Yorba Linda Water District

2005 Domestic Water System Master Plan

Job No. 200218

May 2005

Carollo Engineers

The undersigned has approved this document for and on behalf of Carollo Engineers, P.C.

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Yorba Linda Water District

2005 DOMESTIC WATER SYSTEM MASTER PLAN

FINAL REPORT

May 2005

carollo engineers

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EXECUTIVE SUMMARY

1.1 INTRODUCTION

Yorba Linda Water District (District) is an independent special district that provides water and sewer service to residents and businesses within its service area. The District's history dates back to 1909 when the privately owned Yorba Linda Water Company was formed. The present District was organized as the Yorba Linda County Water District (YLCWD) on January 2, 1959, as a result of a vote of local residents.

Through 1959, the service area was largely rural in character with a small residential community at its center. In 1959, the service area covered 4,710 acres and the YLCWD provided service to 1,412 active connections. From 1959 through the mid-1970s, YLCWD experienced a gradual transition from a rural, agriculturally oriented area to a suburban community. In 1978, YLCWD's Board of Directors agreed to annex lands to the east of then current boundaries that more than doubled YLCWD's size.

The District's Board of Directors commissioned the preparation of a Water Facilities Master Plan (James M. Montgomery, Consulting Engineers, 1978) in response to proposed annexations of new land into the District. The Plan identified water facilities needed to service the newly acquired territory. The annexations were divided into two Improvement Districts representing separate areas of benefit to future homeowners.

In November 1985, the Board of Directors, seeking a more accurate identification as an independent special district, dropped the "County" designation, thus officially changing the District's name to Yorba Linda Water District. In recent years, the District has updated Five-Year Plans to help plan facilities on a relatively short-term basis and has developed a computer model of the water system to assist with the planning of system improvements.

In late 2003, the District retained Carollo Engineers (Carollo) to complete a new Water Master Plan. This report is the result of the study conducted by Carollo to prepare a new 2005 Domestic Water System Master Plan for the District. The purpose of the master planning process is to provide a guide for the orderly improvement and enhanced operation of the District's water system. This effort supports the District's goal of providing a safe and reliable water supply at a reasonable cost to its customers.

1.1.1 Master Plan Objectives

The overall goals of this water master plan are to evaluate what improvements are needed or will be needed to meet current and future water demands, to identify improvements or operational changes necessary to meet current and upcoming water quality regulations, and to maximize the efficiency of system operations.

The District Master Plan has been prepared to provide a reference document for the existing water system operations and maintenance and a framework for future water system planning. The plan objectives can be divided into four primary areas: supply/demand, facilities planning, operational, and financial.

1.1.2 Supply/Demand Objectives

The supply/demand objectives included a review of the District's existing water supply sources. Estimates were developed for water demands and supply needs through the year 2020. Historical water demands were compared to supply records to determine how much water was unaccounted-for. The preferred supply source(s) needed to meet the District's existing and future supplies were identified. The costs of the District's supply sources were estimated to determine the preferred source based on cost.

1.1.3 Facilities Planning Objectives

Minimum performance criteria were developed in order to have a "yard stick" to measure the performance of the existing system against. The hydraulic computer model was updated and used to identify existing and future deficiencies in the water system. Numerous scenarios were developed in the computer model for various planning periods through the year 2020.The model was also used to evaluate the effectiveness of proposed facilities to mitigate the deficiencies.

1.1.4 Operational Objectives

The operation of the water system was evaluated with respect to increasing efficiency, maximizing the preferred water supply source(s), improving reliability, enhancing water quality, and providing adequate storage. The efficiency of the distribution system was reviewed and inefficient operational areas were identified. The computer model was used to determine the best operational strategies to operate in various supply modes, such as imported water only, groundwater only, and a combination of both sources. Emergency scenarios were developed and their impact on the existing facilities was evaluated. Storage needs for fire fighting, operational, and emergency needs were evaluated on a zone-by-zone basis and deficiencies were identified. Water quality objectives were reviewed, and existing and pending regulations were identified and discussed.

1.1.5 Financial Objectives

A comprehensive capital improvements program (CIP) was developed that identified all of the recommended improvements for the District through the year 2020. The improvements were prioritized and included recommended improvements from the District's Security

Vulnerability Assessment and Water Reservoir Nitrification Prevention and Control reports. Alternative funding sources available to the District were also reviewed and discussed.

1.2 GENERAL

1.2.1 Master Plan Analysis and Design Criteria

To help quantify the performance objectives for the District's system, a minimum acceptable level of service needed to be established to help identify deficiencies in existing facilities as well as to help determine the need for, and size of, proposed improvements. The primary goal in establishing a minimum level of service was to assure a safe and dependable supply of water to the entire service area. The criteria identified was established to quantify the minimum service requirements for the water system and was intended to be the minimum acceptable conditions under which the water system would be considered adequate. The criteria included:

- Water quality objectives.
- Minimum and maximum system pressures.
- Minimum and maximum velocities.
- Fire flow requirements.
- Emergency scenarios.
- Storage requirements.

1.3 DISTRICT SERVICE AREA

1.3.1 District Location

The District is located in north Orange County, California. Figure 1.1 shows the District's service area within the county. The service area was originally located within an unincorporated area of Orange County, but it now lies mostly within the City of Yorba Linda (incorporated in 1967). In addition to serving the City of Yorba Linda, the District also provides water service to areas within the cities of Brea, Placentia, and Anaheim. In addition, the District's service area still includes some unincorporated county "islands" as seen in Figure 1.2. The area within the District's service area is about 14,500 acres.

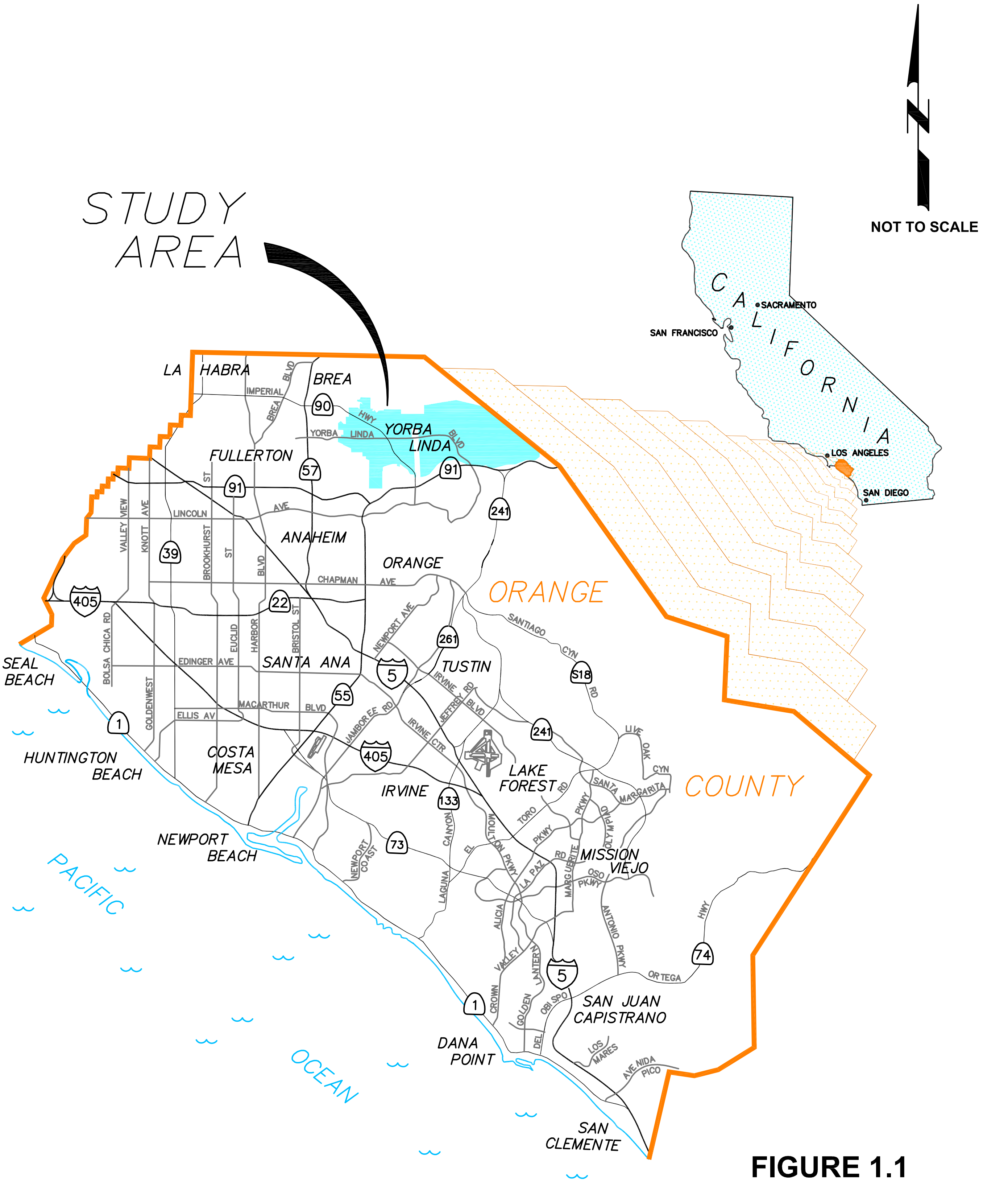

FIGURE 1.1

VICINITY MAP

YORBA LINDA WATER DISTRICT

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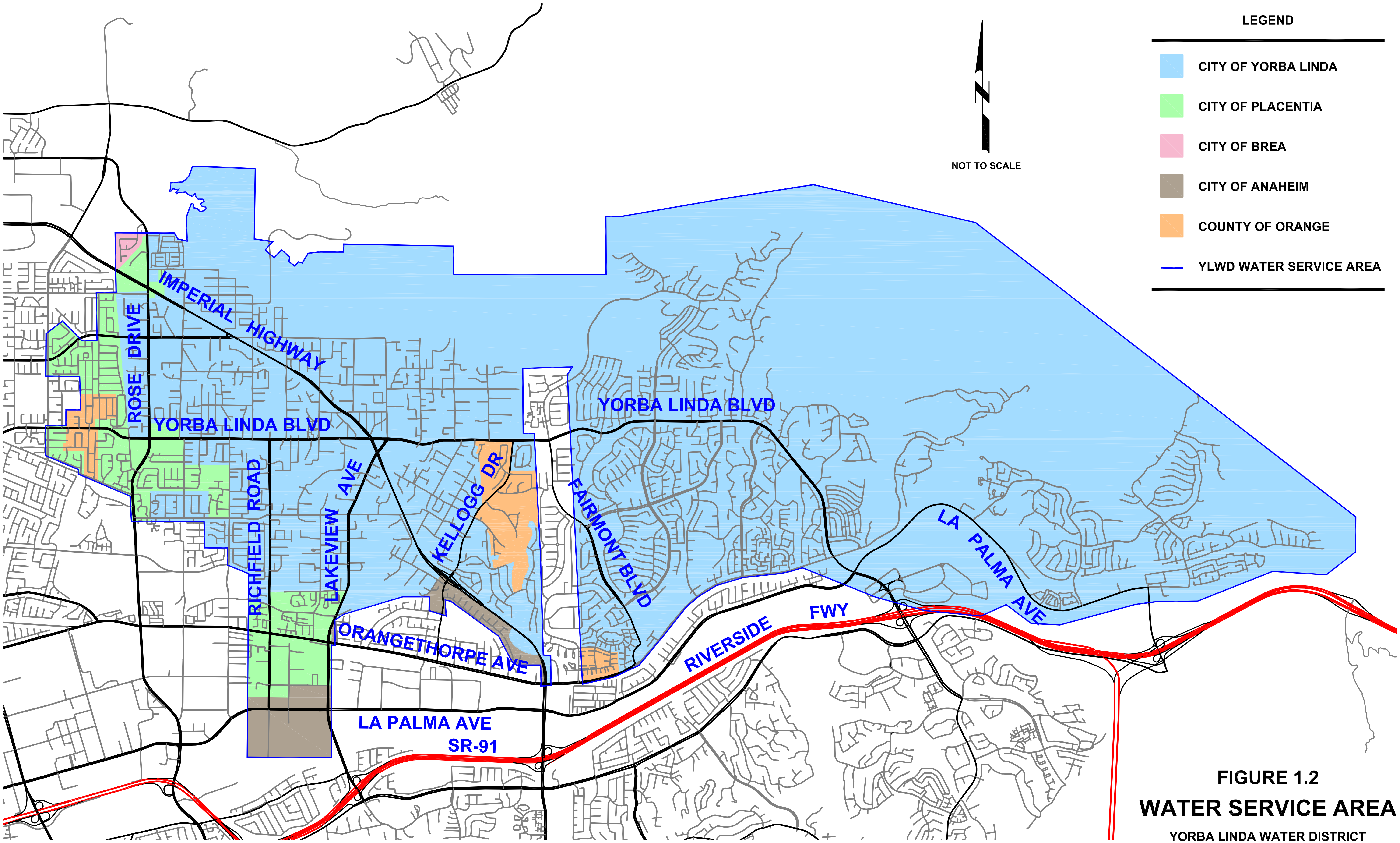

FIGURE 1.2
WATER SERVICE AREA
YORBA LINDA WATER DISTRICT

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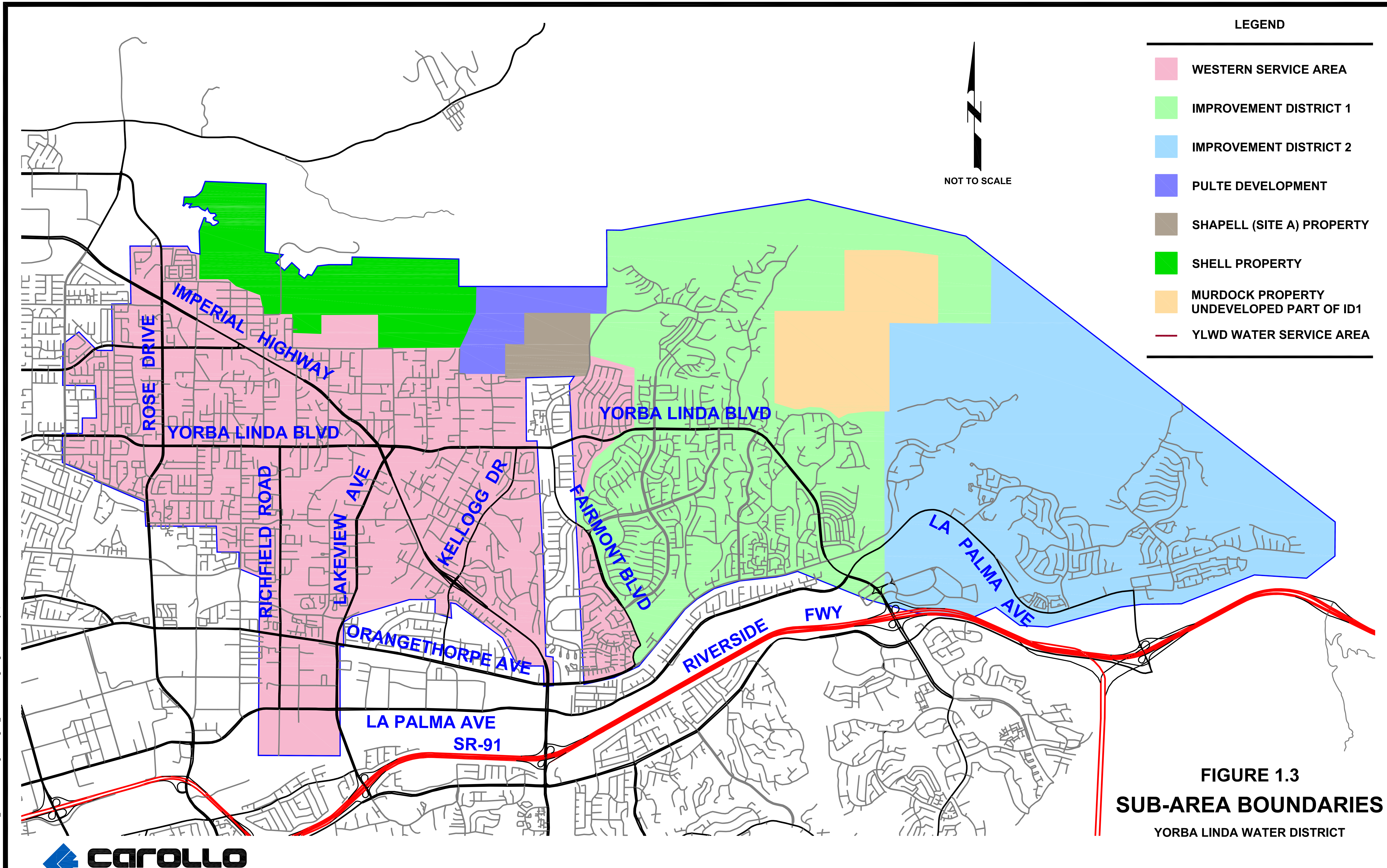

FIGURE 1.3
SUB-AREA BOUNDARIES
YORBA LINDA WATER DISTRICT

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1.3.2 District Improvement Areas

The District's existing service area includes the western service area (WSA), which is essentially the original service area and Improvement Districts No. 1 and 2 (ID Nos. 1 and 2). The District's service area was divided into the three sub-areas because of the arrangements that financed the major "backbone" facilities. Figure 1.3 identifies the boundaries of each of these sub-areas, as well as areas currently under development or areas planned for future development.

The Board of Directors approved the annexation of ID Nos. 1 and 2 in May and June of 1978, respectively. In June 1978, voters in both Improvement Districts authorized issuance of general obligation bonds to finance construction of backbone facilities. To date, ID No. 1, which consists of approximately 4,300 acres, has issued two series of general obligation bonds and one series of refunding bonds. Covering approximately 3,500 acres, ID No. 2 has issued three series of general obligation bonds and two series of refunding bonds. The WSA, which covers approximately 5,800 acres of the older section of the District, does not currently have public debt. All bonds for the WSA have been retired.

During the upcoming 5-year period, the District anticipates annexation and development of properties owned by Shapell Industries, Inc. (S&S Construction). These developments will be annexed into the Western Service Area. These proposed development projects north of the WSA must fund the "backbone" facilities required to serve their projects without help from the District.

1.4 EXISTING LAND USE AND PROPOSED DEVELOPMENT

The District provides water service to approximately 74,800 people through about 23,000 service connections. The majority of the water use is for residential customers. Future development is also expected to be primarily residential. Population is expected to continue to grow as this development occurs. Table 1.1 presents an estimate of future population growth in the District's service area.

Table 1.1 Existing and Projected Population Estimates
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Estimated Population
2003	72,600
2005	74,800
2010	81,200
2020	84,100

1.4.1 Land Use

Land use within a water agency's service area can help to identify patterns of water use, as well as requirements for fire flows. In addition, future land use plans may identify expected areas of growth or redevelopment. The land use used in this master plan is based on the City of Yorba Linda's most recent General Plan (May 1992).

1.4.2 Existing Service Connections

At the end of 2003, the District provided water to 22,417 service connections. These services consisted of about 93 percent residential, 4 percent commercial and industrial, 3 percent landscape, and less than 1 percent agricultural and untreated meters.

1.4.3 Proposed Development

There are four large residential developments in the District's service area that are in various stages of development. Some homes have already been constructed, some homes are currently under construction, and other phases are still in the planning stages. The location of these proposed development projects is shown in Figure 1.3. These projects include:

- The Kerrigan Ranch Planned Community by Pulte Homes.
- Sites A, B, and C owned by Shapell Industries.
- The Vista del Verde Planned Community by Shell/Toll Brothers.
- The Murdock Property (Pacific Holding).

In addition to the four large developments, many other small residential and commercial projects are currently planned for development or redevelopment. All of these proposed development projects, large and small, were included in the projected water demands for the future planning years studied in this master plan.

1.5 WATER DISTRIBUTION SYSTEM

The District's distribution system includes 8 groundwater production wells, 4 imported water connections (3 treated and 1 untreated), 12 booster pumping stations, 13 water storage reservoirs, 36 pressure reducing stations, and 10 emergency interconnections with neighboring agencies. These facilities are shown in Figure 1.4. The distribution system consists of many different pressure zones. Figure 1.5 presents the pressure zones that comprise the service area.

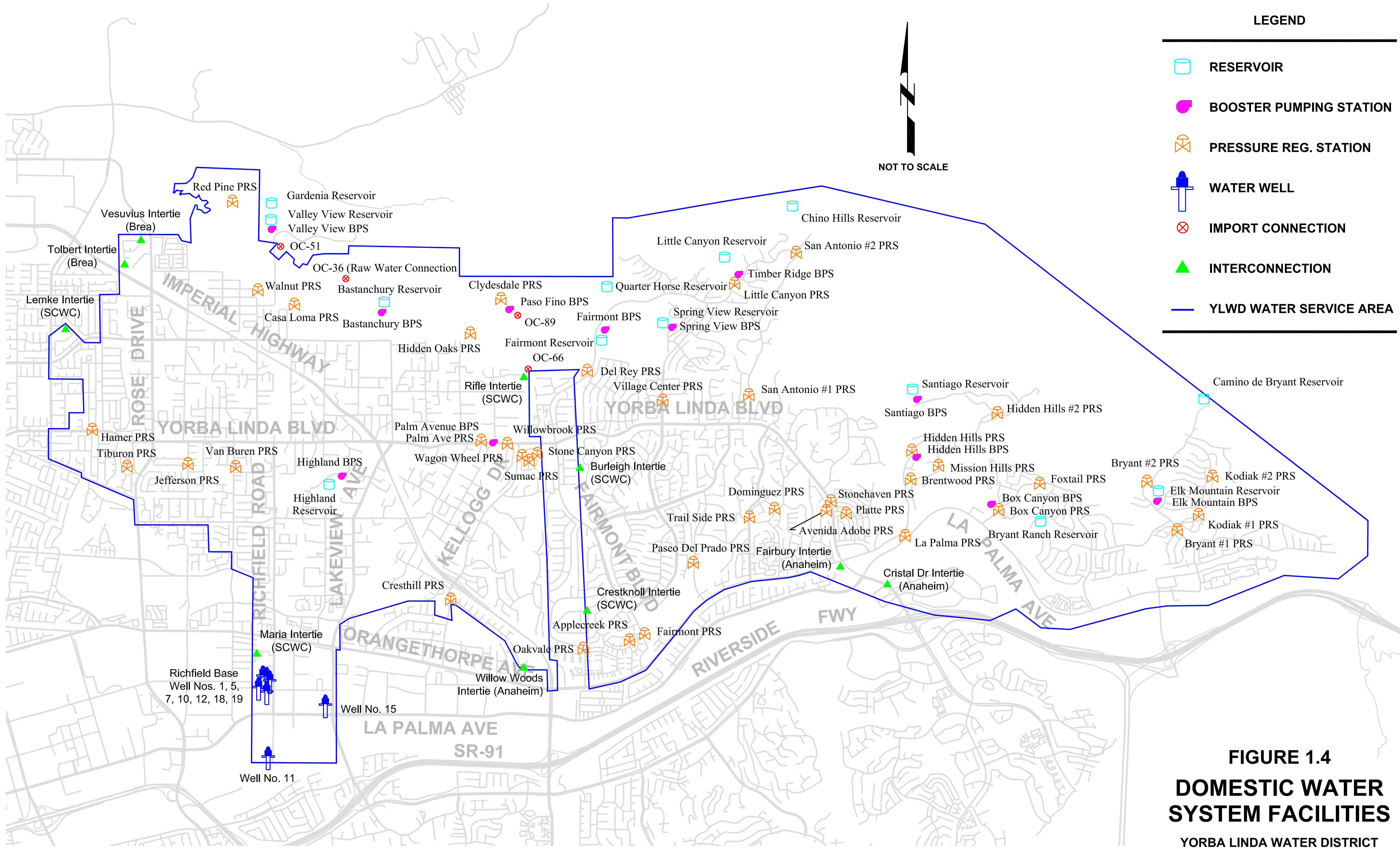

FIGURE 1.4
DOMESTIC WATER SYSTEM FACILITIES

YORBA LINDA WATER DISTRICT

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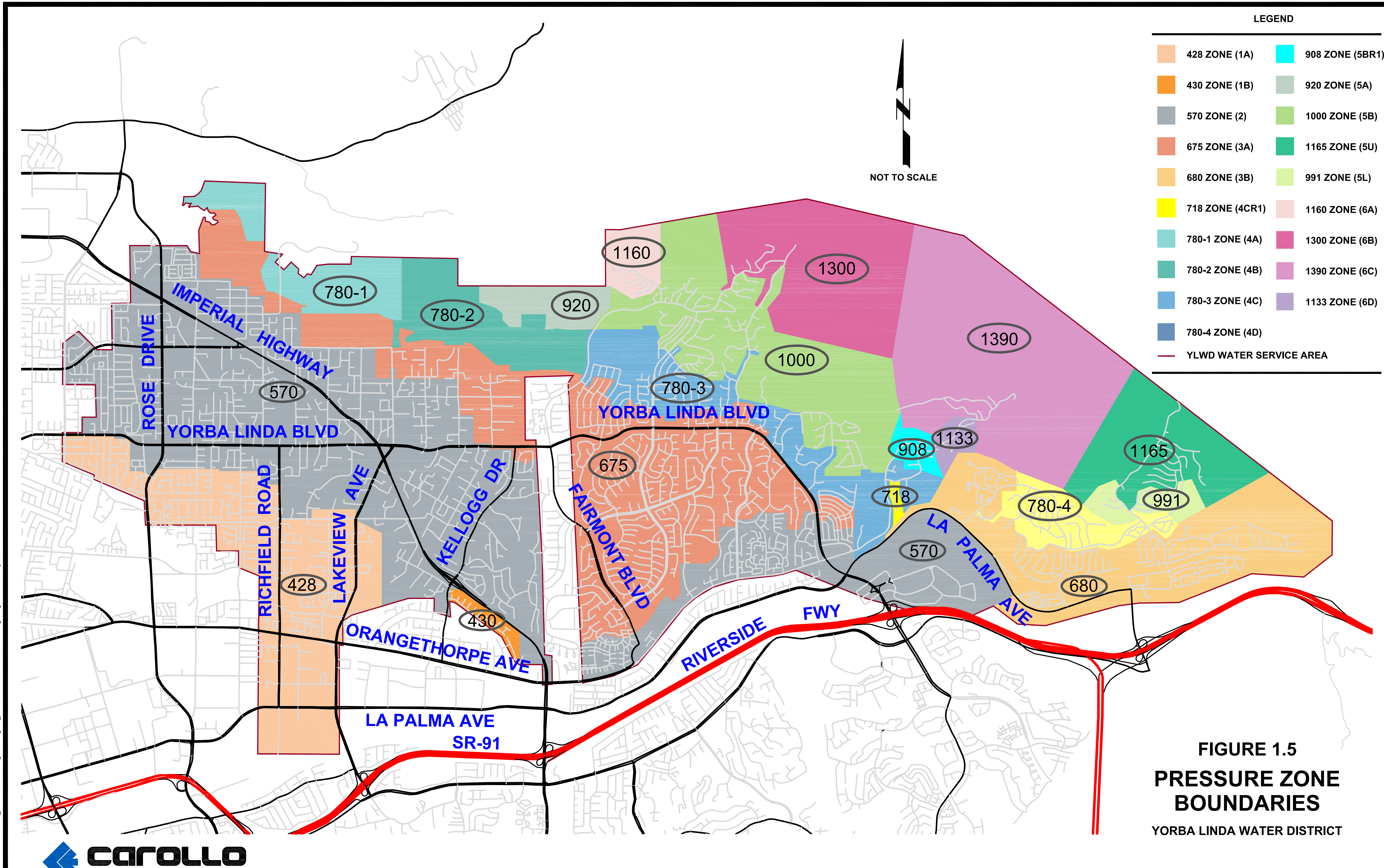

FIGURE 1.5
PRESSURE ZONE BOUNDARIES
YORBA LINDA WATER DISTRICT

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1.5.1 Existing Distribution and Transmission Mains

The District's service area includes about 640 miles of pipelines ranging in size from 4 to 39 inches in diameter. The distribution system includes pipes constructed of asbestos cement pipe (ACP), cast iron pipe (CIP), ductile iron pipe (DIP), polyvinyl chloride (PVC) pipe, and steel pipe.

1.5.2 Existing Groundwater Wells

The District's groundwater wells, which pump water from the lower Santa Ana Basin, provide the District with one of its primary sources of water supply. These wells deliver potable water that does not require treatment and only needs to be disinfected. The eight active wells have a combined nominal production capacity of about 16,400 gpm. However, the actual combined production capacity in recent years has been significantly less primarily due to the groundwater basin being lower than normal. This loss in production capacity is most pronounced during the late summer months when less water is being recharged and the District's production is increased. In addition to the eight active wells, the District has one new well that is currently under construction.

Most of these wells are at or near the District's Richfield Plant. This is mainly due to the high producing aquifer located in this area. Other areas within the District's service area have aquifers with much lower production rates. The close proximity of the Richfield Plant wells to each other offers potential benefits and potential risks. The risks include concerns about a potential contaminant affecting some or all of the District's wells. Contaminating several or all of the District's wells is a realistic concern and the District may not want to put all of their eggs in one basket. Drilling new wells away from the Richfield Plant could lower the risk of multiple wells being contaminated by the same contaminant, but this would likely require going outside the District's service area to drill the well. On the other hand, having the wells near each other improves the treatment options available, should treatment be required. In addition, if the contaminant concentration is low enough, blending the water with uncontaminated well water could potentially reduce the concentration below regulatory thresholds such that treatment would not be required. Therefore, while there may be some concerns about having most of the District's groundwater production in one location, this should not be the only consideration when siting a new well.

The District's wells discharge into a common transmission pipeline up to Highland Reservoir. Sodium hypochlorite (a weak bleach solution) is generated onsite at the Richfield Plant, where it is used to disinfect the well water in the transmission pipeline. Sodium hypochlorite is a form of chlorine and commonly used as a disinfectant in water distribution systems.

1.5.3 Existing Imported Water Connections

The District's other source of water supply is imported water from the Metropolitan Water District of Southern California (MWD) via three treated water connections and one raw water connection. MWD imports and treats water from the Colorado River and the State Water Project. MWD owns and operates an extensive network of transmission pipelines and five water treatment plants in Southern California. Locally, MWD operates the Diemer Filtration Plant, which is located in the hills north of the District's Western Service Area boundary. MWD also owns and operates several large diameter transmission pipelines that go through the District's service area. The District has interconnections to these transmission pipelines at four locations. The three treated water connections are named OC-51, OC-66, and OC-89. The untreated water connection is named OC-36. Figure 1.4 shows the location of these interconnections.

The District's OC-51 connection is designed for 22 cfs (9,900 gpm), but the current meter capacity is only 10 cfs (4,500 gpm). The District's total allocation in the Allen McColloch Pipeline (AMP) through connections OC-66 and OC-89 is limited to 30 cfs (13,500 gpm). The OC-66 connection is designed for 50 cfs (22,400 gpm), but the current meter capacity is only 30 cfs (13,500 gpm). The total available capacity from the three treated water connections today is 40 cfs (18,000 gpm).

In addition to the treated water connections described above, the District has one active untreated water connection on MWD's Lower Feeder. This connection, known as OC-36, has a rated capacity of 4 cfs (1,800 gpm) and supplies water for the City of Yorba Linda-owned Black Gold golf course.

MWD disinfects the treated water with chloramines (chlorine with ammonia) before it is distributed to the District and other agencies in Southern California. Like sodium hypochlorite, chloramination is another commonly used form of disinfectant in potable water systems. MWD uses chloramines to minimize the formation of disinfection by-products. In the near future, MWD plans to add fluoride to the distributed water for the associated dental benefits. The implications of these two practices were addressed in this master plan.

1.5.4 Existing Pressure Zones

Water systems are frequently divided into different hydraulic regions, known as pressure zones, to maintain adequate pressures throughout the distribution system in spite of varying topography. A hydraulic grade line (HGL) is established for each pressure zone, and the high water levels in reservoirs are set to maintain these HGLs.

The District provides water service to homes and businesses with service elevations that vary from 250 feet to about 1,275 feet above mean sea level. Due to the variations in topography, the District engineers separated the service area into multiple pressure zones. Figure 1.5 presents a map of the District's pressure zone boundaries.

The District is currently in the process of renaming the pressure zones according to the HGL within the zone. Figure 1.5 lists the pressure zones according to HGL, but also lists the original pressure zone designation in parentheses following the new name.

1.5.5 Existing Storage Facilities

Water distribution systems rely on stored water to help equalize fluctuations between supply and demand, to supply sufficient water for fire fighting, and to meet demands during an emergency or an unplanned outage of a major source of supply.

The District currently stores water in 13 reservoirs, with a total storage capacity of 45.8 MG. Figure 1.4 shows the locations of these reservoirs. With the exception of the Highland Reservoir and the Bastanchury Reservoir, all of the reservoirs are buried concrete reservoirs. The Bastanchury Reservoir site includes two above-ground steel tanks, with capacities of 2.0 MG each.

The Highland Reservoir is a partially buried reservoir that was constructed in 1910. It is a prismatoidal-shaped reservoir with a concrete-lined floor and slopes. An aluminum roof deck supported on steel trusses and columns covers the reservoir. Due to the age and condition of the reservoir, as well as the difficulty in securing the roof of the reservoir, the District is planning to replace the Highland Reservoir. This project is currently in the preliminary design stages.

The new Quarter Horse Reservoir is being constructed in two phases. Construction was completed on the first phase of the reservoir in 2004. The second phase, which adds an additional 3.52 MG of storage, will be completed in early 2005.

1.5.6 Existing Booster Pumping Stations

Booster pumping stations deliver water from lower pressure zones into higher pressure zones. Multiple pumps at each station, or multiple pump stations that serve the same pressure zone, help to increase water system reliability by ensuring that water can still be boosted into that zone if one or more pumps are out of service. In addition, critical booster pumping stations may be equipped with emergency power supplies in case of failure of the primary power supply.

The District owns and operates 12 booster pumping stations. Many of these booster pumping stations share locations with the reservoirs of the same name. The locations of the stations are shown in Figure 1.4. Some of the District's booster pumping stations include pumps that operate using an alternative power source in case of failure of the primary power supply. This includes the Bastanchury, Highland, Paso Fino, Santiago, Timber Ridge, and Valley View Booster Pumping Stations. The Fairmont Booster Pumping Station runs on natural gas and has propane available as a backup fuel source.

1.5.7 Existing Pressure Reducing Stations

Pressure reducing stations allow distribution systems to transfer water from higher pressure zones to lower pressure zones. The water is transferred through a valve that reduces the pressure to a specified pressure setting.

The District currently maintains 37 pressure reducing stations. Figure 1.4 identifies the station locations. These pressure reducing stations are equipped with combination pressure reducing/pressure sustaining valves, and many of them include a lead valve with one or two additional valves with larger capacities. Many of the stations are also outfitted with pressure relief valves that open if the pressure gets too high. This helps keep the pressure zone from exceeding the pressure it was designed for.

1.5.8 Existing Emergency Interconnections

Water distribution systems are often connected to neighboring water systems to allow the sharing of supplies during short-term emergencies or during planned shutdowns of a primary supply source. The District's water distribution system is interconnected with the systems of three neighboring water agencies:

- City of Anaheim.
- City of Brea.
- Southern California Water Company (SCWC).

The District's distribution system includes 10 interconnections to these adjacent water distribution systems. The interconnections allow the District to import water from these agencies or export water to these agencies during emergencies. Figure 1.4 shows the locations of the emergency interconnections.

1.6 HISTORICAL WATER PRODUCTION

The District's total water production has increased significantly since the District was established. In the 1930's, the District's water production was about 3,500 ac-ft/yr. Water production increased at a steady, gradual rate from 1930 through the late-1970s to about 5,600 ac-ft/yr. Following the completion of the 1978 Water Master Plan and annexation of ID Nos. 1 and 2, the District's water production nearly doubled. In 1980 the District's total production was about 11,200 ac-ft/yr. Since that time, water production rates have generally continued to increase, but have also fluctuated based on precipitation and water conservation efforts.

Historically, the District has imported approximately half of its water supply from MWD. Table 1.2 presents the historical water production from the groundwater wells and the water purchased from MWD during the past 10 years.

Table 1.2 Historical Groundwater and Imported Water Production
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Total Groundwater Production (ac-ft)	Total Imported Water (ac-ft)	Percent Groundwater	Percent Imported Water
1994	9,541	8,235	54%	46%
1995	10,007	8,036	55%	45%
1996	10,242	9,426	52%	48%
1997	10,010	10,858	48%	52%
1998	9,166	8,994	50%	50%
1999	10,253	11,989	46%	54%
2000	10,812	11,169	49%	51%
2001	10,533	11,044	49%	51%
2002	10,091	13,366	43%	57%
2003	9,354	13,286	41%	59%

1.6.1 Existing Sources of Supply

1.6.1.1 Groundwater Wells

The District currently pumps less than half of its total annual water supply from groundwater. The District's eight active groundwater wells pump from the lower Santa Ana basin, which is contained within the Orange County groundwater basin. The Orange County Water District (OCWD) is responsible for managing the use, replenishment, and protection of Orange County's groundwater basin.

OCWD monitors the groundwater basin and sets a Basin Pumping Percentage (BPP), which is a ratio of the maximum amount of groundwater production to total water supply that member agencies are allowed to pump. The allowable percentage is set based upon basin groundwater levels, water replenishment capacity, seawater intrusion, and other factors. For the past several years through April 2003, OCWD set and maintained a BPP of 75 percent. In April 2003, the OCWD Board of Directors reduced the BPP to 66 percent to reverse the trends of lower groundwater levels and saltwater intrusion into the basin after 4 years of drought conditions in Southern California. The OCWD has subsequently lowered the BPP again to 62 percent beginning in fiscal year 2005/2006.

Since groundwater is generally more economical to provide than imported water, the District's goal is to increase groundwater production to 75 percent of the total supply. The District has completed several major capital improvement projects to improve reliability and increase groundwater pumping capacity. However, additional improvements are necessary to be able to fully utilize groundwater and reduce the District's dependence on more expensive imported water.

The District's estimated cost to produce groundwater is currently about $237 per acre-foot, excluding O&M. The costs of pumping groundwater include fees paid to OCWD and energy costs to pump the water from the ground into the distribution system. Although OCWD has recently raised its replenishment assessment (RA) and is expected to raise it again in 2005, the cost of groundwater production is still significantly less expensive than imported MWD supplies.

1.6.1.2 Imported Water

The District imports the balance of its water supply from MWD. MWD is the largest wholesale water agency in the United States, distributing water to a service area that extends from Ventura to the California-Mexico border. The Municipal Water District of Orange County (MWDOC) is the billing agent between MWD and the District, as well as other local water retail agencies in Orange County. MWDOC also represents its member agencies in negotiations with MWD, disseminates information to the retail agencies, and coordinates a regional public information and school education program.

MWD currently supplies treated water to the District via three connections, with a combined capacity of 44 cfs (18,000 gpm), through the Lower Feeder and the AMP, which was originally owned by MWDOC and a group of water agencies (including the District). The District imports untreated water through one MWD connection, with a capacity of 10 cfs (4,500 gpm).

The estimated cost to the District to purchase treated water from MWD is about $481 per acre-foot. This cost includes fees charged by MWD and MWDOC for maintenance and other purposes.

1.6.1.3 Cost Differential

For every 10% (of total production) increase in groundwater use, the District will save over half a million dollars ($500,000) per year. Therefore, it is important that the District make every reasonable effort to maximize its use of groundwater.

Based on the estimated cost of water for the District's two main sources of water, it is obvious that there is a significant difference in costs. Groundwater costs about $237 per acre-foot while MWD water costs about $481 per acre-foot, almost double. This is a difference of $244 per acre-foot. If the District could pump 66 percent of its demands in 2005, instead of 41 percent as it did in 2003, the District could save about $1.4 million on its water supply costs in only one year. Similar savings would be expected in subsequent years depending on the availability of groundwater from OCWD. Nevertheless, the point is clear that groundwater is significantly less expensive than imported MWD water. Furthermore, based on historical trends, it is expected that groundwater will continue to be significantly less expensive than imported MWD water. Therefore, the District should make every reasonable effort to maximize its allocation of groundwater.

1.6.1.4 Emergency Interconnections

In the event of a local emergency, the District's available emergency sources of water supply consist of the emergency interconnections to the City of Anaheim, City of Brea, and the Southern California Water Company. Most of these emergency interconnections are not metered and some only benefit the neighboring agency due to limited pressure in the adjacent system.

1.6.2 Future Sources of Supply

1.6.2.1 Groundwater

It is expected that groundwater will continue to be the District's least expensive supply source for potable water into the foreseeable future. Therefore, it is prudent planning for the District to examine ways to maximize its groundwater pumping capacity. This should include refurbishing or replacing wells that have lost a significant amount of capacity, drilling new wells as appropriate, and participating in programs that promote the District's use of groundwater.

During the past 10 years, the District has investigated several new groundwater well options to increase the supply of groundwater available for the District's system. The District has considered developing water wells owned by the Texaco Oil Company, the Etchandy family, the Eastlake Village Homeowners Association, and in the area generally north of Yorba Linda Boulevard and east of Ohio Street. However, these options were discarded after studies revealed water quality problems or production volumes that would be too low for economical operation.

The Orange County Groundwater Storage Project provides some potential for participating agencies, including the District, to use additional groundwater supplies. This project would allow participating agencies to store excess surface water in the groundwater basin when it is available and use more groundwater during shortages of imported surface water. The construction of a new domestic water well at the District's Richfield Plant, Well No. 19, is currently under construction as part of this project.

1.6.2.2 Imported Water

In 1990, several agencies in south Orange County requested additional imported water supply to meet their service area needs. To meet these projected demands, as well as increasing demands in all of Southern California, MWD proposed to construct the Central Pool Augmentation Project. This project consists of a pipeline from Lake Matthews, tunneled through the mountains, and terminating near Lake Forest. Completion of the project is scheduled for 2010.

In the interim, MWDOC proposed expansion of the AMP capacity to meet increased water demands until the Central Pool Augmentation Project is finished. MWDOC's proposal, known as the Flow Augmentation Project, includes the installation of a parallel pipeline in south Orange County, and the construction of a future booster station at the Diemer Filtration Plant. AMP participants were offered the opportunity to purchase additional capacity in the Flow Augmentation Project. The District chose not to buy more capacity and, in fact, sold 20 cfs of its capacity in the AMP.

1.6.2.3 Untreated (Raw) Water

MWD's Lower Feeder is an untreated water pipeline that traverses across the northern portion of the District's service area. The Black Gold Golf Course is currently supplied untreated water through the OC-36 turnout off the Lower Feeder. There are no current plans to deliver untreated water to any other sites for irrigation within the District's service area.

1.6.2.4 Recycled Water

Current treatment technology and economics indicate that wastewater reclamation is more efficient when administered regionally by agencies such as the Orange County Sanitation District (OCSD) and OCWD. In 1993 the District Board of Directors reviewed a report on a proposed wastewater treatment plant near the Yorba Linda lakebed. The report concluded that it was not cost-effective to construct and operate a wastewater treatment plant at this site at this time. A wastewater treatment plant was studied for the Shell Development project but was dropped for cost and environmental reasons.

In April 2001 the OCSD and OCWD approved a plan to construct the Groundwater Replenishment System (GWRS) project, which will treat wastewater from OCSD's Fountain Valley plant. Once completed, the GWRS project will bring recycled wastewater from Fountain Valley to the Santa Ana River lakes area for recharge into the underground aquifers. There are no current plans to use recycled water supply for irrigation within the District's service area.

1.6.3 Water Conservation

1.6.3.1 Existing Conservation Programs

The District has implemented many water conservation projects to reduce the overall system demands and the need to increase water supply. In general, the District's customers have been responsive to requests to conserve water during periods of drought. Below are some of the water conservation programs the District currently has in place, although not all of the District's programs are included here.

- Resolution on Voluntary Water Use Reduction
- Education Programs
- Community Involvement
- Community Outreach

- Media Relations
- Drought Tolerant Landscaping
- Plumbing Retrofit Program
- Water Audits
- Coordination with Local Cities

1.6.3.2 Future Conservation Programs

The District is currently working to develop and implement additional water conservation measures that may help to reduce future water demands. These programs are in various stages of development. The District will evaluate the benefits of the following programs and implement them as appropriate:

- Water Conservation Workgroup
- Media Advertising
- Town Hall Meetings
- Alternative Pricing Programs
- Conservation Monitoring Program
- Flow Restrictor Devices

1.6.4 Future Water Supply Requirements

As the cost differential between groundwater and MWD water indicates, groundwater is significantly less expensive to produce than imported water from MWD. This trend is expected to continue in the foreseeable future. Therefore, the District should continue to maximize the use of groundwater to supply its system. The amount of groundwater that the District can produce will be limited by the BPP established by OCWD. Assuming that the BPP will eventually return to 75 percent, the District should aim to maintain enough groundwater pumping capacity to supply 75 percent of the demands within the OCWD boundary with local groundwater. Annexation of areas outside OCWD's boundary and within the District's service area would further increase the amount of groundwater the District could produce.

Table 1.3 presents the estimated future water production that the District will need to meet the projected future water demands (including unaccounted-for-water). This table also includes the groundwater pumping capacity required to meet 75 percent of the projected demand in each planning year, except for the year 2005 which uses a basin pumping percentage of 66 percent.

Table 1.3 Projected Future Water Production
2005 Domestic Water System Master Plan
Yorba Linda Water District

	Total Projected Demands (ac-ft/yr)	Groundwater Production Goal(1) (ac-ft/yr)	Imported Water Supply Goal(2) (ac-ft/yr)
2005	23,260	15,352	7,908
2010	25,198	18,898	6,300
2020	26,069	19,552	6,517

Notes:
(1) Assumes that the areas of the District service area currently outside the OCWD boundary are annexed into OCWD. For 2010 and 2020, assumes that the basin pumping percentage returns to 75 percent. Basin pumping percentage for 2005 is 66 percent.
(2) Based on providing the remaining supply with imported MWD water.

As the District's supply needs increase, it will become increasingly important to maximize the use of groundwater. Assuming that the current cost differential of $244 per acre-foot continues, that the basin pumping percentage returns to 75 percent, and that the areas outside OCWD's boundary are annexed into the OCWD, the District will be able to save about $1.5 million (in 2005 dollars) per year. Year after year, this will continue to add up.

1.7 WATER DEMANDS

Water demands (or water use) represent water that leaves the distribution system through metered or unmetered connections, or at pipe joints (leaks) or breaks. These demands include metered water use and unaccounted-for water, or water that leaves the system without being metered. Water demands occur throughout the distribution system based on the number and type of consumers in each location. Water demands vary throughout the day, resulting in a diurnal demand pattern that typically includes one peak in the morning and a second in the evening. Demands also vary seasonally, with the peak demands typically occurring during the summer months.

1.7.1 Historical Metered Water Use

Table 1.4 summarizes the historical metered water use in the District's service area over the past 10 years. With the exception of 1998, which was a particularly wet year, metered water use increased steadily during the late 1990s. Since then, water use has remained relatively consistent from year to year.

