res. (SFD)	1	19	21	-	21
Lyon Ranch (Beazer Homes)	Res. (SFD)	1	113	78	-	78
Randazzo	Res. (SFD)	2	7	1	-	1
Saddleback Meadows[1]	Res. (SFD)	LT1	241	299	-	299
Saint Michael's[1]	PQF	PQF	41	-	48	48
Santiago Ranch	Open Space	OSC	70	-	0	0
Santiago Ranch Adjacent	Open Space	OSC	119	-	0	0
Schefflete (Panter Ranch)	Res. (SFD)	1	25	11	-	11
Serrano	Res. (SFD)	2	9	3	-	3
Seventh Day Adventist	Res. (SFD)	1	66	36	-	36
Shimomura	Res. (SFD)	2	78	38	-	38
South El Toro Property	Res. (SFD)	LT1-OUT	36	46	-	46
Southern California Edison	N/A	LT1-OUT	108	73	-	73
SCE North	PQF	PQF	2	-	0	0
SCE North	PQF	PQF	5	-	0	0
Standard Concrete[1]	Commercial	CC	--	-	50	50
Strand	Res. (SFD)	OSC	2	0	-	0
Tittle	Res. (SFD)	LT1	7	5	-	5
Tittle	Nursery	CC	14	-	70	70
Tittle[1]	Commercial	CC	1	-	7	7
Tittle	Open Space	OSC	3	-	0	0

Table 2-2
Estimated Build-Out Dwelling Units
(Continued)

Property Owner/Name	Ex. Property Land Use	Land Use (ac/du)	Area(ac)	RDU	ERDU	EDU
TCWD-West	PQF	PQF	0	-	0	0
Varshney (Call)	Res. (SFD)	4	1	0	-	0
Varshney (Call)	Res. (SFD)	4	84	25	-	25
Watson (Haskell)	Res. (SFD)	2	102	48	-	48
Zadeh	Res. (SFD)	2	47	20	-	20
North Planning Area Subtotal				1,381	181	1,562
Central						
Bach	Res. (SFD)	4	150	37	-	37
Beardslee	Res. (SFD)	2	19	10	-	10
Beardslee	Open Space	CC	23	-	0	0
Bishop of Orange	Res. (SFD)	4	9	3	-	3
Boy's Town[1]	Res. (SFD)	2	74	7	-	7
Boy's Town	Irrigation	--	--	-	63	63
Canyon Creek	Res. (SFD)	2	27	24	-	24
Cleveland National Forest-B	Open Space	OSC	319	-	0	0
Cleveland National Forest-C	Open Space	OSC	8	-	0	0
Edgar Sky Ranch (Njd)	Open Space	OSC	2	-	0	0
Edgar Sky Ranch (Njd)	Res. (SFD)	10	528	48	-	48
Emory's General Store	Commercial	CC	1	-	1	1
Federal S&L Insurance Corp.	Res. (SFD)	4	153	36	-	36
Felch	Res. (SFD)	4	6	1	-	1
Ferber	Res. (SFD)	4	294	50	-	50
Ferber	Res. (SFD)	2	158	100	-	100
Fossil Resources	Res. (SFD)	10	70	8	-	8
Goren	Res. (SFD)	4	33	9	-	9
Grier	Res. (SFD)	4	29	7	-	7
Hamilton Trail (Various Owners)	Res. (SFD)	2	190	87	-	87
Hinrichs (Porter)	Open Space	OSC	95	-	0	0
Hinrichs (Porter)	Res. (SFD)	1	79	92	-	92
Hinrichs (Porter)	Open Space	OSC	45	-	0	0
Hunky Dory (Various Owners)	Res. (SFD)	2	52	32	-	32
Joplin Boys' Ranch[1]	PQF	PQF	292	-	36	36
Lambrose Canyon-E. (Var. Owners)	Res. (SFD)	2	16	5	-	5
Lambrose Canyon-W. (Var. Owners)	Res. (SFD)	4	34	9	-	9
Lang	Res. (SFD)	2	16	7	-	7
Live Oak Center[1]	Commercial	CC	5	-	3	3

Table 2-2
Estimated Build-Out Dwelling Units
(Continued)

Property Owner/Name	Ex. Property Land Use	Land Use (ac/du)	Area (ac)	RDU	ERDU	EDU
Live Oak Center	Irrigation	--	--	-	12	12
Live Oak-C (Various Owners)	Residential	2	15	10	-	10
Live Oak-D (Various Owners)	Res. (SFD)	4	37	8	-	8
Live Oak-D (Various Owners)	Res. (SFD)	2	6	3	-	3
Live Oak-E (Various Owners)	Res. (SFD)	4	9	2	-	2
Live Oak-F (Various Owners)	Res. (SFD)	4	19	4	-	4
Lucarelli (Live Oak Canyon Est.)	Res. (SFD)	4	147	36	-	36
Lyon	Res. (SFD)	LT1	2	12	-	12
Mitchell-East	Res. (SFD)	4	15	4	-	4
Mitchell-East	Open Space	OSC	27	-	0	0
Mitchell-West	Res. (SFD)	2	33	20	-	20
Mitchell-West	Open Space	OSC	64	-	0	0
Mt. View (Var. Owners)	Res. (SFD)	LT1	11	47	-	47
Newell	Res. (SFD)	4	56	14	-	14
Nursery	Open Space	OSC	77	-	0	0
Nursery Properties	Nursery	LT1	144	600	-	600
O'Neill Regional Park[1]	Open Space	OSC	670	-	1	1
O'Neill Regional Park	Irrigation	--	--	-	179	179
Porter	Residential	2	15	12	-	12
Racki	Res. (SFD)	2	39	20	-	20
Rose Canyon	Res. (SFD)	2	38	20	-	20
SCE-South	PQF	PQF	6	-	0	0
Schwendeman-West	Res. (SFD)	2	5	2	-	2
Schwendeman-East	Open Space	OSC	35	-	0	0
Schwendeman-East	Res. (SFD)	1	5	8	-	8
Señor Licos	Commercial	CC	2	-	3	3
TCWD-East	PQF	PQF	1	-	0	0
TCWD-South	PQF	PQF	2	-	0	0
Trabuco Canyon Fire Station[1]	PQF	PQF	1	-	4	4
Trabuco Community Church[1]	PQF	PQF	1	-	3	3
Elementary School[1]	PQF	PQF	4	-	21	21
Trabuco Oaks (Var. Owners)	Res. (SFD)	LT1	35	156	-	156
Trabuco Oaks Steak House	Commercial	CC	0	-	6	6
Trabuco PWT Corporation	Commercial			-	4	4
Trabuco PWT Corporation	Res. (SFD)	4	97	24	-	24
Trabuco PWT Corporation	Open Space	OSC	27	-	0	0

Table 2-2
Estimated Build-Out Dwelling Units
(Continued)

Property Owner/Name	Ex. Property Land Use	Land Use (ac/du)	Area (ac)	RDU	ERDU	EDU
Trabuco Ranches (Var. Owners)	Res. (SFD)	2	58	24	-	24
U.S. Post Office				-	2	2
Uysugi	Res. (SFD)	4	14	3	-	3
Vendata (Ramakrishna) [1]	PQF	PQF	44	-	10	10
Central Planning Area Subtotal				1,601	348	1,949
South						
Dove Canyon	Res. (SFD)	LT1		1,265	-	1,265
Dove Canyon Commercial[1]	Commercial	CC		-	45	45
Dove Canyon Golf Course	Irrigation	--		-	1,812	1,812
O'Hill (w/Trabuco Marketplace) [1]	Res. (SFD)/Com.	LT1		53	134	187
Robinson Ranch/ Trabuco Highlands	Res. (SFD)	LT1		1,412	-	1,412
Rancho Cielo	Res. (SFD)	LT1		260	-	260
TCWD-East	PQF	PQF	3	-	0	0
Walden	Res. (SFD)	LT1		121	-	121
South Planning Area Subtotal				3,111	1,991	5,102
Total Within Study Area				6,093	2,520	8,613

Note: 1. Change in maximum dwelling units from the original FTSP.
2. TCWD is the Trabuco Canyon Water District

Equivalent Dwelling Units

Different classes of water users such as residential, commercial, agricultural, irrigation, and others use water at different rates. The concept of Equivalent Dwelling Units (EDUs) was developed by planners to provide a mechanism by which all users could be evaluated on an equal footing. This evaluation determines the amount of water use compared to the typical residential dwelling unit's water use. Therefore, a single-family residence would be one EDU; an apartment complex may be equivalent to 10 EDUs, a commercial development to 12 EDUs, and so on. This concept allows the District to base all evaluations on a single measurement, the EDU. This same concept applies directly to EDUs for wastewater generation evaluations.

To determine the number of EDUs for any individual property in the District, the two dwelling unit numbers in **Table 2-2** (RDU and ERDU) are added together as shown in the EDU column of **Table 2-2**. The resultant value indicates the total EDUs for the property including residential, apartment, commercial, irrigation, and agricultural uses.

The District currently defines an EDU as a fixture count of 22. Therefore, water fixtures must be tallied for each service to determine the appropriate number of EDUs. The American Water

Works Association (AWWA) publishes a table that relates quantities of water available through water service meter connections of different sizes. As part of the master planning effort, a copy of this information was provided to the District. It is recommended that the District consider the possibility of using a service connection size basis for connection charges instead of the current EDU basis of service charge connection determination. The size of service connection limits the amount of water that can be used by a customer and, in determining connection fees based on service connection size, each customer is charged for their water use capacity as opposed to their number of fixtures, and therefore number of EDUs.

Phasing

The timing of future water demands is a function of the phasing of new developments. An initial phasing period is based on including all developments that are currently in progress or that have made it known to the District that they will be developing soon. The properties involved with these developments are listed below, and are shown in **Figure 2-3**, for each planning area:

- **North.** Edgar 4-S Ranch North, Edgar 4-S Ranch South, Edgar Panter Ranch, Lyon (a.k.a. Beazer), Saddleback Meadows, Schefflete (Panter Ranch), South El Toro, Watson, and Zadeh.
- **Central.** Ferber, Hinrichs (Porter), Nursery properties, Porter, and Rose Canyon.
- **South.** None.

It is anticipated that the above properties will develop within the next 11 years, by the year 2010. All other properties are anticipated to develop between the year 2010 and Build-Out. It is understood that the timing of property development can change at a rapid pace. If additional properties develop sooner than projected, or if properties planned for development take longer than anticipated, then the phasing of improvements would need to be adjusted accordingly. Phasing of improvements is presented in additional detail in Section 8 of this Master Plan. (Note: The District was recently approached by several of these developers for service sooner than anticipated in this master plan. This would change any planned system improvements but would require implementation sooner than anticipated.)

POPULATION PROJECTIONS

Population projections for Southern California are typically developed by the California Department of Finance (countywide projections) and the Southern California Association of Governments (SCAG). These projections are typically developed based on census tracts and the boundaries of political divisions such as cities or counties. The US Census Bureau prepares projections on a statewide basis.

The boundaries of the District do not correspond to any of the readily available entities for which population data is available. However, in response to District requests, the Orange County Environmental Management Agency (OCEMA) has prepared population estimates for the District each year since 1987. Therefore, the District has privately maintained track of its population since 1988. Annual population data since 1994 are presented in **Table 2-3** and are shown in **Figure 2-4**. The current population of the District at the beginning of 1998 was

estimated to be 10,282 people. Since 95 percent of the District's connections are residential and almost all of the future connections are anticipated to be residential, the historical number of people per residential connection within the District was investigated. Over the past five years, this number has been relatively constant, varying from 2.80 to 2.93 and averaging 2.87, people per residential connection. Therefore, for planning purposes, it is assumed that this number will remain constant at 2.87 people per residential connection.

Based on the amount and assumed timing of future development given above, and 2.87 people per residential dwelling unit, the year 2010 and build-out populations have been estimated to be 12,500 and 17,340 persons, respectively. Assuming recent growth trends, build-out conditions for the District are estimated to be reached by the year 2030. This is equivalent to an average annual growth rate of 1.64 percent per year. This growth projection is shown in **Figure 2-4**.

The population estimate for the year 2010 is a minimum value based on developments that have been identified in early 1999 and that are on the verge of being implemented. It is anticipated that development of adjacent parcels may occur once these larger parcels develop.

Table 2-3
District Population

Year	Population[1]	Residential Connections	People/Res. Connection
1994	7,943	2,714	2.93
1995	8,886	3,034	2.93
1996	9,413	3,362	2.80
1997	10,103	3,555	2.84
1998	10,282	3,614	2.85
2010[2]	12,504	4,357	2.87
Build-out[2]	17,340	6,042	2.87

Note: 1. Historical population from annual estimates prepared for District by OCEMA.
2. Estimated.

POTABLE WATER DEMANDS

In this subsection, the water demands in the District's service area are discussed with respect to historical water production and usage, peaking factors for maximum day and peak hour demands, and future anticipated water use. Sources of water supply and allocation of water demand throughout the District are discussed in Sections 4 and 5.

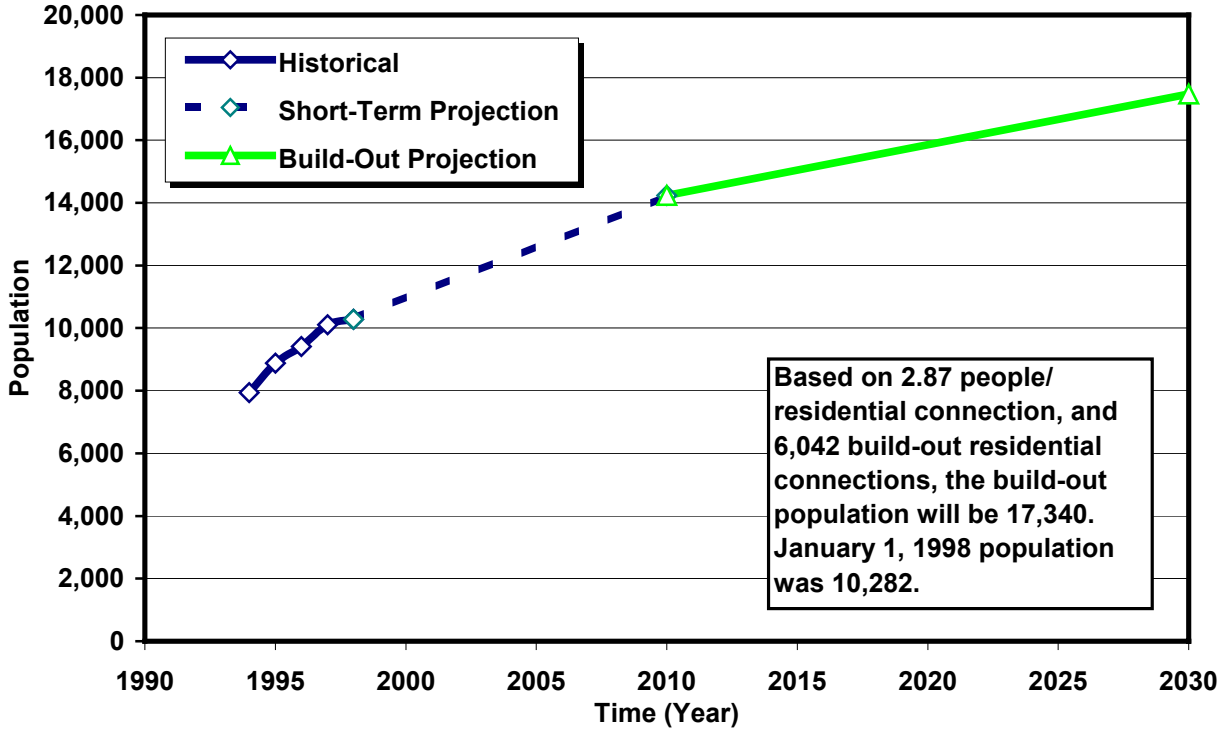
Historic Water Usage

The District has changed their operational methods in the past few years, resulting in operation that is more efficient and in a reduction in the maximum day demands. Based on this, only data from the three most recent years, 1996, 1997, and 1998, are valid to be utilized in the evaluation of potable water supply and demand. The El Niño phenomenon in 1998 was a very wet year, which resulted in a commensurate reduction in water use within the District. Therefore, 1997 production and demand information is used as the basis for typical demands and operations.

Figure 2-3
Phasing of Future Developments

11x17

Figure 2-4
Historical and Projected District Population: Average Annual Demand



Calculations were made to determine the 1997 values for the percentage of water used for each billing type by number of connections and by quantity of water billed. The results of these calculations are shown in **Table 2-4**.

As shown in **Table 2-4**, almost all of the District's connections are residential, but these connections account for only two-thirds of the water billed. Therefore, there is a large irrigation demand in the District that could potentially be provided by reclaimed water.

Table 2-4
Summary of 1997 Water Use Percentage by Billing Class

Billing Class	No. of Connections	Percentage of Connections (%)	Percentage of Water Billed (%)
Residential[1]	3,724	95	65
Apartments	36	1	2
Commercial[1]	58	2	6
Irrigation	80	2	19
Agricultural	5	0	8
Total	**3,903**	**100**	**100**

Note: 1. Includes 530 residential and 2 commercial connections in Portola Hills.

Magnitude and Peaking Factors

The District keeps daily records on the amount of water obtained from each source. These sources include the Dimension Water Treatment Plant (DWTP), the Allen-McColloch Pipeline (AMP) through Santa Margarita Water District (SMWD), wells, and interties with other agencies. Review of the production records indicates that proper implementation of record keeping procedures had been sporadic. The District is in the process of refining and optimizing its record-keeping process. Based on this understanding, it was decided that the best available information for determining existing water demands would be the monthly billing records.

The 1997 monthly billing records indicate a total of 824 million gallons (mg) of water was used by customers. The most realistic estimate of the amount of unaccounted for water is approximately eight percent of the total water billed. Unaccounted for water is a fact in all water systems and is due to many things. For example, customer service meters may read "slow" and do not account for all of the water that actually passes through them. Other sources of unaccounted include fire fighting, water flushed but not metered from fire hydrants, unmetered construction water, and illegal connections to the District's system. Assuming an unaccounted for water loss of eight percent gives a total District production of 890 mg per year. Therefore, the existing average annual system demand is estimated to be 890 mg. This average annual demand equates to an average day demand (ADD) of 2.44 million gallons per day (mgd).

One of the critical elements in quantifying the water necessary for a system is the accurate determination of the maximum day demand (MDD). The MDD is defined as the amount of water used during the single day of the year with the largest demand. This MDD value is also the amount of water necessary to be available from a combination of all water sources so that customers can obtain their necessary water during all times of the year. Demands in excess of the MDD are provided out of treated water storage, and these storage reservoirs are refilled during slack times in demand.

An analysis of daily production and storage data for the past three years was performed to determine the maximum day demand. This analysis focused on the amount of water produced on a daily basis and the daily changes in system storage. Water going into storage is deducted from daily production to get daily demand; water taken from storage is added to production. The three-year period of 1996-1998 is used in the evaluation because during prior years, potable water was used as make-up for the reclaimed water system, which artificially increased the maximum day demand. This practice has been eliminated and non-potable, urban runoff captured in Dove Lake is now used for make-up water.

The results of the analysis are shown in **Table 2-5**. This table shows the average day demand has decreased from 2.84 mgd in 1996 to 2.50 mgd in 1998. The average demand for these three years was 2.71 mgd. The maximum day demand for this period ranged from 5.28 mgd in 1996 to 5.78 mgd in 1997. The ratio of maximum day demand to average day demand ranged from 1.86 to 2.22 with an average of 2.04. Based on this analysis, maximum day demand factor of 2.0 is used for the existing potable water system.

Since the potable water demands include substantial amounts of irrigation uses (agricultural and landscape), the maximum day demand factor must be separated into irrigation and non-irrigation

Table 2-5
Historical Maximum Day Demand Factors

Year	Average Day Demand (mgd)	Maximum Month Demand (mgd)	MMD/AAD Factor	Maximum Day Demand (mgd)	MDD/AAD Factor
1996	2.84	4.36	1.54	5.28	1.86
1997	2.79	4.21	1.51	5.78	2.07
1998	2.50	3.67	1.47	5.54	2.22
Average	**2.71**	**4.08**	**1.51**	**5.53**	**2.04**

fractions. This will allow the evaluation of the effect of reclaimed water usage on peak potable water system demands. Irrigation water demands are a function of evapotranspiration, effective precipitation, and irrigation efficiency. Little direct data is available on the maximum day demands for irrigation in the District service area. Therefore, regional values of evapotranspiration and precipitation are used to estimate the monthly pattern of irrigation usage. Maximum day irrigation demands can be about 20 percent higher than the highest month. These data indicate the peak month demand for irrigation is about 2.2 times the average annual demand. Deducting the irrigation demands from the other demands and applying this factor results in a potable demand MDD factor of 1.95 times ADD. These factors of 1.95 for potable demands and 2.2 for non-potable (irrigation) demands will be used for future system planning.

The final peaking factor to be determined is the peak hour demand (PHD) to MDD factor. As previously discussed, the MDD is the maximum amount of water needed on any one day and, in a similar fashion, the PHD is the maximum amount of water needed during any one hour. By definition, the peak hour is the hour of peak demand during the maximum day.

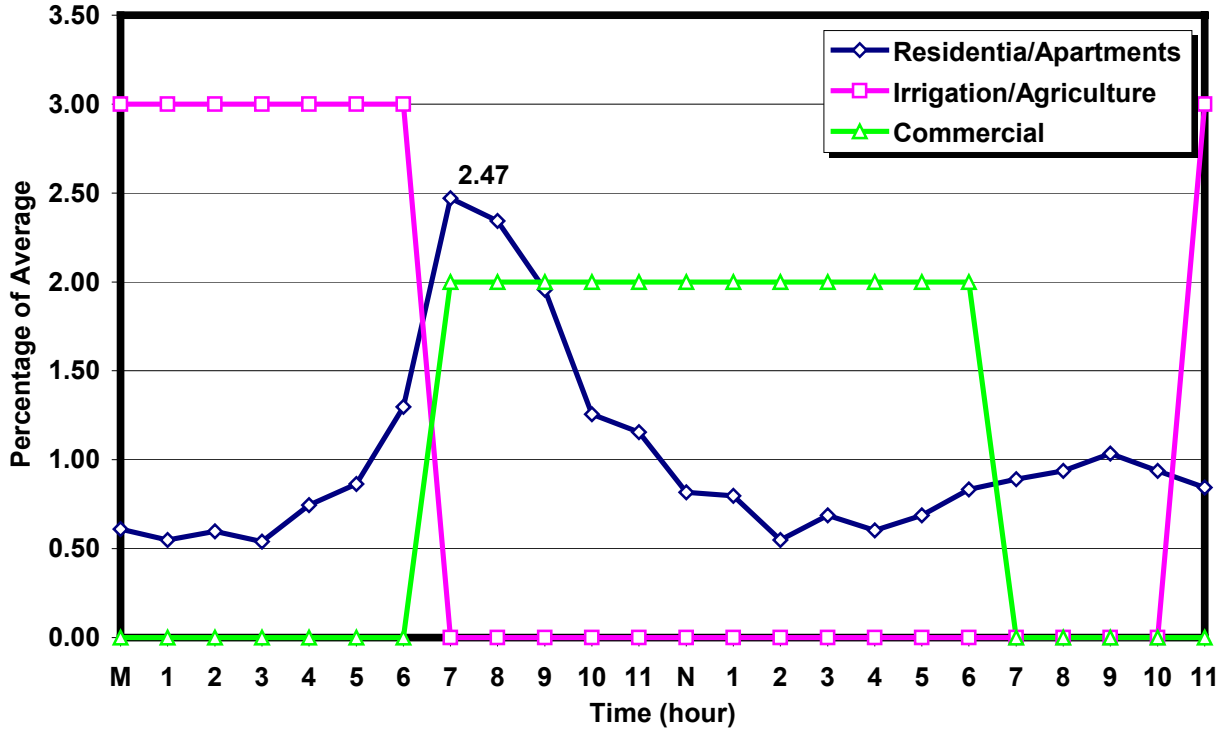
The District has a Supervisory Control and Data Acquisition (SCADA) system that monitors the pump flows and pressures, reservoir water levels, and the flows through some of the control valves. This SCADA system is able to deliver information in time increments as small as three minutes and should theoretically provide an excellent summary of flows and pressures throughout the distribution system. Flow and pressure information for several different days were obtained and reviewed in an effort to investigate the hourly variation in demands throughout the system. The information received appeared to be erroneous during some time periods and the confidence factor in the data was not high enough for the data to be utilized.

In May 1998, District staff conducted a month-long evaluation of hourly water use in the Dove Canyon pressure zone. This isolated area of the system is almost completely residential. Most of the irrigation in this zone, including the irrigation of the Dove Canyon Golf Course, is provided through the reclaimed water system. The analysis of the water use in this zone provides a diurnal curve that is almost exclusively reflective of residential demands. A residential diurnal curve was developed from the analysis and the PHD:MDD factor determined was 2.47. This indicates that the peak hour demand is 2.47 times as large as the average demand on the maximum day, and it

occurred at 7:00 am. Therefore, the peak hour demand is 1.95 multiplied by 2.47, or 4.82 times as large as the average day demand.

Current irrigation practices were reviewed by inspection of existing irrigation timer settings and review of reclaimed water pumping patterns over a five-day period. Based on this information, it was determined that the majority of irrigation use occurs between the hours of 10:00 PM and 6:00 AM. Based on the nature of commercial businesses within the District, it is assumed that typical commercial users use water between the hours of 7:00 AM and 7:00 PM. A graphical representation of the percentage of average water used each hour, for the various types of water users, is presented in **Figure 2-5**. This includes diurnal curves for residential/apartments, irrigation/agricultural, and typical commercial accounts. Several non-typical commercial accounts were identified and assigned their own diurnal water use pattern. The information shown in **Figure 2-6** is similar to the information shown in **Figure 2-5**, but has been adjusted to reflect the respective total water demands in 1997. Therefore, **Figure 2-6** shows the total demand for each billing classification, on an hourly basis, for the maximum day of demand. This does not include the non-typical commercial classifications, which accounted for approximately two percent of the total water used.

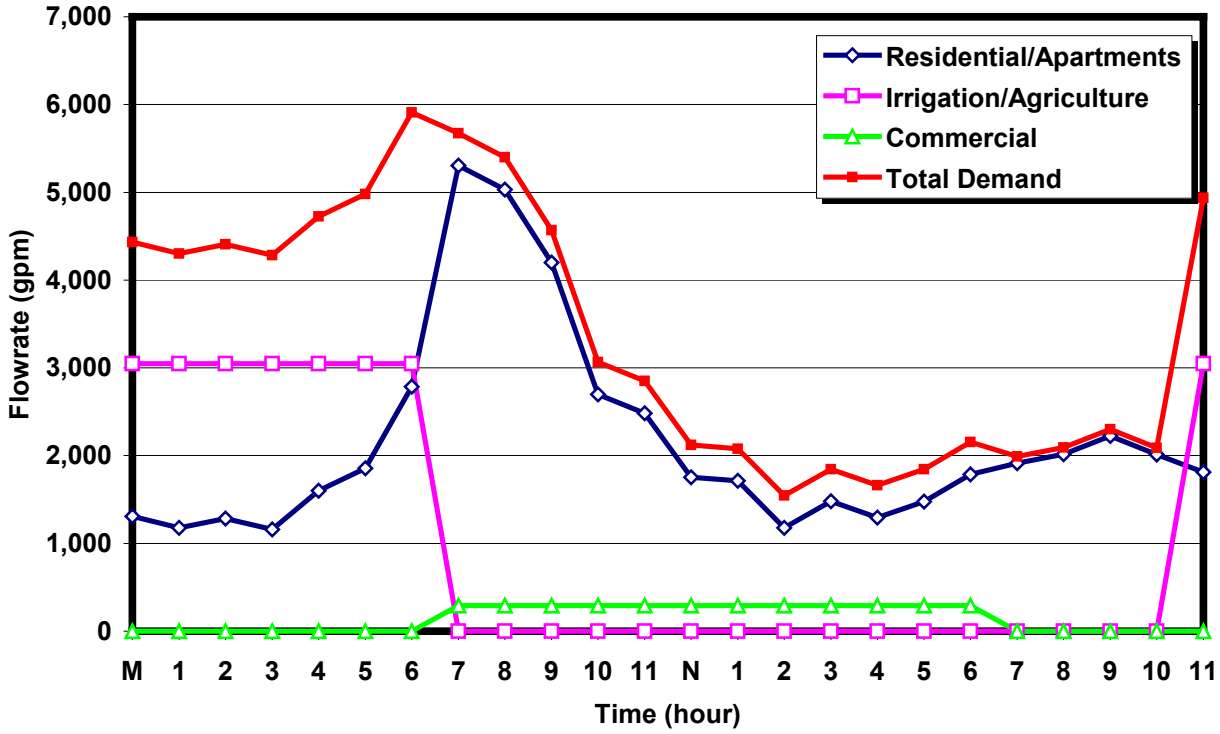
Figure 2-5
Diurnal Curves for District Billing Classifications
(Percentage of Average)



Future Demands

All anticipated average day future demands were determined based on the build-out land use information and phasing described earlier. The determination of future average day demands for

Figure 2-6
Diurnal Curves for District Billing Classifications
(Total Flow on Maximum Day, 1997)



each of the respective billing classes is as follows:

- Residential and Apartment. The number of anticipated residential dwelling units at build out has been determined for each parcel within the District. It is assumed that the residential water demand per dwelling unit will remain the same in the future as it is now. Therefore, each anticipated RDU is multiplied by the appropriate demand/RDU to arrive at the total anticipated future residential demand.

- Commercial. The historical water demand for each commercial property has been determined. It has been assumed that the existing commercial demands will remain the same, and no new commercial development will occur (this is consistent with all existing planning documents). Therefore, future commercial demands remain the same as existing. In addition, an ERDU was determined for each commercial property.

- Non-Residential Irrigation. Demands of strictly irrigation properties (such as the Dove Canyon Golf Course) have been identified and assumed to have the same demand in the future as they have currently. An ERDU has been determined for each non-residential property.

- Other Irrigation. Future irrigation demands for residential developments, such as greenbelt areas, have been determined based on existing demand for similar areas. The irrigation

demands for the Robinson Ranch development were evaluated to determine a gallon per acre of area served demand for "other" irrigation. The development of this demand is discussed later under non-potable demands. A factor for irrigation use per RDU was then determined and applied to all appropriate properties.

- Agricultural. Similar to commercial billing accounts, the agricultural accounts assumed to be in service in the future have been identified and it is assumed that their historical demands will continue into the future. An ERDU has been determined for each agricultural property. It is assumed that the nursery (agricultural) properties south of Trabuco Creek will be developed into residences in the near future.

In general, the future peaking factors should be similar to the existing ones, with potential impacts from future conservation. Two classifications of future conservation are typically evaluated: (1) reductions in water use due to specific water shortages and (2) long term reductions due to reduced-water fixtures. Based on historical evidence with other agencies, reductions in water use due to short-term water conservation regulations such as even/odd watering days or voluntary water reductions do not have long-term impacts. When the water restrictions are lifted, water use tends to return to its original pattern and magnitude.

However, installation of reduced-water fixtures and other water saving devices in new construction appears to result in lower average day demands than systems that do not include these devices. However, there is typically not an effect on the maximum day demand. Therefore, the future peaking factors are assumed to be the same as the existing peaking factors.

Based on the above information, **Table 2-6** summarizes the anticipated total water demand. The demands shown in **Table 2-6** include only the anticipated potable (drinkable) water demands. Non-potable water demands are discussed in the reclaimed water subsection of this Section.

NON-POTABLE WATER DEMANDS

The District currently provides reclaimed water service to non-potable water users in its service area from the Robinson Ranch Wastewater Treatment Plant. This subsection discusses historical reclaimed water demands within the District's service area, estimates of future non-potable demands, potential reclaimed water users, and peaking factors for peak month and peak day.

Allowable Reclaimed Water Uses

Under State law, the use of potable domestic water for non-potable uses such as irrigation of cemetery, golf course, park, and highway landscaped areas and other industrial and irrigation uses is a waste or unreasonable use of water if reclaimed water:

1. is of adequate quality and is available for these uses,
2. can be furnished at a reasonable cost to the user,
3. is not detrimental to public health, and
4. will not adversely affect downstream water rights, degrade water quality, and is not injurious to plant life, fish, and wildlife. (California Water Code, Section 13550)

Table 2-6
Summary of Anticipated Potable Water Demand

Year and Area	Average Annual Demand (acre-ft/yr)	Average Daily Demand (mgd)	Maximum Day Demand (mgd)	Peak Hour Demand (mgd)
Existing				
Northern Area	90	0.08	0.15	0.37
Central Area	179	0.16	0.31	0.77
Southern Area	1,669	1.49	2.90	7.16
Total	**1,938**	**1.73**	**3.36**	**8.30**
Year 2010				
Northern Area	392	0.35	0.68	1.68
Central Area	605	0.54	1.05	2.59
Southern Area	1,669	1.49	2.90	7.16
Total	**2,666**	**2.38**	**4.63**	**11.43**
Build-Out (Year 2030)				
Northern Area	482	0.43	0.83	2.05
Central Area	874	0.78	1.52	3.75
Southern Area	1,691	1.51	2.95	7.29
Total	**3,047**	**2.72**	**5.30**	**13.09**

In addition, any person or public agency shall not use potable quality water for non-potable uses including irrigation and industrial uses if suitable reclaimed water is available.

The State Department of Health Services (DHS) has established regulations and guidelines for the use of reclaimed water. These uses include various agricultural irrigation uses; irrigation of golf courses, cemeteries, freeway landscapes, parks, playgrounds, schoolyards, and other areas where the public has similar access or exposure; recreational and landscape impoundments; and industrial uses. These regulations and criteria specify required levels of treatment, water quality and reliability requirements. In the District service area, reclaimed water produced at the Robinson Ranch Wastewater Treatment Plant is supplied for landscape and golf course irrigation. Reclaimed water may be used in accordance with Order No. 97-52 issued by the California Regional Water Quality Control Board, San Diego Region to the South Orange County Reclamation Authority (SOCRA). SOCRA is a joint powers agency formed to develop uniform water reclamation requirements for its member agencies, of which the District is one of nine members.

Historical Reclaimed Water Demands

Until 1998, the District had two reclaimed water customers: Dove Canyon Country Club and Dove Canyon Master Association. These customers used reclaimed water for irrigating the golf course and landscaped slopes in the Dove Canyon development. In August 1998, the Robinson Ranch Home Owners Association and the Trabuco Highlands Community Association

commenced use of recycled water for irrigating landscaped slope and park areas in the Robinson Ranch development.

Evaluation of historical irrigation usage by the existing reclaimed water customers indicates the existing reclaimed water demand is 606 acre-ft/yr based on 1998 consumption data. Since 1998 was a very wet year, it is not representative of normal reclaimed water demands. Water use in the early months of 1998 was substantially lower than the corresponding months in 1997, while 1998 usage was higher in the later months of the year. In addition, some users had no usage in 1997. Consequently, a comparison was made of annual demands for each user in 1997 and 1998 to determine the highest potential usage.

Table 2-7 presents a comparison of historical demands for existing reclaimed water users. This table indicates the maximum usage by existing reclaimed water users could be 892 acre-ft/yr or 0.80 mgd. This level of usage is higher than the current wastewater treatment plant effluent production of 0.65 mgd. Demand in excess of effluent production must be met by other supplemental water sources. The District currently uses storm runoff collected in Dove Lake to meet peak demands in summer months. As a result, the use of reclaimed water directly offsets current potable water demands in the District service area.

The District has identified additional reclaimed water users in the Robinson Ranch area that could be served by the existing reclaimed water distribution system. Other users in the vicinity could be served with reclaimed water if the existing distribution system is extended or enlarged. The District has a number of irrigation customers that could theoretically use reclaimed water in the Robinson Ranch and Dove Canyon areas. These users have a maximum potential demand of about 555 acre-ft/yr as shown in **Table 2-8**. Some of these users may not be able to use reclaimed water due to site constraints, most of which are in the Dove Canyon area. In addition to these users, the nurseries have a non-potable water demand on the District's system that varies with the local water supply conditions. The nurseries have their own well sources that are used to meet some of their water needs. They only use District water when their demand exceeds their well capacity. The nursery usage of District water is about 0.2 mgd or 224 acre-ft/yr. The total existing non-potable average annual demand is estimated to be about 1.49 mgd or 1,670 acre-ft/yr.

Future Non-potable Water Demands

In addition to these potential uses, new irrigation demands are expected to occur when the nurseries and other undeveloped properties are developed. As discussed previously, the adopted land use plans for the District area allow approximately 6,000 homes to be constructed. Since detailed development plans have not been prepared for these properties, there are no estimates of the potential irrigation demand. Therefore, it is assumed that the type of development will be similar to that in the Robinson Ranch development. In the Robinson Ranch area, the slope and common area irrigation totals about 324 acre-ft/yr for a developed area of 411 acres, or 0.79 acre-ft/yr/acre. This equates to 252 gallons per day per dwelling unit. Application of this figure to the existing and future residential developments plus the existing demand results in a total non-potable demand of 1.97 mgd or 2,207 acre-ft/yr. It may be that future developments have less irrigation on a unit basis than that experienced for past developments. This could be due to

Table 2-7
Existing Reclaimed Water Usage

User	Usage – acre-ft/yr		
	1997	1998	Maximum[1]
Dove Canyon Country Club	474.8	322.2	474.8
Dove Canyon Master Assoc.	336.4	219.5	336.4
Robinson Ranch HOA	0.0	9.5	9.5
Trabuco Highlands Comm. Assoc.	71.3	54.8	71.3
Total	**882.5**	**606.0**	**892.0**

Note: 1. Maximum is the higher demand for 1997 and 1998.

Table 2-8
Other Irrigation Users Near the Reclaimed Water System

User	Usage – acre-ft/yr		
	1997	1998	Maximum[1]
Dove Canyon Country Club	36.9	53.2	53.2
Dove Canyon Master Association	56.2	41.5	59.6
Dove Canyon Plaza	0.0	2.4	2.4
Rancho Cielo	93.2	66.2	93.2
Robinson Ranch HOA	39.4	33.5	40.2
Saddleback Unified School District	8.3	7.2	8.3
Trabuco Highlands Comm. Assoc.	175.2	167.3	199.4
Trabuco Marketplace	8.6	9.8	9.8
Walden HOA	42.8	23.7	42.8
O'Neill Regional Park	46.3	45.4	46.3
Total	**506.9**	**450.2**	**555.2**

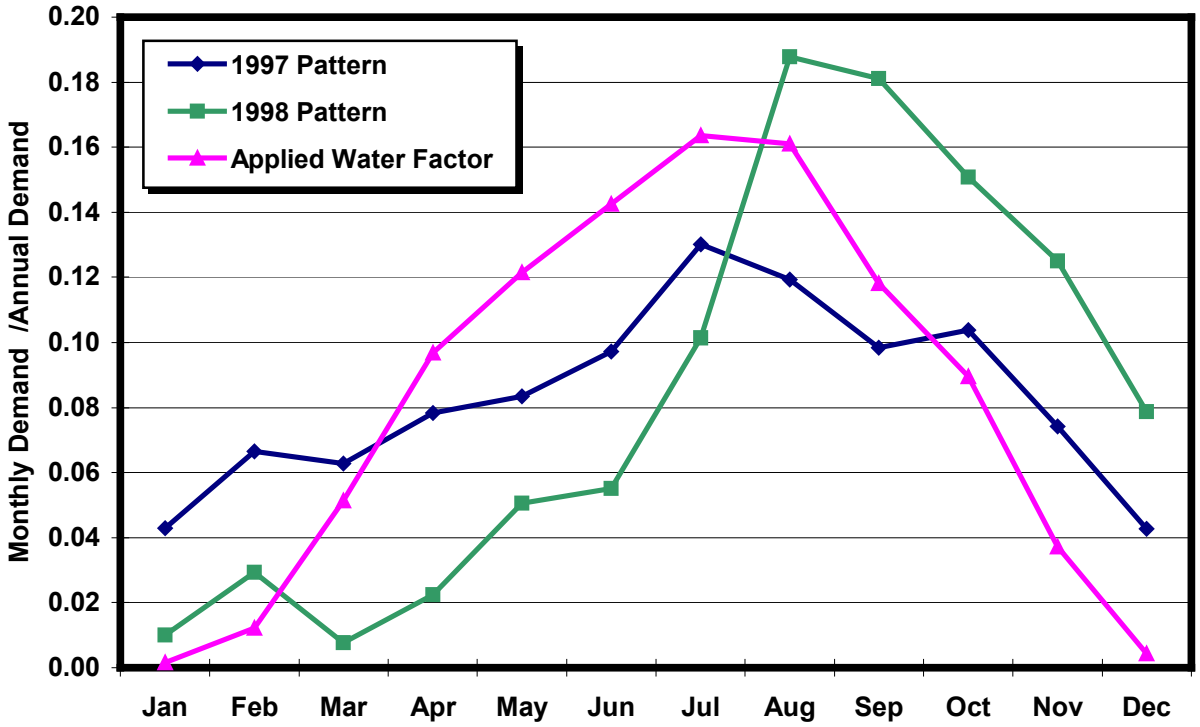
Note: 1. Maximum is the higher demand for 1997 and 1998.

an increased level of clustering of developments resulting in more natural open space. However, this is only speculation and, to determine values on the conservative side, the assumption of irrigation water use near the same level as has occurred in the past was made.

Peaking Factors

Since reclaimed water is used for irrigation purposes in the District, the reclaimed water demand fluctuates based on seasonal factors. Demands are highest in summer months when evapotranspiration (ET) is high and rainfall is low, and is low in winter months when rainfall is high and ET is low. Evaluation of historical data for 1997 and 1998 indicates a seasonal pattern as shown in **Figure 2-7**. In addition, average monthly applied water factors are evaluated based on typical ET and precipitation for the Trabuco Canyon area for comparison to historical data.

Figure 2-7
Monthly Non-potable Water Demand Patterns



For planning purposes, the peaking factors will be based on the computed applied water distribution. The peak month demand is estimated to be 1.95 times the average daily demand. No data is available to document historical maximum day reclaimed water demand. However, typical maximum day demands are about 10 to 20 percent higher than the peak monthly value. Therefore, the maximum day reclaimed water demand is 2.2 times the average daily demand. Peak hour demands vary widely with irrigation timer settings and place of use restrictions. For planning purposes, it is assumed that reclaimed water will be delivered to customers over an eight hour period in the evening hours to avoid direct public contact. This assumption results in a peak hour demand of 3.0 times the maximum day demand or 6.6 times the average daily demand.

Table 2-9 summarizes the existing and projected future reclaimed water demand. This table indicates the future maximum day demand could be as much as 4.33 mgd with a peak hour demand of 12.99 mgd if all identified users are served. This demand will serve as the basis for evaluation of options for the expansion of the reclaimed water system.

TOTAL WATER DEMAND

The total water demand for the District is the sum of the potable and non-potable uses. These demands are presented in **Table 2-10**. Total existing average day demand is 3.22 mgd with a maximum day demand of 5.98 mgd. By the year 2010, the average day demand is projected to increase to 4.03 mgd with a maximum day demand of 7.59 mgd. The average day demand for build-out conditions is 4.69 mgd with a maximum day demand of 9.63 mgd. These demands are

Table 2-9
Existing and Projected Future Non-potable Water Demand

Year and Area	Average Annual Demand (acre-ft/yr)	Average Daily Demand (mgd)	Maximum Day Demand (mgd)	Peak Hour Demand (mgd)
Existing				
North Area	45	0.04	0.10	0.30
Central Area	291	0.26	0.56	1.68
South Area	1,333	1.19	2.61	7.83
Total	**1,669**	**1.49**	**3.27**	**9.81**
Year 2010				
North Area	213	0.19	0.42	1.26
Central Area	302	0.27	0.58	1.74
South Area	1,333	1.19	2.61	7.83
Total	**1,848**	**1.65**	**3.61**	**10.83**
Build-Out (Year 2030)				
North Area	246	0.22	0.49	1.47
Central Area	526	0.47	1.03	3.09
South Area	1,434	1.28	2.81	8.43
Total	**2,206**	**1.97**	**4.33**	**12.99**

used in Section 3 in evaluating system alternatives for meeting both potable and non-potable demands.

WASTEWATER FLOWS

In this subsection, sewage flow rates generated within the District's service area are discussed with respect to historical sewage flow rates, peaking factors for peak month and peak day based on historical sewage flow rates, and projections to future sewage flow rates for total buildout of the District.

The District wastewater system consists of a collection system, eight sewer lift stations, and a wastewater treatment plant. The existing collection system is separated into three collection zones: 1) El Toro Road, 2) Dove Canyon, and 3) Robinson Ranch. Flows from the El Toro Road collection zone are pumped into the SMWD system for treatment via the El Toro Road Sewer Lift Station. Flows generated within the Dove Canyon collection zone are pumped to the Robinson Ranch Wastewater Treatment Plant (WWTP) via the Golf Club Drive Sewer Lift Station, and flows generated within the Robinson Ranch collection zone are pumped to the WWTP via the Heritage Sewer Lift Station. No wastewater flows enter the plant directly by gravity.

Table 2-10
Summary of Total Water Demands

Year and Area	Average Annual Demand (acre-ft/yr)	Average Daily Demand (mgd)	Maximum Day Demand (mgd)	Peak Hour Demand (mgd)
Existing				
Potable	1,938	1.73	3.36	8.30
Non-potable	1,669	1.49	3.27	9.81
Total	**3,607**	**3.22**	**6.63**	**Note 1**
Year 2010				
Potable	2,666	2.38	4.63	11.43
Non-potable	1,848	1.65	3.61	10.83
Total	**4,514**	**4.03**	**8.24**	**Note 1**
Build-out (Year 2030)				
Potable	3,047	2.72	5.31	13.09
Non-potable	2,206	1.97	4.33	12.99
Total	**5,253**	**4.69**	**9.64**	**Note 1**

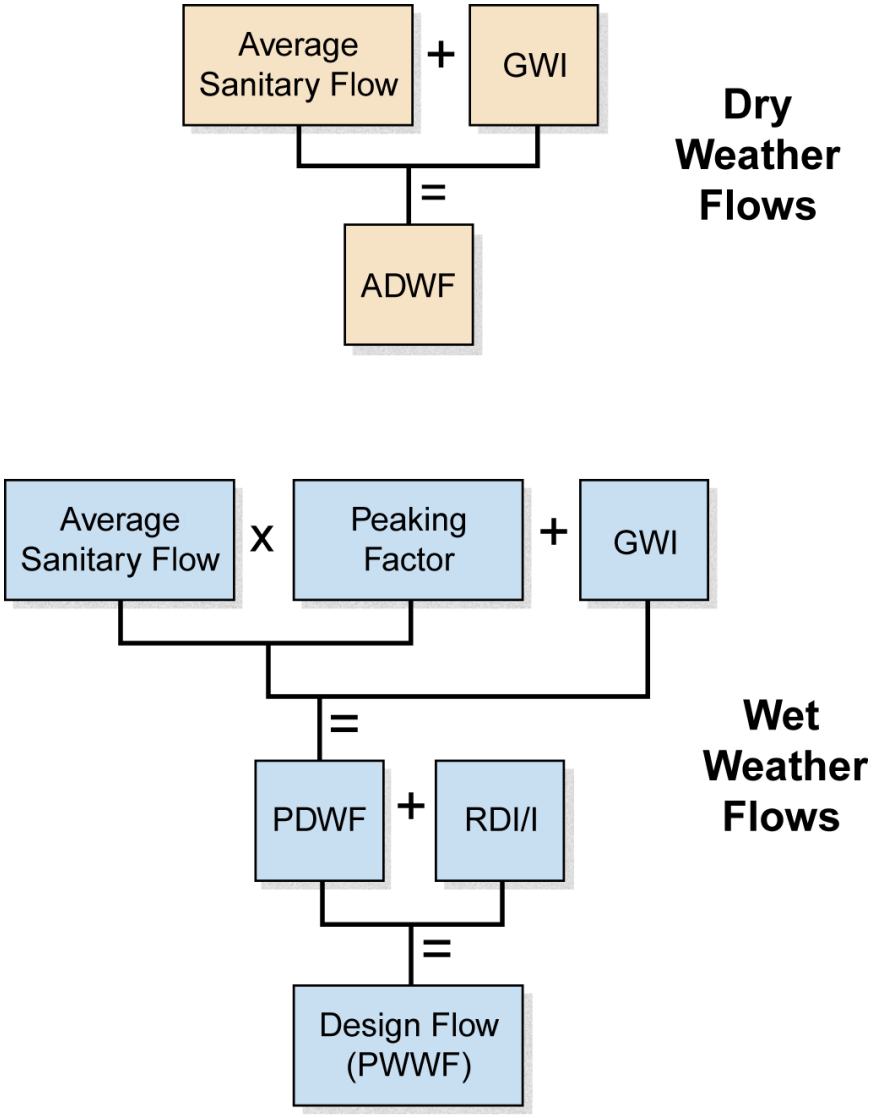
Note: 1. Peak hour demands for potable and non-potable demands would not occur simultaneously.

Typically, wastewater flow rates vary both throughout the day (diurnal fluctuations) and seasonally (peak dry and peak wet weather flows). For each type of flow rate variation, peaking factors or multipliers can be used to scale the average daily flow rates to simulate the flow variations. For diurnal variations, peak flow periods typically occur in the morning and early evening hours, while seasonal variations are likely to encounter peak flow periods during either rainy months or months of tourism for vacation destination communities. The components of sanitary sewage flow rates are shown in **Figure 2-8**. This figure represents the standard method for combining the various components of wastewater flows into a design flow representing both sanitary flows and groundwater infiltration (GWI) and inflow (rainfall dependent infiltration and inflow - RDI/I) flows. Theoretically, groundwater inflow rates will remain relatively constant at all times and are usually expressed as a percentage of the average dry weather flows (ADWF). The peaking factors associated with ADWF account for diurnal behavior; therefore, groundwater infiltration should not be peaked. RDI/I is also generally assumed to be a percentage of the ADWF.

In this report, the two inflow and infiltration flows are not separately evaluated, because no long-term flow monitoring was performed to establish either a baseline for the average sanitary flows and groundwater infiltration or inflow impacts due to storm events. The effect of diurnal and seasonal fluctuations are separated where daily behavior expressed as dry weather flows is super-imposed upon the seasonal fluctuations expressed as wet weather flows.

The sewage generation rates given in this report combine both domestic inputs and groundwater infiltration with a peaking factor. This peaking factor is dependent on the magnitude of the flow rates and is applied to the total ADWF to arrive at a peak dry weather flow (PDWF) rate, contradicting the standard approach shown in **Figure 2-8**. In addition, peak wet weather flows

Figure 2-8
Standard Method for Computing Components of Sanitary Sewage Flows



GWI = Groundwater Infiltration
ADWF = Average Dry Weather Flow
PDWF = Peak Dry Weather Flow
RDI/I = Rainfall Dependent Infiltration and inflow
PWWF = Peak Wet Weather Flow

(PWWF) are calculated by multiplying the PDWF by a second peaking factor. Mathematically, it can be shown that a peaking factor used to peak the combined domestic and groundwater infiltration flow rates for peak dry weather flows is equal to a linear multiple of the separate

domestic wastewater peaking factor. The multiple accounts for the percentage of groundwater infiltration contained in average dry weather flows as shown in the following:

$$PF' = (1 + \alpha) \times PF$$

where: PF = Average Sanitary Flow Peaking Factor
PF' = Combined Flow Peaking Factor
α = GWI/Average Sanitary Flow

A modified version of **Figure 2-8,** which has been followed in this report, is shown in **Figure 2-9**. The modified peaking factor used to peak combined sanitary and groundwater infiltration flows is used in the remainder of this report and is further discussed below.

Historic Sewage Flow Rates

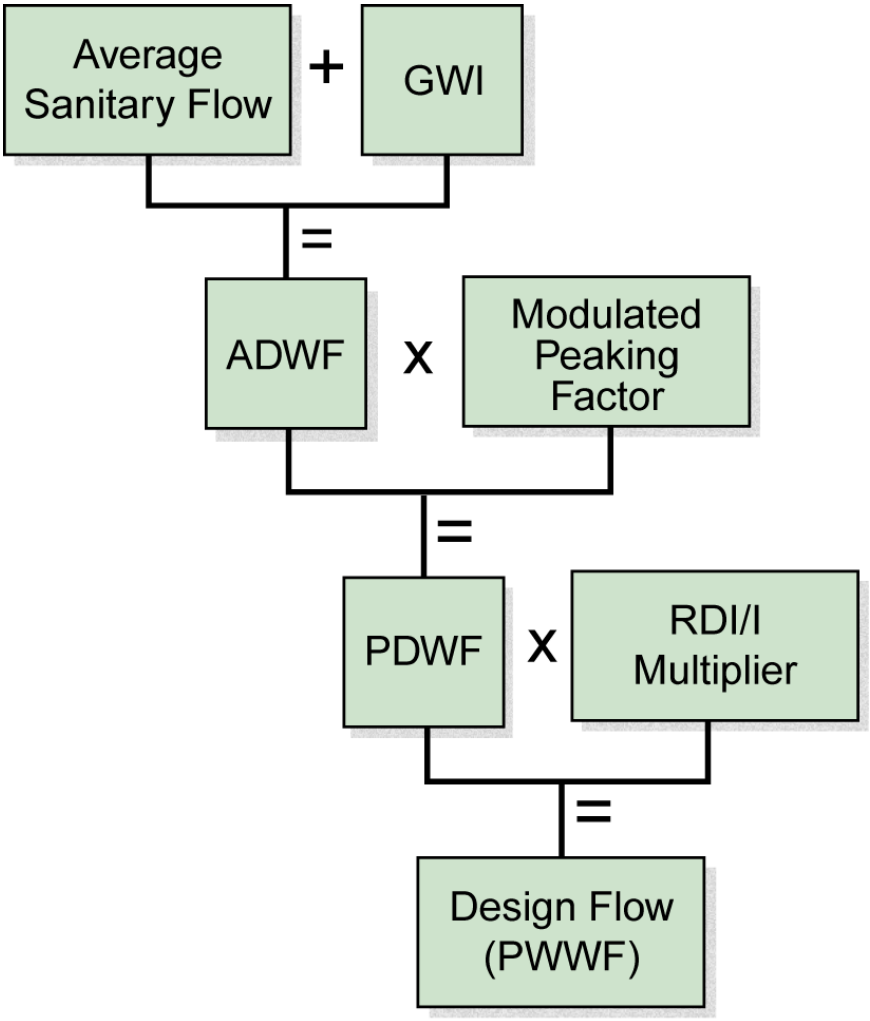
The evaluation of historic wastewater flows was based solely on Sewer Lift Station pump run time records for the calendar years of 1996 and 1997. Pump run time records have been recorded at six major sewer lift stations located in the District: Barneburg, Bell Canyon, Golf Club, Heritage, Plano Trabuco, Via Alegre, and actual flow rate data was recorded for the El Toro Road Sewer Lift Station. This data has been used to determine the annual average flow rates for sewage generation within the District. The annual average flow rate measured at each sewer lift station was then used to determine per capita generation rates, and this determination is described more thoroughly in Section 6 under the subsection heading for model calibration.

To determine the flow rates from the run time records, a total monthly flow volume was determined by multiplying the total monthly hours of operation for a given sewer lift station pump times the measured output of the respective pump. This total monthly flow volume was converted to a flow rate by dividing by the total time for the time period of operation and then converting to a standard flow rate designation such as gallons per minute (gpm) or mgd. In this calculation, the respective pump output was measured during a recent pump efficiency test. This pump efficiency test data was provided by the District. For the El Toro Road Sewer Lift Station, the flow rate data measured at the pump was taken directly from the tabulated data.