Table 1.4 Historical Metered Water Use
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Metered Water Use (ac-ft/yr)
1994	17,806
1995	17,721
1996	19,255
1997	20,078
1998	16,618
1999	20,422
2000	21,267
2001	20,824
2002	21,988
2003	21,119

1.7.2 Unaccounted-for Water

Water taken out of the distribution system at metered connections is relatively easy to measure. Unfortunately, not all water that leaves the system does so at metered connections. Water that exits the distribution system and cannot be measured or accounted for is known as unaccounted-for water. Unaccounted-for water can be estimated by calculating the difference between known water consumption and water production. Most water systems experience a difference of 5 to 10 percent, which is generally considered acceptable. Over the last 10 years, the District's unaccounted-for water has varied between 2 and 8 percent, which is generally considered good to acceptable. The average of the last 10 years is 4 percent.

1.7.3 Fire Flow Requirements

In addition to providing adequate water supply and pressure to serve residential, commercial, and industrial water demands placed on the system, the water system must also deliver an adequate supply for fire fighting. Since fires can occur at any time, the water system must always be ready to provide the required flow with an adequate residual pressure. The water system should be capable of providing the fire flow during the day of the year with the highest water demands, or the maximum day demands.

The fire flow requirements defined in the California Fire Code were used as a guide in developing the fire flow criteria for this master plan. Table 1.5 summarizes the fire flow criteria used for the District's Master Plan.

Table 1.5 Fire Flow Requirements
2005 Domestic Water System Master Plan
Yorba Linda Water District

Category	Minimum Flow Required (gpm)	Minimum Residual Pressure (psi)	Duration (hr)
Single Family Residential	1,500	20	2
Multi-Family Residential	2,500	20	2
Public Facilities/Schools	3,500	20	3
Commercial	2,500	20	3
Industrial	5,000	20	4
Hospital (Linda Vista)	5,000	20	4

1.7.4 Water Demand Calculations

In general, the total water demand for a distribution system can be correlated to the number of service connections in the service area. The demands vary throughout the system based on the density of service connection in each geographical area. Future demands for the District's system can be projected based on the proposed number of service connections that will be added to different geographical locations in the service area.

Table 1.6 presents the estimated average water demands for each of the future planning years studied in this master plan. The estimated water demands are expected to increase by about 12 percent between 2005 and 2020.

Table 1.6 Projected Average Water Demands
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Estimated Number of Service Connections	Estimated Water Demand (ac-ft/yr)	Estimated Water Demand (mgd)	Estimated Water Demand (gpm)
2003	22,417	22,585	20.2	14,028
2005	23,100	23,260	20.8	14,447
2010	25,067	25,198	22.5	15,651
2020	25,950	26,069	23.3	16,192

1.7.5 Demand Variation and Peaking Factors

It is important to study the variability of water demands with respect to time to fully evaluate water system operation under variable operating conditions. Water demand varies with respect to the time of year. Water demand is typically higher than average on hot summer days, primarily due to increased water demands for irrigation. On cool winter days, water demands are lower than average due to lower temperatures and increased precipitation, which significantly reduces irrigation demands. Peaking factors are used to account for these daily fluctuations in demands. Peaking factors are determined by dividing the water system demand for a selected period by the average day demand. Table 1.7 lists the peaking factors developed in this master plan and the resulting projected demands.

Table 1.7 Projected Peak Water Demands
2005 Domestic Water System Master Plan
Yorba Linda Water District

	Estimated Average Day Demand (gpm)	Estimated Maximum Day Demand (gpm)	Estimated Peak Hour Demand (gpm)
Peaking Factor	**1.0**	**1.48**	**2.55**
2003	14,028	20,761	35,771
2005	14,447	21,382	36,840
2010	15,651	23,163	39,910
2020	16,192	23,964	41,290

1.7.5.1 Average Day Demand

The average day water demand is calculated by dividing the total annual water demand by the number of days in the year. The total production for the year 2003 was 22,640 ac-ft (7,377 MG), resulting in an average daily production of 20.2 mgd. This is equivalent to an average daily water usage of 14,028 gpm.

1.7.5.2 Maximum Day Demand

The maximum day demand peaking factor for the system was determined from production data in calendar year 2003. The maximum-day production in 2003 occurred on August 26, 2003. The total production for the day was 29.9 mgd. The maximum-day demand peaking factor was obtained by dividing the maximum-day production by the average daily production (20.2 mgd), resulting in a maximum day demand peaking factor of 1.48.

1.7.5.3 Peak Hour Demand and Diurnal Demand Curve

The peak hour represents the hour with the highest water system demand during the maximum day. Water systems often experience the highest demand on reservoirs and booster stations during the peak hour demand period. This period can also be the controlling demand period for pipeline sizing, although the maximum day plus fire flow demand is often more critical for establishing pipeline sizes. Minimum water system criteria, such as the minimum allowable system pressure, are often evaluated using peak hour demands.

The peak hour peaking factor for the District's system was established using hourly production records and reservoir levels provided by the District for the maximum day in 2003. The peak hour occurred between 5:00 am and 6:00 am. The estimated water demand during this period was about 35,800 gpm. Therefore, the peak hour peaking factor relative to the average day demand is 2.55.

1.7.5.4 Diurnal Demands

The hourly production records and reservoir levels were also used to establish a peak day diurnal demand pattern for the District's system. This pattern was established by comparing the demand over each hour to the average hourly demand for the day. The resulting demand pattern was used in the hydraulic computer model to more accurately evaluate how the distribution system operates on an hour by hour basis.

1.8 COMPUTER MODELING ANALYSIS

A computer model of the water distribution system is an important tool for any analysis of a water system and especially for a water master plan. The widespread use of personal computers and availability of modeling software has made network analysis modeling efficient and practical for virtually any water system. Computer modeling can be used to analyze existing water systems, future water systems or even specific improvements to the existing water system. In master planning, the computer model assists in measuring system performance, in analyzing operational improvements, and in developing a systematic method of determining the size and timing required for new facilities. The computer model allows numerous scenarios to be analyzed relatively quickly and easily and provides answers to many "what if" questions.

Prior to developing this master plan, the District had developed and calibrated a hydraulic computer model using H_2ONET® modeling software. Carollo started with the District's computer model and updated the model to include facilities that had been constructed after the model was developed.

1.8.1 GENERAL COST ASSUMPTIONS

Cost estimates developed for this master plan are based on February 2005 dollars. Total project cost estimates include estimated costs for construction, engineering, legal, administration, construction management, and contingency. Estimated construction costs are based on historical bids submitted by contractors for similar projects for the District and Carollo. The estimated costs of engineering, legal, administration, and construction management was assumed to be 35 percent of the estimated construction cost. A contingency of 25 percent of the estimated construction cost was also included in the total project cost estimates.

The cost estimates are based on current perceptions of conditions at the project locations. These estimates reflect Carollo Engineer's (Carollo's) professional opinion of costs at this time and are subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

1.8.2 Hydraulic Modeling Results

As part of the Master Plan project, a number of model simulations were conducted to identify deficiencies in the existing and future distribution system and to analyze proposed or recommended system improvements. The analysis included simulations for:

- Average Day Demands (2005, 2010, and 2020)
- Maximum Day Demands (2005, 2010, and 2020)
- Peak Hour Demands (2005, 2010, and 2020)
- Fire Flow Analysis (2005, 2010, and 2020)
- Groundwater Supplies Only (2005, 2010, and 2020)
- MWD Supplies Only (2005, 2010, and 2020)
- Blend of Groundwater and MWD for Average Day Demands (2005, 2010, and 2020)
- Blend of Groundwater and MWD for Maximum Day Demands (2005, 2010, and 2020)

Where system deficiencies were identified in the simulations identified above, system improvements were modeled to verify that the improvements would mitigate the deficiencies. After a deficiency was identified, it was categorized as either a health/safety improvement (such as improving fire flows), a reliability improvement (such as increasing emergency storage), or an operational improvement (such as reducing pumping). Where there was overlap between these classifications, a judgment was made to put the improvement into the best category.

1.8.2.1 Fire Flow Analysis

The fire flows identified in Table 1.5 were distributed to various junction nodes in the hydraulic computer model based on the land use obtained from the City of Yorba Linda. Schools were identified from maps of the city. The fire flow demands were added to maximum day demands. As shown in Figure 1.6, inadequate fire flows were identified in three areas of the District's service area.

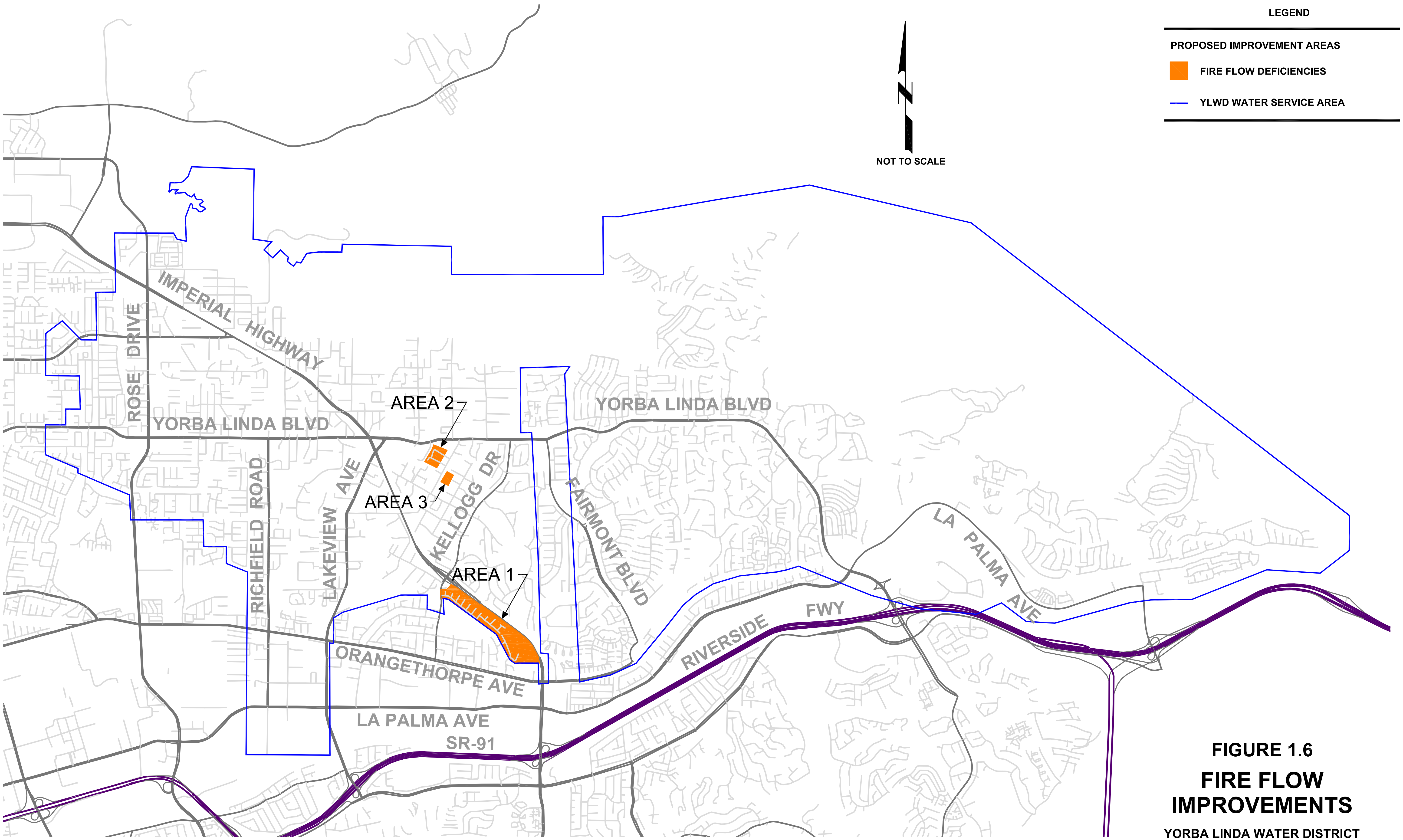

FIGURE 1.6

FIRE FLOW IMPROVEMENTS

YORBA LINDA WATER DISTRICT

carollo engineers

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It may be feasible to construct an alternative project at a significantly lower cost. The District should investigate the feasibility of an emergency interconnection with Anaheim that could supply the needed fire flow to Zone 430 (1B).

The areas with deficient fire flow capacity include:

- Cresthill Drive (Zone 430 (1B))
- Via Sereno
- Area south of Gordon Lane between Ohio Street and Grandview Avenue

The estimated project cost to correct these deficiencies is $786,000 in February 2005 dollars.

1.8.2.2 System Pressures Analysis

The distribution system was analyzed to identify areas of the system that experienced pressures below 40 psi or above 125 psi (based on the criteria developed for this master plan). Various scenarios were used to analyze system pressures under an array of conditions. For example, when a pumping station is running, the pressures downstream are increased while the pressures on the upstream side are decreased. During the hydraulic modeling analysis, it was noted that there were several conditions where increasing flows from a nearby booster station reduced the pressure on the suction side of the station below 40 psi. In other cases, simply the increased system demands resulted in the reduction in system pressures.

Several areas of the system were identified as having low pressures (pressures below 40 psi) during average day, maximum day, or peak hour demand periods. These areas are shown in Figure 1.7. This figure shows the areas where the existing pressure zones are proposed to be modified by allowing a higher pressure zone to serve the areas shown.

The estimated cost to correct all of the District's pressure problems is about $3,139,000 in February 2005 dollars. These improvements would increase pressure in areas where low pressures have been a problem and improve system operations by reducing the amount of water needed from higher-pressure zones.

1.8.2.3 Operational Analysis

Operational improvements were considered where these would help maximize the District's use of groundwater and minimize pumping of water while maintaining the minimum pressure criteria (40 psi). In general, this means that water should only be pumped once and that water in a higher pressure zone should not be used as a supply for a lower pressure zone, unless it is the only source.

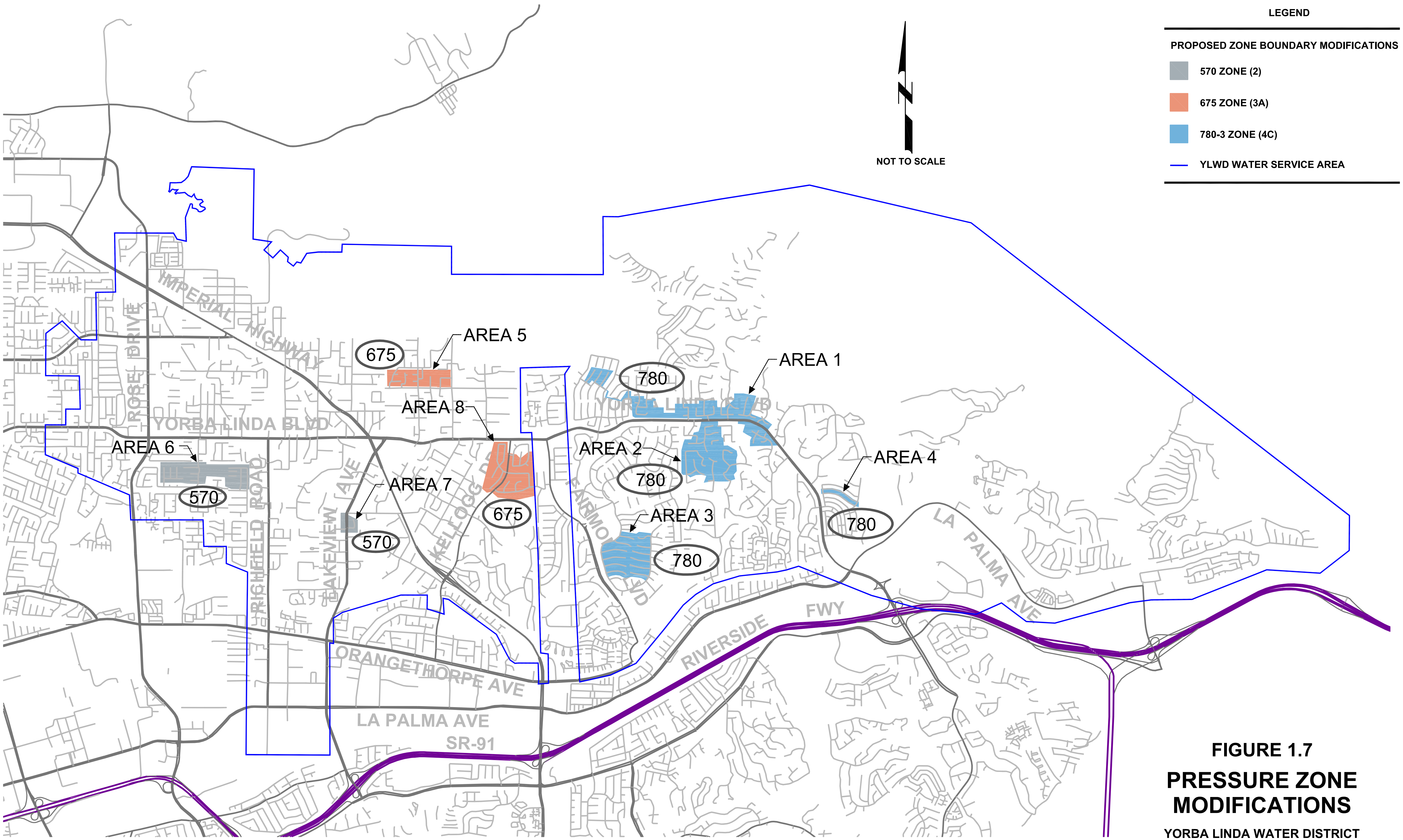

FIGURE 1.7
PRESSURE ZONE MODIFICATIONS
YORBA LINDA WATER DISTRICT

carollo engineers

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The areas identified and analyzed using the hydraulic computer model include the following improvement projects:

- Groundwater Capacity Restoration. Maintain a minimum groundwater production capacity of about 16,000 gpm through capacity restoration projects of the District's existing wells and a proposed new well to replace Well No. 9.
- Zone 2 (Zone 570) transmission main from Highland Booster Station to Bastanchury Reservoir.
- Bastanchury Booster Station Upgrade. Zone 3A (Zone 675) pipeline in proposed extension of Lakeview Avenue (SWEPI).
- Construct 3,200 lf of 18-inch pipeline in the proposed extension of Bastanchury Road from Lakeview Avenue east to the existing 18" pipeline.
- Palm Avenue Booster Station Upgrade. Includes pressure reducing station and new parallel pipeline in Yorba Linda Blvd.
- Install a check valve on the 8-inch pipeline in Kellogg Drive just south of Old Ranch Road to prevent water from moving south.
- Construct 8,600 lf of 36-inch transmission main in the proposed Bastanchury Road and Lakeview Avenue extensions to connect Zone 780-1 (4A) to Zone 780-2 (4B).
- Construct 3,500 lf of 18-inch transmission main in the proposed Bastanchury Road extension from White Pine Lane to Fairmont Blvd.
- Construct 3,500 lf of 36-inch transmission main in the proposed Bastanchury Road extension to connect Zone 780-2 (4B) to Zone 780-3 (4C).
- Close the gate valve in the water main on Esperanza Road west of Paseo del Prado.
- Construct 500 lf of 24-inch pipeline from the Fairmont Booster Station south to the existing 39" pipeline.
- Construct a Zone 5 booster station to pump 1,650 gpm from Zone 920 (5A) to Zone 1000 (5B). Also requires 1,500 lf of 12-inch pipe to provide water from Quarterhorse Reservoir near Fairmont Booster Station.

The estimated cost to improve the District's operations is about $24,153,000 in February 2005 dollars. These improvements would reduce the amount of pumping required, increase the District's ability to maximize the use of groundwater, and reduce the dependence on imported MWD supplies.

1.8.2.4 Development Driven Facilities

Most of the remaining undeveloped lands left in the District's service area are along the north edge in the higher pressure zones. Most of the facilities required to provide water service to these proposed development projects is either already in place or will be constructed by the developer when the project is built. This primarily involves the construction of pipelines and in some cases additional storage facilities. One exception to this is the Pacific Holding Development.

The Pacific Holding Development (Murdock Property) does not have existing backbone facilities in place. Because the development project is within Improvement District No. 1, the District is obligated to provide backbone facilities to serve the project. This includes a transmission pipeline, booster pumping station, and reservoir. The estimated cost to provide backbone facilities to the Pacific Holding Development is $8,236,000 in February 2005 dollars.

1.9 WATER QUALITY

An important purpose of the District's domestic water system is to provide consumers with high quality water that meets all government regulations. To this end, it is important to consider current and future water quality issues when developing a long term planning document for the District's system. Prior to developing this portion of the Master Plan, the District conducted a meeting with Carollo to discuss current water quality concerns in the water system, as well as current operational practices that may affect water quality. The District noted that they have very few water quality problems in their system, but identified a few areas of concern based on pending water quality regulations, recent or pending changes in MWD's operations, and potential local environmental groundwater pollution.

1.9.1 Regulatory Requirements

Existing and future regulatory requirements may impact the District's water supply sources, treatment requirements, and system operations. The regulatory information and framework contained in this master plan was updated through February 2005.

Potential constituents that may be a particular concern to the District are identified in Table 1.8. Many of these contaminants have been identified at low levels in the District's or MWD's source water. Table 1.8 also identifies the current and pending regulations that govern these contaminants.

Table 1.8 Contaminants of Concern
2005 Domestic Water System
Yorba Linda Water District

Contaminant	Regulation
Arsenic	Primary Drinking Water Standards Arsenic Rule
Atrazine	Primary Drinking Water Standards
Coliphage	No Regulations Identified
Fluoride	Primary Drinking Water Standards Secondary Drinking Water Standards California Safe Drinking Water Act
Manganese	CDHS Notification Levels Secondary Drinking Water Standards
Methyl tertiary butyl ether (MTBE)	Primary Drinking Water Standards (CA Title 22) Secondary Drinking Water Standards USEPA Contaminant Candidate List Federal Unregulated Contaminant Monitoring Rule
Perchlorate	CDHS Notification Levels USEPA Contaminant Candidate List Federal Unregulated Contaminant Monitoring Rule
Radon	Radon Rule
Simazine	Primary Drinking Water Standards
TDS	Secondary Drinking Water Standards

1.9.2 Future Regulations

CDHS is currently in the process of establishing new MCLs for some contaminants, including arsenic, chromium-6, and perchlorate. The status of each of these regulations is discussed below. In addition, the following proposed federal regulations will apply to the District's system once they are finalized:

- Groundwater Rule.
- Radon Rule.
- Stage 2 Disinfectants/Disinfection By-Products Rule.
- Long Term Stage 2 Enhanced Surface Water Treatment Rule.

The District should continue to follow the progress of the pending state and federal regulations to ensure that the District's system remains in compliance with all water quality regulations.

1.9.3 Nitrification Monitoring Plan

In February 2001, CDHS required the District to establish a nitrification-monitoring program for early warning signs of bacteriological and other water quality problems in all reservoirs that receive chloraminated surface water from MWD. After the monitoring program began, the District observed indications of nitrification in all eight of the reservoirs that receive MWD water. The District retained Carollo Engineers to conduct a study to prevent and control future nitrification in these reservoirs (Water Reservoir Nitrification Prevention and Control, Carollo Engineers, September 2002).

Following the completion of the Water Reservoir Nitrification Prevention and Control Report, the District implemented many of the recommended operational changes. Since then, the District has not detected any significant problems with nitrification in these reservoirs.

The District should implement all of the recommendations outlined in the Water Reservoir Nitrification Prevention and Control Report to reduce water age, increase mixing, and prevent the loss of disinfectant residual in the reservoirs.

1.9.4 Blending of Chlorinated and Chloraminated Water

The District currently disinfects groundwater pumped from the District's wells with free chlorine, while water imported from MWD is disinfected using chloramines. Throughout much of the District's distribution system, water from the two sources remains isolated. However, there are portions of the system where MWD water blends with groundwater. This blending of chlorinated water and chloraminated water can create water quality problems in the distribution system.

The mixing of free chlorinated with chloraminated water can lead to the loss of an effective disinfectant residual and eventually poor quality due to sloughing. Mixing of free chlorine and chloramine residuals may lead to taste and odor problems caused by the formation of dichloramines or by biofilm sloughing. When chloramines and free chlorine are mixed, a chemical reaction can form chlorine compounds that are not effective disinfectants. The loss of the residual through this reaction and taste and odor problems will be encouraged if the free chlorine residuals are above breakpoint chlorination or a large amount of free chlorinated water is mixed with a small amount of chloraminated water. The potential loss of disinfectant residual presents a potential public health concern and allows bacteria to grow, including nitrifying bacteria that are responsible for nitrification. Ultimately, this may prohibit the District from meeting the requirements of the SWTR.

To resolve the potential problems associated with the blending of multiple disinfectants, the District has three options:

- Isolate the portions of the system that receive MWD water from those that receive groundwater to prevent blending.
- Add sufficient free chlorine to the MWD water beyond breakpoint chlorination prior to blending with the groundwater to maintain a free chlorine residual throughout the blended zone.

- Convert the existing groundwater disinfection facilities from free chlorine to chloramines. This will provide a consistent disinfectant residual throughout the entire system.

To avoid blending water supplies with different disinfectants, it is recommended that the District keep the two supply sources separate. Groundwater should be used exclusively in the zones that have a hydraulic grade line below 780 ft-MSL, and MWD water should be used in zones that have a hydraulic grade line equal to or above 780 ft-MSL. This will help to ensure that dissimilar disinfectants do not blend in the distribution system.

1.9.5 Fluoride

In 1995, the California legislature passed a bill requiring all water agencies to fluoridate their water supplies if money was provided to the agencies to do so. To date, this money has not been provided, and the District has not been adding fluoride to the water supply. Due to the lack of state funding, the District is not required to fluoridate, and therefore, is not out of compliance by not fluoridating.

In 2003, MWD announced plans to begin fluoridating its water supply within the next few years. As noted earlier, the District does not add fluoride to its water supply. If the District does not begin fluoridating at the same time as MWD, there will be portions of the distribution system with water that contains fluoride, portions where it does not contain fluoride, and portions where the two sources are mixed.

The District should evaluate the benefits and drawbacks of fluoridating its groundwater supply to determine whether it is appropriate to adopt fluoridation procedures consistent with MWD's planned procedures. However, keeping the supply sources separate would provide a way for customers to know whether or not their drinking water contains fluoride.

1.10 STORAGE ANALYSIS

This analysis evaluated the ability of the District's storage facilities to meet the storage requirements for operational, fire, and emergency storage. The resulting volume must be allocated to the pressure zones where the demands are or within a higher-pressure zone.

1.10.1 Operational Storage

The required volume of water for operational storage is determined by the volume required for regulating the difference between the rate of supply and the daily variations (peaks) in water usage. This difference results in the lowest and highest operating levels in the reservoirs under normal conditions. The resulting volume must be allocated to either the pressure zones (where the demands are) or in a higher pressure zone (for use by the lower zone).

1.10.2 Fire Storage

The volume of water storage required for fire fighting is a function of the instantaneous flow rate required to fight the fire, the duration of the fire flow, and the number of fire flows that occur before the volume can be replenished. The fire flow requirements listed in Table 1.5 were used to establish the flow rate and duration for each pressure zone; using these criteria, the largest volume of water required for fire fighting was identified within each pressure zone. The volumes that resulted from these fire flow ranged from 0.18 million gallons (MG) to 1.2 MG.

1.10.3 Emergency Storage

Emergency storage is a dedicated source of water that can be used as a backup supply in the event a major supply is interrupted. This can be provided by water from a second independent source, by water stored in reservoirs, or a combination of both. The District has built a significant amount of redundancy into the distribution system, both in terms of supply sources and power supplies for wells and booster stations. Therefore, numerous scenarios were evaluated in analyzing the necessary amount of emergency storage in each pressure zone.

1.10.4 Recommended Storage Improvements

A detailed analysis was performed on each pressure zone in the District's system. The results of this analysis identified about 24.0 MG in new storage needs. Some of these facilities were already being planned by the District. Table 1.9 summarizes the recommended reservoir improvements and their estimated project costs.

Table 1.9 Estimated Project Costs for New Storage Facilities
2005 Domestic Water System Master Plan
Yorba Linda Water District

Reservoir Name		Recommended Volume	Estimated Project Cost(1)
1390 (6C)	Hidden Hills Reservoir	2.0 MG by 2010	$3,500,000
1300 (6E)	Pacific Holding Reservoir	4.0 MG by 2020	$6,000,000
920 (5A)	Quarterhorse II Reservoir	3.5 MG by 2010	$5,250,000
570 (2)	Bastanchury II Reservoir	8.37 MG by 2010	$12,555,000
426 (1A)	Highland Reservoir Replacement	6.0 MG by 2010	$9,000,000
Total Estimated Costs			**$36,305,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal costs, administrative costs, and a 25 percent contingency, but exclude land acquisition and offsite facility costs.

1.10.5 Estimated Project Costs for Nitrification Control Improvements

In 1992, the District developed a plan to address water quality concerns in reservoirs, which receive a combination of supplies that use different disinfectants (e.g., Fairmont Reservoir) and reservoirs that primarily receive chloraminated water from MWD (e.g., Springview Reservoir). The Water Reservoir Nitrification Prevention and Control report (Carollo Engineers, September 2002) presents the results of an investigation that examined eight of the Districts reservoirs. The recommended improvements for these reservoirs is presented in Table 1.10.

Table 1.10 Estimated Project Costs for Nitrification Control Improvements
2005 Domestic Water System Master Plan
Yorba Linda Water District

Reservoir Name	Zone	Service Area	Estimated Project Cost(1)
Fairmont Reservoir	675 (3A)	WSA & ID-1	$250,000
Springview Reservoir	780 (4C)	ID-1	$250,000
Little Canyon Reservoir	1000 (5B)	ID-1	$250,000
Chino Hills Reservoir	1300 (6B)	ID-1	$250,000
Santiago Reservoir	1000 (5B)	ID-2	$250,000
Bryant Ranch Reservoir	680 (3B)	ID-2	$250,000
Elk Mountain Reservoir	780 (4D)	ID-2	$250,000
Camino de Bryant Reservoir	1165 (5U)	ID-2	$250,000
Total Estimated Costs			**$2,000,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal costs, administrative costs, and a 25 percent contingency.

1.11 DISTRIBUTION SYSTEM OPERATIONS

The operation of the District's distribution system is very complex. The topology of the District's service area contributes to the complexity by requiring a relatively large number of pressure zones to adequately regulate pressure throughout the distribution system. Two separate water supply sources (groundwater and MWD), water quality issues, and fluoridation (planned by MWD) add to an already complex operational situation. In addition, the routine maintenance of the District's facilities is important to keeping the distribution system performing its function.

1.11.1 Operational Strategies

Operational strategies were developed using the hydraulic computer model to identify modes of operation and specific set points for the District's reservoirs, booster pumping stations, and pressure regulating stations. With the recommended operational improvements, these recommended operational strategies will improve the operational efficiency of the distribution system.

1.11.2 OPERATIONS AND MAINTENANCE PROGRAMS

1.11.2.1 Unidirectional Flushing Program

The District's water mains are typically sized to handle fire flows. Normal system demands, including peak hour demands, are usually small compared to the demands of a fire flow. This results in the distribution system experiencing slow moving water almost all of the time. Slow moving water in the water mains allows mineral and sediments to deposit and accumulate over time. These deposits can result in colored water and water quality problems, can restrict the flow of water in the mains, and contribute to the corrosion of some of the pipes. Flushing may also be appropriate to address customer complaints. It is recommended that the District develop a UDF program and implement it to minimize the deposits in the water mains and promote water quality in the distribution system.

1.11.2.2 Valve Turning Program

The purpose of a valve turning (or exercising) program is to ensure that the main line valves are functioning properly, that the valves are in the correct position, and that the valves have not been paved over. The primary goal of this program is to make sure that the main line valves are in working order and can be found when a water main break occurs and an area must be isolated. Locating all of the available main line valves reduces the amount of time required to isolate the area, reduces the number of valves to be closed, and minimizes the number of customers affected by the shut down. In addition, the valve turning program can prolong the live of the valve and identify closed valves that should be open. Closed valves in the distribution system can have a serious impact on the District's ability to provide adequate pressure and fire flow. A valve turning program can be implemented using in-house staff or an outside company.

It is recommended that the District implement a valve turning program. The program should include a complete database of every valve in the distribution system.

1.11.2.3 Hydrant Operation and Maintenance Program

Since the main function of a fire hydrant is to provide an adequate flow of water for fire protection, it is extremely important that they function properly when needed. Lives may depend on the quick availability of water to fight a fire. Therefore, a hydrant O&M program is recommended for the District. AWWA recommends that all hydrants be inspected regularly, at least once a year. Therefore, it is recommended that the District inspect, operate, and perform routine maintenance on every fire hydrant in the District's service area at least once a year. A database of hydrants in the distribution system should be developed and maintained.

1.11.2.4 Meter Maintenance Program

Water meters are key to the District's ability to collect revenues for the water it sells. However, like any other mechanical device, water meters require routine maintenance to function properly. Typically, water meters that are not regularly maintained will read less than the actual amount flowing, but it is also not uncommon for these meters to stop working altogether. This results in errors that are typically in the customer's favor. Therefore, it is in the District's interest to ensure that meters are being maintained on a routine basis. In addition, it is frequently found that most meter maintenance programs pay for themselves through improved accuracy in meter readings. It is recommended that the District monitor the condition of its water meters and maintain them as appropriate based on the findings of meters that are inspected and/or replaced. If it is found that a large number of meters are not reading properly when they are inspected, then the maintenance schedule should be shortened.

1.11.3 Pipeline Replacement Program

Based on the hydraulic computer model database, the District's distribution system includes about 640 miles of 4- to 39-inch water mains. Assuming a replacement cost of $15 per diameter-inch for total project cost, the value of these existing pipelines is $246 million. If the expected useful life of the existing pipelines is 100 years, then an average of 1 percent should be replaced each year. This indicates that the District should be budgeting about $2.46 million (in February 2005 dollars) every year for pipeline replacement projects. The actual costs may be lower where rehabilitation options are available, but may be slightly higher if existing pipelines are upsized.

It is recommended that a pipeline replacement program be implemented by the District. This may be included as part of an overall asset management program, or as a separate plan. The plan should provide a cash-flow diagram of the annual credits and debits to the pipeline replacement fund. It is also recommended that a minimum budgetary amount be identified and increased in future years as necessary to maintain a positive cash flow. The goal of the plan should be to establish a budget starting point and gradually increase the budget to avoid catastrophic budget increases in later years when the pipelines begin to fail in large numbers. It is also prudent that consideration be given to developing a comprehensive asset management plan to establish future fiscal needs for preservation of the District assets.

1.12 CAPITAL IMPROVEMENTS PROGRAM

The capital improvements program (CIP) is an important element of a master plan. The CIP summarizes the recommended facilities, identifies the estimated costs of these facilities, and develops a timetable for the implementation of the recommendations. Where appropriate, recommended improvements from other reports (such as the District's Security

Vulnerability Assessment) were included in the CIP in an effort to provide a comprehensive picture of the District's complete CIP.

1.12.1 Recommended Capital Facilities

The recommended improvements identified in this master plan include the recommended facilities for fire flow, pressure, and operational improvements, water quality, and storage. In addition, the recommended improvements from two other studies were incorporated into the CIP. These two reports include the Water Reservoir Nitrification Prevention and Control report (Carollo Engineers, September 2002) and the Security Vulnerability Assessment (Carollo Engineers, December 2003). Due to security concerns, the actual recommendations from the Security Vulnerability Assessment are not included in this master plan due to security concerns. Only the estimated capital amount of the recommended improvements from the Security Vulnerability Assessment is included here.

The recommended improvements were prioritized into three categories:

- High priority:
    - These are health and safety related, such as improvements that are needed for fire flows or as identified in the District's Security Vulnerability Assessment for security.
    - These improvements should be implemented immediately; therefore, they have been scheduled as Year 2005 Improvements.
- Medium priority:
    - These are typically operational improvements that improve system pressure, improve the District's ability to use groundwater, or are developer driven for a project that fits within this timeframe.
    - These improvements are also important and are scheduled for implementation between 2005 and 2009.
    - The medium priority improvements are shown as Year 2005 to 2010 Improvements.
- Low priority:
    - While important, these improvements are not as essential as those that fall under the first two categories. Typical improvements for this category include developer driven improvements that may not be required until 2010 or later and other miscellaneous facilities.
    - These improvements are scheduled for implementation between 2010 and 2020.
    - The low priority improvements are shown as Year 2010 to 2020 Improvements.

Table 1.11 summarizes the recommended CIP projects for the District by project type and priority level.

Table 1.11 Summary of CIP Project Cost Estimates
2005 Domestic Water System Master Plan
Yorba Linda Water District

Improvement Type	Year 2005 High Priority(1)	Year 2005-2010 Medium Priority(1)	Year 2010-2020 Low Priority(1)
Fire Flow Improvements	$786,000		
System Pressure Improvements		$3,159,000	
Operational Improvements		$24,133,000	
Developer Driven Improvements			$8,236,000
Storage Improvements(2)		$30,305,000	
Water Quality Improvements(3)		$2,000,000	
Security Related Improvements(4)	$1,100,000	$1,250,000	$950,000
Totals	**$1,886,000**	**$60,847,000**	**$9,186,000**
		GRAND TOTAL	**$71,919,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal, and administrative costs and a contingency.
(2) The proposed Pacific Holding Reservoir is included with the Developer Driven Improvements and not with the Storage Improvements.
(3) Source: Water Reservoir Nitrification Prevention and Control report.
(4) Source: Security Vulnerability Assessment report. Costs escalated 5 percent to estimate February 2005 dollars. O&M costs are not included. Some costs were excluded to avoid duplication of costs.

1.12.2 ALTERNATIVE FINANCING SOURCES

Alternative funding sources were reviewed and discussed for possible consideration by the District for the improvements identified in this master plan. These potential sources include:

- Pay-As-You-Go Funding
- Drinking Water State Revolving Fund Loan Program
- General Obligation Bonds
- Revenue Bonds
- Alternatives for Structuring Bond Debt

- Certificates of Participation
- Commercial Paper (Short-Term Notes)
- Assessment Bonds

INTRODUCTION

2.1 GENERAL

In 2003, the Yorba Linda Water District (District) began to develop an updated Domestic Water System Master Plan (Master Plan) to aid in the planning of water system improvements and system operations. District retained Carollo Engineers (Carollo) to complete the Master Plan. District's previous long-term planning document, the Water Facilities Plan, was completed in 1978 by James M. Montgomery, Consulting Engineers. Since then, the District has continued to develop Five-Year Plans and has developed a computer model of the water system to assist with the planning of system improvements.

The overall goals of the Master Plan are to evaluate what improvements are needed or will be needed to meet current and future water demands, to identify improvements or operational changes necessary to meet current and upcoming water quality regulations, and to maximize the efficiency of system operations.

2.2 CHAPTER OBJECTIVES

The objectives of this chapter of the Master Plan are to:

- Describe the origins and history of the District.
- Identify the objectives of the Master Plan.
- Outline the changes that have occurred since the Water Facilities Plan was completed in 1978.
- Outline major unknowns that could significantly impact facilities planning.
- Outline the methodology and key assumptions used for the water master plan.
- Define the design criteria that will be used for evaluating the performance of existing facilities and for designing proposed future improvements.
- List abbreviations and acronyms used in this report, as well as common unit conversions to convert between units used in the report.

2.3 HISTORY AND BACKGROUND INFORMATION

The District is an independent special district providing water and sewer service to residents and businesses within its service area. Figure 2.1 identifies the general location of the District's service area. The service area was originally located within an unincorporated area of Orange County. It now lies mostly within the City of Yorba Linda (incorporated in 1967), but also includes areas within the cities of Brea, Placentia, and Anaheim. The District's service area still includes some unincorporated county "islands." Figure 2.2 illustrates the city boundaries and unincorporated areas within the District's service area.

The District's history dates to 1909 when the privately owned Yorba Linda Water Company was formed. The present District was organized as the Yorba Linda County Water District (YLCWD) on January 2, 1959, as a result of a vote of local residents. The new district was formed according to the provisions of County Water District law under Division XII of the California Water Code (Section 30000 et seq.). On January 2, 1959, voters in the proposed district authorized issuance of $1,900,000 in General Obligation bonds to finance the purchase of assets belonging to the Yorba Linda Water Company and construction of water improvements to the growing Yorba Linda community. Through 1959, the service area was largely rural in character with a small residential community at its center. In 1959, the service area covered 4,710 acres and the YLCWD provided service to 1,412 active connections.

From 1959 through the mid-1970s, YLCWD experienced a gradual transition from a rural, agriculturally oriented area to a suburban community. In 1978, YLCWD's Board of Directors agreed to annex lands to the east of the [then] current boundaries that more than doubled YLCWD's size. These annexations made YLCWD the largest County Water District in terms of geographic area in Orange County. Annexations completed in 1989 added 50 acres to the service area. Annexations completed in 1996 (including acreage in the former Shell Oil property) added another 843 acres. The District's present size is about 14,500 acres.

In response to the proposed annexations in 1978, the Board commissioned the preparation of a Water Facilities Master Plan by James M. Montgomery, Consulting Engineers. The Plan identified water production, storage and transmission facilities to service the newly acquired territory, and estimated the cost to construct the major water facilities. The proposed annexations were divided into two Improvement Districts representing separate areas of benefit to future homeowners.

The Yorba Linda County Water District Board of Directors approved annexation of Improvement District No. 1 in May of 1978 and Improvement District No. 2 in June of 1978. Subsequently, voters in the two Improvement Districts authorized issuance of General Obligation Bonds to finance construction of backbone facilities in these Improvement Districts. To date, two series of General Obligation Bonds have been issued in Improvement District No. 1 and three series, along with one refinancing issue, have been issued in Improvement District No. 2.

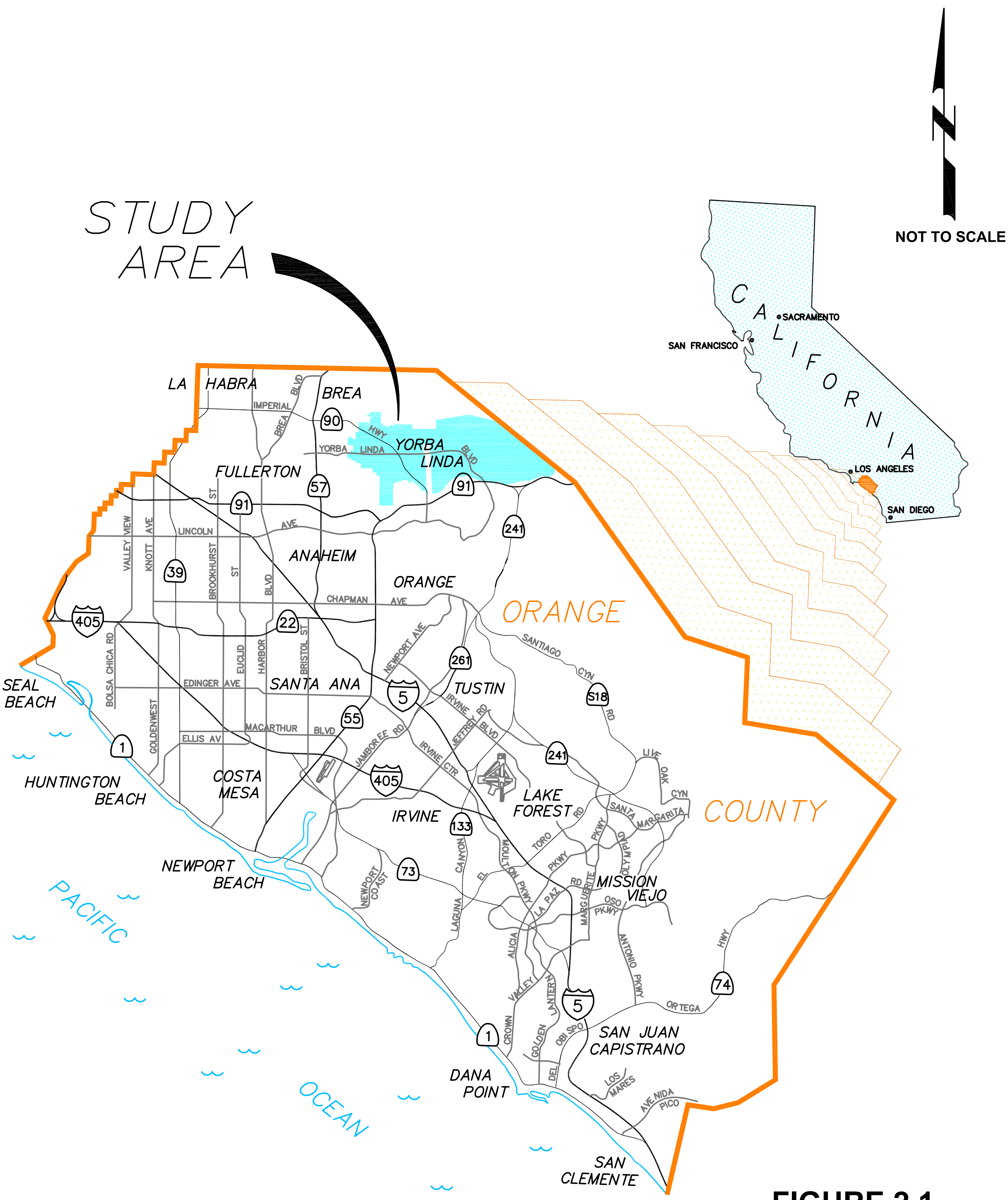

FIGURE 2.1

VICINITY MAP

YORBA LINDA WATER DISTRICT

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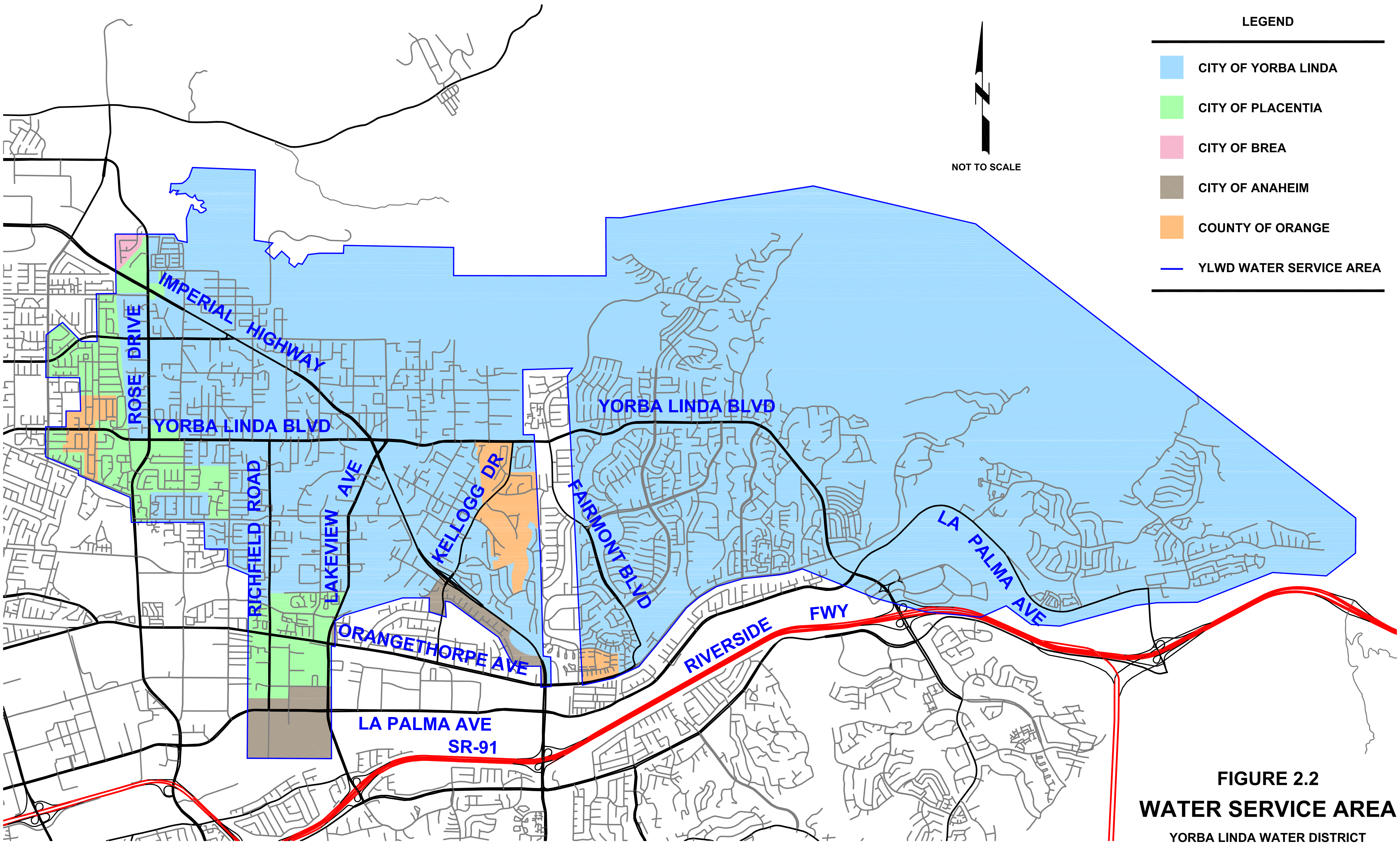

FIGURE 2.2
WATER SERVICE AREA
YORBA LINDA WATER DISTRICT

carollo engineers

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In November 1985, the Board of Directors, seeking a more accurate identification as an independent special district, dropped the "County" designation, thus officially changing the District's name to Yorba Linda Water District.