Table 2-11 summarizes the average annual, minimum month, and peak month flow rate data for each sewer lift station based on the two-year period for the calendar years of 1996 and 1997. It should be noted that at times during the winter months, flow rates for the Plano Trabuco and Heritage Sewer Lift Stations were expected to be higher. However, during this period, wastewater flows were diverted to the SMWD system because of the low demand for reclaimed water. An inspection of the peak month peaking factors (presented below) does not show any significant difference between the peak month peaking factor for these two sewer lift stations and the remaining sewer lift stations. Therefore, the data was not further refined to reflect the change in operating conditions occurring during bypass scenarios.

The El Toro Road, Heritage, and Golf Club sewer lift stations represent total flows for their respective areas of the District's collection system; hence, their various flows can be summed directly to yield totals for the District. The other sewer lift stations are measures of flows

Figure 2-9
Method Utilized for Computing Components of Sanitary Sewage Flows



GWI = Groundwater Infiltration
ADWF = Average Dry Weather Flow
PDWF = Peak Dry Weather Flow
RDI/I = Rainfall Dependent Infiltration and inflow
PWWF = Peak Wet Weather Flow

generated from intermediate areas within the District's system that are subsequently conveyed by either the El Toro Road, Heritage, or the Golf Club Sewer Lift Stations. In addition, approximately 0.35 mgd of flow is generated within IRWD (based on 1,596 EDUs out of a potential total of 2,378 EDUs, 67 percent developed based on EDUs and 50 percent based on flow) and SMWD (233 residential connections, assumed to be 100 percent developed), that is subsequently pumped by the El Toro Road Sewer Lift Station. This flow is not generated from

Table 2-11
Sewer Lift Station Peak Month Factors

Sewer Lift Station	Daily Flow Rate (mgd)			Peak Month Peaking Factor
	Average Annual	Minimum Month	Peak Month	
Barneburg	0.073	0.043	0.112	1.53
Bell Canyon	0.052	0.031	0.179	3.44
El Toro	0.487	0.377	0.716	1.47
Golf Club	0.345	0.245	0.440	1.28
Heritage	0.420	0.139	0.892	2.12
Plano Trabuco	0.323	0.000	0.592	1.83
Via Alegre	0.074	0.049	0.106	1.43
Flow-weighted average				**1.71**

Note: 1. No historical data was available for the Zadeh sewer lift station.

District customers, but is only pumped by the District's sewer lift station for treatment downstream.

For the two year period of 1996-1997, the total flows for the District are listed in **Table 2-12**. These flows are based on flows measured at the El Toro Road, Heritage, or the Golf Club Sewer Lift Stations where the current average annual flow rate generated within the District is 0.929 mgd. The 0.35 mgd generated outside of the District has already been subtracted from the flow rates measured at the El Toro Road Sewer Lift Station.

Table 2-12
Total District Wastewater Flow Rates

Sewer Lift Station	Daily Flow Rate (mgd)		
	Average Annual	Minimum Month	Peak Month
El Toro	0.487	0.377	0.716
Heritage	0.420	0.139	0.892
Golf Club	0.345	0.245	0.440
Total	**1.252**	**0.761**	**2.048**

Of the total flows, current flows conveyed to the WWTP total 0.765 mgd as measured at the Heritage and Golf Club Sewer Lift Stations. This matches closely with the flow rates independently measured at the WWTP and confirms the methodology employed in this study for computing wastewater flows from sewer lift station run time records.

Figures 2-10 through **2-16** show the monthly flow rates measured or determined for each sewer lift station over the entire two year period. These figures demonstrate the seasonal fluctuations in flow expected for the District where the greatest flows are observed during the winter months. The plotted flow rates do not indicate any specific long-term trends that could be construed as

major changes in demographics or sewage generation within the District (i.e., definable growth or development). The only data that could be considered suspect is the data shown for the Plano Trabuco, Via Alegre, and Heritage Sewer Lift Stations for the early winter months of 1997. The data show the lowest flows (even zero for the Plano Trabuco Sewer Lift Station) during this time period which indicates the bypassing of the WWTP. The impact of this bypass on evaluation of the historical data and subsequent calibration of the model has been discussed previously.

Peaking Factors

Two sets of data were utilized to present peaking factors for wastewater flows: 1) Hourly flow rate readings at three sewer lift station locations taken between December 9, 1997 and December 19, 1997 and 2) Sewer Lift Station pump run time records for 1996 and 1997. Each of these historic data records are discussed separately below.

Diurnal - Hourly Flow Rate Readings

The relationship between the average and peak hourly wastewater flow rates is generally expressed as the hourly peaking factor. The hourly peaking factor, as used in this report, is the ratio of the ADWF rate (both domestic input and groundwater infiltration) to the PDWF rate. The hourly peaking factors are highest for smaller areas with fewer contributing users whose inputs form a greater proportion of the flow. The hourly peaking factor tends to decrease as the total contributing area increases due to flow travel times. Long flow travel times can dampen peak flow surges and lower the probability that flows will occur at the same time.

Figure 2-10
Barneburg Sewer Lift Station Flow Rates: 1996-1997

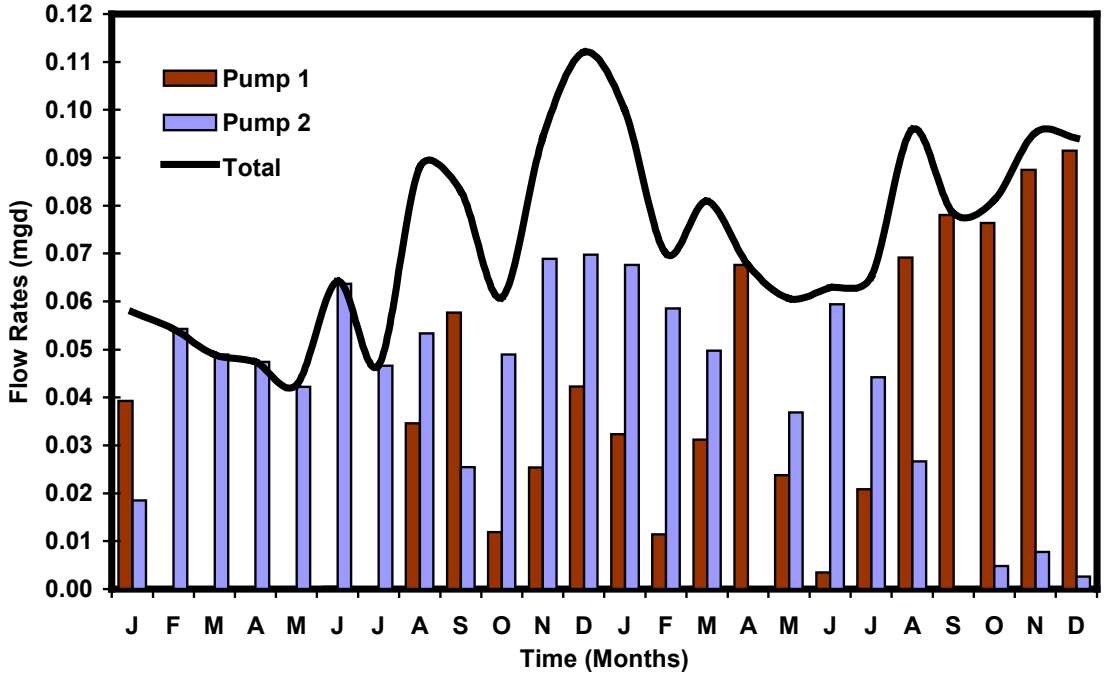


Figure 2-11
Bell Canyon Sewer Lift Station Flow Rates: 1996-1997

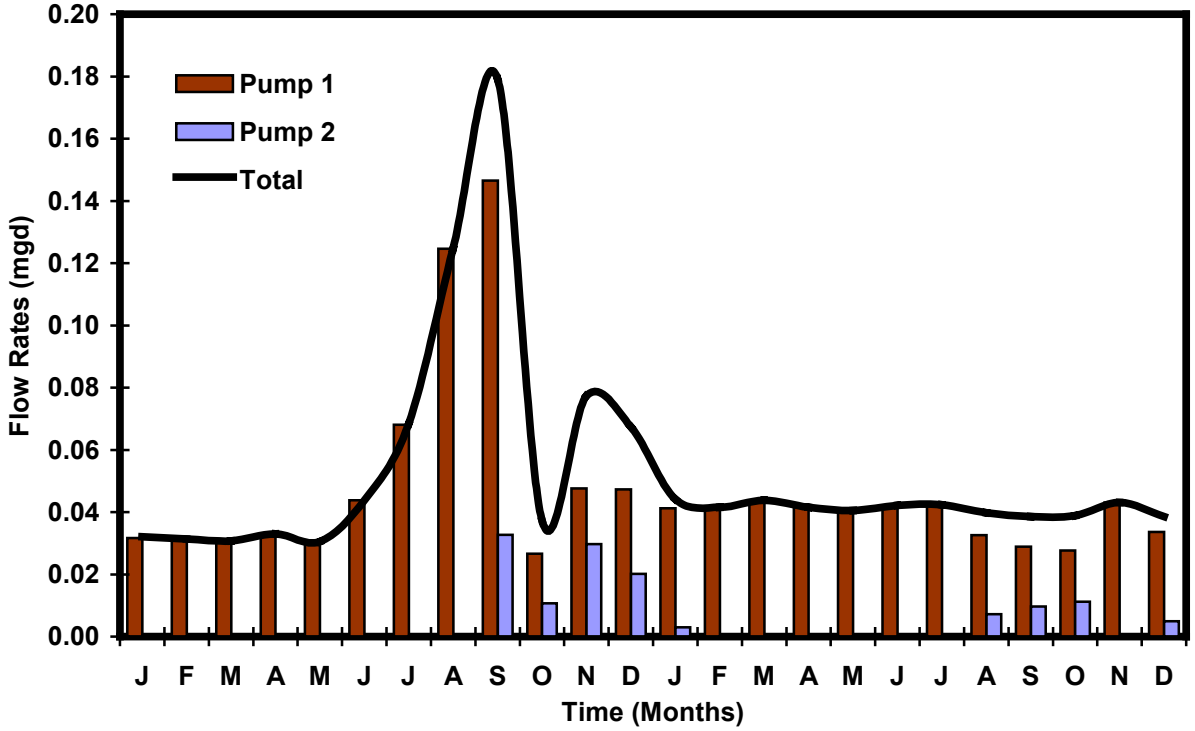


Figure 2-12
El Toro Road Sewer Lift Station Flow Rates: 1996-1997

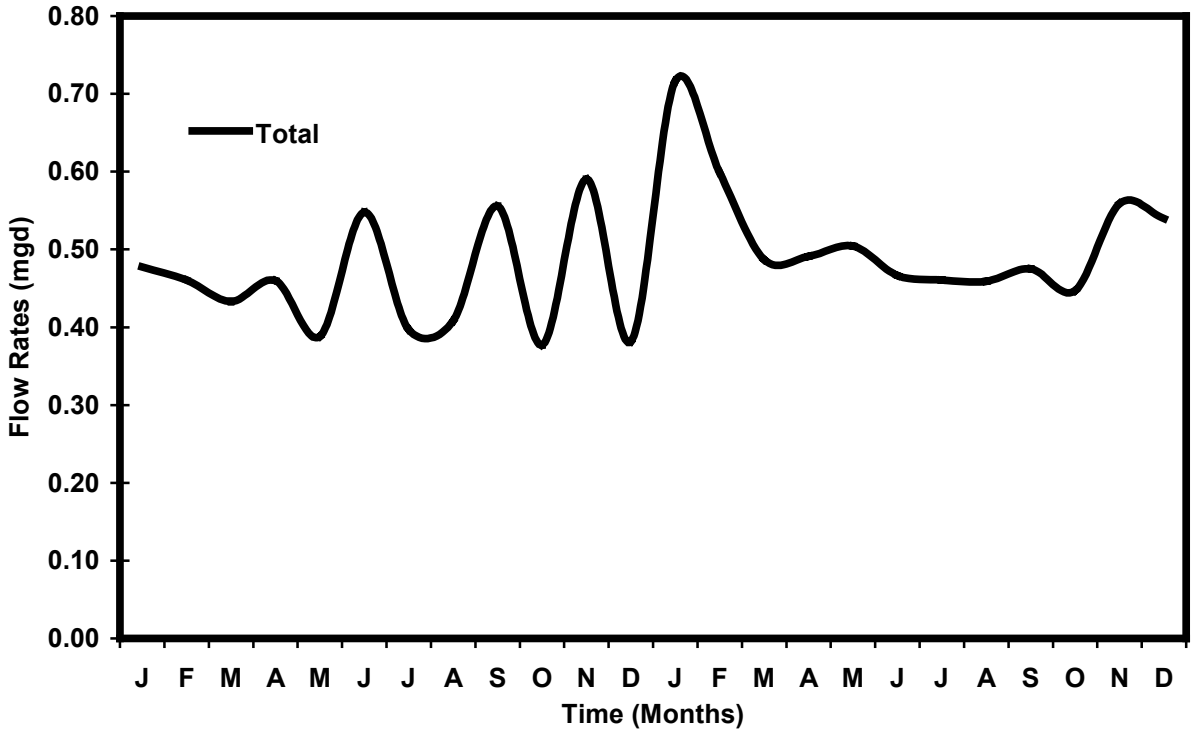


Figure 2-13
Golf Club Sewer Lift Station Flow Rates: 1996-1997

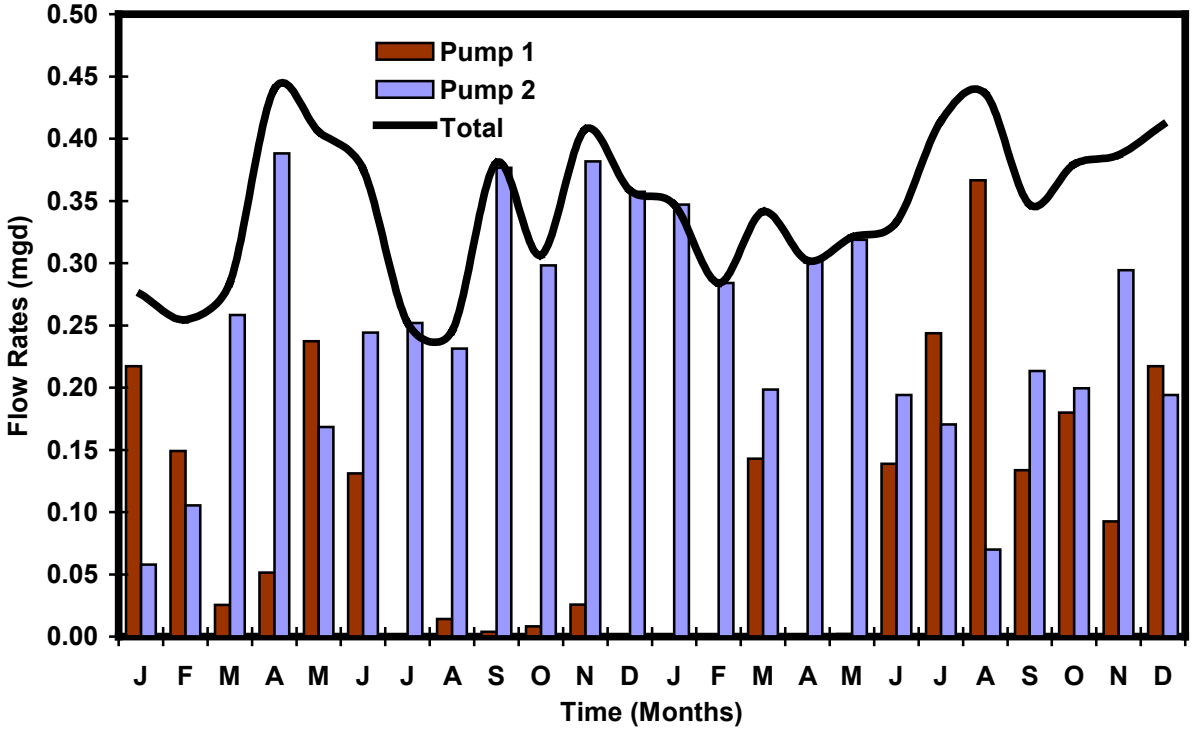


Figure 2-14
Heritage Sewer Lift Station Flow Rates: 1996-1997

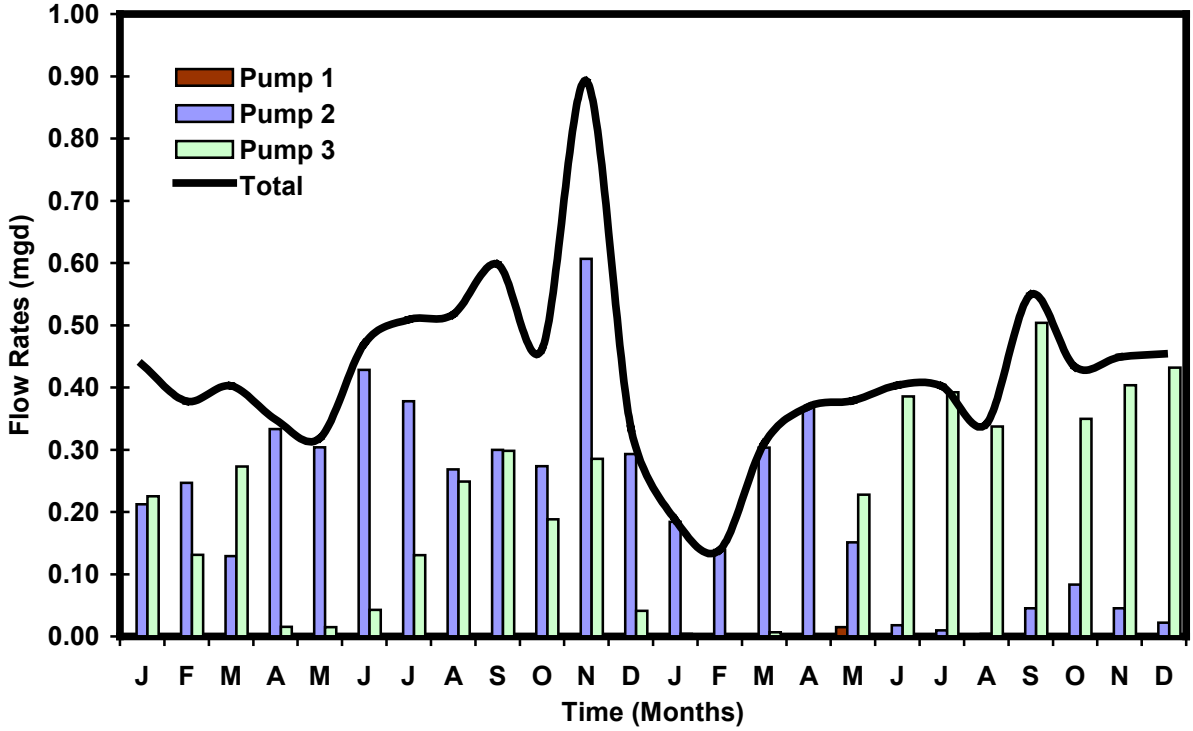


Figure 2-15
Plano Trabuco Sewer Lift Station Flow Rates: 1996-1997

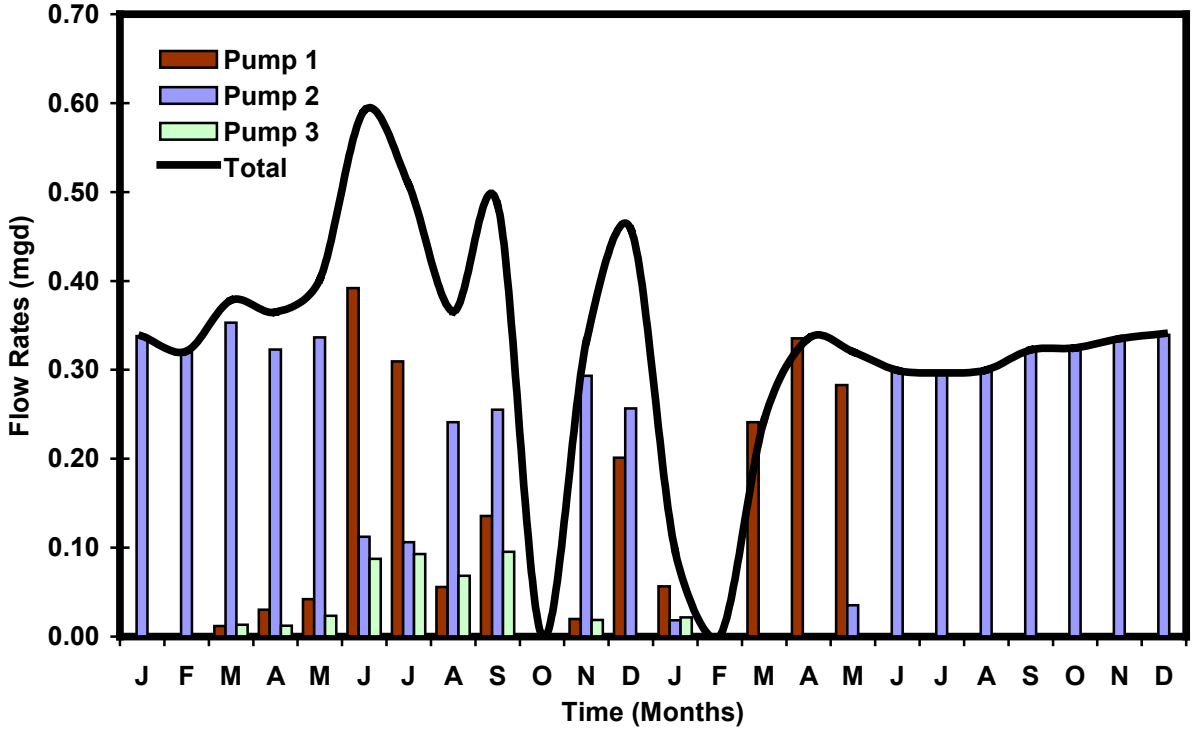
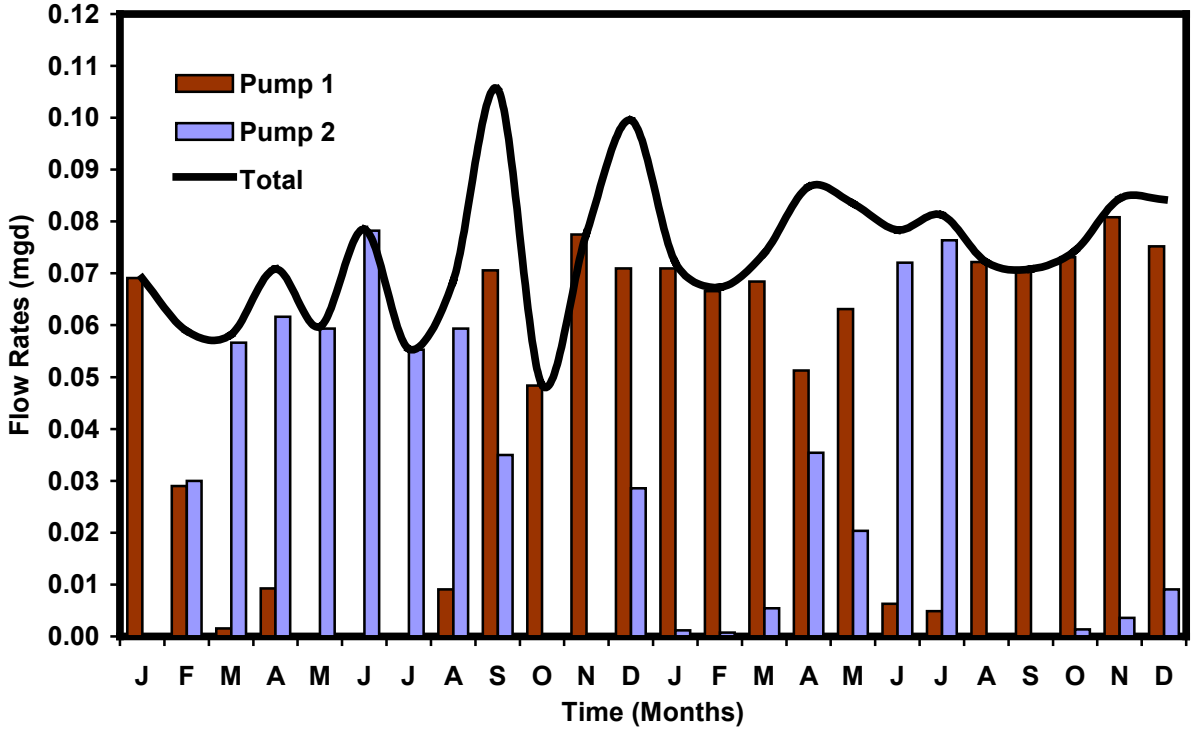


Figure 2-16
Via Alegre Sewer Lift Station Flow Rates: 1996-1997



Approximately three days of hourly readings were taken at the Plano Trabuco, Via Alegre, and Golf Club Dr. Sewer Lift Stations. This data has been used to evaluate the diurnal flow characteristics of sewage generation within the sewer lift station service areas, and it is assumed that similar characteristics would be observed throughout the District since the District is nearly homogeneous with respect to land use (i.e., nearly 100% residential).

Figure 2-17 shows the diurnal flow behavior measured at each sewer lift station over the test period with respect to time of day where the y-axis has been scaled by the total flow measured at a given sewer lift station (i.e., relative flow rate per time of day). These figures demonstrate both reproducibility or consistency across the District and classic diurnal behavior expected in a traditional residential setting with a minimum flow rate occurring during the earliest morning hours and a peak hour flow rate corresponding to the morning constitutional. In addition, secondary peaks are noted for evening meal and constitutional activities.

The measured data showed peak hour peaking factors ranging from 1.77 to 1.92 for the three sewer lift stations with a flow-weighted average of 1.85. The validity of this data was assessed by comparing the measured peaking factors to calculated peaking factors determined using a formula developed by the Los Angeles County Sanitation Districts (LACSD) from field flow data for sewer systems. The formula was developed by LACSD as a best-fit solution taken from a peak flow curve. The formula is given by:

$$Q_{PDWF} = 1.84 \times \left(Q_{ADWF}\right)^{0.92}$$

where: Q is flow and is given in cfs.

Table 2-13 summarizes the individual daily peak hour peaking factors derived from the data for each sewer lift station and calculated using the LACSD formula.

Seasonal - Sewer Lift Station Pump Run Time Records

Seasonal peaking factors are intended to account for major shifts in demographics due to substantial influxes of tourism, migratory behavior of residents, and the effects of weather. It is assumed that seasonal changes in flow rates in the District are only due to rainy weather which occurs during the winter months; whereas, any effect of tourism would be felt at a relatively constant rate all year and would form a portion of the baseline flow for the District.

The sewer lift station pump run time records were used to determine the annual average sewage flow rates for the District. In this subsection, this same data is used to determine the peak month, i.e., peak wet weather or seasonal, flow characteristics of sewage generation throughout the entire sewered area of the District. **Figures 2-10** through **2-16** illustrate the seasonal variations in flow over the two year period of 1996 and 1997. As shown in **Table 2-13**, the peak month peaking factors do not show any significant, systematic deviation between the various sewer lift stations; therefore, the “holes” in the data resulting from the bypass of the treatment plant are not considered significant.

Figure 2-17
Sewer Lift Station Diurnal Flows: 1996-1997

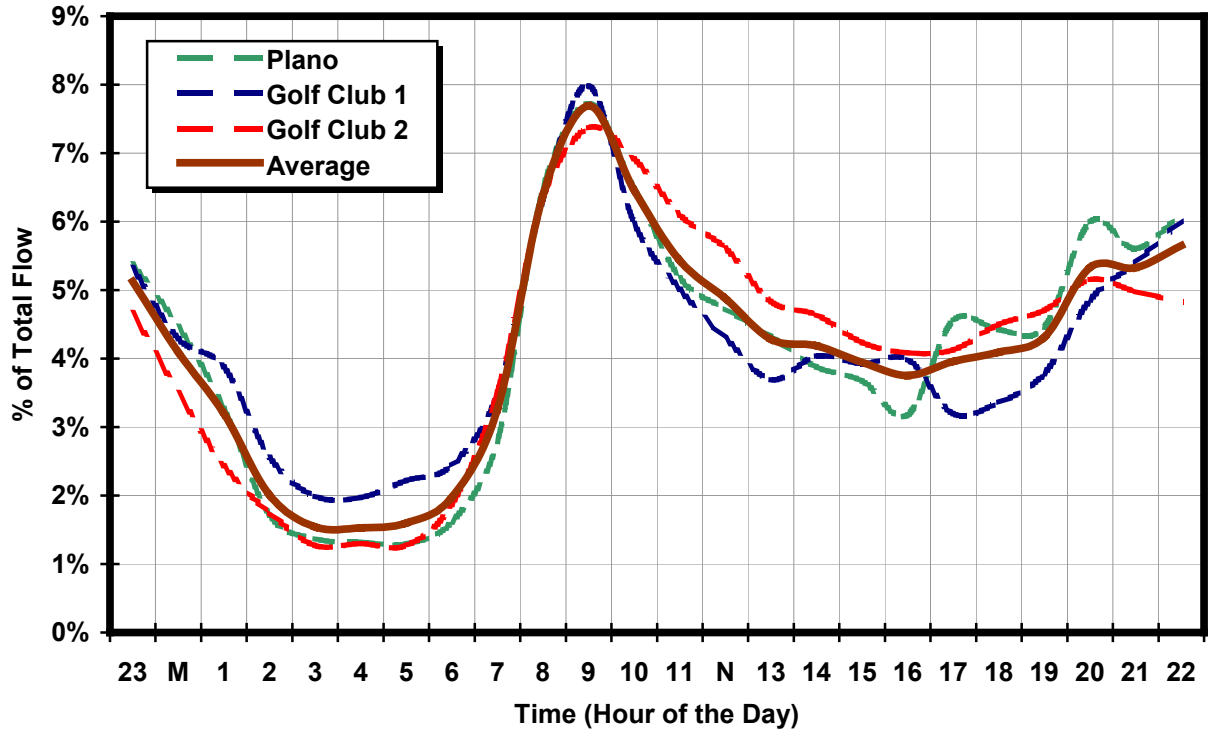


Table 2-13
Sewer Lift Station Wastewater Hourly Flow Rates

Sewer Lift Station	Average Flow Rate (gpm)	Hourly Peaking Factor			
		Measured Minimum	Measured Peak	Calculated Peak[1]	Peak Ratio[2]
Plano Trabuco	212	0.31	1.85	1.95	1.05
Via Alegre	310	0.47	1.92	1.90	0.99
Golf Club Dr.	248	0.30	1.77	1.93	1.09
Flow-weighted Average		**0.37**	**1.85**	**1.92**	**0.01**

Notes: 1. Calculated using the formula developed by the LACSD.
2. Calculated as follows: Calculated Peak/Measured Peak.

Future Wastewater Flow Rates

All anticipated future average day sewer flow rates have been determined based on the build-out land use information and phasing described earlier and refined in the subsection describing future water demands. The determination of future average day sewer flow rates was based on water demands as follows:

$$Q_{Sewage} = Generation\ Rate \times \left(EDU_{Buildout\ Total} - EDU_{Irrigation}\right)$$

where:

Generation Rate ≡ the value of flow input to the sewer system per EDU determined from the calibration of the model with flow data taken from the pump run time records as discussed above.

$EDU_{BuildoutTotal}$ ≡ the total future EDUs determined for various land uses within the District for water service.

$EDU_{Irrigation}$ ≡ the total future EDUs for various land uses within the District that are known to be irrigation demand that would not yield flows that would enter the sewer system.

The wastewater generation rate has been determined to be 270 gpd/EDU based on calibration of the sewer model. In general, existing and future peaking factors should be similar because the demographics for future development will be similar to existing demographics. Based on the above information, **Table 2-14** summarizes the estimated total wastewater flows generated within the District for existing, Year 2010, and build-out conditions.

The peaking factors in **Table 2-14** are computed from the respective ratio of peak dry weather and average dry weather flow rates.

Table 2-14
Summary of Estimated Wastewater Flows

Year and Area	Average Annual Flow (acre-ft/yr)	Average Daily Flow (mgd)	Peak Month Flow (mgd)	Peak Hour Flow (mgd)
Existing				
North Area	179	0.16	0.27	0.50
Central Area	0	0.00	0.00	0.00
South Area	807	0.72	1.23	2.28
Total	**986**	**0.88**	**1.50**	**2.78**
Year 2010				
North Area	358	0.32	0.55	1.02
Central Area	246	0.22	0.38	0.70
South Area	807	0.72	1.23	2.28
Total	**1,411**	**1.26**	**2.16**	**4.00**
Build-Out (Year 2030)				
North Area	437	0.39	0.67	1.24
Central Area	515	0.46	0.79	1.46
South Area	997	0.89	1.52	2.81
Total	**1,949**	**1.74**	**2.98**	**5.51**

Section 3
Future System Alternatives and Selection

The District has several planning alternatives that it could implement to meet future needs. Each alternative defines a different approach for meeting the future water supply and wastewater treatment and disposal needs of the District's customers. The purpose of this section is to define and evaluate alternative systems and to select a preferred approach. This preferred alternative is used to define the future facilities requirements of the District.

SUMMARY OF FUTURE DEMANDS AND FLOWS

In Section 2, the future water demand and wastewater flow projections are developed. Water demand projections include both potable and non-potable uses. These projections are summarized by planning area and for the entire District in **Figure 3-1**. The evaluations in Section 2 indicate the total average annual water demands will increase from 3.22 mgd currently to 4.69 mgd at build-out. Of this amount, 2.72 mgd is potable demand while 1.97 mgd is non-potable use. Average annual wastewater flows in the District are projected to increase from 0.88 mgd to 1.74 mgd at build-out.

SUMMARY OF EXISTING WATER SUPPLY AND WASTEWATER TREATMENT

Section 4 of this master plan presents a detailed analysis of the District's water supply capabilities. For the analysis of alternatives, the supply capabilities are summarized briefly. The District has two imported water sources. Untreated water from the Baker Aqueduct, which is treated at the District's Dimension Water Treatment Plant, can currently produce up to 5.94 cfs (3.84 mgd). Treated water from the Allen-McColloch Pipeline can produce up to 4 cfs (2.59 mgd). This water is conveyed to the District through the South County Pipeline and SMWD's Antonio Delivery System. The District owns 6 cfs of conveyance capacity in this system. As discussed in Section 2, District customers in the Portola Hills area receive water service from IRWD, but the District bills these customers and pays IRWD for the water supply. The water obtained from IRWD averages 0.37 cfs (0.24 mgd) with an estimated maximum day demand of 0.74 cfs (0.48 mgd). This IRWD water is counted as a supply source. The District also has three local wells that are capable of producing about 3.3 cfs (2.13 cfs); however, this supply is not reliable in the summer when peak demands are experienced or in dry, winter months. The combined potable water production capability during summer months, which is limited to the imported water supplies, is 10.68 cfs (6.91 mgd).

Section 6 of this master plan presents an evaluation of the District's wastewater collection and treatment capability, which is summarized briefly herein. The District can treat up to 0.85 mgd of wastewater at its Robinson Ranch Wastewater Treatment Plant. Effluent from this plant is stored in a 130 acre-ft on-site reservoir and delivered to non-potable users in the Robinson Ranch and Dove Canyon areas. The District also owns 0.558 mgd of capacity in the Santa Margarita Water

Figure 3-1
District Planning Zones

District's (SMWD) wastewater collection system and Chiquita Wastewater Reclamation Plant, some of which is reserved for projected future developments by landowners in the North portion of the District.

DISTRICT GOALS AND OBJECTIVES

Future facilities planning decisions must consider the District's goals and objectives. Local water resources are limited to several wells that have limited yield, producing supplies primarily in the winter and spring months, when there is sufficient runoff in Trabuco Creek. In summer months when demands are high, the groundwater yield is typically lowest. Consequently, the District must depend on imported water supplies to meet its peak demands, some of which must be conveyed through adjacent water districts' systems. This water supply is expensive and must be pumped multiple times to serve District customers.

The District also has constraints on its wastewater operation. Wastewater from the North Planning Area must be exported to SMWD for treatment and disposal due to a lack of District facilities to utilize this water. The Central Planning Area is currently unsewered. Wastewater from the South Planning Area is treated at the Robinson Ranch facility. Effluent from the wastewater treatment plant must be reused because surface water discharge of effluent is not currently permitted. During wet weather periods, the San Diego Region Water Quality Control Board requires the District to have up to 84 days of seasonal storage capacity for reclaimed water plant production unless it has a permit for surface water discharge. The stored reclaimed water is used during the summer months. However, since the District does not currently have sufficient seasonal storage capacity for reclaimed water, it must bypass a portion of its wastewater flow to the SMWD Chiquita System for treatment and disposal during the winter months. The District is currently able to divert more wastewater than its contractual rights since there is excess treatment capacity in the SMWD WWTP. However, in the future, as SMWD flows approach plant capacity or build-out conditions, it is expected that no surplus capacity will be available. Therefore, the District will need to be self-sufficient in terms of its wastewater treatment and disposal capabilities.

The District is heavily dependent on imported water sources. Since this water must be purchased and pumped to District customers, it is prudent to minimize this expense to the extent practical. Reusing as much of the District's wastewater as possible can offset the purchase of expensive imported water supplies.

Based on these considerations, the following goals are established for developing and evaluating alternative system configurations:

1. Maximize the use of the District's reclaimed water supplies
2. Minimize the need for imported water supplies
3. Maximize the District's operational flexibility
4. Minimize implementation issues
5. Minimize the costs of water supply, wastewater treatment and disposal.

DESCRIPTION OF ALTERNATIVES

Five general concepts have been identified that address the collection and treatment of wastewater under expected buildout conditions. These alternatives make reference to North, Central and South Planning areas of the District as defined in Section 2.

Alternative 1 – Maintain Existing Wastewater Treatment Capacity

This alternative involves maintaining the existing system facilities. No new wastewater treatment capacity would be constructed. However, additional water supply capacity would be required. This alternative is shown in **Figure 3-2**.

Wastewater Facilities

The wastewater treatment capacity at the Robinson Ranch WWTP would be maintained at the current capacity of 0.85 mgd, which would treat 96 percent of the buildout flow of 0.89 mgd from the South Planning area. Wastewater generated in the Central Area would be collected and pumped to the South Area. New gravity sewers would collect flows from the Central Area to a sewer lift station near O'Neill Park on Trabuco Canyon Road. A force main would convey wastewater from the sewer lift station to the existing wastewater system. Excess flow from the South Area (0.04 mgd) would be combined with the Central Area flow of 0.46 mgd and exported to the SMWD Chiquita System (total of 0.5 mgd). The District would need to negotiate an average of 0.37 mgd of additional wastewater treatment and disposal capacity with SMWD to provide a total capacity of 0.5 mgd on the south side of the District. The wastewater flows generated within the North Area of 0.39 mgd would continue to be conveyed to the SMWD El Toro system for treatment. However, sewer capacity ownership of individual property owners may need to adjusted to accommodate current development plans.

Wet weather operations at the Robinson Ranch plant would be limited by the existing storage capabilities of 130 acre-ft. At build-out flows, the existing storage can handle an average flow of 0.85 mgd for 50 days. Once this storage is filled, all wastewater would need to be diverted to SMWD. This flowrate would be 1.35 mgd. If additional storage is constructed to provide the full 84 days of storage, it is possible that this level of wet weather flow diversion would still be required but for a shorter period of time.

Reclaimed Water Facilities

Non-potable water usage would be limited to the available average reclaimed water supply of 0.85 mgd. Maximum day non-potable usage would be 1.87 mgd. This is sufficient to continue serving the existing reclaimed water customers; however, no capacity is available for expansion. Summer peak flows would be met from the reclaimed water reservoir. Since annual supply and demand are essentially equal, any wastewater diverted when storage is full would need to be supplemented with water stored in Dove Lake as is currently occurring. During dry years when there is inadequate runoff into Dove Lake, the District would need to make up any reclaimed water shortages with treated potable water.

Figure 3-2
Alternative 1 – No Additional Treatment

Potable Water Facilities

The annual potable water demand would average 3.84 mgd after deducting 0.85 mgd of reclaimed water usage. The maximum day potable water demand would be 7.77 mgd (12.02 cfs) after deducting maximum day reclaimed water usage. Since this amount of water exceeds the District's current supply capabilities, additional supply capacity of at least 0.86 mgd (1.33 cfs) would be required. The District owns conveyance capacity in the SMWD Antonio Delivery System for this amount of water but would need to obtain 2 cfs of additional capacity in the AMP. Options related to this source are discussed in Section 4.

Alternative 2 – Expand Existing Wastewater Plant to 1.35 mgd

This alternative involves expansion of the Robinson Ranch WWTP, increased reclaimed water usage and some additional water supply capacity. This alternative is shown graphically in **Figure 3-3.**

Wastewater Facilities

The treatment capacity at the Robinson Ranch WWTP would be increased to 1.35 mgd to treat all wastewater flows generated within Central and South Areas of the District. New gravity sewers would collect flows from the Central Area to a sewer lift station near O'Neill Park on Trabuco Canyon Road. A force main would convey wastewater from the sewer lift station to the existing wastewater system for treatment at the enlarged Robinson Ranch plant. Portions of the existing system may require upgrading to handle the higher flows. Flow generated in the North Area of the District, 0.39 mgd, would continue to be exported to the SMWD for treatment.

Increased seasonal storage capacity for reclaimed water would be required. The existing seasonal storage capacity is sufficient to provide 31 days of storage at 1.35 mgd. Additional wastewater storage amounting to 218 acre-ft would be required to provide a full 84 days of storage. In winter months, it is possible that some wastewater would need to be diverted to SMWD if storage becomes filled.

Reclaimed Water Facilities

Non-potable water would be served in the Central and South Areas. Usage would be limited to the available average reclaimed water supply of 1.35 mgd. Peak non-potable usage would be 2.97 mgd. Summer peak flows would be met from the reclaimed water seasonal storage reservoir and could be supplemented with water stored in Dove Lake as is currently occurring. The District may be able to increase reclaimed water usage if it can negotiate an agreement to obtain reclaimed water from SMWD.

Potable Water Facilities

The average annual potable water demand would 3.34 mgd. Maximum day potable demand would be 6.67 mgd (10.32 cfs). Since this is less than the current summer production capacity, no additional potable water capacity would be needed.

Figure 3-3
Alternative 2 – Expand Existing Treatment Plant to 1.35 mgd

Alternative 3 – Construct New North Treatment Plant

This alternative involves conveying all wastewater generated in the Central and North Areas to a central location for treatment and reuse. The new treatment plant would be located in the North Area to supply effluent to future non-potable uses. The existing Robinson Ranch plant would continue to operate at its present capacity. This alternative is shown in **Figure 3-4**.

Wastewater Facilities

The wastewater treatment capacity at the Robinson Ranch WWTP would be maintained at the current capacity of 0.85 mgd, which would treat 96 percent of the 0.89 mgd build-out flow from the South Planning area. Excess flow generated in the South Area would continue to be exported to SMWD within the existing contract. The remaining wastewater flows generated within the District, 0.85 mgd, would be conveyed to a new WWTP located in the North Area of the District. New gravity sewers would convey wastewater generated in the Central Area to a new sewer lift station located near O'Neill Regional Park along Trabuco Canyon Road. A new force main would convey wastewater from the sewer lift station to the crest of Live Oak Canyon Road at Harris Grade where a gravity sewer would convey the wastewater to the new treatment plant site. Ideally, the plant would be sited to maximize potential effluent reuse. However, locating a wastewater treatment plant in this area would be difficult due to property owner opposition and environmental concerns.

Increased seasonal storage capacity for reclaimed water would be required. The existing seasonal storage capacity is sufficient to provide 50 days of storage at 0.85 mgd. An additional 89 acre-ft of seasonal storage would be required to provide 84 days of storage at the Robinson Ranch plant. At the new North plant, 219 acre-ft of seasonal storage would be required. Three potential storage sites exist near the proposed treatment plant site. However, obtaining the necessary permits for new storage may be difficult. An alternative to storage involves obtaining a NPDES permit for surface discharge, which may also be difficult to obtain. In winter months, it is possible that some wastewater would need to be diverted to SMWD if storage becomes filled.

Reclaimed Water Facilities

Non-potable water usage would be a function of the service area demands or the available average reclaimed water supply from the two treatment plants, whichever is less. Water reuse at the Robinson Ranch would average 0.85 mgd and peak non-potable usage would be 1.93 mgd. Summer peak flows could be met from the reclaimed water seasonal storage reservoir and could be supplemented with water stored in Dove Lake as is currently occurring. Water reuse from the new North treatment plant would be limited to the projected non-potable demand of 0.69 mgd. This would leave 0.16 mgd of effluent that would need disposal, principally during winter months. This excess effluent could potentially be delivered to SMWD's Upper Oso Reservoir for reuse by others if an agreement is negotiated with SMWD.

Potable Water Facilities

The average annual potable water demand would 3.15 mgd. Maximum day potable demand would be 6.25 mgd (9.67 cfs). Since the MDD does not exceed the current summer production

Figure 3-4
Alternative 3 - Construct New Northern Treatment Plant

capacity, no additional potable water capacity would be needed.

Alternative 4 – Construct New Central Treatment Plant

This alternative is similar to Alternative 3. It involves conveying all wastewater generated in the Central and North Areas to a central location for treatment and reuse. The new treatment plant would be located in the Central area to supply effluent to future non-potable uses. The existing Robinson Ranch plant would continued to operate at its present capacity. This alternative is shown in **Figure 3-5**.

Wastewater Facilities

The wastewater treatment capacity at the Robinson Ranch WWTP would be maintained at the current capacity of 0.85 mgd, which would treat 96 percent of the 0.89 mgd build-out flow from the South Planning area. Excess flow generated in the South Area would continue to be exported to SMWD within the existing contract. The remaining wastewater flows generated within the District, 0.85 mgd, would be conveyed to a new WWTP located in the Central Area of the District. A new sewer lift station would be constructed along El Toro Road to pump wastewater from the North Area through a force main into the Central Area. New gravity sewers would convey wastewater generated in the Central Area to a new treatment plant located near O'Neill Regional Park along Trabuco Canyon Road. The plant would be sited to maximize potential effluent reuse. However, property owner and environmental concerns would make siting a plant in this are extremely difficult.

Increased seasonal storage capacity for reclaimed water would be required. The existing seasonal storage capacity is sufficient to provide 50 days of storage at 0.85 mgd. An additional 89 acre-ft of seasonal storage would be required to provide 84 days of storage at the Robinson Ranch plant. At the new Central treatment plant, 219 acre-ft of seasonal storage would be required. No potential storage sites are located near the proposed plant site. Reclaimed water could potentially be stored at Upper Oso Reservoir if an agreement is negotiated with SMWD. In winter months, it is possible that some wastewater would need to be diverted to SMWD if storage becomes filled.

Reclaimed Water Facilities

Non-potable water usage would be a function of the service area demands or the available average reclaimed water supply from the two treatment plants, whichever is less. Water reuse at the Robinson Ranch would be 0.85 mgd and peak non-potable usage would be 1.93 mgd. Summer peak flows could be met from the reclaimed water seasonal storage reservoir and could be supplemented with water stored in Dove Lake as is currently occurring. Water reuse from the new Central treatment plant would be limited to the projected non-potable demand of 0.47 mgd in the Central Area to avoid the need to pump reclaimed water back into the North Area. This would leave 0.38 mgd of effluent that would need disposal, principally during winter months. This excess effluent could be discharged into Trabuco Creek provided an NPDES permit is obtained.

Figure 3-5
Alternative 4 – Construct New Central Treatment Plant

Potable Water Facilities

The average annual potable water demand would be 3.37 mgd. Maximum day potable demand would be 6.73 mgd (10.42 cfs). Since this demand does not exceed the current summer production capacity, no additional potable water capacity would be needed.

Alternative 5 – Treat All Wastewater At Expanded Robinson Ranch Plant

This alternative involves conveying all wastewater generated in the Central and North Areas to the Robinson Ranch Plant for treatment and reuse. This alternative is shown in **Figure 3-6**.

Wastewater Facilities

The treatment capacity at the Robinson Ranch WWTP would be increased to 1.74 mgd to treat all wastewater flows generated within the District (North, Central, and South Areas). Wastewater flows generated outside of the District but conveyed by the El Toro Collection Zone, 0.43 mgd at build-out from the IRWD (1,600 connections) and SMWD (233 connections), would continue to be conveyed to the SMWD for treatment. In this alternative, a sewer lift station would pump wastewater generated in the North Area through a new force main to the Central Area. All wastewater generated in the Central Area and the North Area would be pumped to the Robinson Ranch Plant through a new sewer lift station constructed near O'Neill Park along Trabuco Canyon Road.

Increased seasonal storage capacity for reclaimed water would be required. The existing seasonal storage capacity is sufficient to provide 50 days of storage at 0.85 mgd. An additional 320 acre-ft of seasonal storage would be required to provide 84 days of storage at the Robinson Ranch plant. Two potential storage sites exist near the plant, one east of the plant and the other north near Trabuco Creek. In winter months, it is possible that some wastewater would need to be diverted to SMWD if storage becomes filled.

Reclaimed Water Facilities

Nearly all non-potable water usage would be served under this alternative. Non-potable demand is 1.97 mgd of which 1.74 mgd would be served with reclaimed water. The remaining 0.23 mgd of average demand could be served with non-potable water from Dove Lake, if desired. Peak non-potable usage of reclaimed water would be 3.83 mgd.

Potable Water Facilities

The average annual potable water demand would be 2.95 mgd. Maximum day potable demand would be 5.81 mgd (8.99 cfs). Since this is less than the current summer production capacity, no additional potable water capacity would be needed.

Summary

The basic features of the five alternatives are summarized in **Table 3-1.** This table shows the amounts of wastewater treated, reused and disposed for each alternative as well as the potable

Figure 3-6
Alternative 5 – Expand Existing Treatment Plant to 1.74 mgd

water requirements for build-out conditions.

Table 3-1
Summary of Alternatives

Alternative	Wastewater – mgd				Potable Water – mgd		
	Total Flow	Treated	Reused	Disposed	Average Day	Maximum Day	Additional Capacity Needed
1	1.74	0.85	0.85	**0.89**	3.84	7.77	**0.86**
2	1.74	1.35	1.35	0.39	3.34	6.67	0.00
3	1.74	1.70	1.54	0.20	3.15	6.25	0.00
4	1.74	1.70	1.32	0.42	3.37	6.73	0.00
5	1.74	1.74	1.74	0.00	2.95	5.81	0.00

Note: Wastewater disposal or potable water requirements in excess of existing capacities are indicated in **boldface** type.

EVALUATION OF ALTERNATIVES

An evaluation of the advantages and disadvantages of each alternative has been prepared as summarized in **Table 3-2.** Each of the alternatives meets the District's objectives to differing degrees. The evaluation of alternatives focuses on the ability of each alternative to meet the objectives as defined previously.

Maximize The Use Of The District's Local Water Supplies

Alternative 5 – Treat All Wastewater at Expanded Robinson Ranch Plant provides the best utilization of District wastewater effluent while essentially eliminating export of wastewater to other agencies. This alternative utilizes 1.74 mgd of reclaimed water. Alternative 3 is a close second. Alternative 1 provides the least reuse of wastewater.

Minimize The Need For Imported Water Supplies

Under Alternatives 2, 3, 4 and 5, there is no need for additional imported water supply capacity. Alternative 5 provides the greatest surplus potable supply capacity of 1.10 mgd while Alternative 4 provides the least surplus (0.17 mgd). Alternative 2 has 0.24 mgd (0.37 cfs) of surplus potable supply capacity. Alternative 3 has 0.18 mgd (0.28 cfs) of additional imported supply capacity. Only Alternative 1, which minimizes the use of reclaimed water, needs additional imported water capacity of 0.86 mgd or 1.33 cfs. The District owns 2 cfs of additional potable water conveyance capacity in the SMWD Antonio Delivery System, but would need to purchase additional capacity in the AMP as discussed in Section 4.

Maximize The District's Operational Flexibility

Alternative 1 provides the least flexibility for meeting future needs. Conversely, Alternatives 2, 3 and 4 provide fair amounts of flexibility. Alternative 5 provides the greatest flexibility since it can be easily modified depending on development patterns and District needs in the future. An

Table 3-2
Evaluation of System-Wide Alternatives

Alternative	Description	Advantages	Disadvantages
1	Maintain Existing Wastewater Treatment Capacity	• Eliminates need for additional storage	• Additional potable water capacity required • Requires additional SMWD wastewater capacity at unknown cost and availability • No additional RW usage potential
2	Expand Robinson Ranch Plant to 1.35 mgd	• Provides potential for additional reuse • No additional potable water capacity required • Needs no additional WW export • Can use existing plant site	• Site limitations may restrict expansion • Additional RW storage required • Modified discharge permit required • No option for wet weather discharge
3	Construct New North Treatment Plant	• Provides new opportunities for reuse in west portion • No additional potable water capacity required • Needs no additional WW export • Has option for wet weather surface water discharge	• Insufficient RW demand in western portion to utilize all effluent in TCWD • Locating additional sites for RW storage may be difficult • Locating site for new WWTP may be difficult • NPDES permit for creek discharge may be difficult to obtain
4	Construct New Central Treatment Plant	• Provides new opportunities for reuse in west portion • No additional potable water capacity required • Needs no additional WW export • Has option for wet weather surface water discharge • RW demand is closer to WWTP	• Insufficient RW demand in western portion to utilize all effluent in TCWD • Locating additional sites for RW storage may be difficult • Locating site for new WWTP may be difficult • NPDES permit for creek discharge may be difficult to obtain
5	Treat All Wastewater at Expanded Robinson Ranch Plant	• Provides increased opportunities for reuse • No additional potable water capacity required • Eliminates all wet weather wastewater export • Provides maximum retention of District's resources	• Requires additional wastewater storage • Site may have limited expansion potential • Requires extensive distribution system to reuse all effluent

additional flexibility issue involves the operation of facilities prior to reaching build-out conditions.

Minimize Implementation Issues

Each alternative has its own different implementation issues as presented in **Table 3-2**. Alternative 1 relies on the uncertain availability of wastewater treatment capacity with SMWD. Similarly, Alternative 1 requires additional imported water capacity that may be difficult or costly to obtain. Alternatives 2 through 5 require increasing levels of wastewater storage which may be difficult to site. Similarly, Alternatives 3 and 4 require land for new wastewater treatment plants, which may be difficult to site and obtain the necessary permits. These two alternatives may require surface discharge of wastewater in the winter months which needs an NPDES permit. These alternatives would also require construction of two or three new pipelines in Live Oak Canyon Road, which is relatively narrow and congested. Alternatives 2 and 5 have many of these same issues but does not require an NPDES permit. Based on these considerations, both Alternatives 2 and 5 appear to be the easiest to implement.

Minimize the Costs of Water Supply, Wastewater Treatment and Disposal

The preparation of detailed cost evaluations for each alternative is outside the scope for this master plan. However, the relative order of magnitude of potential costs for each alternative has been evaluated based on the facilities required. Alternatives 2 and 4 have the lowest order of magnitude costs since they have the least facility requirements. Alternatives 1 and 3 are roughly 20 percent more expensive than Alternatives 2 and 4. Alternative 5 is about 40 percent more costly than Alternatives 2 and 4. Based on this screening-level evaluation, Alternatives 2 and 4 appear to be the most cost-effective to the District.

PREFERRED ALTERNATIVE

Based on review of the alternatives with District staff, the preferred system alternative is Alternative 2 – Expand Robinson Ranch Plant to 1.35 mgd. This alternative provides a number of advantages to the District. It makes good use of the reclaimed water available within the District, while requiring no additional imported water supplies. The alternative is readily amenable to staging. Wastewater generated by development in the North Area could continue to flow to the SMWD system. An initial phase could include the construction of a sewer lift station and force main to convey wastewater from the Central Area to the Robinson Ranch plant. This would allow connection of O'Neill Park to the sewer system. As the nursery properties are developed, gravity sewers could be constructed and the existing Robinson Ranch plant could be expanded to accommodate this additional flow. As future development occurs in the Central area, the wastewater system can be expanded to collect additional wastewater from these areas. If the timing or magnitude of future development changes, the District has the option of re-evaluating the implementation plan and deferring construction until required. The evaluation of water, wastewater and reclaimed water facilities will be based on the concepts defined for Alternative 2.

Section 4
Water Sources

This section discusses water sources for the District with respect to the quantity of water available both now and in the future, and how these quantities compare with the water needed. A comparison of water currently available through existing contracts against existing and future demands is made to determine the need for additional source water. An evaluation of the adequacy of existing source water treatment facilities plus any treated water obtained from outside the District, compared to system demands, is made for both existing and future conditions. In addition, water production and consumption records are compared to determine unaccounted for water.

The analysis of system alternatives in Section 3 indicates that Alternative 2 is the preferred alternative. This selection results in an average daily potable supply need of 3.34 mgd and a maximum day supply need of 6.67 mgd at build-out conditions. This section evaluates the adequacy of existing supplies to meet these demand levels considering both current and future planning issues.

SUPPLY RELIABILITY CRITERIA

The uncertainty of existing water supplies due to hydrologic variations and regulatory constraints has emphasized the need to establish water supply reliability requirements. It is no longer possible to assume that all demands will be met at all times. Consequently, agencies must plan for sufficient supplies to meet demands not only under average periods but also in dry periods when demands are higher. Since supplies may not be adequate to meet the projected water demands at all times, reliability requirements specify the frequency of shortages when an acceptable level of water rationing may be required.

Metropolitan Water District of Southern California (Metropolitan) adopted reliability goals in 1993 in conjunction with the preparation of its Integrated Resources Plan (IRP). These goals stated that Metropolitan would provide full deliveries to its customers 90 percent of the time. Water deliveries would not be cut more than 20 percent in the worst case hydrologic event (occurring approximately once in 50 years). Subsequent analysis performed for the IRP indicates that Metropolitan should be capable of providing full retail deliveries between now and 2005. In November 1998, Metropolitan reaffirmed its supply reliability stating that it will be able to fully meet imported water demands through 2010 (Metropolitan, 1998).

The retail reliability requirements recommended for the District are shown in **Table 4-1**. These criteria assume that a greater level of imported water shortage may occur than is currently predicted by Metropolitan. It has been established that District build-out is estimated to occur by the year 2030 based on historical trends.

Table 4-1
Potable Water Supply Reliability Requirements

Percent of the Time (%)	Percent of Annual Demands (%)	Minimum Required Supplies (ac-ft/yr)			
		Current	2010	2020[1]	2030
95	100	2,800	3,461	3,601	3,741
100	90	2,520	3,115	3,241	3,367
Maximum Day Demand (mgd)		5.22	6.20	6.44	6.67

1 – Interpolated values.

For the year 2010, these reliability requirements mean that the District must provide sufficient water supplies to meet the projected annual demand of 3,461 ac-ft/yr in nineteen out of twenty years. The minimum dependable supply should be 3,115 ac-ft/yr. At build-out (2030), annual potable supply requirements are 3,741 acre-ft/yr, with minimum dependable supply requirements of 3,367 acre-ft/yr. If these requirements are met, mandatory water conservation of up to ten percent could be required once every twenty years, on average. As discussed in Section 3, the potable water requirements assume a significant level of reclaimed water usage in the District.

The ability to meet maximum day demands is also a critical element of supply reliability. **Table 4-1** also presents the required maximum day demand assuming that the reclaimed water supplies are fully operable. If the reclaimed water system cannot meet the peak summer demands, the potable system would need to be capable of supplying up to 2.97 mgd (4.6 cfs) of additional water. Therefore, it is critical that the reclaimed water system be capable of reliably meeting non-potable demands.

EXISTING SOURCES

Each source of supply and emergency connection was reviewed, and capacities and directions of flow (either into the District, out of the District, or both) were identified. The District has four potable water sources:

1. V. P. Baker Aqueduct (untreated imported water)
2. Allen-McColloch Pipeline (treated imported water)
3. Local Groundwater
4. Irvine Ranch Water District
5. Interties with other water agencies

The locations of imported water facilities serving the District are shown in **Figure 4-1**.

V. P. Baker Aqueduct

The District receives untreated imported water from the V. P. Baker Aqueduct. The Baker

Figure 4-1
Surrounding Water Districts and Major Pipelines

Aqueduct is owned and operated by the Santiago Aqueduct Commission (SAC), a joint powers agency formed in 1961. The original participants in the aqueduct were Los Alisos and El Toro Water Districts and the Municipal Water District of Orange County (MWDOC). MWDOC subsequently assigned its capacity rights to East Orange County, Irvine Ranch, Moulton-Niguel, Santa Margarita, Santiago County, and Trabuco Canyon water districts and the County of Orange. The SAC agreement has been amended six times.

Water for the Baker Aqueduct originates from either Metropolitan or from Irvine Lake. The Baker Aqueduct receives Colorado River water, which flows from Lake Mathews through the Lower Feeder and the Santiago Lateral, from Metropolitan's OC-33 connection. The aqueduct is divided into five reaches. The 54-in diameter upper reach has a capacity of 104.9 cfs. The remaining four reaches of the pipeline have a diameter of 39-in and have capacities of 44.5 and 38.5 cfs. **Figure 4-1** shows the location of the aqueduct along with other major water facilities in Orange County in relation to the District's service area.

The District has a total contractual capacity of 5.944 cfs (3.84 mgd) in the Baker Aqueduct as shown in **Table 4-2**. The District's original capacity was 5 cfs. The capacity has been adjusted five times because of various contract amendments and other agreements between the District and the other participating agencies.

Table 4-2
District's Baker Aqueduct Capacity

Description	Year	Capacity (cfs)
Original Capacity	1961	5.000
Reallocation after construction of Allen-McColloch Pipeline	1978	+ 1.000 6.000
Purchase of extra capacity	1983	+ 1.000 7.000
Capacity adjustment (based on clarification letter)	1984	– 0.066 6.934
Transfer to SMWD (Facility transfer)	1988	– 0.390 6.544
Transfer to IRWD (Portola Hills)	1990	– 0.600
Current Capacity		**5.944**

The Baker Aqueduct can also receive raw water stored in Irvine Lake (also referred to as the Santiago Reservoir). The SAC has 13.25 cfs of capacity in the Irvine Lake Pipeline between Irvine Lake and the Baker Aqueduct and has 159 acre-ft (51.8 MG) of leased storage capacity in Irvine Lake, as a result of a 1970 agreement between SAC and The Irvine Company which expires in 2010. This leased storage capacity is for emergency use only. The DHS permitted the use of stored water as an approved source in 1998. The District purchased native water stored in Irvine Lake from Serrano Water District during 1988 and 1999.

Flows in the Baker Aqueduct are controlled by SAC through Los Alisos Water District (LAWD). The District must contact LAWD in advance to modify its desired flow. The District is required to give a 24-hour notice of flow changes and is limited to flow changes in whole cfs increments.

From the Baker Aqueduct, the water is conveyed to the Dimension Water Treatment Plant (DWTP) through a 16-inch diameter pipeline. The DWTP is located outside of the District's service area and provides water to the District through 14, 16, 20, and 24-inch diameter pipelines. The Dimension plant has a capacity of 3.88 mgd (6 cfs) and provides water directly to Cooks Reservoir. Details of the DWTP are presented later in this section.

Allen-McColloch Pipeline

The Allen-McColloch Pipeline (AMP) was constructed in 1982 by Orange County water agencies to convey treated imported water to the eastern and southern portions of the county. The AMP extends from Metropolitan's Diemer Filtration Plant in Yorba Linda to Lake Forest. The pipeline varies in diameter from 114 inches at its beginning to 48 inches at its terminal delivery point and has a capacity of 416 cfs. Metropolitan purchased the AMP from the Orange County agencies in 1996.

The District has a contractual capacity of 4 cfs in the AMP. Water from the AMP is conveyed to the District by Santa Margarita Water District (SMWD) through the South County Pump Station and South County Pipeline/Antonio Delivery System, respectively. The District owns 6 cfs of conveyance capacity in the South County Pipeline/Antonio Delivery System. The treated water enters the District at the Plano Trabuco intertie with SMWD. The District could increase its AMP capacity by 2 cfs if it pays a non-refundable fee to the other AMP participating agencies as discussed in the Future Sources portion of this Section.

Groundwater

The District operates three groundwater wells, the Rose Canyon, Lang, and US wells, which have a combined maximum pumping capacity of approximately 1,500 gpm. These wells extract water from the Arroyo Trabuco aquifer, which is part of the San Juan Basin. Groundwater well locations are shown in **Figure 5-1**.

Groundwater supply for the District is obtained from shallow alluvial aquifers underlying Arroyo Trabuco. Arroyo Trabuco originates in the Santa Ana Mountains at an elevation of nearly 5,600 ft. Much of the tributary watershed consists of metamorphosed rock with volcanic intrusives. Detrital materials that collected in the canyon bottoms formed shallow alluvial deposits. In the vicinity of the District's wells, the alluvium averages about 50 ft thick. Studies performed by DWR estimate the storage capacity of the upper reach of Arroyo Trabuco to be about 1,500 acre-ft (DWR, 1972). This small storage capacity fills rapidly during storm events but also depletes rapidly by pumping.

The sole source of groundwater in the arroyo is precipitation within the watershed. A study performed by the United States Geological Survey (USGS) provides a mechanism for estimating water losses and recoverable water from mountain watersheds in Southern California (Crippen,

1965). This approach involves estimating watershed precipitation less natural losses to estimate recoverable water. Average annual precipitation within the watershed ranges from 18 to 31 inches based on Orange County Environmental Management Agency (OCEMA) data for the period 1941-1980 (OCEMA, 1987). Peak annual watershed precipitation has ranged from 36 to 69 inches in extremely wet years. Given an estimated watershed area of about 18 square miles (11,500 acres), the average precipitation tributary to the District's wells is about 23 inches/yr or 22,300 acre-ft/yr. Natural water losses predominantly include evapotranspiration in the watershed and are affected by elevation, climate, geology and the types of native vegetation present. Using data for other Southern California watersheds presented in the USGS study, natural losses are estimated to average about 18 inches/yr or 17,500 acre-ft/yr. Recoverable water is the difference between precipitation and natural losses. For Arroyo Trabuco, recoverable water is estimated to be about 4,800 acre-ft/yr. This water flows as runoff that percolates into the shallow alluvium where it is captured by wells belonging to the District and private pumpers. Since the storage capacity of the basin is relatively small, most of the recoverable water leaves the basin as runoff. It is not known whether the District has any established numerical rights to extract groundwater from the Arroyo Trabuco. However, the District has established a pumping history that would be useful in case of a water rights dispute.

The water supply for the District's wells varies from year to year. In wet years, there is sufficient recoverable water to allow the wells to be operated all year. However, in years of average runoff conditions, the wells operate about seven months before water levels drop too low to maintain pumping. In dry years, the wells have been only be operable for as few as two months. Based on available records, the District has produced water about 80 percent of the time during the month of June, but only 60 percent of the time in July and 40 percent of the time in August. Based on this data, it is apparent that the wells cannot reliably help meet the high demands in the summer months. Therefore, the production capacities of the wells are not included in the source water evaluation.

Due to their low cost of operations, water production from these wells should be maximized when it is available. The District recently made improvements to the wells that allow increased capture of water in the summer months by reducing the rate of production. In addition, on October 9, 1998, the District filed Application A030790 for a water right permit with the State Water Resources Control Board Division of Water Rights to appropriate 1,000 acre-ft/yr of Trabuco Creek underflow at a maximum rate of 3 cfs. This application essentially covers the District's current groundwater extraction from the creek alluvium.

Irvine Ranch Water District

A portion of the Portola Hills development is within the District boundaries. However, under terms of an agreement with Irvine Ranch Water District (IRWD), IRWD supplies water to the 532 connections. However, the District reads the meters and bills the customers for water service. IRWD then bills the District for the water supplied to these customers. The evaluation of water demands indicates these customers have an average demand of 0.24 mgd and a maximum day demand of 0.48 mgd. To properly account for this demand and supply, this master plan includes the IRWD supply as a water source with a capacity equal to the maximum day demand.

Interties with Other Agencies

The District maintains interties with four other districts: SMWD, IRWD, El Toro Water District (ETWD), and Santiago County Water District (SCWD). The boundaries for each of these water districts are shown in **Figure 4-1**and the intertie locations are shown in **Figure 5-1**.

Quantities of water listed here as being available from interties are not true water supply sources, as the water can only be used as an emergency water source if the neighboring agency agrees and if excess water is available. The exception is 2 cfs from SMWD which can be purchased on a case-by-case basis, assuming SMWD agrees and has water available, and 4 cfs from the AMP which passes through an intertie with SMWD via SMWD's Antonio Delivery System in which TCWD has contractual capacity. The flow rates and other pertinent information regarding these interties are provided in **Table 4-3**.

Table 4-3
Summary of District Interties

District	Direction	Capacity (cfs)	Comment
SMWD			
Coto de Caza	To District	2	
Valley Vista	To SMWD	3	
Plano Trabuco	Either Way	6	Includes 4 cfs from AMP
Zone 4	To SMWD	4	
Zone 5	To SMWD	0.33	
IRWD			
Ridgeline No. 1	To IRWD	3	Not used
Ridgeline No. 2	To IRWD	--	Not used
ETWD			
El Toro via Larchmont Booster	To ETWD To District	1.0 0.75	Not used
SCWD			
NW Corner of District	Either Way	0.45	Into District. Will flow both ways when Falcon Booster is built

Summary

A summary of the sources of potable water and their respective contract or hydraulically feasible flow rates is provided in tabular form in **Table 4-4**. Each flow rate represents the maximum quantity of water available from the respective source. The total summer water currently available to the District is 9.944 cfs, with the potential to obtain an additional 2 cfs from the

AMP through SMWD. The total winter water currently available is 13.234 cfs, with the potential for increase in AMP capacity by 2 cfs.

SUPPLY VERSUS DEMAND

The District water sources must be of sufficient quantity to supply the existing and future maximum day demands. The MDD is presented in **Table 2-5**, and repeated here in **Table 4-5** for clarity.

A review of the supply and demand quantities presented in **Table 4-5** indicates there is sufficient water to meet maximum day demands until about 2030. The District's source water supply

Table 4-4
Summary of Source Water Available

Source	Flow Rate		Comments
	cfs	mgd	
Imported Water			
Baker Aqueduct	5.944	3.84	Lake Mathews or Irvine Lake raw water
AMP	4.0	2.59	Treated water via SMWD
IRWD	0.74	0.48	Supply to Portola Hills portion of District
Wells:			
U.S.	1.0	0.65	Winter and spring
Rose Canyon	1.29	0.83	Winter to early summer
Lang	1.0	0.65	Winter to early summer
Total Summer:	**10.684**	**6.91**	Excludes well capacity
Total Winter:	**13.974**	**9.04**	Includes well capacity
Interties:			
SMWD	2	1.29	Based on water availability

Table 4-5
Summary of Anticipated Potable Water Demand

Demand and Supply	Year (mgd)			
	Current	2010	2020	2030
Maximum Day Demand[1]	5.22	6.20	6.44	6.67
Summer Production Capacity[2]	6.91	6.91	6.91	6.91
Surplus (Deficit)	**1.69**	**0.71**	**0.47**	**0.24**

Notes:
1. From Table 4-1
2. From Table 4-4

capacity of 6.43 mgd exceeds the build-out potable demand of 6.67 mgd. Therefore, the District will have 0.24 mgd of surplus production capacity during summer months. The MDD value assumes that all potential reclaimed water uses in the Central and South areas are provided by reclaimed water. If these uses were not all served, then the potable water supply surplus would be diminished. Consequently, it is critical that the District work expeditiously to supply all customers with reclaimed water that can use this supply.

FUTURE SOURCES

In addition to the District's need for additional water supplies, future changes in its existing sources may affect decisions on how to meet future demands. These changes are discussed below.

Baker Aqueduct

In recent years, the utilization of the Baker Aqueduct has decreased. Of the eight agencies that jointly own the pipeline, only IRWD and the District are using the pipeline. In 1997, SAC conducted a study to evaluate a range of options for the future use of the Baker Aqueduct (Boyle, 1997). The objective of the study was to determine whether the pipeline could be better utilized as part of an integrated water supply system serving south Orange County. Six categories of potential use were evaluated: 1) untreated imported water, 2) local treatment of imported water, 3) Metropolitan treated imported water, 4) groundwater, 5) regional reclaimed water, and 6) disposition or non-use options. Over 30 sub-options were identified and evaluated.

Of these sub-options, four candidate alternatives were identified. These alternatives were: 1) Base Case (No Action), 2) Conversion to AMP Parallel Pipeline, 3) Water Delivery Extension to South Orange County, and 4) Groundwater Delivery System. The preferred alternative was the use of the pipeline to convey groundwater from a wellfield in the City of Orange to water agencies in southern Orange County. Several of the agencies that would receive groundwater would need to annex to Orange County Water District (OCWD). Conversion of the pipeline to convey groundwater would require the District to take treated water from the AMP, negating its investment in the Baker Aqueduct and the Dimension Water Treatment Plant. An important issue requiring resolution involves who would pay for the District's stranded costs along with the cost to connect to the AMP. Another issue involving the annexation policy of OCWD was resolved at the June 2, 1999 OCWD Board Meeting, where the Board reaffirmed its existing annexation policy. This policy allows annexation of areas within the Orange County portion of the Santa Ana River watershed, but excludes requests by El Toro and Los Alisos water districts, which do not qualify under the current policy.

The District could potentially purchase additional capacity in the Baker Aqueduct from one of the other participants. However, the feasibility of such a purchase would depend on the cost of the purchase, the on-going pipeline operations and water treatment costs (including future upgrades), along with the cost of untreated imported water. The availability of capacity depends on the future use of the Baker Aqueduct.

If the Baker Aqueduct were ultimately converted to a groundwater conveyance facility, the District's existing capacity would probably be replaced with a connection to the AMP, which is adjacent to the aqueduct near the DWTP. In this case, the treatment plant would be abandoned and treated imported water would be pumped to the distribution system at this location.

Allen-McColloch Pipeline

As a condition for purchase of the AMP, Metropolitan is obligated to augment the capacity of the AMP when the need arises. Metropolitan plans to operate the AMP on a utility or open-capacity basis once it completes the AMP flow augmentation project. This project was originally anticipated to involve the installation of a pumping station at the Diemer Filtration Plant, which would increase the hydraulic gradient of the pipeline allowing conveyance of additional flows to the south Orange County area. However, recent planning studies performed by Metropolitan indicate that there will be no additional capacity available at Diemer to support the pumping station by the time the flow augmentation project is required. Consequently, the flow augmentation project will likely involve the construction of an interconnection with the proposed Central Pool Augmentation Project, which is discussed below.

Metropolitan is preparing an Orange County Area Study to determine the future water demands and facility requirements in Orange County. This study involves two phases: Phase 1 is a system reliability study focusing primarily on seismic risks while Phase 2 will be a master planning effort to evaluate demands and facility needs. The Phase 1 study was expected to be completed in late 1999. Phase 2 will follow completion of Phase 1 with a draft report completed in Spring 2000. Metropolitan anticipates working closely with the Orange County water agencies in the completion of these studies.

The District has purchased capacity rights to take another 2 cfs through the South County Pipeline and SMWD's Antonio Delivery System if the water is available from the AMP. To fully access this capacity, the expansion of SMWD's Foothill Booster Station may be necessary. However, under the terms of the AMP purchase agreement (designated the *Participants Agreements)*, the Orange County water agencies agreed to restrict usage of the AMP to its existing capacity until Metropolitan augments the capacity of the AMP. Any agency requesting additional capacity in the AMP must pay a non-refundable fee (currently about $420,000 per cfs) to the other agencies participating in the AMP. This rate escalates at 4 percent per year. Once Metropolitan completes the flow augmentation project, the AMP is expected to be operated on a "utility basis", serving all Metropolitan members without regard to their capacity rights.

Since no additional supply capacity is required, the District can avoid the cost of purchasing additional AMP capacity. However, the District should retain its capacity ownership in the SMWD system as a contingency pending the outcome of the Baker Aqueduct studies. It is valuable to retain this capacity in any event to provide additional supply redundancy.

Central Pool Augmentation Project

Metropolitan conducted distribution system studies as part of its IRP process. The System Overview study (1996) indicated the need for additional treatment and pipeline capacity to meet

projected demands in Orange County. The Central Pool Augmentation (CPA) Project is proposed to consist of a new outlet structure at Lake Mathews, a new water treatment plant in Eagle Valley, an 18-mile long tunnel through the Santa Ana Mountains, and other distribution pipelines. The ultimate capacity of the CPA project will be 800 cfs. The first stage of the CPA project would have a capacity of 400 cfs and will be required by 2013. However, more rapidly increasing water demands could change this need to as early as 2004. Metropolitan would construct the second stage of this project between 2014 and 2020, depending on demands. This project would relieve demand on the Diemer Plant freeing up capacity to serve other portions of Metropolitan's service area and provide treated water to the Corona-Temescal-Elsinore area of Riverside County. Since the project is very sensitive to the rate of future demand growth, Metropolitan intends to re-evaluate the need for this project regularly (Metropolitan, 1996). Recent information from Metropolitan's capital improvement program indicates that the timing for this project has been delayed until at least 2015 due to lower than projected growth. The timing will be further refined when Metropolitan completes its Orange County Area Study in Spring 2000.

Metropolitan plans to connect the CPA project to the AMP and the South County Pipeline (SCP) northwest of the El Toro Marine Corps Air Station. Metropolitan also proposes to construct about 2.5 miles of 78-inch pipeline parallel to the AMP (designated the S4B/S5 Pipeline) to connect the CPA project directly to the SCP. Metropolitan also plans to extend the CPA project to the East Orange County Feeder No. 2 and the Tri-Cities MWD Aufdenkamp Pipeline.

Since the CPA project will pass several miles north of the District's boundary, there is a future opportunity to gain additional supply redundancy through a connection to this facility. In addition, this future supply source may reduce the District's energy costs by providing water at a higher hydraulic gradeline. Since construction of this facility is at least ten years in the future, the District should monitor this project in conjunction with its future needs to determine whether a connection should be made.

Water Conservation

Because of an agreement between urban, agricultural and environmental interests during the Bay-Delta Water Quality process, urban water suppliers are asked to sign the *Memorandum of Understanding Regarding Urban Water Conservation* (MOU), dated September 1991 (as amended April 8, 1998) (CUWCC, 1998). As signatories to the MOU, participating water agencies commit to make a "good faith effort" to: (1) develop comprehensive conservation Best Management Practices (BMP) programs using sound economic criteria and (2) consider water conservation on an equal basis with other water management options. Metropolitan signed the MOU on behalf of all water purveyors that receive water from Metropolitan. At Metropolitan's request, many Southern California water purveyors have also signed. The District is signatory to the MOU. By signing the MOU, individual water suppliers agree to: (1) develop comprehensive conservation BMP programs using sound economic criteria and (2) consider water conservation on an equal basis with other water management options.

The MOU has identified a list of BMPs for urban water conservation that are generally recognized as producing more efficient water usage and are technically and economically feasible. The list of BMPs was updated in September 1997 to include the following:

1. Water Survey Programs for Single-Family Residential and Multi-Family Residential Customers
2. Residential Plumbing Retrofit
3. System Water Audits, Leak Detection and Repair
4. Metering with Commodity Rates for all New Connections and Retrofit of Existing Connections
5. Large Landscape Conservation Programs and Incentives
6. High-Efficiency Washing Machine Rebate Programs (new)
7. Public Information Programs
8. School Education Programs
9. Conservation Programs for Commercial, Industrial, and Institutional Accounts
10. Wholesale Agency Assistance Programs (new)
11. Conservation Pricing
12. Conservation Coordinator
13. Water Waste Prohibition
14. Residential Ultra Low Flush Toilet (ULFT) Replacement Programs

As a signatory to the MOU, the District is obligated to submit reports to the California Urban Water Conservation Council (CUWCC) every other year documenting its progress in implementing the BMPs. This change from annual reporting was made when the MOU was amended on April 8, 1998.

Since much of the development within the District has taken place since the mid-1980s, most homes have been constructed with plumbing fixtures that meet current plumbing codes. Therefore, water demands reflect the implementation of many of the BMPs. The District is currently evaluating its water rate structure including the use of conservation pricing. The District should evaluate BMP 6 – High-Efficient Washing Machine Rebate Programs for its possible application in conjunction with activities of MWDOC and Metropolitan.

The District has an on-going water reclamation program where a significant amount of the wastewater generated in the District is reused. This directly offsets the need for potable water supplies. The analysis of potable supply needs assumes that the District can reclaim and deliver its entire average wastewater flow to non-potable users. If the District could obtain access to other non-potable sources, it could augment its non-potable deliveries and further reduce the need for additional potable supply capacity. The water reclamation program is discussed in detail in Section 7.

The District is required to adopt an urban water management plan and submit the plan to the DWR every five years, as required by State law. The last plan was prepared in 1995 and the next plan must be submitted by December 31, 2000. As part of that plan, the District should conduct an evaluation of the feasibility of the various water conservation measures listed in the BMPs and establish a budget for water conservation activities.

Recommended Source Augmentation Approach

The District does not need to augment its existing supply capacity unless reclaimed water usage does not occur to the level identified in Section 3. If the anticipated level of reclaimed water usage does not materialize, the District may need to supplement the non-potable system with potable water. As discussed above, there are a number of future options available to the District to obtain additional potable water capacity. The District should continue to participate in the discussions taking place regarding the future use of the Baker Aqueduct and negotiate the best possible settlement if a decision to convert the pipeline to another use is made. The District also may be able to increase its conservation to reduce the need for additional potable water capacity.

WATER QUALITY

Drinking Water Regulations

This subsection discusses existing water quality regulations and how they impact the District's sources of supply. A detailed description of existing and future regulations pertaining to surface and groundwater are presented in Appendix A, and the pertinent portions of that document are summarized below.

Current Regulations

The Safe Drinking Water Act (SDWA, Public Law 99-339), originally enacted in 1974, gave the federal government, through the Environmental Protection Agency (EPA), the authority to set standards for drinking water quality in water delivered by community (public) water suppliers. In August 1996, Congress passed a new set of Amendments to the SDWA (PL 104-182). The new Amendments will impact the process EPA uses to establish drinking water standards and will specifically impact the standard-setting process for radon, arsenic, sulfate, disinfection by-products, and ground water disinfection.

The California Safe Drinking Water Act is contained in Health and Safety Code sections 4010 through 4037.5. The primacy agency for California is the DHS. California drinking water regulations are contained in Title 22, Chapters 15 through 17, "Domestic Water Quality and Monitoring Regulations" sections 64400 through 64692. As a primacy state, California drinking water regulations must be at least as stringent as federal regulations. State regulations can be more stringent than federal requirements and, in some cases, they are.

The EPA has established new maximum contaminant levels (MCLs) and monitoring requirements for many additional contaminants pursuant to the federal Safe Drinking Water Act

Amendments of 1986 and 1996. As primacy agency in California, the DHS has adopted even more stringent standards for a number of inorganic chemicals (IOCs), volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs).

Maximum Contaminant Levels. Since the last District Master Plan was prepared in 1992, EPA added standards for 60 contaminants in their Phase II and Phase V regulations in 1991 and 1992, respectively. Most of these contaminants were previously regulated in California. No significant impact is foreseen concerning water quality compliance for these contaminants. In 1993, the State of California passed a law requiring public water systems with 10,000 or more service connections to fluoridate their water supplies. Due to its size, the District is not affected by this requirement.

Interim Enhanced Surface Water Treatment Rule. In December 1998, the EPA published the final Interim Enhanced Surface Water Treatment Rule. This rule:

- Establishes a requirement to achieve a 2-log reduction in *Cryptosporidium* for surface water systems that filter;
- Lowers the existing turbidity performance standards from 0.5 NTU in 95 percent of the monthly measurements not to exceed 5 NTU, to 0.3 NTU in 95 percent of the monthly measurements not to exceed 1 NTU;
- Credits public water systems meeting the new turbidity performance standards with the required 2-log reduction in *Cryptosporidium*;
- Establishes requirements for continuous monitoring of individual filter effluents;
- Requires filing an exceptions report with the State if individual filters are not performing adequately (as defined) and may require a comprehensive performance evaluation;
- Establishes requirements for covers on new finished water reservoirs;
- Requires states to conduct periodic sanitary surveys (every three years);
- Requires certain systems to compile a disinfection profile and prepare a disinfection benchmark;
- Mandates HAA monitoring within three months of publication of the final rule (quarterly monitoring of four distribution system samples for HAAs for one year) to determine if systems serving greater than 10,000 people must compile a disinfection profile and prepare a disinfection benchmark. THM and HAA monitoring to determine if a disinfection profile and a disinfection benchmark are required must occur in the same year. ICR data can be used for public water systems serving over 100,000 people.

The Interim Enhanced Surface Water Treatment Rule applies to systems utilizing surface water or groundwater under the direct influence of surface water and serving greater than 10,000 people. These systems must comply by December 16, 2001. The District is affected by these requirements; however, DHS has established more stringent requirements under its 1995 *Cryptosporidium* Action Plan (CAP), including the goal of achieving a filtered effluent quality of

0.1 NTU. The District was informed in May 1998 that it must optimize the Dimension Treatment Plant to comply with the CAP.

Disinfectants/Disinfection By-Product Rule. The EPA published the Stage 1 Disinfectant/Disinfection By-Product (DBP) Rule in December 1998. This new rule:

- reduces the existing MCL for total trihalomethanes (THM) from 0.10 mg/L to 0.080 mg/L
- establishes new MCLs for haloacetic acids (HAAs) at 0.060 mg/L, bromate at 0.010 mg/L and chlorite at 1.0 mg/L
- establishes Maximum Residual Disinfectant Levels (MRDLs) for chlorine (4 mg/L), chloramines (4 mg/L), and chlorine dioxide (0.8 mg/L) within the distribution system
- establishes enhanced coagulation requirements for the reduction of DBP precursors (organics)

Since the District serves more than 10,000 people, it must comply with this rule by December 16, 2001.

California Action Levels. DHS has adopted "Action Levels" for several dozen unregulated chemicals that are shown in **Table B-8** of Appendix B. These Action Levels are health-based advisory levels, not enforceable standards. DHS recommends that water systems provide public notification if Action Levels are exceeded, unless the sources are taken out of service. Water systems are required to notify local governing agencies within 30 days whenever an Action Level is exceeded. There are no chemicals in the District's water supplies that exceed the Action Levels.

Future Regulations

Several regulations are under development at the federal level that could affect water utilities using, or planning to use, groundwater to augment their supplies. Five pending regulations could be significant for local groundwater: arsenic, radon, sulfate, groundwater treatment rule, and Stage 2 DBP rule. These new regulations are summarized below.

Arsenic. The EPA is required to publish a revised MCL for arsenic by January 2001. Arsenic is a naturally occurring inorganic contaminant found in some groundwater and surface water supplies and is considered a known human carcinogen. In its March 1999 report, the National Research Council stated that "the current MCL of 50 µg/l does not achieve the EPA's goal for public-health protection and, therefore, requires downward revision as promptly as possible." Based on the EPA's policy of regulating carcinogens in the 10^{-4} to 10^{-6} risk range, a revised arsenic standard could be between 0.02 and 2 µg/l. However, at this point, most laboratories have a detection limit of 2 to 5 µg/l, so many utilities do not know whether they will have an arsenic problem. Current District supplies have arsenic levels in the range of <2 to 2.8 µg/l. If the arsenic MCL is established at less than 2 µg/l, the District may need to treat its water sources to remove arsenic.

Radon. Radon is a naturally occurring gas that is a radioactive decay product in certain rock formations. Under the 1996 Amendments to the SDWA, the EPA published for public comments a health risk reduction and cost analysis for a potential radon standard on February 5, 1999. The EPA must propose a radon regulation in August 1999 and must publish a final regulation in August 2000. On November 2, 1999, the EPA published for public comment the proposed MCL for radon of 300 picocuries per liter (pCi/l) for groundwater systems serving 10,000 or more people. However, the 1996 SDWA Amendments require the EPA to establish an alternate MCL (AMCL) for radon if the contribution of radon from water to radon in indoor air is less than background levels in outdoor air. This AMCL is proposed to be 4,000 pCi/l. Under the proposed regulations, the District could comply with the AMCL, if an EPA- or State-approved multi-media mitigation (MMM) program is in place. A MMM is "a State or community water system program plan of goals and strategies developed with public participation to promote indoor radon risk reduction." The impact of this regulation on the District is unknown at this time as no radon data is available.

Sulfate. Currently, the EPA and the DHS have secondary MCLs for sulfate of 250 mg/l with the DHS having an "upper limit" of 500 mg/l based on aesthetic (taste and odor) effects. The EPA proposed a MCL for sulfate of 500 mg/l in 1994. However, the sulfate standard was never finalized. The EPA is authorized (but not required) to establish a regulation for sulfate in the 1996 SDWA Amendments. The EPA must consider the regulation of sulfate by August 2001. If the sulfate MCL is established at 500 mg/l, there will be no impact on the District.

Groundwater Rule. The EPA is developing a groundwater rule to assure public health protection from bacterial and viral pathogens or fecal contamination indicators in groundwater. The proposed ground water rule will specify appropriate use of disinfection and encourage the use of alternative approaches, including management practices and control of contamination at its source. During 1998, the EPA held three stakeholder meetings around the country to provide an update on the status of development of the groundwater rule and to indicate possible regulatory directions. According to EPA staff, the agency will try to release a draft of the groundwater rule for review by stakeholders sometime in early 1999. Under the 1996 Amendments to the SDWA, a final groundwater rule must be published by May 2002. (It is the EPA's intention, however, to publish a final groundwater rule by November 2000, allowing groundwater systems to comply with the Groundwater Rule and the Stage 1 DBP Rule at the same time). The groundwater rule may potentially affect the District's current disinfection practices for its wells. However, the need to comply with the Surface Water Treatment Rule (discussed later in this Section) will have a greater impact on the District.

Stage 2 DBP Rule. The EPA is required to finalize a Stage 2 Disinfectants/Disinfectant Byproducts Rule by May 2002. The EPA began discussions with stakeholders in December 1998 on the direction for these rules. The EPA anticipates proposed rules in early 2001. The intent of the rules is to provide additional public health protection, if needed, from DBPs and microbial pathogens. Initial indications are that this future rule could further reduce the MCL for THMs to 0.040 mg/L. This rule could require a major change in the District's method of disinfection to meet the anticipated lower MCL.

Source Water Quality

Table 4-6 shows the results of annual water quality monitoring for the District's water supplies as published in its 1997 annual water quality report. The water quality characteristics of each source are discussed below.

Raw Imported Water

Untreated imported water from the Baker Aqueduct is principally comprised of Colorado River water from Lake Mathews with minor amounts of Irvine Lake water. Colorado River water is relatively mineralized with total dissolved solids (TDS) ranging from 612 to 674 mg/L in 1997. Colorado River quality is primarily affected by flow conditions in the river. During the wet periods of the mid-1980s, the TDS dropped to as low as 525 mg/L. However, during dry periods, Colorado River TDS has been as high as 850 mg/L. The median TDS for the period of 1941 to 1997 is 694 mg/L. Colorado River water has total hardness ranging from 290 to 320 mg/L as $CaCO_3$. Sodium concentrations ranged from 91 to 102 mg/L. Colorado River water has a relatively high sulfate content with concentrations ranging from 249 to 276 mg/L. Specific water quality data for Irvine Lake was not presented in the District's annual water quality report. However, this source generally has better mineral quality than Colorado River water.

No samples violated any primary MCLs. Although Colorado River water exceeds the DHS "recommended" secondary standards for TDS of 500 mg/L and sulfate of 250 mg/L, it does not exceed the "upper limit" of 1,000 mg/L and 500 mg/L, respectively. Perchlorate, a salt used in the production of rocket fuels, munitions and fireworks, is an emerging water quality problem in the Colorado River water. Perchlorate has been detected in Colorado River at concentrations ranging from 5 to 9 µg/L compared to a State Action Level of 18 µg/L. Although some water sources have been affected by high perchlorate levels, the District supplies are not impacted.

Treated Imported Water

Treated imported water from the Diemer Filtration Plant (supplying the AMP) is a blend of SWP and Colorado River water. The blend varies during the year and from year-to-year depending on Metropolitan's system operations and available water supplies. In 1997, Diemer Plant effluent averaged about 13 percent State Water Project (SWP) water and 87 percent Colorado River water. Consequently, the quality shown in **Table 4-6** for 1997 is similar to that of untreated Colorado River water.

Groundwater

Local groundwater from Arroyo Trabuco has a better mineral quality than the District's imported water sources. The groundwater can be classified as a calcium-carbonate water. TDS levels ranged from 380-420 mg/L in 1997. A review of analyses for previous years indicates the TDS of groundwater could be as low as 270 mg/L and as high as 470 mg/L. Total hardness is also lower than Colorado River water with measurements of 214 to 244 mg/L as $CaCO_3$. The groundwater supply has a very low sodium and chloride content (22-24 mg/L and 20-22 mg/L, respectively).

Table 4-6
Source Water Quality - 1997

Parameter	MCL – mg/L	Diemer	Lake Mathews	Groundwater
Inorganics				
Total Dissolved Solids	500[1] 1,000[2]	530-674	612-674	380-420
Specific Conductance (μmho/cm)	900[1] 1,600[2]	849-1060	963-1056	530-580
Hardness as $CaCO_3$		249-317	290-320	214-244
Alkalinity as $CaCO_3$		111-135	119-135	176-192
Sodium		79-102	91-102	22-24
Potassium		3.8-4.8	4.3-4.9	1.0-1.1
Calcium		60-77	70-78	55-65
Magnesium		24-31	27-31	19-20
Chloride	250[1] 500[2]	79-96	84-94	20-22
Nitrate	10	0.09-0.35	0.02-0.23	1.4-1.9
Fluoride	1.4-2.4	0.23-0.31	0.26-0.33	0.32-0.39
Sulfate	250[1] 500[2]	200-276	249-276	85-92
Metals				
Aluminum	1 (0.2[2])	0.137-0.307	0.013-0.066	<0.01
Antimony	0.006	ND	ND	ND
Arsenic	0.05	0.0020-0.0027	0.0024-0.0028	<0.002
Asbestos (million fibers/L)	7	ND	ND	NA
Barium	1	0.097-0.112	0.101-0.131	0.026-0.030
Beryllium	0.004	ND	ND	<0.001
Cadmium	0.005	ND	ND-0.024	<0.002
Chromium	0.05	ND	ND	<0.02
Copper	1.0[2] 1.3[3]	<0.02		
Cyanide	0.2	ND	ND	<0.02
Iron	0.3[1]	ND	0.062-0.075	<0.03-0.19
Lead	0.015[3]	<0.020		
Manganese	0.05[2]	ND	ND-0.011	<0.03-0.021
Mercury	0.002	ND	ND	<0.0002
Nickel	0.1	ND-0.003	0.002-0.003	<0.01
Selenium	0.05	ND	ND	<0.005
Silver	0.1	ND	ND	<0.01
Thallium	0.002	ND	Y	<0.001
Zinc	5.0*	ND	ND	<0.03
Radionuclides				
Gross Alpha	15	ND-11.7	1.9-8.9	ND
Gross Beta	50	1.2-11.2	ND-9.8	ND
Radium-226	5	ND-2.8	ND-1.8	ND
Radium-228	5	ND	ND	ND
Strontium-90	8	ND-1.3	ND	ND

Table 4-6
Source Water Quality - 1997
(Continued)

Parameter	MCL – mg/L	Diemer	Lake Mathews	Groundwater
Tritium	20,000	ND	ND	ND
Uranium	20	3.3-4.7	3.4-5.8	ND
Physical				
Corrosivity	Non-corrosive		Non-corrosive	
Color	15	1		
Odor	3	1.0		
Turbidity	0.5	0.06-0.08		0.071-0.51
MBAS	0.5	ND	ND	<0.10
pH	6.5-8.5	7.98-8.06	8.07-8.51	7.4-7.5
Organics				
Total Trihalomethanes	0.10	0.27-0.93		
Other Organics	See Appendix A	ND	ND	ND

Notes:
1. State "recommended" secondary MCL
2. State "upper level" secondary MCL
3. Federal action level under Lead and Copper Rule.

Sulfate concentrations are 85 to 92 mg/L. The groundwater also is very low in nitrate (less than 2 mg/L as N) which is reflective of the lack of development in the watershed.

The DHS has classified the water produced by the Rose Canyon and Lang wells as groundwater under the direct influence of surface water. This classification was based on the shallow depths and perforations, the absence of annular seals and their proximity to the creek. DHS requested the District to monitor concurrently Lang Well, Rose Canyon Well and the creek on a weekly basis for temperature, turbidity, pH, and TDS. Analysis of this data indicated a strong correlation between the two wells and the creek water. Because of this classification, DHS has directed the District to comply with the surface water treatment rule. Alternatives for compliance with the surface water treatment rule are discussed later in this section.

WATER SUPPLY FACILITIES

This section discusses the individual water supply facilities and any recommended improvements.

Dimension Water Treatment Plant

The DWTP consists of a pressure regulating valve (PRV), static mixer, four Microfloc Trident clarifier/filter systems, four low-head effluent pumps, a clearwell, and three booster pumps. The filtered water is disinfected with chlorine gas before entering the clearwell. In addition, there are two air scour blowers and a backwash waste recovery system including two sump pumps, two

settling tanks, and a backwash recovery pump. This treatment plant was last upgraded in 1993. The location of the DWTP is shown in **Figure 5-1**.

Of the four Microfloc treatment units, three have capacities of one cfs and one has a capacity of three cfs for a total treatment capacity of six cfs. The clearwell has a capacity of 85,000 gallons, is 30 feet in diameter, and is 16 feet high. The booster pumps are described in the booster pump section of this report. The District has discontinued the practice of recovering the backwash water to the headworks, and now disposes of it by discharge to the sewer system.

There is no dedicated backwash storage facility. Instead, backwash water is provided by the Cooks Reservoir located approximately 22,000 feet downstream of the booster pumps. The District should consider the construction of a dedicated backwash storage reservoir on-site to minimize the adverse effects of high backwash flows (up to 4,200 gpm) on the distribution system. The size of the backwash storage reservoir should be at least 84,000 gallons based on backwashing the 3 cfs filter unit at a rate of 4,200 gpm for 20 minutes.

In May 1998, DHS conducted an inspection of the DWTP to verify its compliance with the Surface Water Treatment Rule (SWTR) and the DHS *Cryptosporidium* Action Plan (CAP). DHS found that the plant is in good condition and is being adequately operated and maintained. DHS identified the following issues that required action by the District:

1. A revised Operations Plan must be submitted to DHS for review and approval as soon as possible.
2. The District needs to optimize the treatment plant to meet the CAP goals.
3. The turbidimeter influent lines are improperly designed and installed which results in incorrect turbidity readings after the filters are placed back into service following backwash.
4. The SCADA system only stores alarm events for 48 hours. The District is required to keep a record of alarm events for a minimum of five years. (Note: Alarms are currently written to a computer file.)
5. Effluent turbidity values are manually entered into a spreadsheet for monthly reporting to DHS causing typographical errors. DHS required improved accuracy for the monthly reports.

District staff has indicated that each of these deficiencies has been corrected.

DHS noted that while the plant has a capacity of 6 cfs, operation at the maximum allowable filtration loading rate of 6 gpm/ft^2 limits the plant capacity to 4.65 cfs. However, later in the report, DHS stated that the filters do comply with the maximum filtration loading rate requirement. This is clearly problematic given the District's reliance on the plant. A review of the data presented in the report indicates the three 1-cfs filters could operate at a maximum filtration rate of 6.4 gpm/ft^2 while the 3-cfs filter could operate at 4.8 gpm/ft^2. Adjustment of the flowrates to comply with the maximum allowable filtration rate results in maximum flowrates of 0.93 cfs in the small units and 3.74 cfs in the large unit. This gives an actual plant capacity of 6.53 cfs.

Therefore, no capacity limitations appear to exist. However, the District should ensure that the maximum filtration rate is not exceeded in any of the filters.

DHS also evaluated the plant's ability to achieve the disinfection requirements under the SWTR. The SWTR requires a three-log (99.9 percent) removal of *Giardia* cysts and a four-log (99.99 percent) removal of viruses. According to the DHS evaluation, the treatment plant is credited with a 2.5-log (99.5 percent) removal for *Giardia* and one log (90 percent) removal for virus. The disinfection process must make up the difference. The parameter CT, the product of disinfectant residual (C) multiplied by contact time (T), is used to determine the effectiveness of disinfection. CT is a function of water temperature, pH and disinfectant residual. To achieve the remaining 0.5 log inactivation of *Giardia*, a CT of 14 is required with a 1.4 mg/L chlorine residual for a water temperature of 20° C and a pH of 8.0. Since the CT for a three-log inactivation of viruses is 2, the CT for *Giardia* controls.

Chlorine is added prior to the clearwell at a dosage of 2 mg/L and the chlorine residual after the clearwell is typical 1.2 to 1.6 mg/L. At an average chlorine residual of 1.4 mg/L, a contact time of about 10 minutes is required. In computing the contact time to the first service connection, the DHS gave minimal credit to the clearwell under the assumption that it is poorly baffled. The DHS assigned 1 minute for the clearwell and 27 minutes for the 6,900 ft 16-inch transmission pipeline, giving a total of 28 minutes. Montgomery Watson computed a slightly higher contact time for the clearwell of 3 minutes, giving a total of 30 minutes. The existing system provides about three times the required CT. If the clearwell had adequate baffling, it could provide a contact time of up to 28 minutes for a total of 55 minutes.

In the future, the enhanced SWTR will require more stringent treatment to control *Cryptosporidium*. The DHS has already prepared its CAP, which emphasizes improved treatment performance to control *Cryptosporidium*. This could result in higher CT requirements. However, chlorine dosage cannot be increased due to the risk of violating the DBP regulations, which have a lower limit for trihalomethanes and other compounds. When this happens, the District may have difficulty meeting the required disinfection levels. Therefore, it should consider conducting tracer studies to determine the actual contact time of the existing clearwell. If the existing system cannot meet the future requirements, the District should consider replacing the existing clearwell with a new baffled clearwell having a larger effective volume. Construction of a new buried clearwell could eliminate the need for the existing low-head effluent pumps. The District may be able to add baffling to the existing clearwell to improve the CT credit.

The District may experience some difficulties complying with the reduced MCL for THMs of 0.08 mg/L specified in the new DBP Rule. The District periodically exceeds this level of THMs within its existing disinfection system. Generally, THMs are lower when the District uses well water or treats water from Irvine Lake due to their lower organic content. The District should evaluate its ability to meet this requirement on a consistent basis before the compliance date of December 2001. This may require a change in the method of disinfection at the filtration plant. A review of the plant drawings indicates that ammonia feed equipment for chloramination has been provided but is not currently in use. However, since chloramination is not as effective a disinfectant as free chlorine, the required CT could increase by a factor of 38 times. Thus,

chloramination is not practical as the primary method of disinfection. As an alternative, the District could continue to use free chlorination as its primary disinfection method with ammonia feed following the clearwell. If the existing ammonia feed equipment is adequate, an ammonia feed point could be installed downstream of the clearwell. This would allow the District to meet the CT requirement with free chlorine and to use chloramination to maintain the residual in the distribution system. However, replacement of the DWTP clearwell with an adequately baffled clearwell providing an effective contact time of at least 15 minutes is necessary for this option to be viable.

For budgeting purposes, a new ammonia storage and feed system is recommended; however, the District should verify the adequacy of any existing ammonia feed equipment. To confirm this approach, the District should conduct an investigation of all options for meeting the Stage 1 DBP Rule including an evaluation of alternative disinfection locations, the potential use of chloramination and ozonation and modification of treatment facilities to minimize THM formation. This investigation should be conducted during the year 2000.

Groundwater Wells and Pumps

The District's three well sites contain a single well each, the Rose Canyon, Lang, and US wells. Due to the proximity of the Rose Canyon and Lang well sites, they are commonly referred to together as the Canyon Well sites. The Canyon Well sites are located on Rose Canyon Road approximately 550 feet north of Trabuco Canyon Road. All three wells operate and deliver water to the Harris Grade pressure zone. **Table 4-7** presents a summary of the construction data for each of the District's wells. A summary of well pump information is provided in **Table 4-8.** Well locations are shown in **Figure 5-1**.

Table 4-7
Well Construction Data

Name	State Well Number	Year Drilled	Depth (ft)	Casing Diameter (in)	Perforation Depth	Surface Seal	Sanitary Seal
Rose Canyon	06S/07W-11P1S	unknown	44	36	24-36	None	None
Lang	06S/07W-11P2S	1925	44	16	24-36	None	None
US Well[1]	unknown	1957	110	10	34-78	Yes	None

Notes: 1. Upper Schwendeman Well

The Rose Canyon well has a depth of 44 ft; the year of construction is unknown. The well is equipped with two pumps, one a vertical turbine pump having a capacity of 500 gpm and the other a submersible pump having a capacity of 80 gpm. The small pump is generally operated all year while the large pump is operated primarily in the winter and spring. Each pump has a total dynamic head (TDH) of 500 feet. A Southern California Edison (SCE) pump test of the larger pump conducted in 1997 indicated the well was operating at 545 gpm and a TDH of 467 ft. At the time of the test, the well had a specific capacity of nearly 130 gpm per foot (gpm/ft) of drawdown. However, the specific capacity is more typically 70 gpm/ft. The overall pump efficiency (wire-to-water) was 65.7 percent. Since the well yield changes monthly with water

level depth, operation at peak efficiency is difficult. No modifications to this well are recommended.

Table 4-8
Groundwater Well Pumps

Name	Motor Size (hp)	Pump Setting (ft)	Design Data		Pump Test Data		
			Capacity (gpm)	TDH (feet)	Capacity (gpm)	TDH (feet)	Pump Efficiency
Rose Canyon No. 1	100	38	500	500	545	467	65.7%
Rose Canyon No. 2	30	38	80	500	NT	NT	NT
Lang	75	38	450	504	204	687	53.5%
US Well No.1	15	105	450	76	291	112	41.1%
US Well No. 2	75	N/A	500	346	NT	NT	NT

Note: All wells deliver water to the Harris Grade pressure zone.
NT – Not tested; N/A – Not applicable.

The Lang Well was constructed in 1925 with a total depth of 44 ft. The Lang Well is equipped with a vertical turbine pump having a design capacity of 450 gpm with a 504 ft TDH. An SCE test conducted in 1997 indicated the well was producing 204 gpm at a TDH of 687 ft. The well has a specific capacity of 16.3 gpm/ft of drawdown. The overall pump efficiency was 53.5 percent, which is very low. Review of the design pump curve indicates the well is operating at a substantially higher discharge head than the original design, due to the use of a Cla-Valve to throttle the discharge when the groundwater levels are low. This well was recently redeveloped and now produces 450 gpm at peak yield.

The US (Upper Schwendeman) Well site is currently leased from a property owner. The US Well site contains one well with two pumps operating in series to extract groundwater at a rate of up to 450 gpm. The first pump extracts water from the groundwater table to the surface (TDH of 76 ft) while the second pump lifts water from the first pump to the Harris Grade pressure zone (TDH of 346 ft). The US Well is located on the north side of Trabuco Canyon Road approximately 4,000 feet northeast of the Canyon Well sites. The SCE pump test conducted in 1997 indicated the well pump was operating at 291 gpm and a TDH of 112 ft. The specific capacity of the well is 3.7 gpm/ft of drawdown. The well pump was operating at a measured efficiency of 41 percent, which is very poor. A new well pump was recently installed to replace the old low-efficiency pump. However, the well owner has requested the District continue using a separate booster pump to lift the water to system pressure.

The District should have SCE pump tests conducted annually and evaluate the results against historical measurements. This will provide an indication of whether the pumps are operating efficiently within desired parameters. In addition, the collection and evaluation of specific capacity data will allow the District to assess the need for rehabilitation if a drop in specific capacity is observed.

Groundwater Treatment

As discussed previously, the District has two groundwater wells, Rose Canyon and Lang, that have been determined to be under the direct influence of surface water. Based on this finding, the DHS has determined that these wells must comply with the SWTR.

Alternatives

There are three principal alternatives for complying with the SWTR at the Rose Canyon and Lang wells:

1. Discontinue use for potable supply; pump groundwater into non-potable water system;
2. Construct a pipeline to convey raw water to the existing DWTP and use existing capacity at DWTP for treatment during winter months; or
3. Construct a treatment facility near the existing well sites.

The District could elect not to treat the Rose Canyon and Lang wells and instead convert the wells to non-potable supplies. Pumped water could be piped into the existing or future reclaimed water system to augment that supply. However, the fact that the groundwater is available in the winter months when non-potable water demand is low argues against this option. Construction of a new non-potable seasonal storage reservoir would make this option more viable.

Since the wells produce water primarily in the winter and spring months, it may be possible to use the existing DWTP to treat the well water when demands are low. However, the distance from the wells to the DWTP is at least 35,000 ft. Assuming the installation of a 12-in diameter pipeline, the cost of the pipeline alone would be at least $4.5 million. Additional pumping costs would be required to replace the head loss between the wells and the plant. Based on these considerations, treatment at the DWTP is probably infeasible.

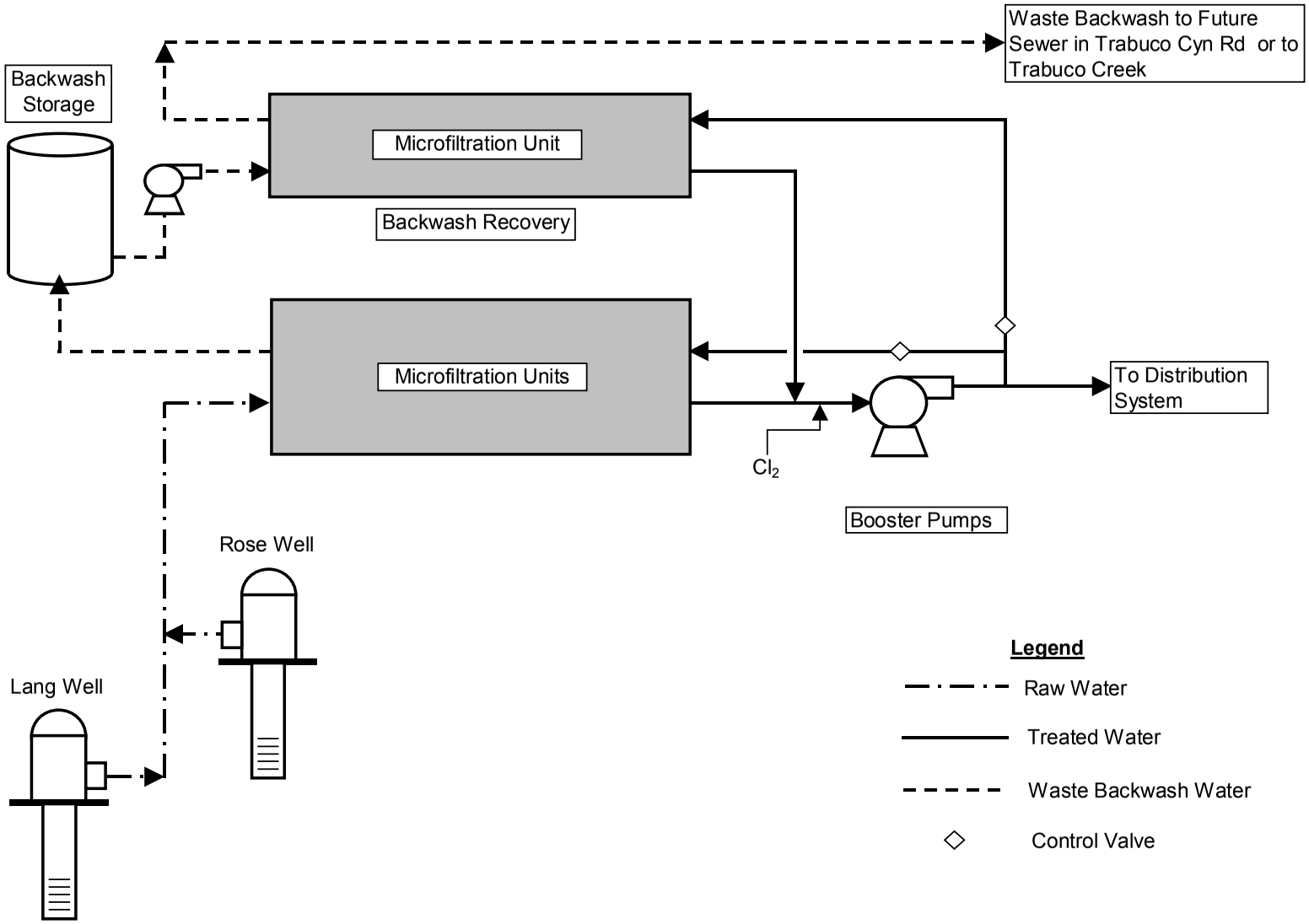
The third alternative involves treatment near the existing well sites. The capacity of the treatment facilities should match those of the two wells, 1.6 mgd. For this capacity, there are four possible options including: two-stage filtration, conventional dual media filtration and microfiltration. Two-stage filtration is the process used at the DWTP. Conventional filtration uses flocculation, sedimentation and dual-media filtration. Microfiltration is a low-pressure membrane (0.2 microns) process that removes turbidity and bacteria (including *Giardia* cysts and *Cryptosporidium* oocysts) without chemical addition. **Table 4-9** compares the advantages and disadvantages of these processes. Based on the advantages and disadvantages for this application, microfiltration is recommended as the treatment process for these wells.