2.4 MASTER PLAN OBJECTIVES

The District Master Plan has been prepared to provide a reference document for the existing water system operations and maintenance and a framework for future water system planning. The plan objectives can be divided into four primary categories: supply/demand, facilities planning, operational, and financial.

2.4.1 Supply/Demand Objectives

The objectives of the Master Plan with respect to water supply and demand are to:

- Review and tabulate the District's current local groundwater and imported water supplies.
- Tabulate historic water production and consumption.
- Forecast future water demand based upon projected service connections.
- Compare water supplies and demands to determine the adequacy of the District sources of local and imported water supplies.
- Tabulate present and future water supplies and the facilities required to optimize usage of local water supplies.
- Evaluate the potential use of additional untreated water supplies for irrigation.

2.4.2 Facilities Planning Objectives

The objectives of the Master Plan with respect to water system facilities planning include:

- Develop performance criteria for both existing and proposed water facilities.
- Use the computer model to conduct hydraulic analyses of the existing water system and identify current deficiencies in existing water system facilities.
- Identify and evaluate system improvements that will alleviate existing system deficiencies.
- Incorporate projected water demands into the model and identify future system improvements that will be needed to meet the future demands.

2.4.3 Operational Objectives

The objectives of the Master Plan with respect to water system operation include:

- Perform hydraulic analyses of the water system using the computer model to evaluate operations of the current and future water systems.
- Review operational issues and develop strategies for water system reliability and cost-effectiveness.
- Review operational scenarios during normal operation and emergency conditions.
- Analyze existing and future storage by pressure zone for operational, fire, and emergency storage needs.
- Review and summarize water quality and proposed regulations that may have an impact on local water supplies.

2.4.4 Financial Objectives

The objectives of the Master Plan with respect to financial issues include:

- Develop a capital improvement program and capital costs for water system improvements and expansion. The capital improvement program should address the costs of proposed improvements in the District's Security Vulnerability Assessment.
- Develop a phased project list to prioritize future water system improvement projects.
- Review alternative financing programs for possible funding sources to pay for the recommended improvements.

2.5 CHANGED CONDITIONS

The District water service area has expanded substantially in both land area and customers served since the 1978 Water Facilities Plan was completed. The 1978 Water Facilities Plan was an instrumental planning document in the expansion of the District water service area to include Improvement District Numbers 1 and 2.

2.5.1 Development

The 1978 Water Facilities Plan reported that the District served approximately 9,500 active service connections. In March of 2003, the number of service connections had increased to 22,100. Significant development has occurred in Improvement District Numbers 1 and 2, which are now above 90 percent build out. The primary new development areas are open space and former oil field areas in northern Yorba Linda. These developments include:

- The Vista del Verde Planned Community by Shell/Toll Brothers.
- The Kerrigan Ranch Planned Community by Pulte Homes.
- Sites A, B and C owned by Shapell Industries.
- Murdock & Pacific Holding.

2.5.2 Water Production

Water production has increased from approximately 6.2 mgd in 1978 to 20.2 mgd in 2003. The District depends on two primary sources of water supply: groundwater and imported water from the Metropolitan Water District of Southern California (MWD). The sources of supply in 1978 included one treated water connection with MWD (4,500 gpm), one untreated water connection with MWD (1,800 gpm), and six active wells (11,400 gpm total capacity). Today, the District imports water from MWD through three treated water connections (18,000 gpm total capacity) and one untreated water connection (1,800 gpm), and operates eight active wells (16,400 gpm total capacity). Chapter 5 discusses these facilities in more detail.

2.5.3 Storage

In 1978, the District's total water storage facilities included 16.1 MG of storage and consisted of the Highland (Zone 428 (1A)), Bastanchury (Zone 570 (2)), and Fairmont (Zone 675 (3A)) Reservoirs. At the end of 2003, the District storage totaled 46.0 MG and included 12 reservoir sites in 6 pressure zones.

2.5.4 Distribution System

Prior to the 1978 Water Facilities Plan, the District consisted only of the area to the west of Fairmont Boulevard, currently known as the Western Service Area. The 1978 Water Facilities Plan was a key document in the planning, financing, and formation of Improvement District Numbers 1 and 2. The addition of Improvement District Numbers 1 and 2 has increased the District's water service area by 7,800 acres to a total of approximately 14,875 acres.

2.5.5 Operations

The scope of operations work has increased significantly to service and maintain new facilities that have been constructed to serve the Improvement District Numbers 1 and 2 water service areas. The following operations changes have been implemented since the 1978 Water Facilities Plan:

- The Water Operations and Maintenance Group has implemented an ongoing maintenance and repair program to maintain fire valves, hydrants, meters and new service connections; repair leaks in the water distribution system and conduct fire hydrant flow testing and flushing.

- The Water Production Group has implemented and regularly upgraded a Supervisory Control and Data Acquisition (SCADA) System to provide remote water system monitoring and control capabilities. The SCADA System monitors all wells, pump stations, and reservoirs, as well as some pressure reducing stations. The Water Production Group uses the SCADA system to actively monitor water system operation and maintains the computer systems, telemetry and remote control devices that comprise the SCADA system.

- Time of Use (TOU) operations (pumping during off-peak hours only) has been implemented at selected pumping stations to reduce operating costs through energy cost savings. This program is offered by Southern California Edison (SCE) to help them meet peak summer demands for electricity by shifting some electrical demands to the evening and nighttime hours. SCE offers reduced power costs as an incentive to the District for facilities that operate during off-peak hours only.

2.5.6 Water Quality

State and federal drinking water standards continue to become more stringent over time. The following water quality programs have been implemented since the 1978 Water Facilities Plan:

- A cross-connection control program has been implemented to provide annual inspection and maintenance of all backflow devices within the District's service area. The District's cross-connection inspection program meets current state health department requirements. The program requires annual inspection of backflow prevention devices to document cross-connection procedures, inventory cross-connection devices, establish new cross connection device requirements and enforce all cross-connection regulations.

- A new water quality laboratory has been constructed to enable the District to actively sample the water system and perform water quality testing.

- Circulation in reservoirs has been studied and improvements to enhance circulation in reservoirs are currently being designed.

- New and proposed changes in state and federal water quality standards periodically increase the number of contaminants that must be tested and monitored. The following water quality programs have been implemented in complaince with state and federal water quality regulations:
    - Microbiological monitoring throughout the water distribution system and water wells.

- Residual and disinfection by-products monitoring program throughout the distribution system since 1983.
- Lead and copper tri-annual monitoring program.
- Compliance monitoring program to meet other water quality standards both of the Safe Drinking Water Act and the California Drinking Water Standards.
- Reservoir Nitrification Control and Monitoring Program.
- Monitoring of chlorite and chlorate due to the use of sodium hypochlorite.
- Blending program for arsenic and manganese of Well 15 with other District wells.

2.6 FUTURE AREAS OF CONCERN

The District's sources of supply are under the jurisdiction of two other agencies: the Orange County Water District (OCWD), which governs the use of the Orange County groundwater basin and MWD, which imports and treats water from the Colorado River and the State Water Project before distributing it to the District. Future changes in these agencies' regulations or rates may have an effect on the District's future sources of water supply. Therefore, the uncertainty regarding changes in these agencies policies leaves some uncertainty in future projections regarding the District's water supply. The current issues facing these agencies that may affect the District's sources of supply are presented below.

2.6.1 Annexation to OCWD

When ID No. 1 was formed, approximately 2,000 acres out of a total 4,300 acres were already annexed to the Orange County Water District (OCWD). None of the land within Improvement District No. 2, which consists of approximately 3,500 acres, was annexed into OCWD, as there was no infrastructure to transfer groundwater that far east. The District is currently developing a plan to annex these portions of its water service area to OCWD. The areas proposed for annexation into OCWD are the Pulte property, the Shapell Industries property, the North Orange County Community College District (NOCCCD) property, the Travis property, the Savi Ranch property, the balance of ID No.1 not currently within the boundary of OCWD and all of ID No. 2. Since OCWD's Basin Pumping Percentage can only be applied to areas within the OCWD boundary, the District can increase overall usage of groundwater by annexing this territory, even if groundwater is never provided to all the specific areas annexed. The Orange County Surveyor is currently creating legal descriptions and maps for annexation of the above properties into the District and OCWD.

2.6.2 MWD/Regional Issues

The District is dependent on a reliable source of imported water from MWD to meet existing and future water demands. The following potential future changes in imported water service and rates may have a significant impact on the reliability and cost of imported water:

- Colorado River and State Water Supply Reliability: Future water supplies will be insufficient to meet future population growth without achieving long-term solutions to the Colorado River and State Water Supply problems.

- Changes in MWD Rate Structure: The unbundling of MWD's rate structure and additional fees such as growth/demand charges, wheeling rates, reliability classes of service, and treatment surcharges may substantially increase future rates for imported water supply from MWD.

The District will continue to stay informed regarding the changes in MWD's rates, policies, and supplies. The impacts of these changes will need to be considered when evaluating future water supply sources for the District's system.

2.7 MASTER PLAN ASSUMPTIONS

Portions of this Master Plan have been based on fundamental assumptions that were established throughout the project. The District and Carollo discussed these assumptions and agreed that they resulted in a reasonable approach to developing the Master Plan.

The end of 2003 was assumed to represent the current status of the District's water system. This allowed for the use of a full calendar year of data and provided an accurate picture of the District's system. The years 2005, 2010, and 2020 were used as future planning years throughout the Master Plan.

2.8 MASTER PLAN ANALYSIS AND DESIGN CRITERIA

To help quantify the performance objectives for the District's system, a minimum acceptable level of service needed to be established to help identify deficiencies in existing facilities as well as to help determine the need for, and size of, proposed improvements. The primary goal in establishing a minimum level of service was to assure a safe and dependable supply of water to the entire service area. The criteria listed below was established to quantify the minimum service requirements for the water system and was intended to be the minimum acceptable conditions under which the water system would be considered adequate. The criteria were intended to be used to analyze existing facilities and design proposed improvements. Where applicable, the sources of these criteria are provided in parentheses.

1. The water provided to the consumers shall meet all federal, state and local regulations governing water quality for potable use.

2. The water system shall be capable of providing the minimum fire flow as determined in this master plan with a minimum residual pressure of 20 psi (Fire Marshall, NFPA).

3. The water system shall be capable of providing at least 40 psi to the service connections for the following demand periods: average day, maximum day, and peak hour. Where the maximum pressure at the service connection exceeds 80 psi, individual pressure regulators shall be equipped at the service connections in accordance with the Uniform Plumbing Code (UPC). The maximum pressure at any connection should not exceed 125 psi. Where the pressure exceeds 125 psi, special consideration should be given to the design of these facilities, including but not limited to increasing the pressure rating of the pipe and appurtenances.

4. The maximum velocity in any proposed pipeline should be in accordance with the following guidelines (industry practice):

Average Day Analysis:	Desired Range	0 to 5 fps
	Questionable Range	5 to 7 fps
	Deficient Range	Greater than 7 fps
Maximum Day and Peak Hour Analysis:	Desired Range	0 to 7 fps
	Questionable Range	7 to 10 fps
	Deficient Range	Greater than 10 fps
Fire Flow Analysis:	Desired Range	0 to 15 fps
	Deficient Range	Greater than 15 fps

   Pipes with velocities in the Questionable Range should be reviewed on an individual basis. Those with velocities in the Deficient Range should be considered for replacement or paralleling.

5. The water system and each pressure zone shall have at least two independent supply sources (AWWA). Where water is pumped from another zone or from an imported supply source, the booster pumping station shall have a backup pump online and equal in size to the largest pump in the station. The station shall also have a backup (or secondary) power source. A portable generator can be considered acceptable as a backup power source for the booster station.

   Where two sources of supply are not practical, the zone should have sufficient storage to meet all emergency criteria with the supply out of service.

6. The water system shall have adequate storage for operational, fire flow, and emergency storage in accordance with AWWA guidelines. Based on industry practices in Southern California, operational storage shall be at least 30 percent of the maximum day demands. However, based on the District's experience, additional operational storage is required. The amount of operational storage recommended to provide the flexibility required to manage water quality, time of use pumping, and other issues is at least 1.0 times the maximum day demands. Storage for fire flows shall be at least the largest volume determined for any fire flow and shall be available within each pressure zone

(either directly or from a higher zone). Emergency storage shall be based on the largest volume required to meet the criteria listed below within each pressure zone:

a. For pressure zones with only one supply source, the amount of emergency storage available shall be 5.0 times the average daily demands.

b. For pressure zones with two or more supply sources, the amount of emergency storage available shall be the larger of:

   1) 5.0 times the quantity of the average daily demands minus the available supply with the largest single supply source out of service, or

   2) 3.0 times the quantity of the average daily demands minus the available supply with the two largest supply sources out of service.

c. The storage required to offset the loss of all groundwater supplies for seven average days of demands. MWD supplies are still available under this scenario.

d. The storage required to offset a loss of all imported MWD supplies and the two largest groundwater wells for seven average days of demands.

e. The storage required to offset the loss of electricity district-wide for two days of maximum day demands.

f. The storage required to offset the loss of natural gas district-wide for two days of maximum day demands.

The sum of the operational storage, fire flow, and emergency storage volumes shall be the minimum required storage for the water system.

7. The water system and each pressure zone shall be capable of providing adequate service (as defined in this subsection) for each of the following emergency scenarios: loss of the largest water supply source, loss of MWD supplies, loss of all groundwater supplies, a district-wide power outage, or a district-wide loss of natural gas.

8. To meet pressure and velocity objectives, the following criteria are recommended for new pipelines. The minimum diameter for new pipelines shall be 8 inches, except in short cul-de-sac streets where 6-inch pipe may be used beyond the last hydrant. In commercial and business areas, the minimum diameter for new pipelines shall be 12 inches. These diameters shall not preclude the use of larger diameters when needed to meet the minimum fire flows or other criteria. All pipelines shall be looped (excluding short cul-de-sac streets) with appropriate shut-off valves to prevent one pipeline outage from disrupting service to an area.

9. Operational improvements are difficult to quantify. Nevertheless, proposed operational improvements that increase the system reliability or efficiency, or reduce the cost to

deliver water, should be examined. Where a benefit is found, the proposed improvement should be recommended.

2.9 ORGANIZATION OF THIS REPORT

This report has been structured to help the District staff easily locate and identify information regarding the District's water system. The Executive Summary (Chapter 1) provides an overview of the Master Plan process and document. Chapter 3 describes the District's service area and sub-areas, including the Improvement Districts and areas proposed for annexation. Existing and future land use and populations are summarized in Chapter 4. Chapter 5 identifies the facilities in the District's water system. Chapter 6 evaluates the District's historical and future water production, while Chapter 7 presents the current and projected water demands. The District's hydraulic computer model is described in Chapter 8. The relevant current and proposed water quality regulations are highlighted in Chapter 9. Chapter 10 presents an analysis of the District's water storage to determine if it is sufficient to meet current and future operational, fire, and emergency requirements. The District's current distribution system operations are summarized in Chapter 11, along with recommendations for improving operations. Chapter 12 identifies recommended system improvements and the estimated capital costs associated with the improvements.

2.10 ABBREVIATIONS

The following abbreviations and acronyms are used in this report:

ACP	asbestos cement pipe. This is a common material for water pipelines.
ac-ft	acre-feet. One acre-foot of water is equal to 325,829 gallons.
ADD	average day demands.
ac-ft/yr	acre-feet/year.
AMP	Allen McColloch Pipeline.
AWWA	American Water Works Association.
BPP	Basin Pumping Percentage. Allowable groundwater use established by OCWD.
BPS	booster pumping station.
ccf	one hundred cubic feet.
CDHS	California Department of Health Services.
cfs	cubic feet per second.
DI	ductile iron. This is a common material for water pipelines.
dia	diameter.
du	dwelling units.
du/ac	dwelling units per acre.
ENR	Engineering News Record.
EPS	extended period simulation. Special type of hydraulic model simulation.
FAR	floor area ratio. Ratio of building floor area to land area.
FCV	flow control valve.
fps	feet per second.

ft	foot or feet
ft-MSL	feet above mean sea level.
gpcd	gallons per capita per day.
gpd	gallons per day.
gpd/ac	gallons per day per acre. Volume of water used per acre of land.
gpd/du	gallons per day per dwelling unit.
gpm	gallons per minute.
GWRS	Groundwater Replenishment System.
HGL	hydraulic grade line.
hp	horsepower.
HWL	high water level.
ID	Improvement District.
in	inch or inches.
kW	kilowatt.
kWh	kilowatt-hours.
MCL	maximum contaminant level.
MDD	maximum day demands.
MG	million gallons.
MG/yr	million gallons per year.
mgd	million gallons per day.
mg/L	milligrams per liter.
MSL	mean sea level.
MWD	Metropolitan Water District of Southern California.
MWDOC	Municipal Water District of Orange County.
N/A	not available.
NFPA	National Fire Protection Association.
N.O.	normally open.
NOCCCD	North Orange County Community College District
O&M	operations and maintenance.
OC	Orange County.
OCFA	Orange County Fire Authority.
OCSD	Orange County Sanitation District.
OCWD	Orange County Water District.
PM	private meter.
PRS	pressure reducing station.
PRV	pressure reducing valve.
psi	pounds per square inch (measure of pressure).
PSV	pressure sustaining valve.
PVC	polyvinyl chloride. This is a common material for water pipelines.
res	reservoir.
SCADA	Supervisory Control and Data Acquisition.
SCE	Southern California Edison.
SCWC	Southern California Water Company.
SOI	sphere of influence.

TDH	total dynamic head.
TOU	time of use.
UFC	Uniform Fire Code.
µg/L	micrograms per liter.
UPC	Uniform Plumbing Code.
USGS	United States Geological Survey.
WSA	Western Service Area.
YLCWD	Yorba Linda County Water District.
YLWD	Yorba Linda Water District.

2.11 UNIT CONVERSIONS

This report uses standard engineering units when reporting volumes, flow rates, etc. However, the use of selected units when discussing different aspects of the water system can make comparisons difficult if the proper conversion factors are not known. This section provides a list of conversion factors that are commonly used to convert values from one unit to another.

2.11.1 Volume

Two common units used in the water industry to measure volume are acre-feet and gallons (or million gallons). Water production is often reported in terms of acre-feet (ac-ft). Stored water, such as in a reservoir, is commonly measured in million gallons (MG). Conversion factors are listed below for the units of volume used in this report. To convert a volume from MG to the equivalent volume in units of ac-ft, the value in MG should be multiplied by 3.0691 (see conversion factor below) to convert the value into ac-ft.

Convert MG to ac-ft	multiply by 3.0691
Convert ac-ft to MG	multiply by 0.32583

2.11.2 Flow Rate

Common units used to report flow rates include acre-feet per year (ac-ft/yr), cubic feet per second (cfs), gallons per day (gpd), gallons per minute (gpm) and million gallons per day (mgd). Flow rates may represent instantaneous flows, such as cfs or gpm, or flow rates over a longer period of time, i.e., ac-ft/yr. Conversion factors for many units of flow rate are listed below. To convert a flow rate from ac-ft/yr to gpm, multiply by the factor 0.621 from the list below.

Convert ac-ft/yr to cfs	multiply by 0.001381
Convert ac-ft/yr to gpd	multiply by 892.7
Convert ac-ft/yr to gpm	multiply by 0.621
Convert ac-ft/yr to mgd	multiply by 0.000893
Convert cfs to ac-ft/yr	multiply by 724

Convert cfs to gpd	multiply by 646300
Convert cfs to gpm	multiply by 448.8
Convert cfs to mgd	multiply by 0.646
Convert gpd to ac-ft/yr	multiply by 0.00112
Convert gpd to cfs	multiply by 0.000001547
Convert gpd to gpm	multiply by 0.0006944
Convert gpd to mgd	multiply by 0.000001 (or divide by one million)
Convert gpm to ac-ft/yr	multiply by 1.61
Convert gpm to cfs	multiply by 0.002228
Convert gpm to gpd	multiply by 1440
Convert gpm to mgd	multiply by 0.00144
Convert mgd to ac-ft/yr	multiply by 1120
Convert mgd to cfs	multiply by 1.547
Convert mgd to gpd	multiply by 1,000,000 (one million)
Convert mgd to gpm	multiply by 694.4

2.12 ACKNOWLEDGEMENTS

2.12.1 The District's Board of Directors

Michael J. Beverage, President
Paul R. Armstrong, Vice President
John W. Summerfield, Director
Ric Collett, Director
William R. Mills, Director

Arthur C. Korn, (former Director of the District)

2.12.2 The District's Management Staff

Michael Payne, General Manager
Kenneth Vecchiarelli, P.E., Assistant General Manager/Engineering Manager
Lee Cory, Operations Manager
Beverly Meza, Business Manager
Michael Robinson, Assistant Administrator

2.12.3 Engineering and Operations Departments

Bill Moorhead, P.E., Senior Project Engineer-Capital Projects
Chuck Gray, Senior Project Engineer-Development
Leon De Los Reyes, Water Quality Engineer

Hank Samaripa, Project Engineer
Rick Walkemeyer, Chief Plant Operator
Scott Moulton, P.E., Project Engineer
Jeff Coplen, Engineering Technician
Ricardo Hipolito, Engineering Technician
Jill Weber, Secretary
Raymond M. Hahn, P.E., (formerly with the District)
Nemesciano Ochoa, (formerly with the District)

2.12.4 Carollo Engineers

Ash Wason, P.E., Partner-in-Charge
Brian Powell, P.E., Project Manager
Dennis Wood, P.E., Technical Advisor
Tony Akel, P.E., Technical Advisor
Helene Baribeau, Ph. D., P.E., Water Quality
Joon Min, Ph. D., Regulations
Robb Granthum, Financial Alternatives
Dennis Van Kirk, Cost Estimating
Karen Hermack, P.E., (formerly with Carollo)

Chapter 3

YLWD SERVICE AREA

3.1 INTRODUCTION

The Yorba Linda Water District (District) service area includes most of the City of Yorba Linda and portions of the Cities of Anaheim, Brea, and Placentia. In addition, some unincorporated areas of Orange County are included in the service area. Historically, The District's service area has been divided into three parts: the Western Service Area (WSA) and Improvement District's Number 1 and 2 (ID Nos. 1 and 2). In addition, upcoming developments will soon be annexed into the District's service area. This chapter provides a general description of the District's service area, as well as these smaller sub-areas.

3.2 CHAPTER OBJECTIVES

The goals of this section of the Master Plan are to:

- Describe the District's service area.
- Describe the existing divisions within the service area and the reasons for dividing the service area into smaller sub-areas.
- Identify new and upcoming development that the District anticipates annexing into its service area.

3.3 SERVICE AREA DESCRIPTION

The District is the largest county water district in Orange County with a service area of over 14,000 acres. Figure 3.1 illustrates the boundaries of the District's service area, as well as the different sub-areas within the service area. The service area is bounded on the west by the City of Placentia, on the northwest by the City of Brea, and on the south by the City of Anaheim. The District's eastern boundary line is the Orange/San Bernardino County line, while the northern boundary abuts the Chino Hills State Park.

Table 3.1 identifies the total acreage in the District's service area, broken down according to the cities within the service area. This table also identifies the areas within the City of Yorba Linda that are not served by the District. This includes the North Orange County Community College District (NOCCCD), Shapell Industries property, and a 400-acre strip of land commonly referred to as the Locke Ranch area. The NOCCCD is served by the District, but is not currently annexed into the District's service area. The NOCCCD will be annexed into the District's service area as part of the future Shapell Industries development. The Locke Ranch area consists of mostly residential dwellings with

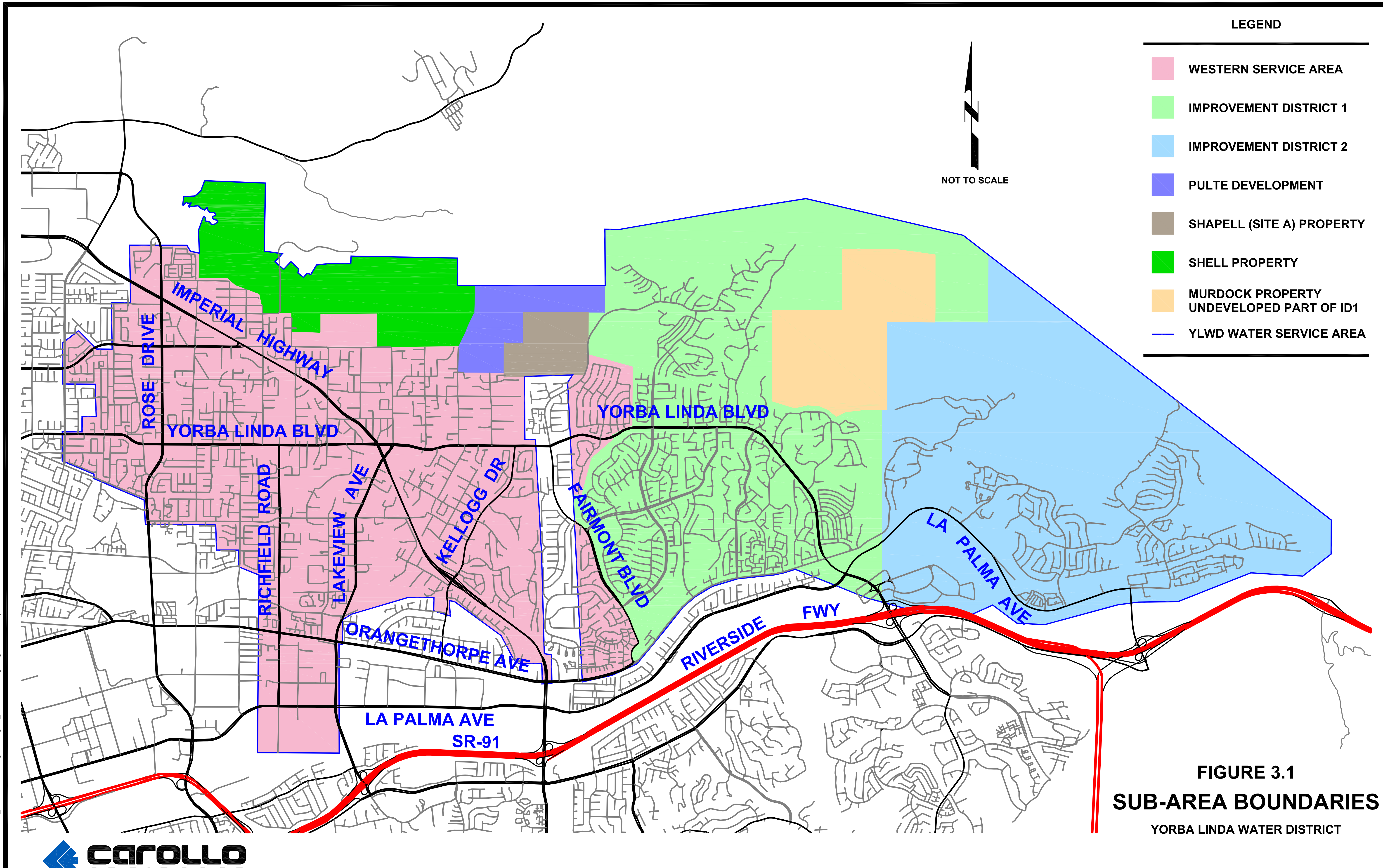

FIGURE 3.1
SUB-AREA BOUNDARIES
YORBA LINDA WATER DISTRICT

H:\Client\YorbaLin_SAO\6853A00\Figures\Fig3-1_SubAreas.dwg <Figure3.1> May 2, 2005 commercial centers at Yorba Linda and Fairmont Boulevards and on Esperanza Road at Fairlynn Avenue. The Southern California Water Company (SCWC) serves water to the residents in the Locke Ranch area, while the District owns and maintains the sewer system.

Table 3.1 Estimated District Water Service Area Acreage
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Acreage	Percent of Total
Total City of Yorba Linda Acreage	12,621	
City of Yorba Linda Areas Not Served by the District		
Locke Ranch (served by SCWC)	-457	
Shapell Industries Property[(1)]	-177	
Total City of Yorba Linda Subtractions	-634	
District Service Area within the City of Yorba Linda	**11,987**	**83%**
Other Areas in the District's Service Area		
Unincorporated County of Orange	1,462	
City of Placentia	774	
City of Anaheim	235	
City of Brea	17	
District Service Area Outside of the City of Yorba Linda	**2,488**	**17%**
Total Acreage in District Service Area	**14,475**	

Notes:
(1) North Orange County Community College District will be annexed into the District service area in the near future with annexation of the Shapell Site A property.

3.4 SERVICE AREA DIVISIONS

The District's existing service area includes the WSA, which is essentially the original service area and ID Nos. 1 and 2. Figure 3.1 identifies the boundaries of each of these sub-areas, as well as areas currently under development or areas planned for future development.

The District's service area was divided into the three sub-areas because of the arrangements that financed the major "backbone" facilities. The WSA does not currently have public debt. All bonds for the WSA have been retired. New development projects north of the WSA must fund the "backbone" facilities required to serve their projects without help from the District.

The Board of Directors approved the annexation of ID Nos. 1 and 2 in May and June of 1978, respectively. In June 1978, voters in both Improvement Districts authorized issuance of general obligation bonds to finance construction of production, storage, and transmission, or “backbone” facilities. To date, ID No. 1 has issued two series of general obligation bonds and one series of refunding bonds. ID No. 2 has issued three series of general obligation bonds and two series of refunding bonds.

3.4.1 Western Service Area

The WSA covers approximately 5,800 acres of the older section of the District lying generally between Valencia Avenue in the City of Placentia and Fairmont Boulevard in the City of Yorba Linda. This land has been under development since the establishment of the Yorba Linda Water Company in 1909. It is approximately 95 percent developed. Remaining open land will be developed with in-fill projects consisting primarily of single-family dwellings.

3.4.2 Improvement District Number 1

ID No. 1 covers approximately 4,300 acres. This area lies generally east of Fairmont Boulevard, north of Esperanza Road and west of Hidden Hills Road. It was formed in June 1978 by a vote of the electorate living in the area at the time. The sole purpose of ID No. 1 was to define an area of benefit and use general obligation bonds to finance construction of production, storage, and transmission facilities for this area. Construction of homes began in late 1978 with the first occupancies beginning in the spring of 1979.

3.4.3 Improvement District Number 2

ID No. 2 covers approximately 3,500 acres, generally east of Hidden Hills Road and north of the Santa Ana River, and extends to the Orange/San Bernardino County Line. ID No. 2 was also formed in June 1978 by a vote of the electorate living in the area at the time. The sole purpose of ID No. 2 was to define an area of benefit and use general obligation bonds to finance construction of production, storage and transmission facilities for this area. Construction of homes began in 1981, with the first occupancies beginning in the spring of 1982.

3.4.4 Annexations

During the upcoming 5-year period, the District anticipates annexation and development of properties owned by Shapell Industries, Inc. These developments will be annexed into the Western Service Area. These properties are within the District’s sphere of influence established by the Orange County Local Agency Formation Commission. Each annexation is carefully analyzed to ensure the development pays its own way without subsidy from existing customers. Annexations to the District will be processed and administered in accordance with established District policies. The proposed annexation area is shown in

Figure 3.1. The Pulte Home Development and the Shell Property, also shown in Figure 3.1 along the northerly boundary of the WSA, have already been annexed into the District. The Murdock Property is planned for development beginning around 2010.

Chapter 4

LAND USE AND PLANNED DEVELOPMENT

4.1 INTRODUCTION

Yorba Linda Water District (District) provides water service to approximately 74,800 people through about 23,000 service connections. Most of these customers and most of the land use in the District's service area are residential. Future development in the service area is expected to be primarily residential, with some associated commercial growth accompanying the residential developments. The existing population within the service area is expected to continue to grow as this development occurs.

4.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan are to:

- Outline land use in the District's service area.
- Summarize the types and quantities of service connections in the District's system.
- Identify the proposed future developments in the service area.
- Project the number of service connections for each of the future planning years.
- Establish current and future population estimates for the District's service area.

4.3 LAND USE

Land use within a water agency's service area can help to identify patterns of water use, as well as requirements for fire flows at different locations in the service area. In addition, future land use plans may identify expected areas of growth or redevelopment within the service area. The City of Yorba Linda completed a General Plan in May 1992. Figure 4.1 presents the land use from this General Plan. According to the City of Yorba Linda, this represents the most recent land use available.

4.4 LAND USE CATEGORIES

- The land use categories used by the City of Yorba Linda were used in this report to determine the appropriate fire flow requirements at different locations in the District's distribution system. Table 4.1 presents a summary of the land use categories used by the City of Yorba Linda.

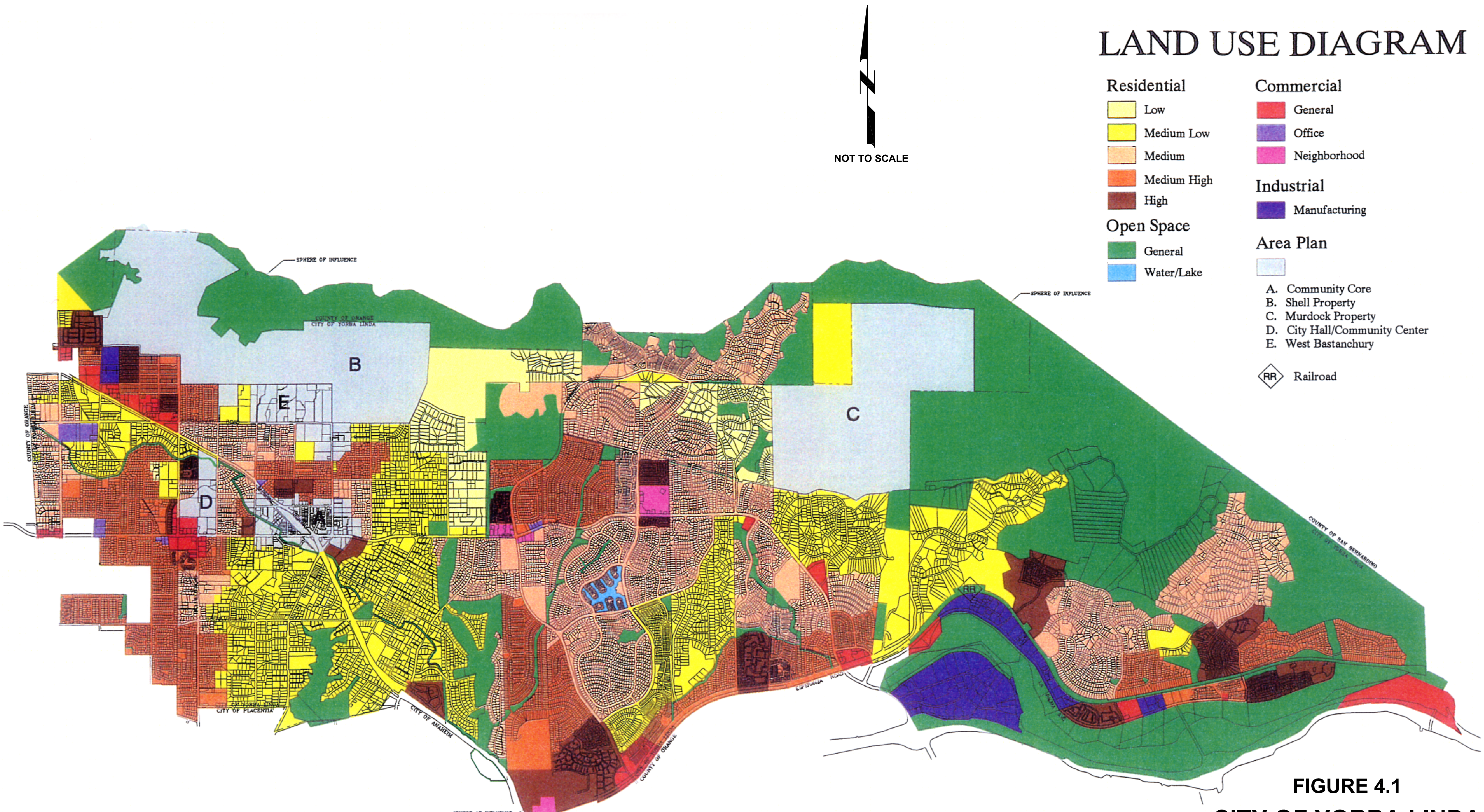

FIGURE 4.1

CITY OF YORBA LINDA ZONING MAP

YORBA LINDA WATER DISTRICT

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**Table 4.1 Land Use Categories
2005 Domestic Water System Master Plan
Yorba Linda Water District**

Land Use Designation	Average Density
Residential	
Low	1.0 du/ac
Medium Low	1.8 du/ac
Medium	3.0 du/ac
Medium High	4.0 du/ac
High	4-10 du/ac
Commercial	
General	N/A
Office	N/A
Neighborhood	N/A
Industrial	
Manufacturing	N/A
Open Space	
Open Space	N/A
Water/Lake	N/A
Area Plan	
Community Core	N/A
Shell Property (Toll Brothers)	See Section 4.6
Murdock Property (Pacific Holding)	See Section 4.6
City Hall/Community Center	N/A
West Bastanchury	N/A

4.5 EXISTING SERVICE CONNECTIONS

At the end of 2003, the District served 22,417 water service connections. The District categorizes its customers into seven major categories.

- **Residential:** This class is for residential accounts with a single-family home, duplex, or condominium. Water use tends to be related to weather conditions, the level of awareness of water conservation, and the size of the lot.

- **Commercial and Industrial:** The commercial class includes apartment buildings as well as commercial businesses. The commercial customers include markets, service stations, restaurants, hospitals, office buildings, car washes, and other commercial service industry establishments. Currently, the District's service area does not include any heavy industry or water intensive commercial activities.

- **Landscape:** This class includes private and public agency accounts that use water for landscaping purposes. The City of Yorba Linda is the District's largest landscape customer. This does not include the untreated water used for the city owned Black Gold golf course.

- **Agricultural:** When the District was formed, water used for agricultural irrigation accounted for a majority of the water use in the District's service area. Today, the agricultural class of service only includes approximately 20 meters. As land use continues to change, this number is expected to decrease.

- **Construction:** Temporary connections may be established for construction purposes.

- **Untreated Water:** This class of service was established in 2000. The Black Gold golf course is currently the only connection in this class.

Table 4.2 breaks down the number of connections at the end of 2003 by each category. This table also includes the percent of the total connections in each category and the percent of water use by each account.

Table 4.2 Service Connections by Customer Categories for 2003
2005 Domestic Water System Master Plan
Yorba Linda Water District

Customer Category(1)	Number of Connections	Percent of Total Connections	Percent of Water Use
Residential	20,583	92%	71%
Commercial and Industrial(2)	1,059	5%	9%
Landscape	772	3%	16%
Agricultural	29	<1%	<1%
Untreated Water	1	<1%	3%
Total	**22,417**	**100%**	**100%**

Notes:
(1) Construction accounts are not included due to the temporary nature of the accounts.
(2) Includes apartment complexes.

4.6 FUTURE DEVELOPMENT

There are four large residential developments in the District's service area that are in various stages of development. Some homes have already been constructed, some homes are currently under construction, and other phases are still in the planning stages. These developments are:

- The Vista del Verde Planned Community by Shell/Toll Brothers.
- The Kerrigan Ranch Planned Community by Pulte Homes.
- Sites A, B, and C owned by Shapell Industries.
- The Murdock Property (Pacific Holding).

Table 4.3 presents the estimated total number of dwelling units that are planned for construction in each of these communities, as well as the estimated number of units that have already been completed. The table also includes forecasts of the additional number of dwelling units in each of these developments that are planned for construction by the end of the planning years.

In addition to the four large developments, many other small residential projects are currently planned for development or redevelopment in the District's service area. These developments are also identified in Table 4.3. In addition to the currently planned residential development, there will most likely be additional non-residential development in the District's service area throughout the planning years. This may include non-residential service connections associated with these residential developments, as well as commercial development. To account for this future non-residential development, the total number of non-residential service connections during each of the planning years was estimated by assuming that the ratio of residential connections to non-residential service connections would remain constant and identical to the current ratio.

Table 4.3 Planned Residential Development
2005 Domestic Water System Master Plan
Yorba Linda Water District

Development	Existing Units	Estimated Additional Units Constructed by			Total Projected Units
		2005	2010	2020	
Vista del Verde (Toll Bros)	673	122	946	0	1,741
Kerrigan Ranch (Pulte)	30	123	140	0	293
Murdock Property (Pacific Holding)	0	0	150	471	621
Shapell Industries					
Area A (Medium Density)	0	0	100	67	167
Area A (High Density)	0	0	100	283	383
Area B	0	100	213	0	313
Area C	0	0	5	0	5
Other Developments					
Old Orchard (HQT Homes)	0	39	0	0	39
Woodbridge, Tr. No. 16186	0	51	0	0	51

Table 4.3 Planned Residential Development
2005 Domestic Water System Master Plan
Yorba Linda Water District

Development	Existing Units	Estimated Additional Units Constructed by 2005	2010	2020	Total Projected Units
Woodbridge, Tr. No. 15501	0	14	0	0	14
Watermark	0	7	0	0	7
Yorba Linda Craftsman	0	39	0	0	39
Yorba Linda Pines	0	22	0	0	22
Compass Homes	0	17	0	0	17
Parkwood Senior Apartments	0	101	0	0	101
Town Center Revitalization Plan	0	0	175	0	175
Total Residential	**703**	**635**	**1,829**	**821**	**3,988**
Non-Residential Units	**NA**	**48**	**138**	**62**	**248**
Total	**703**	**683**	**1,967**	**883**	**4,236**

Some commercial development projects are already planned for the District's service area. Construction for these projects is expected to be complete by 2005. Table 4.4 presents a summary of these projects. The number of service connections for each development has been estimated based on the proposed square footage of the development.

Table 4.4 Proposed and Recently Completed Commercial Development
2005 Domestic Water System Master Plan
Yorba Linda Water District

Development	Square Footage	Estimated Number of Service Connections	Projected Year of Development
Western Service Area			
Town Center Revitalization Project (downtown Yorba Linda)	70,000	3	2006
Denny's Diner (Bastanchury Rd. & Imperial Hwy.)	5,100	1	2005
Yorba Linda Friends Church Expansion (Lakeview Ave. & Yorba Linda Blvd.)	120,000	5	2005
Krezewski Medical Offices (Yorba Linda Blvd. & Rose Dr.)	13,000	1	2005
Sav-on Drug Store (Eureka Ave. & Imperial Hwy.)	15,000	1	2005

Table 4.4	Proposed and Recently Completed Commercial Development 2005 Domestic Water System Master Plan Yorba Linda Water District		
Development	Square Footage	Estimated Number of Service Connections	Projected Year of Development
Yorba Linda High School[1] (West of Fairmont Blvd and north of proposed Bastanchury Road)	N/A	51	2010
Western Service Area Total	**223,100**	**62**	
Improvement District No. 1			
Canyon Hills Friends Church (Esperanza & Fairmont Expansion)	26,000	2	2005
Eastlake Village Commercial (Village Center Dr. & Yorba Linda Blvd.)	9,000	1	2004
Lazy Boy Commercial (Savi Ranch)	25,000	2	2003
Extended Stay America (117 rooms) (Savi Ranch)	5,200	1	2003
Improvement District No. 1 Total	**65,200**	**6**	

Notes:
(1) Number of service connections assumes 1,500 students, 30 gpd per student, and 882 gpd per equivalent service connection.

Table 4.5 presents the total number of estimated service connections in each of the planning years based on the existing number of service connections at the end of 2003. As this table indicates, the number of service connections is expected to increase by 15 percent by 2020.

Table 4.5	Future Commercial Development 2005 Domestic Water System Master Plan Yorba Linda Water District	
Planning Year	Residential Service Connections	Total Service Connections
2003	20,743	22,417
2005	21,378	22,987
2010	23,207	24,954
2020	24,028	25,837

4.7 EXISTING AND PROJECTED POPULATION

The total population with the District's service area can be estimated based on the number of service connections in the service area. However, it is not necessary to include non-residential service connections in this estimate, since these connections do not represent dwelling units. Table 4.6 presents population estimates for the District's service area in 2003, 2005, and in future planning years. These estimates assume that there are approximately 3.5 people for each residential service connection in the service area.

Table 4.6 Existing and Projected Population Estimates
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Estimated Number of Residential Service Connections	Estimated Population
2003	20,743	72,600
2005	21,445	74,800
2010	23,547	81,200
2020	24,496	84,100

Chapter 5

DISTRIBUTION SYSTEM FACILITIES

5.1 INTRODUCTION

Yorba Linda Water District's (District's) distribution system includes 8 wells, 1 untreated water and 3 treated water import connections with the Metropolitan Water District of Southern California (MWD), 12 booster pumping stations, 13 water storage reservoirs, 36 pressure reducing stations, and 10 emergency interconnections with neighboring agencies. The District obtains approximately half of its water from wells and the remaining half from the MWD import connections. The system consists of many different pressure zones and serves approximately 23,000 potable water service connections. Figure 5.1 shows the locations of the District's facilities.

5.2 TRANSMISSION AND DISTRIBUTION MAINS

The District's service area includes about 640 miles of pipelines ranging in size from 4 to 39 inches in diameter. Pipelines 12 inches in diameter and larger are considered transmission mains, while all smaller pipes are considered distribution mains. All pipelines that are more than 30 years old are located in the Western Service Area. The District's system includes pipes constructed of asbestos cement pipe (ACP), cast iron pipe, ductile iron pipe (DIP), polyvinyl chloride (PVC) pipe, and steel pipe.

5.3 GROUNDWATER WELLS

The District's groundwater wells, which pump water from the lower Santa Ana Basin, provide the District with one of its primary sources of water supply. These wells deliver potable water that does not require treatment and only needs to be disinfected. Table 5.1 summarizes the characteristics of the District's eight active water wells and one new well that is currently under construction.

Table 5.1 Groundwater Well Summary
2005 Domestic Water System Master Plan
Yorba Linda Water District

Well No. (#)	Location	Energy Source	Horsepower (hp)	Nominal Capacity(1) (gpm)
1	913 S. Richfield Road	Natural Gas	365	2,800
5	913 S. Richfield Road	Natural Gas	365	2,300
7	913 S. Richfield Road	Natural Gas	365	2,000
9(2)	913 S. Richfield Road	Electric	75	0
10	913 S. Richfield Road	Electric	200	1,850
11	1111 S. Richfield Road	Electric	200	1,900
12	913 S. Richfield Road	Natural Gas	365	2,000
15	1231 Lakeview Avenue	Electric	125	1,250
16	Abandoned in 2002			
17	Abandoned in 2002			
18	913 S. Richfield Road	Natural Gas		2,300
Total Existing Capacity				**16,400(3)**

Notes:
(1) Nominal capacities are based on individual flow rates and have not been reduced for combined flow with other wells or summer time limitations.
(2) Well No. 9 is out of service and scheduled for abandonment.
(3) Total capacity does not include the capacity of inactive Well No. 9.

Figure 5.1 shows the locations of the District's groundwater wells. Well Nos. 1, 5, 7, 9, 10, and 12 are located at the District's Richfield Plant. Well No. 9 is currently inactive. Well No. 11 is located at the south end of Richfield Road adjacent to Orange County Water District's spreading basins. Well No. 15 is located northwest of the intersection of Lakeview and La Palma Avenues in the City of Anaheim. Well Nos. 16 and 17, located along the Santa Ana River at the eastern end of the District's service area, had operational and water quality problems that were not economically or technically feasible to remedy. Therefore, they were abandoned in 2002.

Well No. 18 is a new well that was drilled in 2002 to provide water supply to the Vista del Verde development. Well No. 18 pumping facilities are designed to pump approximately 2,300 gpm. Construction of Well No. 18 pumping facilities was completed in the first quarter of 2004.

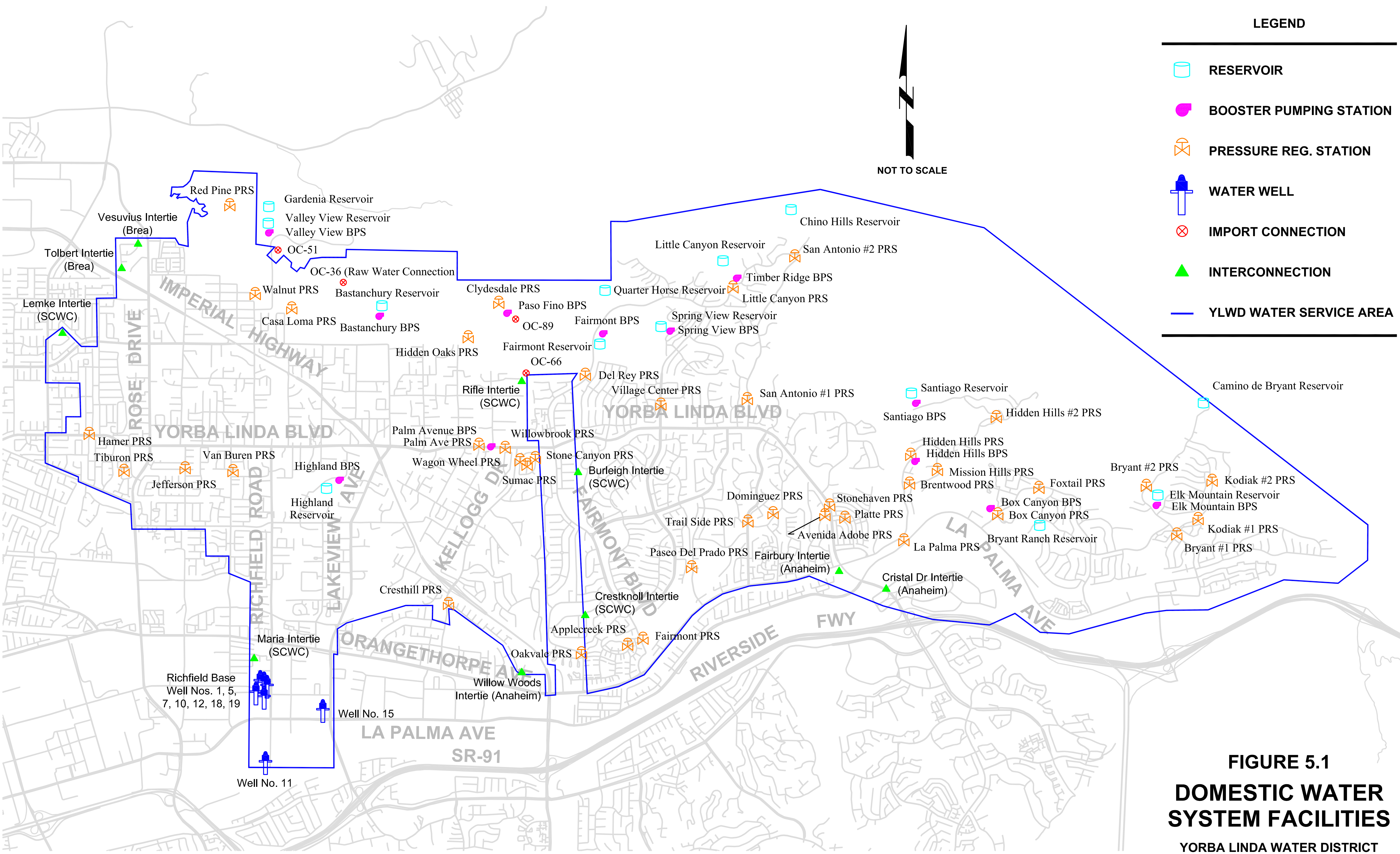

FIGURE 5.1
DOMESTIC WATER SYSTEM FACILITIES
YORBA LINDA WATER DISTRICT

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Well No. 19 is currently under construction at the District's Richfield Plant. This well is part of the Orange County Groundwater Storage Project which will allow participating agencies to store excess surface water in the groundwater basin for later extraction during years of shortages in imported supplies.

Most of these wells are at or near the District’s Richfield Plant. This is mainly due to the high producing aquifer located in this area. Other areas within the District’s service area have aquifers with much lower production rates. The close proximity of the Richfield Plant wells to each other offers potential benefits and potential risks. The risks include concerns about a potential contaminant affecting some or all of the District’s wells. Contaminating several or all of the District’s wells is a realistic concern and the District may not want to put all of their eggs in one basket. Drilling new wells away from the Richfield Plant could lower the risk of multiple wells being contaminated by the same contaminant, but this would likely require going outside the District’s service area to drill the well. On the other hand, having the wells near each other improves the treatment options available, should treatment be required. In addition, if the contaminant concentration is low enough, blending the water with uncontaminated well water could potentially reduce the concentration below regulatory thresholds such that treatment would not be required. Therefore, while there may be some concerns about having most of the District’s groundwater production in one location, this should not be the only consideration when siting a new well.

The District currently chlorinates the water from all of its wells. The wells located on the Richfield Plant discharge into a common transmission pipeline. The water from Well Nos. 11 and 15, which are located offsite, is pumped to the Richfield Plant and into the common transmission pipeline. Sodium hypochlorite is generated onsite at the Richfield Plant, where it is used to disinfect the well water in the transmission pipeline.

5.4 IMPORTED WATER CONNECTIONS

The District’s other source of water supply is imported from MWD via three treated water connections and one raw water connection. MWD disinfects the treated water with chloramines before it is distributed to the District and other agencies in Orange County. Table 5.2 summarizes the District’s imported water supply connections and their capacities. Figure 5.1 identifies the locations of the three treated water import connections.

**Table 5.2 Imported Water Supply Connections
2005 Domestic Water System Master Plan
Yorba Linda Water District**

Turnout	Pipeline	Capacity	
		cfs	gpm
	Treated Water		
OC-51	Lower Feeder (Treated)	10[(1)]	4,500
OC-66	Allen McColloch Pipeline	30[(2)]	13,500
OC-89	Allen McColloch Pipeline	4[(2)]	1,800
Available Treated Water Capacity		**40[(2)]**	**18,000**
	Untreated (Raw) Water		
OC-36	Lower Feeder (Untreated)	4	1,800

Notes:
(1) OC-51 connection is designed for 22 cfs but current meter capacity is only 10 cfs.
(2) The District's total allocation in the AMP (OC-66 and OC-89) is limited to 30 cfs. The OC-66 connection is designed for 50 cfs but the current meter capacity is only 30 cfs.

MWD owns and operates an extensive network of transmission pipelines and five water treatment plants in Southern California. Locally, MWD operates the Diemer Filtration Plant, which is located in the hills north of the District's Western Service Area boundary. MWD also owns and operates several large diameter transmission pipelines that go through the District's service area.

In the mid-1960s, the District faced growing water demands and the need for a backup, or redundant, supply for emergencies. To meet these requirements, the District built a treated water connection to MWD's Lower Feeder pipeline. The Lower Feeder pipeline supplies water from MWD's Diemer Treatment Plant. The District's connection to the Lower Feeder, referred to as OC-51, has a maximum rated capacity of 22 cfs (9,900 gpm) but the existing meter capacity is only 10 cfs (4,500 gpm). Water from this connection flows by gravity into the Western Service Area.

In response to the 1978 proposed annexations in eastern Yorba Linda, the District adopted a master plan that identified future imported water requirements of 50 cfs. The imported water was allocated as follows: 26.8 cfs (12,060 gpm) to ID No. 1; 13.2 cfs (5,940 gpm) to ID No. 2; and 10 cfs (4,500 gpm) to the Western Service Area. To provide this supply, the District, in 1978, signed a partnership agreement with other Orange County water agencies to build a transmission pipeline, the Allen-McColloch Pipeline (AMP). The District selected this option instead of building its own pipeline from the Diemer Plant to the newly annexed area. The District bought 50 cfs of capacity in the pipeline, but has since sold back 20 cfs of this capacity. Originally, the OC-66 connection provided the District's only connection to the AMP.

The AMP delivers imported treated water from MWD's Diemer Plant to northern and southern Orange County. A unique feature of the agreement regarding the AMP is the guarantee to deliver imported water at a hydraulic gradient of 781 feet at the District's OC-66 turnout. The District engineered and constructed the majority of the capital facilities in both ID Nos. 1 and 2 to take maximum advantage of the guaranteed hydraulic gradient.

Recently, the District negotiated an agreement with Pulte Home Corporation that required the developer to construct a second treated water connection to the AMP. This connection, known as OC-89, has a maximum rated capacity of 4 cfs. The connection will also serve the planned Shapell Industries development adjacent to the North Orange County Community College District property. Construction of the OC-89 connection was completed in 2002. Although the combined capacity of the two connections to the AMP pipeline exceeds 30 cfs, the District is limited contractually to a total allocation of 30 cfs from this pipeline. Thus, Pulte and Shapell will pay any extra costs to take water at a flow rate greater than 30 cfs.

In addition to the treated water connections described above, the District has one active untreated water connection on MWD's Lower Feeder. This connection, known as OC-36, has a rated capacity of 4 cfs (1,800 gpm) and supplies water for the City of Yorba Linda owned Black Gold golf course.

5.5 PRESSURE ZONES

Water systems are typically divided into different hydraulic regions, known as pressure zones, to maintain adequate pressures throughout the distribution system in spite of varying topography. A hydraulic grade line (HGL) is established for each pressure zone, and the high water levels in reservoirs are set to maintain these HGLs.

The District provides water service to homes and businesses with service elevations that vary from 250 feet to about 1,275 feet above sea level. Due to the variations in topography, District engineers separated the service area into multiple pressure zones. Figure 5.2 presents a map of the District's pressure zone boundaries. Table 5.3 summarizes the pressure zones, as they exist within the District's distribution system today. The District is currently in the process of renaming the pressure zones according to the HGL within the zone. Table 5.3 lists the pressure zones according to HGL, but lists the original pressure zone designation in parentheses following the new name.

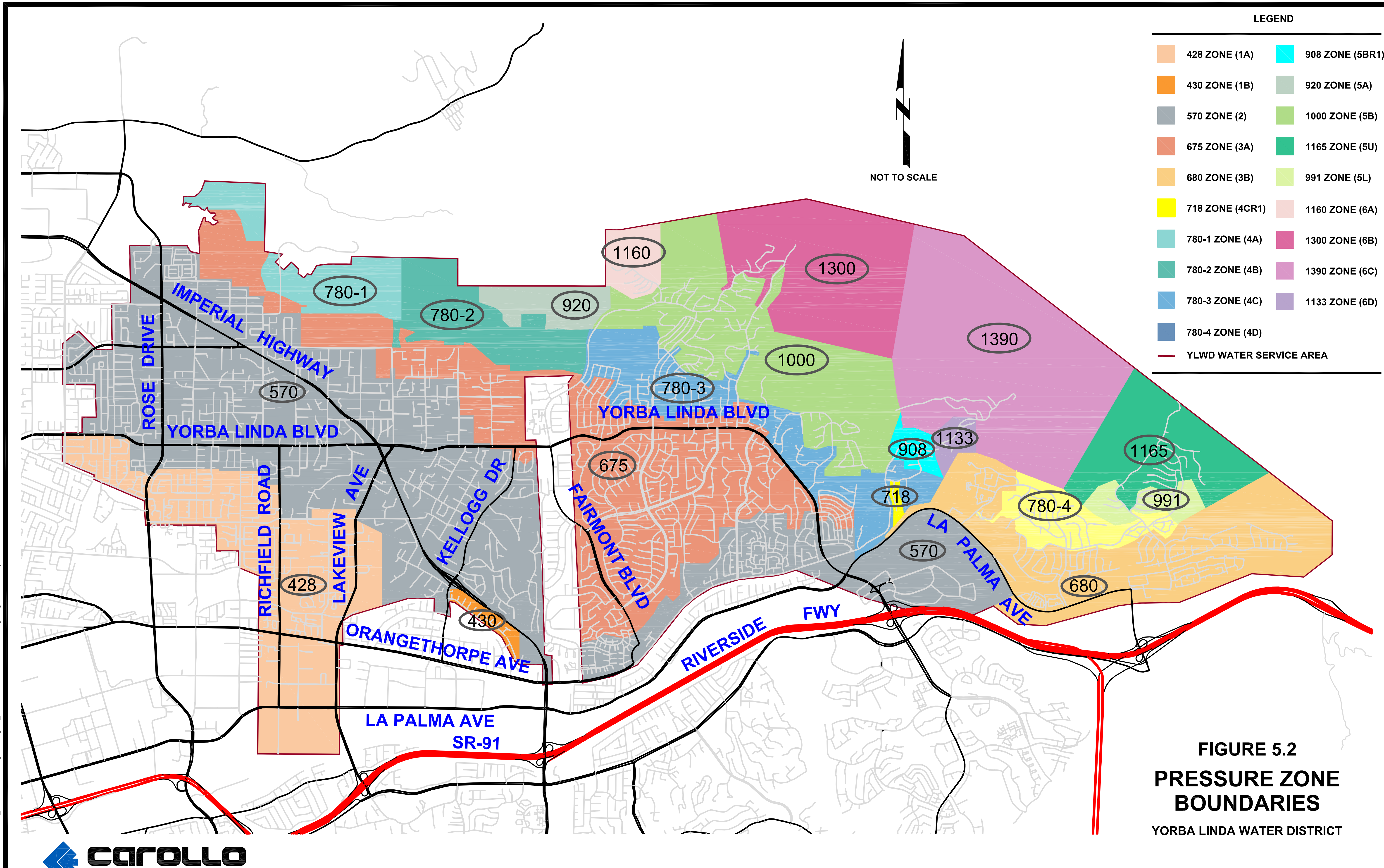

FIGURE 5.2
PRESSURE ZONE BOUNDARIES
YORBA LINDA WATER DISTRICT

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Table 5.3 Summary of Pressure Zones
2005 Domestic Water System Master Plan
Yorba Linda Water District

Pressure Zone	Reservoir HWL or PRS HGL (ft-MSL)	Lowest Elevation Served (ft-MSL)	Highest Elevation Served (ft-MSL)
428 (Zone 1A)	428	250	320
430 (Zone 1B)	430	271	330
570 (Zone 2)	570	321	450
675 (Zone 3A)	675	434	580
680 (Zone 3B)	680	320	580
718 (Zone 4CR1)	718	424	544
780-1 (Zone 4A)	780	545	680
780-2 (Zone 4B)	780	581	680
780-3 (Zone 4C)	780	581	680
780-4 (Zone 4D)	780	581	680
908 (Zone 5BR1)	908	568	814
920 (Zone 5A)	920	633	820
991 (Zone 5L)	991	681	870
1000 (Zone 5B)	1,000	681	900
1133 (Zone 6D)	1,133	781	1,045
1160 (Zone 6A)	1,160	890	1,045
1165 (Zone 5U)	1,165	871	1,065
1300 (Zone 6B)	1,300	875	1,020
1390 (Zone 6C)	1,309	1,045	1,275

The District's water system is designed so that home and business pad elevations are normally between 100 feet and 300 feet below the high water mark of the water reservoir serving each zone. This means that within any given zone, at any given time, residences or businesses will have water pressures ranging from a low of about 40 psi to a high of 135 psi. When water pressure at a particular residence or business exceeds 80 psi, plumbing regulations require the developers to install pressure regulators on individual services. Typically, it is considerably less expensive to require the developers to install individual pressure regulators on the buildings than to have the District construct additional reservoirs closer together so that pressures do not exceed 80 psi.

5.6 STORAGE FACILITIES

Water distribution systems rely on stored water to help equalize fluctuations between supply and demand, to supply sufficient water for fire fighting, and to meet demands during an emergency or an unplanned outage of a major source of supply. Storage requirements are discussed in more detail in Chapter 10.

The District currently stores water in 13 reservoirs, with a total storage capacity of 45.8 MG. Figure 5.1 shows the locations of these reservoirs. Table 5.4 provides additional information about these reservoirs. With the exception of the Highland Reservoir and the Bastanchury Reservoir, all of the reservoirs are buried concrete reservoirs. The Bastanchury Reservoir site includes two above-ground steel tanks, with capacities of 2.0 MG each.

The Highland Reservoir is a partially buried reservoir that was constructed in 1910. It is a prismatoidal-shaped reservoir with a concrete-lined floor and slopes. An aluminum roof deck supported on steel trusses and columns covers the reservoir. Due to the age and condition of the reservoir, as well as the difficulty in securing the roof of the reservoir, the District is planning to replace the Highland Reservoir. This project is currently in the preliminary design stages.

The new Quarter Horse Reservoir was being constructed in two phases. Construction was completed on the first phase of the reservoir in 2004. The second phase, which adds an additional 3.52 MG of storage, will be completed in early 2005.

Table 5.4 Reservoir Characteristics
2005 Domestic Water System Master Plan
Yorba Linda Water District

Reservoir Name	Year Built	Pressure Zone Served	Capacity (MG)	Dimensions	Base Elevation (ft-MSL)	Overflow Height (ft)	High Water Level (ft-MSL)
Highland	1910	428 (1A)	4.60	95’ x 600’	412	16	428
Bastanchury	1960	570 (2)	4.00	104’ DIA	540	30	570
Fairmont	1973	675 (3A)	7.50	200’ x 120’ x 2 Basins	651	24	675
Valley View	2002	675 (3A)	1.98	117.5’ x 85’	645	30	675
Bryant Ranch	1986	680 (3B)	2.30	116’ x 136’	656	24	680
Gardenia	2002	780-1 (4A)	1.98	117.5’ x 85’	750	30	780
Spring View	1981	780-3 (4C)	8.00	175’ x 155’ x 2 Basins	756	24	780
Elk Mountain	1992	780-4 (4D)	6.00	253’ x 79’ x 2 Basins	756	24	780

Table 5.4 Reservoir Characteristics
2005 Domestic Water System Master Plan
Yorba Linda Water District

Reservoir Name	Year Built	Pressure Zone Served	Capacity (MG)	Dimensions	Base Elevation (ft-MSL)	Overflow Height (ft)	High Water Level (ft-MSL)
Quarter Horse (Phase I)	2004	920 (5A)	3.75	158.5' x 119'	890	30	920
Little Canyon	1986	1000 (5B)	0.88	77.5' x 77.5'	980	20	1,000
Santiago	1989	1000 (5B)	1.10	98' x 78'	979	21	1,000
Camino De Bryant	1992	1165 (5U)	3.20	111.3' x 111.3' x 2 Basins	1,135	25	1,161
Chino Hills	1989	1300 (6B)	0.50	64' x 64'	1,277	20	1,300
Total Existing Storage Capacity			**45.79**				
Quarter Horse (Phase II)	2005	920 (5A)	3.52	158.5' x 110.5'	890	30	920
Total Future Storage Capacity			**49.31**				

5.7 BOOSTER PUMPING STATIONS

Booster pumping stations deliver water from lower pressure zones into higher pressure zones. Multiple pumps at each station, or multiple pump stations that serve the same pressure zone, help to increase water system reliability by ensuring that water can still be boosted into that zone if one pump is out of service. In addition, critical booster pumping stations may be equipped with emergency power supplies in case of failure of the primary power supply.

The District owns and operates 12 booster pumping stations. Many of these booster pumping stations share locations with the reservoirs of the same name. The locations of the stations are shown in Figure 5.1. Table 5.5 presents detailed information regarding the pumps and capacities of each booster pumping station. As this table indicates, some of the District's booster pumping stations include pumps that operate using an alternative power source in case of failure of the primary power supply. This includes the Bastanchury, Highland, Paso Fino, Santiago, Timber Ridge, and Valley View Booster Pumping Stations. The Fairmont Booster Pumping Station runs on natural gas and has propane available as a backup fuel source.

Table 5.5 Summary of Booster Pumping Stations
2005 Domestic Water System Master Plan
Yorba Linda Water District

Location	Booster Number	Pumps from Zone	Pumps to Zone	Energy Source	Elevation (ft-MSL)	Rated Horsepower (hp)	Rated Capacity (gpm)
Highland	1	428 (1A)	570 (2)	Electric	398.5	125	2,300
	2	428 (1A)	570 (2)	Electric	398.5	125	2,300
	3	428 (1A)	570 (2)	Electric	398.5	200	3,000
	4	428 (1A)	570 (2)	Electric	398.5	200	3,000
	5	428 (1A)	570 (2)	N.G.	398.5	304	3,200
Bastanchury	1	570 (2)	675 (3A)	Electric	541	30	400
	2	570 (2)	675 (3A)	Electric	541	30	400
	3	570 (2)	675 (3A)	N.G.	541	200	1,500
Palm Avenue	1	570 (2)	675 (3A)	Electric	430	60	1,250
Valley View	1	675 (3A)	780-1 (4A)	Electric	648	30	600
	2	675 (3A)	780-1 (4A)	Electric	648	30	600
	3	675 (3A)	780-1 (4A)	N.G.	648	65	1,200
Paso Fino	1	780-2 (4B)	920 (5A)	Electric	690	40	700
	2	780-2 (4B)	920 (5A)	Electric	690	40	700
	3	780-2 (4B)	920 (5A)	N.G.	690	50	1,000
Box Canyon	1	780-3 (4C)	780-4 (4D)	Electric	359	40	2,000
	2	780-3 (4C)	780-4 (4D)	Electric	359	40	2,000
Fairmont(1)	1	780-3 (4C)	1000 (5B)	N.G.	663	145	1,500
	2	780-3 (4C)	1000 (5B)	N.G.	663	145	1,500
Spring View	1	780-3 (4C)	1000 (5B)	Electric	753	40	400
	2	780-3 (4C)	1000 (5B)	Electric	753	40	400
	3	780-3 (4C)	1000 (5B)	Electric	753	20	200
Hidden Hills	1	780-3 (4C)	1000 (5B)	Electric	568	40	400
	2	780-3 (4C)	1000 (5B)	Electric	568	40	400
	3	780-3 (4C)	1000 (5B)	Electric	568	40	400
	4	780-3 (4C)	1000 (5B)	Electric	568	20	200
Elk Mountain	1	780-4 (4D)	1165 (5U)	Electric	756	40	250
	2	780-4 (4D)	1165 (5U)	Electric	756	200	1,250
	3	780-4 (4D)	1165 (5U)	Electric	756	200	1,250

Table 5.5 Summary of Booster Pumping Stations
2005 Domestic Water System Master Plan
Yorba Linda Water District

Location	Booster Number	Pumps from Zone	Pumps to Zone	Energy Source	Elevation (ft-MSL)	Rated Horsepower (hp)	Rated Capacity (gpm)
Timber Ridge	1	1000 (5B)	1300 (6B)	Electric	811	15	75
	2	1000 (5B)	1300 (6B)	Electric	811	40	325
	3	1000 (5B)	1300 (6B)	Electric	811	40	325
	4	1000 (5B)	1300 (6B)	N.G.	811	250	1,500
Santiago	1	1000 (5B)	1390 (6C)	Electric	946	25	100
	2	1000 (5B)	1390 (6C)	Electric	946	75	300
	3	1000 (5B)	1390 (6C)	Electric	946	100	500
	4	1000 (5B)	1390 (6C)	N.G.	946	240	1,200

Notes:
(1) Fairmont can also be operated from Zone 675 (3A) to 780-3 (4C).

5.8 PRESSURE REDUCING STATIONS

Pressure reducing stations allow distribution systems to transfer water from higher pressure zones to lower pressure zones without exceeding the allowable pressures in the lower zones. The water is transferred through a valve that reduces the pressure to a specified pressure setting, while maintaining the pressure in the upper pressure zone. That is, the valve will not allow water to transfer into the lower pressure zone if the pressure in the upper zone drops below a certain level. This ensures that a main break, or similar emergency, in the lower pressure zone does not drain too much water from the upper pressure zone. Many pressure reducing stations are also outfitted with pressure relief valves that allow water to bleed from the higher pressure zone into the lower pressure zone if the pressure gets too high in the upper zone. The lowest pressure zone discharges excessive pressure into a local storm drain.

The District currently maintains 37 pressure reducing stations for the six pressure zones in the service area. Table 5.6 presents a summary of the settings of the pressure reducing stations in the District's service area, and Figure 5.1 identifies the station locations. These pressure reducing stations are equipped with combination pressure reducing/pressure sustaining valves, and many of them include a lead valve with one or two additional valves with larger capacities. Some of the stations also include pressure relief valves, as indicated in Table 5.6.

Table 5.6 **Pressure Reducing Station Summary**
2005 Domestic Water System Master Plan
Yorba Linda Water District

Name	Location	From Zone	Reduces to Zone	Elevation (ft-MSL)	No. and Size of Valves[1]	Pressure Setting (psi)	HGL	Normal Max. Flow Rate[2] (gpm)
Adobe	5530 Avenida Adobe	675 (3A)	570 (2)	446	1-4" 1-8"	52 51	566 564	800 3,100
Applecreek	Applecreek & Ivy Hill Lane	675 (3A)	570 (2)	415	1-2" 1-6"	67 65	570 565	208 1,800
Box Canyon[3]	Via Lomas De Yorba West & Copper Canyon	780-4 (4D)	680 (3B)	359	1-3" 1-4" 1-6" 1-4" RV	100 98 96 155	590 585 580 636	460 800 1,800 800
Brentwood	Brentwood & Mission Hills	780-3 (4C)	718 (4CR1)	540	1-3" 1-8"	77 75	718 713	460 3,100
Bryant #1	Camino De Bryant & Kodiak	780-4 (4D)	680 (3B)	591	1-2" 1-8" 1-4" RV	42 40 55	688 683 718	208 3,100 800
Bryant #2	Camino De Bryant & Maiden Moor	1165 (5U)	991 (5L)	872	1-2" 1-6" 1-4" RV	47 42 60	981 969 1,011	208 1,800 800
Casa Loma	North of Bastanchury Rd. in the Shell Oil Project	675 (3A)	570 (2)	460	1-10"	46	566	4,900
Casa Loma[5] (Automated)	North of Bastanchury Rd. in the Shell Oil Project	780-1 (4A)	675 (3A)	490	1-8"	80	675	3,100

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Table 5.6 Pressure Reducing Station Summary
2005 Domestic Water System Master Plan
Yorba Linda Water District

Name	Location	From Zone	Reduces to Zone	Elevation (ft-MSL)	No. and Size of Valves[1]	Pressure Setting (psi)	HGL	Normal Max. Flow Rate[2] (gpm)
Clydesdale[5] (Automated)	Clydesdale Ln. south of Paso Fino Way	920 (5A)	780-2 (4B)	633	1-3" 1-8"	50 48	749 744	460 3,100
Cresthill	Cresthill Dr. east of Kellogg Dr.	570 (2)	430 (1B)	271	1-2" 1-4"	69 65	430 421	208 800
Del Rey[4]	Fairmont Blvd. & Del Rey	780-3 (4C)	675 (3A)	550	1-3" 1-8"	48 42	680 675	460 3,100
Dominguez	Dominguez Ranch & Via Dianza	675 (3A)	570 (2)	440	1-4" 1-8"	53 51	562 558	800 3,100
Fairmont	Fairmont Blvd. & Coachwood	675 (3A)	570 (2)	401	1-2" 1-8" 1-4" RV	65 63 70	551 546 563	208 3,100 800
Foxtail	Via Lomas De Yorba West & Foxtail	780-4 (4D)	680 (3B)	574	1-2" 1-4" 1-8" RV	44 40 58	676 666 708	208 800 3,100
Hamer	Hamer Lane & Yorba Linda Blvd.	570 (2)	428 (1A)	298	1-2" 1-6" 1-6" 1-4" RV	55 53 51 68	425 420 416 455	208 1,800 1,800 800
Hidden Hills	Hidden Hills south of Stonewood	1000 (5B)	908 (5BR1)	568	1-3" 1-8" 1-3" RV	147 145 160	908 903 938	460 3,100 400

Table 5.6 Pressure Reducing Station Summary
2005 Domestic Water System Master Plan
Yorba Linda Water District

Name	Location	From Zone	Reduces to Zone	Elevation (ft-MSL)	No. and Size of Valves[1]	Pressure Setting (psi)	HGL	Normal Max. Flow Rate[2] (gpm)
Hidden Hills 2	Hidden Hills and Skyridge	1390 (6C)	1133 (6D)	1048	1-2" 1-8" 1-4" RV	37 35 50	1,133 1,129 1,164	208 3,100 800
Hidden Oaks[5] (Automated)	Hidden Oaks Dr. south of Green Oaks Rd.	780-2 (4B)	675 (3A)	560	1-3" 1-8"	50 48	676 671	460 3,100
Jefferson	Jefferson St. south of La Collette Pl.	570 (2)	428 (1A)	321	1-6" 1-6" 1-4" RV	45 43 60	425 420 460	1,800 1,800 800
Kodiak #1	Kodiak Mt. & Alpine Ln.	991 (5L)	780-4 (4D)	681	1-2" 1-6" 1-4" RV	44 42 55	783 778 808	208 1,800
Kodiak #2	Kodiak Mt. & Mt. Triumph Way	1165 (5U)	991 (5L)	878	1-2" 1-6" 1-4" RV	49 44 62	991 980 1021	208 1,800
La Palma	La Palma Ave. west of Mercado Del Rio	780-3 (4C)	680 (3B)	373	1-4" 1-8" 1-4" RV	125 120 145	662 650 708	800 3,100
Little Canyon	Fairmont Blvd. & Quail Circle	1300 (6B)	1160 (6A)	811	1-2" 1-6" 1-4" RV	151 147 161	1,160 1,151 1,183	208 1,800
Mission Hills	22476 Mission Hills	908 (5BR1)	780-3 (4C)	670	1-3" 1-8"	47 45	779 774	460 3,100

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Table 5.6 Pressure Reducing Station Summary
2005 Domestic Water System Master Plan
Yorba Linda Water District

Name	Location	From Zone	Reduces to Zone	Elevation (ft-MSL)	No. and Size of Valves[1]	Pressure Setting (psi)	HGL	Normal Max. Flow Rate[2] (gpm)
Oakvale	Fairlynn Blvd. & Oakvale Dr.	675 (3A)	570 (2)	370	1-2" 1-6” 1-4” RV	80 77 105	555 548 613	208 1,800
Palm	Palm Ave.	675 (3A)	570 (2)	430	1-4” 1-6”	58 56	565 560	800 1,800
Platte	Platte St. & Avenida Adobe	675 (3A)	570 (2)	451	1-3" 1-8” 1-4” RV	53 51 70	573 569 613	460 3,100
Paseo Del Prado	Paseo Del Prado & Travis Road	675 (3A)	570 (2)	427	1-3" 1-8”	65 63	577 573	460 3,100
Red Pine[5] (Automated)	Valley View Cir. Southwest of Red Pine Rd.	780-1 (4A)	675 (3A)	546	1-3” 1-8”	50 48	662 657	460 3,100
San Antonio #1	San Antonio north of Contento	780-3 (4C)	675 (3A)	544	1-4" 1-8” 1-8” 1-6” RV	57 55 53 67	676 671 666 699	800 3,100 3,100
San Antonio #2	San Antonio south of Fairmont Blvd.	1300 (6B)	1000 (5B)	882	1-4" 1-8” 1-4” RV	47 45 60	991 986 1021	800 3,100
Stone Canyon	5071 Stone Canyon Ave.	675 (3A)	570 (2)	450	1-2"	42	547	208

Table 5.6 Pressure Reducing Station Summary
2005 Domestic Water System Master Plan
Yorba Linda Water District

Name	Location	From Zone	Reduces to Zone	Elevation (ft-MSL)	No. and Size of Valves[(1)]	Pressure Setting (psi)	HGL	Normal Max. Flow Rate[(2)] (gpm)
Stonehaven	Yorba Linda Blvd. south of Stonehaven	780-3 (4C)	675 (3A)	458	1-4" 1-6" 1-4" RV	95 93 110	677 673 712	800 1,800
Sumac	5122 Sumac Ridge Dr.	675 (3A)	570 (2)	433	1-2"	48	544	208
Tiburon	Tiburon Dr. & Pacifica Dr.	570 (2)	428 (1A)	288	1-2" 1-6"	59 57	424 420	208 1,800
Trailside	Yorba Ranch Rd. & Trailside	675 (3A)	570 (2)	415	1-4" 1-8" 1-4" RV	61 59 80	556 551 600	800 3,100
Van Buren	Van Buren south of La Collette	570 (2)	428 (1A)	325	1-6" 1-6" 1-4" RV	45 43 62	429 424 468	1,800 1,800
Village Center	Village Center north of Yorba Linda Blvd.	780-3 (4C)	675 (3A)	565	1-6" 1-8" 1-10" 1-6" RV	45 43 41 55	669 664 660 692	1,800 3,100 4,900
Wagon Wheel	5102 Wagon Wheel Dr.	675 (3A)	570 (2)	439	1-2"	45	543	208

Table 5.6 Pressure Reducing Station Summary
2005 Domestic Water System Master Plan
Yorba Linda Water District

Name	Location	From Zone	Reduces to Zone	Elevation (ft-MSL)	No. and Size of Valves[1]	Pressure Setting (psi)	HGL	Normal Max. Flow Rate[2] (gpm)
Walnut[5] (Automated)	Walnut St. & Valley View Ave.	675 (3A)	570 (2)	434	1-3” 1-8”	52 50	554 549	460 3,100
Willowbrook	Willowbrook & Westknoll Ave.	675 (3A)	570 (2)	436	1-4"	57	568	800

Notes:
(1) All valves are pressure reducing valves unless labeled as a relief valve (RV).
(2) Source: Cla-Val Valve Capacity Chart.
(3) SCADA operated based on Bryant Reservoir level.
(4) SCADA operated based on Fairmont Reservoir level.
(5) PRS hydraulic controls are normally overridden and the valve closed by SCADA, except during periods when MWD water is supplied in-lieu of groundwater.

5.9 EMERGENCY INTERCONNECTIONS

Water distribution systems are often connected to neighboring water systems to allow the sharing of supplies during short-term emergencies or during planned shutdowns of a primary supply source. The District's water distribution system is interconnected with the systems of three neighboring water agencies:

- City of Anaheim.
- City of Brea.
- Southern California Water Company (SCWC).

The District's distribution system includes 10 interconnections to these adjacent water distribution systems. The interconnections allow the District to import water from these agencies or export water to these agencies during emergencies. Table 5.7 summarizes the District's emergency interconnections. Figure 5.1 illustrates the locations of the emergency interconnections.

Table 5.7 Emergency Interconnections
2005 Domestic Water System Master Plan
Yorba Linda Water District

Agency	Location	Other Agency HGL (ft-MSL)	YLWD Pressure Zone	Size
City of Brea	Tolbert Ave. near Vesuvius Dr.	605	570 (2)	8"
City of Brea	Vesuvius Dr. near Spur Cir.	605	570 (2)	8"
City of Anaheim (#12)	Fairbury Ln. north of La Palma Ave.	555	570 (2)	12"
City of Anaheim (#14)	Willow Woods Dr.	445	430 (1B)	8"
City of Anaheim (#15)	Crystal Dr. near Weir Canyon Rd.	555	570 (2)	16"
SCWC-YL System	Rifle Range Rd. (Locke Ranch)	714	780-3 (4C)	8"
SCWC-YL System	Crestknoll Dr. near Glendale St. (Locke Ranch)	693	675 (3A)	8"
SCWC-YL System	East End Ave. near Burleigh Ave. (Locke Ranch)	714	675 (3A)	8"
SCWC-Placentia System	Lemke Dr.	529	570 (2)	6"
SCWC-Placentia System	Maria Ave.	529	428 (1A)	6"

Chapter 6

WATER SUPPLY

6.1 INTRODUCTION

Yorba Linda Water District (District) aims to provide its customers with high-quality, reliable water at the most economical cost. To accomplish this goal, the District obtains potable water from two supply sources: groundwater from Orange County's groundwater basin, and imported water purchased from the Metropolitan Water District of Southern California (MWD). In addition, the District purchases untreated water from MWD for irrigation of the Black Gold Golf Course. Importing untreated water for irrigation purposes reduces the overall cost to the District of purchasing water from MWD.

6.2 CHAPTER OBJECTIVES

The objectives of this chapter are to:

- Evaluate the District's historical water production.
- Describe existing water supply sources.
- Identify the costs associated with producing water from the two primary supply sources.
- Identify potential future water supply sources.
- Discuss the District's water conservation efforts, which may reduce the need for future supplies.
- Evaluate future water supply requirements.

6.3 WATER SOURCE GOALS

The District aims to provide its customers with a reliable supply of water that meets or exceeds all local, state, and federal standards, while minimizing costs to the consumer. As development continues in the future, the District may need to consider expanding its existing water supplies to achieve these goals. In addition, conservation measures that are currently in place or under consideration may help to reduce the per capita water usage, reducing the need for new water supplies.

6.4 HISTORICAL WATER PRODUCTION

The District's total water production has increased significantly since the District was established. Table 6.1 summarizes the District's historical water production rates since 1930. Water production increased at a steady, gradual rate from 1930 through the late-1970s. Following the completion of the 1978 Water Master Plan and annexation of ID Nos. 1 and 2, the District's water production nearly doubled. Since that time, water production rates have generally continued to increase, but have fluctuated based on precipitation and water conservation efforts.

Table 6.1 Total Historical Water Production
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Total Annual Water Production (ac-ft)
1930	3,507[(1)]
1940	3,707[(1)]
1950	3,905[(1)]
1960	4,708[(1)]
1970	5,630[(1)]
1980	11,192
1985	14,627
1990	19,488
1993	17,989
1994	17,776
1995	18,043
1996	19,668
1997	20,868
1998	18,160
1999	22,243
2000	21,980
2001	21,577
2002	23,457
2003	22,640

Notes:
(1) From the District's Urban Water Management Plan, 2000.

The District imports approximately half of its water supply from MWD and pumps the remaining half from the groundwater basin. Table 6.2 presents the historical water production from the groundwater wells, as well as the water purchased from MWD, during the past 10 years.

Table 6.2 Historical Groundwater and Imported Water Production 2005 Domestic Water System Master Plan Yorba Linda Water District

Year	Total Groundwater Production (ac-ft)	Total Imported Water (ac-ft)	Percent Groundwater	Percent Imported Water
1994	9,541	8,235	54%	46%
1995	10,007	8,036	55%	45%
1996	10,242	9,426	52%	48%
1997	10,010	10,858	48%	52%
1998	9,166	8,994	50%	50%
1999	10,253	11,989	46%	54%
2000	10,812	11,169	49%	51%
2001	10,533	11,044	49%	51%
2002	10,091	13,366	43%	57%
2003	9,354	13,286	41%	59%

The District produces significantly more water during the summer months to meet the increase in demand. Table 6.3 summarizes the production from the groundwater wells and imported water connections by month during 2003.

Table 6.3 2003 Monthly Groundwater and Imported Water Production 2005 Domestic Water System Master Plan Yorba Linda Water District

Month	Total Groundwater Production (ac-ft)	Total Imported Water (ac-ft)	Total Production (ac-ft)	Percent Groundwater	Percent Imported Water
January	494	1,125	1,619	31%	69%
February	410	730	1,140	36%	64%
March	468	801	1,269	37%	63%
April	722	957	1,679	43%	57%
May	909	948	1,857	49%	51%
June	995	1,013	2,008	50%	50%
July	1,239	1,361	2,600	48%	52%
August	1,184	1,602	2,786	42%	58%
September	966	1,525	2,491	39%	61%
October	845	1,393	2,238	38%	62%
November	586	951	1,537	38%	62%
December	537	879	1,416	38%	62%

6.5 EXISTING SOURCES OF SUPPLY

6.5.1 Groundwater Wells

The District currently pumps about half of its total annual water supply from groundwater. The District's eight active groundwater wells pump from the lower Santa Ana basin, which is contained within the Orange County groundwater basin. The Orange County Water District (OCWD) is responsible for managing the use, replenishment, and protection of Orange County's groundwater basin.

OCWD monitors the groundwater basin and sets a Basin Pumping Percentage (BPP), which is a maximum percentage of groundwater production to total water supply that member agencies are allowed to pump. The allowable percentage is set based upon basin groundwater levels, water replenishment capacity, seawater intrusion, and other factors. For the past 5 years through April 2003, OCWD set and maintained a BPP of 75 percent. In April 2003, the OCWD Board of Directors reduced the BPP to 66 percent to reverse the trends of lower groundwater levels and saltwater intrusion into the basin after 4 years of drought conditions in Southern California. The OCWD has subsequently lowered the BPP again to 62 percent beginning in Fiscal Year 2005/2006.

Since groundwater is generally more economical to provide than imported water, the District's goal is to increase groundwater production to 75 percent of the total supply. The District has completed several major capital improvement projects to improve reliability and increase groundwater pumping capacity. In 1992, two important facilities were constructed which allowed the District to increase groundwater production. One facility was the Palm Avenue Booster Pump Station, and the other was a transmission pipeline in Esperanza Road that moves groundwater into Zone 570 (2) in ID No. 1. In 1998, the District completed the Richfield Plant Phase I Improvements, which included upgrading the well pumping facilities for conversion from a double lift to single lift operation, and providing a chlorine facility for disinfection of the well water supply. In 2001, the District completed construction of the Zone 1 (Zone 428) transmission main, which supplies groundwater from the Richfield well field directly to Highland Reservoir (which gravity feeds Zone 428 (1A))through a dedicated transmission pipeline without turnouts.

The District's ability to increase groundwater pumping and transmission is limited until additional distribution facilities are complete. Several recently completed and upcoming improvement projects will enhance groundwater pumping and transmission capabilities. These projects and their current status include:

- Well No. 18 Pumping Facilities (completed 2004).
- Well No. 15 Discharge Pipeline (completed 2004).
- Zone 3 (Zone 675) Transmission Pipeline in Bastanchury Road west of Lakeview Avenue to Valley View Reservoir (completed 2004).

- Zone 3 (Zone 675) Transmission Pipeline in Bastanchury Road from Lakeview Avenue east to Fairmont Boulevard (completed through to Pulte Development 2004).
- Zone 3 (Zone 675) Transmission Pipeline in Bastanchury Road through Shapell Development (design phase 2005).
- Highland Pump Station Expansion (completed 2005).
- Highland Reservoir Replacement (design phase).
- Bastanchury Pump Station Expansion (design phase).
- Zone 2 (Zone 570) Transmission Pipeline (construction phase 2005).
- Palm Avenue Pump Station (Zone 570 (2) to Zone 675 (3)) Expansion (design phase).

The District's estimated cost to produce groundwater is currently about $237 per acre-foot, excluding O&M. The costs of pumping groundwater include fees paid to OCWD and energy costs to pump the water from the ground into the distribution system. Table 6.4 provides a breakdown of the District's costs to produce groundwater (excluding O&M costs).

OCWD charges a replenishment assessment for each acre-foot of groundwater pumped from the basin to finance its activities. The OCWD replenishment assessment charge identified in Table 6.4 is based on the current rate for Fiscal Year 2004/2005. For Fiscal Year 2005/2006, OCWD has proposed increasing the replenishment assessment to $214 per acre-foot.

The District uses a combination of electrical and natural gas energy to operate its groundwater wells. Electrical energy is supplied by Southern California Edison and the City of Anaheim, while natural gas is supplied by The Gas Company. Table 6.4 identifies the projected average energy costs for pumping well water that was established by the District in the Five-Year Plan for Fiscal Year 2003/2004.

Table 6.4 Estimated Cost of Producing Groundwater
2005 Domestic Water System Master Plan
Yorba Linda Water District

Cost Component	Cost per Acre-Foot
OCWD Replenishment Assessment Rate for FY04/05	$172
Average Energy Costs	$65
Estimated Cost to Produce Groundwater excluding O&M	$237

6.5.2 Imported Water

The District imports the remaining half of its water supply from MWD through three treated water turnouts and one untreated water turnout. MWD brings imported water into Southern California from the Colorado River via the Colorado River Aqueduct, and from Northern California via the State Water Project. MWD is the largest wholesale water agency in the United States, distributing water to a service area that extends from Ventura to the California-Mexico border.