A schematic of the potential treatment process is shown on **Figure 4-2**. The process includes waste backwash water recovery to minimize waste discharges. Waste backwash water could either be discharged to Trabuco Creek or pumped to the RRWWTP for treatment. The latter option would require a force main to Plano Trabuco Sewer Lift Station. This could be part of a larger project to sewer Trabuco Canyon (Central Area). Well pumps could be restaged to provide

Table 4-9
Comparison of Water Treatment Processes

Process	Advantages	Disadvantages
Two-Stage Filtration (Microfloc Trident, Roberts Filters, Culligan)	• Equal to conventional treatment with respect to Giardia and virus log removals • Compact process units • Demonstrated treatment of moderately high turbidity • Competitive with conventional treatment in capacities up to 10 mgd • Can be housed in secure building • District staff familiarity with operation	• Requires proper pre-treatment with coagulant and filter aid, and close operator attention with variable source quality • Limited ability to use high coagulant dosages for arsenic and TOC removal • Requires additional land for on-site waste washwater handling • Limited capabilities for treating low turbidity waters
Conventional Dual Media Filtration	• Capable of treating high turbidity sources for extended periods of time • Resilient process that can accommodate gradual changes in source quality • Capable of TOC and arsenic removal • Relatively low headloss requirement	• Sludge production • Need for greater operator attendance during periods of variable source quality • Requires additional land for on-site waste washwater handling • Limited capabilities for treating low turbidity waters
Microfiltration	• Can meet Giardia and Cryptosporidium log removals with minimal free chlorine contact time • Does not require coagulant addition • Waste washwater flows can be discharged into surface waters without treatment • Housed in secure building • Superior ability to treat low turbidity waters • Can use well pumps to provide inlet head • Can be operated remotely from Dimension plant	• Chemical waste from the membrane cleaning process must be disposed off-site • Cannot remove arsenic or TOC without upstream pre-treatment (coagulation/flocculation and sedimentation) • May require pilot testing to ensure that mineral fouling of the membrane does not occur

Figure 4-2
Groundwater Treatment Process Schematic



the proper head needed for microfiltration. A booster station would be needed to pump back to system pressure.

Estimated Costs

The estimated cost of the project is shown in **Table 4-10**. The costs assume microfiltration treatment, waste backwash water recovery, a concrete block building, emergency power supply,

Table 4-10
Estimated Cost for Groundwater Treatment

Item	Capital Cost
Treatment Equipment	
Membrane System	$1,030,000
Rinse water storage	20,000
Chlorination	40,000
Subtotal	$1,090,000
Building	320,000
SCADA System	160,000
Site Electrical & Generator	150,000
Site Work & Yard Piping	200,000
Subtotal - Treatment Plant	$1,920,000
Booster Pumping Plant	250,000
Well Restaging	30,000
Backwash Water Disposal	50,000
Contingency – 30% of above costs	680,000
Construction Cost	**$2,930,000**
Engineering, Legal & Admin – 25% of construction	730,000
Capital Cost	**$3,660,000**

Note: Costs do not include land or other site-specific costs.
ENR Construction Cost Index - LA: 6865 (October 1998)

SCADA system for remote operation from the DWTP, well pump restaging, booster pumping to system pressure and waste discharge into Trabuco Creek. Land costs are not included – these costs should be added if the District does not have a suitable site near the wells.

Some site-specific costs are given order-of-magnitude estimates (site work and yard piping) due to the lack of a plant site. Construction contingency (30 percent) and engineering, legal and administrative costs (25 percent) are included in the capital costs. The capital cost of the facility is estimated to be approximately $3.7 million. This opinion of probable cost is an order-of-magnitude estimate with a variation of plus or minus 30 percent. Annual operations and maintenance costs are estimated to be about $130,000 per year including well and booster pumping. Amortizing the capital costs at an interest rate of 5.5 percent for 30 years, the total

annual cost would be about $380,000 per year. Assuming an annual production of 1,000 acre-ft/yr, the unit cost of treatment would be about $380 per acre-ft. At lower levels of production, the unit cost of treatment will increase. If annual production is 750 acre-ft/yr, the unit cost would be about $500/acre-ft.

Because of the sensitivity of these costs to the annual yield, the District should conduct a detailed feasibility study of all options for the Rose Canyon and Lang wells.
The schedule for project design and construction is estimated to be 24 to 30 months based on experience with similar projects. In the first six to twelve months, site location, preliminary design and permitting would take place, followed by pre-purchase of the membrane treatment system, final design and construction of the treatment plant.

PRODUCTION COSTS

The average cost of water production is presented in **Table 4-11**. The current costs are broken down into water purchase, conveyance, treatment and pumping cost components.

Table 4-11
Current Water Production Costs

Source	Unit Cost - $ per acre-ft				
	Water Cost	Conveyance Costs	Treatment Cost	Pumping Cost[1]	Total Cost
Baker Aqueduct	349	0	68	63	$480
Allen-McColloch Pipeline	431	218	0	78	$727
Rose Canyon Well	0	0	1	58	$59
Lang Well	0	0	1	77	$78
US Well	0	0	1	225	$226

[1] All sources pump to the Harris Grade zone.

The most cost-effective sources are the Rose Canyon and Lang wells. To minimize production costs, operation of these wells should maximized based on water availability as is currently done. Production from the US Well is the next most economical source, followed by Baker Aqueduct water. If the District decides to construct treatment for the Rose Canyon and Lang wells, the cost of these sources would be on the order of $380-500/acre-ft. The most expensive water source from the AMP. The District currently minimizes use of this source to control production costs.

SUMMARY OF SUPPLY RECOMMENDATIONS

The analysis of potable water sources has identified the need for several future improvements as listed below:

1. The District should maximize its use of reclaimed water so that no additional potable supply will be required. The reclaimed water system is discussed in Section 7.

2. The District will need no additional production capacity to meet build-out demands unless reclaimed water usage does not develop as expected. The District should carefully monitor potable water demands to determine whether the existing supply is adequate.

3. The Baker Aqueduct may be used to convey groundwater or other water sources in the future. If this happens, the District must be kept whole regarding its water supply from this source. One option may involve a connection to the AMP near the DWTP, which would replace the Baker Aqueduct capacity.

4. The District should monitor the up-coming Orange County Area Study being performed by Metropolitan to ensure its future needs are considered.

5. The District should update its Urban Water Management Plan by December 31, 2000. This update should evaluate implementation of additional conservation measures that could reduce the need for supplemental potable water supplies in the future.

6. The District should prepare for compliance with the Enhanced Surface Water Treatment Rule and the Disinfectants/Disinfection By-product Rule by December 16, 2001. This will require optimization of the treatment process at the DWTP and may require a change in the method of disinfection.

7. The District should continue to monitor proposed drinking water regulations for their impact on District operations. A proposed radon regulation was published in November 1999. The impact of this regulation on the District is unknown at this time.

8. The District should construct an 84,000 gallon backwash storage tank at the DWTP to minimize distribution system impacts during filter backwash. The District should also construct a new 100,000 gallon baffled clearwell for the treatment plant or modify the existing clearwell to incorporate baffling to increase the CT credit.

9. The District should conduct a study of alternate disinfection methods at the DWTP to ensure compliance with new drinking water regulations in the most cost-effective means. This study should be conducted during the year 2000 to allow time to implement recommendations prior to the December 16, 2001 deadline. For budgeting purposes, it is assumed that ammonia feed will be installed following the DWTP clearwell.

10. The District should conduct a detailed study of the feasibility of constructing treatment for the Rose Canyon and Lang wells. This study should evaluate alternative treatment processes, plant siting, operational issues and the potential use of the wells as a non-potable supply to augment the reclaimed water system.

Section 5
Water System Facilities

This section presents a summary of the District's potable water system facilities, an evaluation of the adequacy of existing facilities, and recommendations for system improvements through build-out conditions. As described in previous Sections of this Master Plan, the District has adequate water to provide for anticipated demands through build-out. Therefore, this Section does not discuss water sources, but instead focuses on water system facilities.

EXISTING WATER DISTRIBUTION SYSTEM

The District is divided by pumps, closed pipes, and control valves into nine primary and three secondary pressure zones. Primary pressure zones either include reservoirs or are supplied water through pressure regulating stations (PRSs), while secondary pressure zones are hydropneumatic zones. District facilities include a treatment plant, groundwater wells, connections to other utilities, booster pump stations, storage reservoirs, PRSs, and pipelines. Geographical locations of the pressure zones and water facilities are shown in **Figure 5-1** and a hydraulic schematic of the same information is shown in **Figure 5-2**.

Pressure Zones

The primary water source for the District is the Dimension Water Treatment Plant (DWTP) which provides water into the Cooks Reservoir pressure zone for further transmission to the rest of the distribution system. The Cooks Reservoir pressure zone is primarily outside and west of the District's service area with the exception of one facility, Cooks Reservoir. High service booster pumps at the DWTP lift water from the clearwell directly into this zone and pump to the water level in Cooks Reservoir. The maximum hydraulic grade line (HGL) in this zone can exceed the maximum water level in Cooks Reservoir (1,165 feet) through pumping from the DWTP, and can reach an HGL of 1,250 feet. Some customers in this zone are commercial users. Water is boosted from this zone to the Harris Grade Reservoirs in the Harris Grade pressure zone by the Ridgeline and El Toro Road booster pumps. This zone is connected to three other water districts through interties. Water can be received from SMWD through the Coto de Caza intertie, supplied to SMWD through the Valley Vista intertie, supplied to IRWD through the Ridgeline No. 1 intertie, and either received or supplied to ETWD through the El Toro intertie. A summary of pressure zone information is shown in **Table 5-1**.

Harris Grade is the largest pressure zone in the District and encompasses most of the north and all of the central region of the District's service area. This zone is bounded on the north and south by the District's service area boundary, on the east by Trabuco Reservoir pressure zone, and on the west by the Cooks Reservoir pressure zone. The primary source of water for this zone is water pumped from Cooks Reservoir zone through Ridgeline and El Toro booster stations. During the winter and spring Harris Grade pressure zone also obtains water from three groundwater production wells: Lang, Rose, and US. Finally, the interties in Harris Grade can

share water with three different water districts. Water can be taken or given to SMWD through the intertie at Plano Trabuco Road, can be provided to SMWD at the Zone 4 and 5 interties, can be provided to IRWD at the Ridgeline No.2 intertie, and can be either taken or given to SCWD at the northwest intertie. The Harris Grade pressure zone has two reservoirs, one with a capacity of 0.42 MG and the other with a capacity of 2 MG, for a total storage capacity of 2.42 MG. The maximum HGL in this zone is set by the Harris Grade reservoirs and is approximately 1,504 feet.

Table 5-1
Pressure Zones

Name	Abbreviation	Elevation (ft)		Max. HGL (ft)
		Min.	Max.	
Primary				
Cooks Reservoir	CR	700	1,165	1,250
Harris Grade	HG	980	1,473	1,504
High Country	HC	1,272	1,365	1,496
Joplin Reservoir	JR	1,924	1,934	1,940
Lower Dove Canyon	LDC	976	1,097	1,258
Rose Canyon Reservoir	RCR	1,070	1,250	1,357
Trabuco Oaks	TO	1,000	1,080	1,208
Trabuco Reservoir	TR	1,272	1,601	1,686
Upper Dove Canyon	UDC	1,030	1,386	1,418
Secondary				
Canyon Creek	CC	1,360	1,520	1,682
Falcon Street	FS	1,375	1,645	1,742
Topanga Canyon Road	TCR	1,350	1,430	1,533

Note: Falcon Street and Topanga Canyon Road zones are currently under construction.

The High Country pressure zone is the smallest of all the zones within the District. This zone covers only the immediate area surrounding High Country Road and is surrounded by the Harris Grade pressure zone on the north, the Trabuco Reservoir pressure zone on the east, and the Upper Dove Canyon pressure zone on the west and south. The zone's source of water is from Trabuco Reservoir pressure zone and the pressure is regulated by the Lower Trabuco pressure regulating station (PRS) located on Robinson Ranch Road between High Country Drive and Heritage Drive. A closed valve located in a pipe at the end of Weeping Willow Street that extends to High Country Road separates the Upper Dove Canyon and High Country pressure zones. The maximum HGL in this zone is 1,496 feet. There are no reservoirs, booster stations, or interties located in this zone.

The Joplin Reservoir pressure zone is a small zone where the District owns a single 80,000 gallon reservoir serving the Joplin Boy's Home. There are two additional treated water storage reservoirs within the Joplin Reservoir pressure zone that are owned by the County of Orange Probation Department (County). These reservoirs have volumes of 125,000 and 30,000 gallons, giving the entire pressure zone a treated water storage volume of 225,000 gallons. In addition, the

Figure 5-1
Existing Potable Water System

11x17

Figure 5-2
Existing Potable Water System Schematic

County is plans to build a additional 125,000 gallon reservoir at their existing site. A dedicated pump station (Rose Canyon) fills the Joplin reservoir once every few days from the Rose Canyon reservoir. There are no other connections to this zone. The maximum HGL in this zone is 1,940 feet.

The Lower Dove Canyon pressure zone is in the most southerly portion of the District and is bounded by the Upper Dove Canyon pressure zone to the north and the District boundary to the east, west, and south. The sole source of water for this zone is from the Upper Dove Canyon pressure zone, supplied by two PRSs (Bell and Sycamore Canyon) located on Bell Canyon Drive and at the intersection of Sycamore Drive and Inverary, respectively. There are no reservoirs, booster stations, or interties located in the Lower Dove Canyon pressure zone. The maximum HGL in this zone is 1,258 feet.

The Rose Canyon pressure zone consists of the Rose Canyon Reservoir and booster station, two PRSs, and connecting pipelines between the PRSs and the Reservoir. This zone is supplied water from the Harris Grade zone through a single PRS and delivers water to customers in both Joplin and Trabuco Oaks zones. The Rose Canyon Booster Station provides water to the Joplin zone and the two PRSs provide water to the Trabuco Oaks zone. The PRS that supplies water to the Rose Canyon zone is controlled by the water level in the Rose Canyon Reservoir. When the water level falls to a predefined level, the PRS opens allowing water to fill the Reservoir. The maximum HGL in this zone is 1,357 feet, set by the water level in the Rose Canyon Reservoir.

The Trabuco Oaks pressure zone is primarily served by the Rose Canyon Reservoir zone and is supplemented by service from the Harris Grade pressure zone. Three PRSs regulate the pressure and provide fire protection in this zone, two from Rose Canyon Reservoir zone and one from Harris Grade zone. There are no reservoirs, booster stations, or interties located in the Trabuco Oaks pressure zone. The maximum HGL in this zone is dependent upon the PRS settings, but is typically set at 1,208 feet.

The Trabuco Reservoir pressure zone is located directly east of the Harris Grade pressure zone. This zone is bounded by the District's service area boundary to the east, the wastewater treatment plant property to the south, and the Harris Grade pressure zone to the west. Water for this zone comes solely from the Harris Grade pressure zone and is pumped by the Robinson Ranch booster station. Trabuco Reservoir pressure zone has two reservoirs with capacities of 1.5 MG and 3.0 MG for a total storage of 4.5 MG. The maximum HGL in this zone is 1,686 feet. This zone has no interties.

The Upper Dove Canyon pressure zone is the second largest zone based on area and is bounded on the east and west by the District's service area boundary, on the north by Harris Grade pressure zone, and on the south by the Lower Dove Canyon pressure zone. Water is provided solely from the Harris Grade pressure zone and pressure is regulated by one PRS, used as a flow control valve, located on Plano Trabuco Road directly southeast of the SMWD intertie. This PRS supplies a HGL of 1,418 feet. There is a physical connection (normally closed) from the High Country zone that could supply water to the Upper Dove Canyon zone if needed. The Upper Dove Canyon pressure zone has one reservoir with a capacity of 2.5 MG and a maximum HGL

of 1,418 feet. This reservoir also serves the Lower Dove Canyon pressure zone via two PRSs. This zone has no booster stations or interties.

The secondary pressure zones; Canyon Creek, Topanga Canyon Road, and Falcon Street are not included in the model. They are hydropneumatic zones, each supplied water by dedicated booster and fire flow pumps in conjunction with a hydropneumatic tank. Canyon Creek zone provides water to six homes and one church, and typical pressures on the upper end of this zone are approximately 70 pounds per square inch (psi). Topanga Canyon Road and Falcon Street zones provide water to 13 and 22 homes, respectively.

Facilities

This section describes each of the existing facility types in additional detail: booster pumps, storage reservoirs, pressure regulating stations, and pipelines. Descriptions of existing facilities only are provided and a determination of the adequacy of the existing facilities is provided later in this section.

Booster Pumps

The District currently has nine booster pump stations in the distribution system. These booster stations provide water to the Cooks, Harris Grade, Joplin, and Trabuco Reservoirs, as well as the Canyon Creek, Topanga Canyon Road, and Falcon Street hydropneumatic pressure zones. The DWTP, El Toro, and Ridgeline booster pumps are all controlled either manually or by the water level in Harris Grade No. 1 reservoir. Robinson Ranch booster pumps are controlled by the water level in the Trabuco reservoirs and the Canyon Creek, Falcon Street, and Topanga Canyon Road booster pumps are each part of hydropneumatic systems and are controlled by their respective system logic. The Plano Trabuco and Rose Canyon booster pumps are manually controlled. Each booster station is shown geographically on **Figure 5-1** and is schematically represented on **Figure 5-2**. Booster station information is also summarized in **Table 5-2**.

Storage Reservoirs

The District has six storage reservoir sites with a total of eight storage reservoirs. The total capacity of storage reservoirs owned by the District is 9.98 MG. An additional 0.155 MG is owned by Orange County in the Joplin Reservoir zone and is available for fire protection in that zone. Cooks Reservoir is the smallest within the District with a capacity of 60,000 gallons. It is located approximately 950 feet southeast of the intersection of Santiago Canyon Road, El Toro Road, and Live Oak Canyon Road. Cooks Reservoir is within the Cooks Reservoir pressure zone and allows the DWTP high service pumps to boost water to a fixed water surface, at an elevation of approximately 1,160 feet. In addition, this reservoir is used to supply backwash water to the DWTP. An altitude/pressure relief valve located at this facility allows an elevation of 1,250 feet in the Cooks Reservoir zone by closing off the reservoir inlet and having the DWTP booster pumps lift water up to the suction side of the El Toro and Ridgeline booster stations. This valve also relieves any excess Cooks Reservoir zone pressure to the reservoir/overflow.

Table 5-2
Booster Pumps

Name	Pump No.	Zone		Power (hp)	Rated Capacity (gpm)	Data Available[1]
		From	To			
Dimension	1	DWTP	CR	100	450	P,E,C
Dimension	2	DWTP	CR	200	900	P,E,C
Dimension	3	DWTP	CR	300	1,350	P,E,C
Larchmont	1	ETWD	CR	60	400	P
Ridgeline	1	CR	HG	120	900	E,C
Ridgeline	2	CR	HG	150	1,350	C
Ridgeline[2]	3	CR	HG	120	1,350	N, Diesel
El Toro Rd.	1	CR	HG	60	450	E,C
El Toro Rd.[2]	2	CR	HG	60	450	E,C
El Toro Rd.[2]	3	CR	HG	60	450	E,C
El Toro Rd.[2]	4	CR	HG	60	450	E,C
Plano Trabuco	1	SMWD	HG	200	1,800	E
Plano Trabuco	2	SMWD	HG	100	900	E
Rose Canyon	1	HG	JR	60	180	E
Rose Canyon[2]	2	HG	JR	60	180	E
Robinson Ranch	1	HG	TR	50	450	E
Robinson Ranch[2]	2	HG	TR	50	450	E
Falcon St.[3]	1	HG	FS	75	500	P
Falcon St.	2	HG	FS	15	75	P
Topanga Canyon Rd.[3]	1	HG	TS	100	1,620	P
Topanga Canyon Rd.	2	HG	TS	7.5	120	P
Canyon Creek	1	HG	CC	15	100	C
Canyon Creek[3]	2	HG	CC	40	300	C

Note: 1. E = Southern California Edison, C = Manufacturer's Test Curve Data, P = Plans, N = No Data
2. Standby
3. Fire pump

The Harris Grade Reservoir site contains two storage reservoirs, Harris Grade No. 1 and Harris Grade No. 2, with storage capacities of 2.0 MG and 0.42 MG, respectively. Both reservoirs have identical bottom elevations, but the smaller reservoir is shorter by eight feet and is therefore equipped with a recirculation pump to assist in keeping its volume fresh. The Harris Grade reservoir site is located north of Live Oak Canyon Road approximately 1,500 feet west of the intersection of Live Oak Canyon Road and Hamilton Truck Trail. Harris Grade Reservoir No. 1 has a high water surface elevation of 1,504 feet and Reservoir No. 2 has a high water surface elevation of 1,496 feet. Reservoir No. 2 also has an altitude valve to prevent overflow. Both reservoirs serve the Harris Grade pressure zone.

Joplin Reservoir has a storage capacity of 80,000 gallons and a high water surface elevation of 1,940 feet. Located just east of Rose Canyon Road approximately one mile north of Trabuco

Canyon Road, the Joplin Reservoir provides water solely for the Joplin Boy's Home. In addition, two other reservoirs also provide treated water storage for the Joplin Reservoir zone. These reservoirs are owned by the County and have volumes of 125,000 and 30,000 gallons. This provides a total treated water storage capacity in this zone of 235,000 gallons.

Rose Canyon Reservoir has a storage capacity of 0.42 MG and a high water surface elevation of 1,357 feet. Located just east of Rose Canyon Road approximately one mile north of Trabuco Canyon Road, the Rose Canyon Reservoir is used to serve the Trabuco Oaks and Rose Canyon pressure zones. This reservoir is filled from the Harris Grade zone through a PRS dedicated for that purpose.

The Trabuco Reservoir site contains two storage reservoirs, Trabuco No. 1 and Trabuco No. 2 with storage capacities of 1.5 MG and 3.0 MG, respectively, and with identical high water surface elevations of 1,686 feet. This reservoir site contains the largest storage capacity within the District with a total storage capacity of 4.5 MG. The Trabuco Reservoir site is located west of Robinson Ranch Road on the east side of the District's service area and serves the Trabuco Reservoir pressure zone.

The Dove Canyon Reservoir has a storage capacity of 2.5 MG and a high water surface elevation of 1,418 feet. Located approximately 750 east of Glen Echo Road and approximately 500 feet north of the cul-de-sac of Fields Point, the Dove Canyon Reservoir is within the Upper Dove pressure zone. This reservoir serves the Upper Dove Canyon pressure zone directly, and the Lower Dove Canyon pressure zone via PRSs.

Storage reservoir locations are shown geographically in **Figure 5-1**, schematically in **Figure 5-2**, and their characteristics are summarized in **Table 5-3**.

Table 5-3
Storage Reservoirs

Name	Vol. (MG)	Zone Served	Diam. (feet)	Height (feet)	Elevation (feet)		Type	Year Built
					Min.	Max.		
Cooks	0.06	CR	22	22	1,143	1,165	Steel	1963
Harris Grade No. 1	2.00	HG	105	31	1,473	1,504	Steel	1980
Harris Grade No. 2	0.42	HG	48	23	1,473	1,496	Steel	1965
Joplin	0.08	JR	40	10	1,924	1,934	Steel	1979
Rose Canyon	0.42	HG	53	26	1,331	1,357	Steel	1979
Trabuco No. 1	1.50	TR	99	26	1,660	1,686	Steel	1984
Trabuco No. 2	3.00	TR	141	26	1,660	1,686	Steel	1984
Upper Dove Canyon	2.50	UDC	116	32	1,386	1,418	Steel	1988
Total	**9.98**							

Note: 1. Two additional non-District reservoirs exist in this zone with volumes of 125,000 and 30,000 gallons.

Pressure Regulating Stations

There are nine PRSs in the District and five pressure zones receive water only through PRSs: Rose Canyon Reservoir, Trabuco Oaks, Upper Dove Canyon, Lower Dove Canyon, and High Country. The Rose Canyon PRS with an eight-inch diameter valve is located approximately 40 feet north of the Rose Canyon Well and provides water from Harris Grade to the Rose Canyon Reservoir. The water level in the Rose Canyon Reservoir controls the PRS setting.

The following three PRSs serve water to the Trabuco Oaks pressure zone: Upper Trabuco, Middle Trabuco, and Lower Trabuco. The Lower Trabuco PRS regulates pressure from the Harris Grade zone and the other two regulate pressure from the Rose Canyon Reservoir zone. The Upper Trabuco PRS is located on Trabuco Oaks Road directly north of North Street, the Middle Trabuco PRS is located just east of Rose Canyon Road on Mountain View Road, and the Lower Trabuco PRS is located on Trabuco Oaks Road approximately 300 feet north of Trabuco Canyon Road.

The Plano Trabuco PRS provides water to the Upper Dove pressure zone and is located directly east of Plano Trabuco booster station. This valve is used to electronically control flow into the Upper Dove Canyon pressure zone from the Harris Grade pressure zone.

The Lower Dove Canyon pressure zone is supplied water from two PRSs that regulate the pressure entering this zone from the Upper Dove Canyon pressure zone. These PRSs are generally located in the southeast portion of the District's service area. The Bell Canyon PRS is located on Bell Canyon Drive approximately 500 feet south of Golf Ridge Drive and regulates the pressure entering from the southeast portion of Upper Dove Canyon Drive. The second PRS, Sycamore Canyon, is located on Sycamore Canyon Drive and Inverary. This PRS regulates pressure from the southwest portion of the Upper Dove Canyon pressure zone.

The High Country PRS is located just north of the Robinson Ranch booster station. This PRS regulates pressure from the Trabuco Reservoir pressure zone. The Weeping Willow PRS is located between the Harris Grade and the Upper Dove Canyon pressure zones, but is currently out of service. The PRSs are shown geographically in **Figure 5-1**, schematically in **Figure 5-2**, and pertinent details are summarized in **Table 5-4**.

Pipelines

The District's existing water distribution system consists of almost 53 miles (284,697 feet) of pipeline ranging from 2 to 24-inches in diameter. Almost 50 percent of the existing pipelines are eight inches in diameter. The majority of the eight-inch diameter pipelines are located in the Harris Grade and Upper Dove Canyon pressure zones with 21 percent and 17 percent of the total, respectively. Graphical and tabular summaries of pipeline quantities are given in several following figures. A summary of pipeline quantities by diameter, material, and pressure zone are tabulated and shown in **Tables 5-5** through **5-7** and **Figures 5-3** through **5-5**, respectively. In addition, summary of pipeline diameter and material by pressure zone are tabulated and shown in **Tables 5-8** and **5-9** and in **Figures 5-6** and **5-7**.

Table 5-4
Pressure Regulating Stations

Name	Valve Sizes (inches)	Model Size[2] (inches)	Pressure Zone Served	Setting (psi)	Setting (feet)
Rose Canyon	8	8	RCR	160	1,375
Upper Trabuco	3 and 6	6	TO	50	1,185
Middle Trabuco	6	6	TO	68	1,207
Lower Trabuco	3	3	TO	90	1,208
Plano Trabuco[1]	6 and 6	6	UDC	109	1,416
Bell Canyon	2, 4, 8	8	LDC	70	1,258
Sycamore Canyon	2, 4, 6	6	LDC	64	1,228
High Country	3	3	HC	95	1,496
Weeping Willow	Not in service	N/A	N/A	N/A	N/A

Note: 1. Operates as a flow control valve.
2. Indicates the largest size valve and is the valve size used in the model.

A summary of the year of construction of all District water facilities is presented in **Figure 5-8**.

Table 5-5
Pipe Diameter vs. Total Length

Diameter (inches)	Total Length (feet)	Percent of Total
2	61	0.0%
2.5	95	0.0%
4	3,224	1.1%
6	8,014	2.8%
8	142,437	50.0%
10	44,452	16.0%
12	31,752	11.1%
14	19,573	6.9%
16	31,088	10.9%
20	1,052	0.4%
24	2,978	1.0%
Total	**284,697**	**100.0%**

Figure 5-3
Pipe Diameter vs. Total Length

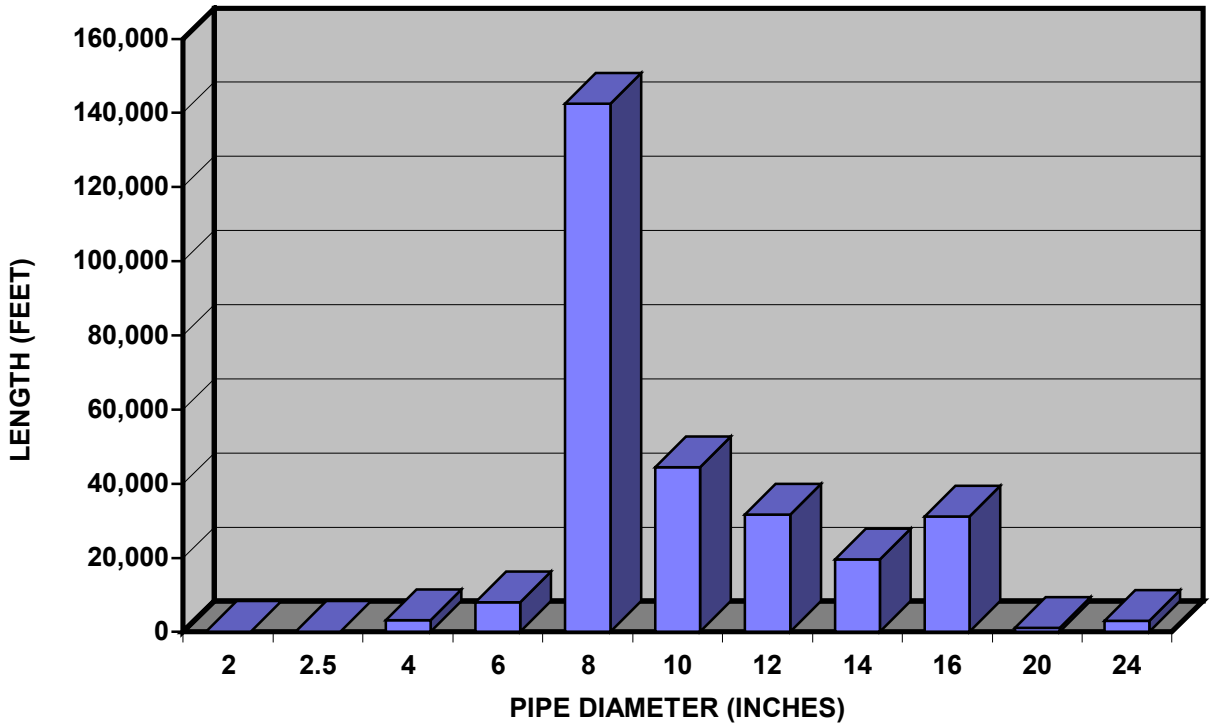


Table 5-6
Pipe Material vs. Total Length

Type of Pipeline	Total Length (feet)	Percent of Total
Asbestos Cement Pipe (ACP)	71,185	25.0%
Ductile Iron Pipe (DIP)	27,798	9.8%
Polyvinyl Chloride Pipe (PVC)	126,787	44.5%
Welded Steel Pipe (WSP)	58,928	20.7%
Total	**284,697**	**100.0%**

Figure 5-4
Pipe Material vs. Total Length

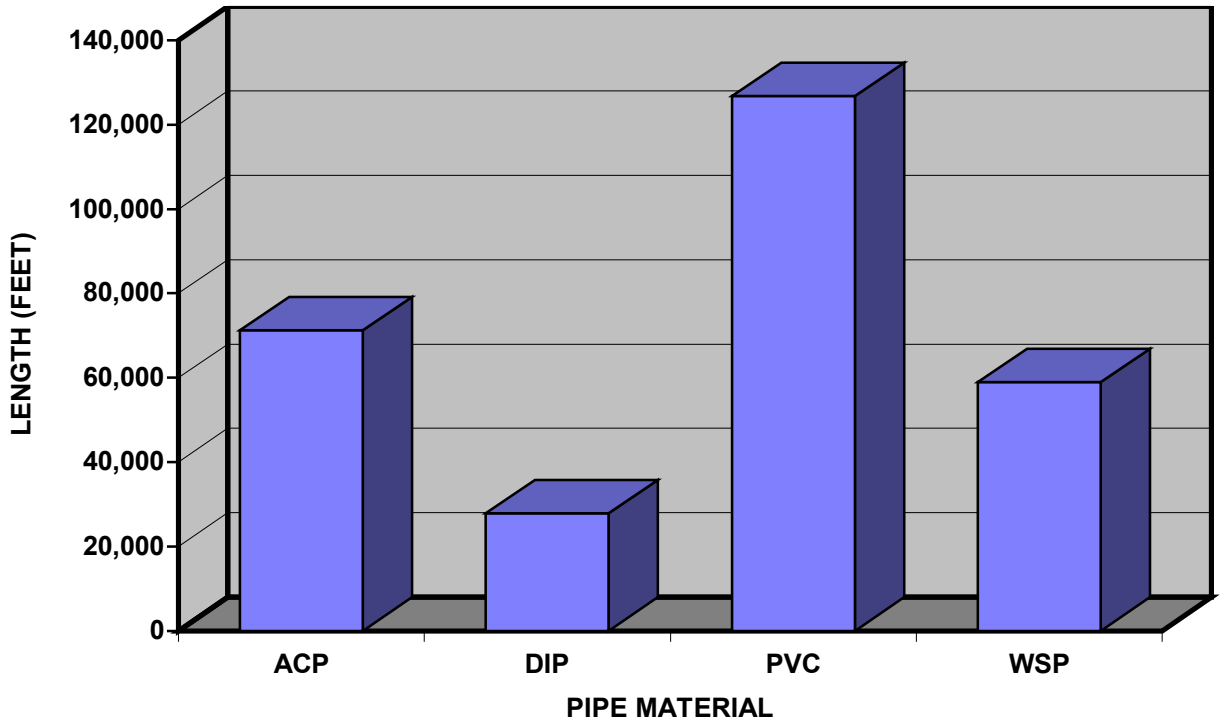


Table 5-7
Pressure Zone vs. Total Length

Pressure Zone	Total Length (feet)	Percent of Total
Cooks	26,641	9.4%
Harris Grade	122,535	43.0%
High Country	2,995	1.1%
Interzone	1,469	0.5%
Joplin Reservoirs	339	0.1%
Lower Dove Canyon	20,534	7.2%
Trabuco Oaks	8,119	2.9%
Trabuco Reservoirs	28,194	9.9%
Upper Dove Canyon	73,871	25.9%
Total	**284,697**	**100.0%**

Figure 5-5
Pressure Zone vs. Total Length

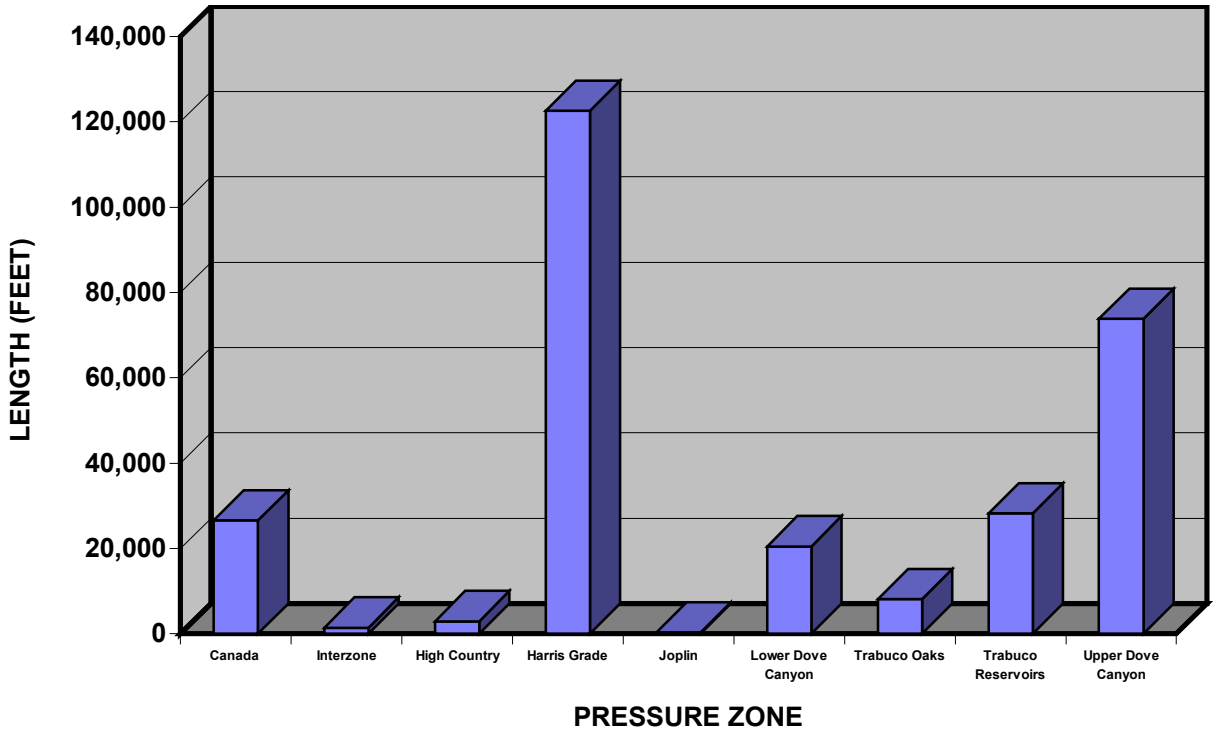


Table 5-8
Sum of Pipe Length by Zone and Diameter

Diameter (inches)	Length (feet)	Percent of Total
HARRIS GRADE		
2	61	0.0%
6	4,198	3.4%
8	62,181	50.7%
10	24,697	20.2%
12	3,562	2.9%
14	12,234	10.0%
16	14,794	12.1%
20	809	0.7%
Subtotal	118,073	100.0%
HIGH COUNTRY		
8	1,489	49.7%
10	239	8.0%
12	1,268	42.3%
Subtotal	2,995	100.0%
INTERZONE		
8	202	13.8%
10	443	30.2%
16	824	56.1%
Subtotal	1,469	100.0%
JOPLIN RESERVOIRS		
8	339	100.0%
Subtotal	339	100.0%
LOWER DOVE CANYON		
8	13,114	63.9%
10	7,419	36.1%
Subtotal	19,748	100.0%

Diameter (inches)	Length (feet)	Percent of Total
COOKS		
10	3,907	14.7%
14	7,339	27.5%
16	12,174	45.7%
20	243	0.9
24	2,978	11.0%
Subtotal	27,075	100.0%
TRABUCO OAKS		
4	2,968	36.6%
6	1,871	23.0%
8	3,281	40.4%
Subtotal	8,450	100.0%
TRABUCO RESERVOIRS		
2.5	95	0.3%
6	624	2.2%
8	14,297	50.7%
10	6,338	22.5%
12	6,840	24.3%
Subtotal	28,194	100.0%
UPPER DOVE CANYON		
4	256	0.3%
6	1,322	1.8%
8	47,533	64.3%
10	1,409	1.9%
12	20,056	27.1%
16	3,296	4.5%
Subtotal	74,628	100.0%
TOTAL	**284,697**	

Table 5-9
Sum of Pipe Length by Zone and Material

Material	Length (feet)	Percent of Total
HARRIS GRADE		
ACP	58,483	47.7%
DIP	3,670	3.0%
PVC	23,519	19.2%
WSP	36,863	30.1%
Subtotal	122,535	100.0%
HIGH COUNTRY		
PVC	2,995	100.0%
Subtotal	2,995	100.0%
INTERZONE		
DIP	158	10.8%
PVC	645	43.9%
WSP	666	45.3%
Subtotal	1,469	100.0%
JOPLIN RESERVOIRS		
WSP	339	100.0%
Subtotal	339	100.0%
LOWER DOVE CANYON		
DIP	7,932	38.6%
PVC	12,602	61.4%
Subtotal	20,534	100.0%

Material	Length (feet)	Percent of Total
COOKS		
ACP	2,603	9.8%
DI	2,978	11.2%
WSP	21,060	79.1%
Subtotal	26,641	100.1%
TRABUCO OAKS		
ACP	8,119	100.0%
Subtotal	8,119	100.0%
TRABUCO RESERVOIRS		
ACP	1,024	3.6%
PVC	27,170	96.4%
Subtotal	28,194	100.0%
UPPER DOVE CANYON		
ACP	955	1.3%
DIP	13,060	17.7%
PVC	59,856	81.0%
Subtotal	73,871	100.0%
TOTAL	**284,697**	**100.0%**

Figure 5-6
Pressure Zone vs. Total Length by Pipe Diameter

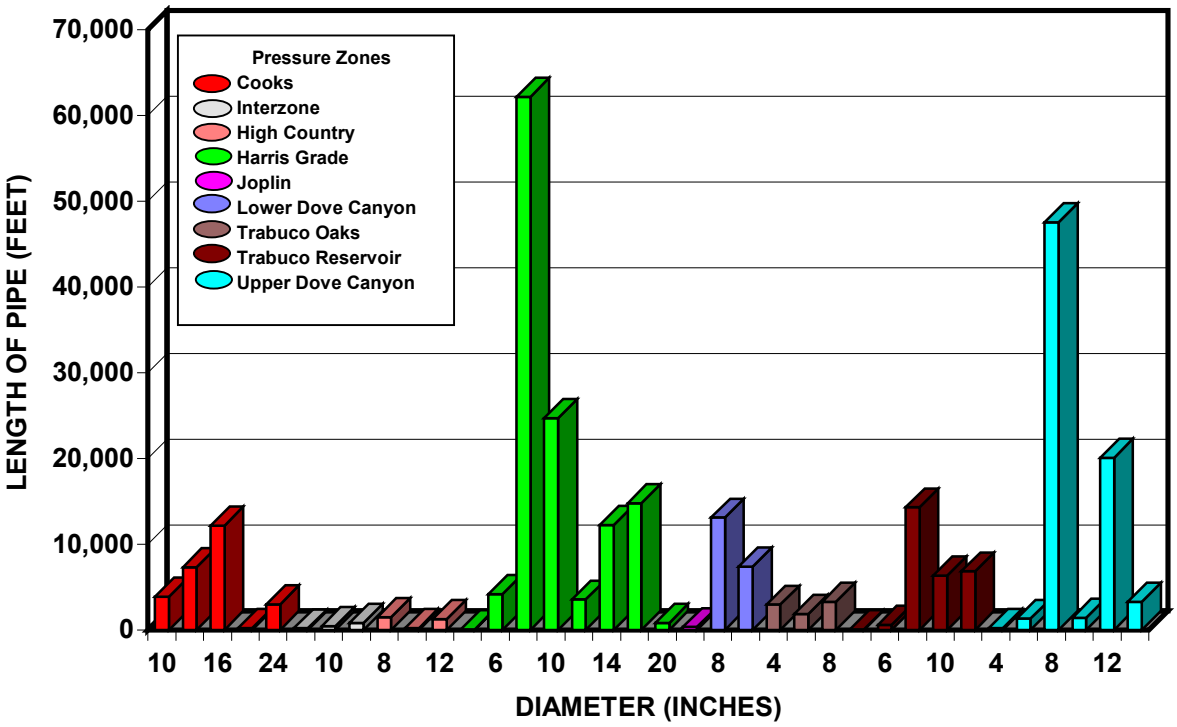
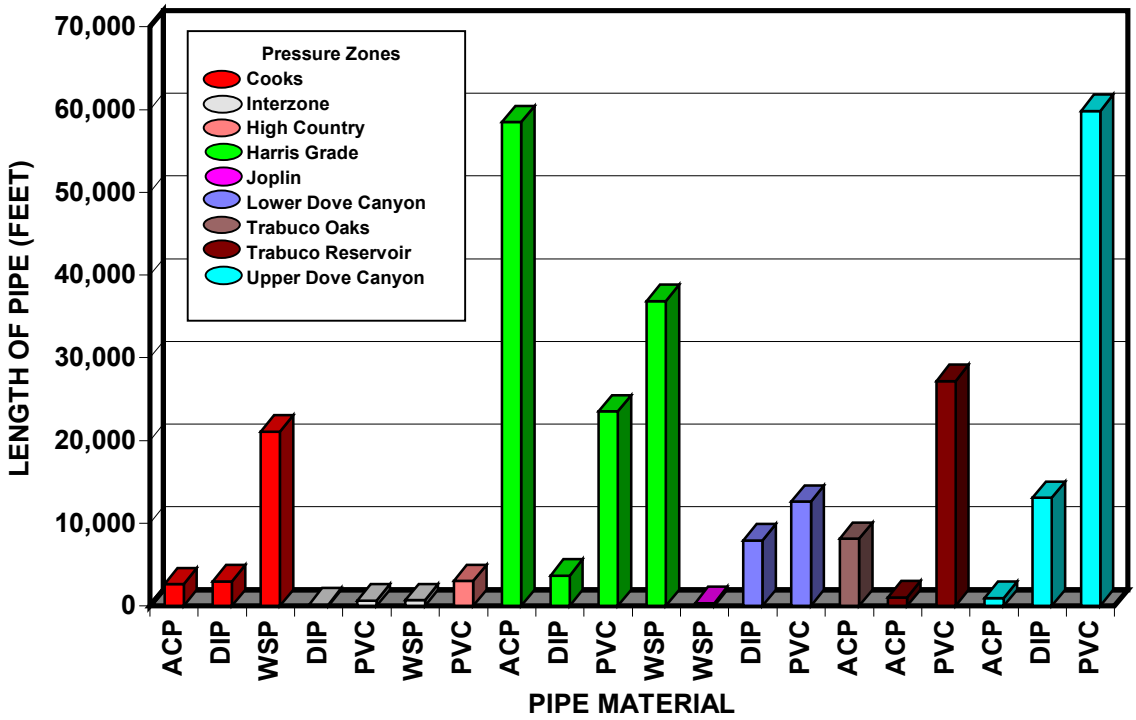


Figure 5-7
Pressure Zone vs. Total Length by Pipe Material



MODELING METHODOLOGY AND CALIBRATION

A computer model of the District's system is developed to simulate both existing and future situations to assist in the evaluation of hydraulic recommendations. The initial H_2ONET hydraulic model of the existing system was developed by District staff. This model included the DWTP, groundwater wells, reservoirs, pumps, control valves, and pipelines. The District staff developed a residential diurnal curve and had geographically located each of the residential connections to particular model nodes. In addition, the District staff identified and input initial operating control levels (based on water level in the control reservoirs) for the pump stations.

This subsection describes the additional work performed in the verification, enhancement, and calibration of the model received from the District. Differences in development techniques between the existing and future system models are discussed where applicable.

Model Verification

The model information was compared with available system information and any necessary corrections and additions were made. Pipeline configurations (connections), diameters, and materials were verified, as well as node elevations and number of assigned residential connections. Tank physical parameters and connectivity, control valve settings, and pump connections and curve data were also verified. The most up-to-date street map obtainable was incorporated into the background of the model for reference. Model elevations were all re-determined from digital terrain models and all non-residential demands were allocated according to the best available records.

Demand Allocation

Allocation of water demands to the model nodes is a critical element of ensuring an accurately calibrated network model. The methods used to allocate existing and future demands are based on the information available and the locations of future potable demands.

Existing System

The model was set up for the most recent applicable demand conditions to evaluate hydraulic deficiencies in the existing system. As 1998 was not a peak demand year due to the El Niño phenomenon, the demands were evaluated to determine the most likely current demand based on 1997 and 1998 billing records. The total existing demand was determined directly from billing records. It was assumed that there was an eight percent unaccounted for water loss and this additional water was divided equally among all model nodes.

District potable water billing records for 1997 and 1998 were obtained for all user classifications: residential, apartment, commercial, irrigation, and agricultural. Detailed monthly records for this time period, including the water use of each individual customer, were obtained for commercial, irrigation, and agricultural users. Each of these records was reviewed, and specific demands were placed on each user's model node. Therefore, each existing commercial, irrigation, and

Figure 5-8
Water System Facilities and Year of Installation

agricultural account was accounted for directly in the H_2ONET model. Residential demands were set up as per the District's original model.

Separate diurnal curves were input to the model for residential/apartments, commercial, and irrigation/agricultural as detailed in Section 2. The current uses of potable water for irrigation purposes in various locations throughout the District were incorporated into the existing system model.

Future System

As described previously, based on the selection of Alternative 2 in Section 3 of this Master Plan, the future potable water system will serve all of the potable water demands as well as some of the non-potable water demands in the North and Central areas. The South area non-potable water needs will be completely supplied by the treated effluent from the expanded RRWWTP. In addition, there will be enough treated effluent to also supply the non-potable water needs of the Nursery property in the Central area.

The non-potable water demand in the North area is an ADD of 0.22 mgd and a MDD of 0.48 mgd. This demand may be served by either potable water or by a reclaimed water pump station and piping system from Upper Oso Reservoir of SMWD. Section 7 of this Master Plan, Reclaimed Water System, recommends that the District pursue the implementation of a water exchange with SMWD to obtain the 0.48 mgd of reclaimed water supply source to serve the North area. However, in the interest of planning for alternative eventualities, this Section assumes that no arrangement can be made with SMWD and that the non-potable water use in the North must be served by potable water. This is a "worst case" assumption for the potable water system model.

The Central area non-potable water demand, with the exception of the Nursery property, is assumed to be all provided by potable water. This is an ADD of 0.32 mgd and a MDD of 0.70 mgd. Therefore, the total build-out ADD and MDD are estimated to be 3.26 and 6.49 mgd, respectively. As the current maximum supply is only 6.46 mgd (9.944 cfs), the additional water is anticipated to be obtained from the Baker Aqueduct or the AMP. For the purpose of this analysis, it is assumed that this water will be provided to the District distribution system through the DWTP.

In addition to the non-potable water needs, additional potable water demands are anticipated to be residential and each parcel in the District was allocated its appropriate build-out demand based on the EDU information presented in Section 2. Existing commercial and other non-residential demands were anticipated to maintain their current use and were so modeled.

Calibration

Model calibration is instrumental in ensuring that the developed model accurately reflects the actual field conditions. Typical EPS calibration involves collecting hourly information for a 24-hour period, referred to as the calibration day. The hourly information collected consists of flows and pressures from any original water sources such as wells, treatment plants, or interties with

other agencies, flows and pressures at pump stations, water levels in tanks and reservoirs, flows through any control valves, and any available information on system pressures outside of specific facilities.

The hourly flow information is used to determine the hourly system demands, both for the system as a whole and for any separate pressure zones for which adequate flow information is available. These demands are input to the model and, after the model is run, the measured pressures, flows, and water levels are compared with the model values to determine the adequacy of the first level of model calibration. The second level of model calibration is typically obtained from fire hydrant test data.

Flowing fire hydrants provides information that is useful in evaluating both static water system conditions (by measuring the pressure at the hydrant prior to flowing it) and dynamic water system conditions (by flowing the hydrant at a high rate to draw down the pressure in a local area and then measuring the corresponding pressure drop at a nearby hydrant). It is critical to do the fire hydrant testing during the same day as the system flow and head monitoring so that complete system operating conditions are understood for the duration of the hydrant tests. Comparison of hydrant field test pressures with model predicted pressures provides the second level of model calibration. A model is considered to be adequately calibrated when the first and second level field values are closely replicated in the model, for the same conditions.

Information Available

The District provided information from the Supervisory Control and Data Acquisition (SCADA) system on pump flows and tank levels for the day of calibration. No information on pressures was available from the SCADA system. In addition, there are no flow meters on the pressure and flow control valves so the quantity of interzone water transfers through these devices cannot be recorded. The only exception is the Plano Trabuco PRS where flow is metered for payment purposes. All groundwater wells were shut down for the calibration day, and all interties with other agencies were likewise closed. Therefore, the only water entering the District system was from the DWTP. Review of the supplied SCADA information indicated that there were inconsistencies in the reported data and that the flows and water levels reported were not useful for calibration purposes. Earlier attempts to use SCADA information to determine the diurnal demands of the Dove Canyon area required a month-long effort and the elimination of much of the reported data.

MW and District staff performed 13 fire hydrant flow tests on December 9, 1998 between 9:30 am and 3:30 PM. These hydrants were selected in the Harris Grade, Trabuco Reservoir, Trabuco Oaks, and Upper and Lower Dove Canyon pressure zones to provide second level model calibration information.

Procedures and Results

Diurnal curves as described in Section 2 were used and the total model demand was adjusted to match the total water production experienced during calibration day. As mentioned above, the detailed SCADA data could not be used for the calibration effort, but maximum static pressures

for each pressure zone were determined from maximum reservoir water levels and from assumed PRS settings.

Appendix C presents information on the test locations and the calibration results. It was confirmed that the model was providing reasonable results in that the model controls were causing the pumps to turn on and off when the controlling tank water level changed to the appropriate elevation. In addition, the tank water levels and system pressures were also reasonable for the time of year and operational methodologies.

In zones that are completely controlled by PRSs, the modeled PRS settings were adjusted to represent the static pressures recorded during the fire hydrant testing procedure more accurately. In addition, the hydrant testing results indicated that the closed pipeline between High Country and Upper Dove Canyon pressure zones was actually further west than was previously indicated (on Weeping Willow near the intersection with Via Del Lago instead of between Weeping Willow and High Country). This resulted in HGLs of 1,203, 1,560, 1,356 and 1,244 feet for the Trabuco Oaks, High Country, Lower Dove Canyon East and Lower Dove Canyon West pressure zones, respectively and also resulted in complete agreement between the field data and the model in these areas.

In the zones not directly controlled by PRSs, namely the Harris Grade, Trabuco Reservoir, and Upper Dove Canyon, the modeled and field values agreed within acceptable tolerances. Considering that there was a scarcity of accurate hourly pump and reservoir field information and that the field measurements were obtained in the low-demand portion of the year, the model is considered to be adequately calibrated for master planning purposes. More detailed data gathering with respect to system performance is recommended prior to utilizing the model as an operational tool.