The Municipal Water District of Orange County (MWDOC) is the billing agent between MWD and the District, as well as other local water retail agencies in Orange County. MWDOC also represents its member agencies in negotiations with MWD, disseminates information to the retail agencies, and coordinates a regional public information and school education program.

As described in Chapter 5, MWD currently supplies treated water to the District via three connections, with a combined available capacity of 40 cfs (18,000 gpm), through the Lower Feeder and the Allen-McColloch Pipeline (AMP), which was originally owned by MWDOC and a group of water agencies (including the District). The District imports untreated water through one MWD connection, with a capacity of 10 cfs (4,500 gpm).

In 1991, MWDOC (original owner of the AMP) and its AMP partners began negotiations to sell the AMP to MWD. In 1994, the sale was completed. The District continued making lease payments until 2004 when it paid off its obligation. Due to the conditions of the sale of the AMP, the District's payments are now lower than those previously made to MWDOC. The primary advantage of MWD ownership is lower annual operation and maintenance costs for the AMP facilities. MWD agreed to guarantee the current hydraulic gradient of 781 feet at the District's AMP turnout.

Based on an average annual use of 13,286 ac-ft of treated imported MWD water (the treated water imported in 2003), the estimated cost to the District to purchase treated water from MWD is about $481 per acre-foot. This cost is based on the projected costs for Fiscal Year 2003/2004 presented in the District's Five-Year Plan and assumes that all three of the District's treated water connections will be active. Table 6.5 breaks down the cost to the District of importing MWD water. This cost includes a flat rate that is charged to each water agency (Readiness to Serve Charge), a maintenance charge for each connection, and a cost per acre-foot of water. All of these fees are charged by MWD. In addition, MWDOC charges a surcharge on each acre-foot of water sold in its service area, as well as a per connection charge on each active service connection in the agency's service area.

Table 6.5 Estimated Cost of Importing Treated Water from MWD
2005 Domestic Water System Master Plan
Yorba Linda Water District

Cost Component[(1)]	
MWD Annual Readiness to Serve Charge	$223,135
MWD Import Connection Charges (Annual)	
Connection Maintenance Charge (per Connection)	$18,000
Number of Treated Water Connections	3
Total MWD Import Connection Charges (per year)	$54,000
MWDOC Service Connection Charges	
Annual Connection Charge (per Active Service Connection)	$6
Number of Active Service Connections[(2)]	22,417
Total MWDOC Service Connection Charges (per year)	$134,502
Total Non-Incremental Service Charges	**$411,637**
Total Imported Treated Water for 2003[(3)] (ac-ft)	13,286
Average Non-Incremental Service Charges ($ per ac-ft)	$31
MWD Commodity Charge ($ per ac-ft)	$445
MWDOC Incremental Surcharge ($ per ac-ft)	$5
Average Cost of Treated Imported Water ($ per ac-ft)	**$481**

Notes:
(1) Costs are based on Fiscal Year 2003/2004 costs provided in the District's Five-Year Plan (2003/2008).
(2) Number of active service connections at the end of December 2003.
(3) Based on calendar year 2003.

6.5.3 Cost Differential

For every 10% (of total production) increase in groundwater use, the District will save over half a million dollars ($500,000) per year.

Based on the estimated cost of water for the District's two main sources of water, it is obvious that there is a significant difference in costs. Groundwater costs about $237 per acre-foot while MWD water costs about $481 per acre-foot, almost double. This is a difference of $244 per acre-foot. If the District could pump 66 percent of its demands in 2005 (the current basin pumping percentage), instead of 41 percent, as it did in 2003, the District could save about $1.4 million on its water supply costs in only one year. Similar savings would be expected in subsequent years depending on the availability of groundwater from OCWD. Nevertheless, the point is clear that groundwater is significantly less expensive than imported MWD water. Furthermore, based on historical trends, it is expected that groundwater will continue to be significantly less expensive than imported MWD water.

Therefore, the District should make every reasonable effort to maximize its allocation of groundwater.

6.5.4 Emergency Supply

In the event of a local emergency, the District's available emergency sources of water supply consist of the emergency interconnections to the City of Anaheim, City of Brea, and the Southern California Water Company (SCWC). These emergency interconnections are described in detail in Chapter 5. Water storage can also be critical during an emergency. Chapters 7 and 10 discuss emergency storage requirements for water that should be reserved for an emergency, which includes an unscheduled loss of a supply source.

6.6 FUTURE SOURCES OF SUPPLY

An important element of the Master Plan is to ensure that the District will have sufficient water supplies to meet the future demands in the planning years 2005, 2010, and 2020. Possible future sources of water supply include additional groundwater production, new treated or raw water connections to MWD, and recycled water. As discussed above, the District has already started to develop some facilities that will provide additional groundwater and imported water supplies. The following subsections describe additional actions the District has taken towards investigating additional sources of supply, as well as regional issues that may impact future supplies of groundwater and imported water.

6.6.1 Groundwater

During the past 10 years, the District has investigated several new groundwater well options to increase the supply of groundwater available for the District's system. The District has considered developing water wells owned by the Texaco Oil Company, the Etchandy family, the Eastlake Village Homeowners Association, and in the area generally north of Yorba Linda Boulevard and east of Ohio Street. However, the District discarded these options after studies revealed water quality problems or production volumes that would be too low for economical operation.

The Orange County Groundwater Storage Project provides some potential for participating agencies, including the District, to use additional groundwater supplies. This project would allow participating agencies to store excess surface water in the groundwater basin when it is available and use more groundwater during shortages of imported surface water. The construction of a new domestic water well at the District's Richfield Plant, Well No. 19, is currently under construction as part of this project.

In April 2001, MWD selected the groundwater storage project, which was proposed by OCWD and MWDOC, for funding consideration under Proposition 13 Funds. The groundwater storage project calls for 60,000 acre feet (ac-ft) of excess MWD surface water supplies to be delivered by MWD through existing connections and stored in the Orange

County groundwater basin, when available, during normal and wet years. When called on by MWD during dry-year shortages of imported water, the Orange County groundwater producers participating in the groundwater storage project could extract up to an additional 20,000 ac-ft per year (ac-ft/yr) of groundwater from the basin. This additional groundwater production would decrease, by an equivalent amount, the demand for MWD firm deliveries, thereby making additional MWD firm deliveries available to the region. On October 5, 2001, the District declared interest in participating in the groundwater storage project through a written response to OCWD's request for interested participants.

6.6.2 Imported Water

In 1990, several agencies in southern Orange County requested additional imported water supply to meet their service area needs. To meet these projected demands, as well as increasing demands in all of Southern California, MWD proposed to construct the Central Pool Augmentation Project. This project consists of a pipeline from Lake Matthew's, tunneled through the mountains, and terminating near Lake Forest. The environmental studies are currently underway. Completion of the project is scheduled for 2010. Construction has not started yet, so this date will most likely slip to later than 2010.

In the interim, MWDOC proposed expansion of the AMP capacity to meet increased water demands until the Central Pool Augmentation Project is finished. MWDOC's proposal, known as the Flow Augmentation Project, includes the installation of a parallel pipeline in south Orange County, and the construction of a future booster station at the Diemer Filtration Plant. AMP participants were offered the opportunity to purchase additional capacity in the Flow Augmentation Project. The District chose not to buy more capacity and, in fact, sold 20 cfs of its capacity in the AMP.

6.6.3 Untreated (Raw) Water

MWD's Lower Feeder is an untreated water pipeline that traverses across the northern portion of the District's service area. The Black Gold Golf Course is currently supplied untreated water through the OC-36 turnout off the Lower Feeder. There are no current plans to deliver untreated water to any other sites for irrigation within the District's service area.

6.6.4 Recycled Water

Current treatment technology and economics indicate that wastewater reclamation is more efficient when administered regionally by agencies such as the Orange County Sanitation District (OCSD) and OCWD. In 1993 the District's Board of Directors reviewed a report on a proposed wastewater treatment plant near the Yorba Linda lakebed. The report concluded that it was not cost-effective to construct and operate a wastewater treatment plant at this site at this time. A wastewater treatment plant was studied for the Shell Development project but was dropped for cost and environmental reasons.

In April 2001 the OCSD and OCWD approved a plan to construct the Ground Water Replenishment System (GWRS) project, which will treat wastewater from OCSD's Fountain Valley plant. Once completed, the GWRS project will bring recycled wastewater from Fountain Valley to the Santa Ana River lakes area for recharge into the underground aquifers. There are no current plans to use recycled water supply for irrigation within the District's service area.

6.7 WATER CONSERVATION

6.7.1 Existing Programs

The District has implemented many water conservation projects to reduce the overall system demands and the need to increase water supply. In general, the District's customers have been responsive to requests to conserve water during periods of drought. This section summarizes some of the water conservation programs the District currently has in place, although not all of the District's programs are discussed here.

6.7.1.1 Resolution on Voluntary Water Use Reduction

The District's Board of Directors unanimously voted to pass a resolution on June 14, 1990, urging consumers to voluntarily adopt water conservation measures. This resolution includes voluntary restrictions on irrigation and hand watering, water use to wash down outdoor areas, the use of ornamental fountains, hand washing of vehicles and equipment, and non-essential water use. In addition, the resolution encourages consumers to use drought tolerant plants, use water-saving plumbing devices, insulate hot water pipes, run appliances that use significant quantities of water (e.g., dishwashers) only when full, and serve water in restaurants only when requested.

6.7.1.2 Education Programs

The District conducts two tours each year to water facilities such as MWD's Diemer Water Treatment Plant, the District's Richfield Road Headquarters, wells, a Xeriscape Demonstration Garden, and other relevant facilities. These tours, which are offered to local residents, include significant discussions on water conservation. Since 1985, approximately 1,500 people have attended these tours.

Upon request, the District also provides speakers to local schools and civic or business groups. The District's staff members make presentations and distribute information to these groups. In addition, the District offers tours to some of these groups, such as scout or youth groups.

6.7.1.3 Community Involvement

The District participates in local community parades and events to increase awareness of water conservation issues. The District enters floats in two local community parades each year and sponsors information booths at other local community events. The District estimates that more than 15,000 people have seen these floats or information booths.

In conjunction with MWD, MWDOC, and the State Department of Water Resources, the District participates in promoting the annual Water Awareness Month during the month of May. This often includes conducting an open house at the Richfield Plant.

The District works with local restaurants to increase awareness regarding water conservation issues. “Table Tent” cards are available to all restaurants within the District’s service area with a brief message regarding water conservation.

6.7.1.4 Community Outreach

The District distributes information to both new and existing customers via mail on a regular basis. Often, these mailings include information about water supply and water conservation. The District distributes Water Conservation Kits and brochures to residents opening new service accounts and other interested customers.

The District publishes a quarterly “Water Lines” newsletter that is sent to all customers with their water bills. Topics related to water conservation, water supply, and water quality are highlighted, along with the District's services and organization. The District publishes an Annual Report that includes information on:

- Water conservation, supply, and quality.
- District services, finances, and organization.
- Improvements to the water and sewer systems.
- Other related water issues.

The District also maintains an Internet web site to provide information on the District's services and organization; water conservation, supply, and quality; and many other water and sewer service related topics. This website address is www.ylwd.com.

The information section on all of the District’s water bills is used to remind customers to “Use Water Wisely” and to keep them informed of water related issues, toilet exchange events, and other upcoming public events.

Citizens in the local community sometimes contact the District about observed “water waste” in the community. In response, the District often sends postcards with drought and water conservation information to select businesses and residences as a reminder on an as-needed basis.

6.7.1.5 Media Relations

The District issues press releases and maintains contact with local print and electronic media to inform the public about water issues, public events, and other relevant news. The District also uses the local cable television public access channel to announce events and encourage water conservation.

6.7.1.6 Drought Tolerant Landscaping

Since approximately 50 percent of the water use in the District's service area is for landscape irrigation, this usage provides a good opportunity for significant water conservation. In 1989, the District established a drought tolerant garden at the Fairmont Reservoir site, which may be viewed by the public. The District maintains drought tolerant landscaping at all of its facilities.

6.7.1.7 Plumbing Retrofit Program

The District works with MWD and MWDOC to encourage customers to voluntarily install ultra-low-flow toilets. Toward that end, the District customers may replace older, less efficient toilets with new water-conserving models and receive a rebate from MWDOC. The District also encourages its customers to install water saving showerheads, dishwashers, clothes washers, and other water-conserving fixtures.

6.7.1.8 Water Audits

The District has worked with MWDOC to make materials available regarding water audits for residential, commercial/industrial, and landscape users.

6.7.1.9 Coordination with Local Cities

The District has coordinated with the Cities of Yorba Linda and Placentia to develop drought response programs and possible water conservation ordinances. Examples include working to reduce water use for public landscaping purposes, enforcing the plumbing code, establishing drought tolerant landscape requirements for new construction, and making information available about the use of gray water (recycled water from bath and kitchen sources).

6.7.2 Future Programs

The District is currently working to develop and implement additional water conservation measures that may help to reduce future water demands. These programs are in various stages of development. The District will evaluate the benefits of the following programs and implement them as appropriate:

- Water Conservation Workgroup: The District may consider the formation of an interdisciplinary workgroup of employees to plan and implement new water conservation activities.

- Media Advertising: The District may purchase local newspaper, radio, and television advertisements to describe the effects of the drought, recommend conservation measures, and possibly implement mandatory reductions in water use.
- Town Hall Meetings: Prior to implementing emergency drought actions, the District may schedule town hall meetings to inform customers of the water supply situation and programs for dealing with it.
- Alternative Pricing Programs: The District may consider implementing a different pricing policy to benefit consumers that use less water and motivate customers to practice conservation measures.
- Conservation Monitoring Program: The District may hire and train additional personnel to patrol the service area to identify water waste.
- Flow Restrictor Devices: The District will study the possible installation of flow restrictor devices on meters or reduction in the size of the meter where consumption exceeds targeted amounts.

6.8 WATER SUPPLY SOURCE RELIABILITY

As discussed previously, the District depends on groundwater wells and imported water from MWD to provide water to the entire service area. Within the service area, certain pressure zones may be dependent on the operation of booster pump stations to deliver water to that particular zone. If one of these sources of supply were out of service for an extended time, the District would have to rely on the alternative supply source and the emergency interconnections with neighboring water agencies. The District's water storage reservoirs would help to deal with a short- to moderate-term loss of supply.

In general, imported water from MWD is a very reliable source of supply. However, it is possible to have an interruption in service for an extended period. Most water agencies typically plan for a 7 to 10 day loss of service from MWD. Because the District's three treated-water import connections are connected to two different MWD pipelines, this reduces the probability that both import connections will be out of service at the same time. If the District's imported water supply connections were out of service, operation of the District's booster stations may become critical, since some pressure zones do not have alternative supply or pumping sources within the zone. These include the Paso Fino BPS, Timber Ridge BPS, Santiago BPS, Hidden Hills BPS, Box Canyon BPS, and Elk Mountain BPS.

The operation of the District's groundwater wells, as well as the booster pump stations, is dependent on the energy source. Therefore, these facilities may not be as reliable as the MWD connections. Backup or alternative energy sources (i.e., onsite propane tanks, emergency generators, and natural gas supplies), which are available at many of the

District's facilities, help to improve the reliability of the groundwater wells and booster pump stations. In addition, the District's multiple wells provide redundancy in the system, reducing the likelihood that all groundwater wells will be out of service simultaneously.

6.9 FUTURE WATER SUPPLY REQUIREMENTS

As the cost analysis in this section indicated, groundwater is typically less expensive to produce than imported water from MWD. This trend is expected to continue in the future. Therefore, the District should continue to maximize the use of groundwater to supply its system. The amount of groundwater that the District can produce will be limited by the BPP established by OCWD. Assuming that the BPP will eventually return to 75 percent, the District should aim to maintain enough groundwater pumping capacity to supply 75 percent of the demands within the OCWD boundary with local groundwater.

Table 6.6 presents the estimated future water production that the District will need to meet the projected future water demands (including unaccounted-for-water). These projected demands are developed in the following chapter. This table also includes the groundwater pumping capacity required to meet 75 percent of the projected demand in each planning year except for 2005, which uses a basin pumping percentage of 66 percent.

Table 6.6 Projected Future Water Production
2005 Domestic Water System Master Plan
Yorba Linda Water District

Planning Period	Total Projected Demands (ac-ft/yr)	Groundwater Production Goal(1) (ac-ft/yr)	Imported Water Supply Goal(2) (ac-ft/yr)
2005	23,260	15,352	7,908
2010	25,198	18,898	6,300
2020	26,069	19,552	6,517

Notes:
(1) Assumes that the areas of the District's service area currently outside the OCWD boundary are annexed into OCWD. For 2010 and 2020, assumes that the basin pumping percentage returns to 75 percent. Basin pumping percentage for 2005 is 66 percent.
(2) Based on providing the remaining supply with imported MWD water.

As the District's supply needs increase, it will become increasingly important to maximize the use of groundwater. Assuming that the current cost differential of $244 per acre-foot continues, that the basin pumping percentage returns to 75 percent and that the areas outside OCWD's boundary are annexed into the OCWD, the District will be able to save about $1.5 million (in 2005 dollars) per year. Year after year, this will continue to add up.

Chapter 7

WATER DEMANDS

7.1 INTRODUCTION

Water demands (or water use) represent water that leaves the distribution system through metered or unmetered connections, or at pipe joints (leaks) or breaks. These demands include metered water use and unaccounted-for water, or water that leaves the system without being metered. Water demands occur throughout the distribution system based on the number and type of consumers in each location. Water demands vary throughout the day, resulting in a diurnal demand pattern that typically includes one peak in the morning and a second in the evening. Demands also vary seasonally, with the peak demands typically occurring during the summer months.

The total demand in a distribution system can be correlated to the number of service connections in the system. In a system like Yorba Linda Water District's (DISTRICT), where most of the customers are residential, water use is relatively similar for most of the service connections in the system. Future system demands can be estimated by evaluating the potential growth in an area, identifying the projected number of new homes or businesses, and quantifying the number of future service connections. If the historical average water use per service connection remains relatively constant, the future demand can be estimated by multiplying the number of service connections by the average use per connection.

7.2 CHAPTER OBJECTIVES

The objectives of this chapter are to:

- Summarize historical water demands.
- Calculate the percentage of unaccounted-for water.
- Identify fire flow requirements.
- Identify seasonal and daily variations in water demands.
- Estimated projected water demands for future planning years.

7.3 HISTORICAL METERED WATER USE

Table 7.1 summarizes the historical metered water use in the District's service area over the past 10 years. With the exception of 1998, which was a particularly wet year, metered water use increased steadily during the late 1990s. Since then, water use has remained relatively consistent from year to year.

Table 7.1 Historical Metered Water Use
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Metered Water Use (ac-ft/yr)
1994	17,806
1995	17,721
1996	19,255
1997	20,078
1998	16,618
1999	20,422
2000	21,267
2001	20,824
2002	21,988
2003	21,119

7.4 UNACCOUNTED-FOR WATER

Water taken out of the distribution system at metered connections is relatively easy to measure. Unfortunately, not all water that leaves the system does so at metered connections. Water that exits the distribution system and cannot be measured or accounted for is known as unaccounted-for water. Unaccounted-for water can be estimated by calculating the difference between known water consumption and water production. Most water systems experience a difference of 5 to 10 percent, which is generally considered acceptable.

Many factors contribute to unaccounted-for water. These include leaks in pipelines, main breaks, fire hydrant testing and flushing, storage tank drainage and maintenance, inaccurate meters, unauthorized use, and unmetered services. The sources of unaccounted-for water are often difficult or impossible to pinpoint. It is important for water models to include unaccounted-for water in the system demands so that the total water demand will balance with the total water supply.

The District's unaccounted-for water was estimated over the past 10 years. The historical production records summarized in Chapter 6, and the historical water consumption records listed above, were used to determine the unaccounted-for water for the District's system. The average unaccounted-for water over the past 10 years has been 4 percent.

Table 7.2 Unaccounted-for Water
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Water Production (ac-ft/yr)	Water Consumption (ac-ft/yr)	Unaccounted-for Water
1994	17,776	17,806	0%
1995	18,043	17,721	2%
1996	19,668	19,255	2%
1997	20,868	20,078	4%
1998	18,160	16,618	8%
1999	22,243	20,422	8%
2000	21,980	21,267	3%
2001	21,577	20,824	3%
2002	23,457	21,988	6%
2003	22,640	21,119	7%
Average			4%

7.5 FIRE FLOW REQUIREMENTS

In addition to providing adequate water supply and pressure to serve residential, commercial, and industrial water demands placed on the system, the water system must also deliver an adequate supply for fire fighting. Since fires can occur at any time, the water system must always be ready to provide the required flow with an adequate residual pressure. The water system should be capable of providing the fire flow during the day of the year with the highest water demands, or the maximum day demands.

To determine the ability of the system to provide adequate fire flows, minimum demand requirements, minimum residual pressures, and minimum system pressures were established for various locations throughout the distribution system. In master planning, fire flow demands are usually based on the type of land use in the area of the fire flow. For example, a residential area may require a minimum fire flow of 1,500 gpm while an industrial area may require 4,000 gpm.

The Orange County Fire Authority (OCFA) is the agency responsible for establishing fire flow requirements for the District's service area. Andrew Keyworth, with OCFA's Fire Protection Engineering Department, was contacted during the preparation of this Master Plan. Mr. Keyworth indicated that the OCFA fire flow requirements are based on the fire flow requirements listed in the California Fire Code. Mr. Keyworth was also consulted about any known areas of the District's distribution system with fire flow deficiencies. He was unaware of any such areas.

The fire flow requirements defined in the California Fire Code were used as a guide in developing the fire flow criteria for this study. Table 7.3 summarizes the fire flow criteria used for the District's Master Plan.

Table 7.3 Fire Flow Requirements
2005 Domestic Water System Master Plan
Yorba Linda Water District

Category	Minimum Flow Required (gpm)	Minimum Residual Pressure (psi)	Duration (hr)
Single Family Residential	1,500	20	2
Multi-Family Residential	2,500	20	2
Public Facilities/Schools	3,500	20	3
Commercial	2,500	20	3
Industrial	5,000	20	4
Hospital (Linda Vista)	5,000	20	4

7.6 WATER DEMAND CALCULATIONS

In general, the total water demand for a distribution system can be correlated to the number of service connections in the service area. The demands vary throughout the system based on the density of service connection in each geographical area. Future demands for the District's system can be projected based on the proposed number of service connections that will be added to different geographical locations in the service area.

7.6.1 Historical Water Service Connections

Table 7.4 presents the historical number of service connections in the District's system since 1930, as well as the total annual water production for each of these years. During the District's early history, much of the service area consisted of agricultural users. Thus, the average water use per connection during these years was very high compared to recent years.

Following the annexation of ID No. 1 and ID No. 2 in the late 1970s, water production has increased consistently with the number of service connections in the District's service area, as Figure 7.1 illustrates. The ratio of water produced to the number of service connections has remained relatively constant throughout this period, since most of the customers have been residential during this time. Fluctuations in annual rainfall and water conservation have had the most significant impact on this ratio. The average water production per service connection between 1980 and 2003 was 882 gpd. The average annual rainfall during this period was about 14.1 inches. In 2002, the ratio of production to service connections increased to 967 gpd, but the annual rainfall was only 6.45 inches. Similarly, in 1998, this ratio decreased to 767, but the rainfall was above average at 28.41 inches.

Table 7.4 Historical Water Service Connections and Water Production
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Average Service Connections	Total Annual Water Production (MG/yr)	Demand per Connection (gpd)	Annual Rainfall(2) (in)
1930	350(1)	1,142(1)	8,939	14.74
1940	380(1)	1,208(1)	8,709	19.04
1950	585(1)	1,272(1)	5,957	9.60
1960	1,412(1)	1,534(1)	2,976	9.68
1970	5,135(1)	1,834(1)	979	13.52
1980	11,071	3,647	902	26.64
1985	13,973	4,766	934	5.14
1990	19,030	6,350	914	7.43
1994	20,313	5,792	781	10.97
1995	20,505	5,879	785	22.95
1996	20,698	6,408	848	22.22
1997	20,937	6,799	890	15.45
1998	21,147	5,917	767	28.41
1999	21,150	7,247	939	5.37
2000	21,207	7,162	925	10.19
2001	21,356	7,030	902	15.33
2002	21,660	7,643	967	6.45
2003	22,279	7,377	907	11.04

Notes:
(1) Source: The District's Urban Water Management Plan, 2000.
(2) Source: Western Regional Climate Center (www.wrcc.dri.edu). Where rainfall was not available for Yorba Linda, Tustin/Irvine Ranch was used.

7.6.2 Demand Variation and Peaking Factors

It is important to study the variability of water demands with respect to time to fully evaluate water system operation under variable operating conditions. Water demand varies with respect to the time of year. Water demand is typically higher than average on hot summer days, primarily due to increased water demands for irrigation. On cool winter days, water demands are lower than average due to lower temperatures and increased precipitation, which significantly reduces irrigation demands. Peaking factors are used to account for these daily fluctuations in demands. Peaking factors are determined by dividing the water system demand for a selected period by the average day demand.

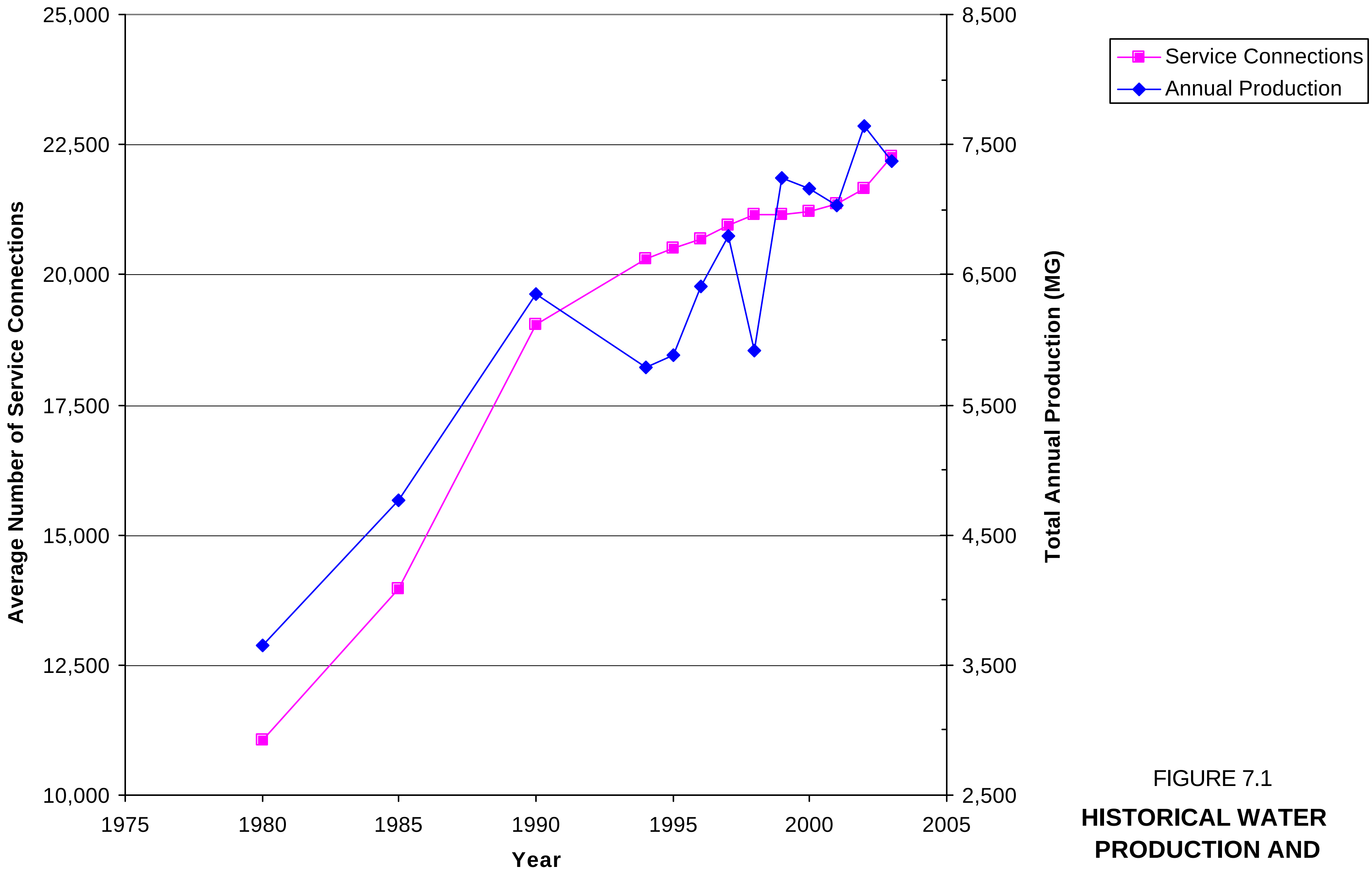

FIGURE 7.1

HISTORICAL WATER PRODUCTION AND SERVICE CONNECTIONS

YORBA LINDA WATER DISTRICT

Water demands also vary throughout a 24-hour period. In residential areas, peaks typically occur in the morning and the late afternoon. Areas with automatic sprinkler systems used for irrigation usually see peak periods late at night through the early morning hours. An hourly water use curve, known as the system diurnal curve, is used to help identify how demands in a water system change throughout the day.

7.6.2.1 Average Day Demand

The average day water demand is calculated by dividing the total annual water demand by the number of days in the year. The total production for the year 2003 was 22,640 ac-ft (7,377 MG), resulting in an average daily production of 20.2 mgd. This is equivalent to an average daily water usage of 14,028 gpm.

7.6.2.2 Maximum Day Demand

The maximum day demand peaking factor for the system was determined from production data in calendar year 2003. The maximum-day production in 2003 occurred on August 26, 2003. The total production for the day was 29.9 mgd. The maximum-day demand peaking factor was obtained by dividing the maximum-day production by the average daily production (20.2 mgd), resulting in a maximum day demand peaking factor of 1.48.

7.6.2.3 Peak Hour Demand and Diurnal Demand Curve

The peak hour represents the hour with the highest water system demand during the maximum day. Water systems often experience the highest demand on reservoirs and booster stations during the peak hour demand period. This period can also be the controlling demand period for pipeline sizing, although the maximum day plus fire flow demand is often more critical for establishing pipeline sizes. Minimum water system criteria, such as the minimum allowable system pressure, are often evaluated using peak hour demands.

The peak hour peaking factor for the District's system was established using hourly production records and reservoir levels provided by the District for the maximum day in 2003. The peak hour occurred between 5:00 am and 6:00 am. The estimated water demand during this period was 35,800 gpm. Therefore, the peak hour peaking factor relative to the average day demand is 2.55.

The hourly production records and reservoir levels were also used to establish a peak day diurnal demand pattern for the District's system. This pattern was established by comparing the demand over each hour to the average hourly demand for the day. Table 7.5 presents the resulting hourly demand factors. Figure 7.2 illustrates the diurnal demand pattern for the maximum day.

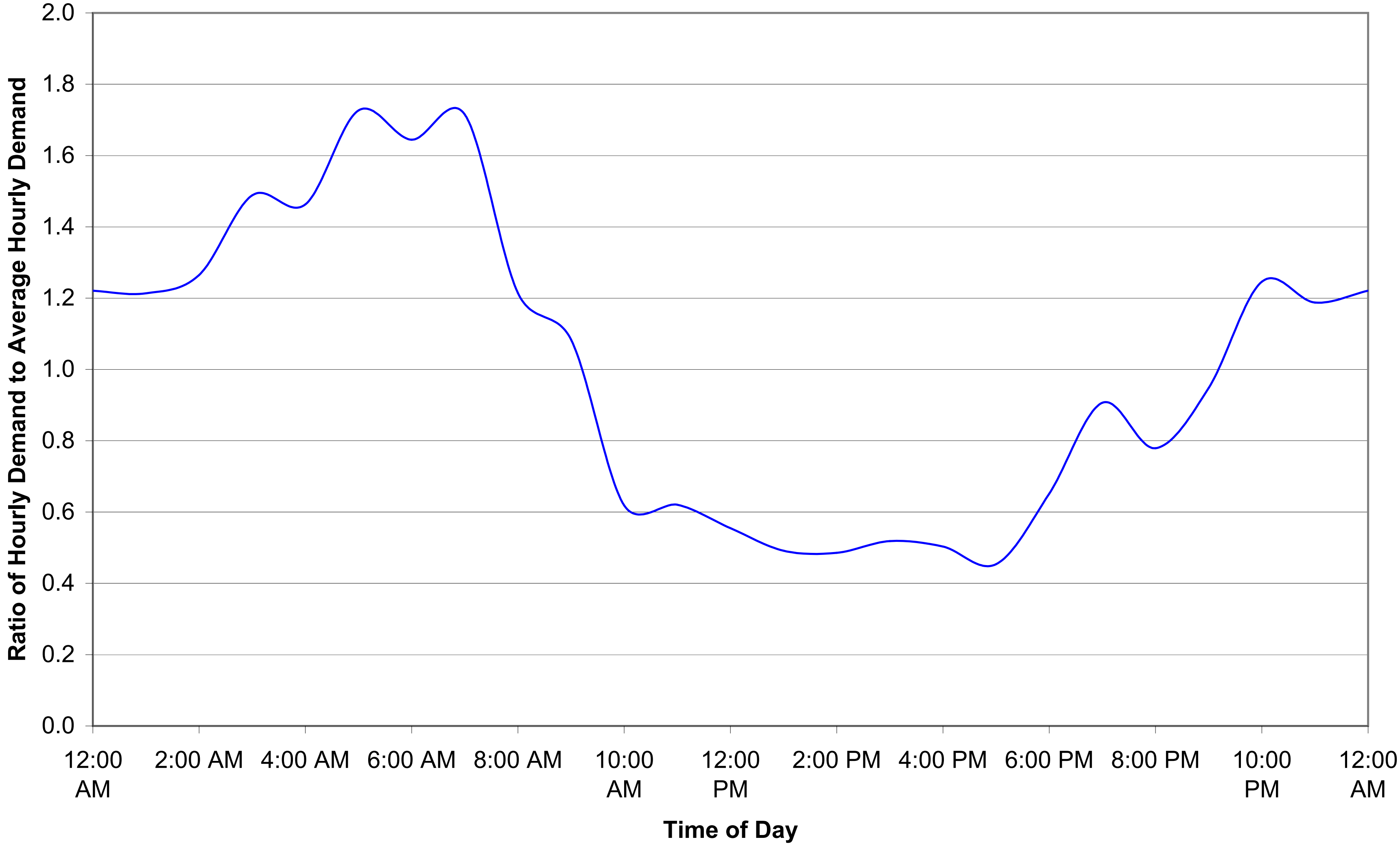

FIGURE 7.2

2003 MAXIMUM DAY DIURNAL DEMAND CURVE

YORBA LINDA WATER DISTRICT

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Table 7.5 Hourly Demand Pattern
2005 Domestic Water System Master Plan
Yorba Linda Water District

Time	Demand Ratio	Time	Demand Ratio
12 am - 1 am	1.22	12 pm - 1 pm	0.55
1 am - 2 am	1.21	1 pm - 2 pm	0.49
2 am - 3 am	1.26	2 pm - 3 pm	0.49
3 am - 4 am	1.49	3 pm - 4 pm	0.52
4 am - 5 am	1.46	4 pm - 5 pm	0.50
5 am - 6 am	1.73	5 pm - 6 pm	0.45
6 am - 7 am	1.64	6 pm - 7 pm	0.65
7 am - 8 am	1.71	7 pm - 8 pm	0.91
8 am - 9 am	1.21	8 pm - 9 pm	0.78
9 am - 10 am	1.08	9 pm - 10 pm	0.95
10 am - 11 am	0.62	10 pm - 11 pm	1.25
11 am - 12 pm	0.62	11 pm - 12 am	1.19

7.7 FUTURE WATER DEMAND PROJECTIONS

The projected water demands for the District's system were estimated for each of the future planning years based on the projected number of service connections and the average water use per connection. Table 7.6 presents the estimated average water demands for each of the future planning years. The peaking factors established in the previous section were then used to estimate the maximum day demand and the peak hour demand for each of the planning years. Table 7.7 presents the current and projected future average day, maximum day, and peak hour demands.

Table 7.6 Projected Average Water Demands
2005 Domestic Water System Master Plan
Yorba Linda Water District

Year	Estimated Number of Service Connections	Estimated Water Demand (ac-ft/yr)	Estimated Water Demand (MGD)	Estimated Water Demand (gpm)
2003	22,417	22,585	20.2	14,028
2005	23,100	23,260	20.8	14,447
2010	25,067	25,198	22.5	15,651
2020	25,950	26,069	23.3	16,192

Table 7.7 Projected Peak Water Demands
2005 Domestic Water System Master Plan
Yorba Linda Water District

	Estimated Average Day Demand (gpm)	Estimated Maximum Day Demand (gpm)	Estimated Peak Hour Demand (gpm)
Peaking Factor	1.0	1.48	2.55
2003	14,028	20,761	35,771
2005	14,447	21,382	36,840
2010	15,651	23,163	39,910
2020	16,192	23,964	41,290

Chapter 8

DISTRIBUTION SYSTEM MODELING

8.1 INTRODUCTION

A computer model of the water distribution system is an important tool for any analysis of a water system and especially for a water master plan. The widespread use of personal computers and availability of modeling software has made network analysis modeling efficient and practical for virtually any water system. Computer modeling can be used to analyze existing water systems, future water systems or even specific improvements to the existing water system. In master planning, the computer model assists in measuring system performance, in analyzing operational improvements, and in developing a systematic method of determining the size and timing required for new facilities. The computer model allows numerous scenarios to be analyzed relatively quickly and easily and provides answers to many “what if” questions.

The computer model is composed of two main parts: a data file that defines the physical system, and a computer program that solves a series of hydraulic equations for pressure and flow. The data file includes information on the water system facilities, operational characteristics, and production/consumption data. The system facilities include pipes, nodes, control valves, pumps, and reservoirs. Operational characteristics include parameters that control how the water moves through the system, such as pump settings, control valve settings, or main line valve closures. Data for production and consumption determine where the water enters and exits the distribution system. The computer program analyzes all of the information in the system data file and generates results in terms of pressures, flow rates, and operating status. The key to the use of the computer model is correctly interpreting these results and understanding how the water distribution system is affected.

8.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan Report are to:

- Describe the process that Yorba Linda Water District (District) used to develop the original model.
- Summarize the modifications that Carollo made to the model as part of this project.
- Present the existing and future system deficiencies identified by the model simulations.

8.3 MODEL DESCRIPTION

Prior to developing this Master Plan, the District had developed and calibrated a hydraulic computer model using $H_2ONET^{®}$ modeling software. This section includes a description of the model development as it was described in the District's documentation. In addition, modifications that were made to the model as part of the Master Plan are discussed below.

8.3.1 Modeling Software

The District purchased $H_2ONET^{®}$ Analyzer Version 3.0 (6,000-Links) for ACAD 14 on March 3, 2001. An upgrade (Version 3.5) was later obtained to maintain compatibility with ACAD 2002. The District purchased one model license for 6,000 pipes. The model was subsequently upgraded to version 5.2 for use with AutoCAD 2005.

$H_2ONET^{®}$, which is distributed by MWH Soft, is widely used for modeling pressurized water system networks. It has many features not found in other programs and is priced competitively. $H_2ONET^{®}$ utilizes the graphics capabilities of AutoCAD and Microsoft Windows to prepare the network model and to present the model results.

8.3.2 Base Map

The District purchased an ETAK Map to use as a basemap to place facilities during model development. The basemap was purchased from American Digital Cartography, Inc. (ADCI) on April 11, 2001. ADCI is a nationwide distributor of this data type.

The ETAK Map is set in the California NAD 83 coordinate system. The horizontal accuracy of the ETAK map is the same as that of USGS maps, which are created at a scale of 1:24,000. The maps are guaranteed to be accurate within 40 feet. The double-lines that represent streets and roads are arbitrary offsets from centerline data. The District found that other graphics that were overlaid with the base map, such as orthophotography, plat sheets, and parcel maps, correlated very well.

8.3.3 Facilities

The District's model includes reservoirs, pumps, pipes, wells, and selected valves (including pressure reducing and pressure relief valves). The District created a majority of these facilities in previous versions of the model. However, Carollo added or updated some new and future facilities that were not already included in the model. The District's major facilities and their hydraulic relationship within the system are shown in Figure 8.1.

Reservoirs in the system are modeled with unique curves relating the volume in the reservoir to the water level. The curves were established from reservoir geometry. New curves were input to the model for the Gardenia, Valley View, and Quarterhorse Reservoirs, which have all been constructed recently.

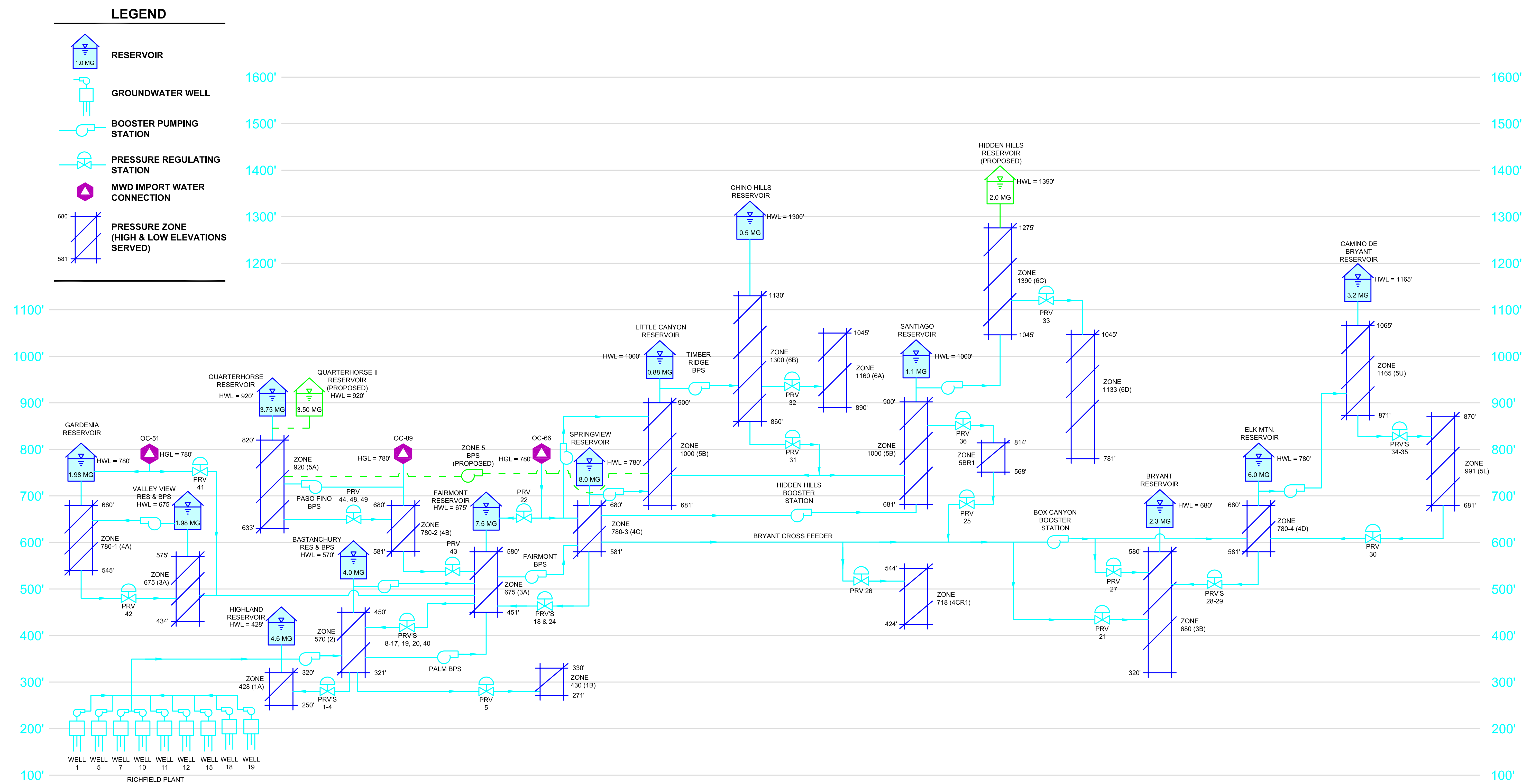

FIGURE 8.1
HYDRAULIC PROFILE SCHEMATIC
YORBA LINDA WATER DISTRICT

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Wells were modeled using a pump and a reservoir. The reservoir was modeled as constant-head reservoir (with no geometry), which maintains a constant water level regardless of the volume pumped out of the reservoir. The District established the water levels in the model based on the drawdown elevation for each well. These values may require adjustment on a seasonal basis since the aquifer levels may fluctuate.

Each pump in the system (booster pumps and well pumps) is modeled with a unique pump curve (flow vs. head) based on the manufacturer's pump curve. The model also has ON/OFF control settings for each pump based on typical settings used by the Operations Department. The model was updated as part of this Master Plan to include three sets of pump controls to represent three different operational scenarios:

- Typical Operations.
- Operations to Optimize Groundwater Production and Distribution.
- Operations to Maximize MWD Water Production and Distribution.

The pressure reducing stations (PRS) are modeled with multiple valves in parallel, similar to their configuration in the field. The size and headloss coefficient associated with each valve are included in the model. The District established the headloss coefficients based on calibration tests comparing model-predicted flow rates and theoretical flow rates provided by the valve manufacturer (Cla-Val). The valve settings for each PRS were updated as part of the Master Plan Report based on information provided by the District's Operations Department. These valve settings were summarized in Chapter 5 of this report.

8.3.4 Elevations

Elevation data for the original model was developed by Digital Map Products (DMP), located in Costa Mesa, California. (Contact Daniel McCroskey or Amelia Nunez, (714) 751-7373). DMP completed the following four tasks:

- Converted model node data into shape file format for elevation extraction process.
- Provided 10'-contour data in GIS format and CAD format.
- Developed triangular irregular network (TIN) to correlate the contour data to specific node coordinates.
- Extracted elevation data from the TIN for each node in the model.
- Provided data in format compatible for insertion back into the model (i.e., Excel spreadsheet).

The contour data that was used to create the TIN was derived from a flight performed in the early 1990's for an Orange County project. The contour data was the best-available data relative to the cost.

8.4 WATER DEMANDS

8.4.1 Existing Average Day Demands

The District developed demands for the existing development in the model. These demands were derived from historical billing data provided by the Business Department. Peggy McClure, a consultant to the District, generated billing reports on all customers for calendar years 1998, 1999, and 2000. The reports included the account number, customer name, meter class, meter route number, total consumption units, total gallons, and annual average usage (in gpm).

Annual averages for each account in 1998, 1999, and 2000 were compared to identify any anomalies based on the standard deviation. Usage data with a standard deviation greater than one between the three years was reviewed by the Business Department to determine if an erroneous value existed in the data. In all such cases, the Business Department provided an amended value that correlated within the set standard deviation criteria. Approximately 60 accounts required data to be amended, which represents only 0.3 percent of the entire customer base. After the usage data was amended and all three years exhibited excellent correlation within each account, the latest year (2000) was used as that account's annual demand.

Accounts that used more than 3 gpm in Year 2000 were classified as a Large User. Four hundred thirty two (432) large users were identified in the database, representing 20 percent of the District's annual consumption.

Demands were originally allocated in the model based on the meter routes and the large users. The total demand for each meter route (excluding large users) was distributed to the nodes geographically located within a route's boundary. Some nodes within the meter routes were left with no demand to ensure spatial equality within a route boundary. Point demands were then inserted into the model to represent the large users based on the addresses of the users.

As part of this Master Plan, the demands in the District's original model were modified to represent the District's average system demands in 2003. The demands established for the 2000 scenario were scaled proportionately to increase the total system demand to the average day demand for 2003. Future demands were also incorporated into the model based on the planned development discussed in Chapter 4. The future demands were allocated for each planned development based on the location of the development, the estimated number of service connections, and the average water consumption per service connection.

The District established two demand patterns to simulate demand variation throughout a 24-hour period. Originally, the District developed a standard demand pattern to represent a majority of consumers based on a compilation of demand patterns from similar agencies in the surrounding area. However, as part of this Master Plan, this demand pattern was updated to represent the District's typical maximum day diurnal demand pattern. The original demand pattern was replaced with the pattern shown in Figure 7.2. The second demand pattern, which was developed by the District, is used for irrigation services, which typically operate between 10:00 p.m. to 5:00 a.m.

8.4.2 Peaking Factors

The maximum day and peak hour peaking factors that were established in Chapter 7 were used to develop model demands for the maximum day and peak hour scenarios. These peaking factors (1.48 for maximum day and 2.55 for peak hour) were applied to the updated 2003 average day demands to develop 2003 maximum day and peak hour demand sets. The same peaking factors were applied to the future average day demand sets to develop future maximum day and peak hour demand sets. These demand sets were then used in the maximum day and peak hour steady state simulations. In addition, the maximum day demand sets were used for all extended period simulations.

8.5 MODEL CALIBRATION

The model calibration process was described in documentation provided by the District. Based on this description, the process is summarized below.

8.5.1 Elevations

The calibration process and preliminary model simulations resulted in several erroneous system pressures. These errors revealed that several node elevations differed from elevations found in as-built drawings. The difference in elevations between model data and as-built drawing data ranged from a couple feet to 80 feet. The discrepancies were most apparent in the hilly terrain found in the northeast section of the District's service area. Several elevations in the model were changed to reflect as-built conditions. Those nodes that have undergone an elevation change are classified in the model as "Adjusted" within the "EL_ADJUST" column of the Junction Information database table. The elevations in the model were adjusted on an as-needed basis.

8.5.2 C-Factors

the District performed approximately 70 field tests to provide data for calibrating the pipe C-factors used in the model. Seven of the tests were "passive tests," engaged by connecting mobile pressure recording devices to hydrants and recording local pressure throughout an extended period (24 hours or 1 week). The remaining tests were hydrant flow tests conducted to compare pressures and flow rates at various locations in the system.

Initial estimates for pipe C-factors were derived from an AWWA curve based on the pipe age, material, and lining. Model simulations were conducted using these C-factors, and the model results were compared to the results of the field tests. These model simulations were setup to mimic the field conditions (i.e., reservoir levels, pump status, and system demands) during the calibration tests. After comparing the results of the model simulations and the field tests, the initial C-factors were adjusted until the model results were within 5 percent of the values observed in the field.

8.6 GENERAL COST ASSUMPTIONS

Cost estimates developed for this master plan are based on February 2005 dollars. Total project cost estimates include estimated costs for construction, engineering, legal, administration, construction management, and contingency. Estimated construction costs are based on historical bids submitted by contractors for similar projects for the District and Carollo. The estimated costs of engineering, legal, administration, and construction management was assumed to be 35 percent of the estimated construction cost. A contingency of 25 percent of the estimated construction cost was also included in the total project cost estimates.

Table 8.1 General Project Cost Assumptions
2005 Domestic Water System Master Plan
Yorba Linda Water District

Description	Value
Engineering, Administration, Legal, and Construction Management	35% of the construction cost estimate
Contingency	25% of the construction cost estimate

The cost estimates are based on current perceptions of conditions at the project locations. These estimates reflect Carollo Engineer's (Carollo's) professional opinion of costs at this time and are subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

8.6.1 Estimated Project Costs for Pipelines

The project costs for distribution pipelines and transmission mains was estimated using a unit cost of $15 per diameter-inch per foot of pipe. This unit cost was assumed to include the material and installation, as well as engineering, legal, administration, construction management, and contingency. The cost of acquisition of land or easements is not included in the pipeline cost estimates.

8.6.2 Estimated Project Costs for Miscellaneous Valves

The project costs for gate valves, check valves, pressure reducing valves, and pressure reducing stations was assumed to include the material and installation, engineering, legal, administration, construction management, and contingency. The cost of acquisition of land or easements is not included in these cost estimates. Table 8.2 lists the estimated project costs for the miscellaneous valves identified in this master plan.

Table 8.2 Estimated Project Costs for Miscellaneous Valves
2005 Domestic Water System Master Plan
Yorba Linda Water District

Description	Estimated Project Cost
8" Gate Valve	$8,000 each
8" Check Valve in a Small Vault	$20,000 each
1" Pressure Reducing Valve	$500 each
8" Pressure Reducing Station in a Vault	$150,000 each

8.6.3 Estimated Project Costs for Booster Pumping Stations

The estimated project costs for booster pumping stations was estimated using the following equation:

Estimated Pumping Station Project Cost = $1.6 * 10^{(0.7583*\log(Q)+3.1951)}$; where Q is in gpm

Source: Pumping Station Design, Sanks et al. (adjusted to 2/2005 dollars)

This equation has a reference ENR of 4500; therefore, the costs were modified with an ENR factor to determine the estimated cost in February 2005 dollars. This equation includes estimated costs for engineering, legal, administration, construction management, and contingency. The estimated pumping station project costs do not include operations and maintenance costs to operate the station. The cost of acquisition of land or easements is not included in the pumping station cost estimates.

8.6.4 Estimated Project Costs for Groundwater Wells

The project costs for groundwater production wells was estimated using a unit cost of $1,000 per gpm of well production. This unit cost was assumed to include the well drilling and development, wellhead development, as well as engineering, legal, administration, construction management, and contingency. The cost of acquisition of land or easements is not included in the pipeline cost estimates. The estimated groundwater well project costs do not include operations and maintenance costs to operate the well.

8.7 MODEL SIMULATIONS

The hydraulic computer model was used to model the existing water distribution system in various ways in an effort to identify a deficiency that might show up under certain conditions. As part of the Master Plan project, a number of model simulations were conducted to identify deficiencies in the existing and future distribution system and to analyze proposed or recommended system improvements. Table 8.3 identifies the model simulations that were conducted for each of the planning years. In addition, this table lists the demand set that was used for each scenario, as well as the operational control set.

Table 8.3 Model Simulations
2005 Domestic Water System Master Plan
Yorba Linda Water District

Simulation	2005	2010	2020	Duration	Demands	Operational Controls
Average Day	X	X	X	Steady State	Avg Day	Typical Operations
Maximum Day	X	X	X	Steady State	Max Day	Typical Operations
Peak Hour	X	X	X	Steady State	Peak Hour	Typical Operations
EPS - Typical	X	X	X	24 hours	Avg Day	Typical Operations
EPS - GW Only	X	X	X	24 hours	Avg Day	Maximize Groundwater
EPS - MWD Only	X	X	X	24 hours	Avg Day	Maximize MWD
EPS - Typical	X	X	X	24 hours	Max Day	Typical Operations
Fireflow	X	X	X	Steady State	Max Day	Typical Operations

8.8 EXISTING DISTRIBUTION SYSTEM RESULTS

The existing distribution system was analyzed to identify existing system deficiencies and operational inefficiencies. Where existing system deficiencies were identified, system improvements were modeled to verify that the improvements would mitigate the deficiencies. In some cases, more than one alternative was available to mitigate the deficiency. Where competing improvements provided the same level of service, then the less expensive alternative (considering capital and O&M costs) was recommended. After a deficiency was identified, it was categorized as either a health/safety improvement (such as improving fire flows), a reliability improvement (such as increasing emergency storage), or an operational improvement (such as reducing pumping). Where there was overlap between these classifications, a judgment was made to put the improvement into the best category.

Operational improvements were investigated for their ability to reduce pumping and/or the need for MWD water. When the estimated cost of the improvement was less than the operational savings, the improvement was recommended. Operational savings included the cost of pumping water and the cost of MWD water as compared to groundwater (after accounting for any hydraulic grade differences). Generally, groundwater is less expensive up to the production level allowed under the BPP set by OCWD. Above this level, MWD water is less expensive than producing groundwater above the BPP. Therefore, this master plan focuses on maximizing the use of groundwater up to the BPP and then supplementing the remaining demands with MWD water.

8.8.1 Fire Flow Analysis

The fire flows identified in Table 7.3 of this report were distributed to various junction nodes in the hydraulic computer model based on the zoning shown in Figure 4.1. Schools were identified from maps of the city. The fire flow demands were added to maximum day demands for 2004 (20,731 gpm).

Inadequate fire flows were identified in three areas of the District's service area. Figure 8.2 shows where the areas with inadequate fire flows are located. Table 8.4 summarizes the areas and lists the nodes from the hydraulic computer model.

Table 8.4 Existing Fire Flow Deficiencies
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Location	Model Nodes
1	Cresthill Drive (Zone 430 (1B))	Nodes: 1866, 1867, 1868, 1869, 1870, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891
2	Via Sereno	Node: 1683
3	Area south of Gordon Lane between Ohio Street and Grandview Avenue	Node: 1661

Area 1: The area along Cresthill Drive (just north of Esperanza High School), is within the Zone 430 (1B) pressure zone and is served by Zone 570 (2) through a pressure reducing station, located at Kellogg Drive and Cresthill Drive. The land use in this area is considered single family residential, so the fire flow demand is 1,500 gpm. The pressure reducing station includes 2-inch and 4-inch pressure reducing valves. The fire flow analysis indicates that these valves cannot provide adequate capacity to meet the 1,500 gpm fire flow demand. Additional modeling indicated that a larger valve by itself did not fix the problem. There was too much head loss through the pipes both upstream and downstream of the pressure reducing station. One complication is that the elevation of the end of the pipe is about 40 feet higher than the pressure reducing station. Additional modeling indicated that a significant amount of 12-inch pipe would be required to provide the required fire flow.

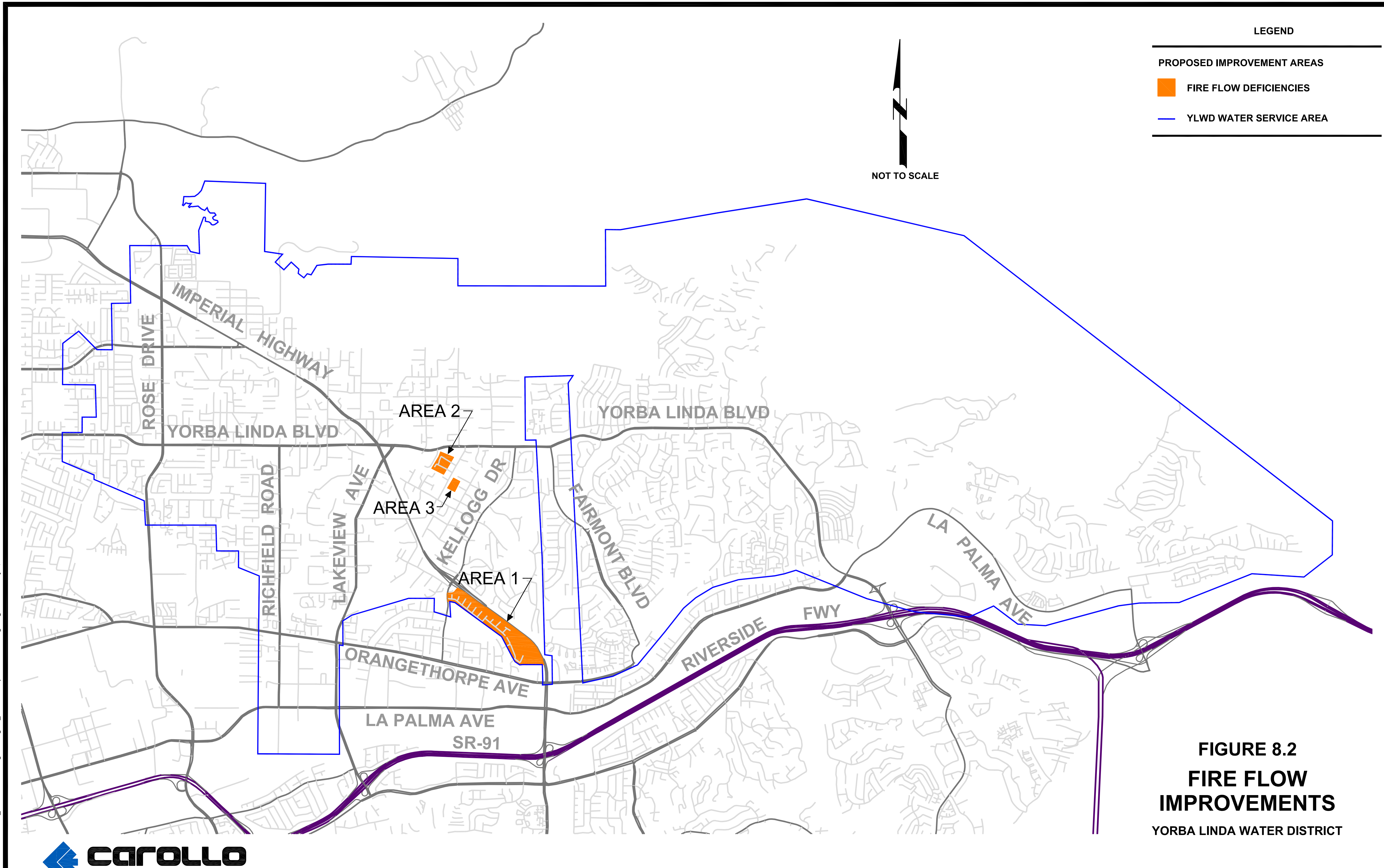


FIGURE 8.2

FIRE FLOW IMPROVEMENTS

YORBA LINDA WATER DISTRICT

An alternative may be available to serve this flow through an emergency interconnection with the City of Anaheim. However, modeling this interconnection to determine the actual fire flow available was beyond the scope of this study. The District should pursue this as a less expensive alternative to the recommended project in this master plan. If it is determined that sufficient fire flow can be provide through an emergency interconnection with the City of Anaheim, then this alternative should replace the recommended facilities in this master plan.

It may be feasible to construct an emergency interconnection with Anaheim to supply the balance of the needed fire flow to Zone 430 (1B) at a significantly reduced cost compared to the recommended alternative. The District should investigate this alternative along with Anaheim to determine the most cost-effective solution.

Additional hydraulic modeling indicated that Zone 570 (2) had sufficient pressure if a large enough pipeline was used to convey the water into Zone 430 (1B). This approach involves bringing a 12-inch pipeline down from Zone 570 (2) into the Zone 430 (1B) area, solely for fire protection purposes. Service connections would remain on the existing pipelines, but fire hydrants would be changed over to the new pipeline. The hydraulic computer model indicates that this will provide the required fire flow and pressure to the end of Cresthill Drive.

<u>Area 2</u>: The land use in the vicinity of Via Sereno is single family residential. The fire flow demand assigned for this land use was 1,500 gpm. The hydraulic computer model indicated that this flow rate could not be provided with a 20 psi residual pressure. After replacing the existing 6-inch pipe constructed in 1955 with a new 8-inch pipe, the model indicated that sufficient fire flow capacity would be available. Therefore, it is recommended that the existing 6-inch pipe in Via Sereno be replaced with new 8-inch pipe. The estimated length of this pipe replacement was 700 feet.

<u>Area 3</u>: The land use for the area south of Gordon Lane between Ohio Street and Grandview Avenue is single family residential. The fire flow demand associated with this land use is 1,500 gpm. According to the hydraulic computer model, a residual pressure of 20 psi could not be achieved. Replacing the existing 4-inch pipe constructed in 1956 with a new 8-inch pipe corrected this. The estimated length of this replacement pipeline is 350 feet.

Various improvements were proposed to correct the fire flow deficiencies identified above. Each proposed improvement was analyzed using the hydraulic computer model and evaluated for its effectiveness at improving fire flows relative to the costs. Table 8.5 lists the improvements recommended to correct the existing fire flow deficiencies and summarizes their estimated costs.

Table 8.5 **Estimated Costs for Recommended Fire Flow Improvements**
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Improvement	Length/Size	Estimated Project Cost[(1)]
1	Construct 500 lf of 12" replacement pipe in Kellogg Drive and 2,300 lf of new 12" pipe, and 1,300 lf of new 8" pipe in Cresthill Drive.	2,800 lf of 12" pipe 1,300 lf of 8" pipe	$504,000 156,000 $660,000
2	Construct 675 lf of 8" replacement pipe in Via Sereno from Ohio Street to Camino Verde.	700 lf of 8" pipe	$84,000 $84,000
3	Construct 350 lf of 8" replacement pipe south of Gordon Lane from Ohio Street to the east.	350 lf of 8" pipe	$42,000 $42,000
		Total Estimated Costs	**$786,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal, and administrative costs and a contingency.

8.8.2 System Pressures Analysis

The distribution system was analyzed to identify areas of the system that experienced pressures below 40 psi or above 125 psi (these criteria were identified in Chapter 2 of this report). Various scenarios were used to analyze system pressures under an array of conditions. For example, when a pumping station is running, the pressures downstream are increased while the pressures on the upstream side are decreased. During the hydraulic modeling analysis, it was noted that there were several conditions where increasing flows from a nearby booster station reduced the pressure on the suction side of the station below 40 psi. In other cases, simply the increased system demands resulted in the reduction in system pressures.

Low pressures can be corrected in several different ways. In some cases, the problem can be corrected with no physical improvement (such as by increasing the pressure setting of an upstream pressure regulating valve to resolve intermittent pressure problems), but frequently substantial improvements may be required. Improvements may include replacing older pipelines with larger diameter pipelines to reduce friction losses, construction of a new pumping station or pressure regulating station, or modifying the boundaries of a pressure zone. Where improvements had already been proposed by the District, such as pipeline replacements, these improvements were analyzed with the hydraulic computer model to evaluate their impact on the problem. Where there were no improvements proposed, alternatives were developed and analyzed using the hydraulic computer model.

Several areas of the system were identified as having low pressures (pressures below 40 psi) during average day, maximum day, or peak hour demand periods. Table 8.6 lists the areas with low pressures that were analyzed. These areas are also shown in Figure 8.3.

Table 8.6 Existing System Pressure Deficiencies
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Location	Pressure	Model Nodes
1	North of Yorba Linda Blvd between Fairmont Blvd and Yorba Ranch Road	<40 psi @ MDD	Numerous.
2	South of Yorba Linda Blvd along Paseo de las Palomas including: Calle Pera, Ave de los Reyes, Paseo Alto, Via Ingresso, and Paseo Rico	<36 psi @ ADD	Nodes: 2506, 2507, 2510, 2542, 2543, 2545, 2558, and 2579.
3	Midway along the following streets: Via Habana, Via Canarias, Via Trovador, Via Zaragoza, and Via Burgos	<40 psi @ ADD	Nodes: 2331, 2312, 2345, 2338, 2319, and 2330.
4	Feather Ave.	<35 psi @ MDD	Node: 2917.
5	Between Lakeview Avenue and Ohio Street, north of Oriente Avenue, and south of La Casita Avenue.	<40 psi @ MDD	Nodes: 1359, 1360, 1363, 1364, 1365, 1366, 1367, 1369, 1370, 1372, 1375, 1376, 1377, 1378, 1409, and 1414.
6	North of Vina Del Mar Avenue, south of Montevideo Avenue, east of Puerto Natales Drive, and west of (and including) Raintree Street	<40 psi @ ADD	Nodes: 374, 375, 376, 377, 378, 379, 380, 381, 3890, 396, 397, 398, 399, 413, 414, 415, 416, 417, 418, 4344, 4350, 4355, 470, 518, 519, 520, 861, and 862
7	Lakeview Avenue at Buena Vista Avenue and Via Arboleda.	<40 psi @ ADD	Nodes: 1324, 1325, 1299, 1308, and 1309.
8	Kellogg Drive south of Yorba Linda Boulevard to Old Ranch Road.	<40 psi @ ADD	Valves: V4081, V4091, V4101, and V4111

Area 1: This area sees low pressures much of the time. The District uses existing pressure reducing stations, located on Village Center Drive and San Antonio Road, to boost the pressure, but this an inefficient way to maintain adequate pressures. To correct this problem, the area should be moved into the higher pressure zone located just to the north. This will require construction of some new pipelines, opening some gate valves that are currently closed between the two zones, closing some existing gate valves that are currently open, and installing some new gate valves that would be normally closed.

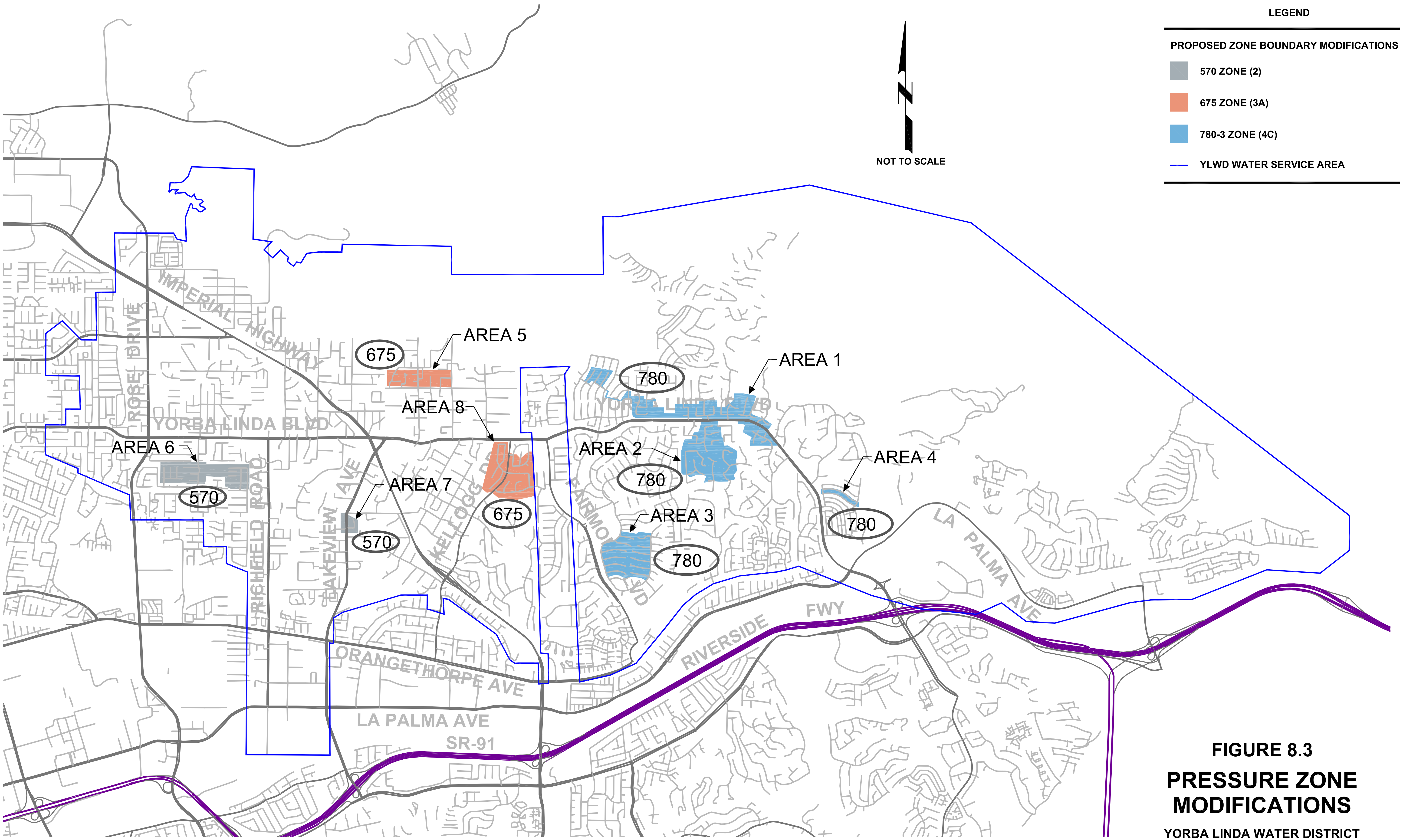


FIGURE 8.3
PRESSURE ZONE MODIFICATIONS
YORBA LINDA WATER DISTRICT

carollo engineers

H:\Client\YorbaLin_SAO\6853A00\Figures\Fig8-3_PressureZoneModifications.dwg <Figure8.3> May 2, 2005

In addition, since the pressure would be increased about 80 psi for most of the existing customers, these service connections would need to be retrofitted with individual pressure regulators. The hydraulic model indicates that the proposed modification would significantly reduce the amount of water needed from Zone 780 (4) to maintain the pressure in Zone 675 (3A).

Area 2: The area south of Yorba Linda Boulevard along Paseo de las Palomas has a similar problem to the previous area, but the proposed solution is different. This area can be isolated from the other pressure zones and served through a proposed pressure reducing station. This would create a new subzone between Zone 675 (3A) and Zone 780-3 (4C). The advantage to using a pressure reducing station to serve this area is that pressures can be maintained below 80 psi, which will avoid the need for individual pressure regulators on customer's homes. Sufficient pressure for normal operations and fire flows is provided. The proposed pressure reducing station would be located near the intersection of Yorba Linda Boulevard and Paseo de las Palomas. The proposed 12-inch pipeline in Yorba Linda Boulevard (included in the previous area) would be the source for the pressure reducing station. Normal pressures would be maintained between 40 and 80 psi. Installation of up to 10 gate valves was assumed to sufficiently isolate this area.

Area 3: The area that includes Via Habana, Via Canarias, Via Trovador, Via Zaragoza, and Via Burgos is a relatively high elevation for pressure Zone 675 (3A). Since low pressures are chronic in this area, increasing the hydraulic grade of the water serving the area is proposed. The new subzone proposed for the previous area would also provide adequate pressure for this area. The only difference is that the proposed 10-inch pipeline connecting the two areas would not provide enough fire flow capacity. To correct this, two check valves are proposed to provide additional flow and pressure from Zone 675 (3A). With the two check valves added, the hydraulic model indicates that all of the fire flow demands for this area can be provided. The facilities required to correct the pressure problems in this area include 4,300 feet of 10-inch pipe, 1,600 feet of 8-inch pipe, an estimated 10 new gate valves, and 2 check valves. Other existing gate valves would need to be closed to isolate this area from Zone 675 (3A). Individual pressure regulators will not be required.

Area 4: The pressure at node 2917 on Feather Avenue is shown to fall below 35 psi during maximum day demands. This pressure is based on an elevation of 567 feet. The street just to the north is on a higher pressure zone. To correct the pressure problems on Feather Avenue, it is proposed that Zone 780-3 (4C) be extended south to include Feather Avenue, which is currently served by Zone 675 (3A). It is expected that this zone reconfiguration can be accomplished by closing selected gate valves into Zone 675 (3A), opening selected gate valves into Zone 780-3 (4C), and installation of up to four new gate valves to isolate selected areas. Individual pressure regulators will be required on the services on Feather Avenue.

Area 5: This area is between Lakeview Avenue and Ohio Street, north of Oriente Avenue, and south of La Casita Avenue. Pressures are low here mainly due to the elevation of the area within Zone 570 (2) and the increased flow from the Palm Avenue Booster Station. The higher elevations within this area are at an elevation of about 467 ft-MSL. Since Zone 675 (3A) is located immediately north of this location, it is recommended that the pressure zone boundaries be modified to move this area from Zone 570 (2) into Zone 675 (3A). This will require about 1,300 feet of 8-inch pipe, approximately eighty (80) 1-inch pressure reducing valves, closing selected gate valves into Zone 570 (2), opening selected gate valves into Zone 675 (3A), installation of up to eight new gate valves to isolate selected areas, and one new 8-inch pressure reducing station. The pressure reducing station is proposed to help with intermittent pressure problems south of Oriente Avenue.

Area 6: The area bounded by Vina Del Mar Avenue, Carlsbad Street, and Yellowstone Avenue to the north, Puerto Natales Drive to the east, Montevideo Avenue and Collette Place to the south, and Raintree Street to the west is near the top of Zone 428 (1A). The higher elevations in this area are at 330 ft-MSL. Pressures drop below 40 psi during average day demand for the existing system and get worse in future years. There are two pressure reducing stations that regulate flow from Zone 570 (2) into this portion of Zone 428 (1A). With these valves set properly, adequate pressure can be maintained, but a significant amount of water is dropped from Zone 570 (2) into Zone 428 (1A), especially during maximum day demand periods. This not an efficient way to maintain pressures in this area. It is recommended that a new subzone be created for this area. The new subzone would be served by the two existing pressure reducing stations, one in Van Buren and the second in Jefferson Street, to avoid the need for individual pressure regulators on the service lines. Selected existing gate valves would need to be closed. It was assumed that up to 8 new gate valves may be required to complete the isolation of this new subzone. An 8-inch pressure reducing station is also proposed from this new subzone into Zone 428 (1A) to provide maximum day pressure for a short period of time (about 2 hours).

Area 7: The area along Lakeview Avenue from Buena Vista Avenue south to Via Arboleda have a chronic problem with system pressure. The elevation of these nodes is about 336 ft-MSL. Even with Highland Reservoir full and no head loss to this area, the static pressure would be less than 40 psi. Since Zone 570 (2) is adjacent to this area, it is recommended that an 8-inch pipeline be extended from Zone 570 (2) south along Lakeview Avenue to Via Arboleda. This will require approximately 600 ft of 8-inch pipe, about ten (10) 1-inch pressure reducing valves, closing selected gate valves into Zone 428 (1A), opening selected gate valves into Zone 570 (2), and one new 8-inch pressure reducing station. The pressure reducing station is proposed to help with intermittent pressure problems in Zone 428 (1A) south of Via Arboleda.

Area 8: The area on both sides of Kellogg Drive south of Yorba Linda Boulevard is served from Zone 570 (2) through an 8-inch pipeline in Kellogg Drive and through pressure reducing stations from Zone 675 (3A). When pressures drop in Zone 570 (2), this area relies on the pressure reducing stations to provide adequate pressure. Once the Palm Avenue Booster Station is upgraded (proposed for 2010), this area sees even lower pressures from Zone 570 (2) and requires more flow from the pressure reducing stations. In fact, to maintain adequate pressure to this area, the pressure reducing stations provide so much flow that up to 300 gpm flows south in Kellogg Drive into Zone 570 (2). To minimize the flow required from Zone 675 (3A), it is recommended that a check valve be installed in the 8-inch pipe in Kellogg Drive south of Old Ranch Road. This still allows Zone 570 (2) to serve this area when there is adequate pressure while minimizing the flow through the pressure reducing stations.

Table 8.7 lists the estimated costs for the recommended facilities to mitigate the existing pressure deficiencies in the water system.

Table 8.7 Estimated Costs for Recommended Facilities to Improve System Pressure
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Improvement	Size/Length	Estimated Project Costs[1]
1	Reconfigure Zone 780-3 (4C) to include areas that are currently in Zone 675 (3A) (north of Yorba Linda Boulevard)	3,600 lf of 12” pipe 1,600 lf of 8” pipe 10 - 8” GV 300 - 1” PRVs	$648,000 192,000 80,000 150,000 $1,070,000
2	Create a subzone using a proposed pressure reducing station to serve the area south of Yorba Linda Boulevard - Assumes area 1 is also improved.	10 - 8” GV 1 - 8” PRS	$80,000 150,000 $230,000
3	Extend the proposed new subzone to this area - Assumes areas 1 and 2 are also improved.	4,300 lf of 10” pipe 1,600 lf of 8” pipe 10 - 8” GV 2 - 8” CV	$645,000 192,000 80,000 16,000 $933,000
4	Reconfigure Feather Avenue from Zone 675 (3A) to Zone 780-3 (4C).	4 - 8” GV 14 - 1” PRVs	$32,000 7,000 $39,000
5	Reconfigure Zone 675 (3A) to include areas that are currently in Zone 570 (2). Also, construct a PRS where Ohio Street crosses Oriente Avenue.	1,300 lf of 8” pipe 8 - 8” GV 80 - 1 PRV 1-8” PRS	$156,000 64,000 40,000 150,000 $410,000

Table 8.7	Estimated Costs for Recommended Facilities to Improve System Pressure 2005 Domestic Water System Master Plan Yorba Linda Water District		
Area	**Improvement**	**Size/Length**	**Estimated Project Costs(1)**
6	Create a new subzone between Zone 570 (2) and Zone 428 (1A) using the Van Buren and Jefferson Street pressure reducing stations and closing selected gate valves.	10 - 8" GV 1-8" PRS	$80,000 150,000 $230,000
7	Extend Zone 570 (2) south along Lakeview Avenue from Buena Vista Avenue to Via Arboleda. Construct an 8" pressure reducing station at Lakeview Avenue and Buena Vista Avenue.	600 lf of 8" pipe 10 - 1" PRV 1-8" PRS	$72,000 5,000 150,000 $227,000
8	Install a check valve on the 8" pipeline in Kellogg Drive just south of Old Ranch Road to prevent water from moving south.	1 - 8" CV	$20,000 $20,000
		Total Estimated Costs	**$3,159,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal, and administrative costs and a contingency.

As shown in Table 8.5, the estimated cost to correct all of the District's pressure problems is about $3,139,000. These improvements would increase pressure in areas where low pressures have been a problem and improve system operations by reducing the amount of water needed from higher-pressure zones.

8.8.3 Operational Analysis

Operational improvements were considered where these would help maximize the District's use of groundwater and minimize pumping of water while maintaining the minimum pressure criteria (40 psi) established earlier. In general, this means that water should only be pumped once and that water in a higher pressure zone should not be used as a supply for a lower pressure zone, unless it is the only source.

Since MWD water enters the District's system in Zone 780 (4), it is best used in Zones 780 (4) and above. Groundwater, on the other hand, enters the system near the bottom in Zone 428 (1A). Therefore, groundwater can be most efficiently used in the lower zones. The existing maximum day demands in Zones 428 (1A), 430 (1B), 570 (2), and 675 (3A) total about 14,000 gpm. This is nearly equal to the District's existing groundwater production capacity. Therefore, this analysis focused on maximizing the use of groundwater to Zones 675 (3A) and below while taking advantage of the higher hydraulic grade of MWD water for Zones 780 (4) and above.

The areas identified and analyzed using the hydraulic computer model are summarized in Table 8.8.

Table 8.8 Existing Operational Deficiencies
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Location	Model Nodes/Valves/Pumps
1	Richfield Plant Groundwater Production.	Pumps: W6001, W6005, W6009, W6010, and W6012.
2	Transmission capacity from Highland Booster Station into Bastanchury Reservoir.	N/A
3	Bastanchury Booster Pumping Station.	Pumps: BP6031, BP6032, and BP6033
4	Bastanchury Road Zone 675 (3A) Transmission Main.	N/A
5	Palm Avenue Booster Pumping Station.	Pump: BP6021
6	Zone 780-1 (4A) to 780-2 (4B) Transmission Main in Bastanchury Road and Lakeview Avenue.	N/A
7	Zone 675 (3A) transmission main in Bastanchury Road east to Fairmont Blvd.	N/A
8	Zone 780-2 (4B) to 780-3 (4C) Transmission Main in Bastanchury Road east to Fairmont Blvd.	N/A
9	Zone 570 (2) east of Paseo del Prado.	Pipe: 24045
10	Fairmont Blvd south of Fairmont Booster Station.	Pipe: 28347
11	Quarterhorse Reservoir.	Tanks: R5009 and R5009B

Area 1: Groundwater production is one of the District's most important assets. It provides the least expensive water available to the District and is highly reliable. In recent years, the capacity of several of the existing wells has dropped off due to lower levels in the groundwater basin. Several options are available to restore the capacity of these wells and one or more may be required for each well: add an additional stage (pump bowl) to the existing pump, lower the bowls below the pumping water level, and/or replace the pump with a higher head pump. The wells designated for capacity restoration include: Well No. 1, Well No. 5, Well No. 10, and Well No. 12. A budgetary estimate of $250,000 per well was established for each of these wells.

In addition to losing well capacity, Well No. 9 needs to be replaced. The well should be replaced with a new well constructed to the District's standards. The estimated cost of a new well at the Richfield Plant is $2,000,000. The combined capacity of all of the District's groundwater production wells should be about 16,000 gpm for 2005 and 16,500 gpm by 2020.

Area 2: Upgrades to the Highland Booster Station should be completed in 2005. The new capacity will help convey groundwater from Zone 428 (1A) into Zone 570 (2). The booster station upgrades also rely on the construction of a 30-inch transmission main from Highland Booster Station to Bastanchury Reservoir. Based on the results of the hydraulic modeling, this transmission main should be connected to the distribution system at Yorba Linda Boulevard, Lemon Drive, Oriente Drive, and at Bastanchury Road. Connections at these locations help maintain system pressures in the distribution system while still allowing the Bastanchury Reservoir to be filled. At the time of this master plan report, it was noted that the design had already been completed for the transmission main and that the alignment used in the hydraulic model was based on the completed design. Therefore, the alignment of this pipeline was not reviewed. However, the District may want to review the alignment based on the hydraulic requirements needed to move water toward the Palm Avenue Booster Station.

Area 3: The Bastanchury Booster Station pumps water from Zone 570 (2) into Zone 675 (3A). The existing station has a capacity of 2,300 gpm from two (2) electric pumps and one (1) natural gas driven pump. The District's Five Year Plan proposes a 2,000 gpm upgrade to the existing station. To maximize the use of groundwater, the capacity of this station should be increased to 5,000 gpm. To facilitate this additional capacity, the proposed 12-inch pipeline in the proposed expansion of Lakeview Avenue is also required. This pipeline will provide a better connection between Valley View Reservoir and the majority of Zone 675 (3A). However, the hydraulic computer model indicates that Valley View Reservoir will fill up long before Fairmont Reservoir. To help distribute the flow of water into both reservoirs, a hydraulically operated valve is recommended in the proposed 12-inch pipeline just west of the Bastanchury Booster Station. This proposed valve would close when Valley View Reservoir is nearly full and not open again until the level has dropped several feet. This will promote the exchange of fresh water into Valley View Reservoir. This type of valve is preferred over an altitude valve located at the reservoir because the altitude valve would not promote the exchange of fresh water into the reservoir.

Area 4: To help convey water in Zone 675 (3A) to the east, a pipeline is proposed from Lakeview Avenue to the existing 18-inch pipeline in the proposed Bastanchury Road extension through the Pulte Development. Based on the hydraulic analysis, an 18-inch pipeline is recommended. This will require construction of about 3,200 lf of 18-inch pipeline.

Area 5: The Palm Avenue Booster Station pumps water from Zone 570 (2) into Zone 675 (3A). Its single electric pump is currently rated at 1,250 gpm. the District's Five

Year Plan proposes to upgrade this station to 3,000 gpm. Based on the hydraulic modeling results, a capacity of 4,500 gpm is needed to reduce Zone 675's (3A) dependency on higher-pressure zones to maintain adequate pressures. Although the Bastanchury Booster Station also pumps from Zone 570 (2) into Zone 675 (3A), it provides most of its supply in the north west corner of the zone. On the other hand, the Palm Avenue Booster Station provides its supply along Yorba Linda Boulevard near where the pressure reducing stations are located. By increasing the pressure at this location, the pressure reducing stations are not needed to maintain adequate pressure in Zone 675 (3A).

In addition to the booster station improvements, pipeline improvements are also required to allow increased capacity in the Palm Avenue Booster Station. These pipeline improvements include a new pipeline parallel to the existing pipeline in Yorba Linda Boulevard between Lakeview Avenue and the Palm Avenue Booster Station. A 24-inch pipeline is proposed to reduce the pressure drop in Zone 570 (2) from the increased flow. From the Palm Avenue Booster Station to the existing 16-inch pipeline east of Fairmont Boulevard, a 24-inch pipeline is proposed. At this point, the pipeline reduces to 20-inch and continues on to Village Center Drive.

<u>Area 6</u>: Pressure Zone 780 (4) is currently separated into four hydraulically separate pressure zones. With the future development of planned projects, Zones 780-1 (4A) (served by Gardenia Reservoir and OC-51), 780-2 (4B) (served by oc-89 but no reservoir), and 780-3 (4C) (served by Springview Reservoir and OC-66) will be connected and function as one pressure zone by the year 2010. The pipeline that connects Zone 780-1 (4A) and 780-2 (4B) is planned for 2005. This pipeline includes 8,600 lf of 36-inch transmission main in the proposed Bastanchury Road and Lakeview Avenue extensions. It would connect to the existing 36-inch transmission main in Bastanchury Road at the east end and to the existing 36-inch transmission main in Lakeview Avenue east of Jeffrey Drive at the west end. This pipeline is recommended to connect the Zone 780 (4) pressure zones and to allow MWD water from the OC-51 connection to be conveyed to the east.

<u>Area 7</u>: Zone 675 (3A) is divided hydraulically between the area east of Fairmont Blvd and west of Fairmont Blvd. There are only two (2) existing 12-inch pipelines connecting the east side to the west side. To improve the use of groundwater in this pressure zone, more hydraulic capacity is required. Extension of the existing 18-inch transmission main in Bastanchury Road (near White Pine Lane east to Fairmont Blvd where it connects to the existing 27-inch that feeds into Fairmont Reservoir) is recommended. The timing of this 3,500 lf pipeline is dependant on the development of Bastanchury Road through the Shapell Development and is currently scheduled to be completed in 2008.

<u>Area 8</u>: Pressure Zones 780-2 (4B) and 780-3 (4C) are not hydraulically connected. Extension of the existing 36-inch pipeline in Bastanchury Blvd would connect these two zones. This connection is important for several reasons: 1) it provides Zone 780-2 (4B) with storage capacity from Zone 780-3 (4C), 2) it allows MWD supplies from OC-51 and OC-89 to be conveyed into Zone 780-3 (4C), and 3) it provides another supply source to

Zones 780-1 (4A) and 780-2 (4B). Extension of the existing 36-inch transmission main in Bastanchury Road (near White Pine Lane east to the existing 12-inch in Fairmont Blvd) is recommended. At the east end of this 3,500 lf transmission main, a tie-in to the existing 39-inch transmission main in Fairmont Blvd is also recommended. The timing of this pipeline is dependant on the development of Bastanchury Road through the Shapell Development and is currently scheduled to be completed in 2008.

Area 9: The area of Zone 570 (2) east of Paseo del Prado depends heavily on the pressure reducing stations that allow water to flow from Zone 675 (3A) into this area. To maintain adequate pressure in this area, the pressure reducing stations frequently provide more flow than is required for the demands alone. This was observed in the model as water in the 12-inch pipeline in Esperanza Road flowed westerly. To improve efficiency in the system, it is preferred that flow through these pressure reducing stations is minimized. To limit the flow through these stations to the demands in the area identified, the pipe just west of Paseo del Prado was closed in the model. This reduced flow through the pressure reducing stations and pressures remained adequate.

Area 10: The pipeline that conveys water south from the Fairmont Booster Station is an existing 12-inch pipeline. This ends up being a bottleneck for water being pumped from Zone 675 (3A) into 780-3 (4C). A parallel pipeline is proposed from the station south to the existing 39-inch transmission main about 500 feet south of the station. An interconnection with the existing 12-inch pipeline is also proposed at this point.

Area 11: The Quarterhorse Reservoir expansion will provide 7.25 MG of storage, most of which should be allocated to emergency storage. To utilize this emergency storage in the higher pressure zones, a booster station is proposed near the existing Fairmont Booster Station. The Zone 5 Booster Station would pump water from Zone 920 (5A) into Zone 1000 (5B) where it could be pumped even higher. The proposed capacity of this station is 1,650 gpm. A pipeline is also proposed from the existing 16-inch pipeline near the reservoir to the proposed location of the Zone 5 Booster Station near the existing Fairmont Booster Station. The length of this proposed 12-inch pipeline is about 1,500 feet.

The estimated costs for the recommended facilities to improve water system operations are summarized in Table 8.9.

Table 8.9 Estimated Costs for Recommended Facilities to Improve Operations
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Improvement	Size/Length	Estimated Project Costs[1]
1	Groundwater Capacity Restoration. Maintain a minimum groundwater production capacity of about 16,000 gpm through capacity restoration projects of the District's existing wells and a proposed new well to replace Well No. 9.	2,000 gpm well 4 - capacity restoration	$2,000,000 1,000,000 $3,000,000
2	Zone 2 (Zone 570) transmission main from Highland Booster Station to Bastanchury Reservoir.	9,500 lf of 30" pipe	$4,275,000 $4,275,000
3	Bastanchury Booster Station Upgrade. Zone 3A (Zone 675) pipeline in proposed extension of Lakeview Avenue (SWEPI).	3,000 gpm BPS 4,400 lf of 12" pipe 1 - 12" control valve	$1,086,000 792,000 150,000 $2,028,000
4	Construct 3,200 lf of 18" pipeline in the proposed extension of Bastanchury Road from Lakeview Avenue east to the existing 18" pipeline.	3,200 lf of 18" pipe	$864,000 $864,000
5	Palm Avenue Booster Station Upgrade. Includes pressure reducing station and new parallel pipeline in Yorba Linda Blvd.	4,500 gpm BPS 7,500 lf of 24" pipe 3,400 lf of 20" pipe 1 - 8" PRS	$1,477,000 2,700,000 1,020,000 150,000 $5,347,000
6	Construct 8,600 lf of 36" transmission main in the proposed Bastanchury Road and Lakeview Avenue extensions to connect Zone 780-1 (4A) to Zone 780-2 (4B).	8,600 lf of 36" pipe	$4,644,000 $4,644,000
7	Construct 3,500 lf of 18" transmission main in the proposed Bastanchury Road extension from White Pine Lane to Fairmont Blvd.	3,500 lf of 18" pipe	$945,000 $945,000
8	Construct 3,500 lf of 36" transmission main in the proposed Bastanchury Road extension to connect Zone 780-2 (4B) to Zone 780-3 (4C).	3,500 lf of 36" pipe	$1,890,000 $1,890,000
9	Close the gate valve in the water main on Esperanza Road west of Paseo del Prado.	None	None
10	Construct 500 lf of 24" pipeline from the Fairmont Booster Station south to the existing 39" pipeline.	500 lf of 24" pipe	$180,000 $180,000

Table 8.9 Estimated Costs for Recommended Facilities to Improve Operations
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Improvement	Size/Length	Estimated Project Costs[1]
11	Construct a Zone 5 booster station to pump 1,650 gpm from Zone 920 (5A) into Zone 1000 (5B). Also requires 1,500 lf of 12" pipe to provide water from Quarterhorse Reservoir near Fairmont Booster Station.	1,650 gpm BPS 1,500 lf of 12" pipe	$690,000 270,000 $960,000
		Total Estimated Costs	**$24,133,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal, and administrative costs and a contingency.