HYDRAULIC PLANNING CRITERIA

The purpose of this section is to define the criteria to be used in the evaluation of the hydraulic models of the existing and future water systems. The planning criteria presented here are based on typical criteria used by similar water purveyors, local codes, and commonly accepted industry standards. The “industry standards” are typical ranges of acceptable values for the criteria and are utilized more as a check to confirm that the values being developed are reasonable.

Several system evaluation criteria are important for this project including adequacy of water sources, system pressures, maximum pipeline velocities, water storage volumes, fire fighting capabilities, and back-up power and equipment for emergency purposes. A summary of the recommendations for system criteria to be used is presented in **Table 5-10**, and each of the criteria are discussed in more detail following.

Water Source Production

The District’s contractual rights to enough water to supply MDD under build-out conditions was addressed in Section 4 of this Master Plan. This section evaluates the ability of District facilities to actually provide that water to customers.

According to the American Water Works Association (AWWA), the California Department of Health Services (DHS), and common engineering practice, a water system should be able to provide enough source water to supply the system's MDD with the largest pump or water producing facility out of service.

Table 5-10
Recommended Water System Criteria

Description	Value	Units
Water Source Production	Capacity to meet MDD without largest pump[1]	
Maximum System Pressure	120	psi
Minimum System Pressure		
Peak Hour	40	psi
Maximum Day plus Fire	20	psi
Maximum Pipeline Velocity		
Peak Hour	7	fps
Maximum Day plus Fire	10	fps
Storage Volume		
Operational	10 hours at MDD	MG
Fire (maximum of 4 hours at 4,000 gpm)	0.96	MG
Emergency: Earthquake[2]	7 days at 0.5*ADD	MG
Emergency: Metropolitan Outage[2]	7 days at ADD	MG
Fire Fighting Capabilities[3]		
Single Family Residential (2 hours)	1,500	gpm
Public/Quasi-Public (3 hours)	2,500	gpm
Multi-Family Residential (2 hours)	3,000	gpm
Commercial (3 to 4 hours)	3,500 to 4,000	gpm

Notes: 1. Available capacity equal to the largest pump, in the form of another pump or emergency connection to another water system, should be available.
2. The more severe of the two emergency conditions provides the governing criteria.
3. Fire flow volumes can be met from a combination of pumps and reservoirs.

System Pressures

Acceptable system pressures are typically determined by several criteria including what has been acceptable to customers in the past and what the District's goals are for the system in general. System pressures will be evaluated under two scenarios: peak hour and maximum day plus fire. Pressures are considered to be acceptable if they are less than 120 psi under any circumstances, if they are at least 20 psi during the average hour of the maximum day with a fire occurring, and if they are at least 40 psi during the peak hour of the maximum day.

The range of pressures listed above, between 40 and 120 psi except during a fire, is the District's goal for optimum service. This range is not a critical limit, such that facility improvements will

be recommended for nodes with pressures slightly lower or higher than the limits, but is a desired goal. Areas that cannot meet the goal will be identified and improvements for areas that are unacceptably out of tolerance will be recommended. Marginal areas will be evaluated on a case-by-case basis to determine their severity. It is understood that some areas within the District, notably the Trabuco Canyon area within Harris Grade zone, experience pressures higher than the maximum acceptable. These areas will be reviewed for potential re-zoning. Nodes adjacent to storage reservoirs, wells, and pump stations where services are not present will be ignored for pressure evaluation purposes.

Pipeline Velocities

Distribution system pipeline velocities will be evaluated based on both peak hour and maximum day plus fire flows. In addition, other factors will be considered when developing recommendations for improvements to existing pipelines. These factors include the amount of leaks historically experienced, system reliability, and the phasing of scheduled improvements for other facilities such as pumps, tanks, and control valves.

Two criteria are typically evaluated with respect to analyzing the adequacy of pipelines; headloss and velocity. Headloss is measured in feet of headloss per 1,000 feet of pipeline length and velocity is measured in feet per second (fps). One of these criteria is selected as the governing criteria and, based on economics and on typical industry practices, maximum limits are set separately for normal operations and for fire fighting conditions. Based on previous experience, it is recommended that a maximum velocity of seven and ten fps for peak hour and fire fighting conditions, respectively, would be appropriate.

As described above for pressure criteria, staying within the accepted pipeline velocity goals is desirable, but marginal velocities are not reason enough to recommend that pipelines be improved. Areas that exceed the listed criteria will be identified and improvements will be recommended for areas that are unacceptably out of tolerance.

Storage Volume

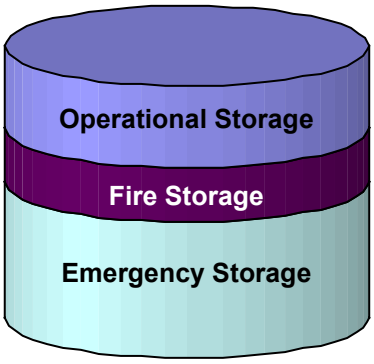
The total required volume of storage in a water system consists of water for operational, emergency, and fire fighting uses. The three components of treated water storage are shown graphically in **Figure 5-9**. **Figure 5-9** also depicts the relative elevations of the three storage components within a storage tank, assuming the tank is supplying water to its respective zone by gravity. This is the case for all of the District's tanks. All storage tank sizing calculations are done with consideration of all three components. Storage volumes can be supplied by either storage reservoirs, additional source water beyond MDD (groundwater, additional WTP capacity, water from interties), or a combination of the two.

Operational Storage

Operational storage is the quantity of water required to moderate daily fluctuations in demand beyond the capabilities of the production facilities. The production rates of the water sources and the available storage capacity are coordinated to provide a continuous treated water supply.

Based on economic considerations, water source production systems are often designed to produce the average flow on the day of maximum demand. Water must be stored to supply the difference between the peak demands and the capacity of the water sources. Operational storage is then replenished during off-peak hours when the demand is less than production. Lacking specific diurnal system demand information, AWWA recommends supplying a volume equal to one-quarter of the demand experienced during one maximum day (six hours at MDD).

Figure 5-9
Typical Components of Treated Water Storage



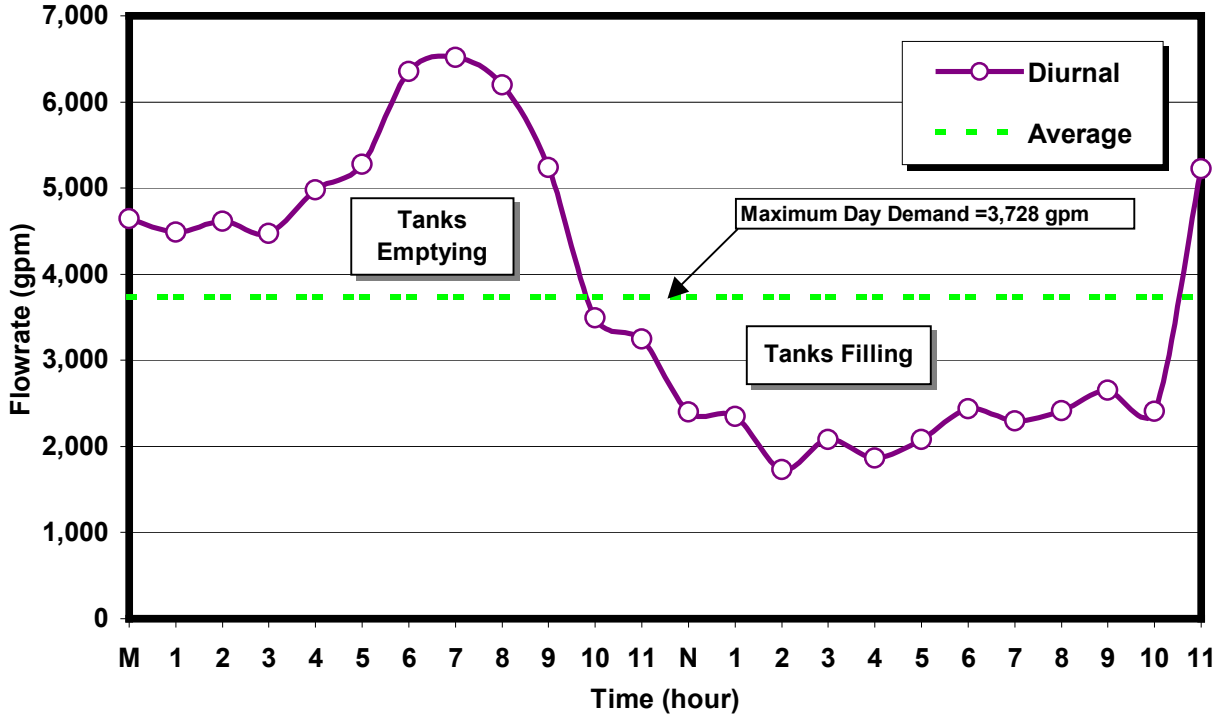
However, the quantity of operational storage required can be determined directly from a combination of the system-wide maximum day diurnal demand curve and the quantity of source water available on a continuous basis during maximum day. A graphical representation of the existing system-wide diurnal demand information for the District is shown in **Figure 5-10**. The dashed line in this figure corresponds to the average demand on the maximum day. This average demand is the total amount of source water needed spread equally throughout the day. The cyclical solid line is the hourly system demand; a combination of the hourly demands of residential, apartment, commercial, irrigation, and agricultural demands, and represents a summation of the hourly quantity of water needed. During the hours of the day when system demands are less than source water production (10:00 am to 10:30 PM) treated water would be stored, and during the hours when system demands are greater than source water production (10:30 PM to 10:00 am) stored water would be provided to the system to assist in meeting system demands. The treated water that is stored to supply water during peak hourly periods is referred to as operational water.

Fire Protection Storage

Water storage for fighting fires in the District is regulated in quantity by the Orange County Fire Authority (OCFA). Requirements are given in terms of flow rates for a given duration. For example, the minimum fire protection required is 1,500 gpm for two hours. Fire protection requirements are based on, among other things, the area of buildings, building uses (shopping mall, residential, etc.), type of building construction, and the separation between buildings.

Typical master planning practice is to assume that fire protection requirements are based on the respective land use or zoning classification (i.e. single- or multi-family residential, commercial,

Figure 5-10
System-Wide Diurnal Curve



industrial, etc.) for a particular area. The requirements for each zoning classification are determined based on the OCFA requirements, but analyses for individual buildings is not conducted on a master planning basis.

According to conversations with the Deputy Fire Marshall of Planning and Development for Orange County, the OCFA typically evaluates fire protection requirements on a case-by-case basis and does not provide requirements based solely on land use or zoning classification. The Deputy Fire Marshall could not give a specific value and duration for the amount of fire protection necessary for each location in the District, because she would need to know the details about each particular structure to be protected. She did state that the OCFA gives a credit for buildings with sprinkler systems of one-half of the fire protection flow rate.

Required fire flows and durations for the respective District zoning classifications were developed and reviewed by the OCFA. A summary of these requirements is presented in **Table 5-11**. A summary of the fire flow requirements within the District, by location, are shown in **Figure 5-11**.

According to the Insurance Services Organization (ISO), required fire flows may be met by any combination of pumping and storage. A 1,500 gpm fire for two hours would require 180,000 gallons, a 2,000 gpm fire for three hours would require 360,000 gallons, and a 4,000 gpm fire for four hours would require 960,000 gallons of water. Water stored for fire fighting purposes may also, by use of PRSs or bypass pipelines, be available to fight a fire occurring in a lower pressure

zone, and booster pump stations can provide water to assist in combating a fire in an upper pressure zone. This ability to "share" water allocated to meet fire flow requirements leads to a calculation of storage volumes which is not constrained by pressure zone boundaries.

Table 5-11
Fire Flow Requirements By Zoning Classification

District Zone Description	OCFA Zone Description	Flow (gpm)	Duration (hours)	Volume (gallons)
Open Space/Conservation	Open Space	0	0	0
10 Ac/du	Single Family Residence	1,500	2	180,000
4 Ac/du	Single Family Residence	1,500	2	180,000
2 Ac/du	Single Family Residence	1,500	2	180,000
1.00 – 1.99 Ac/du	Single Family Residence	1,500	2	180,000
Less than 1 Ac/du	Single Family Residence	1,500	2	180,000
Less than 1 Ac/du - outside	Single Family Residence	1,500	2	180,000
Public/Quasi-Public	Public Facilities	2,500	3	450,000
Commercial Residential	Local Business	3,000	3	540,000
Community Commercial	General Business	3,000	3	540,000
Community Commercial - outside	General Business	3,000	3	540,000
Standard Concrete[1]	Commercial - Industrial	4,000	4	960,000

Note: 1. A larger fire protection flow is required for this commercial establishment.

Emergency Storage

The volume of water allocated for emergency uses is typically determined based on the historical record of emergencies experienced and on the amount of time expected to lapse before an anticipated emergency can be corrected. Possible emergency situations include events such as water contamination, earthquakes, loss of electrical power, several simultaneous fires, and other unplanned events. Because the occurrence and magnitude of an emergency situation is not subject to a direct evaluation, the volume of emergency storage is generally based upon engineering judgment and/or utility policy.

Based on our experience with Southern California water agencies and on conversations with District staff, two governing potential emergency scenarios have been identified. These two emergency scenarios are (1) Metropolitan Water District (Metropolitan) raw water aqueduct outage and (2) an earthquake. It is assumed that these emergencies will not happen simultaneously. Each of these scenarios are presented in additional detail below.

MWD Raw Water Aqueduct Outage. Metropolitan reserves the right to take the raw water aqueduct out of service for up to seven days with adequate warning. Based on anticipated timing of potential aqueduct outages, Metropolitan has required that each member agency shall be able to continue to provide adequate water for their customers assuming that water from the aqueduct will not be available for a period of time equivalent to the demand experienced during seven

Figure 5-11
Fire Flow Requirements

average days (ADD x 7). It is assumed that the AMP treated water source will not be affected by the raw water aqueduct outage.

Earthquake. The effects of an earthquake in the Trabuco Canyon area could potentially sever all connections with outside water sources. Based on Montgomery Watson's historical experience with master planning other earthquake-prone areas, it is recommended that adequate emergency water be provided to be able to supply one-half of the ADD for a period of seven days, without any connections to other water systems. As an earthquake is an emergency that is immediately recognizable by all of the populace, it is assumed that water demands can be minimized under these conditions, irrespective of the time of year.

Pump Stations

Any new pump stations recommended should include (at a minimum) three pumps, each at half of the required flow, to increase operator flexibility. This arrangement is superior to two pumps, each capable of producing the maximum required flow, because it allows operators to turn on half of the total needed flow for non-peak operating situation.

EXISTING SYSTEM EVALUATION

The existing system evaluation is composed of several independent analyses. These analyses include a review of hydraulic evaluations such as pressure zone delineations, source water delivery capacity, treated water storage volumes, booster station capacities, adequacy of control valves, and adequacy of pipelines to meet peak hour and fire protection requirements. In addition, non-hydraulic evaluations including recommendations determined from field investigations and inspections are presented. A summary of each of these analyses are presented in this section.

Pressure Zones

The only pressure zone that requires modifications is the High Country zone.

High Country

This recommended pressure zone modification is located where the Trabuco Reservoir, High Country, Harris Grade, and Upper Dove Canyon zones come together. As the elevations increase along Robinson Ranch Road, from Plano Trabuco Road up to the Trabuco Reservoirs site, the pressure zone changes from Harris Grade to Trabuco Reservoir. There is a band of services on each side of Robinson Ranch Road that are too high to be adequately served from the Harris Grade zone and too low to be served from the Trabuco Reservoir zone. At peak hour, the Harris Grade HGL is as low as 1,420 feet in this area and so could serve elevations up to a minimum of 1,325 feet with water at 40 psi. The Trabuco Reservoirs provide a static pressure of approximately 120 psi at an elevation near 1,400 feet and so elevations lower than this would exceed the pressure limits. A straight-forward solution is to expand the High Country zone. This zone is provided water through a PRS directly downstream from the Robinson Ranch Booster Station. Increasing the current setting of 95 to 100 psi would provide an HGL of about 1,510 feet

resulting in static pressures between 120 and 40 psi for elevations between 1,233 and 1,418 feet, respectively.

The District has received complaints of low pressure in the upper reaches of the Upper Dove Canyon pressure zone, near the Rancho Cielo development. Adjusting the pressure zone boundary between the revised High Country and Upper Dove Canyon would alleviate this problem. This modification to the High Country pressure zone boundary can be made by closing several valves and by the addition of approximately 1,150 linear feet of eight-inch diameter pipeline. The recommended pressure zone modifications are shown in **Figure 5-12**.

Source Water

As described in Section 3, the District has more than enough water available to serve existing demands. Source water capacity of 6.46 mgd is available which is more than adequate to provide the existing MDD of 5.78 mgd. Under the MDD situation, it is assumed that the DWTP and the Plano Trabuco intertie with SMWD will provide 3.86 and 1.92 mgd, respectively.

In the District's situation, the largest source water pump is the 300 hp booster pump at the DWTP. There is currently no back-up for this pumping capacity and, based on the criteria of needing to be able to supply MDD with the largest pump out of service, it is recommended that a spare 300 hp pump and motor be kept in stock as a back-up. However, implementation should be deferred until a decision is made on the future use of the Baker Aqueduct as discussed in **Section 4**.

The District also relies on water from SMWD through the Plano Trabuco intertie. There are two booster pumps at this pump station; 200 and 100 hp with 1,800 and 900 gpm capacity, respectively. As the District requires approximately 1,300 gpm (1.92 mgd) from this connection during MDD, an outage of the larger pump would result in a source water deficit of 400 gpm. Providing an additional 400 gpm (50 hp) pump would ensure that the District could meet existing MDD with the largest pump out of service, but may not be adequate for future demands with the 200 hp pump out of service. Based on conversations with District staff regarding customary use of this pump station during historical maximum days, the recommended improvement would best be implemented in conjunction with any future recommendations. Therefore, no improvements are recommended under existing conditions. Future improvements are discussed later in this Section.

Improvements necessary for the Rose Canyon and Lang Wells as source water are described in Section 4. These wells are not counted on as a reliable source because the water available can not be guaranteed to be available. However, when water is available it should be used as it is much less expensive than other water sources.

Storage Volumes

The required storage volumes for operational, fire fighting, and emergency purposes have been analyzed and the results are presented here. In addition, the District has requested an investigation into the ability of the system to provide adequate storage if all water service

Figure 5-12
High Country Pressure Zone Modifications

connections crossing Trabuco Creek are washed out (major flood condition). The recommendations for this condition are also presented in this section.

Operational

Existing conditions consist of ADD and MDD of 2.69 and 5.37, respectively. These demands include both potable uses and non-potable uses that are currently served by potable water. Based on the diurnal information presented in **Figure 5-10**, 2.23 MG of treated water is necessary to provide operational storage requirements during a maximum day demand of 5.37 mgd.

Fire Protection

The largest fire anticipated in the District is 4,000 gpm for four hours at the Standard Concrete facility. Based on this, a required fire protection treated water storage volume of 960,000 gallons (0.96 MG) is required. Standard Concrete has requested switching its water service to LAWD. If this takes place, the maximum fire flow within the District would be reduced to 3,000 gpm for 3 hours. This would reduce the fire storage requirement to 0.54 MG. The pump station and control valve evaluation presents an evaluation of the system's capability of supplying the fire protection storage to the area of need.

Emergency

Two emergency storage conditions are evaluated: 1) Metropolitan Raw Water Aqueduct Outage and 2) Earthquake or other similar catastrophic outage.

MWD Raw Water Aqueduct Outage. Metropolitan requires seven average days of storage for maintenance outages. An outage of the raw water aqueduct, also known as the Baker Aqueduct, would result in the DWTP not receiving any water to treat. The District would continue to receive treated water from the AMP, transported through SMWD pipelines and entering the distribution system at the Plano Trabuco booster station. As the maximum water available through the Plano Trabuco intertie is 4 cfs, or 2.6 mgd, and as the existing ADD is 2.69 mgd, seven days of ADD would be seven days at 0.09 mgd or 0.63 MG.

Earthquake. In the event of an earthquake, there is no guarantee that all storage tanks, pumps, control valves, and pipelines will be undamaged enough to continue to provide water. However, under the assumption that District facilities will be in working order but that it will be impossible to obtain any water from outside the District, either raw or treated, it has been estimated that storage adequate for providing seven days at one-half of ADD will be acceptable. This is a total volume of 9.4 MG.

Treated Water Storage Volume Recommendations

The summation of the operational, fire, and emergency treated water storage requirements is 12.59 MG. The total existing treated water storage is 9.98 MG leaving a deficiency of 2.61 MG. The additional treated water storage in the Joplin Reservoir zone, not owned by the District, does not factor into the required storage volume on a system-wide basis. This water is only applied

towards a fire in the Joplin Reservoir zone and does not reduce the overall fire protection requirement.

The selection of the location for this additional treated water storage is important to the proper distribution of water in the distribution system. Without creating additional pressure zones, the locations available for adding treated water storage are the existing reservoir locations, namely (1) Cooks, (2) Harris Grade, (3) Joplin, (4), Rose Canyon, (5) Trabuco, and (6) Upper Dove Canyon. Cooks and Rose Canyon are immediately dropped from consideration because the Harris Grade tank site provides a direct supply to these tanks through PRSs, and Joplin is discarded as a choice because it serves a specific need and would not benefit from additional storage. The Upper Dove Canyon tank only serves the Dove Canyon area and any additional storage placed in this zone could not be utilized elsewhere. The water stored at the Trabuco Reservoir site can be used in the Trabuco Reservoir Zone and, through the use of bypass valves and piping, in the High Country, Dove Canyon, and portions of the Harris Grade Zones. However, this water cannot be used in the upper reaches of the Harris Grade Zone and there is already more than enough water at this site to serve the needs of the surrounding area. Therefore, it is recommended that the additional 2.61 MG of treated water storage be constructed at or near the existing Harris Grade site. If the Harris Grade site is used, the District should consider demolishing the existing 0.42 MG Harris Grade No. 2 and constructing a 3.0 MG reservoir at the site.

Trabuco Creek Crossing Outage

This condition would effectively separate the South and Plano Trabuco areas from the North and the bulk of the Central areas. The evaluation of this “emergency” scenario is based on the assumption that Metropolitan will not schedule a raw water outage during this condition. Under this assumption, the treated water storage needed is a summary of that necessary for operational, fire, and an earthquake. An earthquake or a major flood event may very well be the cause of the Trabuco Creek outage.

North of Trabuco Creek. Based on the previously stated assumptions, the area north of Trabuco Creek would need operational, fire, and emergency volumes of 0.28, 0.96, and 1.19 MG for a total treated water storage volume of 2.43 MG. The existing treated water storage volume of 2.98 MG is more than adequate to meet this need. If the Trabuco Creek was out and the DWTP remained in service then the approximately 3.8 mgd of treated water capacity would be of great advantage in continuing to provide service to areas north of Trabuco Creek.

South of Trabuco Creek. The area south of Trabuco Creek would similarly need treated water storage volumes of 1.95, 0.45, and 8.21 MG for a total treated water storage volume of 10.61 MG. The existing treated water storage capacity of 7.0 MG would be insufficient to meet this requirement. If the AMP connection remained in service when the Trabuco Creek was out then an additional 4 cfs (2.6 mgd) would be available. In addition, if the SMWD was unaffected by the Trabuco Creek outage then an additional 2 cfs (1.3 mgd) could be purchased and provided through the Zone 4 connection. This would result in a storage volume of 7.0 MG and a treated

water input of 3.9 mgd, which should be adequate to meet the total storage volume requirement of 10.61 MG.

Booster Stations

Booster stations were evaluated for their ability to pass the flows normally required for their situation, for being able to operate adequately with the largest pump out of service, and for being able to pass any required fire flows. The DWTP and Plano Trabuco booster pumps were evaluated above, therefore this analyses is concerned with the Larchmont, Ridgeline, El Toro Rd., Rose Canyon, and Robinson Ranch booster stations, as well as the secondary pressure zones described below.

The Topanga Canyon Road secondary pressure zone needs to be able to supply 1,500 gpm for two hours or the equivalent of 180,000 gallons of treated water storage. As this zone has a fire pump capacity of 1,620 gpm, no improvements are necessary. The Falcon St. secondary zone has been permitted to require only 1,000 gpm of fire protection for two hours. An agreement has been reached such that both the District and SCWD will each provide 500 gpm to the Falcon St. zone in the event of a fire. This meets the required fire flow for this zone. The Canyon Creek secondary zone has a fire protection requirement of 2,500 gpm for three hours due to the presence of the Trabuco Community Church. Currently, there is only a 300 gpm fire pump available. Therefore, a 2,200 gpm fire pump (300 hp) along with a diesel generator is recommended for this pressure zone. All evaluations of secondary pressure zones assume that adequate water is available to supply the fire pumps.

Larchmont

The Larchmont booster station provides water from ETWD to the Cooks Reservoir zone of the District. As this connection provides the vehicle for obtaining water from ETWD in the event of an emergency, there is no need for redundant pumps. However, an on-going maintenance program should be in effect so that this pump can operate in an emergency situation. There are no fire protection requirements for this pump station.

El Toro Road and Ridgeline

The combination of these two pump stations provides a boost to all water leaving the DWTP and entering the District distribution system. These pumps boost water to the Harris Grade Reservoirs, from which the water is distributed to the rest of the system. The existing MDD requirement of 5.78 mgd (4,014 gpm) is met by the combined pumping capacity of 5,400 gpm. The pumping capacity with the largest pump out of service (1,350 gpm) is still 4,050 gpm, which exceeds the MDD requirement. Therefore, no modifications are necessary at the El Toro and Ridgeline booster stations. In the event of a fire, water stored in Harris Grade and other reservoirs will be adequate to provide the water needed.

Rose Canyon. The Rose Canyon booster pump station currently fills the Joplin Boys Ranch storage tanks and operates approximately once per week. The pump station contains complete redundancy with two pumps each capable of supplying 180 gpm at the required TDH. This is

more than adequate capacity to provide all normal flows. The Joplin Boys Ranch area is zoned as Public/Quasi-Public, requiring 2,500 gpm for three hours or 450,000 gallons. Sprinklers are scheduled for installation in fiscal year 2000, which would reduce the required fire protection, by half, resulting in a need for 225,000 gallons of storage. The existing Joplin Reservoir has a capacity of 80,000 gallons and the two non-District treated water storage reservoirs provide an additional 155,000 gallons for a total treated water storage volume of 235,000 gallons. In addition, the two Rose Canyon booster pumps operating at 180 gpm for three hours would provide 64,800 gallons giving a grand total of 299,800 gallons. Therefore, adequate treated water storage exists for this zone. Power to the Rose Canyon pump station is provided through a single feed up Rose Canyon Road. In the event of a fire, this power connection may not be operational. It is recommended that a diesel generator be installed to provide power to the booster pumps in such an emergency.

Attention should be paid to the Joplin Reservoir zone with respect to ensuring that the required fire protection storage volume is always available. Assuming the Rose Canyon booster pumps are in operation in the event of a fire, it is critical to ensure that a minimum of 150,200 gallons of water (450,000 gallons required minus 299,800 gallons available) is available at all times for fire protection to the Joplin Reservoir zone.

Robinson Ranch

This booster pump station currently includes two identical pumps, each sized at 50 hp and 450 gpm. The MDD in the Trabuco Reservoir and High Country zones is currently about 470 gpm, indicating that the booster pumps are slightly undersized for the anticipated demand. In addition, the recommended changes in pressure zones will increase the amount of water necessary to be pumped at this booster station due to the expansion of the High Country zone. The anticipated MDD following zone expansion is approximately 650 gpm. Due to the increase in demand, an additional flow of 200 gpm is necessary. This could be supplied by the addition of a 25 hp booster pump to meet the incremental demand increase and to allow for the largest booster pump to be out of service while still providing water at the MDD rate.

Pipelines

Pipeline recommendations are driven by three considerations: (1) pressure zone modifications, (2) peak hour demands, and (3) fire protection. Many of the low pressure problems under peak hour conditions, the high pressure problems under normal conditions, and the areas of inadequate fire protection are solved by the modifications to pressure zones. The pipelines necessary for pressure zone modifications are shown graphically in **Figure 5-12**. Following the pressure zone improvements, there are no additional pipeline improvements necessary to provide adequate water during peak hour demands.

With respect to providing adequate protection during a fire, there are only two locations that are in question following the pressure zone reconfiguration. These are (1) north along Santiago Canyon Road and (2) along Mountain View Road in the Trabuco Oaks zone. The District recently installed 3,300 feet of 12-inch diameter pipeline, parallel to the existing 8-inch diameter pipeline, north along Santiago Canyon Road from the intersection of Santiago Canyon Road with

Live Oak Canyon and El Toro Roads. One existing property under development is the Zadeh property for which the OCFA has stated that 1,000 gpm of fire protection will be adequate. The computer model confirmed that, with the recent 12-inch pipeline addition, 550 gpm will be available from the District to the Zadeh property. This development has also secured 500 gpm of available water for fire fighting conditions from the SCWD system.

The second location, near the peak of Mountain View Road in the Trabuco Oaks zone, can only provide approximately 1,300 gpm during a fire instead of the required 1,500 gpm. Two options are available to remedy this situation, replacing the six-inch diameter pipeline that supplies the area at the peak of Mountain View Road with an eight-inch diameter pipeline (approximately 700 feet), or constructing 800 feet of new eight-inch diameter pipeline from Trabuco Canyon Road, along Mountain View Road, to intersect with the existing 6-inch diameter pipeline in Mountain View Road. This alternative would require another PRS, but would provide additional redundancy to the Trabuco Oaks zone, and is therefore recommended.

Control Valves

Only one additional PRS is required, as described above in the Pipeline discussion. In addition, all control valves should have their settings confirmed and, where more than one control valve supplies a single pressure zone, it should also be confirmed that the valve settings are coordinated with each other. The control valves supplying water to the Trabuco Oaks zone; the Upper, Middle, and Lower Trabuco control valves, should all have pressure settings equivalent to a hydraulic grade of about 1,230 feet. The Plano Trabuco control valve is currently at the appropriate setting of 109 psi, equivalent to approximately 1,416 feet. The Bell Canyon and Sycamore Canyon control valves both supply water to the Lower Dove Canyon zone and should have setting equivalent to a HGL of 1,255 feet. As part of the rezoning of the High Country zone, the High Country control valve should have a pressure setting of 100 psi, equivalent to a HGL of 1,511 feet. Finally, it should be ensured that the Weeping Willow PRV, currently inoperative in the Harris Grade zone, remains locked open so that flow can pass freely through it.

Field Investigations and Inspections

Montgomery Watson met with District staff on April 6, 1998 to identify data immediately available and data needed to be located. On April 20, 1998 Montgomery Watson conducted a detailed inspection of the District's potable water system. A summary inspection report was developed for each facility. The reports detail the present condition of each facility providing information on the interior and exterior conditions, intended function, capacities and sizes, materials, types of pumps, valves and meters, and general remarks of the overall facility condition. Recommendations and comments are also presented in the reports. The reports include photographs displaying the general location and condition of each corresponding facility.

A summary of comments comprised from this investigation are presented in **Table 5-12.** The complete summary, along with photographs of facilities, are submitted in a separate document to this Master Plan. **Table 5-12** also includes improvements made to facilities since the date of inspection.

Table 5-12
Summary of Inspection from Field Investigation

Facility	Comments
Dimension WTP	In good condition, filters backwashed directly from distribution system.
Ridgeline BS	In good condition.
El Toro Rd. BS	Equipment in good condition.
Inter-ties	In good condition.
Larchmont BS	In good condition.
Plano Trabuco BS	In good condition.
Rose Canyon Res. and BS	Pumps in average mechanical condition. Some denting of reservoir visible near ground level.
Canyon Creek BS	Pumps recently repainted and are in average electrical condition. Hydropneumatic tank is newly painted.
Harris Grade Res.	In average condition.
Trabuco Res.	Some rust on tanks should be touched up and re-coated. Asphalt recently repainted. Water present was due to run-off.
Dove Canyon Res.	In good condition.
Lang Well	In average mechanical and good electrical condition.
Rose Canyon Wells	In good condition.
U.S. Well	In average mechanical and electrical condition.

The District has retained Aqua Video Engineering Inspections to inspect the treated water storage tanks. A summary of the results of these inspections is given in **Table 5-13**. **Table 5-13** also includes recommendations by District staff for necessary reservoir improvements.

FUTURE SYSTEM EVALUATION

Pressure Zones

A single pressure zone modification is suggested for the build-out condition. This is the addition of an Upper Harris Grade Zone.

In the North and Central areas, the District provides water service, at a minimum pressure of 40 psi, up to an elevation of approximately 1,390 feet. Currently, the Harris Grade tanks can not provide adequate pressure to developments along the upper elevations of Live Oak Canyon Road, the Hamilton Truck Trail, and Santiago Canyon Road. Booster pump stations coupled with hydropneumatic tanks are required to serve areas at higher elevations. Several of these hydropneumatic zones are already in service, notably the Canyon Creek, Falcon St., and Topanga Canyon Road zones. The District has set out hydraulic criteria for these hydropneumatic zones, including pressure and fire protection guidelines that are followed by the contractor constructing homes in the respective areas.

It is not advisable to attempt to serve all locations in the North and Central areas from primary pressure zones as the topography rises too high. Service to some areas will need to continue to be

Table 5-13
Summary of Tank Inspection Recommendations

Date[1]	Reservoir	Volume (MG)	Recommendations
1/30/95	Dove Canyon	2.5	Coating is in good condition. Reservoir recently cleaned. Repair damaged areas on side walls. Cathodic protection appears to be good.
1/16/96	Trabuco No. 1	1.5	Coating is in good condition except for crazing and blistering near ladder. Reservoir recently cleaned. Cathodic protection appears to be good.
1/16/96	Trabuco No. 2	3.0	Coating is in good condition. Reservoir recently cleaned. Cathodic protection appears to be good.
1/16/96	Harris Grade 1	2.0	No action necessary.
11/20/96	DWTP	0.08	No action is recommended for coating correction.
6/17/97	Rose Canyon	0.42	Recoat inside and out, earthquake-proofing, and an OSHA-approved ladder.
3/4/98	Harris Grade 2	0.42	Needs interior coating, earthquake-proofing, and an OSHA-approved ladder (if not demolished for new tank).
3/5/98	Cooks	0.06	Needs interior coating, earthquake-proofing, and an OSHA-approved ladder.

Note: 1. Date of most recent inspection.

provided through secondary, or hydropneumatic, pressure zones. However, the District owns land in the northeast corner of the Saddleback Meadows property that is at a higher elevation than the Harris Grade Reservoirs. This land is at an elevation of approximately 1,600 feet and was obtained with the intention of constructing a treated water reservoir to serve higher elevation properties. Utilizing a reservoir at this location, referred to as the Upper Harris Grade location, would provide a minimum of 40 psi to properties at elevations of 1,508 feet and lower and could directly serve areas down to an elevation of approximately 1,350 feet with water at a maximum pressure of 120 psi.

One idea was to remove the existing Harris Grade Reservoirs and relocate all of the treated water storage capacity to the Upper Harris Grade site. The problem with this is that the lowest elevations of Harris Grade Zone are near the O'Neill Park region and currently experience pressures on the order of 200 to 250 psi. Raising the HGL in the Harris Grade Zone would result in increased pressures in this area and the potential need for replacement of existing pipelines with higher pressure pipelines. Another option that could be pursued if the Harris Grade Reservoirs were relocated would be to serve the O'Neill Park region through PRSs installed in Live Oak Canyon and Trabuco Canyon Roads. This option was discarded because it would reduce the system reliability and negatively impact the HGL in the eastern portion of the Harris Grade Zone by forcing all water through the pipeline in the Hamilton Truck Trail instead of through both the Hamilton Truck Trail and the Live Oak/Trabuco Canyon Roads pipelines.

Therefore, it is recommended that a new pressure zone be created, the Upper Harris Grade Zone. This would require a booster pump station to be constructed at the Harris Grade Reservoirs site, along with additional pipelines and a new Upper Harris Grade Reservoir located on the District's property in the Saddleback Meadows property. It is anticipated that these improvements would be constructed in tandem with the development of the Saddleback Meadows property. The service area possible to be served by the Upper Harris Grade Zone is shown in **Figure 5-13**. Not all areas within the possibly served sphere are recommended for service from this zone, specifically the isolated area shown in the northeast edge of the service area and the northeast "extension" of area, also in the northeast.

The implementation of the Upper Harris Grade Zone would allow water to be served directly from a primary zone to areas both north and south of the Hamilton Truck Trail. In addition, the Canyon Creek and Topanga Canyon Rd. secondary pressure zones could be eliminated if pipeline connections were made to them. The alignment would dictate the construction of pipelines down easements and potentially across properties and so it is recommended that the implementation of secondary zone consolidation be left to the discretion of developers. The District is providing water to customers and potential customers along the major streets within the service area. It is up to individual developers to utilize this water in an acceptable fashion to serve their construction needs.

Source Water

As described in Section 3, the District will not be using all available water to meet anticipated demands. The build-out MDD will be 6.67 mgd and the existing source water capacity is 6.91 mgd, leaving a surplus of 0.24 mgd. Under the build-out MDD situation, it is assumed that the DWTP and the Plano Trabuco intertie with SMWD will provide 3.84 and 2.35 mgd, respectively. Supply to the District's Portola Hills customers from IRWD would be 0.48 mgd under build-out MDD conditions.

Under build-out conditions, the District will be utilizing nearly all of the 2.60 mgd (4 cfs) available through the Plano Trabuco intertie with SMWD. There are currently two booster pumps at this pump station, one 200 hp, 1,800 gpm pump and one 100 hp, 900 gpm pump. Since the 1,800 gpm pump is equivalent to the entire 2.60 mgd, an additional pump with a capacity of 900 gpm should be added to this booster station for redundancy. This would bring the total reliable capacity of the booster station to 1,800 gpm. The District should purchase a spare 100 hp pump and motor to be kept in stock in the event of a pump failure.

Storage Volumes

Recommendations for identical situations as previously outlined for the existing system are presented here for the build-out conditions. This includes a summation of recommendations for operational, fire protection, and emergency treated water storage requirements as well as an evaluation of the effects on the distribution system of an outage of the Trabuco Creek crossing.

Operational

Build-out conditions consist of ADD and MDD of 3.37 and 6.72 mgd, respectively. These demands include all of the potable water demands plus the non-potable water demands that cannot be provided reclaimed water from the RRWWTP. Based on the District's diurnal water use pattern, 2.79 MG of treated water is necessary to provide operational storage requirements during a maximum day demand of 6.72 mgd.

Fire Protection

Fire protection requirements are not anticipated to increase as the District approaches build-out. The largest fire anticipated in the District is 4,000 gpm for four hours. Based on this, a required fire protection treated water storage volume of 960,000 gallons (0.96 MG) is required. As discussed earlier, the transfer of Standard Concrete to LAWD could reduce the fire storage requirement to 0.54 MG. The pump station and control valve evaluation presents an evaluation of the system's capability of supplying the required fire protection volume to the area of need.

Emergency

MWD Raw Water Aqueduct Outage. Metropolitan requires seven average days of storage for maintenance outages. An outage of the Baker Aqueduct would result in the DWTP not receiving any water to treat. The District would continue to receive treated water from the AMP, transported through SMWD pipelines and entering the distribution system at the Plano Trabuco booster station. As the maximum water available through the Plano Trabuco intertie is 4 cfs, or 2.6 mgd, and as the existing ADD is 3.37 mgd, seven days of ADD would be seven days at 0.77 mgd or 5.39 MG.

Earthquake. In the event of an earthquake, there is no guarantee that all storage tanks, pumps, control valves, and pipelines will be undamaged enough to continue to provide water. However, under the assumption that District facilities will be in working order but that it will be impossible to obtain any water from outside the District, either raw or treated, it has been estimated that storage adequate for providing seven days at one-half of ADD will be acceptable. This is a total volume of 11.8 MG.

Treated Water Storage Volume Recommendations

The summation of the operational, fire, and emergency treated water storage requirements is 15.55 MG. The total existing treated water storage will be 12.59 MG after implementation of the existing system recommendations, leaving a deficiency of 2.96 MG. It is recommended that approximately 3.0 MG of additional storage be constructed at the tank site owned by the District in the new Upper Harris Grade Zone to be created. This maximizes the ability of the District to provide water to any zone in need, in most cases without the need for additional pumping. However, many other combinations of storage volumes (totally 5.61 MG) between the Harris Grade and Upper Harris Grade zones would be acceptable, as long as sufficient water is provided in the Upper Harris Grade zone to satisfy emergency, fire, and operational requirements.

Figure 5-13
Upper Harris Grade Pressure Zone

Trabuco Creek Crossing Outage

This condition would effectively separate the South and Plano Trabuco areas from the North and the bulk of the Central areas. The evaluation of this "emergency" scenario is based on the assumption that Metropolitan will not schedule a raw water outage during this condition. Under this assumption, the treated water storage needed is a summary of that necessary for operational, fire, and an earthquake. An earthquake may very well be the cause of the Trabuco Creek outage.

North of Trabuco Creek. Based on the previously stated assumptions, the area north of Trabuco Creek would need operational, fire, and emergency volumes of 1.47, 0.96, and 6.13 MG for a total treated water storage volume of 8.56 MG. The treated water storage volume would consist of the existing 2.98 MG plus the recommended storage volumes of 2.61 and 3.00 MG for a total of 8.59 MG which is more than adequate to meet this need. If the Trabuco Creek was out and the DWTP remained in service then the approximately 3.8 mgd of treated water capacity would be of great advantage in continuing to provide service to areas north of Trabuco Creek.

South of Trabuco Creek. The area south of Trabuco Creek would similarly need treated water storage volumes of 1.32, 0.45, and 5.67 MG for a total treated water storage volume of 7.44 MG. This requirement is reduced from that determined for the existing system because the non-potable water uses currently provided water from the potable system are anticipated to receive their water from the RRWWTP treated effluent under build-out conditions. The existing treated water storage capacity of 7.0 MG would be slightly inadequate to meet the treated water storage requirement. If the AMP connection remained in service when the Trabuco Creek was out, then an additional 4 cfs (2.6 mgd) would be available. The combination of water from treated water storage and the AMP should be adequate to meet the total storage volume requirement of 7.44 MG.

Booster Stations

As described in the evaluation of the existing system, booster stations were evaluated for their ability to pass the flows normally required for their situation, for being able to operate adequately with the largest pump out of service, and for being able to pass any required fire flows. The DWTP and Plano Trabuco booster pumps were evaluated above; therefore, this analyses is concerned with the Ridgeline, El Toro Rd., Rose Canyon, and Robinson Ranch booster stations. In addition, a new booster pump is needed to lift water from the Harris Grade Reservoirs to the new Upper Harris Grade Reservoir. The secondary pressure zone fire fighting requirements are not expected to change from the existing conditions, and assuming the existing system recommendations are implemented, there is no need for additional improvements to the Falcon St., Topanga Canyon Rd., and Canyon Creek zones.

El Toro Road and Ridgeline

The build-out MDD demand of 6.72 mgd is anticipated to be met by 2.6 mgd from the Plano Trabuco pump station and the remainder, 4.12 mgd (6.34 cfs or 2,862 gpm) from the DWTP. Therefore, the pumping capacity of the El Toro and Ridgeline booster pump stations, with the largest pump out of service (1,350 gpm), is 4,050 gpm, which exceeds the MDD requirement.

Therefore, no modifications are necessary at the El Toro and Ridgeline booster stations. In the event of a fire, water stored in Harris Grade and other reservoirs will be adequate to provide the water needed.

Rose Canyon

No additional facilities are needed for the Rose Canyon booster station beyond those recommended for the existing system.

Robinson Ranch

The recommendation for existing system improvement was the addition of a 25 hp booster pump to provide an additional 200 gpm of flow. At build-out, the MDD in the Trabuco Reservoir and High Country zones is anticipated to be approximately 730 gpm. This is an increase of 280 gpm over the existing demand and only 80 gpm over the anticipated existing system demand after pressure zone restructuring. The total additional booster pump power required to provide build-out MDD flows is approximately 30 hp. Therefore, it is recommended that a 30 hp instead of 25 hp pump be added to the Robinson Ranch Booster Pump Station initially to avoid future minor additions.

Upper Harris Grade

A booster station with reliable capacity equal to the anticipated MDD of the area being served is required. The approximate anticipated service area is shown in **Figure 5-13** and the maximum anticipated MDD at build-out is approximately 290 gpm. With a TDH of approximately 200 feet, the total pump station power requirement is on the order of 50 hp. It is recommended that this be divided among three pumps for operator flexibility.

Pipelines

Recommended pipeline additions are in relation to the development of a new pressure zone, the Upper Harris Grade (UHG) zone. The hydraulics of this zone were evaluated under both maximum day plus fire and peak hour conditions. Based on the results of the analyses, eight-inch diameter pipelines would be adequate in all locations. The recommended pipeline additions are shown in **Figure 5-13** and are summarized in **Table 5-14**.

Under the existing conditions, an agreement is in place such that the SCWD will provide 500 gpm to the suction side of the Zadeh development fire pump station in the event of a fire. The other 500 gpm will come from the District. Other developments along Santiago Canyon Road require 1,500 gpm of fire protection and some of them cannot obtain this protection from the existing distribution system. Providing 1,500 gpm at 20 psi residual during maximum day demands is necessary along Santiago Canyon Road up to where the Adams property begins. Pipeline improvements are necessary from the juncture of where the 12-inch diameter new pipeline ends in Santiago Canyon Road (3,300 feet north of the intersection with Live Oak Canyon and El Toro Roads). With no improvements, 930 gpm is available at 20 psi at the south end of the Adams property. It is necessary to continue the 12-inch diameter pipeline in Santiago

Canyon Road to its intersection with the Shimomura property to provide the required flow and pressure at the Adams property. Therefore, approximately 2,300 feet of 12-inch diameter pipeline is needed in Santiago Canyon Road for fire protection. Protection at nearby properties at higher elevations would require additional improvements to be made by the property developers.

Control Valves

No control valve additions or modifications are anticipated.

SUMMARY OF EXISTING AND BUILD-OUT RECOMMENDATIONS

This section summarized the recommendations provided earlier for both existing and build-out conditions. These recommendations are in the categories of source water, treated water storage, booster pumps, control valves, and pipelines. Pressure zone modifications are not explicitly listed but are recommended through implementation of a combination of the above facilities. Each recommendation is accompanied by a brief explanation of the reason why the recommendation was made. A summary of the recommendations is presented in **Table 5-14**, including the page number in this report where the recommendation was originally made.

In some instances, a recommendation made for the existing system is overridden by a recommendation for the build-out system. This is due to the desire to make improvements to the system based on a global understanding of ultimate requirements. A graphical presentation of recommended system improvement locations is presented in **Figure 5-14**.

Table 5-14
Summary of Existing and Build-Out Recommendations

Facility Description	Recommendation		Comment	Page
	Existing	Build-Out		
Source Water				
DWTP Booster Pump	300 hp	None	Spare pump and motor for redundancy	5-32
P T Booster Pump	None	100 hp	Spare pump and motor for redundancy	5-41
Treated Water Storage				
Harris Grade Site	2.61 MG	None	For Ex. System Needs[2]	5-35
Harris Grade No. 2	Various	None	Recoat, EQ-proof, and OSHA ladder[2]	5-40
Upper Harris Grade Site	None	3.00 MG		5-42
Rose Canyon	Various	None	Recoat, EQ-proof, and OSHA ladder	5-40
Cooks	Various	None	Recoat, EQ-proof, and OSHA ladder	5-40
Booster Pump				
Rose Canyon Diesel Generator	100 hp	None	Fire protection for Joplin	5-37
Canyon Creek Fire Pump	300 hp	None	At build-out, entire zone can be served by Upper Harris Grade zone.	5-36
Robinson Ranch	30 hp	None	Additional 5 hp added now for build-out	5-37, 5-46
Upper Harris Grade	None	50 hp	Supply new Upper Harris Grade Reservoir	5-46
Control Valve				
Harris Grade to Trabuco Oaks	8-in	None	Fire Protection	5-38
Pipeline				
Mountain View Rd, 8-in.	800 ft.	None	Fire Protection.	5-38
Santiago Canyon Rd, 12-in.	None	2,300 ft.	Required for Fire Protection	5-48
Via Del Lago St., 8-in.	510 ft.	None	High Country Zone modification between Weeping Willow St. and Via Del La Luz	5-32
Via Del Lago St., 8-in.	640 ft.	None	High Country Zone modification; Via Del La Luz to Via Del Sol.	5-32
Booster Station piping, 8-in	None	400 ft.	Suction and discharge; UHG zone.	5-46
Live Oak Canyon Rd, 8-in	None	1,700 ft.	Edgar 4-S to Truck Trail; UHG zone.	5-46
Live Oak Canyon Rd, 8-in	None	2,740 ft.	Truck Trail to Canyon Cr.; UHG zone.	5-46
Hamilton Truck Trail, 8-in	None	5,300 ft.	Live Oak to Trabuco Oak; UHG zone.	5-46
Easement, 8-in	None	1,160 ft.	Live Oak to UHG Res.; UHG zone.	5-46
Easement, 8-in	None	2,500 ft.	UHG Res. to Canyon Cr.; UHG zone.	5-46
Canyon Creek Prop., 8-in	None	3,050 ft.	On Canyon Cr. Property; UHG zone.	5-46

Note: 1. EQ = Earthquake.
2. Alternatively, Harris Grade No. 2 could be demolished and a 3.0 MG reservoir installed instead of a 2.6 MG reservoir.

Figure 5-14
Recommended Water System Improvements

Section 6
Wastewater System

This section presents the results of an evaluation of the District's wastewater facilities including both the sewer collection system and the wastewater treatment plant. For the sewer collection system, a computer model using Eagle Point software has been developed that includes trunk mains, major street laterals, and sewage lift stations. Each set of facilities is discussed in detail below. A map of the sewer system, that also indicates the location of the Robinson Ranch Wastewater Treatment Plant (RRWWTP), is shown in **Figure 6-1**. **Figure 6-2** shows the year of construction of the wastewater facilities based on available District data and records.

EXISTING WASTEWATER COLLECTION SYSTEM

The District's sewer collection system consists of three zones that are served by gravity sewers, and lift stations. Similar to the water system, this wastewater collection system serves only a portion of the entire service area. The wastewater service area includes Robinson Ranch, Dove Canyon, and the El Toro Road system. There are portions of the service area located in Trabuco Canyon and other isolated properties that have individual sewage treatment systems (septic tanks). Significant areas within the District service area are undeveloped and are not currently served.

The District owns and operates the RRWWTP, which has a current design capacity of 0.85 mgd. The District also owns 0.558 mgd of capacity in SMWD's wastewater collection system and Chiquita Water Reclamation Plant. Of the 0.558 mgd total, 0.13 mgd is reserved for the Robinson Ranch and Dove Canyon areas, with 0.428 mgd reserved for the El Toro Road area. Several property owners in the District have purchased capacity in the El Toro Road system amounting to 0.270 mgd with the District owning the remaining 0.158 mgd for its Portola Hills customers.

Collection Zones

The District's sewer system consists of three collection zones: El Toro Road, Robinson Ranch and Dove Canyon. The separation of the sewer system into collection zones was based on "trunk and branch" boundaries where all flows entering laterals or mains within a zone are conveyed to a single trunk line or force main leaving a zone. **Figure 6-1** notes the boundaries of the collection zones and **Figure 6-3** presents a flow schematic diagram illustrating the flow relationship between collection zones. **Table 6-1** provides a summary of the existing collection zones.

El Toro Road Zone

The El Toro Road Collection Zone receives wastewater flows from the District, SMWD and IRWD. This wastewater flows into the jointly-owned El Toro Road Sewage Collection System, which includes a gravity sewer in El Toro Road, the El Toro Road Sewage Lift Station and a dual

force main in Santa Margarita Parkway to the SMWD wastewater system. The District owns a total capacity of 1.12 mgd in the El Toro Road System and 0.428 mgd in the SMWD Chiquita sewage system including collection, treatment (Chiquita Water Reclamation Plant) and disposal (Chiquita Land Outfall and SERRA Ocean Outfall). IRWD owns 0.76 mgd of capacity in the El Toro Road system and 0.642 mgd in the SMWD system. SMWD owns 0.08 mgd of capacity in the El Toro System. The total system capacity is 1.96 mgd; however, annual flow is limited by the total capacity currently owned in the SMWD wastewater treatment and disposal capacity of 1.15 mgd.

Table 6-1
Existing Sewer Collection Zones

Name	Minimum Elevation (feet)	Maximum Elevation (feet)
El Toro Road	740	1,400
Dove Canyon	965	1,290
Robinson Ranch	1,140	1,500

This zone consists of a gravity system that converges to a 10-inch diameter gravity sewer trunk located in Santiago Canyon Road and then to a 12-inch diameter trunk that transitions to a 15-inch diameter gravity sewer trunk located in old El Toro Road (bike trail). All wastewater conveyed through this gravity system flows to the El Toro Road Sewer Lift Station. At this lift station, sewage flows are pumped through one of two parallel force mains, 8 and 12-inches in diameter, and discharged into a 15-inch diameter gravity sewer in Santa Margarita Parkway, which is a component of the SMWD system. Currently, flows are pumped through the 8-inch diameter force main. As flows increase to the ultimate capacity of the lift station, the 12-inch diameter force main will be used for peak flows with the 8-inch diameter pipeline serving as backup and also used for low flows.

The Zadeh Sewer Lift Station is located in the northwestern area of this collection zone. There is a high point in Santiago Canyon Road about 1/2 mile from the service area boundary. Wastewater generated in this area is collected at the Zadeh lift station and pumped through a 2-inch force main to an 8-inch gravity sewer at the top of the grade. Wastewater flows southeast along Santiago Canyon Road and eventually to the collector in El Toro Road.

As of June 1999, SMWD has 233 EDUs feeding the El Toro Road zone at Valley Vista, while the IRWD has 1,596 EDUs feeding into the El Toro Road zone at Glenn Ranch Road. The District currently has 629 EDUs served by this system. Measured flows in the El Toro System averaged 547,000 gpd in June 1999 including IRWD and SMWD units.

Dove Canyon Zone

The Dove Canyon collection zone consists of a set of gravity sewers that convey sewage flows to three integrated lift stations: (1) Bell Canyon, (2) Barneburg, and (3) Golf Club. As shown in **Figure 6-3**, the Bell Canyon and Barneburg Sewer Lift Stations collect flows and pump them

Figure 6-1
Existing Sewer System Facilities

11x17

Figure 6-2
Sewer System Facilities – Year of Installation

11x17

Figure 6-3
Sewer System Schematic

directly to the Golf Club Sewer Lift Station via 8-in diameter force mains, which in turn pumps flows directly to the RRWWTP through an 8-inch diameter force main.

Robinson Ranch Zone

The Robinson Ranch collection zone consists of a gravity system that conveys flows to three integrated lift stations: (1) Via Alegre, (2) Plano Trabuco, and (3) Heritage. As shown in **Figure 6-3**, these lift stations act in series while also collecting additional gravity flows. The Via Alegre Sewer Lift Station collects flows conveyed by the gravity sewers serving the development areas of O'Hill, Dove Canyon Center, northwestern portion of Dove Canyon Development, Walden (formerly Brock), and Rancho Cielo and pumps to the Plano Trabuco Sewer Lift Station via a 6-inch diameter force main. The Plano Trabuco Sewer Lift Station pumps Via Alegre flows plus additional gravity flows collected from the western portion of the Robinson Ranch area through an 8-inch diameter force main to the Heritage Sewer Lift Station. The Heritage Sewer Lift Station pumps Plano Trabuco flows plus additional gravity flows collected from the remaining portions of the Robinson Ranch area through a 10-inch diameter force main to RRWWTP.

Pipelines

The District's sanitary sewer system currently includes gravity pipelines ranging from 8- to 15-inches in diameter, with the oldest piping dating to circa 1985. The most common construction materials for the sewer pipelines have been vitrified clay and polyvinyl chloride (PVC). Recent manholes have been constructed of pre-cast concrete where older manholes may have been constructed of mortar and brick. The mortar and brick type manholes are rare, and few, if any, exist in this system. Force mains are constructed of polyvinyl chloride (PVC) C900 pipe, with some portions being ductile iron.

Sewer Lift Stations

As noted above, the District currently operates eight sewer lift stations. The locations of these lift stations are shown in **Figure 6-1**. Relevant data for each lift station are listed in **Table 6-2** and a brief description of each lift station is given below.

Via Alegre Sewer Lift Station

This sewer lift station has a submersible pump configuration, with two pumps each having an average capacity of 105 gpm. The lift station is equipped with both a surge protection system for the 6-inch diameter force main and a diesel-driven electric generator to provide standby power in the event of a power failure or other interruption of electrical service. This lift station is a part of the Robinson Ranch Zone and pumps flows to the Plano Trabuco Road Sewer Lift Station through a 6-inch diameter force main. This pump station handles approximately 35 percent of the total sewage generated within the Robinson Ranch Zone.

Plano Trabuco Sewer Lift Station

This lift station has a wet pit/dry pit configuration with three pumps installed in the dry pit. The average capacity of each of the three pumps is 650 gpm. The lift station is equipped with a diesel-driven electric generator to provide standby power to the pumps in the event of a power failure or other interruption of electrical service. This lift station is a part of the Robinson Ranch Zone and pumps both gravity and pumped flows from the Via Alegre Sewer Lift Station to the Heritage Sewer Lift Station through an 8-inch diameter force main. This pump station handles approximately 65 percent of the total sewage generated within the Robinson Ranch Zone. At this lift station, there is a gravity bypass to divert wastewater to the SMWD collection system for eventual treatment at the Chiquita Water Reclamation Plant.

Table 6-2
Sewer Lift Station Data

Name	Pump No.	Zone	Ground Elevation (ft)	Power (hp)	Nominal Capacity		Standby Power or Capacity	Data Available[1]
					Flow (gpm)	Head (ft)		
Plano Trabuco	1-1	Robinson Ranch	1,167	50	614	125	Electrical Generator, Gravity Bypass	P,E
	1-2			50	717	102		
	1-3			40	628	150		
Heritage	2-1	Robinson Ranch	1,247	25	288	NA	None – Gravity Bypass	P,E
	2-2			50	367	125		
	2-3			40	600	102		
El Toro	3-N1	El Toro Road	740	100	850	169	Four-150 hp diesel-driven pumps	P,E
	3-N2			100	850	125		
	3-S1			100	850	169		
	3-S2			100	850	125		
Via Alegre	4-1	Robinson Ranch	1,097	30	98	100	Electrical Generator	P
	4-2			30	111	99		
Golf Club	5-1	Dove Canyon	1,037	50	600	92	Electrical Generator	P,C,E
	5-1a			50	600	243		
	5-2			50	600	141		
	5-2a			50	600	240		
Barneburg	6-1	Dove Canyon	995	25	232	125	Electrical Generator	P,E
	6-2			25	201	125		
Bell Canyon	7-1	Dove Canyon	977	15	148	90	Electrical Generator	P,E
	7-1a			20	148	110		
	7-2			15	92	90		
	7-2a			20	92	110		
Zadeh	8-1	El Toro	1,375	2	30	75	None	E
	8-2			2	30	75		

Notes: 1. E = TCWD Efficiency Test, C = Manufacturer's Test Curve Data, P = Plans, NA = No Data

Heritage Sewer Lift Station

This lift station has a wet pit/dry pit configuration with three centrifugal pumps in the dry pit. The capacity of the largest pump is 600 gpm. This lift station is not equipped with any backup

diesel pumps or electrical generator. However, the piping and valving in the lift station is capable of diverting sewage flows back through the 8-inch Plano Trabuco Sewer Lift Station force main at approximately 200 to 300 gpm. Under such conditions, the flows would be diverted into the SMWD system via the bypass present at the Plano Trabuco Sewer Lift Station. This lift station is a part of the Robinson Ranch Zone and pumps both gravity and pumped flows from the Plano Trabuco Sewer Lift Station to the RRWWTP through a 10-inch diameter force main. The gravity flows collected at this lift station account for essentially all sewage generated within the Robinson Ranch Zone.

Zadeh Sewer Lift Station

This lift station has a submersible pump configuration with two pumps rated at 30 gpm each. This lift station is located at the intersection of Falcon Drive and Santiago Canyon Road and is part of the El Toro Road Zone. It collects flows from the northwestern most part of the service area and discharges through a 2-inch diameter force main into an 8-inch gravity sewer in Santiago Canyon Road.

El Toro Road Sewer Lift Station

This lift station has a dry pit/wet pit configuration with two separate wet wells and a single dry pit. Each wet well has one pair of electrical centrifugal pumps that operate in series and one pair of diesel engine-driven pumps for standby capacity. The capacity of the lift station is about 1,700 gpm. The lift station is equipped with both gaseous chlorine for odor control and a dual force main surge protection system. This lift station pumps flows from the El Toro Road Zone to a 15-inch diameter gravity line located in Santa Margarita Parkway that is part of the SMWD system. Sewage flows are pumped through one of two parallel force mains, 8 and 12-inches in diameter, and discharged into a 15-inch diameter gravity sewer in Santa Margarita Parkway, which is a component of the SMWD system. Currently, flows are pumped through the 8-inch diameter force main. As flows increase to the ultimate capacity of the lift station, the 12-inch diameter force main will be used for peak flows with the 8-inch diameter pipeline serving as backup and also used for low flows.

Barneburg Sewer Lift Station

This lift station has a submersible configuration with two pumps, each with an average capacity of 215 gpm. The lift station is equipped with a gaseous chlorine odor control system and a surge protection system for the 6-inch force main. The lift station has a diesel-driven electrical generator to provide standby power to the pumps in the event of a power failure or other interruption of electrical service. This lift station is a part of the Dove Canyon Zone and pumps flows to the Golf Club Drive Sewer Lift Station.

Bell Canyon Sewer Lift Station

This lift station has a submersible configuration with two sets of pumps working in series. Each pair of pumps has an average capacity of 120 gpm. The lift station is equipped with a gaseous chlorine odor control system and a surge protection system for the 6-inch force main. The lift

station has a diesel-driven electrical generator to provide standby power to the pumps in the event of a power failure or other interruption of electrical service. This lift station is also a part of the Dove Canyon Zone and pumps flows to the Golf Club Drive Sewer Lift Station through a 6-inch diameter force main.

Golf Club Drive Sewer Lift Station

This lift station has a wet pit/dry pit configuration. There are two pairs of pumps that work in series. Each set consists of a submersible pump in the wet well, which discharges to a centrifugal pump in the dry pit. The capacity for each pair of pumps is 600 gpm. The lift station is equipped with a surge protection system for the 8-inch diameter force main. It also has a diesel-driven electrical generator to provide standby power to the pumps in the event of a power failure or other interruption of electrical service. This lift station is the primary lift station in the Dove Canyon Zone and pumps both gravity and pumped flows from the Barneburg and Bell Canyon Sewer Lift Stations directly to the RRWWTP through an 8-inch diameter force main.

ROBINSON RANCH WASTEWATER TREATMENT PLANT

The RRWWTP treats flows collected in the Robinson Ranch and Dove Canyon Zones of the District's sewer system. The RRWWTP is an activated sludge-type treatment plant utilizing sequencing batch reactors (SBRs). The treatment plant is equipped with tertiary wastewater treatment facilities consistent with Title 22 for unrestricted irrigation. The plant currently operates under a zero surface discharge criteria where all flows are reclaimed or spray irrigated. Disposal of collected sewage flows is accomplished in one of three ways as follows:

- Treated effluent can be reclaimed through irrigation of the Dove Canyon golf course and other greenbelt areas when reclaimed water demands are high. Reclaimed water flows can be augmented as necessary with fresh water or recycled water from Dove Lake during peak demands.
- Treated effluent can be conveyed through the RRWWTP headworks back through the 10-inch Heritage Sewer Lift Station force main and the 8-inch Plano Trabuco Sewer Lift Station force main to the Plano Trabuco Sewer Lift Station where the flow can be diverted to the SMWD collection system.
- Raw sewage can also be diverted directly into the SMWD sewer system through the gravity bypass at the Plano Trabuco Sewer Lift Station.

The RRWWTP has a capacity of 0.85 mgd in its current configuration. However, the plant has treated influent flows of up to 1.20 mgd while meeting Title 22 discharge limits. The Regional Water Quality Control Board, San Diego Region (RWQCB) currently has permitted the plant to operate at 1.1 mgd under Order 92-67. Current flows average 0.74 mgd.

The facilities at the RRWWTP can be separated into the main line flow process unit facilities and the solids stabilization and handling facilities. **Figure 6-4** shows the overall site plan for the RRWWTP including the on-site reclaimed water reservoir. **Figure 6-5** presents a layout of the plant processes.

Figure 6-4
Robinson Ranch WWTP Site Plan

Figure 6-5
Robinson Ranch WWTP Existing Facilities Layout

Main Line Flow Facilities

The main line flow facilities at the Robinson Ranch plant consist of a climber screen, influent Parshall flume, primary equalization tanks, sequencing batch reactors, secondary effluent equalization tank, filter influent pump station, dual media pressure filters, disinfection and reclaimed water reservoir. Each of these processes and facilities are discussed below.

Climber Screen

Wastewater from the Golf Club Drive and Heritage Sewer Lift Stations flow through a climber screen unit following discharge from the force mains. The climber screen unit consists of a rotating climber screen, which removes rags and other material for land disposal. The climber screen facility, including the discharge location for the two force mains, is covered and provided with foul air ventilation that is connected to a common carbon absorption unit designed for the climber screen and influent flow meter units. The climber screen is also equipped with pre-chlorination for odor control.

Influent Parshall Flume Flow Meter

The influent flow meter consists of a 6-inch diameter throat width Parshall flume. Flows are conveyed to and from the Parshall flume by 12-inch diameter pipelines. The flow range capacity of the 6-inch diameter flume is 0.035 to 2.53 mgd. This facility is covered and provided with foul air ventilation as discussed above.

Primary Equalization Tanks

The primary flow equalization tanks equalize the primary influent flow before it enters the SBRs. The equalization tanks utilize the basins that previously functioned as aerobic digesters. Raw influent flows are conveyed to two, in-line raw influent flow equalization tanks that have a total volume of 155,000 gallons. Under normal operations, the equalization tanks are operated in-line. However, valving on the 12-inch influent line can be configured to provide a bypass around the primary equalization tanks. The tanks are equipped with a single 1,100 gpm equalization pump that feeds the secondary treatment process. In addition, mixing jets are provided in the equalization tanks to prevent sedimentation. Both tanks are covered and provided with foul air ventilation for odor control.

Sequencing Batch Reactors

There are two SBRs that operate in a two-stroke mode. Each SBR is equipped with a Wyss fine air diffuser system, a jet air system, a decanter, and a sludge removal manifold. Each SBR reactor tank has a volume of 450,000 gallons.

Under the two-stroke mode of operation, a given reactor fills with raw influent, is aerated and mixed, and then is allowed to be quiescent for settling solids. The normal operation of the SBRs for this two-stroke mode is as follows:

1. Fill/Aerate – 2.5 hours
2. Aerate/No Additional Influent – 1.0 hour
3. Settle/Air shut off – 1.0 hour
4. Decant to Secondary Effluent Equalization Basin – 45 minutes

The normal high water operating level in the SBRs is 15.0 feet where the pressure blowoffs on the blowers are set at 15.5 feet of water. The decant level currently is set at 10.5 feet. Solids settled in the reactor following treatment are wasted during the decant portion of the cycle and are conveyed to the aerobic digesters.

Each SBR has two dedicated aeration systems: Wyss fine air diffusers and jets. Each system has a dedicated blower for each SBR with a positive displacement blower connected to the jet air system to provide agitation within each SBR and a dedicated centrifugal blower connected to the fine air diffusers to provide process aeration within each SBR. The positive displacement blowers are rated at 30 hp each, and the centrifugal blowers are rated at 60 hp each. Each dedicated blower system is hard-connected to its respective aeration system. Standby air for process aeration can be provided by a 40 horsepower blower normally used to aerate the aerobic digesters.

Secondary Effluent Equalization Tank

Treated secondary effluent from the SBRs is conveyed to a secondary effluent equalization tank. This tank has a volume of 200,000 gallons.

Filter Influent Pump Station

A filter influent pump station pumps flows from the secondary effluent equalization tank to the dual media pressure filters. This pump station consists of two pumps each with a design capacity of 600 gpm and a TDH of 115 feet. The force main is equipped with in-line alum injection and flash mixing.

Dual Media Pressure Filters

The filtration units are dual media pressure filters containing 12 inches silica sand and 24 inches of anthracite coal. The filter bank consists of six filters, three vertical and three horizontal. Each filter has a capacity of 100 gpm with all six filters in service and a capacity of 125 gpm each with one filter unit out of service. These capacities correspond to filter loading rates of 2.0 and 2.5 gpm/ft^2, respectively. Although no dedicated flocculation is provided prior to the filters, District staff has noted that adequate flocculation is provided in the headspace of the filters. The backwash cycle for the filters is based strictly on a pre-determined frequency, where each filter is manually backwashed once per day. Filter backwash can be conveyed to either a spent backwash surge tank or the influent flow meter box immediately downstream of the flow meter.

Disinfection

Treated effluent disinfection at the plant is achieved with gaseous chlorine. However, the District is currently in the process of converting to a sodium hypochlorite feed system. The chlorine contact units follow the filters where the units are equipped with a flash mixer. The total volume of the existing chlorine contact tank is 105,000 gallons. Currently, 120 pounds per day of chlorine is added at the chlorine contact tank for effluent disinfection.

Reclaimed Water Reservoir

The treated, disinfected effluent from the RRWWTP enters a man-made, open reservoir formed by an earthen dam. The reservoir has a volume of 130 acre-feet. The District has the capability of augmenting the supply using local runoff water collected in Dove Lake and pumped to the reclaimed system. Supplemental water can also be obtained from the potable water system through a 6-inch diameter supply line with an air gap.

Solids Stabilization and Handling Facilities

Solids stabilization facilities consist of aerobic digestion and belt press dewatering. Each of these processes is described below.

Aerobic Digestion

Solids generated in the SBR process are aerobically digested in a 402,000 gallon aerobic digester. A single submersible pump is used for both sludge pumping and decanting. The aerobic digester is equipped with a Wyss fine air diffuser air system. Under normal operations, digester air is supplied by a 40 horsepower blower. However, in the event that this 40 horsepower blower is required to provide air to the SBRs, then two standby 15 horsepower blowers can be operated to provide air to the aerobic digesters on an emergency basis.

Belt Press Dewatering

Solids dewatering at the plant is accomplished using a belt filter press. A single one-meter press is installed in a solids handling building located on site. The building is equipped with a polymer feed system for use in conjunction with the sludge dewatering and a dedicated foul air control system. The belt press currently produces solids at 14-18 percent concentration. Solids are stored in sludge bins prior to being trucked off-site for disposal in landfills or composting yards. The belt press is currently operated approximately 8 hours per week.

Wastewater System Facility Inspection

On April 27, 1998, Montgomery Watson conducted a detailed inspection of the District's wastewater system. A summary report, including photographs, was developed for each facility. The reports detail the present condition of each facility providing information on the interior and exterior conditions, intended function, capacities and sizes, materials, types of pumps, valves and meters, and general remarks of the overall condition of the facility. Recommendations and

comments are also presented in the reports. Included with the reports are photographs displaying the general location and condition of each corresponding facility. A tabular summary of recommendations based on the report information is presented in **Table 6-3**.

Table 6-3
Wastewater Facility Inspection Summary

Facility Name	Comment	Recommendation
El Toro Sewer Lift Station	Facility in excellent condition.	
Golf Club Drive Sewer Lift Station	Minor crack in walls seeping groundwater. Should monitor seepage. Uses gas chlorine for odor control.	Investigate pressure sealing of cracks. Convert to hypochlorite.
Via Alegre Sewer Lift Station	Close to residential area, which could make odor control an issue.	Evaluate cost effects of corrosion and odor control of wet well
Barneburg Sewer Lift Station	Good condition, no apparent problems. Uses gas chlorine for odor control.	Evaluate cost effects of corrosion of wet well. Convert to hypochlorite.
Bell Canyon Sewer Lift Station	Good condition. Uses gas chlorine for odor control.	Convert to hypochlorite.
Heritage Sewer Lift Station	Pump room saturated with groundwater seepage, could be unsafe working conditions. Standby pump missing from housing. No odor control facilities.	Investigate leak correction with hydraulic cement or pressure grout, verify that standby pump can be re-installed. Provide odor control.
Plano Trabuco Sewer Lift Station	Facility in good condition. No odor control facilities.	Evaluate corrosion and odor control needs.
Reclaimed Water Pumping Station	Facility in good condition, look into pump maintenance.	Develop preventive pump maintenance
Robinson Ranch Wastewater Treatment Plant	Overall facility in good condition. Check reliability and redundancy features in the plant.	Develop a plan to upgrade the plant to meet Title 22 requirements.

MODELING METHODOLOGY AND CALIBRATION

The District provided Montgomery Watson with a hydraulic model of the wastewater collection system that was developed by District staff. Montgomery Watson calibrated the model and then used it to analyze the existing wastewater collection system. The proposed future collection system was also modeled to determine the impact of future flows on existing facilities and to size proposed future facilities.

Typically, wastewater generation rates are determined by conducting flow monitoring studies within the wastewater collection system. Homogeneous areas of a single land usage would be identified and then monitored for a period of time. The data generated from this field monitoring would then be compared to water consumption data, historic wastewater flow data (if any) and pump run times for sewage lift stations (if any) to determine its reasonableness. Such an approach provides sewage generation rate information that is relatively simple to calculate, but a large number of flow monitoring sites can be required for study areas with highly variable land uses. Furthermore, this approach can be time-consuming and involves an iterative calculation technique that is only as accurate as the latest iteration.

As an alternative, a linear programming (LP) technique was used that eliminated the iterative calculations and provided a unique, optimized value where the differences between the field-measured and model-generated flow rates are minimized, for each land use. Theoretically, the values determined are independent of location or number of monitoring sites within the system.

Utilizing this LP approach, a given objective function is subjected to an underlying system of constraints. A solution is determined by solving the objective function while simultaneously satisfying the constraints. For sewer modeling, an LP solution would use flow monitoring data to determine a unique generation rate for each land use. The format of the specific LP problem for this case is:

Objective:

$$Minimize \sum_{j=1}^{m} \left| Error_j \right| \qquad (1)$$

Constraints:

$$\sum_{i=1}^{n} \left(\langle Land\ Use\ Area \rangle_i \times \langle Gen.\ Rate \rangle_i \right) + Error_j = \langle Flow\ Monitoring\ Rate \rangle_j \qquad (2)$$

A system of equations consisting of constraint expressions written for each flow monitoring site (in this case, pump stations with recorded run times) would be simultaneously solved. For the constraint equation, the “Flow Monitoring Rate” would be the actual flow rate determined from pump run times. “Land Use Area” would be the actual areas of each land use contributing flows to a given lift station. “Generation Rate” would be the unknown in the system of equations corresponding to a unique generation rate for each land use.

This approach follows the same format as an iterative calculation approach. However, the LP solution provides the optimum generation rate for each land use, simultaneously determined from the solution of the entire system of constraint equations with no additional calculation iterations required. In the above expressions, the “error” term is the “fudge factor” which allows the system of constraint equations to be solved. By minimizing these errors through the objective expression, the overall fit of calculated generation rates more closely matches the actual flow monitoring flow rates.

For the District, the "Land Use Area" may be changed to "EDUs" or service connections to reflect the type of data available. The number of service connections may better represent the level of development within the District and such a change does not alter the use of the LP approach or the determination of generation rates from flow monitoring data. The seven pump stations that have run time records provide seven locations for regressing observed flow rates to a generation rate reflective of the current land usage within the District. These seven sites are sufficient to yield statistically consistent values for generation rates; therefore, no additional flow monitoring was conducted.

Based on this LP methodology, the sewage generation rate for residential land uses was determined to be 270 gallons per EDU per day based on 2.7 persons per EDU and 100 gpcd. The percentage contribution of commercial or industrial uses within the existing land areas providing flow to the given pump stations was statistically insignificant and generation rates for these types of land use were not determined. Wastewater flow rates for commercial or industrial uses were based on 270 gpd per EDU and the ERDU value that was calculated for all properties in the service area, as documented in Section 2.

EXISTING SYSTEM EVALUATIONS

Using the hydraulic model described above, the existing collection system was analyzed under expected peak hour flow conditions.

El Toro Road Collection Zone

Under existing conditions, the El Toro Road trunk sewer and other sewer lines appear to be adequate. The El Toro Road and Zadeh sewer lift stations have adequate capacity to handle the existing flows. As noted above, the El Toro Road zone receives flows from the SMWD and IRWD. The location of these connections is shown on **Figure 6-1**.

Dove Canyon Collection Zone

The analysis did not identify any deficient pipelines in the Dove Canyon area. The Barneburg, Bell Canyon and Golf Club sewer lift stations have adequate capacity to serve existing flows.

Robinson Ranch Collection Zone

The analysis did not identify any deficient pipelines in the Robinson Ranch area. The Via Alegre, Plano Trabuco and Heritage sewer lift stations have adequate capacity to serve existing flows.

Sewer Lift Stations

In 1998, District staff conducted pump efficiency tests at the sewer lift stations. These tests indicated efficiencies ranging from 10 percent to 67 percent. Several low efficiency pumps were replaced at the Golf Club, Plano Trabuco and Heritage sewer lift stations. The reason for low efficiencies could be due to improper sizing for current conditions. It is recommended that the

District conduct a detailed evaluation of each sewer lift station to determine if the pump capacities and lifts are proper for current flows and operating conditions.

Robinson Ranch Wastewater Treatment Plant

Although, the existing RRWWTP is designed and permitted for a capacity of 0.85 mgd, it has not been inspected in a number of years by the RWQCB or DHS to determine compliance with the Title 22 requirements, especially with respect to reliability and redundancy features. As a part of this master planning effort, the condition of the existing RRWWTP was evaluated to determine compliance with Title 22 requirements and deficiencies identified. The initial evaluation encompasses recommended improvements, upgrades, and associated costs to the existing treatment plant to provide reliable capacity of 0.85 mgd consistent with the Title 22 requirements. The latter part of the evaluation presents discussions and evaluations required to increase the plant capacity to 1.35 mgd including individual process sizing and associated costs.

The Title 22 evaluation presented here consists of two elements. The first element consists of the following:

- Identify flows, loading and discharge requirements outlined in the Report of Waste Discharge (RWD) for the RRWWTP and determine if the existing plant meets all these requirements.
- Identify the reliability and redundancy features for the individual process units as outlined in the Title 22 requirements and determine if the existing plant meets these requirements. Also, determine the modifications/improvements required to meet the reliability and redundancy requirements outlined in the Title 22 requirements.

Table 6-4 presents the Title 22 requirements, which includes flows, loading, discharge requirements, redundancy and reliability features.

In an effort to determine the extent and nature of improvements required to meet the Title 22 requirements, a field visit to the RRWWTP was carried out by Montgomery Watson with a representative from the District. Each unit process within the treatment plant was evaluated and the results of the evaluation are described below. The description of the process units is presented generally in an upstream to downstream fashion. **Table 6-5** presents a summary of the evaluation including opinion of probable costs required for modifications/improvements.

Process Units

Preliminary Treatment. Preliminary treatment at the Robinson Ranch WWTP requires improvements to the flow metering and addition of grit removal. The Parshall flume in the headworks channel is inundated at peak flow conditions which results in erroneous flow measurements. To correct this situation, it is recommended that an alternate flow measurement device such as an electromagnetic or an ultrasonic flow meter be utilized, and be located on the influent pipe before the flow enters the headworks channel. The District is constructing this meter. The existing climber screen can be pivoted out of the influent channel for maintenance. Since a manual bar screen is located behind the climber screen, no bypass channel is required.

Table 6-4
Title 22 Requirements

Description	Unit	Value
Design and Permitted Capacity	mgd	0.85
Reliable Hydraulic Capacity Amount of wastewater that can be treated with the single largest treatment unit out of service and still consistently comply with waste discharge requirements	mgd	0.4
Effluent Quality Requirements		
Turbidity (average)	NTU	2
Total Coliform		
7-day median	MPN/ 100 ml	2.2
Maximum Coliform Level	MPN/ 100 ml	23
Total Suspended Solids	mg/l	30
5-day Biochemical Oxygen Demand		
7-day average	mg/l	30
30-day average	mg/l	30

RELIABILITY AND REDUNDANCY REQUIREMENTS

Biological Treatment

A biological treatment unit must be provided with one of the following reliability features:

- An alarm and multiple biological treatment units capable of producing oxidized wastewater with the largest unit not in operation.
- An alarm, short-term retention or disposal provisions, and standby replacement equipment.
- An alarm and long-term storage and disposal provisions
- Automatically actuated long-term storage or disposal provisions.

Under Title 22, the biological units must treat the permitted influent flow with one unit out of service.

Short-term retention facilities must be dedicated to the purpose of storing or disposing of wastewater for at least 24 hours. The facilities must include necessary diversion devices, provision for odor control, conduits, and pumping and pump back equipment. Where long-term storage or disposal provides reliability, the facility must consist of storage facilities, sewers that transport to other treatment or disposal facilities, or any other facilities dedicated to storing or disposing of wastewater. These facilities shall be of sufficient capacity to provide storage or disposal for at least 20 days and shall include the same components as short-term storage.

Tertiary Treatment

Filtration

The guideline for filter loading rate is 5 gpm/sq ft. at peak flow condition with one filter unit out of service.

Disinfection

(Note: Recent regulations require preparation of a RMP for gas chlorine disinfection systems or replacement of gas chlorine systems with alternate disinfection technologies.)

For disinfection systems that use chlorine, Title 22 requires the following features for uninterrupted chlorine feed:

- Standby Chlorine Supply
- Manifold systems to connect chlorine cylinders
- Chlorine Scales
- Automatic devices for switching to full chlorine cylinders

Additionally, all disinfection unit processes using chlorine shall be provided with one of the following reliability features:

- An alarm and standby chlorinator
- An alarm, short-term retention or disposal provisions, and standby replacement equipment
- An alarm and long-term storage or disposal provisions
- Automatically actuated long-term storage or disposal provisions
- An alarm and multiple point chlorination, each with independent power source, separate chlorinator, and separate chlorine supply.

There is no grit removal facility at the existing RRWWTP. The grit settles in the downstream processes resulting in frequent cleaning of the process tanks and also increases wear and tear on the valves, pipes and fittings. To avoid the likelihood of grit accumulation in the downstream processes or damaging the equipment and fittings it is recommended a new grit chamber be installed at the plant headworks. The grit chamber facility would also consist of grit pumps, cyclone and grit classifier. A single, vortex-type grit chamber with a chamber depth of 7.0 feet and a diameter of 9.5 feet would be required to provide adequate grit removal for existing flows. The grit chamber would have detention times of 6.3 and 2.5 minutes under existing average and peak day flow conditions, respectively. For this system, two 5 hp grit pumps would be required where one of the pumps would be considered standby. The grit chamber could be located between the existing screening structure and the flow meter box. Although headloss through a grit chamber can be quite insignificant, the hydraulics through the new headworks should be evaluated prior to construction of a grit chamber.

Raw Influent Flow Equalization Tanks. The existing flow equalization tanks should be drained, cleaned and inspected to determine the condition of submerged sections of mixing mechanisms.

SBR Aeration Capacity. A number of calculations were performed to assess the aeration systems for the SBRs. These calculations were based on the following assumptions:

- Total Cycle Time = 5.25 hours
- Aeration Portion of Cycle Time = 3.5 hours
- Influent BOD5 Concentration = 250 mg/L
- Existing Influent Flow Rate Annual Average = 0.85 mgd
- Peak Month Peaking Factor = 1.71 (as determined from pump run time records)
- Peak Day Peaking Factor = 2.50 (assumed in this study)
- Air solubility efficiency of the fine air system = 22 percent
- Air solubility efficiency of coarse air system (agitation system) = 11 percent

Based on the calculations, it was determined that the existing treatment facility requires a total aeration horsepower of 51 hp per SBR, where 34 hp would be required per SBR if operated continuously in an aeration mode. Under the current operational scheme, a total of 71 hp is available for each SBR with no aeration system off-line. This 71 hp is composed of 60 hp for the fine air system and an additional 11 hp of aeration being provided by the 20 hp agitation system. In the event that the largest aeration horsepower is off-line (60 hp off-line), the process aeration would be provided by the 40 hp system that normally supplies air to the Aerobic Digester. In this case, the existing system can provide a total of 51 hp of aeration to each SBR, which exactly equals the total aeration requirement cited above. It should be cautioned, though, that a large number of assumptions were employed in determining the aeration requirements and existing, available horsepower. If the agitation system does not provide 11 percent efficiency, or the Peak Day peaking factor is greater, then the existing aeration system would not have adequate capacity if the 60 hp blower were to be taken off-line.

Table 6-5
Evaluation of Existing Robinson Ranch WWTP

Unit Process	Improvements Required to Provide Increased Reliability and Redundancy	Cost
Preliminary Treatment	Influent Parshall Flume Flow Meter - The Parshall flume flow meter gives erroneous readings due to flooding. Replace the Parshall flume with a sonic meter. The sonic meter will be located at the influent force main, before the flow enters the climber screen. Chlorine Addition at Climber Screen - Change the source of chlorine to hypochlorite instead of gas chlorine. Install new grit chamber, cyclone and classifier.	$ 1,000 300,000 **$301,000**
Raw Influent Equalization Tanks	Drain, clean and inspect submerged sections and mixing mechanisms in both the primary equalization basins (normal maintenance - no capital cost).	**$0**
Sequencing Batch Reactors	Drain, clean and inspect submerged sections and aeration/mixing devices in the Sequencing Batch Reactors (normal maintenance - no capital cost). Provide an additional 60 hp blower to the process aeration system for the SBRs to provide standby aeration capacity. Determine aeration requirements and replace the existing aeration system with a higher efficiency aeration system. Install high water alarm and aeration system failure alarm	0 25,000 200,000 **$225,000**
Secondary Effluent Flow Equalization	Drain, clean and inspect the submerged sections of the flow equalization basins (normal maintenance - no capital cost).	**$0**
Filter Influent Pump Station	Check & Inspect the condition of the existing pumps (normal maintenance - no capital cost).	**$0**
Dual Media Pressure Filters	Drain, clean and inspect the filters annually (normal maintenance - no capital cost). Provide a high headloss and high turbidity alarms in the filters.	**$3,000**
Disinfection	Remove existing gas chlorine cylinders and replace with liquid sodium hypochlorite system to meet the new RMP requirements Provide new hypochlorite storage tank and accessories. Provide new chemical feed equipment (metering pumps). Check the contact time in the existing chlorine contact tank.	**$30,000**
Algae Removal Filters	Clean and inspect the existing system and replace the existing system as needed.	Not a part of RRWWTP

Table 6-5
Evaluation of Existing Robinson Ranch WWTP
(Continued)

Unit Process	Improvements Required to Provide Increased Reliability and Redundancy	Cost
Reclaimed Water Reservoir	Provide 84-day wet weather storage capacity.	See Section 7
SOLIDS STABILIZATION AND HANDLING FACILITIES		
Aerobic Digestion	Drain, clean and inspect the existing aerobic digester (normal maintenance - no capital cost). Provide an additional 40 hp blower for meeting stand-by aeration requirements. Evaluate replacement of the existing aeration system with submersible aerators. Provide a high water level alarm in the aerobic digester.	0 25,000 10,000 1,000 **$36,000**
Belt Press Dewatering	Check the condition of the belt on the belt press (normal maintenance - no capital cost). Provide belt press failure alarm. Inspect and check sludge conditioning (polymer) system (normal maintenance - no capital cost).	0 1,000 0 **$1,000**
ELECTRICAL SYSTEM		
Power Distribution Equipment	Evaluate Sizing and Condition of Power Distribution Equipment	**$15,000**
Standby Power Generation	There is sufficient capacity to keep the major processes running in the event of a power failure without affecting effluent quality.	**$0**
Instrumentation and Control Equipment	Verify the various alarms on individual processes and their current condition (normal maintenance - no capital cost) Upgrade instrumentation and control system	**$30,000**
Construction Subtotal		$641,000
Contingency (30 % of construction subtotal)		192,000
Construction Cost		$833,000
Engineering, Legal, and Administrative costs (25 % of construction cost)		208,000
Estimated Capital Cost (rounded)		**$1,040,000**

It is recommended that an additional 60 hp blower should be added to the process aeration system for the SBRs. This blower should be configured so that it could supply air to either SBR process aeration system. A similar blower addition of 40 hp to the agitation aeration system is also recommended. This 40 hp blower should be configured so that it could supply air to either SBR agitation aeration systems or the aerobic digester. Additionally, as part of normal maintenance, it is recommended that the existing SBR tanks be drained, cleaned and the

submerged sections of the aeration/mixing devices in the tanks inspected to determine the physical condition of the equipment. Replacement of the existing aeration system with a higher efficiency aeration system should also be evaluated, as this would significantly reduce the power requirements and operation costs.

Secondary Effluent Flow Equalization. The existing secondary flow equalization basins consist of two rectangular tanks and are in good condition. It is recommended that a high water alarm be provided in the basins to warn the operators of high flow conditions, if not already present.

Filter Influent Pumps. The filter influent pumps are located in the secondary flow equalization basins and there is no dedicated pump station structure. It is recommended that the existing pumps be checked and inspected and their condition assessed.

Dual Media Pressure Filters. The existing dual media pressure filters provide a necessary degree of treatment under the present flow conditions. Discussions with the District staff indicated that the filters were relocated to the RRWWTP from the District's DWTP. For the purpose of Title 22 evaluation, it is recommended that the existing pressure filters be drained, cleaned and inspected. It is recommended that a high headloss alarm and high turbidity alarm be provided at the filters.

Disinfection. Currently, disinfection at the RRWWTP is provided by gas chlorine and the necessary contact time for disinfection is provided in a chlorine contact tank. Recent regulations require preparation of a Risk Management Plan (RMP) for facilities that utilize gas chlorine. Utilization of alternate disinfection technologies like hypochlorination do not require a RMP as the risks associated with the use of gas chlorine do not exist or are minimized with these types of disinfection methods. As a part of the Title 22 evaluation, the disinfection methodology at the treatment plant was discussed with the District staff. The District is in the process of replacing the existing gas chlorine system with a sodium hypochlorite-based system. The existing chlorine contact tank would be utilized to provide the necessary contact time with the hypochlorite disinfection system.

Aerobic Digesters. Currently, there is no dedicated standby blower for the aerobic digester and the existing 40 hp blower is used to supply air both to the aerobic digester and SBRs. To improve the reliability and redundancy of the system, the following steps are recommended:

- Provide a standby 40 hp blower for the aerobic digester.
- Drain, clean and inspect the digester to determine the condition of any submerged equipment (normal maintenance - no capital cost).
- Provide a high water alarm in the digester

The sludge transfer pumps were replaced in 1999; therefore no additional work on the pumps is required at this time.

Belt Press Dewatering. The belt press is capable of handling solids generated at 0.85 mgd flow conditions. No improvements are required. A belt press failure alarm should be provided.

Electrical System

Power Distribution Equipment. No separate analysis or evaluation was carried out as a part of this master plan. Since the District staff did not have any questions or concerns about the power distribution equipment, it is assumed that this equipment is in good condition and no improvements are required at this time.

Standby Power Generation. The emergency generator at the RRWWTP has a capacity of 250 kW and has sufficient capacity to maintain the operation of all major processes without affecting the effluent quality in the event of a power failure.

Instrumentation and Control Equipment. The general instrumentation and control methodology involves local control of individual processes. The alarms for individual processes are located and annunciated locally. Initial discussions with the District staff has indicated that the alarms on the individual processes are in need of update. Further evaluation is recommended to determine the extent and nature of upgrade required for the plant instrumentation and control system.

Opinion of Probable Costs

The approximate costs for Title 22 upgrade to the RRWWTP is $1,041,000. The breakdown of the costs by individual items is presented in **Table 6-5**. These costs have been developed based on the available information or from cost curves and could be utilized for CIP purposes. As more evaluation is carried out and more information is available, these numbers could be refined further.

FUTURE SYSTEM EVALUATIONS

As discussed in Section 2, the Dove Canyon area, Robinson Ranch area and District-served portion of the Portola Hills area have essentially reached buildout conditions at this time. All increases in wastewater flows will be the result of development in other areas and connection of properties currently served by septic tanks.

An analysis of the future collection system was performed using the hydraulic model discussed earlier. Additional pipelines and flows were input to the model to represent future facilities and future development.

Based on the selection of Alternative 2, as discussed in Section 3, a number of new facilities will be required. **Figure 6-6** shows these recommended improvements. These facilities address both current deficiencies and future needs. Components of the future wastewater system can be separated into three categories:

- Future Collection Facilities for Currently Unsewered Areas.

Figure 6-6
Future Wastewater System

11x17

- Existing Collection Facilities Impacted by Future Flows.
- Wastewater Treatment Facilities.

Future Collection Facilities for Currently Unsewered Areas

The Central planning area is currently unsewered, as are portions of the North planning area. Due to the topography of these areas, only one alternative alignment of gravity sewers could be identified. **Figure 6-7** shows a plan perspective while **Figure 6-8** shows a profile of Live Oak Canyon Road and Trabuco Canyon Road, where the main trunk lines serving as the backbone for the future system would be constructed. In this configuration, three separate collection zones would be required:

1. A gravity line would collect flows from new developments in the North area and convey these flows to the El Toro Road sewer trunk. This area is part of the El Toro Collection Zone and these flows would eventually be conveyed to the existing El Toro Sewer Lift Station.

2. Another gravity line would collect flows from the northern portion of the Central area and convey flows to the low point of the Central area near O'Neill Regional Park. For planning purposes, this area has been designated the Central 1 Collection Zone.

3. A third gravity line would collect flows from the southern portion of the Central area and convey flows to the same low point of the Central area. For planning purposes, this area has been designated the Central 2 Collection Zone. Additional trunk collectors are also anticipated in Trabuco Creek Road, Rose Canyon Road and Trabuco Oaks Road/Hamilton Truck Trail. These lines are also shown on **Figure 6-6**.

In addition to the gravity sewers mentioned above, a force main and two sewer lift stations will be required to convey gravity flows from the Central 1 and Central 2 collection zones directly to the existing RRWWTP. For planning purposes, these lift stations have been designated the Live Oak Sewer Lift Station and Nursery Sewer Lift Station. The feasibility of discharging to the Plano Trabuco lift station and then utilizing the existing facilities was investigated. It was determined that the Plano Trabuco and Heritage lift stations were adequate to handle the Robinson Ranch flows, but could not handle the additional flows from the Central Collection Zone. Therefore, the force main from the Nursery Sewer Lift Station would discharge directly to the RRWWTP. It should be noted that **Figure 6-8** is based on a digital elevation model that may not reflect the exact local topography; it is presented to show the general trends in elevation along the pipeline alignments.

A total average annual flow rate of 0.46 mgd is anticipated for these lift stations, with peak flows of about 1.46 mgd. A total of four pumps are assumed for each station, three duty and one standby. Each pump would have a capacity of about 350 gpm at about 370 feet of head. Construction of a single high lift wastewater pump station near O'Neill Park may not be practical since it would have a maximum head of about 315 psi (excluding surge). Construction of two lift stations in series as proposed would reduce the maximum pressures and minimize surge

problems. A 15,800-foot long, 10-inch force main is anticipated to accommodate the 1.46 mgd peak flow with a velocity of about 4.1 fps. An alternative approach could involve the construction of dual 6-inch force mains in a common trench thereby providing improved velocities at the lower initial flows. Initial operation would entail alternating the use of the two force mains. As flows increase, both force mains would be used. These details should be addressed at the preliminary design stage for these facilities.

In addition to the trunk sewers, a number of local gravity sewers will be needed in the Trabuco Oaks, Live Oak Canyon and Rose Canyon areas to convey wastewater from service laterals to the backbone system. These local sewers should all be a minimum of 8-inch diameter. Local topographic features may require construction of small lift stations and force mains. An allowance for these facilities has been included in the capital improvement program, but they cannot be identified specifically at this time. It is assumed that developers will be responsible for construction of sewer lines to serve future development on their property. The minimum sewer size for on-site sewers should be 8-inch diameter.

Existing Facilities Impacted by Future Flows

With the development of Alternative 2, a number of existing facilities will be impacted by the anticipated flows.

1. According to the reported EDUs, the area served by IRWD that contributes wastewater flows to the El Toro Collection Zone is about 67 percent developed based on EDUs and about 55 percent developed based on flows. Future IRWD flows are expected to routed directly to the El Toro trunk sewer at Glenn Ranch Road. No improvements are recommended at this time. However, the District should verify the future flows anticipated by IRWD and monitor the El Toro trunk sewer for surcharging if flows exceed projections.

2. As noted above, the District owns 0.558 mgd of capacity in SMWD's Chiquita system, with 0.428 mgd reserved for the El Toro Collection Zone. Future flow projections given in Section 2 show an annual average wastewater flow of 0.39 mgd at buildout compared to a contractual capacity of 0.428 mgd. This leaves a reserve capacity of 0.038 mgd. The contractual capacity is based on the same average annual flow projections per EDU (270 gpd/EDU) used by SMWD to size their facilities.

It should be noted that not all property owners in the North portion of the District have capacity rights in the El Toro system. These property owners would need to purchase sewer capacity through the District if they wish to connect to the sewer system.

Wastewater Treatment Facilities

The rated capacity of the existing RRWWTP is 0.85 mgd. The average annual dry wastewater flow is projected to increase by 0.50 mgd in the future, which results in an average annual wastewater flowrate of 1.35 mgd to the RRWWTP. This increased flowrate projection would be a result of anticipated future development within the District's service area and increased

Figure 6-7
Proposed Trunk Sewer Alignment

11x17

Figure 6-8
Proposed Trunk Sewer Profile

11x17

connections to the existing sewer system (i.e., customers converting from septic tanks to sewer systems). Upon detailed evaluation, the District has decided to proceed with a plan to increase the capacity of the RRWWTP to an ultimate capacity of 1.35 mgd, as opposed to the construction of a new WWTP at another site.

This section discusses potential modifications and upgrade of the existing RRWWTP to increase the rated capacity of the plant to an ultimate capacity of 1.35 mgd. A discussion of the major upgrades to each process unit within the RRWWTP will be presented. It should be noted that a plant expansion may also require upgrade or expansion of yard piping, chemical feed systems, electrical systems, instrumentation and control systems, and other appurtenant equipment. These items are inherent to any plant expansion or upgrade, but will not be discussed in this report, as this is a master plan level document.

The major upgrades and expansions can be separated into the main line flow process unit facilities and the solids stabilization and handling facilities. A cost estimate for the proposed plant expansion is also be included in this section.

Main Line Flow Process Unit Facilities

The main line flow facilities that are proposed for expansion or upgrade include the headworks facility, sequencing batch reactors, secondary effluent equalization tank, filter influent pumps, tertiary filtration system, and disinfection facility. No change is recommended for the primary equalization tanks.

Headworks Facility. Improvement upgrades for increased redundancy and reliability require a bypass channel around the headworks facility for use in the event that the primary headworks channel requires maintenance or repairs. It is recommended that a new headworks facility be constructed that is designed for an average annual flow of 1.35 mgd (with the capability of handling the daily peak hour flowrate of 4.37 mgd) which would be parallel to the existing headworks facility. The existing headworks facility would then be dedicated as a bypass channel, in the event that the new primary headworks facility requires maintenance. The new headworks facility would be comprised of an influent flowmeter, climber screen, grit removal system, and odor control system. These future improvements should be coordinated with the existing plant improvements to eliminate unnecessary expenditures.

The District's RRWWTP personnel have indicated that the existing Parshall flume cannot be relied upon for accurate flow measurements at times due to downstream hydraulic conditions that cause the flume to be submerged. It is recommended that the Parshall flume be removed from service and a new sonic flowmeter or magmeter be installed upstream of the new headworks facility, after the confluence point of the two force mains that feed the headworks.

A climber screen or other primary screening mechanism is recommended to remove large or obstructive items from the waste stream, which could provide problems for downstream process units. The screening mechanism would be designed for the peak daily flowrates.

A grit removal system is recommended at the new headworks facility to provide adequate grit removal. The grit removal system would be composed of a single, vortex-type grit chamber, cyclone, and classifier. Grit would be removed from the waste stream and disposed of in storage bins.

Primary Equalization Tanks. The existing primary equalization tanks are recommended for continued use to attenuate the diurnal flow fluctuations that occur throughout the day. Because the SBRs operate as batch units requiring fill, aerate, settle, and decant modes, the equalization basins provide storage for the SBRs during the non-fill modes. The existing primary equalization tanks are sized to provide approximately 20 percent of storage of the current average annual flowrate of 0.85 mgd. Due to limited space availability on the plant site property, the recommendation is to utilize the existing equalization basins, but not to construct an additional basin to accommodate the additional 0.50 mgd plant expansion. Instead, an additional SBR will be sized to accommodate a flow greater than 0.50 mgd to provide additional treatment capacity and will also serve to provide additional storage capability in the SBR.

Sequencing Batch Reactor. The two existing SBR basins have a combined volume of 900,000 gallons to treat a flow of 0.85 mgd. The SBRs can provide 25 hours of hydraulic residence time at 0.85 mgd, when operated together. Based on manufacturer's data, the existing SBRs could be operated at a higher flowrate and a lower hydraulic residence time.

As a part of the RRWWTP expansion, it is recommended that one new SBR be constructed with a volume of 450,000 gallons and similar dimensions to the existing SBRs, which would increase the treatment capacity of the SBRs to greater than 1.35 mgd. The additional treatment capacity in excess of 1.35 mgd would provide the additional storage volume required to accommodate diurnal flow fluctuations. The additional treatment capacity would also provide increased operational flexibility to perform scheduled maintenance activities associated with the SBRs.

Secondary Effluent Equalization Tank. The current secondary effluent equalization tanks provide storage to balance flows to the tertiary filters. It is recommended that an additional equalization tank be constructed to accommodate the increased plant capacity and to balance flows to the tertiary filters. A new 100,000 gallon secondary equalization tank is recommended to provide approximately 20 percent of the additional average daily flow of 0.50 mgd. The 20 percent volume may be used as an approximate volume to balance diurnal fluctuations that occur throughout the average day. A more detailed analysis of the historical plant flowrates should be performed to refine the volume necessary to provide balancing capability. It is important to provide balancing storage for the tertiary filtration system downstream because the tertiary filters have a hydraulic restriction based on their maximum loading rate.

It is important to note that the District has the ability to discharge flow to the SMWD sewer system. In the event that the flowrate to the tertiary system exceeds the capacity of the filters, which could occur during a peak day flow event, the excess flow greater than the capacity of the filters could be diverted to the SMWD sewer system. However, when flow is bypassed, it is not available for reuse. Consequently, expanded effluent seasonal storage is essential for maximizing reclamation as discussed in Section 7.

Filter Influent Pumps. Additional pumps would be required to pump water from the secondary effluent equalization tanks to the tertiary filters. The combined pumping capacity of all pumps would be equal to the treatment capacity of the tertiary filtration system.

Tertiary Filtration System. The District requested an evaluation of the current tertiary filters and replacement with a new filtration system, as opposed to providing additional filters to expand the capacity of the current system. The current filters are quite old and were relocated from the District's water treatment plant in 1993; therefore, the District requested evaluation of a new filtration system to accommodate the proposed expanded plant capacity. This alternative has the advantage of providing one uniform filtration system, which simplifies operation and maintenance, as opposed to operating two different filtration systems. Additionally, a new filtration system would be specifically designed for wastewater applications.

Tertiary filtration systems are restricted by the loading rate of the filters; therefore, any flow in excess of the design capacity of the filters must be rejected. The secondary equalization tanks prior to the filters will help to balance flows to the filters during diurnal fluctuations; however, any flow in excess of the capacity of the filters will require diversion to the SMWD sewer system. Other unit processes, such as the SBRs, do not have similar hydraulic restrictions; therefore, increased flow through the SBR process unit results in slightly decreased treatment capability, but would not typically require flow rejection. Because the RRWWTP has limited capability to reject water, it is recommended that the filtration system be designed to accommodate the projected peak month flow of 2.3 mgd, at a minimum, to reduce the risk of rejecting water in the process stream. Pre-design of the future expansion should evaluate designing the filters for the peak day flows to minimize bypassing to the SMWD system.

A continuous backwash package filtration unit is recommended for the tertiary filtration system. This system is recommended because it will facilitate construction, is easy to operate, and does not require any washwater tanks or backwash storage tanks.

Disinfection Facility. The District is currently switching from a chlorine gas to a sodium hypochlorite based system for disinfection capability at the RRWWTP. A 105,000 gallon chlorine contact basin currently provides the necessary contact time for disinfection of the tertiary effluent from the filters. The disinfection facility will also require expansion to match the treatment capacity of the tertiary filtration system in the future. Therefore, the volume of the chlorine contact basin would require expansion by 89,000 gallons, for a total volume of 194,000 gallons, to provide a minimum two-hour contact time in the basin at 2.3 mgd. As a minimum, the sodium hypochlorite system would also require expansion to feed the appropriate dosage of chlorine at a peak month flow of 2.3 mgd.

Solids Stabilization and Handling Facilities

The solids stabilization and solids handling facilities that are proposed for expansion or upgrade include the aerobic digester and the belt press.

Aerobic Digester. The RRWWTP currently has an aerobic digester to stabilize the waste sludge from the SBRs prior to haul-off and disposal. The digester is currently operated with a detention time of 20 days with 1 percent solids at a plant flowrate of 0.85 mgd. It is recommended that a new digester of equivalent size to the existing digester be provided to accommodate the plant expansion to 1.35 mgd. This will allow a detention time greater than 20 days under the present operation of the digesters and provide greater sludge stabilization. If the aeration capacity in the digesters and the solids concentration to the digesters is increased, the increased digester volume may allow for a 40 day detention time under the right conditions, and may allow the sludge to be stabilized to Class B standards for waste disposal.

Belt Press. The current belt press at the RRWWTP has the capacity to process sludge at the proposed treatment plant capacity of 1.35 mgd. This will require the belt press to be operated for a longer duration than is presently practiced, which is currently operated for approximately 8 hours per week. Overall solids production will also increase, which will require either increased frequency to haul away solids or increased volume to haul away at each time. As is the current practice, tanker trucks will be utilized to haul sludge off-site if the belt press is taken out of service for maintenance or repairs.

Opinion of Probable Costs

The approximate cost for expansion of the RRWWTP to an ultimate capacity of 1.35 mgd is approximately $6,440,000. This estimation of probable costs reflects a master plan level estimate for the major process units recommended to expand the RRWWTP from 0.85 mgd to 1.35 mgd. The breakdown of costs by individual items is presented in **Table 6-6**. These costs have been developed based on available information or from cost curves and could be utilized for CIP purposes. When a more extensive evaluation is performed and more information is available, these costs should be refined further.

Figure 6-9 presents modifications to the RRWWTP which are proposed for the plant expansion to 1.35 mgd. The figure presents a preliminary layout of major process units recommended for expansion. It should be noted that the size and location of process units are approximate and preliminary.

SUMMARY OF WASTEWATER IMPROVEMENTS

This section recommended a number of improvements to the District's wastewater system. **Table 6-7** presents a summary of the recommended wastewater improvements along with the recommended capacity and a brief explanation for the improvement. The page number of this section where the recommendation is discussed is also included. **Figure 6-10** presents the location of the proposed improvements and categorizes them between existing and future needs.

The costs of the recommended improvements are presented in Section 8, Capital Improvement Program.

Table 6-6
Estimate of Probable Cost for Robinson Ranch WWTP Expansion

Unit Process	Improvements Required to Increase Plant Capacity to 1.35 mgd	Cost ($)
MAIN LINE UNIT PROCESSES		
Preliminary Treatment	Note: This is part of the reliability improvements associated with Title 22 compliance	$ 0
Primary Influent Flow Equalization	None	0
Sequencing Batch Reactors	Construct new 450,000 gallon SBR basin with associated aeration blowers, pumps, and other appurtenant equipment. Construct new aeration blower facility for new SBR. Replace existing aeration equipment and appurtenant equipment in existing SBR basins.	1,000,000
Secondary Effluent Flow Equalization	Construct new 100,000 gallon equalization tank for additional 0.50 mgd flow.	150,000
Filter Influent Pump Station	Add new pumps to increase pumping capacity to 2.3 mgd.	150,000
Tertiary Filtration System	Remove all equipment associated with existing pressure filtration system. Install package filtration system with a capacity of 2.3 mgd.	700,000
Disinfection	Increase volume of chlorine contact basin from 105,000 gal. to 194,000 gal. Increase sodium hypochlorite feed capacity to treat 2.3 mgd of flow.	200,000 100,000
SOLIDS STABILIZATION AND HANDLING FACILITIES		
Aerobic Digestion	Construct new digester	500,000
Belt Press Dewatering	None	
MISCELLANEOUS		
Instrumentation and Control Equipment	Instrumentation and control equipment associated with plant increase to 1.35 mgd.	300,000
Chemical Feed and Storage	Additional chemical feed and storage capability to accommodate 0.50 mgd expansion.	200,000
Odor Control	Additional odor control capability to accommodate 0.50 mgd expansion.	200,000
Subtotal		$3,500,000
Yard Piping Improvements (7% of subtotal)		250,000
Electrical Improvements (6% of subtotal)		210,000
Construction Subtotal		$3,960,000
Construction Contingency (30% of construction subtotal)		1,190,000
Construction Cost		**$5,150,000**
Engineering, Admin, Legal, etc. (25% of construction total)		1,290,000
Total RRWWTP Expansion Capital Cost		**$6,440,000**

Figure 6-9
Proposed Robinson Ranch WWTP Expansion

Table 6-7
Recommended Wastewater Improvements

Description	Recommendation		Comment	Page
	Existing	Build-out		
RRWWTP				
Title 22 Improvements	Various		Upgrade existing plant	6-23 – 6-24
Plant Expansion		0.5 mgd	Meets future flows	6-39
Sewer Lift Stations				
Golf Club	x		Pressure grout cracks	6-17
Via Alegre	x		Corrosion and odor control	6-17
Heritage	x		Pressure grout cracks, verify standby pump	6-17
Live Oak		200 hp	Serves Central System	6-29
Nursery		200 hp	Serves Central System	6-29
Gravity Sewers				
North System				
Live Oak Canyon Rd., 8-in.		4,500 ft	Flows to El Toro system	6-29
Central System No. 1				
Live Oak Canyon Rd., 8-in		12,500 ft	Flows to Live Oak SLS	6-29
Central System No. 2				
T.O. Dr./Hamilton Truck Tr., 8-in.		9,900 ft	Serves Trabuco Oaks area	6-29
Rose Canyon Rd., 8-in		9,900 ft	Serves Rose Canyon area	6-29
Trabuco Creek Rd., 8-in		11,100 ft	Flows to Live Oak SLS	6-29
Trabuco Canyon Rd., 8-in		3,300 ft	Flows to Live Oak SLS	6-29
Trabuco Canyon Rd., 10-in		900 ft	Flows to Live Oak SLS	6-29
Trabuco Canyon Rd., 12-in		4,900 ft	Flows to Live Oak SLS	6-29
Adkinson Ln., 8-in		500 ft	Local laterals	6-30
Sycamore Dr., 8-in		2,200 ft	Local laterals	6-30
Mountain View Rd., 8-in		2,000 ft	Local laterals	6-30
Flanagan Rd., 8-in		2,000 ft	Local laterals	6-30
Hunky Dorie Ln., 8-in		2,000 ft	Local laterals	6-30
Lambrose Canyon Rd., 8-in		3,200 ft	Local laterals	6-30
Force Mains				
Trabuco Canyon Rd., 10-in		15,800 ft	Flows to RRWWTP	6-30

Figure 6-10
Recommended Wastewater System Improvements

11x17

Section 7
Reclaimed Water System

This section presents a summary of the District's reclaimed water system, including an evaluation of the adequacy of existing facilities and recommendations for system improvements through build-out conditions. Reclaimed water is provided for non-potable water uses from the treated effluent of wastewater treatment plants. As described in Section 3, the District has determined that the expansion of the RRWWTP to serve the Central and South areas and maximize the reuse of that water will best serve the future needs of the District. This Section provides a description of the existing and build-out reclaimed water system evaluations and recommendations based on the implementation of Alternative 2, as described above.