8.8.4 Development Driven Facilities

Most of the remaining undeveloped lands left in the District's service area are along the north edge in the higher pressure zones. Most of the facilities required to provide water service to these proposed development projects is either already in place or will be constructed by the developer when the project is built. This primarily involves the construction of pipelines and in some cases additional storage facilities. One exception to this is the Pacific Holding Development.

The Pacific Holding Development (Murdock Property) does not have existing storage or pumping capacity to utilize. However, since this proposed development project is within Improvement District No. 1, the District is obligated to provide backbone facilities. Based on the projected water demands for this development, 409-gpm ADD and 605-gpm MDD, a 4.0-MG reservoir, a 900-gpm booster station, and about 10,000 feet of 12-inch backbone transmission main will be required. The estimated project costs for the booster station are $436,000. The pipeline is estimated to have a project cost of $1.8 million. The project costs for the proposed reservoir are estimated at $6.0 million (see Chapter 10 for cost assumptions). Table 8.10 summarizes these development driven facility costs.

Table 8.10 Estimated Costs for Development Driven Improvements
2005 Domestic Water System Master Plan
Yorba Linda Water District

Area	Improvement	Length/Size	Estimated Project Cost[1]
1	Pacific Holding Development (Murdock Property)	10,000 lf of 12-inch pipe 900-gpm BPS 4.0-MG reservoir[2]	$1,800,000 436,000 6,000,000 $8,236,000
		Total Estimated Costs	**$8,236,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal, and administrative costs and a contingency.
(2) See Chapter 10 for additional cost assumptions regarding the proposed reservoir.

8.9 2005 DISTRIBUTION SYSTEM RESULTS

Based on the hydraulic analysis for the year 2005, there are no additional facilities recommended. The demands for 2005 increased slightly over the existing system analysis. Average day demands increased by 419 gpm to 14,447 gpm. The maximum day demands increased by 621 gpm to 21,382 gpm. These simulations incorporated pipeline replacements already proposed in the District's Five Year Plan. These include the following pipeline improvements:

- Bastanchury Road between Imperial Highway and Rose Drive.
- Buena Vista Avenue between Lakeview Avenue and Grand View Avenue.
- Ohio Street south of Buena Vista Avenue.
- Grand View Avenue between Mountain View Avenue and Parkwood Drive.

8.10 2010 DISTRIBUTION SYSTEM RESULTS

The hydraulic analysis for the year 2010 did not result in additional recommendations. The demands increased slightly over 2005 demands. The average day demands for 2010 were 15,651 gpm, an increase of 1,204 gpm. The maximum day demands increased by 1,781 gpm to a total of 23,163 gpm.

All of the recommended facilities were given installation dates of 2010 or before, so these simulations included all of the facilities recommended in this master plan, all of the pipeline replacements proposed by the District, and all of the planned development projects. The results indicate that the District's water system meets all of the pressure and fire flow criteria, maximizes the use of groundwater, and improves system operations.

8.11 2020 DISTRIBUTION SYSTEM RESULTS

There were no additional recommendations from the analysis of the District's 2020 water system. Demands for 2020 increased slightly from 2010. The average day demands increased to 16,192 gpm. This is an increase of about 15 percent from existing demands. The maximum day demands increased to 23,964 gpm.

The 2020 computer model represents the best approximation of build-out for the District that can be made at this time. The facilities proposed include all of the facilities in the 2010 analysis, but with slightly higher demands for 2020. The results of these simulations indicate that the District's water system meets all of the pressure and fire flow criteria, maximizes the use of groundwater, and improves system operations.

Chapter 9

WATER QUALITY

9.1 INTRODUCTION

An important purpose of the District’s domestic water system is to provide consumers with high quality water that meets all government regulations. To this end, it is important to consider current and future water quality issues when developing a long term planning document for the District’s system. Prior to developing this portion of the Master Plan, the District conducted a meeting with Carollo to discuss current water quality concerns in the water system, as well as current operational practices that may affect water quality. The District noted that they have very few water quality problems in their system, but identified a few areas of concern based on pending water quality regulations, recent or pending changes in MWD’s operations, and potential local environmental groundwater pollution.

9.2 CHAPTER OBJECTIVES

The objectives of this chapter are to:

- Summarize the quality of the District’s existing sources of supply and potential water quality concerns associated with these sources.
- Highlight the current and pending water quality regulations that affect the District’s domestic water system.
- Summarize the District’s current water quality monitoring practices.
- Identify any water quality concerns associated with future water supply sources and the distribution system.
- Summarize current programs the District has in place to improve water quality.
- Develop recommendations to improve water quality throughout the District’s system.

9.3 WATER QUALITY OBJECTIVES

Traditionally, southern Californians are highly concerned about water quality issues. One of the important elements of the District’s mission is to provide “… water that meets or exceeds all local, state, and federal standards.” The water distributed in the District’s system does comply with all existing water quality regulations, including those pertaining to the aesthetic characteristics of taste, odor, and color.

9.4 EXISTING SOURCES OF SUPPLY

The District imports treated surface water from MWD and pumps groundwater from the lower Santa Ana groundwater basin. Approximately half of the total water demand is supplied by groundwater, and the remaining half is supplied by imported water. Each year, the District compiles and distributes a Consumer Confidence Report, summarizing the water quality from the District's sources and distribution system. The District's 2003 Consumer Confidence Report verified that both sources of supply complied with all current drinking water regulations during 2002.

9.4.1 Groundwater Supply

In general, the District's groundwater wells produce high quality drinking water that meets or exceeds current drinking water regulations. However, the District is aware that upcoming regulations or changes in the conditions of the groundwater basin may make it more difficult to achieve the District's water quality goals. In particular, the District has occasionally detected methyl tertiary butyl ether (MTBE), pesticides (atrazine and simazine), coliphage, arsenic, manganese, and radon in the groundwater basin or at one of the District's wells. The levels of these constituents that are present in the distribution system are safely below current water quality standards (see the District Consumer Confidence Report). However, more-stringent regulations or an increase in the presence of these compounds may require the District to treat the existing groundwater supply.

Throughout the Santa Ana Groundwater Basin, the groundwater typically has high hardness and total dissolved solids (TDS). The District has noted that water from its groundwater wells, which is pumped from this basin, is characteristically high in hardness and TDS. Although this may present aesthetic concerns to some customers, it does not pose any health risk to consumers. Treating groundwater to reduce TDS will concurrently reduce hardness, but TDS treatment options are typically very costly. In addition, TDS treatment may create disposal problems for the District. OCSD, which treats wastewater from the District's service area, establishes limits on the total chloride loads that will be accepted from each service area. If the District treats the well water at the source, disposal of the concentrated brine solution into the sanitary sewer may exceed the allowable chloride limits imposed by OCSD. Therefore, point-of-entry (POE) devices installed at consumers homes may provide a more feasible solution to any customer complaints regarding hardness and TDS.

The District currently does not treat its well water, but disinfects it with sodium hypochlorite before distributing the water to consumers. All of the wells at the Richfield Plant discharge into a common pipeline, and the water from the off-site wells is pumped to the Richfield Plant into the same pipeline. The well water in the transmission pipeline is disinfected with 0.8 percent sodium hypochlorite generated onsite at the Richfield Plant. The District does not add fluoride to the well water. The locations of the District's groundwater wells are shown in Figure 5.1 (see chapter 5).

9.4.2 Imported Water Supply

The water imported from MWD is surface water that MWD treats at one of its treatment facilities before distributing it to the District and other water agencies. MWD is responsible for treating this water to meet all federal, state, and local regulations. Nevertheless, treatment technologies or chemicals that MWD uses may affect the way the treated water interacts with the groundwater in the District's system. MWD disinfects its treated water with chloramines. In the near future, MWD plans to add fluoride to the distributed water for the associated dental benefits. The implications of these two practices will be addressed in later sections of this chapter.

Water distributed by MWD meets all current water quality regulations. Pending regulations, however, may require MWD to perform additional treatment to remove new constituents from the water supply. Specifically, perchlorate has been detected in MWD's water supply. Additional information regarding perchlorate is provided below. Figure 5.1 (see Chapter 5) identifies the locations of the District's potable water import connections.

9.4.3 Treatment of Existing Supplies

Both of the District's existing water supply sources provide water that meets current federal, state, and local regulations without requiring treatment by the District (disinfection is not considered treatment). The District does not own or operate any existing treatment facilities. In addition, the District does not currently have the staff, operational experience, or equipment (such as laboratories or treatment plant monitoring equipment) for operating and maintaining treatment facilities. Therefore, if upcoming regulations require the District to treat its water supplies, this could require a substantial capital investment and operating budget.

9.5 FUTURE SOURCES OF SUPPLY

The District plans to continue using groundwater from the lower Santa Ana basin and treated surface water imported from MWD to meet the water system demands. Therefore, new sources would likely include new groundwater wells and/or additional connections to MWD's system. These future sources of supply are likely to encounter the same water quality problems that the District faces with its current sources of supply. The water quality regulations and monitoring practices that apply to these new sources should be similar, if not identical, to those for the current water supply sources, unless the current regulations change. Additional regulations may be imposed on the District in the future that impact all of the District's sources of supply.

The District has recently constructed a pipeline from Well 15 to the Richfield Plant to facilitate blending and possible future treatment of the well water at a central location. The Richfield Plant currently has sufficient land available to construct treatment facilities. If new wells are constructed near the Richfield Plant, piping to the Richfield Plant may reduce the amount of land required for the new well facilities. If new well sites are constructed further away, the District should consider purchasing enough land to allow room for future treatment facilities. Wells with possible water quality concerns include:

- Well 5 - Coliphage.
- Well 15 - Arsenic and Manganese.

Pending regulations that may impose treatment requirements for the District's groundwater supply are discussed in the following section. In particular, the District expressed interest in identifying possible treatment technologies for arsenic removal, since proposed regulations will significantly reduce the arsenic maximum contaminant level (MCL). There are a number of treatment alternatives available for removing arsenic. These include coagulation filtration (media or membrane), disposable media (Granular Ferric Hydroxide, Granular Ferric Oxide, Activated Alumina (AA), and other catalyzed media), regenerable media (AA and iron coated AA), regenerable ion exchange (conventional or MIEX), and membrane (electrodialysis reversal, nanofiltration, or reverse osmosis). Selection of the most practical process will depend on various criteria, including available waste management options, water quality, site limitations, and costs.

9.6 REGULATORY REQUIREMENTS

Existing and future regulatory requirements may impact the District's water supply sources, treatment requirements, and system operations. The following section presents brief descriptions of the current and future drinking water regulations. Regulatory information and framework contained in this document is current to February 2005.

Table 9.1 presents the list of potential constituents that the District identified as a particular concern, and more detail is presented for each of them in the following subsections. As described previously, many of these contaminants have been identified at low levels in the District's or MWD's source water. Table 9.1 identifies the current and pending regulations that govern these contaminants. The regulations themselves and the enforceable or recommended limits are discussed in more detail in the following sections.

There are currently no regulations for coliphage (one of the constituents identified as a concern by the District) in finished drinking water, as they are nonpathogenic. Therefore, the District is not in violation of any regulations if coliphage is detected in the well water or distribution system. However, the detection of coliphage may indicate the presence of viruses. If these viruses are pathogenic, this could have a significant public health impact. There are currently no MCLs pertaining to viruses, but there are disinfection requirements for viruses in the Surface Water Treatment Rule and the Interim Enhanced Surface Water Treatment Rule for systems that use surface water or groundwater under the direct influence of surface water. Specific pathogenic viruses are addressed in the Contaminant Candidate List and the Unregulated Contaminant Monitoring Rule, so they may be regulated in the near future.

Table 9.1 Contaminants of Concern
2005 Domestic Water System
Yorba Linda Water District

Contaminant	Regulation
Arsenic	Primary Drinking Water Standards Arsenic Rule
Atrazine	Primary Drinking Water Standards
Coliphage	No Regulations Identified
Fluoride	Primary Drinking Water Standards Secondary Drinking Water Standards California Safe Drinking Water Act
Manganese	CDHS Notification Levels Secondary Drinking Water Standards
Methyl tertiary butyl ether (MTBE)	Primary Drinking Water Standards (CA Title 22) Secondary Drinking Water Standards USEPA Contaminant Candidate List Federal Unregulated Contaminant Monitoring Rule
Perchlorate	CDHS Notification Levels USEPA Contaminant Candidate List Federal Unregulated Contaminant Monitoring Rule
Radon	Radon Rule
Simazine	Primary Drinking Water Standards
TDS	Secondary Drinking Water Standards

9.6.1 Regulatory Background

The Safe Drinking Water Act (SDWA) of 1974 established primary drinking water regulations designed to ensure the distribution of safe drinking water. These regulations were the first to be implemented at all public water systems in the United States, covering both chemical and microbial contaminants. These regulations consisted of standards for 18 parameters, referred to as the National Interim Primary Drinking Water Regulations. They remained in place for over 10 years with minor revisions, including a revised fluoride standard, addition of total trihalomethanes standard, and interim regulations for radionuclides in potable water.

In 1986, Congress passed widespread amendments to the SDWA. The 1986 amendments significantly altered the rate at which the USEPA was to set drinking water standards, resulting in a 3-fold increase in the number of contaminants regulated. Also, at that time, the national interim and revised primary drinking water regulations promulgated prior to 1986 were redefined as National Primary Drinking Water Regulations.

The SDWA gives the USEPA authority to delegate primary enforcement responsibilities, or primacy, to individual states. To maintain authority to enforce drinking water regulations under the SDWA, a state must adopt drinking water regulations at least as stringent as the federal standards.

9.6.2 Existing Regulations

The USEPA establishes federal regulations for drinking water quality. The following existing federal drinking water regulations are relevant to the District's water supplies:

- National Primary and Secondary Drinking Water Regulations.
- Radionuclides.
- Lead and Copper Rule.
- Stage 1 Disinfectants/Disinfection By-Products Rule.
- Surface Water Treatment Rule.
- Total Coliform Rule.
- Interim Enhanced Surface Water Treatment Rule.

Within the state of California, the California Department of Health Services (CDHS) enforces drinking water regulations. These regulations are contained in Title 22 of the California Code of Regulations (CCR). The review of regulations included discussions with Cor Shaffer, the District Engineer for the Santa Ana Drinking Water Field Operations Branch of CDHS, to identify the differences between federal and state drinking water regulations.

9.6.2.1 Primary and Secondary Drinking Water Regulations

The National Primary Drinking Water Regulations (NPDWRs) are currently set for 92 contaminants, including turbidity, 8 indicator microorganisms, 4 radionuclides, 19 inorganic contaminants, and 60 organic contaminants. MCLs and maximum contaminant level goals (MCLGs) have been set for 83 contaminants, and 9 other contaminants have treatment technique requirements. CDHS has established more stringent MCLs for some of these contaminants. In addition, CDHS has established MCLs for additional contaminants that are not regulated under the federal requirements. The CDHS regulations take priority over the federal regulations.

Table 9.2 presents the federal and state MCLs for many of the contaminants identified as a potential concern by the District, as well as the non-enforceable secondary standards for these contaminants (where applicable). CDHS has established more stringent requirements than the federal standard for atrazine and fluoride. Fluoride regulations are discussed in detail in a later subsection. Although there is currently not a federal MCL established for MTBE, CDHS does regulate this contaminant. The state MCL is identified in Table 9.2. The federal MCL for arsenic was lowered in 2001 and CDHS is in the process of establishing a new MCL. The future arsenic MCL is discussed in more detail under future regulations.

Table 9.2 Selected Primary and Secondary Drinking Water Regulations
2005 Domestic Water System Master Plan
Yorba Linda Water District

Contaminant	Federal Primary MCL	CDHS Primary MCL	Federal Secondary Standard	CDHS Secondary MCL	MCLG	PHG
Arsenic(1)	0.010 mg/L	0.05 mg/L	NA	NA	0 mg/L	4 ng/L
Atrazine	0.003 mg/L	0.001 mg/L	NA	NA	0.003 mg/L	0.00015 mg/L
Fluoride	4.0 mg/L	2.0 mg/L	2.0 mg/L	NA	4 mg/L	1 mg/L
Manganese	NA	NA	0.05 mg/L	0.05 mg/L	NA	NA
MTBE	NA	0.013 mg/L	0.005 mg/L	0.005 mg/L	NA	0.013 mg/L
Simazine	0.004 mg/L	0.004 mg/L	NA	NA	0.004 mg/L	0.004 mg/L
TDS	NA	NA	500 mg/L	500-1,500 mg/L(2)	NA	NA

Notes:
(1) The federal MCL requires public water supplies to reduce arsenic to 0.010 mg/L by 2006. CDHS is in the process of adopting a new MCL for arsenic.
(2) Recommended Secondary MCL = 500 mg/L; Upper limit = 1,000 mg/L; Short-term limit = 1,500 mg/L.

Federal secondary standards are recommended for 15 contaminants to ensure aesthetic quality of drinking water. Because the federal standards deal primarily with taste and odor, rather than health issues, they are often used only as a guideline. However, CDHS has adopted secondary standards that are enforceable for 16 contaminants. CDHS uses a tiered approach to address violations of secondary MCLs (SMCL), addressing violations that may pose health concerns before they address violations of aesthetic requirements. CDHS has proposed revisions to the current compliance requirements for secondary standards. These revisions are still in draft format.

The federal SMCLs for manganese and MTBE are identical to the state SMCLs. The state has not established a SMCL for fluoride. CDHS has established a SMCL range for TDS, with a recommended SMCL of 500 mg/L, an upper limit of 1,000 mg/L, and a short-term limit of 1,500 mg/L. The federal secondary standard for TDS is 500 mg/L.

9.6.2.2 Radionuclides

On December 7, 2000, the USEPA announced updated standards for radionuclides. This rule became effective on December 8, 2003. CDHS adopted the MCLs shown in Table 9.3 for radionuclides.

Table 9.3 CDHS Radionuclide Regulations
2005 Domestic Water System
Yorba Linda Water District

Constituent	MCL (pCi/L)
Combined Radium-226 and Radium-228	5
Gross Alpha Particle Activity (including Radium-226 but excluding radon and uranium)	15
Tritium	20,000
Strontium-90	8
Gross Beta Particle Activity	50
Uranium	20

9.6.2.3 Lead and Copper Rule

The USEPA has made minor changes to the Lead and Copper Rule (also known as the Lead and Copper Rule Minor Revisions (LCRMR)) to streamline requirements, promote consistent national implementation, and in many cases, reduce the burden on water systems. The LCRMR does not change the action levels of 0.015 mg/L for lead and 1.3 mg/L for copper, or MCLGs established by the 1991 Lead and Copper Rule, which are 0 mg/L for lead and 1.3 mg/L for copper. The LCRMR does not affect the rule's basic requirements to optimize corrosion control and, if appropriate, treat source water, provide public education, and replace lead service lines. The modified rule was published on January 12, 2000, and addresses seven broad categories:

- Demonstration of optimal corrosion control.
- Lead service line replacement requirements.
- Public education requirements.
- Monitoring requirements.
- Analytical methods.

- Reporting and record-keeping requirements.
- Special primacy considerations.

The CDHS adopted the federal revisions to the Lead and Copper Rule in October 2003. The action levels defined by CDHS in the Title 22 requirements are identical to those defined in the federal rule. There are minor differences between the state and federal rules, most of which deal with clarification on items not clearly defined in the federal rule. The CDHS requirements establish timeframes and requirements to determine sampling sites that are not defined in the federal rule. Appendix X includes a letter from the CDHS that summarizes the differences between the state and federal rules (see page 4 of the letter).

9.6.2.4 Stage 1 Disinfectants/Disinfection By-Products Rule

The Stage 1 Disinfectants/Disinfection By-Product Rule (D/DBPR) has been finalized and became effective for public water systems (surface and groundwater) serving more than 10,000 people in December 2001. This rule established the following DBP MCLs:

- Trihalomethanes (THM4):80 μg/L
- Haloacetic Acids (HAA5):60 μg/L
- Bromate Ion (BrO3–):10 μg/L
- Chlorite Ion (ClO2–):1 mg/L

Maximum residual disinfectant levels (MRDLs) were also established for the following disinfectants and DBPs:

- Free Chlorine:4 mg/L
- Chloramines:4 mg/L (total chlorine)
- Chlorine Dioxide:0.8 mg/L

THM4 includes chloroform ($CHCl_3$), bromoform ($CHBr_3$), bromodichloromethane ($CHCl_2Br$), and dibromochloromethane ($CHClBr_2$). The five regulated haloacetic acids are monochloroacetic acid ($CH_2ClCOOH$), dichloroacetic acid ($CHCl_2COOH$), trichloroacetic acid (CCl_3COOH), monobromoacetic acid ($CH_2BrCOOH$), and dibromoacetic acid ($CHBr_2COOH$).

9.6.2.5 Surface Water Treatment Rule

The Surface Water Treatment Rule (SWTR) was promulgated by the USEPA on June 29, 1989, and became effective on December 31, 1990. For systems using surface water or groundwater under the direct influence of surface water for supply, the SWTR requires that treatment be provided to reduce turbidity and the microorganisms Giardia, Legionella, viruses, and heterotrophic plate count (HPC) bacteria. Specifically, the SWTR establishes (1) to maintain a disinfectant residual in the distribution system; (2) treatment and performance standards to provide a minimum reduction of 99.9 percent (3-log) for Giardia cysts, and 99.99 percent (4-log) for viruses; (3) specific filter effluent performances; and (4) watershed protection and other requirements for unfiltered systems. The overall reduction of Giardia and viruses is to be achieved using a combination of physical removal by pretreatment and filtration, and inactivation by disinfection. Assuming that the District's existing groundwater supplies are not under the direct influence of surface water, this rule does not apply to the District's groundwater sources. However, the rule is applicable to the District's system because MWD's water source is surface water.

9.6.2.6 Total Coliform Rule

The Total Coliform Rule (TCR) was promulgated in 1989 and established a MCLG of zero coliforms. For systems that collect 40 or more samples per month, including the District, the rule allowed no more than 5 percent positive samples per month. All TC-positive samples must be analyzed for the presence of *E. coli* or fecal coliforms. If two consecutive samples in the system are TC-positive, and one is also fecal coliform or *E. coli*-positive, then this is defined as an acute violation of the MCL, and the system must notify the public using mandatory language developed by the USEPA and collect repeat samples. The required monitoring frequency for a system depends on the number of people served. Secondary disinfection is required under the TCR in accordance with the following:

- A minimum disinfectant residual of 0.2 mg/L free chlorine or 0.5 mg/L chloramines measured as total chlorine must be present throughout in the distribution system continually.
- A sample with heterotrophic plate count less than 500 cfu/100 mL is assumed to carry the required minimum residual.

The TCR is currently under review by the USEPA to initiate possible revisions to the TCR. The USEPA plans to assess the effectiveness of the current TCR in reducing public health risk, and what alternative or additional monitoring strategies are available to decrease the economic burden while maintaining or improving public health protection. In parallel with the review of the TCR, the USEPA is also considering a possible Distribution System Rule to address distribution system issues that have the potential to impact public health risk.

9.6.2.7 Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule (IESWTR) was promulgated in December 1998. This rule applies to systems serving 10,000 or more people that use surface water or groundwater under the direct influence of surface water. Similar to the SWTR, this rule applies to the District's system because MWD's source water is surface water. The rule establishes a MCLG of zero for *Cryptosporidium*. It also establishes requirements for systems that filter water and requires covers on new finished water storage reservoirs. In January 2002, the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR) applied these same regulations to systems serving less than 10,000 people. Since the District serves more than 10,000 people, the LT1ESWTR does not apply to the District's system.

9.6.2.8 CDHS Fluoride Regulations

The California Safe Drinking Water Act, which was established by CDHS in January 2000, addresses drinking water regulations for fluoride. For public water systems that are fluoridated, the current regulations establish an optimal fluoride level control range based on the annual average air temperature. Fluoride concentrations must be measured daily, and a system is out of compliance if more than 20 percent of the samples collected in a month are outside of the control range. The current MCL established by CDHS for fluoride is 2.0 mg/L. Note that this is more stringent than the federal primary drinking water standard (4.0 mg/L), and that this establishes the maximum allowable level of fluoride in drinking water, not the recommended dose for dental health benefits.

In 1995, the California legislature passed a bill requiring all water agencies to fluoridate their water supplies if money was provided to the agencies to do so. To date, this money has not been provided, and the District has not been adding fluoride to the water supply. Due to the lack of state funding, the District is not required to fluoridate, and therefore, is not out of compliance by not fluoridating.

In 2003, MWD announced plans to begin fluoridating its water supply within the next few years. As noted earlier, the District does not add fluoride to its water supply. If the District does not begin fluoridating at the same time as MWD, there will be portions of the distribution system with water that contains fluoride, portions where it does not contain fluoride, and portions where the two sources are mixed.

9.6.3 Unregulated Contaminants

The following rules deal with contaminants that are not currently regulated, but are being considered for regulation and may require monitoring and notification of the public if they are detected:

- Contaminant Candidate List.
- Federal Unregulated Contaminant Monitoring Rule.

- CDHS Notification Levels.
- CDHS Unregulated Chemicals Requiring Monitoring.

9.6.3.1 Contaminant Candidate List

The 1996 amendments to the SDWA require USEPA to establish a list of contaminants that aid in priority setting for the Agency's drinking water program. The list is divided into categories, which represent priorities for Regulatory Determinations, Research, and Occurrence. The final Contaminant Candidate List (CCL) was published on March 2, 1998. The USEPA will select five or more contaminants from the Regulatory Determination Priorities list every five years and determine whether to regulate them. MTBE and perchlorate are currently in the Research Priorities List. Recently, the USEPA completed its review of the first set of nine contaminants, including manganese, and removed them from the CCL. It is possible that the USEPA will establish regulations for selected contaminants on the CCL, such as MTBE and perchlorate, before completing the five-year review period.

9.6.3.2 Federal Unregulated Contaminant Monitoring Rule

The 1996 SDWA amendments require USEPA to publish a list of not more than 30 unregulated contaminants that public water suppliers are to monitor. These data will be used to determine whether any of these contaminants should be regulated. The final rule was published September 17, 1999.

Under the 1996 Amendment to the Safe Drinking Water Act, USEPA requires monitoring of unregulated contaminants (Unregulated Contaminants Monitoring Rule (UCMR)). Under this amendment, large public water systems that serve more than 10,000 customers are required to submit the monitoring data to the USEPA and the State and to notify consumers of the results of monitoring. Contaminants listed include MTBE and perchlorate.

9.6.3.3 CDHS Notification Levels

CDHS has established notification levels (NLs, known as "action levels" through 2004) for chemicals in drinking water that lack current MCLs. Although NLs are advisory levels and not enforceable standards, drinking water systems are required to notify the governing body of the agency (YLWD Board of Directors) within 30 days under the California Health and Safety Codes §116455 if chemicals are detected at levels greater than the NLs in drinking water wells. In addition to the notice, CDHS recommends that the agency contact consumers about the presence of the contaminant. If the contaminant is present at more than 10 to 100 times the NL depending on the type of risk (cancer and non-cancer risk), CDHS recommends taking the water source out of service.

The CDHS categories the NLs into two groups: NLs for contaminants of current interest, and NLs for contaminants with historical detection or infrequent detection. If contaminants in either category are detected, the requirements and recommendations are the same. The NLs of current interest include manganese and perchlorate. The current NL for manganese is 0.5 mg/L, and the NL for perchlorate is 6 µg/L. The corresponding Response Levels for source removal are 5 mg/L and 60 µg/L for manganese and perchlorate respectively.

9.6.3.4 CDHS Unregulated Chemicals Requiring Monitoring

In the Title 22 regulations, CDHS includes a list of chemicals that are not regulated and do not have MCLs, but require monitoring. Table 9.4 lists the preliminary detection level for reporting (DLR) and Notification Levels, where applicable. MTBE is not listed in California UCMR because it is regulated under Title 22. There is no current federal regulation for MTBE. If the chemicals with established Notification Levels are detected, the requirements described in the previous subsection apply.

Table 9.4 Unregulated Chemicals Requiring Monitoring under Title 22
2005 Domestic Water System Master Plan
Yorba Linda Water District

Chemical	Preliminary DLR (µg/L)	Notification Level (µg/L)
Boron (B)	100	1,000
Chromium VI (Cr(VI), Cr^{6+})	1	--
Perchlorate (ClO_4^-)	4	6
Vanadium (V)	3	50
Dichlorofluoromethane	0.5	1,000
Ethyl tertiary butyl ether (ETBE)	3	--
Tertiary amyl methyl ether (TAME)	3	--
Tertiary butyl alcohol (TBA)	2	12
1, 2, 3-Trichloropropane	--	0.005

9.6.4 Future Regulations

CDHS is currently in the process of establishing new MCLs for some contaminants, including arsenic, chromium-6, and perchlorate. The status of each of these regulations is discussed below. In addition, the following proposed federal regulations will apply to the District's system once they are finalized:

- Groundwater Rule.
- Radon Rule.
- Stage 2 Disinfectants/Disinfection By-Products Rule.
- Long Term Stage 2 Enhanced Surface Water Treatment Rule.

The District should continue to follow the progress of the pending state and federal regulations to ensure that the District's system remains in compliance with all water quality regulations.

9.6.4.1 Arsenic

In January 2001, USEPA promulgated a new standard for arsenic in drinking water that requires public water supplies to reduce arsenic from 50 to 10 µg/L by 2006. The final rule became effective in February 2002. CDHS will be adopting a new California MCL for arsenic by early 2005. CDHS must establish the MCL at a level as close as is "technically and economically feasible" to the public health goal (PHG) for the contaminant, which is set at 0.004 µg/L by the Office of Environmental Health Hazard Assessment (OEHHA). At the present time, the MCL for arsenic remains 50 µg/L. At a minimum, compliance with the 10 µg/L MCL will be required by 2006.

9.6.4.2 Cr(VI)

Resulting from activities related to chromium-6 in January 2001, CDHS adopted a regulation that added chromium-6 to the list of unregulated chemicals requiring monitoring. While "unregulated" in this case usually refers to contaminants that lack maximum contaminant levels, chromium-6 is included in the 50 µg/L MCL for total chromium.

CDHS was required to adopt an MCL for chromium-6 by January 1, 2004. As part of the MCL process, the Office of Environmental Health Hazard Assessment (OEHHA) is performing a health risk assessment, which will lead to a chromium-6 PHG. Because OEHHA has not yet established a PHG for chromium-6, CDHS has not established a MCL for chromium-6.

9.6.4.3 Perchlorate

Currently, there are no state or federal standards for perchlorate in the U.S. CDHS has established a non-enforceable, advisory NL for perchlorate, and California adopted legislation (SB 1822) in September 2002 to establish the country's first drinking water standard for perchlorate by January 2004. In December 2002, California OEHHA published a draft PHG of 2 to 6 µg/L for perchlorate to be used in setting a California standard by CDHS. The OEHHA established a final health goal of 6 µg/L on March 11, 2004. Due to the delay in establishing the perchlorate PHG, CDHS has not yet established a MCL for perchlorate. However, on March 11, 2004, CDHS announced that it will be using an NL of 6 µg/L for perchlorate, to be consistent with the recently established PHG, until the MCL has been finalized. In February 2005, the EPA has announced a higher reference dose for perchlorate exposure based on a study published by the National Academy of Science (NAS) in January 2005. This increase in reference dose may translate into a higher MCL than anticipated, but no firm date has been set for State nor Federal perchlorate standards as of February 2005.

9.6.4.4 Ground Water Rule

This rule will establish disinfection requirements against microbiological contamination for groundwater systems. This rule applies to all public systems that use untreated groundwater, regardless of whether it is under the influence of surface water; therefore, it will apply to the District's system. The rule contains the following major components:

- Periodic on-site inspections of groundwater systems requiring evaluations of 8 key areas (system sanitary survey) and identification of significant deficiencies.
- Hydrogeologic sensitivity assessments for undisinfected systems.
- Source water monitoring for systems drawing from sensitive aquifers without treatment or with other indications of risk.
- Requirement for correction of significant deficiencies or positive microbial samples indicating fecal contamination.
- Compliance monitoring for systems that disinfect to ensure that they reliably achieve 4-log (99.99 percent) inactivation of viruses.

The rule was proposed on May 10, 2000, and the final rule is expected in 2005.

9.6.4.5 Radon Rule

For radon, the most recent proposed rule update was published April 21, 2000. There is no final schedule set for the promulgation of the Radon Rule. The proposed standards will apply only to community water systems that use groundwater or mixed ground and surface water. The USEPA is considering two options:

- States will develop enhanced programs to address the health risks from radon in indoor air (known as Multimedia Mitigation (MMM)) and individual water systems will reduce radon levels in drinking water to 4,000 pCi/L or lower.
- Individual water systems are required to reduce their radon levels in drinking water to 300 pCi/L.

9.6.4.6 Stage 2 Disinfectants/Disinfection By-Products Rule

Stage 2 of the D/DBPR was proposed on August 18, 2003, and is expected to be finalized in 2006. For the Stage 2 Rule, MCLs for THM4/HAA5 of 80/60 µg/L will most likely be changed to a Locational Running Annual Average (LRAA), i.e., each compliance monitoring sampling location has to comply with the MCL on a running annual average. As an interim measure, 3 years after rule promulgation, all systems may be required to comply with THM4 and HAA5 levels of 120 µg/L and 100 µg/L, respectively, based on a LRAA at Stage 1 monitoring sites. In addition, systems must continue to comply with the Stage 1 80/60 µg/L RAA. Systems will conduct an Initial Distribution System Evaluation (IDSE) to determine the locations of maximum LRAA for THM4 and HAA5. The number of locations will depend on the system size or the population. The Stage 2 rule is scheduled to become enforceable 6 to 8 years upon promulgation of the rule.

Four revised compliance-sampling locations (paired samples for both TTHM/HAA5) will be required:

- One at a representative average point (a current Stage 1 location).
- One representative point with high HAA5 levels identified by the IDSE.
- Two representative points with high TTHM levels identified by the IDSE.

The bromate MCL will remain at 10 µg/L and will be extended to all facilities (Stage 1 D/DBP bromate MCL applies only to ozone facilities). This standard could be reviewed as part of USEPA's 6-year review process to determine whether the MCL should be reduced to a lower concentration. The USEPA is also developing guidance to address "significant" DBP peaks. In addition, USEPA is providing IDSE guidance, including how to use historical DBP and water quality data, as well as new monitoring data.

9.6.4.7 Long Term Stage 2 Enhanced Surface Water Treatment Rule

The USEPA proposed the Long Term Stage 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) on August 11, 2003 and expects to finalize the rule in 2006. This rule applies to systems that use surface water or groundwater under the direct influence of surface water. Because the District imports treated surface water from MWD, this rule does apply to the District's system. Six months after promulgation of the rule, all systems serving 10,000 or more people will be required to monitor for *Cryptosporidium* for a 2-year duration. Based on the levels of *Cryptosporidium* observed during this 2-year period, the USEPA will establish required levels of removal and acceptable treatment technologies.

9.7 MONITORING PRACTICES

9.7.1 Distribution System Monitoring

The District currently collects, analyzes, and reports on water quality samples in accordance with the regulations defined by CDHS in Title 22 of the California Code of Regulation. Table 9.5 presents the monitoring parameters, the quantity of samples collected, and the frequency of samples collected to meet these regulations. In addition to this required sampling, the District collects weekly bacteriological and general physical samples from operating wells. The District also collects water samples following customer complaints or questions about water quality. The District has found their current monitoring program to be successful, and no deficiencies in the program were identified as part of this analysis. Therefore, no changes are recommended for the existing monitoring program.

Table 9.5 Current Water Quality Monitoring Practices[1]
2005 Domestic Water System Master Plan
Yorba Linda Water District

Type of Sample	Frequency	Quantity[2]
System bacteriological[3]	Weekly	37
System general physical	Weekly	9
System DBPs:		
Trihalomethanes	Quarterly	12
Haloacetic Acids	Quarterly	12
Chlorate/chlorite	Monthly	12
Chlorine/chloramine	Weekly	37
Customer Lead and Copper[6]	Three Years	30
Reservoir chlorine/chloramine	Weekly	11
Reservoir nitrite	Weekly	10
Reservoir ammonia	Weekly	10
Reservoir bacteriological	Weekly	11
Reservoir water temperature	Weekly	10
Well organic chemicals[4]	Quarterly	9
Well Nitrite/Nitrate[4]	Quarterly	9
Well inorganic chemicals[4]	Three Years	9
Well Radon/Radionuclides[4]	Four Years	9
Well No.15 Arsenic[5]	Monthly (when operating)	1
Other Wells Arsenic	Quarterly	7
Highland Reservoir Arsenic	Weekly	1

Notes:
(1) Source: the District's Five-Year Plan.
(2) Quantity of samples collected per sampling period in 2003.
(3) CDHS requires a minimum of 20 samples per week, but the District staff chooses to take 37 samples per week due to the size of the service area.
(4) Samples are taken from each well on "active status" even if the well has to be started to obtain the sample.
(5) CDHS may require arsenic and manganese sampling, testing, and monitoring at all wells as a condition to allow Well No. 15 blending.
(6) Samples taken at the customer's tap.

9.7.2 Nitrification Monitoring Plan

In February 2001, CDHS required the District to establish a nitrification-monitoring program for early warning signs of bacteriological and other water quality problems in all reservoirs that receive chloraminated surface water from MWD. After the monitoring program began, the District observed indications of nitrification in all eight of the reservoirs that receive MWD water. The District retained Carollo Engineers to conduct a study to prevent and control future nitrification in these reservoirs (Water Reservoir Nitrification Prevention and Control, Carollo Engineers, September 2002).

The final Water Reservoir Nitrification Prevention and Control Report presented a number of recommendations to minimize the nitrification problems the District has experienced. These recommendations are summarized below:

- Conduct additional monitoring and establish appropriate operational responses for different stages of nitrification based on monitoring results.
- Install continuous recirculating sampling pumps to provide more representative, consistent samples of the reservoir water quality.
- Initiate a number of operational strategies and capital improvements to reduce water age, increase mixing, and prevent loss of disinfectant residual in the reservoirs. These strategies included reducing water levels, increasing reservoir turnover frequency, maximizing water level change, and modifying the reservoir inlet/outlets, along with other changes.

Following the completion of the Water Reservoir Nitrification Prevention and Control Report, the District implemented many of the recommended operational changes. Since then, the District has not detected any significant problems with nitrification in these reservoirs.

9.8 DISTRIBUTION SYSTEM

9.8.1 Blending of Chlorinated and Chloraminated Water

The District currently disinfects groundwater pumped from the District's wells with free chlorine, while water imported from MWD is disinfected using chloramines. Throughout much of the District's distribution system, water from the two sources remains isolated. However, there are portions of the system where MWD water blends with groundwater. This blending of chlorinated water and chloraminated water can create water quality problems in the distribution system.

The mixing of free chlorinated with chloraminated water can lead to the loss of an effective disinfectant residual and eventually poor quality due to sloughing. Mixing of free chlorine and chloramine residuals may lead to taste and odor problems caused by the formation of dichloramines or by biofilm sloughing. When chloramines and free chlorine are mixed, a chemical reaction can form chlorine compounds that are not effective disinfectants. The loss of the residual through this reaction and taste and odor problems will be encouraged if the free chlorine residuals are above breakpoint chlorination or a large amount of free chlorinated water is mixed with a small amount of chloraminated water. The potential loss of disinfectant residual presents a potential public health concern and allows bacteria to grow, including nitrifying bacteria that are responsible for nitrification. Ultimately, this may prohibit the District from meeting the requirements of the SWTR.

In an isolated system, chlorine often serves as a better disinfectant than chloramines. Chlorine is a more powerful disinfectant and oxidant. Chloramines may lead to nitrification problems in the distribution system. In addition, chloramines can deteriorate specific rubber components of the distribution system such as seals, gaskets and O-rings, which may lead to structural failure.

Nonetheless, because blending of chlorinated water and chloraminated water is often accompanied by a complete loss of disinfectant residual, it is best to avoid blending the two disinfectant residuals. Since MWD has permanently converted to chloramination, the District should consider possible options for eliminating blending of chlorinated and chloraminated water. These options include isolating the two portions of the system, converting its groundwater disinfection facilities from free chlorine to chloramines, or adding free chlorine to the MWD water supply to disinfect beyond breakpoint chlorination. There are advantages and disadvantages to either option. However, from an operational standpoint, it is very practical to keep the supply sources by serving the lower zones with groundwater and the higher zones with MWD supplies. Therefore, this option should be considered as a viable option.

Although the use of chloramines may create new problems in distribution systems, there are some advantages to using chloramines rather than chlorine. The following is a list of potential benefits:

- Chloramines minimize DBP formation, both THMs and HAAs in order to meet the DBP requirements of either or both of Stage 1 or Stage 2 D/DBP Rules. DBP formation can be reduced even further by optimizing chloramine dosage, chlorine to ammonia ratio, pH, temperature, and mixing and reaction times.
- Chloramines are relatively inexpensive and can be implemented in a relatively short period of time when compared to other DBP control alternatives, such as ozone and biological filtration.
- Chloramines are more persistent or stable than free chlorine, which helps to maintain a residual in the more distant areas of the distribution system away from disinfection facilities.
- Chloramines control biofilms better than free chlorine.
- Chloramines minimize chlorinous taste and odors.

Since all of the District's groundwater is disinfected at the Richfield Plant, the conversion of the District's disinfection facilities from chlorine to chloramines would require the District to add ammonia only at the Richfield Plant. Ammonia storage facilities, pumping facilities, and piping would be required.

If the District converts to chloramination facilities, the ratio of the chlorine (Cl_2) dose to the ammonia (NH_3) dose should be carefully controlled. Excess ammonia concentrations promote nitrification, and at a Cl_2:NH_3 ratio of 3:1, free ammonia concentrations are approximately four times higher than at a Cl_2:NH_3 ratio of 5:1. Experience from similar water utilities suggests that a free ammonia residual concentration of 0.05 mg/L NH3-N or less helps limit nitrification. MWD uses a 5:1 Cl_2:NH_3 ratio, and the District should target the same ratio.

9.9 FINDINGS AND RECOMMENDATIONS

9.9.1 Findings

This water quality analysis has resulted in a number of findings regarding existing and future regulations or water quality concerns that may impact the District's system:

1. There are multiple water quality regulations pending that may impact the operations of the District's domestic water system. The District should continue to remain up-to-date on the status of these regulations to ensure that the District's water supply complies with all future water quality regulations. Pending regulations of particular concern include the arsenic MCL, the perchlorate MCL, the Ground Water Rule, the Radon Rule, and the Stage 2 Disinfectants/Disinfection By-Products Rule.

2. Pending legislation will most likely require the District to conduct an Initial Distribution System Evaluation (IDSE) to identify sampling sites for monitoring disinfection byproducts (DBP). The District will then need to conduct either one year of monitoring or a System Specific Study (SSS), which requires a well-calibrated model and sufficient historical DBP data. According to the current schedule, the monitoring or SSS will need to be complete within 2 to 4 years of Stage-2 DBPR promulgation.

3. Portions of the District's water system currently receive a blend of chlorinated water from the District's wells and chloraminated water from MWD. In general, it is not good practice to blend different residual disinfectants in a distribution system. This can lead to water quality problems, such as a loss of residual, increased HPC levels, and/or nitrification. To resolve the potential problems associated with the blending of multiple disinfectants, the District has three options:

    a. Isolate the portions of the system that receive MWD water from those that receive groundwater to prevent blending.

b. Add sufficient free chlorine to the MWD water beyond breakpoint chlorination prior to blending with the groundwater to maintain a free chlorine residual throughout the blended zone.

c. Convert the existing groundwater disinfection facilities from free chlorine to chloramines. This will provide a consistent disinfectant residual throughout the entire system.

4. In the next several years, MWD will begin fluoridating its water supply. If the District does not fluoridate its groundwater supply, some of the District's customers will get fluoridated water, some will not get fluoridated water, and some will get a blend of fluoridated and unfluoridated water. To further complicate the matter, fluoridation remains a politically sensitive issue.

5. The operational changes that the District has implemented in response to the Water Reservoir Nitrification Prevention and Control Report have successfully limited the nitrification problems in the District's reservoirs.

9.9.2 Recommendations

As part of this analysis, recommendations were developed to help the District address the problems described above. These recommendations are as follows:

1. To avoid blending water supplies with different disinfectants, it is recommended that the District keep the two supply sources separate. Groundwater should be used exclusively in the zones that have a hydraulic grade line below 780 ft-MSL, and MWD water should be used in zones that have a hydraulic grade line equal to or above 780 ft-MSL. This will help to ensure that dissimilar disinfectants do not blend in the distribution system.

2. The District should evaluate the benefits and drawbacks of fluoridating its groundwater supply to determine whether it is appropriate to adopt fluoridation procedures consistent with MWD's planned procedures. However, keeping the supply sources separate would provide a way for customers to know whether or not their drinking water contains fluoride.

3. Implement the recommendations outlined in the Water Reservoir Nitrification Prevention and Control Report to reduce water age, increase mixing, and prevent the loss of disinfectant residual in the reservoirs.

4. If new wells are constructed, consider the proximity to the Richfield Plant or the amount of land needed for future treatment facilities. By piping the well discharge to the Richfield Plant for possible future treatment, the amount of land required for new well sites may be reduced. If this is not practical for potential well sites, the District should consider obtaining enough land to accommodate possible future treatment facilities.

5. Consider performing a preliminary assessment for the treatment of potential contaminants with regulations pending. These studies may include technology evaluation, cost analyses, and footprint requirements so that expansion can be accommodated in the future if treatment is required. This will help to ensure that the District continues to comply with all water quality regulations and help to plan for the capital and operating expenses associated with treatment.

Chapter 10

STORAGE ANALYSIS

10.1 INTRODUCTION

Water distribution systems usually rely on stored water to:

- Help equalize fluctuations between supply and demand.
- Supply sufficient water for fire fighting.
- Meet demands during an emergency or unplanned outage of a major supply source.

This analysis evaluates the ability of the District's storage facilities to meet the above requirements. Adequate storage requirements include the sum of volumes for operational, fire, and emergency storage. The resulting volume must be allocated to the pressure zones where the demands are or within a higher-pressure zone (if there are pressure regulating stations available which allow the water to flow into the lower zone). In most cases, the District's water system is equipped with sufficient pressure reducing stations that allow water to flow into the lower zones.

10.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan Report are to:

- Establish storage needs for each pressure zone in the distribution system.
- Determine where storage deficiencies exist.
- Recommend facilities that mitigate the identified storage deficiencies.