EXISTING RECLAIMED WATER SYSTEM

All of the current reclaimed water use takes place in the South planning area. The existing RRWWTP currently provides treated effluent that is used as reclaimed water for two general areas; Dove Canyon and Robinson Ranch (including Trabuco Highlands). Each of these areas is also an isolated pressure zone. The RRWWTP treated effluent flows to the reclaimed water reservoir by gravity. The reclaimed water is pumped directly from the reservoir to Dove Canyon users and the discharge from the Dove Canyon reclaimed pumps provides suction for the Robinson Ranch reclaimed pumps. The Robinson Ranch reclaimed water pumps then boost the reclaimed water to an adequate head to serve the Robinson Ranch reclaimed water users. Based on the pump heads, the HGL of the Dove Canyon system is approximately 1,400 feet while the Robinson Ranch system HGL is approximately 1,530 feet. If there is not enough water in the reclaimed reservoir then water is pumped into the reclaimed reservoir from Dove Lake. Dove Lake is filled from natural run-off from the contributing watershed and its water is classified as recycled water. The District can also provide supplemental potable water to the reclaimed water system through an air-gapped connection.

In the winter, there are many times when the RRWWTP effluent production exceeds the reclaimed system demands. When this occurs, the District disposes the water through spray irrigation of surrounding landscape areas. If the reclaimed water reservoir fills in the winter, the District bypasses wastewater to the SMWD system.

The Dove Canyon Master Association maintains and operates its own reclaimed water system after receiving reclaimed water from the District. Therefore, the District's reclaimed water responsibility to Dove Canyon ends at the flow meter that records the amount of water used by the Dove Canyon reclaimed water system. The District is responsible for operations and maintenance of all other reclaimed water facilities within the District boundary. A plan view layout of the existing reclaimed water system is shown in **Figure 7-1** and a hydraulic schematic of the existing and proposed system is presented in **Figure 7-2**.

Figure 7-1
Existing Reclaimed Water System

Figure 7-2
Reclaimed Water System Schematic

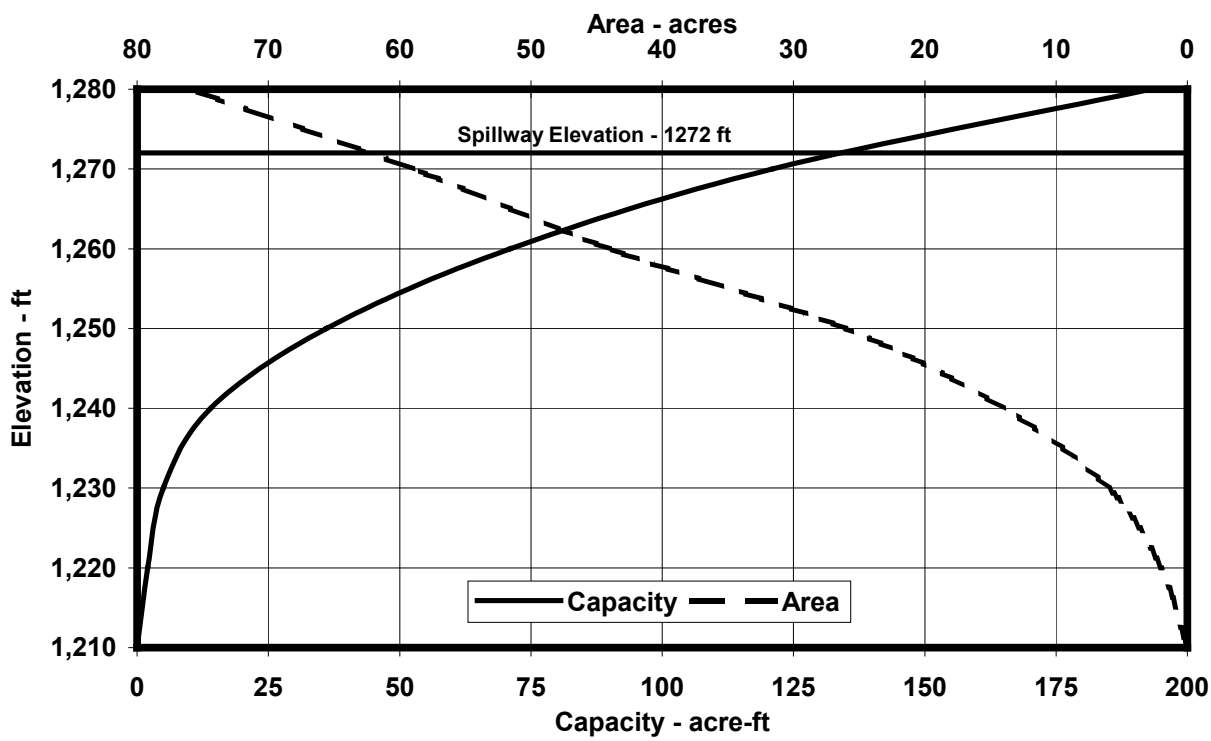
Facilities

This section describes each of the following existing facility types in additional detail: reclaimed water seasonal storage reservoir (RWSR); Dove Lake; booster pumps; and pipelines. Descriptions of existing facilities only are provided and a determination of the adequacy of the existing facilities is provided later in this section.

Reclaimed Water Storage Reservoir

The District's reclaimed water storage reservoir is located adjacent to the RRWWTP as shown previously on **Figure 6-4**. The reservoir provides winter storage for RRWWTP effluent during periods of low demand. The RWSR has a capacity of 130 acre-ft. The depth vs. volume curve is presented in **Figure 7-3**. The earth-fill dam is subject to the jurisdiction of the DWR Division of Safety of Dams.

Figure 7-3
Reclaimed Water Storage Reservoir Area-Capacity Curves

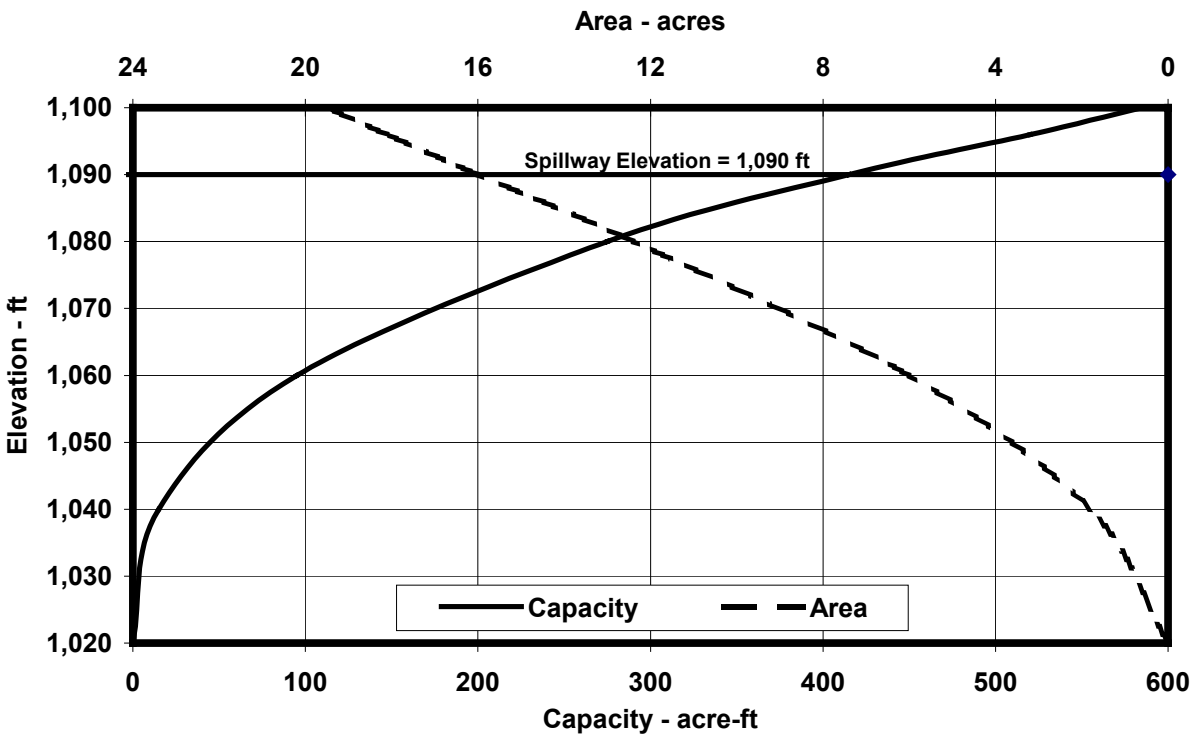


According to the RWQCB's Basin Plan, wastewater treatment plants that do not have permitted surface water discharges must provide 84 days of effluent storage. At the current plant design flowrate of 0.85 mgd, the reservoir provides about 50 days of storage. The District currently relies on its connection with the SMWD wastewater system at Plano Trabuco to provide the remaining disposal capacity. Due to topography and design, this reservoir has minimal inflow from run-off. The only withdrawal from this reservoir occurs from the Dove Canyon reclaimed water pump station.

Dove Lake

Dove Lake collects and stores local runoff from the watershed in upper Dove Canyon. Dove Lake is formed by an earth-fill dam and has a capacity of 415 acre-ft at the crest of the drop inlet structure. The dam and reservoir were originally constructed by the master developer of Dove Canyon and was transferred to the District following construction. The dam is subject to the jurisdiction of the DWR Division of Safety of Dams. The depth vs. volume information based on the design drawings is presented for Dove Lake in **Figure 7-4**. Water from Dove Lake is used to provide "make-up" water to the reclaimed water system when needed. The District refers to water from Dove Lake as "recycled water" to distinguish it from reclaimed water produced by the RRWWTP.

Figure 7-4
Dove Lake Area-Capacity Curves



Booster Pumps

There are two sets of pumps in the reclaimed water system; the Dove Canyon Irrigation Pump Station (DCIPS) and the Robinson Ranch Irrigation Pump Station (RRIPS). All of the pumps are constant speed and both of the pump stations ultimately take water from the reclaimed water reservoir. The DCIPS lifts water from the reclaimed water reservoir to the Dove Canyon reclaimed water system HGL and the RRIPS boosts water from the Dove Canyon HGL to the hydraulic grade necessary to serve customers in the Robinson Ranch area. The District maintains

a pressure of approximately 135 psi at the Dove Canyon meter and the goal for the existing Robinson Ranch customers is to provide a minimum of 30 psi of pressure.

There is a pressure regulating valve (PRV) on the discharge of the RRIPS to increase the flexibility of providing acceptable pressures to the Robinson Ranch customers. A summary of the characteristics of the existing booster pumps is presented in **Table 7-1**.

Table 7-1
Irrigation System Booster Pumps

Name	Power (hp)	Rated Capacity (gpm)	Data Available[1]
Dove Canyon			
Pump 1	150	2,250	C
Pump 2	100	1,500	C
Pump 3	75	1,000	C
Pump 4	30	350	C
Robinson Ranch			
Pump 1		750	C
Pump 2[2]		420	C

Note: 1. E = Southern California Edison, C = Manufacturer's Test Curve Data, P = Plans, N = No Data
2. Standby

Pipelines

The District's existing reclaimed water distribution system consists of almost five miles (25,195 feet) of pipeline ranging from 3 to 20-inches in diameter. A summary of pipeline quantities by diameter and material is tabulated and shown in **Table 7-2**.

In addition, there is a 6-inch diameter PVC pipeline that starts at Plano Trabuco Rd. and Rancho Cielo, runs down Ranch Cielo to Via Del La Luz, runs north in Via Del La Luz to Via Del Lago, runs north in Via Del Lago to Weeping Willow, and continues north in Weeping Willow almost to the end of the cul-de-sac. This pipeline is not currently in use and was originally installed to be used as a pipeline for brine transport but was never used. The total length of this pipeline is approximately 4,440 feet.

Operations

Currently, the amount of reclaimed water available to customers is limited by the amount of effluent available from the RRWWTP. Dove Canyon receives enough reclaimed water for their needs, as well as some customers in the existing reclaimed water service area located south of Robinson Ranch Road and east of High Country Drive. There are additional customers that could be served reclaimed water during parts of the year, but the District has been waiting for the results of this Master Plan report before moving forward with facility sizing and implementation.

Table 7-2
Summary of Pipeline Material and Length, by Diameter

Diameter	CML&C	PVC	Total
3	0	4,111	4,111
4	0	2,389	2,389
6	140	7,866	8,006
8	1,848	826	2,675
10	0	5,319	5,319
16	421	0	421
20	2,274	0	2,274
Total	**4,683**	**20,512**	**25,195**

MODELING METHODOLOGY AND CALIBRATION

A computer model of the District's system is developed to simulate both existing and future situations to assist in the evaluation of hydraulic recommendations. A reclaimed water system model was provided by District staff and was completed and calibrated by Montgomery Watson. The model needed demand information, pump operation information, and verification/ calibration.

This subsection describes the additional work performed in the verification, enhancement, and calibration of the model received from the District. Differences in development techniques between the existing and future system models are discussed where applicable.

Demand Allocation

Existing System

The model was set up for the most recent applicable demand conditions to evaluate hydraulic deficiencies in the existing system. The total existing demand was determined directly from billing records. The Dove Canyon demand was input to the model as a single demand located at the service meter. The Robinson Ranch demands in the existing area were input based on historical usage in the past year. Where customers had less than a full year of billing data, the billing information from the potable water system was used to complete a full year cycle.

Detailed data, on a three-minute basis, was provided by the District for flow data from the RRIPS. Upon review, it was determined that this data was not consistent enough to be of use and the diurnal curve for demands was assumed to be constant from 10:00 p.m. to 5:00 a.m., as shown in Section 2. This assumption was consistent with the data reviewed.

Future System

The potable and non-potable future demands were evaluated simultaneously to ensure that all demands were accounted. Based on this analysis, the additional future reclaimed water demands are demands that are currently being served by potable water but will be transferred to reclaimed water when additional reclaimed water is available. The expansion of the RRWWTP is assumed to provide reclaimed water for future reclaimed water demands in the South planning area and the southeastern portion of the Central planning area.

Calibration

The District was in the process of repairing the meter used to monitor reclaimed water flows through the RRIPS. The data that was obtained was not consistent enough to be used for model calibration. In addition, each of the end users have timers that turn their reclaimed water on and off at different intervals. District staff attempted to document the settings for each of the existing meters but the information received was not readily available and, in combination with the accuracy of data available from the RRIPS meter, it was determined that this approach to model calibration would not be feasible.

Instead, the model results (flows and pressures) were reviewed with District staff for consistency with flows and pressures seen in the field. As the existing reclaimed water system is fairly simple (no loops or PRVs), this review provided the necessary level of comfort that the model was accurately simulating real-world conditions.

HYDRAULIC PLANNING CRITERIA

The purpose of this section is to summarize the criteria to be used in the evaluation of the hydraulic models of the existing and future water systems. Several system evaluation criteria are important for this project including system pressures, maximum pipeline velocities, storage volumes, and back-up power and equipment for emergency purposes. Evaluations of required reclaimed water storage are presented in an appendix. A summary of the recommendations for system criteria to be used is presented in **Table 7-3**.

Table 7-3
Recommended Irrigation Water System Criteria

Description	Value
System Pressure	
Maximum	120 psi
Minimum	60 psi
Maximum Pipeline Velocity	7 fps
Reclaimed Water Storage	84 days

System Pressures

Pressures must be high enough so that the water can be used for sprinkler systems output and low enough so that sprinkler heads and other appurtenances function correctly. Typical values for maximum and minimum pressures on reclaimed water systems are 120 and 60 psi, respectively, and are recommended here.

Pipeline Velocities

The overriding factor in reclaimed water distribution system design criteria is the system pressure, but the maximum pipeline velocity should also be reviewed. If the velocity is too high then the District will end up paying larger operational costs to provide a higher head. Therefore, a maximum pipeline velocity of 7 fps is recommended.

Storage Criteria

The RWQCB's Basin Plan (1994)states that:

> "Theoretical water balance calculations for disposal of reclaimed water at golf courses and other reuse sites in the Region indicate that storage facilities should be sized for 84 days of storage (1975 Comprehensive Water Quality Control Plan Report, Page II-16-32). In situations where reclaimed water storage ponds are necessary, the Regional Board will require reclaimed water producers to:
>
> - provide 84 days of storage capacity; or
> - provide storage capacity based upon water balance calculation procedures such as described in:
>
>> US EPA. 1981. *Process Design Manual for Land Treatment of Municipal Wastewater.* Center for Environmental Research Information. Cincinnati, OH. EPA 625/1-81-013 (COE EM1110-1-501)."

On this basis, 84 days of storage has been selected as the design criteria for this master plan.

EXISTING SYSTEM EVALUATION

The distribution system components, pipes and pumps, are adequately sized to deliver reclaimed water to existing customers. However, the existing system should be expanded as quickly as possible to make reclaimed water available to consumers who are currently using potable water but who could use reclaimed water if it were available. At some times during a normal year, additional reclaimed water is available to provide to customers. In a wet year, even more reclaimed water may be available. However, demands are typically lower during these conditions.

The District would like to maximize the use of reclaimed water, but the existing system is limited by the amount of reclaimed water available. To make more reclaimed water available, it is

necessary to do two things, (1) provide additional reclaimed water storage and (2) ensure that the available reclaimed water can be delivered to consumers.

As discussed previously, the District must provide 84 days of reclaimed water seasonal storage. At the current RRWWTP design capacity, the District should have at least 220 acre-ft of reclaimed water storage. An additional 90 ac-ft of reclaimed water seasonal storage is necessary under existing conditions. A discussion of reclaimed water seasonal storage siting is presented later in this Section.

To provide additional water to existing customers, it is necessary to implement pipeline improvements in the existing Robinson Ranch pressure zone and to create a new pressure zone in the upper area of Robinson Ranch with an additional pump station, pipelines, and a PRS. These recommended improvements are documented below.

Robinson Ranch Pressure Zone

It is recommended that pipelines be installed in the southern Robinson Ranch zone to create a looped system connecting High Country Dr., Weeping Willow St., Via Del Lago Dr., Via Del La Luz Dr., Rancho Cielo Dr. and Plano Trabuco Rd. To achieve this, it is only necessary to connect the pipelines in High Country Dr. and Weeping Willow St. and to construct a pipeline in Plano Trabuco Rd. from Joshua Dr. to Las Amigas Dr. In addition, pipelines should be added in Rancho Cielo Dr. from Plano Trabuco to Via Del Lago and in Via Del La Luz from Rancho Cielo Dr. to Via Del Lago.

In the northern portion of the Robinson Ranch zone, additional pipelines are recommended north of Robinson Ranch Rd. A six-inch diameter pipeline should be constructed from Cimmaron Ln. west along the nursery property line for approximately 2,300 feet to north of Mill Stream Rd. From this point, a four-inch diameter pipeline is recommended to extend directly south to Mill Stream Rd., follow Mill Stream Rd. southeasterly to Country Hollow Ln., and turn south down Country Hollow Ln. to intersect with the reclaimed water pipeline in Robinson Ranch Rd. These improvements are shown graphically in **Figure 7-5**, schematically in **Table 7-2**, and are summarized in **Table 7-4**. No pump station modifications are necessary to serve these users.

Upper Robinson Ranch Pressure Zone

To serve the potential customers in this new pressure zone, it is necessary to add a new booster station, PRS, and pipelines. Two new pumps are recommended and these pumps would obtain suction from the discharge of the DCIPS, similar to the existing RRIPS, and would provide water to the Upper Robinson Ranch pressure zone. The pumps would each provide 710 gpm and would need to be approximately 75 hp. In addition, a PRS is recommended in Robinson Ranch Road for pressure relief and for redundancy. Finally, additional pipelines are recommended as summarized in **Table 7-4** and as shown in **Figure 7-5**.

Figure 7-5
Reclaimed Water System Improvements

Table 7-4
Recommended Existing System Pipeline Additions

Location	Diameter (in)	Length (ft)
Robinson Ranch Zone		
Between High Country Dr. and Weeping Willow St.	6	170
Plano Trabuco Rd.	3	1,340
Rancho Cielo Dr.	4	3,030
Via De La Luz	4	970
Property line between Cimmaron Ln. and Mill Stream Rd.	6	2,300
Between property line and Mill Stream Rd.	4	240
Mill Stream Rd.	4	730
Country Hollow Ln.	4	880
Upper Robinson Ranch Zone		
Between new Pump Station and Brookseed Dr.	10	2,730
Brookseed Dr., from end of cul-de-sac to Sentinel Dr.	8	1,430
Sentinel Dr., between Brookseed Dr. and Robinson Ranch Rd.	8	1,200
Robinson Ranch Rd., between Sentinel Dr. and Raintree Ln.	8	1,660
Robinson Ranch Rd., between Raintree Ln. and Shadow Rock Ln.	6	700
Raintree Ln., between Robinson Ranch and Porter Ranch Rds.	8	1,690
Porter Ranch Rd., between Shadow Rock Ln. and Quicksilver Dr.	6	1,800
Quicksilver Dr., between Porter Ranch Rd. and Shadow Rock Ln.	6	310
Shadow Rock Ln., between Quicksilver Dr. and Robinson Ranch Rd.	6	1,060
Total		**22,240**

FUTURE SYSTEM EVALUATION

After completion of improvements necessary to serve potential reclaimed water consumers in the South and Central planning areas, there are no additional facility improvements necessary outside of additional reclaimed water storage. Reclaimed storage of 130 ac-ft (in addition to the 90 ac-ft needed for existing conditions) is recommended.

RECLAIMED WATER STORAGE

As discussed above, the District needs to acquire at least 220 acre-ft of reclaimed water storage to meet existing and future requirements. This storage volume could be larger depending on the District's goals and the patterns of supply and demand. For example, if storage of other non-potable water (such as groundwater from the Rose Canyon and Lang wells) is contemplated, then

additional storage capacity would be required. Similarly, the monthly demand pattern of non-potable users compared to supply availability may dictate a different storage volume. The size of storage would also be dictated by the desired frequency of bypassing flows to the SMWD wastewater system.

A storage analysis was performed to assess the adequacy of the 84-day storage criteria. This analysis assumed a monthly demand distribution based on typical evapotranspiration and precipitation data for the Trabuco Canyon area and uniform monthly reclaimed water production. Demand and supply are both assumed to average 1.35 mgd for build-out conditions. The analysis shows that 84-days of storage (350 acre-ft) may not provide sufficient storage to eliminate the need to bypass wastewater flows to SMWD in winter months. Under the assumptions used, a storage volume of as much as 115 days, or 470 acre-ft at build-out flowrates is required to avoid bypassing. It should be emphasized that this storage analysis is very sensitive to the reclaimed water demand and supply assumptions. Currently, there is only two years of reclaimed water billing data available. During this period, reclaimed water demands varied significantly due to weather conditions and the addition of new users making this data non-representative. The District should closely monitor reclaimed water demands to determine the expected range in monthly demands. In addition, the District should determine how frequently and under what conditions bypassing of flows to SMWD is desirable in the future. These data and criteria would be used in further evaluating the storage requirements.

The siting of new storage is outside of the scope of this master plan. However, based on discussions with District staff and review of topographic maps of the area, there are several potential options available for reclaimed water storage:

- Enlarge the existing reclaimed water storage reservoir
- Store reclaimed water in Dove Lake
- Construct new storage in a watershed near the RRWWTP
- Work in conjunction with SMWD to utilize a portion of SMWD's Portola Reservoir

Expansion of the existing reclaimed water reservoir is not likely to be viable given the limited space available at the existing site. Consequently, other options must be considered.

Dove Lake currently stores local runoff. To use this facility for reclaimed water storage, a means of bypassing storm flows and providing downstream flood protection would be required. The RWQCB requires that reclaimed water storage facilities must be protected against 100-year frequency peak storm flows. This may be difficult at Dove Lake given the size of the watershed and the rapid rate of inflow during storm events. It may be more practical to continue using Dove Lake to store local runoff for use as make-up water in the reclaimed water system.

Construction of a new reservoir could provide the necessary storage capacity needed. A suitable site should ideally have a narrow dam site to minimize construction costs while maximizing storage volume. The site should be reasonably close to the RRWWTP and at a comparable

elevation to the existing storage to minimize conveyance and pumping costs. Reservoir siting necessarily must include a detailed geologic investigation to ensure technical feasibility. Detailed environmental analysis will also be required to minimize adverse environmental impacts. In addition, an evaluation of property ownership is required. Due to the urgent need for additional storage, the District should proceed immediately with the necessary investigations to locate a feasible reclaimed water storage site.

Section 8
Capital Improvement Program

The capital improvement program (CIP) defines the District's planned expenditures for current and future system improvements. In this section, all of the improvements recommended in previous sections are compiled, and opinions of probable construction cost are identified. A discussion of the phasing of recommended improvements is presented along with the rationale for making improvements at particular levels of District development. "Trigger points" are defined and listed for recommended improvements so that the District has an identification of improvement timing, related to actual District growth rate, as opposed to projected calendar year. Capital costs for improvements that serve both existing and future needs are allocated between existing and future users. This information will be used to develop the basis for system connection charges to be developed separate from this master plan. This section also presents a discussion of environmental documentation needs in relation to the recommended improvements and guidelines for future updates to this Master Plan.

COST CRITERIA

Opinions of probable capital costs are based on data obtained from industry manufacturers and from Montgomery Watson's experience working on similar master planning projects. Pipeline, reservoir, and pump station costs have been calculated using recent cost data for work completed by Montgomery Watson in other communities. In addition, recent pipeline construction costs were received from Santa Margarita Water District for comparison purposes. All estimates have been adjusted to an Engineering News Record Construction Cost Index of 6,865 (Los Angeles, October, 1998) and are consistent with the American Association of Cost Engineers guidelines for developing reconnaissance-level estimates, which should range between 50 percent above and 30 percent below actual capital expenditures. Because this is a master plan-level document, a 30 percent contingency is included in the estimated construction costs. As more details regarding construction issues become apparent and the recommended projects proceed through the design process, many of the unknown issues will be resolved and the contingency can be lowered. The contractor's overhead and profit are included in the cost estimates. Engineering, administration, and legal (EA&L) costs are estimated to be 25 percent of construction costs. Therefore, the total add-on to the construction costs, including the 30 percent contingency and the 25 percent EA&L, is 62.5 percent. Costs for acquisition of land, rights-of-way and easements are not included.

Cost estimates are based on assumptions regarding the location and types of facilities to be constructed in the future. Pressure water pipelines and sewer force mains are assumed to be constructed with four feet of cover. Potable and reclaimed water pipeline cost estimates include a 20 percent allowance for appurtenances such as valves, hydrants, fittings, and others. Gravity sewer pipelines are constructed at varying depths, dependent upon the required slopes. The costs for sewer pipelines assume construction at depths of 10 to 14 feet and include manholes. However, no allowance has been included for groundwater dewatering during construction, rock excavation, soil contamination, or house laterals.

All cost tables present the total unit cost including contingency, engineering, administrative, and legal costs as described above. No effort was made to determine probable estimates of costs for facilities outside of those necessary for District system improvements.

Preliminary costs have been developed for new reclaimed water storage based on an assumed reservoir site east of the existing reservoir. New reclaimed water storage is assumed to be constructed using a roller-compacted concrete dam having a crest length of 400 feet, crest width of 12 feet, a 90 feet height, vertical upstream face and a 0.7:1 sloping downstream face. Such a dam would store approximately 90 acre-ft of water to satisfy existing requirements. Assuming $80/cubic yard plus 62.5 percent for contingency, engineering, administration, and legal costs results in an order-of-magnitude unit cost of $50,000/acre-ft of storage. Land acquisition costs are not included since specific sites have no been evaluated in detail. It is recommended that the District conduct a detailed evaluation of potential dam sites and other options for reclaimed water storage.

Costs for certain water and wastewater treatment improvements are presented in Sections 4 and 6, respectively. These costs are based on typical costs for the types of improvements and expansion capacity required for each facility. Pipeline costs were estimated to be more expensive, on a unit-cost basis, for installation lengths less than 1,000 feet.

PHASING AND COSTS OF RECOMMENDED IMPROVEMENTS

It is of critical importance that the District be able to phase the recommended improvements in a manner that is tied to development. If development occurred exactly as desired for smooth implementation of recommended facilities, then all of the developments that benefit from a particular improvement would come on-line simultaneously. What is more likely to happen is that development will occur in sporadic locations, driven by rationale outside of District control. This type of development pattern is typical and the goal is to provide the District with a method of responding to this development, in the most economical fashion possible.

Parcels already identified for short-term development have been listed and graphically represented on **Figure 2-3**. Development typically occurs in clusters. One explanation for this is that when the District constructs the improvements necessary to support particular parcels, it is easier for neighboring parcels to develop because they would then have access to water, wastewater, and, in some cases, reclaimed water service. Another way of looking at this is that the phasing of water, wastewater, and reclaimed water facilities must occur in conjunction with each other as any area that needs one service, typically needs the others. This understanding of development patterns was utilized to develop the anticipated order of facility recommendations listed in the CIP.

As detailed in Sections 4, 5, 6, and 7, improvements have been recommended for both existing and build-out conditions for the water, wastewater, and reclaimed water systems, respectively. Both our understanding of the system's existing needs and conversations with District staff regarding the recommended improvements indicated that many of the recommended

improvements are necessary "as soon as possible". In addition, some capital improvements may be done in-house by District staff as time and resources become available.

The CIP has been developed in three phases. The first phase covers for existing needs through the next six years (Year 2000-2005 Existing CIP). The second phase covers new development expected by 2010 (Year 2000-2010 Future CIP), and for the remainder of new development to build-out (Year 2011 to Build-Out Future CIP). These CIPs are presented in **Tables 8-1** through **8-3** and are summarized in **Table 8-4**.

Table 8-1
Year 2000-2005 Existing CIP

Description	Size/Capacity	Total Cost[1]
WATER		
Construct DWTP Backwash Storage Tank	0.18 MG	$ 270,000
Construct Baffled Clearwell at DWTP	0.1 MG	190,000
Improve DWTP Disinfection System[2]	Lump sum	20,000
Spare Pump and Motor at DWTP	300 hp	50,000
Construct Microfiltration Plant for Rose and Lang Wells	1.6 mgd	3,660,000
Construct New Reservoir at Harris Grade Site[3]	3.0 MG	1,530,000
Demolish: Harris Grade Reservoir No. 2[3]	Lump sum	20,000
Recoat, EQ-proof, install OSHA ladder: Rose Canyon Reservoir	Lump sum	130,000
Recoat, EQ-proof, install OSHA ladder: Cooks Reservoir	Lump sum	70,000
Install Canyon Creek Fire Pump	150 hp	320,000
Install Rose Canyon Pump Station Generator	200 kW	50,000
Install 8-in pipe in Mountain View Rd.	800 feet	110,000
Install 8-in pipe in Via Del Lago St.	500 feet	70,000
Install 8-in pipe in Via Del Lago St.	600 feet	90,000
Year 2000 Water Subtotal		**$6,580,000**
WASTEWATER		
Implement RRWWTP Title 22 Improvements	See Table 6-5	1,040,000
Construct Additional Reclaimed Reservoir Storage[4]	90 ac-ft	4,500,000
Pressure grout cracks at Golf Club Sewer Lift Station	Lump sum	30,000
Implement corrosion and odor control improvements at Via Alegre Sewer Lift Station	Lump sum	100,000
Pressure grout cracks at Heritage Sewer Lift Station	Lump sum	30,000
Install standby generator in Heritage Sewer Lift Station	150 kW	40,000
Year 2000 Wastewater Subtotal		**$5,740,000**

Table 8-1
Year 2000-2005 Existing CIP
(Continued)

Description	Size/Capacity	Total Cost[1]
RECLAIMED WATER		
Install Upper Robinson Ranch Irrigation Booster Sta.	150 hp	600,000
Install Robinson Ranch Rd. PRS	Lump sum	130,000
Install 6-in pipe in High Country/Weeping Willow	170 ft	20,000
Install 3-in pipe in Plano Trabuco Rd.	1,340 ft	100,000
Install 4-in pipe in Rancho Cielo Dr.	3,030 ft	280,000
Install 4-in pipe in Via De La Luz	970 ft	90,000
Install 6-in pipe down property line	2,300 ft	200,000
Install 4-in pipe in Property line to Mill Stream Rd.	240 ft	30,000
Install 4-in pipe in Mill Stream Rd.	730 ft	70,000
Install 4-in pipe in Country Hollow Ln.	880 ft	80,000
Install 10-in pipe from New PS to Brookseed Dr.	2,730 ft	240,000
Install 8-in pipe in Brookseed Dr.	1,430 ft	140,000
Install 8-in pipe in Sentinel Dr.	1,200 ft	120,000
Install 8-in pipe in Robinson Ranch Rd.	1,660 ft	160,000
Install 6-in pipe in Robinson Ranch Rd.	700 ft	70,000
Install 8-in pipe in Raintree Ln.	1,690 ft	170,000
Install 6-in pipe in Porter Ranch Rd.	1,800 ft	160,000
Install 6-in pipe in Quicksilver Dr.	310 ft	40,000
Install 6-in pipe in Shadow Rock Ln.	1,060 ft	100,000
Year 2000 Reclaimed Water Subtotal		**$2,800,000**
Year 2000 Improvements Total		**$15,120,000**

Note:
1. All costs rounded to next higher ten thousand dollars.
2. Need for new disinfection system to be based on a detailed plant evaluation.
3. Assumes demolition of Harris Grade No. 2 and construction of a new 3.0 MG reservoir at the Harris Grade site instead of constructing a new 2.6 MG reservoir.
4. Cost is based on order of magnitude estimate for a roller-compacted concrete dam across canyon near the RRWWTP. A detailed site evaluation is required to better define this estimate.

Table 8-2
Year 2000-2010 Future CIP

Description	Size/Capacity	Total Cost[1]
WATER		
Construct Upper Harris Grade Reservoir	3.0 MG	1,530,000
Construct Upper Harris Grade Booster Station	50 hp	250,000
Install 12-in pipe in Santiago Canyon Rd.	2,300 feet	330,000
Install 8-in Upper Harris Grade BS piping	400 feet	60,000
Install 8-in pipe in Live Oak Canyon Rd.	1,700 feet	170,000
Install 8-in pipe in Live Oak Canyon Rd.	2,700 feet	260,000
Install 8-in pipe in Hamilton Truck Trail	5,300 feet	510,000
Install 8-in pipe in Upper Harris Grade Easement	1,200 feet	120,000
Install 8-in pipe in Upper Harris Grade Easement	2,500 feet	240,000
Install 8-in pipe in Canyon Creek Property	3,100 feet	300,000
Year 2010 Water Subtotal		**$3,770,000**
WASTEWATER		
Expand RRWWTP	0.5 mgd	6,440,000
Construct Additional Reclaimed Reservoir Storage[2]	130 ac-ft	6,500,000
Install Live Oak Sewer Lift Station	200 hp	1,620,000
Install Nursery Sewer Lift Station	200 hp	1,620,000
Install 8-in gravity pipe in Live Oak Canyon Rd.	4,500 feet	950,000
Install 8-in gravity pipe in Live Oak Canyon Rd.	12,500 feet	2,630,000
Install 8-in gravity pipe in Rose Canyon Rd.	4,500 feet	860,000
Install 8-in gravity pipe in Trabuco Creek Rd.	11,100 feet	2,110,000
Install 8-in gravity pipe in Trabuco Canyon Rd.	3,300 feet	630,000
Install 10-in gravity pipe in Trabuco Canyon Rd.	900 feet	190,000
Install 12-in gravity pipe in Trabuco Canyon Rd.	4,900 feet	1,160,000
Install 8-in gravity pipe in Hunky Dorie Ln.	2,000 feet	380,000
Install 8-in gravity pipe in Lambrose Canyon Rd.	3,200 feet	610,000
Install 10-in force main in Trabuco Canyon Rd.	15,800 feet	2,690,000
Additional Localized Facilities[3]	Lump sum	2,170,000
Year 2010 Wastewater Subtotal		**$30,560,000**
Year 2010 Improvements Total[4]		**$34,330,000**

Note:
1. All costs rounded to next higher ten thousand dollars.
2. Cost is based on order of magnitude estimate for a roller-compacted concrete dam across canyon near the RRWWTP. A detailed site evaluation is required to better define this estimate.
3. An allowance of 15 percent of the collection system cost is included for special construction such as local lift stations and creek crossing. The allowance does not include sewer lines serving individual streets and homes.
4. No reclaimed water system improvements are recommended for this time period.

Table 8-3
Year 2011 to Build-Out Future CIP

Description	Size/Capacity	Total Cost[1]
WATER		
Upgrade Plano/Trabuco Booster Pump Station	100 hp	$30,000
Year 2020 Water Subtotal		**$30,000**
WASTEWATER		
Install 8-in gravity pipe in T.O. Dr./Hamilton Truck Tr.	9,900 feet	1,890,000
Install 8-in gravity pipe in Rose Canyon Rd.	5,400 feet	1,030,000
Install 8-in gravity pipe in Adkinson Ln.	500 feet	100,000
Install 8-in gravity pipe in Sycamore Dr.	2,200 feet	420,000
Install 8-in gravity pipe in Mountain View Rd.	2,000 feet	380,000
Install 8-in gravity pipe in Flanagan Rd.	2,000 feet	380,000
Additional Localized Facilities[2]	N/A	440,000
Year 2020 Wastewater Subtotal		**$4,640,000**
Year 2020 Improvements Total[3]		**$4,670,000**

Note:
1. All costs rounded to next higher ten thousand dollars.
2. An allowance of 15 percent of the collection system cost is included for special construction such as local lift stations and creek crossing. The allowance does not include sewer lines serving individual streets and homes.
3. No reclaimed water system improvements are recommended for this time period.

Table 8-4
Summary of Recommended CIP Costs

Description	Total Cost ($)
Year 2000-2005 Existing CIP	
Water	$6,580,000
Wastewater	5,740,000
Reclaimed Water	2,800,000
Subtotal	**$15,120,000**
Year 2000-2010 Future CIP	
Water	3,770,000
Wastewater	30,560,000
Subtotal	**$34,330,000**
Year 2011 to Build-Out Future CIP	
Water	30,000
Wastewater	4,640,000
Subtotal	**$4,670,000**
Grand Total	**$54,120,000**

Figure 8-1 presents a chart of annual expenditures for each of the three systems. This chart assumes uniform annual expenditures for each of the CIP stages. Actual annual expenditures would primarily be a function of development trends. Since most new facilities are required to serve new development, it is anticipated that the property developers will fund these capital improvements either through connection fees or reimbursement agreements. Capital improvements to meet existing user requirements will likely be funded by the District and, hence, would be a function of District funding capabilities.

SENSITIVITY ANALYSIS

All improvements identified as necessary between now and build-out are included in the three CIP tables above and anticipated years of implementation have been identified. These years of implementation are based on assumed development patterns. For example, the improvements recommended in the Year 2010 CIP are based on the assumption that the parcels identified in **Figure 2-3** will develop by the year 2010. However, it is likely that the actual sequence of development will occur in a different pattern than anticipated.

Some recommended improvements are necessary irrespective of development, for example, improvements for fire protection of existing customers and implementation of additional reclaimed water storage volume. All of the improvements recommended as part of the Year 2000 CIP are for current conditions and therefore, these improvements are not sensitive to levels and timing of development. The improvements recommended as part of the Year 2010 and Year 2020 CIPs, however, are sensitive to development and are recommended based on the development as shown in **Figure 2-3**.

Improvement recommendations are organized into groups based on geography and the components in each group should be implemented together. In reviewing the recommended improvements, it is obvious that there are seven general geographic areas of improvement, when looking at the Year 2010 and 2020 improvements only. These general areas are listed below:

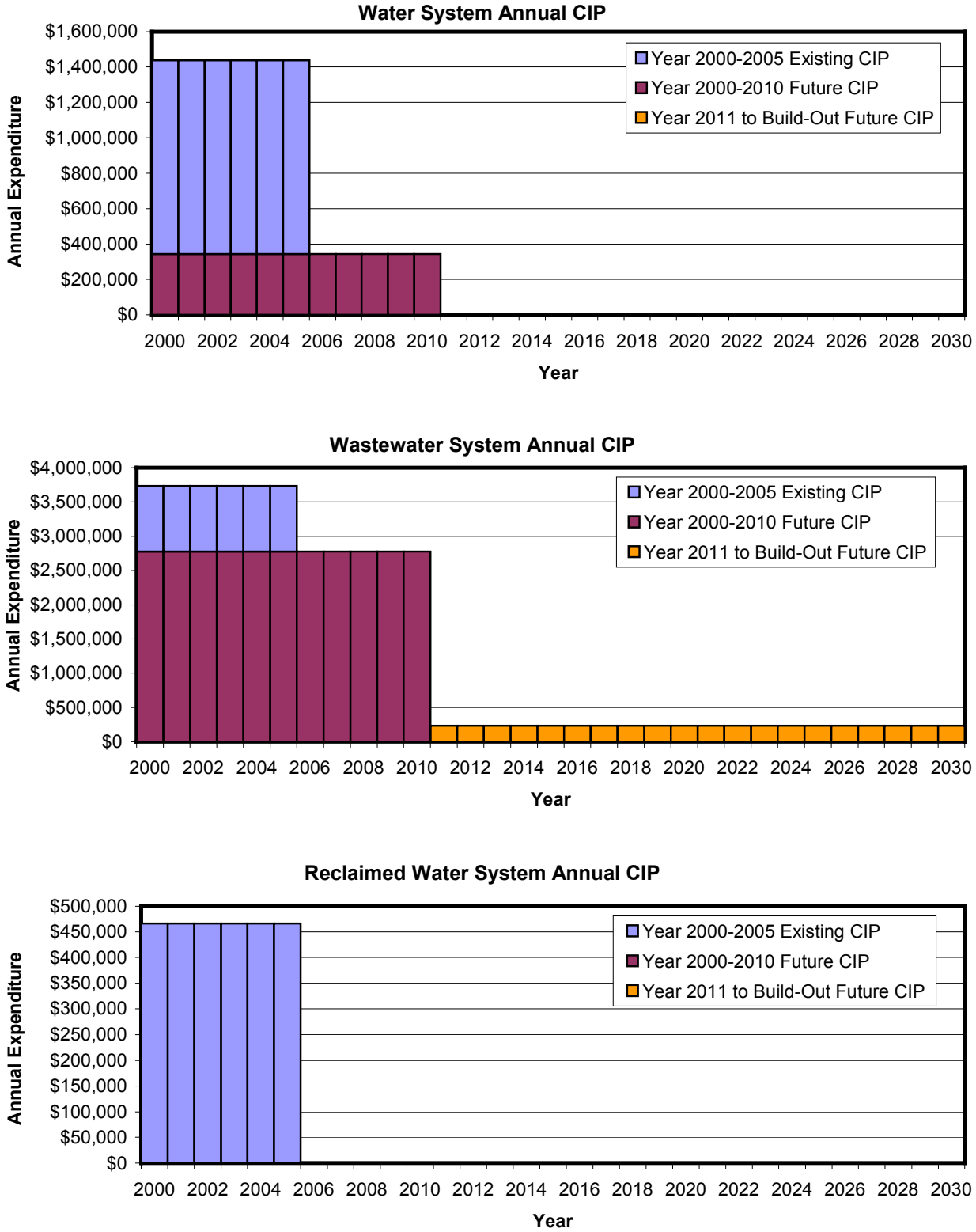
Water

- Upper Harris Grade - a large number of improvements are required for implementation at the same time to create this new pressure zone. The timing for this improvement depends on the development along the north portion of Live Oak Canyon Road down to the Canyon Creek zone and developments along Hamilton Truck Trail. It is assumed that this water system improvement will be implemented in conjunction with a wastewater collection improvement to serve the same area. This has been identified as the Live Oak Canyon Road Gravity Sewer improvement.

Wastewater

- Live Oak and Nursery Sewer Lift Stations in conjunction with the Trabuco Canyon Road Force Main - This improvement allows wastewater from the five primary gravity sewers to be transported to the RRWWTP. This improvement will not be recommended by itself, but will be recommended as part of the first of the five primary gravity sewers to be required.

Figure 8-1
Proposed Capital Improvement Program Expenditures



- Live Oak Canyon Road Gravity Sewer - The timing for this improvement depends on the development along Live Oak Canyon Road. In addition, construction of this improvement requires that the Trabuco Canyon Road Force Main and Lift Stations be operational.
- Hamilton Truck Trail/Trabuco Oaks Drive Gravity Sewer - The timing for this improvement depends on the development along Hamilton Truck Trail and Trabuco Oaks Drive. In addition, construction of this improvement requires that the Trabuco Canyon Road Force Main and Lift Stations be operational.
- Rose Canyon Drive Gravity Sewer - The timing for this improvement depends on the development along Rose Canyon Drive. In addition, construction of this improvement requires that the Trabuco Canyon Road Force Main and Lift Stations be operational.
- Trabuco Creek Drive Gravity Sewer - The timing for this improvement depends on the development along Trabuco Creek Drive. In addition, construction of this improvement requires that the Trabuco Canyon Road Force Main and Lift Stations be operational.
- Trabuco Canyon Road Gravity Sewer - The timing for this improvement depends on the development along Trabuco Canyon Road. In addition, construction of this improvement requires that the Trabuco Canyon Road Force Main and Lift Stations be operational.

Based on the assumed development by the year 2010, as shown in **Figure 2-3**, several of the improvements listed above will be necessary to provide service. It is assumed that the Upper Harris Grade pressure zone will need to be constructed upon the development of either the Edgar 4-S Ranch North, Edgar 4-S Ranch South, or Saddleback Meadows, all of which are anticipated by year 2010. This will also necessitate the construction of the Live Oak Canyon Road gravity sewer and the Live Oak and Nursery Sewer Lift Stations in conjunction with the Trabuco Canyon Road Force Main.

No appreciable developments are anticipated along the Hamilton Truck Trail/Trabuco Oaks Drive gravity sewer by the year 2010 and so this improvement is assumed to be necessary in the year 2020 CIP. With respect to the Rose Canyon Drive gravity sewer, the Rose Canyon and Ferber properties are anticipated to develop by year 2010 and so approximately 4,530 feet of this improvement will be required. The additional 5,370 feet will be necessary in the year 2020 CIP. Both the Porter and Hinrichs (Porter) properties are anticipated to be developed by year 2010 and so the Trabuco Creek Drive gravity sewer will need to be constructed as part of the year 2010 CIP. Finally, the Nursery property is also anticipated to be developed by year 2010, which will drive the need for the Trabuco Canyon Road gravity sewer.

The trigger point for implementing a given system improvement is a developer's request for service from the District. This request starts a review process by the District to determine if the existing facilities are adequate to provide service. If the existing facilities are inadequate to meet the needs of the development, then design and construction of the propose facilities would commence. When development occurs at different time periods or in a different order than assumed in Section 2, the timing for construction of recommended improvements accelerate or decelerate. Furthermore, if additional parcels along a different gravity sewer begin the development process, then they should be reviewed with respect to dates anticipated for

scheduled gravity sewers. The District should use this master plan as a guide in determining what facilities must be constructed and paid for by an individual developer or group of developers.

Many of the parcels that are expected to develop will also require on-site water, sewer or reclaimed water facilities to serve the individual tract. In this case, it is recommended that the developer (or developers) fund the preparation of a subarea master plan. The subarea master plan would define the specific facilities needed to meet the on-site facility needs and identify the points of connection to the District's facilities. If several parcels develop simultaneously, the subarea master plan could identify those facilities that could jointly serve all of the parcels (such as booster pumps, reservoirs, etc.)

There is no way to link recommended improvements to the number of connections or the District's population, because the important information is knowing exactly where in the District each developing parcel is located. The one exception to this is the expansion of the RRWWTP, which should be implemented based on the anticipated amount of wastewater being generated. The average wastewater flow at the RRWWTP in year 2010 will be 0.92 mgd based on development of properties shown in **Figure 2-3.** will be 0.92 mgd This flow exceeds the current treatment plant capacity of 0.85 mgd. The RRWWTP expansion, as described in Section 6, can be performed in a modular fashion. It is recommended that a pre-design of the expansion be conducted in the near future so that proper staging of expansion components can take place at the appropriate time.

ADDITIONAL INVESTIGATIONS AND ON-GOING PROGRAMS

There are several specific investigations that have been recommended in this master plan update. These investigations include:

- Preparation of a reclaimed water seasonal storage reservoir site evaluation study
- Preparation of a pre-design study for modifications to the RRWWTP
- Evaluation of wastewater flows from IRWD into the District's Portola Hills sewers
- Evaluation of changing billing/accounting from being based on the number EDUs (number of water fixtures) to being based on the size of the service connection
- Preparation of a study to evaluate the feasibility of treating the Rose Canyon and Lang wells
- Evaluation of the District's capabilities of meeting the new Disinfectants/Disinfection By-products Rule.

The District should also continue a number of on-going programs including but not limited to:

- Updating and maintaining all District atlas sheets
- Maintaining and replacing defective water and reclaimed water meters
- Maintaining all District facilities to ensure reliable operations

ENVIRONMENTAL REVIEW REQUIREMENTS

The California Environmental Quality Act (CEQA) requires the preparation of environmental documents for discretionary projects involving governmental participation, financing or approval. The purpose of CEQA is to:

1. Inform governmental decision-makers and the public about the potential significant environmental effects of proposed activities.
2. Identify the ways that environmental damage can be avoided or significantly reduced.
3. Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes are feasible.
4. Disclose to the public the reasons why a governmental agency approved the project if significant environmental effects are involved.

The CEQA process is defined in guidelines prepared by the Governor's Office of Planning and Research. The typical environmental review process involves the steps listed below:

1. Lead Agency determines whether the project is subject to CEQA requirements.
2. Lead Agency determines whether the project is exempt from CEQA requirements. If exempt, a Notice of Exemption may be prepared and posted.
3. If the project is not exempt, the Lead Agency may prepare an Initial Study to determine whether the project will have a significant impact on the environment.
4. If the project will have a significant impact on the environment that cannot be mitigated, the Lead Agency must prepare an environmental impact report (EIR).
5. If the project will not have a significant impact or if the identified impacts can be mitigated to a less-than-significant level, the Lead Agency prepares and circulates a negative declaration for a 30-day public review period.
6. If an EIR is prepared, the Lead Agency prepares a Notice of Preparation (NOP) to inform the public that an EIR will be prepared. A 30-day period is allotted for receipt of comments on the NOP.
7. Following preparation of the EIR, it is circulated to the public as a draft EIR for review for a period of at least 45 days. The Lead Agency may conduct a public hearing during the review period.
8. After the conclusion of the review period, the Lead Agency responds to comments on the Draft EIR and prepares a Final EIR.
9. The Lead Agency prepared findings and adopts the Final EIR and the Mitigation Monitoring and reporting Program.

When the "project" involves a series of smaller projects that will be implemented in phases, the guidelines allow the Lead Agency to prepare a Master EIR. The Master EIR evaluates the cumulative impacts of implementing all of the individual projects and streamlines the later environmental review of projects at the time of implementation. The District has the option of

preparing a Master EIR on this master plan. This would allow it to proceed with many of the future projects which are well-defined with minimal additional environmental review. Major projects or projects that are not well-defined in the master plan would still require separate environmental review and documentation. Frequently, the construction of new utility facilities are included in the CEQA documentation for a given development. When this happens, the District should require the developer to include any off-site facilities that support the development in its CEQA documents.

Appendix A
References

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Appendix B
Summary of Current and Future Drinking Water Regulations

INTRODUCTION

This appendix describes the content of the present federal and state drinking water regulations (with an emphasis on regulations that apply to groundwater sources). It also contains a discussion of future regulations that will affect drinking water systems. The information is current as of March 1999.

Safe Drinking Water Act and Amendments

The Safe Drinking Water Act (SDWA, Public Law 99-339), originally enacted in 1974, gave the federal government, through the Environmental Protection Agency (EPA), the authority to set standards for drinking water quality in water delivered by community (public) water suppliers. In 1986, Congress passed sweeping amendments to the SDWA (PL 99-339). Included in the 1986 amendments were requirements for the EPA to set standards for 83 compounds within three years, requirements to establish criteria for filtration of surface water supplies, as well as requirements for all public water systems to provide disinfection. In August 1996, Congress passed a new set of Amendments to the SDWA (PL 104-182). The new Amendments will impact the process EPA uses to establish drinking water standards and will specifically impact the standard-setting process for radon, arsenic, sulfate, disinfection by-products, and ground water disinfection.

California Safe Drinking Water Act

The California Safe Drinking Water Act is contained in Health and Safety Code sections 4010 through 4037.5. The primacy agency for California is the Department of Health Services (DHS). California drinking water regulations are contained in Title 22, Chapters 15 through 17, "Domestic Water Quality and Monitoring Regulations" sections 64400 through 64692. As a primacy state, California drinking water regulations must be at least as stringent as federal regulations. State regulations can be more stringent than federal requirements.

SUMMARY OF EXISTING REGULATIONS

The EPA has established the following water quality regulations that apply to water treatment plants and distribution systems:

- The EPA National Primary Drinking Water Regulations (NPDWR, 1975); originally adopted standards for 22 compounds as "interim" standards in 1975. After the 1986 Amendments to the SDWA, these are no longer referred to as "interim" standards.

- The EPA Secondary Drinking Water Regulations (EPA, 1979, 1991); advisory in nature and to be applied as determined by the states.
- EPA's Trihalomethane Regulation (EPA, 1979).
- EPA Requirements for Special Monitoring (EPA, 1980) for Sodium and Corrosivity Characteristics.
- EPA's Phase I Regulations for 8 Volatile Organic Compounds (final July 1987); Phase I package includes requirements for monitoring unregulated compounds.
- EPA's Surface Water Treatment Rule (SWTR) (final June 29, 1989).
- EPA's revised Total Coliform Rule (TCR) (final June 29, 1989).
- EPA's Phase II Regulations for Synthetic Organic Compounds and Inorganic Compounds) (final January 30, 1991, and July 1991).
- EPA's Lead and Copper Rule (final June 7, 1991).
- EPA's Phase V Drinking Water Regulations (final July 17, 1992): covering 23 inorganic and organic compounds.
- EPA's Stage 1 D/DBP Rule and the Interim Enhanced Surface Water Treatment Rule (final December 16, 1998).

As a primacy state, California has adopted regulations at least as stringent (more stringent in several instances) as the federal regulations.

Inorganic Contaminants

Table B-1 presents the current federal and state MCLs for inorganic chemicals.

In 1993, California passed a law requiring public water systems with 10,000 or more service connections to fluoridate their water supplies. The fluoridation requirement is contingent upon DHS acquiring sufficient funding to cover the capital and operation and maintenance costs of fluoridation for each public water system. The California Fluoridation 2000 Workgroup was established and charged with the task of finding monies to implement the fluoridation requirement. To date, a $10 million grant has been received from the California Endowment (a philanthropic organization established by Blue Cross/Blue Shield). DHS developed fluoridation regulations specifying minimum and maximum levels of fluoride in drinking water. The regulations also include a list of affected public water systems, ranked in order based on the lowest cost per service connection to install fluoridation treatment facilities. Affected public water systems were to prepare capital cost estimates for installing fluoridation equipment for review by DHS. (As part of the new State regulation for fluoride, DHS adopted an MCL of

2 mg/L, together with **Table B-2** below which presents optimal, low and high fluoride concentrations for different temperatures.)

Total Trihalomethanes

California drinking water regulations cite the federal standard for trihalomethanes. The current state and federal standard for THMs is 0.10 mg/L and applies to systems serving over 10,000 people that apply a disinfectant. Compliance with the MCL is based on a running annual average of quarterly averages of distribution system samples.

Table B-1
Federal and State MCLs - Inorganic Chemicals

Contaminant	Federal MCL(mg/L)	State MCL(mg/L)	State MCL same as Federal MCL?
Aluminum	-	1	No
Antimony	0.006	0.006	Yes
Arsenic	0.05	0.05	Yes
Asbestos	7 MFL[a]	7 MFL	Yes
Barium	2	1	No
Beryllium	0.004	0.004	Yes
Cadmium	0.005	0.005	Yes
Chromium	0.1	0.05	No
Cyanide	0.2	0.2	Yes
Fluoride	4	2	No
Mercury	0.002	0.002	Yes
Nickel	-	0.1	No
Nitrate	10 (as N)	10 (as N)	Yes
Nitrite	1 (as N)	1 (as N)	Yes
Total Nitrate and Nitrite	10 (as N)	10 (as N)	Yes
Selenium	0.05	0.05	Yes
Thallium	0.002	0.002	Yes

Note: [a] MFL = million fibers per liter greater than 10 microns in length

On December 16, 1998, the U.S. Environmental Protection Agency (EPA) published the final Stage 1 Disinfectants/Disinfection By-Products (D/DBP) Rule. The Stage 1 D/DBP Rule lowered the existing standard for trihalomethanes (THM) as well as established new standards for disinfectants and other byproducts. The Stage 1 D/DBP Rule includes the following:

- Lowers the existing THM standard from 0.10 mg/L to 0.080 mg/L
- Establishes new standards for haloacetic acids (HAAs) at 0.060 mg/L, bromate at 0.010 mg/L and chlorite at 1.0 mg/L

Table B-2
Optimal Fluoride Levels

Annual average of maximum daily air temperatures, degrees		Optimal fluoride level, mg/L	Control Range, mg/L	
Fahrenheit	Celsius		Low	High
50.0 to 53.7	10.0 to 12.0	1.2	1.1	1.7
53.8 to 58.3	12.1 to 14.6	1.1	1.0	1.6
58.4 to 63.8	14.7 to 17.7	1.0	0.9	1.5
63.9 to 70.6	17.8 to 21.4	0.9	0.8	1.4
70.7 to 79.2	21.5 to 26.2	0.8	0.7	1.3
79.3 to 90.5	26.3 to 32.5	0.7	0.6	1.2

- Establishes Maximum Residual Disinfectant Levels (MRDLs) for chlorine (4 mg/L), chloramines (4 mg/L), and chlorine dioxide (0.8 mg/L) within the distribution system
- Establishes enhanced coagulation requirements wherein certain systems must achieve specific reductions of DBP precursor material (as measured by Total Organic Carbon concentrations)
- Applies to all public water systems
- Includes an MCLG of zero for chloroform as originally proposed in July 1994 (and not an MCLG of 300 µg/L as was proposed in a March 1998 Notice of Data Availability)

Large surface water systems (serving greater than 10,000 people) must comply with the Stage 1 D/DBP Rule by December 16, 2001. Ground water systems and small surface water systems must comply by December 16, 2003.

Regulated Organics

Volatile Organic Chemicals

Table B-3 presents the federal and state maximum contaminant levels for volatile organic chemicals.

Synthetic Organic Chemicals

Table B-4 presents the state and federal MCLs for synthetic organic contaminants.

Total Coliform Rule (TCR)

On June 29, 1989, EPA promulgated a revised regulation for total coliforms. Where the previous regulation was based on the density of coliforms in a given volume of water, the revised rule is based on the presence/absence of coliforms. Under the TCR, utilities must develop a monitoring plan to collect samples representative of water throughout the distribution system. The number of samples collected each month is based on population served. Additionally, positive coliform

samples must be analyzed for fecal coliforms and/or *E. coli*. Follow-up samples collected, that are positive for coliforms, must also be analyzed for fecal coliforms and/or *E. coli*.

If a routine sample is total coliform-positive, the water system must collect a set of repeat samples (three samples) within 24 hours of the positive sample. One of the follow-up samples must be from the same tap as the positive sample, and one repeat sample must be from a site within five service connections upstream of the positive site, and one repeat sample must be within five service connections downstream of the positive site. If one or more of the repeat samples is coliform positive, the utility must collect an additional set of repeat samples. The system must repeat this process until no coliforms are detected or the system is in violation of the coliform rule. All repeat samples are to be collected on the same day. The state can invalidate a positive total coliform sample under certain conditions.

Table B-3
Federal and State MCLs - Volatile Organic Chemicals

Contaminant	Federal MCL (mg/L)	State MCL (mg/L)	State MCL same as Federal MCL?
1,1-Dichloroethylene	0.007	0.006	No
1,1,1-Trichloroethane	0.2	0.20	Yes
1,1,2-Trichloroethane	0.005	0.005	Yes
1,1-Dichloroethane	--	0.005	No
1,2-Dichloroethane	0.005	0.0005	No
1,2-Dichloropropane	0.005	0.005	Yes
1,3-Dichloropropene	--	0.0005	No
1,2,4-Trichlorobenzene	0.07	0.07	Yes
Benzene	0.005	0.001	No
Carbon tetrachloride	0.005	0.0005	No
cis-1,2-Dichloroethylene	0.07	0.006	No
Dichloromethane	0.005	0.005	Yes
Ethylbenzene	0.7	0.7	Yes
Monochlorobenzene	0.1	0.07	No
o-Dichlorobenzene	0.6	0.6	Yes
para-Dichlorobenzene	0.075	0.005	No
Styrene	0.1	0.1	Yes
Tetrachloroethylene	0.005	0.005	Yes
1,1,2,2-Tetrachloroethane	--	0.001	No
Toluene	1	0.15	No
trans-1,2-Dichloroethylene	0.1	0.01	No
Trichloroethylene	0.005	0.005	Yes
Trichlorofluoromethane	--	0.15	No
1,1,2-Trichloro-1,2,2-Trifluoroethane	--	1.2	No
Vinyl chloride	0.002	0.0005	No
Xylenes (total)	10	1.750	No

Table B-4
Federal and State MCLs - Synthetic Organic Chemicals

Contaminant	Federal MCL (mg/L)	State MCL (mg/L)	State MCL same as Federal MCL?
2,3,7,8-TCDD (Dioxin)	3×10^{-8}	3×10^{-8}	Yes
2,4-D	0.07	0.07	Yes
2,4,5-TP (Silvex)	0.05	0.05	Yes
Alachlor	0.002	0.002	Yes
Atrazine	0.003	0.003	Yes
Benzo(a)pyrene	0.0002	0.0002	Yes
Bentazon	--	0.018	No
Carbofuran	0.04	0.018	No
Chlordane	0.002	0.0001	No
Dalapon	0.2	0.2	Yes
Di(2-ethylhexyl)adipate	0.4	0.4	Yes
Di(2-ethylhexyl)phthalate	0.006	0.004	No
Dibromochloropropane (DBCP)	0.0002	0.0002	Yes
Dinoseb	0.007	0.007	Yes
Diquat	0.02	0.02	Yes
Endothall	0.1	0.1	Yes
Endrin	0.002	0.002	Yes
Ethylene dibromide	0.00005	0.00005	Yes
Glyphosate	0.7	0.7	Yes
Heptachlor	0.0004	0.00001	No
Heptachlor epoxide	0.0002	0.00001	No
Hexachlorobenzene	0.001	0.001	Yes
Hexachlorocyclopentadiene	0.05	0.05	Yes
Lindane	0.0002	0.0002	Yes
Methoxychlor	0.04	0.04	Yes
Molinate	--	0.02	No
Oxamyl (vydate)	0.2	0.2	Yes
Pentachlorophenol	0.001	0.001	Yes
Picloram	0.5	0.5	Yes
Polychlorinated biphenyl (PCB)	0.0005	0.0005	Yes
Simazine	0.004	0.004	Yes
Thiobencarb	--	0.07	No
Toxaphene	0.003	0.003	Yes

The Maximum Contaminant Level (MCL) for total coliforms is as follows:

1. For a system collecting more than 40 samples per month, a non-acute violation occurs when more than 5.0 percent of the samples collected during the month total coliform-positive.

2. For systems collecting less than 40 samples per month, a non-acute violation occurs when there is more than one positive coliform sample in a given month.

3. Any fecal coliform-positive repeat sample or *E. coli* positive repeat sample, or any total coliform-positive repeat sample following a fecal coliform or *E. coli* positive routine sample constitutes an acute violation of the MCL for total coliforms.

Significant Rise in Bacterial Count

California drinking water regulations also contain language that defines a "Significant Rise in Bacterial Count." This is not considered a violation of an MCL; however, it does require notification to DHS. The two conditions that result in this classification are listed below:

1. An initial sample that is total coliform-positive is determined to be either fecal- or *E. coli*-positive, as well.

2. At least two repeat samples are total coliform-positive but neither sample is fecal coliform or *E. coli*-positive.

After notifying the DHS of a significant rise in bacterial count, the water supplier must also implement the required emergency notification plan.

California DHS Groundwater Disinfection and Monitoring Policy

In July 1994 the California DHS established a groundwater disinfection and monitoring policy. According to DHS, to "…assure that coliform contamination does not go undetected, the Department has established a raw water monitoring policy for sources which are disinfected. This policy applies to supplies which are disinfected at the source or are blended in the distribution system with other supplies which carry a disinfectant residual."

Initial monitoring of the raw water source prior to disinfection is recommended at a minimum of once a month. The DHS Policy provides recommendations for follow-up if a positive coliform bacteria is detected actions to be taken if coliform bacteria are detected on an ongoing basis. As stated in the DHS document, this policy applies only to systems that disinfect wells at the source, or blend with supplies in the distribution system that carry a disinfectant residual.

Surface Water Treatment Rule

On June 29, 1989 EPA published the final Surface Water Treatment Rule (SWTR). Under the Surface Water Treatment Rule, the general requirements are to provide treatment to ensure at least "…99.9 percent (3-log) removal and/or inactivation of *Giardia lamblia* cysts…" and at least "…99.99 percent (4-log) removal and/or inactivation of viruses…"

In the federal SWTR, for filtering systems there are several specific requirements for turbidity and disinfection. For conventional filtration systems the turbidity requirements are:

a. "…the turbidity of representative samples of a system's filtered water must be less than or equal to 0.5 NTU in at least 95 percent of the measurements taken each month…except that if the State determines that the system is capable of achieving at least 99.9 percent removal and/or inactivation of *Giardia lamblia* cysts at some turbidity level higher than 0.5 NTU."

   "The turbidity level of representative samples of a system's filtered water must at no time exceed 5 NTU…"

The federal disinfection requirements for systems that filter are as follows:

a. "The disinfection treatment must be sufficient to ensure that the total treatment processes of that system achieve at least 99.9 percent (3-log) inactivation and/or removal of *Giardia lamblia* cysts and at least 99.99 percent (4-log) inactivation and/or removal of viruses, as determined by the State."

b. "The residual disinfectant concentration in the water entering the distribution system…cannot be less than 0.2 mg/L for more than 4 hours."

"The residual disinfectant concentration in the distribution system, measured as total chlorine, combined chlorine, or chlorine dioxide, as specified in 141.74(a)(5) and (c)(3), cannot be undetectable in more than 5 percent of the samples each month, for any two consecutive months that the system serves water to the public. Water in the distribution system with a heterotrophic bacteria concentration less than or equal to 500/mL, measured as heterotrophic plate count (HPC)…is deemed to have a detectable disinfectant residual for purposes of determining compliance with this requirement."

The California SWTR provides greater details and requirements than the federal regulation with regard to operation of the treatment plant.

California Surface Water Treatment Rule

The following section presents some brief highlights from the California SWTR. As with the federal SWTR, the California regulation applies to surface water systems and ground water systems under the direct influence of surface water. Under the California SWTR, a ground water under the direct influence of surface water is defined as

> "any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae or large diameter pathogens such as Giardia lamblia, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity or pH which closely correlate to climatological or surface water conditions."

The California SWTR Guidance Manual provides additional language on the determination of whether or not a ground water is under the direct influence of surface water. Factors to be

evaluated include well construction, confined vs. unconfined aquifers, whether the ground water collectors are infiltration galleries or Ranney type collectors, analysis of turbidity, pH, temperature, particles sizes, coliform analysis and a biological analysis.

The inactivation requirements of the SWTR are based on the CT concept, where "C" is the concentration of the disinfectant at the end of the contact time, and "T" is the contact time in minutes. Public water systems are required to monitor for (1) temperature of disinfected water, (2) pH of disinfected water if chlorine is used, (3) disinfectant contact time, and (4) residual disinfectant concentration at the first customer, to determine compliance with the inactivation requirements.

California public water systems must meet the following operational criteria:

- the California SWTR provides specific maximum flow rates for a given type of filtration plant (higher filtration rates can be approved by DHS),
- when a filter is placed back in service following backwashing (or other interruption) the filtered water turbidity from that filter cannot exceed the following limits:
  - 2.0 NTU
  - 1.0 NTU in at least 90 percent of the interruption events during any consecutive 12 month period,
  - 0.5 NTU after the filter has been in operation for 4 hours.
- pressure filters are to be inspected annually,
- coagulation and flocculation unit processes are to be in use at all times the treatment plant is in operation, and
- continuous turbidity monitoring must be provided for each individual filter.

The California SWTR requires that public water systems have an operational plan that describes the treatment plant monitoring program, equipment maintenance, operating personnel, the operation of individual unit processes, emergency response procedures and reliability features. Public water systems are required to have a sanitary survey of their watershed conducted every five years.

Public water systems which construct new filtration and disinfection treatment plants or modify existing treatment plants for which permit approval is required, must meet the following design criteria:

- achieve an average daily effluent turbidity goal of 0.2 NTU for conventional, direct, and diatomaceous earth filtration plants,
- be free of structural and sanitary hazards,
- protect against contamination by backflow,
- meet capacity and pressure requirements,
- provide flow measuring and recording equipment,
- take into consideration earthquakes, fires, floods, freezing and sabotage that are reasonably foreseeable,
- provide reasonable access for inspection, maintenance, and monitoring of unit processes,

- provide for filter-to-waste for each filter unit or addition of coagulant chemical the water used for backwashing,
- provide backwash rates and surface or subsurface water facilities using air, water, or a combination thereof to clean the filter,
- provide solids removal treatment for filter backwash water if it is recycled into the treatment process, with recycled backwash water being returned to the headworks,
- provide for future addition of pretreatment facilities for direct, slow sand, or diatomaceous earth filtration plants,
- provide disinfection equipment sized for the full range of flow conditions expected,
- provide for treatment plant operation without frequent shutdowns and startups or rapid changes infiltration rates.
- whenever coagulation process is used, process selection is to be based on pilot-scale or jar tests that demonstrate effectiveness of the coagulant chemicals.

The California SWTR requires that public water systems incorporate the following reliability features:

- alarms for coagulation, filtration, and disinfection failures
- standby replacement equipment,
- continuous turbidity monitoring on combined filter effluent,
- multiple filter units which provide redundant capacity,
- alternatives can be approved by DHS.

Interim Enhanced Surface Water Treatment Rule [DJR1]

On December 16, 1998 the EPA published the final Interim Enhanced Surface Water Treatment Rule (IESWTR). The IESWTR includes the following:

- Establishes a requirement to achieve a 2-log reduction in *Cryptosporidium* for surface water systems that filter;

- Lowers the existing turbidity performance standards from 0.5 NTU in 95 percent of the monthly measurements never to exceed 5 NTU, to 0.3 NTU in 95 percent of the monthly measurements never to exceed 1 NTU;

- Public water systems meeting the new turbidity performance standards will receive credit for the required 2-log reduction in *Cryptosporidium*;

- Establishes requirements for continuous monitoring of individual filter effluents;

- Individual filters not performing adequately (as defined) require an exceptions report to the State and may require a Comprehensive Performance Evaluation;

- Establishes requirements for covers on new finished water reservoirs;

- States will be required to conduct periodic sanitary surveys (every three years);
- Certain systems must compile a disinfection profile and prepare a disinfection benchmark;
- HAA monitoring must begin within three months of publication of the final rule (quarterly monitoring of four distribution system samples for HAAs for one year) to determine if systems serving greater than 10,000 people must compile a disinfection profile and prepare a disinfection benchmark. THM and HAA monitoring to determine if a disinfection profile and a disinfection benchmark are required must occur in the same year. ICR data can be used for public water systems serving over 100,000 people.

The Interim ESWTR applies to systems utilizing surface water or ground water under the direct influence of surface water and serving greater than 10,000 people. These systems must comply by December 16, 2001.

California Cryptosporidium Action Plan

In April 1995, DHS issued its "*Cryptosporidium* Action Plan" (CAP) to facilitate compliance with the State's existing SWTR. The purpose of the plan is to clarify "existing requirements to support drinking water utilities in optimizing the treatment process and reducing the risk of a waterborne illness outbreak. The plan calls for the following actions:

1. Conducting a watershed sanitary survey every five years as required by State regulations. If cattle and/or sheep are allowed in the watershed, the survey must identify their location, number and the measures taken to prevent contamination from animal waste.
2. Submitting available data to DHS. DHS will request and evaluate summaries of data collected under the federal Information Collection Rule (ICR) and provide additional guidance on steps to minimize the threat of cryptosporidiosis to the public.
3. Perform comprehensive reviews of alternative treatment technologies for compliance with the DHS-specified effluent turbidity standard.
4. Revise plant operations plans to optimize treatment plant operations. Each plant is to update their operations plan with the goal of achieving an effluent turbidity of 0.1 NTU.
5. Ensure reliable plant operations, including the availability of on-line back-up equipment, the ability to quickly replace failed equipment, and alarm systems. In addition, all plants are to install continuous turbidity analyzers and recorders on the plant effluent.
6. Provide public notification of possible problems with the treatment process and the steps being taken to improve the treatment.

Specific requirements under the CAP are shown in **Table B-5.**

Table B-5
Summary of Cryptosporidium Action Plan

Item	Requirements
Sedimentation/Clarification Basin Effluent	1 to 2 NTU
Combined Filter Effluent	0.1 NTU
Reclaimed Backwash Water Effluent	Less than 2.0 NTU
After Filter Backwash/Filter-to-Waste	Less than 0.3 NTU

Radionuclides

Table B-6 presents the current state and federal MCLs for radionuclides.

Table B-6
Federal and State MCLs - Radionuclides

Radionuclide	Federal MCL	State MCL	State MCL same as Federal MCL?
Combined radium-226 and radium-228	5 pCi/L	5 pCi/L	Yes
Gross alpha (including radium-226, excluding radon and uranium)	15 pCi/L	15 pCi/L	Yes
Beta particle and photon activity [1]	4 millirem/year	4 millirem/year	Yes
Gross beta	--	50 pCi/L	No
Uranium	--	20 pCi/L	No

Note: 1. The average annual concentrations assumed to produce an exposure of 4 millirem/year are tritium at 20,000 pCi/L and strontium-90 at 8 pCi/L. These values are listed as MCLs in California regulations.

Lead and Copper Rule

The Lead and Copper Rule (LCR) was published June 1991 and established a treatment technique that includes requirements for home tap monitoring at worst case sites, corrosion control treatment, source water treatment, lead service line replacement, and public education. The LCR establishes "action levels" in lieu of MCLs. The action level for lead was established at 0.015 mg/L while the action level for copper was set at 1.3 mg/L. An action level is exceeded when greater than 10 percent of samples collected from the sample pool contain lead levels above 0.015 mg/L or copper levels above 1.3 mg/L. Unlike an MCL, a utility is not out of compliance with the LCR when an action level is exceeded.

Acrylamide/Epichlorohydrin

In lieu of MCLs for acrylamide and epichlorohydrin, drinking water regulations specify a treatment technique for these two compounds.

Secondary MCLs

Secondary standards are non-enforceable at the federal level. **Table B-7** presents the secondary standards in California. Surface water systems are to monitor annually for secondary standards.

Table B-7
Secondary Standards

Constituent	Secondary Standard (mg/L)
Aluminum	0.2
Chloride	500* (250; 500; 600)
Color (color units)	15
Conductance (micromhos)	1600* (900; 1,600; 2,200)
Copper	1.0
Foaming Agents (MBAS)	0.5
Iron	0.3
Manganese	0.05
MTBE	0.005
Odor, threshold	3
pH	(6.5-8.5)
Silver	0.1
Sulfate	500* (250; 500; 600)
Thiobencarb	0.001
Total Dissolved Solids	1000* (500; 1,000; 1,500)
Zinc	5

*California drinking water regulations include: "recommended," "upper" and "short term" values for these compounds. The values in this table represent the "upper" values, while the values in parentheses represent the recommended, upper, and short-term values.

Surface water systems in California are also to monitor annually for bicarbonate, carbonate and hydroxide alkalinity, calcium, iron, magnesium, manganese, sodium and total hardness. California regulations state that the secondary MCLs are not to be exceeded in water supplied to the public. The California regulations also state that if a secondary MCL is exceeded, the system may be required to conduct a study as described in the regulations.

California Action Levels

DHS has developed "Action Levels" for several dozen unregulated chemicals as shown in Table B-8**.** These Action Levels are health-based advisory levels, not enforceable standards. They are based on available scientific information to provide an adequate margin of safety to prevent potential risks to human health. DHS recommends that drinking water systems provide public notification if Action Levels are exceeded. If sources exceeding Action Levels are taken out of service, customer notification is not needed. However, drinking water systems are

Table B-8
California Drinking Water Action Levels

Contaminant	Action Level (mg/L)
Inorganic Chemicals	
Boron	1.0
Perchlorate	0.018
Organic Chemicals	
Aldicarb (Temik)[1]	0.01
Aldrin[1]	0.00005
Baygon	0.090
a-Benzene Hexachloride	0.0007
b-Benzene Hexachloride[1]	0.0003
n-Butylbenzene	0.045
Captan	0.350
Cararyl (Sevin)[1]	0.060
Chloropicrin	0.050 (0.037)[2]
2-Chlorotoluene[1]	0.045
4- Chlorotoluene[1]	0.045
Diazinon	0.014
1,2-Dichlorobenzene	0.130 (0.010)[3]
1,3-Dichlorobenzene	0.130 (0.010)[3]
Dichlorodifluoromethane[1]	1.0
Dieldrin[1]	0.00005
Dimethoate (Cygon)[1]	0.140
2,4-Dimethylphenol	0.40
1,4-Dioxane	0.003
Diphenamide	0.040
Ethion	0.035
Formaldehyde	0.030
Isopropyl N (3-Chlorophenyl) Carbamate (CIPC)	0.350
Malathion	0.160
Methyl Isobutyl Ketone (MIBK)	0.040
Methyl Parathion	0.030
Methyl-tertiary-butyl ether (MTBE)[1,4]	0.013
N-Nitrosodimethylamine (NDMA)	0.000002
Parathion	0.030
Pentachloronitrobenzene (Terrachlor)	0.0009
Phenol	0.050[5]
Trithion	0.0070

Notes:
1. Chemical is identified as “unregulated” for purposes of monitoring.
2. Taste and odor threshold.
3. Taste and odor threshold either for a single isomer or the sum of two isomers.
4. MTBE also has a secondary MCL of 0.005 mg/L.
5. Taste and odor threshold for chlorinated systems.

required to notify local governing agencies (i.e., city council and/or county board of supervisors) whenever an Action Level is exceeded in a drinking water well within 30 days of discovery or closure, even if the well is taken out of service.

Requirements for Special Monitoring for Corrosivity and Sodium

In 1980, EPA adopted monitoring requirements for sodium and corrosivity characteristics. The regulation did not adopt MCLs or specify limits for sodium or corrosivity. According to the regulations, corrosivity characteristics may be described by pH, alkalinity, hardness, temperature, total dissolved solids, and Langelier Index data. Surface water systems are required to collect an annual sample for sodium analysis, and groundwater systems are required to collect a sample every three years.

While no federal secondary standard exists for sodium, EPA has suggested a guidance level for sodium of 20 mg/L in drinking water for high risk populations (e.g. individuals with a genetic predisposition to hypertension, pregnant women, and hypertensive patients) as recommended by the American Heart Association.

Monitoring for Unregulated Contaminants

Beginning with the federal Phase I regulations (eight VOCs), drinking water utilities have been required to conduct periodic monitoring for unregulated contaminants.

Public Health Goals

Under State law, the Office of Environmental Health and Hazard Assessment establishes Public Health Goals (PHGs) for contaminants that represent the level of contaminants in drinking water that are protective of public health. PHGs are analogous to MCLGs at the federal level (in that they are based solely on health effects, while the MCLs are established taking technology and economics into consideration).

Once a PHG is final, the Department of Health Services will set the MCL as close as feasible to the PHG, taking costs and technology into consideration. **Table B-9** presents the current list of final PHGs. In addition, under California law, public water systems that serve over 10,000 service connections must prepare a brief written report providing information on any chemical that has been detected above the PHG.

Of the PHGs adopted in 1997, DHS has identified four compounds for possible MCL revisions: cyanide, DEHP, ethylbenzene, and oxamyl. DHS identified an additional nine contaminants for possible MCL revisions based on the 1999 list of PHGs: atrazine, cadmium, total chromium, DBCP, 1,2-dichloropropane, methoxychlor, thallium, 1,2,4-trichlorobenzene, and TCE.

FUTURE REGULATIONS

The following sections present information on anticipated future drinking water regulations.

Table B-9
Current Public Health Goals

Chemical	PHG (µg/L)
PHGs adopted December 1997	
Alachlor	4
Antimony	20
Benzo(a)pyrene	0.004
Chlordane	0.03
Copper	170
Cyanide	150
Dalapon	790
1,2-Dichlorobenzene	600
1,4-Dichlorobenzene	6
2,4-Dichlorophenoxyacetic acid (2,4-D)	70
Di(2-ehtylhexyl)phthalate (DEHP)	12
Dinoseb	14
Endothall	580
Ethylbenzene	300
Fluoride	1,000
Glyphosate	1,000
Lead	2
Nitrate	10,000 as N
Nitrite	1,000 as N
Nitrate and Nitrite	10,000 as N
Oxamyl	50
Pentachlorophenol	0.4
Picloram	500
Trichlorofluoromethane (Freon 11)	700
1,1,2-Trichloro-1,2,2,trifluoroethane (Freon 113)	4,000
Xylenes	1,800
PHGs adopted in February 1999	
Atrazine	0.15
Bentazon	200
Cadmium	0.07
Chromium (total)	2.5
1,2-Dibromo-3-chloropropane (DBCP)	0.0017
1,2-Dichloroethane	0.4

Table B-9
Current PHGs (Continued)

Chemical	PHG (µg/L)
1,1-Dichloroethylene	10
1,2-Dichloropropane	0.5
1,3-Dichloropropene	0.2
Endrin	1.8
Heptachlor	0.008
Heptachlor epoxide	0.006
Hexachlorocyclopentadiene	50
Lindane	0.032
Mercury inorganic	1.2
Methoxychlor	30
Thallium	0.1
Toluene (methylbenzene)	150
1,2,4-Trichlorobenzene	5
1,1,2-Trichloroethylene (TCE)	0.8

Arsenic

Under the 1996 Amendments to the Safe Drinking Water Act, EPA is required to publish a revised standard for arsenic by January 2001. The current standard is 50 µg/L.

Arsenic is the 20th most abundant element in nature and the 12th most abundant in the human body. Arsenic occurs in both the organic and inorganic forms. Only inorganic forms of arsenic will be regulated by EPA. The inorganic forms are arsenite (As^{+3}) and arsenate (As^{+5}). These are the most toxic forms of arsenic, and arsenite appears to be the most toxic.

Human exposure to arsenic comes primarily from food sources (shellfish and grain raised in arsenic-laden soils) and is mostly in the organic forms. EPA staff has indicated, however, that drinking water is responsible for 60 to 75 percent of the human exposure to arsenic in the inorganic forms.

Up to now, arsenic has been regulated in drinking water based on its potential to cause skin cancer (usually a non-fatal disease). A published study ("Cancer Risks from Arsenic in Drinking Water, Environmental Health Perspectives, Smith et al, 1992) concludes that "...Arsenic can also cause liver, lung, kidney, and bladder cancer and that the population cancer risks due to arsenic in U.S. water supplies may be comparable to those from environmental tobacco smoke and radon in homes. It was estimated that, at the current EPA standard of 50 µg/L, the lifetime risk of dying from cancer of the liver, lung, kidney, or bladder from drinking 1 L/day of water would be as high as 13 per 1000 persons."

In developing a revised arsenic standard, EPA is evaluating the health effects information, feasible treatment methods, determining what is the practical quantitation level (PQL), and what will be impacts of various standards for arsenic. Estimates currently indicate that approximately 12,000 utilities in the United States have arsenic levels above 2 µg/L in their raw water.

The available health effects information presented by EPA indicates the 10^{-4} (1 in 10,000) cancer risk estimate is 2 µg/L. Since EPA policy has been to regulate carcinogens in the 10^{-4} to 10^{-6} risk range, a revised arsenic standard could fall in the range between 2 µg/L and 0.02 µg/L (20 parts per trillion). At the present time, EPA staff has indicated that they do not believe they can quantify the internal cancer risk information. Arsenic is considered to be a known human carcinogen. The cancer risk estimates presented above are based on skin cancer information.

Potential treatment processes for reducing arsenic levels include:

- activated alumina
- activated carbon
- ion exchange, carbon chemisorption filters
- adsorption/coprecipitation with Fe/Al oxides
- membrane processes

For adsorption/coprecipitation processes, arsenite removal does not depend on pH, arsenate removal is pH dependent (reduced removal at higher pH). From chemical reaction modeling, it has been observed that conventional coagulant doses won't remove arsenic as well as higher doses (such as those required for enhanced coagulation). Modeling has also shown that arsenite is more difficult to remove.

For membrane processes, uncharged species are less easily removed. Arsenite is uncharged at $pH < 9.2$ and arsenate is charged at $pH > 6.8$. Therefore, an oxidation pretreatment step for membranes to oxidize the arsenite to arsenate may provide for better removal.

On March 23, 1999 the National Research Council (NRC) released a report evaluating the latest information on the health effects of arsenic in drinking water. The following is taken from the NRC press release:

> "The U.S. Environmental Protection Agency should develop a stricter standard for allowable levels of arsenic in the nation's drinking water supplies as soon as possible…Arsenic has long been identified as a toxicant, and in drinking water it has been associated with skin cancer and other disorders. But recent studies suggest that drinking water with high levels of arsenic also can lead to bladder and lung cancer, which are more likely to be fatal."

Radon

Under the 1996 Amendments to the SDWA, the EPA must publish for public comment a risk reduction and cost analysis for a potential radon standard by February 6, 1999 and then propose a

regulation by August 6, 1999. A final regulation must be published by August 6, 2000 (the 1996 Amendments to the SDWA required EPA to withdraw the 1991 proposed rule for radon.)

At the present time, the MCL for radon is anticipated to be set around 300 pCi/L. Under the 1996 Amendments, if the MCL for radon is established at a level such that the contribution of radon from water to radon in indoor air is lower than background levels of radon in outdoor air, then EPA is to establish an "alternate MCL (AMCL)." At the present time, the AMCL will likely be set around 4,000 pCi/L. A public water system would be allowed to comply with the higher AMCL (and not the MCL), only if there is an EPA-approved "multimedia mitigation program" in effect for the State or for a given public water system. What would constitute a "multimedia mitigation program" has not yet been defined.

In addition to a radon regulation, EPA will establish a standard for uranium in the fall of the year 2000 and at the same time will make a determination whether or not they will establish revised standards for radium, beta particles, photon and alpha emitters.

Sulfate

A proposed sulfate standard was originally included in the Phase V group of compounds (final standards published July 1992). In 1990, EPA proposed standards of either 400 mg/L or 500 mg/L. However, when the final Phase V standards were published in July 1992, EPA deferred the sulfate standard. On December 22, 1994, EPA re-proposed the standard for sulfate. The MCLG and MCL were proposed at 500 mg/L. The sulfate standard was never finalized.

The health effects associated with ingestion of high levels of sulfate are diarrhea and are considered to be acute and temporary. There is no information indicating long-term health effects associated with exposure to high levels of sulfates. Health effects are typically seen in those people who are not acclimated to a given water (with high levels of sulfate) that include travelers, infants and new residents.

The EPA is authorized (but not required) by the 1996 Amendments to the SDWA to promulgate a regulation for sulfate. The agency was required to complete a joint project with the Centers for Disease Control and Prevention (CDC) by February 6, 1999 that would establish a reliable dose-response relationship regarding the adverse public health effects of sulfate in drinking water. The EPA must consider sulfate for regulation by August 6, 2001.

Groundwater Rule (GWR)

A draft Groundwater Rule was released in July 1992. During 1998, EPA held three Stakeholder meetings around the country to provide an update on the status of development of the groundwater rule and to indicate possible regulatory directions.

Regarding health effects information, EPA staff provided the following information:

Sixty-two percent (356 of 571) of all waterborne disease outbreaks reported to the CDC between 1971 and 1994 occurred in groundwater systems. Of these 356 outbreaks, 287 were determined to be source water related, 113 were in community water systems and 243 were in non-

community water systems. Preliminary data from eight separate studies encompassing 670 wells indicated evidence of fecal contamination occurrence rates ranging from 8 to 38 percent. EPA believes the existing health effects data suggests that they should move forward with some type of GWR but not necessarily a disinfection mandate for all systems.

EPA staff also presented information on Best Management Practices (BMPs) for minimizing the reduction of positive coliform bacteria in distribution systems for groundwaters. An EPA study showed that of six BMPs evaluated, only disinfection and hydrogeologic construction criteria showed a significant statistical relationship to lower statewide TCR violations.

In a study sponsored by the Association of State Drinking Water Agencies, three BMPs were found to be strongly associated with a reduction in total coliform occurrence rates: 1) maintaining a disinfectant residual, 2) operator training, and 3) correcting deficiencies identified by the state. Two BMPs associated with significant reductions in fecal coliform or *E. coli* detections were 1) treatment for purposes other than disinfection (i.e. iron removal) and 2) operator training.

EPA staff has concluded that disinfection and BMPs contribute significantly to reducing well contamination and are the core of EPA's regulatory approach to the GWR.

The EPA presented the framework for four different regulatory approaches identified as 1) Barrier Assessment, 2) Existing State Practices, 3) Setback, and 4) Checklist. Each approach contained the same basic components but varied in the requirements of each component and the level of State-decision making capability. The major components included: 1) criteria to identify vulnerability/significant defects, 2) monitoring requirements to identify risk, 3) establish risk (i.e. high, medium, low), 4) define BMPs or disinfection corresponding to risk classification, 4) monitoring requirements to evaluate effectiveness and 5) mandatory baseline measures.

The most stringent of the four potential regulatory approaches is the "Barrier Assessment." Under this option, system vulnerability would be established based on water quality monitoring results and aquifer characteristics. High risk systems would be required to address deficiencies immediately using the appropriate BMPs and potentially, mandatory disinfection. Enhanced monitoring would be required to verify BMP and/or disinfection effectiveness. Baseline requirements in this option include sanitary surveys (every 3-5 years), start-up procedures for wells not used year-round, cross-connection/backflow prevention programs, and routine disinfection after repair or installation.

According to EPA staff, the Agency will try to release a draft of the groundwater rule for review by Stakeholders sometime in early 1999. Under the 1996 Amendments to the SDWA, a final groundwater rule must be published by May 2002. (It is EPA's intention, however, to publish a final groundwater rule by November 2000, allowing groundwater systems to comply with the Groundwater Rule and the Stage 1 D/DBP Rule at the same time).

Long Term 1 Enhanced Surface Water Treatment Rule

While the Stage 1 Disinfectants and Disinfection Byproducts Rule will apply to systems of all sizes, the Interim Enhanced Surface Water Treatment Rule only applies to systems serving

10,000 or more people. A Long Term 1 Enhanced Surface Water Treatment Rule, due in November 2000, will strengthen microbial controls for small systems i.e., those systems serving fewer than 10,000 people. The rule will also prevent significant increase in microbial risk where small systems take steps to implement the Stage 1 Disinfectants and Disinfection Byproducts Rule.

EPA believes that the rule will generally track the approaches in the Interim Enhanced Surface Water Treatment Rule for improved turbidity control, including individual filter monitoring and reporting. The rule will also address disinfection profiling and benchmarking. The Agency is considering what modifications of some large system requirements may be appropriate for small systems.

Long Term 2 Enhanced Surface Water Treatment Rule and Stage 2 Disinfection Byproduct Rule

The SDWA, as amended in 1996, requires EPA to finalize a Stage 2 Disinfectants and Disinfection Byproducts Rule by May 2002. Although the 1996 Amendments do not require EPA to finalize a Long Term 2 Enhanced Surface Water Treatment Rule along with the Stage 2 Disinfectants and Disinfection Byproducts Rule, EPA believes it is important to finalize these rules together to ensure a proper balance between microbial and DBP risks.

EPA began discussions with stakeholders in December 1998 on the direction for these rules. EPA anticipates proposed rules in early 2001. The intent of the rules is to provide additional public health protection, if needed, from DBPs and microbial pathogens. Initial indications are that this rule could further reduce the MCL for THMs to 0.040 mg/L.

Additional Issues Under the 1996 Amendments

The following section provides information on additional regulatory issues addressed in the 1996 Amendments to the SDWA.

Source Water Protection

The 1996 Amendments to the SDWA established a new source water assessment program (SWAP). On August 6, 1997, the EPA published guidance for primacy states to carry out SWAPs within the state's boundary. The states were required to submit their program to EPA by February 6, 1999. Monitoring relief may be developed from the results of the assessment program. The 1996 Amendments also established a new coordinated and comprehensive protection of groundwater resources program within a state. California submitted its drinking water source assessment and protection (DWSAP) program to EPA in January 1999. Following approval by EPA in November 1999, DHS will have two years (until November 2001) to complete the assessment of all drinking water sources. DHS expects this schedule to be extended until May 2003 if EPA approves an extension. The DWSAP may be performed by DHS staff or the state will provide guidance, recommendations and technical assistance to water systems that choose to do more detailed assessments on their own. A completed drinking water source assessment will likely be a future requirement for water systems to obtain or continue chemical monitoring waivers.

According to the DWSAP program document, DHS is encouraging large systems to do their own source water assessments. Large public water systems with surface water sources should make use of their watershed sanitary surveys to satisfy the requirement for a drinking water source assessment. DHS considers a watershed sanitary survey completed in accordance with existing watershed sanitary survey guidance to satisfy most of the assessment components of the Program. Systems that have performed evaluations for their ground water sources (e.g., work done for Assembly Bill 3030 Groundwater Management Plans) may find that, depending on the extent of those evaluations, they may satisfy all or portions of the components of the DWSAP Program. DHS plans to conduct source water assessments for those sources not voluntarily assessed by public water systems or by local primacy agency (LPA) counties.

Consumer Confidence Reports

EPA promulgated final drinking water regulations on August 19, 1998 establishing the requirement for public water systems to provide annual Consumer Confidence Reports (CCR) to their customers. Every community water system having more than 15 service connections is required to prepare a CCR. The first CCR must be delivered to customers by October 19, 1999. Subsequent reports must be delivered to customers by July 1 of each year.

EPA has released a Guidance Manual on producing a CCR in March 1999. The CCR is required to contain the information shown in **Table B-10.**

However, public water systems in California have already been preparing and distributing annual water quality reports for their customers for about ten years. On November 10, 1998 the Department of Health Services sent a letter to public water systems that attempted to clarify the relationship of the new federal regulations for CCRs to the existing California requirement for annual water quality reports.

California public water systems must deliver their initial report by April 1, 1999. California public water systems must include information on Public Health Goals in their reports. DHS is developing new regulations to formally adopt the federal requirements, but they may not be final until the year 2000.

Effective Date of Regulations

Under the 1996, Amendments compliance with regulations is required three years after promulgation. The deadline can be extended for up to two years for all systems by the EPA in the regulation or for specific public water systems by the state if it is determined that additional time is needed for the capital improvements required.

Contaminant Candidate List

In March 1998, EPA published the final “Drinking Water Contaminant Candidate List” as required under the SDWA Amendments of 1996. This list will serve as the starting point for possible future regulations. The contaminants on this list are not subject to any current or

Table B-10
Basic Consumer Confidence Report Requirements

Water System Information • Name/telephone number of contact person • Information on public participation opportunities • Information for non-English speaking populations, if applicable
Sources of Water • Type, name and location of water sources • Availability of source water assessment • Information on significant sources of contamination, if available
Definitions: MCL, MCLG, others as needed
Detected Contaminants • Table summarizing data on detected regulated and unregulated contaminants • Known or likely source of each detected contaminant • (for MCL violations) health effects language and explanation • information on information on *Cryptosporidium*, radon and other contaminants, if applicable
Compliance with Other Drinking Water Regulations • Explanation of violations, potential health effects, and steps taken to correct the violations • Explanation of variance/exemption, if applicable
Required Educational Information • Explanation of contaminants and their presence in drinking water • Warning for vulnerable populations about *Cryptosporidium* • Information statements about arsenic, nitrate and lead, if necessary

proposed drinking water regulation, are known or anticipated to occur in public water systems, "and may require regulation under SDWA."

By August 2001, EPA will select five or more contaminants from the list and determine whether to regulate them. If the EPA determines that regulations are necessary, then the regulations must be proposed by August 2003 and final by February 2005. The criteria EPA will use to determine if a regulation is needed are whether regulating a compound presents "a meaningful opportunity to reduce health risk."

Table B-11 presents the final drinking water contaminant candidate list.

Table B-11
Drinking Water Contaminant Candidate List

Chemical Contaminants	
1,1,2,2-tetrachloroethane 1,2,4-trimethylbenzene 1,1-dichloroethane 1,1-dichloropropene 1,2-diphenylhydrazine	Disulfoton Diuron EPTC (s-ethyl dipropylthiocarbamate) Fonofos Hexachlorobutadiene
1,3-dichloropropane 1,3-dichloropropene 2,4,6-trichlorophenol 2,2-dichloropropane 2,4-dichlorophenol	p-Isopropyltoluene Linuron Manganese Methyl bromide Metolachlor
2,4-dinitrophenol 2,4-dinitrotoluene 2,6-dinitrotoluene 2-methyl-Phenol Acetochlor	Metribuzin Molinate MTBE Naphthalene Nitrobenzene
Alachlor ESA (and other degradation products of acetanilide pesticides) Aldrin Aluminum Boron Bromobenzene	Organotins Perchlorate Prometon RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) Sodium Sulfate
DCPA mono-acid degradate DCPA di-acid degradate DDE Diazinon Dieldrin	Terbacil Terbufos Triazines and degradation products Vanadium
Microbial Contaminants	
Acanthamoeba	Coxsackieviruses
Adenoviruses	Echoviruses
Aeromonas hydrophila	Helicobacter pylori
Cyanobacteria (blue-green algae), other freshwater algae and their toxins	Microsporidia (Enterocytozoon and Septata)
Caliciviruses	Mycobacterium avium intracellulare complex

Filter Backwash Water Recycling

The 1996 SDWA Amendments require that EPA set a standard on recycling filter backwash within the treatment process of public water systems by August 6, 2000. The regulation will apply to all public water systems, regardless of size. EPA is currently gathering data, reviewing

literature, and consulting with industry representatives, members of the environmental community, and consulting engineers to identify engineering and cost issues that are salient to regulatory development. In June 1998, EPA staff presented a "Strawman" rule with some possible regulatory approaches. The filter backwash rule will be proposed for public comment by August 1999.

Appendix C
Water System Model Calibration

This appendix presents the approach taken for water system model calibration and the results of the calibration effort. The appendix includes Technical Memorandum No. 3 – dated October 7, 1998, fire flow test results and a comparison of field and model results.

Appendix D
Detailed Cost Tables

Opinions of probable capital costs are based on data obtained from industry manufacturers and from Montgomery Watson's experience working on similar master planning projects. Pipeline, reservoir, and pump station costs have been calculated using recent cost data for work completed by Montgomery Watson in other communities. In addition, recent pipeline construction costs were received from Santa Margarita Water District for comparison purposes. All estimates have been adjusted to an Engineering News Record Construction Cost Index of 6,865 (Los Angeles, October, 1998) and are consistent with the American Association of Cost Engineers guidelines for developing reconnaissance-level estimates, which should range between 50 percent above and 30 percent below actual capital expenditures. Because this is a master plan-level document, a 30 percent contingency to the estimated construction costs is included. As more details regarding construction issues become apparent and the recommended projects proceed through the design process, many of the unknown issues will be resolved and the contingency can be lowered. The contractor's overhead and profit are included in the presented cost estimates, and the engineering, administration, and legal (EA&L) costs are estimated to be 25 percent of construction costs. Therefore, the total add-on to the construction costs, including the 30 percent contingency and the 25 percent EA&L, is 62.5 percent. Costs for acquisition of land, rights-of-way and easements are not included.

Cost estimates are based on assumptions regarding the location and types of facilities to be constructed in the future. Pressure water pipelines and sewer force mains are assumed to be constructed with four feet of cover. Potable and reclaimed water pipeline cost estimates include a 20 percent allowance for appurtenances. Gravity sewer pipelines are constructed at varying depths, dependent upon the required slopes. The costs for sewer pipelines assume construction at depths of 10 to 14 feet. However, no allowance has been included for groundwater dewatering during construction, rock excavation, soil contamination, or house laterals.

All cost tables present the total unit cost including contingency, engineering, administrative, and legal costs as described above. No effort was made to determine probable estimates of costs for facilities outside of those necessary for District system improvements.

Preliminary costs have been developed for new reclaimed water storage based on an assumed reservoir site east of the existing reservoir. New reclaimed water storage is assumed to be constructed using a roller-compacted concrete dam having a crest length of 400 feet, crest width of 12 feet, a 90 feet height, vertical upstream face and a 0.7:1 sloping downstream face. Such a dam would store approximately 90 acre-ft of water. Assuming $80/cubic yard plus 62.5 percent for contingency, engineering, administration, and legal costs results in an order-of-magnitude unit cost of $50,000/acre-ft of storage. Land acquisition costs are not included since specific sites have no been evaluated in detail. It is recommended that the District conduct a detailed evaluation of potential dam sites and other options for reclaimed water storage.

Costs for water and wastewater treatment improvements are presented in Sections 4 and 6, respectively. These costs are based on typical costs for the types of improvements and expansion capacity required for each facility. Pipeline costs were estimated to be more expensive, on a unit-cost basis, for installation lengths less than 1,000 feet.

COSTS OF RECOMMENDED IMPROVEMENTS

As detailed in Sections 4, 5, 6, and 7, improvements have been recommended for both existing and build-out conditions for the water, wastewater, and reclaimed water systems, respectively. The existing and build-out recommendations for the water system are summarized, along with their respective costs, in **Tables D-1** and **D-2**. The wastewater system costs for recommended improvements are summarized, for existing and build-out systems in **Tables D-3** and **D-4**. The reclaimed water system costs for recommended improvements are summarized in **Table D-5** and there are no improvements recommended for the reclaimed water system at build-out.

Table D-1
Recommended Improvement Costs for the Existing Water System

Description	Size/Capacity	Unit Cost ($)	Total Cost[1] ($)
Source Water			
DWTP Backwash Storage	0.18 MG	1.50/gal	270,000
DWTP Baffled Clearwell	0.1 MG	1.90/gal	190,000
DWTP Disinfection System[2]			20,000
DWTP Booster Spare Pump & Motor	300 hp	167/hp	50,000
Rose and Lang Well Treatment[3]	1.6 mgd	Lump sum	3,660,000
Treated Water Storage			0
Harris Grade Site (Option 1)[4]	2.61 MG	0.533/gal	1,390,000
Harris Grade Site (Option 2)[4]	3.0 MG	0.51/gal	1,530,000
Harris Grade No. 2 (Option 1)	Note 5	Lump sum	110,000
Harris Grade No. 2 (Option 2)	Demolition	Lump sum	20,000
Rose Canyon	Note 5	Lump sum	130,000
Cooks	Note 5	Lump sum	70,000
Booster Pumps			0
Canyon Creek Fire Pump	150 hp	1,050/hp	320,000
Rose Canyon Generator	200 KW	250/KW	50,000
Robinson Ranch	30 hp	3,700/hp	120,000
Pressure Regulating Station			0
Mountain View Rd., 8-in	LS	130,000/ea	130,000
Pipelines			0
Mountain View Rd., 8-in	800 ft	135/ft	110,000
Via Del Lago St., 8-in.	500 ft	135/ft	70,000
Via Del Lago St., 8-in.	600 ft	135/ft	90,000
Total – Option 1			**$6,780,000**
Total – Option 2			**$6,830,000**

Note:
1. All costs rounded to next higher ten thousand dollars.
2. Need for new disinfection system to be based on a detailed plant evaluation.
3. See Table 4-10 for detailed cost breakdown.
4. Option 1 involves rehabilitating Harris Grade No. 2 and constructing a new 2.61 MG reservoir; Option 2 involves demolishing Harris Grade No. 2 and constructing a new 3.0 MG reservoir.
5. Includes recoating interior, earthquake proofing, and installing an OSHA approved ladder.

Table D-2
Recommended Improvement Costs for the Build-Out Water System

Description	Size/Capacity	Unit Cost ($)	Total Cost[1] ($)
Source Water			
P/T Booster Spare Pump	100 hp	300/hp	30,000
Treated Water Storage			
Upper Harris Grade Reservoir	3.00 MG	0.51/gal	1,530,000
Booster Pumps			
Upper Harris Grade	50 hp	5,000/hp	250,000
Pipelines			
Santiago Canyon Rd, 12-in.	2,300 ft	140/ft	330,000
UHG BS piping, 8-in	400 ft	135/ft	60,000
Live Oak Canyon Rd, 8-in	1,700 ft	95/ft	170,000
Live Oak Canyon Rd, 8-in	2,700 ft	95/ft	260,000
Hamilton Truck Trail, 8-in	5,300 ft	95/ft	510,000
Easement, 8-in	1,200 ft	95/ft	120,000
Easement, 8-in	2,500 ft	95/ft	240,000
Canyon Creek Property, 8-in	3,100 ft	95/ft	300,000
Total			**3,800,000**

Notes: 1. All costs rounded to next higher ten thousand dollars.

Table D-3
Recommended Improvement Costs for the Existing Wastewater System

Description	Size/Capacity	Unit Cost ($)	Total Cost[1] ($)
RRWWTP Title 22 Improvements	each	See Table 6-5	$1,680,000
Reclaimed Water Reservoir[2]	90 acre-ft	50,000/acre-ft	4,500,000
Sewer Lift Stations			
Golf Club	Pressure grout cracks	LS	30,000
Via Alegre	Corrosion and odor control	LS	100,000
Heritage	Pressure grout cracks, 150 KW standby generator	LS 250/KW	30,000 40,000
Total			**$6,380,000**

Note: 1. All costs rounded to next higher ten thousand dollars.
2. Cost is based on order of magnitude estimate for a roller-compacted concrete dam across canyon near the RRWWTP. A detailed site evaluation is required to better define this estimate.
3. LS – lump sum

Table D-4
Recommended Improvement Costs for the Build-Out Wastewater System

Description	Size/Capacity	Unit Cost ($)	Total Cost[1] ($)
RRWWTP Expansion	0.5 mgd	See Table 6-5	$7,100,000
Reclaimed Water Storage[2]	130 acre-ft	50,000/acre-ft	6,500,000
Sewer Lift Stations			
Live Oak Lift Station	200 hp	8,100/hp	1,620,000
Nursery Lift Station	200 hp	8,100/hp	1,620,000
Gravity Pipeline			
North System			
Live Oak Canyon Rd., 8-in.	4,500 ft	210/ft	950,000
Central System No. 1			
Live Oak Canyon Rd., 8-in	12,500 ft	210/ft	2,630,000
Hunky Dorie Ln., 8-in	2,000 ft	190/ft	380,000
Lambrose Canyon Rd., 8-in	3,200 ft	190/ft	610,000
Central System No. 2			
T.O. Dr./Hamilton Truck Tr., 8-in.	9,900 ft	190/ft	1,890,000
Rose Canyon Rd., 8-in	9,900 ft	190/ft	1,890,000
Trabuco Creek Rd., 8-in	11,100 ft	190/ft	2,110,000
Trabuco Canyon Rd., 8-in	3,300 ft	190/ft	630,000
Trabuco Canyon Rd., 10-in	900 ft	205/ft	190,000
Trabuco Canyon Rd., 12-in	4,900 ft	235/ft	1,160,000
Adkinson Ln., 8-in	500 ft	190/ft	100,000
Sycamore Dr., 8-in	2,200 ft	190/ft	420,000
Mountain View Rd., 8-in	2,000 ft	190/ft	380,000
Flanagan Rd., 8-in	2,000 ft	190/ft	380,000
Force Main			
Trabuco Canyon Rd., 10-in	15,800 ft	170/ft	2,690,000
Additional Localized Facilities[3]			2,610,000
Total			**$35,860,000**

Note:
1. All costs rounded to next higher ten thousand dollars.
2. Cost is based on order of magnitude estimate for a roller-compacted concrete dam across canyon near the RRWWTP. A detailed site evaluation is required to better define this estimate.
3. An allowance of 15 percent of the collection system cost is included for special construction such as local lift stations and creek crossing. The allowance does not include sewer lines serving individual streets and homes.

Table D-5
Recommended Improvement Costs for the Existing Reclaimed Water System

Description	Size/Capacity	Unit Cost ($)	Total Cost[1] ($)
Pump Station			
Upper Robinson Ranch, 2 @ 75 hp	150 hp	4,000/hp	$600,000
Pressure Regulating Station			
Robinson Ranch Rd.	6-inch	LS	130,000
Pipelines			
High Country/Weeping Willow, 6-in	170 ft	100/ft	20,000
Plano Trabuco Rd., 3-in	1,340 ft	70/ft	100,000
Rancho Cielo Dr., 4-in	3,030 ft	90/ft	280,000
Via De La Luz, 4-in	970 ft	90/ft	90,000
Down property line, 6-in	2,300 ft	85/ft	200,000
Property line to Mill Stream Rd., 4-in	240 ft	90/ft	30,000
Mill Stream Rd., 4-in	730 ft	90/ft	70,000
Country Hollow Ln., 4-in	880 ft	90/ft	80,000
New PS to Brookseed Dr., 10-in	2,730 ft	85/ft	240,000
Brookseed Dr., 8-in	1,430 ft	95/ft	140,000
Sentinel Dr., 8-in	1,200 ft	95/ft	120,000
Robinson Ranch Rd., 8-in	1,660 ft	95/ft	160,000
Robinson Ranch Rd., 6-in	700 ft	100/ft	70,000
Raintree Ln., 8-in	1,690 ft	95/ft	170,000
Porter Ranch Rd., 6-in	1,800 ft	85/ft	160,000
Quicksilver Dr., 6-in	310 ft	100/ft	40,000
Shadow Rock Ln., 6-in	1,060 ft	85/ft	100,000
Total			**$2,800,000**

Note: 1. All costs rounded to next higher ten thousand dollars.