10.3 STORAGE CRITERIA

10.3.1 Operational Storage

The required volume of water for operational storage is determined by the volume required for regulating the difference between the rate of supply and the daily variations (peaks) in water usage. This difference results in the lowest and highest operating levels in the reservoirs under normal conditions. The resulting volume must be allocated to either the pressure zones (where the demands are) or in a higher pressure zone (for use by the lower zone).

AWWA Manuals of Standard Practices M31 and M42 suggest that a minimum operational storage volume between 20 percent and 40 percent of the maximum daily demand are appropriate for mid-sized potable water distribution systems. In the Southern California area, common practice has been to provide 30 percent of the maximum daily demand for operational storage; however, due to the complexities of operating the District's water system, it was determined that 30 percent would not be adequate for operational storage.

Most of the District's water supply is located at the very bottom of the system in Zone 428 (1A). This supply must be pumped into the higher zones where it is needed. Even the District's secondary supply, imported MWD water, must be pumped from Zone 780 (4) into the higher pressure zones. When water is pumped from one zone into another zone, the pumping capacity of the booster station is frequently limited by the water level in the source reservoir. Managing the pumping rates of the District's 12 existing booster stations while monitoring the water levels in the District's 13 existing reservoirs is a complicated endeavor. It is recommended that 100 percent of the maximum day demand be allocated for operational storage; this ensures that the operations staff has sufficient storage for proper operation of the water system.

Although 100 percent of the maximum day demand is recommended for operational storage within a pressure zone, this may not be adequate for selected zones within the District's system. All of the District's supply sources feed into 4 of the 17 pressure zones. Compared to the overall system, the total demands within these zones may be relatively small. Therefore, if the operational storage is stored based on the maximum day demand within the zone, there may not be enough storage to balance the large volumes of water coming into the zone when the supply sources are operational with the volumes being used within the zone or fed into surrounding zones. For example, in Zone 780-1 (4A), 100 percent of the maximum day demand is approximately 0.39 MG. However, OC-51, which feeds into this zone at a maximum rate of 4,500 gpm, could fill 0.39 MG of storage in less than 90 minutes. This example illustrates that zones with large supply flow rates and relative small demands require another criteria to determine the proper amount of operational storage. Thus, in zones containing a major supply source, a minimum of 20 percent of the volume supplied by that zone during 24 hours is recommended (assuming that this is greater than the operational storage identified by 100 percent of the maximum day demand). This requirement would provide a reasonable amount of storage in these zones and it is consistent with the District's historical practices. For the example cited above, Zone 780-1 (4A), this results in almost 5 hours of continuous maximum flow to fill up the operational storage.

10.3.2 Fire Storage

The volume of water storage required for fire fighting is a function of the instantaneous flow rate required to fight the fire, the duration of the fire flow, and the number of fire flows that occur before the volume can be replenished. The fire flow requirements listed in Table 7.3 were used to establish the flow rate and duration for each pressure zone; using these criteria, the largest volume of water required for fire fighting was identified within each pressure zone (based on the land use in that zone and the flow rates and durations from Table 7.3). The resulting fire flow volumes are shown in Table 10.1.

Table 10.1 Storage Requirements for Fire Storage
2005 Domestic Water System Master Plan
Yorba Linda Water District

Category	Minimum Flow Required (gpm)	Duration (hr)	Required Fire Storage Volume (MG)
Single Family Residential	1,500	2	0.18
Multi-Family Residential	2,500	2	0.30
Commercial	2,500	3	0.45
Public Facilities/Schools	3,500	3	0.63
Industrial	5,000	4	1.20
Hospital (Linda Vista)	5,000	4	1.20

the District's common practice is to maintain sufficient fire flow storage within each pressure zone to fight one fire in each zone simultaneously. Therefore, fire flow storage from a reservoir in an upper zone was not credited to lower zones unless the lower zone had no other storage available. The lowest fire flow volume, 0.18 MG, is the result of a 1,500 gpm fire for a duration of 2 hours (single-family residential land use). A fire flow of 5,000 gpm for a duration of 4 hours resulted in the largest volume of 1.20 MG (industrial land use or a hospital).

During discussions with the District on storage required to fight fire, it was noted that the District does not intend to provide storage to fight brush or wild fires. It was also noted that the volume of water required to fight fires of this type is significantly beyond the capacity of the District to provide. Therefore, the storage requirements identified in this Master Plan Report do not include any allocation for fighting brush fires or wild fires.

10.3.3 Emergency Storage

Emergency storage is a dedicated source of water that can be used as a backup supply in the event a major supply is interrupted. This can be provided by water from a second independent source, by water stored in reservoirs, or a combination of both. The District has built a significant amount of redundancy into the distribution system, both in terms of supply sources and power supplies for wells and booster stations. Therefore, numerous scenarios could be considered to evaluate the necessary emergency storage. For example, a major earthquake could cause a loss of a MWD pipeline and a system-wide loss of electricity, or it could cause the loss of one-half of the District's wells and a system-wide loss of the natural gas supply. However, it may not be realistic or feasible to plan for a loss of all sources of supply and simultaneous losses of all electricity and natural gas supplies.

In addition, the appropriate criteria used to determine the emergency storage requirements may vary from one zone to another. For example, in an isolated zone with only one source of supply (e.g., one booster station, one PRV, or one well), it may be realistic to plan for a 7-day period with no water coming into the zone; however, in a zone with a significant amount of redundancy, this scenario may not be realistic.

On June 23, 2004, the District and Carollo Engineers (Carollo) conducted a workshop to evaluate the alternative emergency scenarios for use in the District's storage analysis. A number of potential scenarios were presented for consideration. Following the workshop, the District staff reviewed these scenarios and established a set of criteria to use as a basis for establishing the emergency storage requirements for each zone.

District staff established the following criteria by determining the realistic emergency scenarios that may occur District-wide or within any pressure zone:

- District-Wide Emergencies:
    - The loss of all MWD supplies and loss of the two largest wells for 7 days of average day demands (ADD).
    - The loss of all groundwater supplies for 7 days of ADD.
    - The loss of electricity for 2 days of maximum day demands (MDD).
    - The loss of natural gas for 2 days of MDD.
- Pressure Zone Specific Emergencies:
    - Zones with only one supply source lose this source for 5 days of ADD.
    - Zones with multiple supply sources lose the largest source for 5 days of ADD.
    - Zones with multiple supply sources lose the two largest sources for 3 days of ADD.

The emergency storage required for each pressure zone was based on the most severe of the criteria identified above.

10.4 STORAGE ANALYSIS

A complex spreadsheet model was developed to analyze the the District's storage requirements on a zone-by-zone basis. This spreadsheet model provides the capability to analyze ADD and MDD demand periods, existing and future years, various supply alternatives, and numerous emergency scenarios. Based on the demands within each zone and the supplies and booster facilities that are operating, the model calculates the water used within each zone, the water pumped into and out of the zone, and the water that enters and leaves the zone through pressure reducing stations. The movement of water between zones is controlled by the demand within each zone and the physical limitations of the existing pumps and valves. The model then determines the amount of operational, fire flow, and emergency storage required by zone. The emergency storage requirement is based on the selected emergency scenario and the duration of the event (e.g., 7 average days, 3 maximum days, etc.). The total required storage is then compared to the existing storage requirements, and the storage deficit or excess within each zone is presented.

Using the storage analysis model, analyses were conducted for the years 2005, 2010, and 2020 for the emergency scenarios presented in Section 10.3.3. These studies included upgrades currently planned for the the District system. The following improvements are included in the storage analysis model for the planning years listed below:

- 2005 Improvements:
  - A second Bastanchury Booster Pumping Station (BPS) will be constructed. The pumps will have a capacity of 2,000 gpm (electric pumps) and a backup capacity of 1,400 gpm (natural gas pump). This project is scheduled for late 2006.
  - Highland BPS capacity increased from 3,200 gpm to 5,200 gpm (electric pumps).
- 2010 Improvements:
  - Zones 780-1 (4A), 780-2 (4B), and 780-3 (4C) are hydraulically connected.
  - OC-51 capacity increases from 10 cfs to 22 cfs.
  - Well 19 is operational.
  - Highland BPS capacity increases from 5,200 gpm to 7,200 gpm (electric pumps).
  - Palm Avenue BPS capacity increases from 1,250 gpm to 3,000 gpm (electric pumps).
  - Pacific Holding BPS is operational with a capacity of 146 gpm.
  - A new 8.0 MG buried concrete reservoir is built to replace the existing steel tanks at Bastanchury Reservoir. This project is estimated to occur in 2007. An additional 4.0 MG buried concrete reservoir will be operational by 2010.
  - The Quarterhorse Reservoir Expansion is complete, increasing the total storage volume from 3.75 MG to 7.25 MG.
  - The original Bastanchury BPS is replaced, increasing the capacity from 800 gpm to 2,000 gpm (electric pumps), and decreasing the backup capacity from 1,500 gpm to 1,400 gpm (natural gas pumps).
- 2020 Improvements:
  - Pacific Holding BPS capacity increases from 146 gpm to 605 gpm.

The storage needs for the District are summarized in Tables 10.2, 10.3, and 10.4 on the following pages for the years 2005, 2010, and 2020, respectively. A brief discussion of the storage analysis for each pressure zone is presented in the sections, which follow the Storage Analysis Tables.

10.4.1 Storage Analysis Discussion

10.4.1.1 Zone 1390 (6C)

This pressure zone does not currently have a storage reservoir. However, this is the area that will be served by the proposed Hidden Hills Reservoir (scheduled for construction before 2010). The storage analysis for 2005 identifies a need for 0.18 MG for fire storage, 0.37 MG for operational storage, and 1.26 MG for emergency storage. The total storage needed in Zone 1390 is about 1.81 MG. The storage required for 2020 is only slightly higher. The storage needs identified for Zone 1390 (6C) also include the needs for Zone 1133 (6D). It is recommended that the proposed Hidden Hills Reservoir be constructed with a nominal volume of 2.0 MG to serve Zones 1390 (6C) and 1133 (6D).

10.4.1.2 Zone 1300 (6B)

This pressure zone is currently served by the Chino Hills Reservoir. The volume of the existing storage facility is 0.50 MG. Storage from this zone is also used to supply Zone 1160 (6A). The storage analysis for all three study periods identifies a need for 0.18 MG for fire storage, 0.74 MG for operational storage, and 2.50 MG for emergency storage. The total storage identified as required is 3.42 MG. This results in a deficit of 2.92 MG. However, due to the difficulty in obtaining land to expand the existing reservoir, it is recommended that the District purchase a portable pump to serve as a backup to the existing Timber Ridge Booster Station, reallocate the existing storage in Chino Hills to provide all of the fire storage needed, and split the remainder between operational storage and emergency storage. The portable pump should be capable of pumping MDD for 2020 (334 gpm) from Zone 1000 (5B) to Zone 1300 (6B). The storage should be reallocated as follows: 0.18 MG for fire storage, 0.16 MG for operational storage, and 0.16 MG for emergency storage. Based on the estimated 2020 demands, this will provide about 11.8 hours of ADD and 8.0 hours during MDD. Maintaining a portable pump ready for use will enable the District staff to quickly respond to an emergency.

10.4.1.3 Zone 1300 (6E)

This area is the proposed development area known as Pacific Holding. It is currently undeveloped, and therefore, it has no storage needs for 2005. By 2010, it is expected that the area will be partially developed. The storage needs for 2010 are shown in Table 10.3 as 1.1 MG. By the year 2020, the storage needs increase to 4.0 MG. It may be possible to reduce the required volume through the addition of a redundant booster station. However, without additional information and firm development plans, this is a reasonable estimate of the required storage for this proposed development.

Table 10.2 Storage Analysis for 2005
2005 Domestic Water System Master Plan
Yorba Linda Water District

Pressure Zone		ADD	Required Storage				Available		Deficit
HGL	Name	Avg. Day Demands (gpm)	Fire Storage (MG)	Operational Storage (MG)	Emergency Storage (MG)	Total Storage (MG)	Total Storage Available (MG)	Reservoir Name	Storage Shortfall
1,390	6C	120	0.18	0.37	1.26	1.81	-	Hidden Hills	1.81
1,300	6B	226	0.18	0.74	2.50	3.42	0.50	Chino Hills	2.92
1,300	6E	0	-	-	-	-	-	Pacific Holding	
1,160	6A	121	-	-	-	-	-		
1,133	6D	55	-	-	-	-	-		
1,165	5U	386	0.18	1.20	4.04	5.42	3.20	Camino de Bryant	2.22
1,000	5B	841	0.18	1.79	0.01	1.98	1.98	Santiago and Little Canyon	
991	5L	176	-	-	-	-	-		
920	5A	92	0.18	0.51	3.06	3.75	3.75	Quarterhorse	
780	4D	385	0.45	0.82	5.00	6.27	6.00	Elk Mountain	0.27
780	4C	814	0.45	1.74	14.82	17.01	8.00	Springview	9.01
780	4B	145	-	-	-	-	-		
780	4A	184	0.18	0.39	1.41	1.98	1.98	Gardenia	
680	3B	1,255	1.20	2.67	-	3.87	2.30	Bryant	1.57
675	3A	3,084	0.45	6.57	14.55	21.57	9.48	Valley View and Fairmont	12.09
570	2	5,038	1.20	10.92	-	12.12	4.00	Bastanchury	8.12
430	1B	87	-	-	-	-	-		
428	1A	1,438	1.20	4.06	-	5.26	4.60	Highland	
	TOTALS	**14,447**	**6.03**	**31.78**	**46.65**	**84.46**	**45.79**		**38.01**

Table 10.3 Storage Analysis for 2010
2005 Domestic Water System Master Plan
Yorba Linda Water District

Pressure Zone		ADD	Required Storage				Available		Deficit
HGL	Name	Avg. Day Demands (gpm)	Fire Storage (MG)	Operational Storage (MG)	Emergency Storage (MG)	Total Storage (MG)	Total Storage Available (MG)	Reservoir Name	Storage Shortfall
1,390	6C	123	0.18	0.38	1.44	2.00	2.00	Hidden Hills	
1,300	6B	226	0.18	0.74	2.50	3.42	0.50	Chino Hills	2.92
1,300	6E	99	0.18	0.21	0.71	1.10	1.10	Pacific Holding	
1,160	6A	121	-	-	-	-	-		
1,133	6D	55	-	-	-	-	-		
1,165	5U	386	0.18	1.20	4.04	5.42	3.20	Camino de Bryant	2.22
1,000	5B	841	0.18	1.79	0.01	1.98	1.98	Santiago and Little Canyon	
991	5L	176	-	-	-	-	-		
920	5A	282	0.63	1.79	4.83	7.25	7.25	Quarterhorse	
780	4D	385	0.45	0.82	5.00	6.27	6.00	Elk Mountain	0.27
780	4C	857	0.45	1.83	5.72	8.00	8.00	Springview	
780	4B	556	-	-	-	-	-		
780	4A	499	0.18	1.06	0.74	1.98	1.98	Gardenia	
680	3B	1,255	1.20	2.67	-	3.87	2.30	Bryant	1.57
675	3A	3,113	0.45	6.64	2.39	9.48	9.48	Valley View and Fairmont	
570	2	5,153	1.20	11.17	-	12.37	12.37	Bastanchury	
430	1B	87	-	-	-	-	-		
428	1A	1,438	1.20	4.72	0.08	6.00	6.00	Highland	
	Totals	**15,651**	**6.66**	**35.02**	**27.46**	**69.14**	**62.16**		**6.98**

Table 10.4 **Storage Analysis for 2020**
2005 Domestic Water System Master Plan
Yorba Linda Water District

Pressure Zone		ADD	Required Storage				Available		Deficit
HGL	Name	Avg. Day Demands (gpm)	Fire Storage (MG)	Operational Storage (MG)	Emergency Storage (MG)	Total Storage (MG)	Total Storage Available (MG)	Reservoir Name	Storage Shortfall
1,390	6C	123	0.18	0.38	1.44	2.00	2.00	Hidden Hills	
1,300	6B	226	0.18	0.74	2.50	3.42	0.50	Chino Hills	2.92
1,300	6E	409	0.18	0.87	2.95	4.00	4.00	Pacific Holding	
1,160	6A	121	-	-	-	-	-		
1,133	6D	55	-	-	-	-	-		
1,165	5U	386	0.18	1.20	4.04	5.42	3.20	Camino de Bryant	2.22
1,000	5B	841	0.18	1.79	0.01	1.98	1.98	Santiago and Little Canyon	
991	5L	176	-	-	-	-	-		
920	5A	381	0.63	2.27	4.35	7.25	7.25	Quarterhorse	
780	4D	385	0.45	0.82	5.00	6.27	6.00	Elk Mountain	0.27
780	4C	857	0.45	1.83	5.72	8.00	8.00	Springview	
780	4B	684	-	-	-	-	-		
780	4A	499	0.18	1.06	0.74	1.98	1.98	Gardenia	
680	3B	1,255	1.20	2.67	-	3.87	2.30	Bryant	1.57
675	3A	3,117	0.45	6.64	2.39	9.48	9.48	Valley View and Fairmont	
570	2	5,153	1.20	11.17	-	12.37	12.37	Bastanchury	
430	1B	87	-	-	-	-	-		
428	1A	1,438	1.20	4.72	0.08	6.00	6.00	Highland	
	Totals	**16,192**	**6.66**	**36.16**	**29.22**	**72.04**	**65.06**		**6.98**

10.4.1.4 Zone 1160 (6A)

This pressure zone is served through a pressure reducing station from Zone 1300 (6B). The storage needs for Zone 1160 (6A) will be provided from Zone 1300 (6B). Therefore, see the discussion presented in Section 10.4.1.2 on Zone 1300 (6B) for the storage needs for Zone 1160 (6A).

10.4.1.5 Zone 1133 (6D)

This pressure zone is served through a pressure reducing station from Zone 1390 (6C). The storage needs for Zone 1133 (6D) will be provided from Zone 1390 (6C). Therefore, see the discussion presented in Section 10.4.1.1 on Zone 1390 (6C) for the storage needs of Zone 1133 (6D).

10.4.1.6 Zone 1165 (5U)

The Camino de Bryant Reservoir serves Zone 1165 (5U) and Zone 991 (5L). The storage analysis identifies a deficit of 2.22 MG for all three study years. The majority of this storage need is for emergency storage. The critical scenario for this zone is the loss of the Elk Mountain Booster Station. Due to the difficulty in obtaining additional land to construct an expansion of the existing reservoir, reallocation of the existing storage is recommended. Allocating 0.18 MG to fire storage, 0.60 MG to operational storage, and the remaining 2.42 MG to emergency storage will provide about 3 days of ADD and 2 days of MDD. Therefore, no additional storage is recommended for this pressure zone.

10.4.1.7 Zone 1000 (5B)

Zone 1000 (5B) is served by two reservoirs: Santiago and Little Canyon. Although the combination of these reservoirs is only 1.98 MG, the storage analysis indicates that this is sufficient storage through the year 2020. The allocation of this storage is as follows: 0.18 MG fire storage, 1.79 MG operational storage, and 0.01 MG emergency storage. No additional storage facilities are required for this zone.

10.4.1.8 Zone 991 (5L)

This pressure zone does not have its own storage facility and is served through a pressure reducing station from Zone 1165 (5U). The storage needs for Zone 991 (5L) will be provided from Zone 1165 (5U). Therefore, see the discussion presented in Section 10.4.1.6 on Zone 1165 (5U) for the storage needs of Zone 991 (5L).

10.4.1.9 Zone 920 (5A)

The existing Quarterhorse Reservoir serves Zone 920 (5A) with a volume of 3.75 MG. This facility is planned for expansion to 7.25 MG by the year 2010. The storage analysis indicates that this reservoir will provide a substantial amount of emergency storage through the year 2020. In the year 2005, the allocation of storage is as follows: 0.18 MG fire storage, 0.51 MG operational storage, and the remaining 3.06 MG for emergency storage. By the year 2020, the allocation has changed significantly: 0.63 MG fire, 2.27 MG operational, and 4.35 MG emergency. The amount of emergency storage provided by Quarterhorse Reservoir in the year 2020 will be approximately 15 percent of the the District's total emergency storage available.

10.4.1.10 Zone 780 (4D)

This zone is served by the existing Elk Mountain Reservoir. This facility provides 6.0 MG of storage to ID-2. The storage analysis shows that the allocation of storage does not change for the three study periods: 0.45 MG fire storage, 0.82 MG operational storage, and 5.00 MG emergency storage. However, this indicates that there is an existing deficit of 0.27 MG. It would be impractical to construct 0.27 MG to address this shortage. Therefore, it is recommended that the existing storage be reallocated to provide all of the fire and all of the emergency storage identified; this will reduce the operational storage to 0.55 MG, which is 67 percent of MDD.

10.4.1.11 Zone 780 (4A, 4B, and 4C)

This pressure zone is hydraulically separated into three separate pressure zones with the same hydraulic grade. By the year 2010, all three of these zones will be hydraulically connected and the zone will function as one pressure zone. Meanwhile, as seen in Table 10.2, the storage requirements for Zone 780-3 (4C) exceed the existing storage available by 9.0 MG. However, once these pressure zones become one zone, the existing storage capacity is shown to be adequate. The significant change in storage needs is due to the additional reliability achieved through combining the zones into one. By the year 2020, the allocation of the existing storage facilities will be as follows: 0.63 MG fire, 2.89 MG operational, and 6.46 MG emergency storage. This amount of emergency storage represents about 22 percent of the available emergency storage in the year 2020. No additional storage facilities are recommended for this zone.

10.4.1.12 Zone 680 (3B)

The existing Bryant Reservoir serves Zone 680 (3B) and provides 2.3 MG of storage. The storage analysis indicates that the allocation of storage does not change for the three study periods: 1.2 MG fire, 2.67 MG operational, and no emergency storage. According to the storage analysis, a deficit of 1.57 MG exists. However, this deficit is primarily due to the need for operational storage. Since this reservoir is served entirely through pressure reducing stations and not through booster stations, it was considered acceptable to reduce the amount of operational storage. Therefore, it is recommended that the allocation of storage for the Bryant Reservoir be as follows: 1.2 MG fire, 1.1 MG operational, and no emergency storage. This provides 40 percent of the MDD for operational storage. No additional storage facilities are recommended for this zone.

10.4.1.13 Zone 675 (3A)

Storage for this zone is available from two existing reservoirs: Valley View Reservoir and Fairmont Reservoir. The combined volume from these reservoirs is 9.48 MG. The storage analysis for the year 2005 indicates a large deficit of emergency storage available (12.09 MG). However, with the addition of pipelines that provide a better hydraulic connection between the two existing reservoirs and additional pumping capacity, the amount of emergency storage is reduced significantly. In fact, by the year 2010 there is no storage deficit in this zone. The allocation of storage for the year 2020 is as follows: 0.45 MG fire, 6.64 MG operational, and 2.39 MG emergency storage. No additional storage facilities are recommended for this zone.

10.4.1.14 Zone 570 (2)

This is the largest pressure zone within the the District's service area and it represents approximately one-third of the total system demands. However, the existing Bastanchury Reservoir provides only 4.0 MG, which represents less than 10 percent of the total system storage. Although the Bastanchury Reservoir is planned for expansion, the increase will only be 2.0 MG. The storage analysis indicates that the zone is short on operational storage of approximately 8.37 MG by the year 2010. The proposed expansion will reduce this shortfall to 6.37 MG. The storage analysis model indicates that there is no need for emergency storage. Therefore, the allocation of storage should be to provide all of the required fire storage and assign the remainder to operational. Considering only the existing storage and the 2.0 MG expansion already planned, the allocation would be as follows: 1.2 MG fire, 4.8 MG operational, and no emergency storage. This only provides about 40 percent of the MDD. This is less than one-half of the desired operational storage volume. Since this need is for operational storage and not emergency storage, expanding other storage facilities will not provide any benefit for this zone. The required storage will need to be constructed within Zone 570 (2). Therefore, it is recommended that the District increase the storage in Zone 570 (2) to a total of 12.37 MG by the year 2010. Considering the existing 4.0 MG Bastanchury Reservoir, an additional 8.37 MG is required.

10.4.1.15 Zone 430 (1B)

This pressure zone does not have its own storage facility and is served through a pressure reducing station from Zone 570 (2). The storage needs for Zone 430 (1B) will be provided from Zone 570 (2). Therefore, see the discussion presented in Section 10.4.1.14 on Zone 570 (2) for the storage needs of Zone 430 (1B).

10.4.1.16 Zone 428 (1A)

The existing Highland Reservoir provides Zone 428 (1A) with 4.6 MG of storage in a facility that was constructed 95 years ago. The District is currently planning to replace the existing facility. The preliminary planning for the existing site indicates that a reservoir as large as 9.7 MG can be constructed on the site. Based on the results of the storage analysis model, a reservoir with a volume of 6.0 MG will provide the required fire and operational storage. Emergency storage is not required for this zone. The operational storage is based on 20 percent of the groundwater production being pumped through the zone. Assuming a groundwater production rate of 16,400 gpm, this provides 5 hours of operational storage. The allocation of storage by the year 2020 is as follows: 1.2 MG fire, 4.72 MG operational, and 0.08 MG emergency. It is therefore recommended that the existing Highland Reservoir be replaced with a 6.0 MG reservoir.

10.5 STORAGE IMPROVEMENT PROJECT COST ESTIMATES

Cost estimates developed for the recommended storage improvements are based on February 2005 dollars. Total project cost estimates include estimated costs for construction, engineering, legal, administration, construction management, and contingency. Estimated construction costs are based on historical bids submitted by contractors for similar projects to the District and Carollo. The estimated costs of engineering, legal, administration, and construction management were assumed to be 35 percent of the estimated construction cost. Additionally, a contingency of 25 percent of the estimated construction cost was included in the total project cost estimates.

The cost estimates are based on current perceptions of conditions at the project locations. These estimates reflect Carollo's professional opinion of costs at the time of this report and are subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

10.5.1 Estimated Project Costs for New Storage Facilities

The project costs for new storage facilities were estimated using a unit cost of $1.5 per gallon of storage for buried concrete construction for reservoirs 4.0 MG and larger. For reservoirs smaller than 4.0 MG, a unit cost of $1.75 per gallon was used. These unit costs were assumed to include engineering, legal, administration, construction management, and contingency. The cost of acquisition of land and offsite improvements (access roads, offsite piping, etc.) for the recommended improvements are not included in the cost estimates.

Table 10.5 summarizes the recommended reservoir improvements and their estimated project costs.

Table 10.5 Estimated Project Costs for New Storage Facilities 2005 Domestic Water System Master Plan Yorba Linda Water District

	Reservoir Name	Recommended Volume	Estimated Project Cost(1)
1390 (6C)	Hidden Hills Reservoir	2.0 MG by 2010	$3,500,000
1300 (6E)	Pacific Holding Reservoir	4.0 MG by 2020	$6,000,000
920 (5A)	Quarterhorse II Reservoir	3.5 MG by 2010	$5,250,000
570 (2)	Bastanchury II Reservoir	8.37 MG by 2010	$12,555,000
428 (1A)	Highland Reservoir Replacement	6.0 MG by 2010	$9,000,000
Total Estimated Costs			**$36,305,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal costs, administrative costs, and a 25 percent contingency, but do not include land acquisition or offsite improvements.

10.6.2 Estimated Project Costs for Nitrification Control Improvements

In 1992, the District developed a plan to address water quality concerns in reservoirs, which receive a combination of supplies that use different disinfectants (e.g., Fairmont Reservoir) and reservoirs that primarily receive chloraminated water from MWD (e.g., Springview Reservoir). The Water Reservoir Nitrification Prevention and Control report (Carollo Engineers, September 2002) presents the results of an investigation that examined eight of the Districts reservoirs:

- Fairmont Reservoir.
- Springview Reservoir.
- Little Canyon Reservoir.
- Chino Hills Reservoir.
- Santiago Reservoir.
- Bryant Ranch Reservoir.
- Elk Mountain Reservoir.
- Camino de Bryant Reservoir.

Other reservoirs, such as Highland and Bastanchury, did not show a risk of nitrification. The nitrification report developed preliminary alternatives and budgetary cost estimates for improvements that would help reduce nitrification risks in the reservoirs studied. In addition, operational modifications were proposed to reduce water age in the reservoirs.

The estimated project costs for improvements to the eight reservoirs varied from approximately $100,000 (simple inlet/outlet modifications) to $440,000 (new chloramine disinfectant station). For this Master Plan Report, an estimate of $250,000 was assumed for improvements to each of the eight reservoirs studied in the nitrification report. Table 10.6 summarizes the estimated project costs for nitrification control improvements to the District's existing reservoirs.

Table 10.6 Estimated Project Costs for Nitrification Control Improvements
2005 Domestic Water System Master Plan
Yorba Linda Water District

Reservoir Name	Zone	Service Area	Estimated Project Cost(1)
Fairmont Reservoir	675 (3A)	WSA & ID-1	$250,000
Springview Reservoir	780 (4C)	ID-1	$250,000
Little Canyon Reservoir	1000 (5B)	ID-1	$250,000
Chino Hills Reservoir	1300 (6B)	ID-1	$250,000
Santiago Reservoir	1000 (5B)	ID-2	$250,000
Bryant Ranch Reservoir	680 (3B)	ID-2	$250,000
Elk Mountain Reservoir	780 (4D)	ID-2	$250,000
Camino de Bryant Reservoir	1165 (5U)	ID-2	$250,000
		Total Estimated Costs	**$2,000,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal costs, administrative costs, and a 25 percent contingency.

Chapter 11

DISTRIBUTION SYSTEM OPERATIONS

11.1 INTRODUCTION

The operation of YLWD's distribution system is very complex. The topology of the District's service area contributes to the complexity by requiring a relatively large number of pressure zones to adequately regulate pressure throughout the distribution system. Two separate water supply sources (groundwater and MWD), water quality issues, and fluoridation (planned by MWD) add to an already complex operational situation. In addition, the routine maintenance of the District's facilities is important to keeping the distribution system performing its function.

11.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan Report are to:

- Establish operational strategies for key facilities.
- Determine storage strategies on a monthly basis.
- Identify operational and maintenance programs that YLWD should implement, retain, and/or expand.

11.3 OPERATIONAL STRATEGIES FOR KEY FACILITIES

11.3.1 Pressure Regulating Stations

Pressure regulating facilities are essential to providing pressure and supply on a short or long-term basis to areas of the system that require it. For some areas, the pressure regulating station is the only source of supply. For other areas, the stations provide a small amount of flow to maintain the system pressure for a few hours per year during only the highest demand periods. Still other stations serve as a backup supply in case the main supply source is unavailable. All of these pressure regulating stations serve a valuable function in the distribution system.

The challenge for YLWD's operations staff is to adjust the pressure regulating valves to provide the correct type of service. For example, setting a pressure reducing valve too low will result in low system pressures while setting the valve too high may allow excessive water to flow from a higher zone into a lower zone. The hydraulic computer model was used to develop the recommended pressure settings for the District's pressure regulating stations after the recommended zone modifications have been implemented. These settings should provide adequate pressure when needed while minimizing flow from higher zones. These settings should be field verified and the hydraulic model should be reviewed if the conditions in the field do not correlate to the model results. Table 11.1 summarizes the recommended pressure regulating station settings for normal and in-lieu (MWD water replaces groundwater) periods.

11.3.2 Pumping Facilities

Booster pumping stations are required to pump water from the supply sources to the higher pressure zones. Groundwater requires the most pumping. The well facilities are used to pump water from the underground basin into the Highland Reservoir for service in Zone 428 (1A). The groundwater is pumped from the Highland Reservoir into the higher zones including Zone 570 (2) and Zone 675 (3A). Under normal operations, water is not pumped from Zone 675 (3A) into the higher zones. This is because MWD water is available at a higher hydraulic gradient. Therefore, MWD water can be use to serve Zone 780 (4A, 4B, and 4C) without being pumped. MWD water could also be used to serve the lower zones, but groundwater is still less expensive than MWD water, so groundwater is mainly used where the least amount of pumping is required (the lower zones). In the zones above Zone 780 (4), pumping is required regardless of the supply source.

In YLWD's distribution system, booster stations can be pumping thousands of gallons per minute from one zone to the next while at the same time one or more pressure reducing stations may be allowing water to flow back down from the zone that it was just pumped into. This is frequently referred to as pumping water in a circle, and can be very inefficient. The goal of the operational improvements discussed in Chapter 8 is to minimize this type of inefficiency. Nevertheless, District operations staff should be aware of this issue and attempt to reduce or eliminate pumping water in a circle wherever possible. Usually the problem involves a pressure regulating station that is not set properly. However, if the pressure regulating station is adjusted in accordance with the settings shown in Table 11.1, then the hydraulic model should be used to determine the problem.

The District's wells and booster stations are set to operate based on the level of water in one or more reservoirs. Using the hydraulic computer model, set points were developed to minimize or eliminate the use of emergency water during normal operations of YLWD's water system. Table 11.2 summarizes these set points for the District's pumping facilities.

11.3.3 Operational Storage

The storage analysis discussed in Chapter 10 identified the volume of water required for fire, emergency, and operational storage. Under normal operating conditions, the distribution system can be operated using the entire amount of operational storage available in each zone. YLWD operations staff should operate the system in such a manner as to maintain reservoir levels that do not consume emergency or fire storage. This level is shown in Table 11.3 as the Minimum Operational Level.

Table 11.1 Recommended PRS Settings After Implementation of Zone Reconfigurations
2005 Domestic Water System Master Plan
Yorba Linda Water District

ID #	Station Name	Station Location	Elevation (ft-MSL)	No. and Size of Valves	Model ID (#)	Normal Pressure Setting (psi)	HGL (ft-MSL)	MWD Only Setting (psi)	HGL (ft-MSL)
1	Hamer	Hamer Lane & Yorba Linda Blvd.	298	1-2" 1-6" 1-6"	V4011 V4012 V4013	51 49 47	416 411 407	51 49 47	416 411 407
2	Tiburon	Tiburon Dr. & Pacifica Dr.	288	1-2" 1-6"	V4021 V4022	56 54	417 413	56 54	417 413
3	Jefferson	Jefferson St. south of La Collette Pl.	321	1-6" 1-6"	V4031 V4032	50 48	437 432	50 48	437 432
4	Van Buren	Van Buren south of La Collette	325	1-6" 1-6"	V4041 V4042	50 48	441 436	50 48	441 436
5	Cresthill	Cresthill Dr. east of Kellogg Dr.	271	1-2" 1-4"	V4051 V4052	67 65	426 421	67 65	426 421
7	Casa Loma	North of Bastanchury Rd. in the Shell Oil Project	460	1-10"	V4071	37	545	37	545
8	Willowbrook	Willowbrook & Westknoll Ave.	436	1-4"	V4081	54	561	54	561
9	Wagon Wheel	5102 Wagon Wheel Dr.	439	1-2"	V4091	53	561	53	561
10	Sumac	5122 Sumac Ridge Dr.	433	1-2"	V4101	56	562	56	562
11	Stone Canyon	5071 Stone Canyon Ave.	450	1-2"	V4111	49	563	49	563
12	Oakvale	Fairlynn Blvd. & Oakvale Dr.	370	1-2" 1-6"	V4121 V4122	68 66	527 522	68 66	527 522
13	Applecreek	Applecreek & Ivy Hill Lane	415	1-2" 1-6"	V4131 V4132	46 44	521 517	46 44	521 517

Table 11.1 Recommended PRS Settings After Implementation of Zone Reconfigurations
2005 Domestic Water System Master Plan
Yorba Linda Water District

ID #	Station Name	Station Location	Elevation (ft-MSL)	No. and Size of Valves	Model ID (#)	Normal Pressure Setting (psi)	HGL (ft-MSL)	MWD Only Setting (psi)	HGL (ft-MSL)
14	Fairmont	Fairmont Blvd. & Coachwood	401	1-2" 1-8"	V4141 V4142	52 50	521 517	52 50	521 517
15	Paseo Del Prado	Paseo Del Prado & Travis Road	427	1-3" 1-8"	V4151 V4152	52 50	547 543	52 50	547 543
16	Trailside	Yorba Ranch Rd. & Trailside	415	1-4" 1-8"	V4161 V4162	56 54	544 540	56 54	544 540
17	Dominguez	Dominguez Ranch & Via Dianza	440	1-4" 1-8"	V4171 V4172	46 44	546 542	46 44	546 542
18	Stonehaven	Yorba Linda Blvd. south of Stonehaven	458	1-4" 1-6"	V4181 V4182	82 80	647 643	82 80	647 643
19	Adobe	5530 Avenida Adobe	446	1-4" 1-8"	V4191 V4192	52 50	566 562	52 50	566 562
20	Platte	Platte St. & Avenida Adobe	451	1-3" 1-8"	V4201 V4202	52 50	571 567	52 50	571 567
21	La Palma	La Palma Ave. west of Mercado Del Rio	373	1-4" 1-8"	V4211 V4212	133 131	680 676	133 131	680 676
22	Del Rey	Fairmont Blvd. & Del Rey	550	1-3" 1-8"	V4221 V4222	54[(2)] 52[(2)]	675 670	54[(2)] 52[(2)]	675 670
23	Village Center	Village Center north of Yorba Linda Blvd.	565	1-6" 1-8" 1-10"	V4231 V4232 V4233	42 40 38	662 657 653	42 40 38	662 657 653

Table 11.1 Recommended PRS Settings After Implementation of Zone Reconfigurations
2005 Domestic Water System Master Plan
Yorba Linda Water District

ID #	Station Name	Station Location	Elevation (ft-MSL)	No. and Size of Valves	Model ID (#)	Normal Pressure Setting (psi)	HGL (ft-MSL)	MWD Only Setting (psi)	HGL (ft-MSL)
24	San Antonio #1	San Antonio north of Contento	544	1-4" 1-8" 1-8"	V4241 V4242 V4243	55 53 51	671 666 662	55 53 51	671 666 662
25	Mission Hills	22476 Mission Hills	670	1-3" 1-8"	V4251 V4252	42 40	767 762	42 40	767 762
26	Brentwood	Brentwood & Mission Hills	540	1-3" 1-8"	V4261 V4262	77 75	718 713	77 75	718 713
27	Box Canyon	Via Lomas De Yorba West & Copper Canyon	359	1-3" 1-4" 1-6"	V4271 V4272 V4273	100(1) 96(1) 94(1)	590 581 576	100(1) 96(1) 94(1)	590 581 576
28	Foxtail	Via Lomas De Yorba West & Foxtail	574	1-2" 1-4"	V4281 V4282	42 40	671 666	42 40	671 666
29	Bryant # 1	Camino De Bryant & Kodiak	591	1-2" 1-8"	V4291 V4292	36 34	674 670	36 34	674 670
30	Kodiak # 1	Kodiak Mt. & Alpine Ln.	681	1-2" 1-6"	V4301 V4302	42 40	778 773	42 40	778 773
31	San Antonio # 2	San Antonio south of Fairmont Blvd.	882	1-4" 1-8"	V4311 V4312	40 38	974 970	40 38	974 970
32	Little Canyon	Fairmont Blvd. & Quail Circle	811	1-2" 1-6"	V4321 V4322	151 149	1160 1155	151 149	1160 1155
33	Hidden Hills	Hidden Hills south of Stonewood	1048	1-3" 1-8"	V4331 V4332	42 40	1145 1140	42 40	1145 1140

Table 11.1 Recommended PRS Settings After Implementation of Zone Reconfigurations
2005 Domestic Water System Master Plan
Yorba Linda Water District

ID #	Station Name	Station Location	Elevation (ft-MSL)	No. and Size of Valves	Model ID (#)	Normal Pressure Setting (psi)	HGL (ft-MSL)	MWD Only Setting (psi)	HGL (ft-MSL)
34	Bryant # 2	Camino De Bryant & Maiden Moor	872	1-2" 1-6"	V4341 V4342	44 42	974 969	44 42	974 969
35	Kodiak # 2	Kodiak Mt. & Mt. Triumph Way	878	1-2" 1-6"	V4351 V4352	36 34	961 957	36 34	961 957
36	Hidden Hills 2	Hidden Hills and Skyridge	568	1-2" 1-8"	V4361 V4362	149 147	912 908	149 147	912 908
40	Walnut (Automated)	Walnut St. & Valley View Ave.	434	1-3" 1-8"	V4401 V4402	N/C(3)	N/C(3)	53 51	556 552
41	Casa Loma (Automated)	North of Bastanchury Rd. in the Shell Oil Project	490	1-10"	V4411	N/C(3)	N/C(3)	150	837
42	Red Pine (Automated)	Valley View Cir. Southwest of Red Pine Rd.	546	1-3" 1-8"	V4421 V4422	N/C(3) N/C(3)	N/C(3) N/C(3)	55 52	673 666
43	Hidden Oaks (Automated)	Hidden Oaks Dr. south of Green Oaks Rd.	560	1-3" 1-8"	V4431 V4432	N/C(3) N/C(3)	N/C(3) N/C(3)	50 48	676 671
44	Clydesdale (Automated)	Clydesdale Ln. south of Paso Fino Way	633	1-3" 1-8"	V4441 V4442	N/C(3) N/C(3)	N/C(3) N/C(3)	56 54	762 758
N/A	Palm Ave.	Yorba Linda Blvd. West of Palm Ave.	430	1-4" 1-6"	N/A V9014	N/A 40	N/A 522	N/A 40	N/A 522

Notes:
(1) Box Canyon PRS controls can be overridden by SCADA based on the water level in Bryant Reservoir.
(2) Del Rey PRS controls can be overridden by SCADA based on the water level in Fairmont Reservoir.
(3) PRS hydraulic controls are normally overridden by SCADA, except during periods when MWD is supplied in-lieu of groundwater.

Table 11.2 Recommended Pumping Facility Set Points for 2005
2005 Domestic Water System Master Plan
Yorba Linda Water District

Pumping Facility	Pump No.	Primary Controlling Reservoir	Pump Controls	Secondary Controlling Reservoir	Override Control
Wells	1	Highland	ON < 15.0’ OFF > 15.7’	N/A	N/A
	5	Highland	ON < 14.0’ OFF > 15.5’	N/A	N/A
	7	Highland	ON < 13.0’ OFF > 14.5’	N/A	N/A
	10	Highland	ON < 12.0’ OFF > 13.5’	N/A	N/A
	11	Highland	ON < 11.0’ OFF > 12.5’	N/A	N/A
	12	Highland	ON < 10.5’ OFF > 12.5’	N/A	N/A
	15	Highland	ON < 10.0’ OFF > 11.5’	N/A	N/A
	18	Highland	ON < 9.0’ OFF > 10.5’	N/A	N/A
	19	Highland	ON < 8.0’ OFF > 9.5’	N/A	N/A
Highland	1	Bastanchury	ON < 25’ OFF > 30’	Highland	OFF < 8.0’
	2	Bastanchury	ON < 22’ OFF > 27’	Highland	OFF < 7.5’
	3	Bastanchury	ON < 19’ OFF > 24’	Highland	OFF < 7.0’
	4	Bastanchury	ON < 16’ OFF > 21’	Highland	OFF < 6.5’
	5	Bastanchury	ON < 13’ OFF > 18’	Highland	OFF < 6.0’
Bastanchury	1	Valley View	ON < 27.0’ OFF > 29.5’	Fairmont Bastanchury	ON < 22.0’ OFF < 12.0’
	2	Valley View	ON < 24.0’ OFF > 28.0’	Fairmont Bastanchury	ON < 20.0’ OFF < 11.5’
	3	Valley View	ON < 21.0’ OFF > 27.0’	Fairmont Bastanchury	ON < 18.0’ OFF < 11.0’
Palm Avenue	1	Fairmont	ON < 20.0’ OFF > 22.5’	Suction Pressure	OFF < 40 psi
Valley View	1	Gardenia	ON < 24.0’ OFF > 27.0’	Valley View	OFF < 12.0’
	2	Gardenia	ON < 22.0’ OFF > 25.0’	Valley View	OFF < 12.5’
	3	Gardenia	ON < 20.0’ OFF > 23.0’	Valley View	OFF < 13.0’
Paso Fino	1	Quarterhorse	ON < 27.5’ OFF > 29.8’	Springview	OFF < 15.0’
	2	Quarterhorse	ON < 27.5’ OFF > 28.5’	Springview	OFF < 16.0’
Box Canyon	1	Elk Mountain	ON < 22.0’ OFF > 23.0’	Springview	OFF < 15.0’
	2	Elk Mountain	ON < 21.5’ OFF > 23.5’	Springview	OFF < 16.0’
Fairmont[(1)]	1	Springview	ON < 19.0’ OFF > 21.0’	Fairmont	OFF < 11.0’
	2	Springview	ON < 17.0’ OFF > 20.0’	Fairmont	OFF < 12.0’

Table 11.2 Recommended Pumping Facility Set Points for 2005
2005 Domestic Water System Master Plan
Yorba Linda Water District

Pumping Facility	Pump No.	Primary Controlling Reservoir	Pump Controls	Secondary Controlling Reservoir	Override Control
Springview	1	Little Canyon	ON < 11.0’ OFF > 13.0’	Springview	OFF < 15.0’
	2	Little Canyon	ON < 9.0’ OFF > 15.0’	Springview	OFF < 16.0’
	3	Little Canyon	ON < 7.0’ OFF > 19.0’	Springview	OFF < 17.0’
Hidden Hills	1	Santiago	ON < 10.0’ OFF > 14.0’	Hidden Hills	OFF < 6.0’
	2	Santiago	ON < 8.0’ OFF > 16.0’	Hidden Hills	OFF < 7.0’
	3	Santiago	ON < 6.0’ OFF > 18.0’	Hidden Hills	OFF < 8.0’
	4	Santiago	ON < 4.0’ OFF > 20.0’	Hidden Hills	OFF < 9.0’
Elk Mountain	1	Camino de Bryant	ON < 18.5’ OFF > 25.0’	Elk Mountain	OFF < 21.1’
	2	Camino de Bryant	ON < 20.0’ OFF > 23.5’	Elk Mountain	OFF < 21.25’
	3	Camino de Bryant	ON < 21.0’ OFF > 22.0’	Elk Mountain	OFF < 21.5’
Timber Ridge	1	Chino Hills	ON < 15.0’ OFF > 17.0’	Timber Ridge	OFF < 10.0’
	2	Chino Hills	ON < 14.0’ OFF > 18.0’	Timber Ridge	OFF < 10.5’
	3	Chino Hills	ON < 13.0’ OFF > 19.0’	Timber Ridge	OFF < 11.0’
	4	Chino Hills	ON < 12.0’ OFF > 19.5’	Timber Ridge	OFF < 11.5’
Santiago	1	Hidden Hills	ON < 26.5’ OFF > 28.0’	Santiago	OFF < 7.0’
	2	Hidden Hills	ON < 25.5’ OFF > 29.0’	Santiago	OFF < 7.5’

Notes:
(1) Fairmont can also be operated from Zone 675 (3A) to 780-3 (4C).

Table 11.3 Recommended Minimum Reservoir Operational Levels for 2005
2005 Domestic Water System Master Plan
Yorba Linda Water District

Reservoir Name	Pressure Zone Served	Total Capacity (MG)	Total Height (ft)	Fire and Emergency Volume (MG)	Minimum Operational Level (ft)	Operational Height Available (%)
Highland	428 (1A)	4.6	16.0	1.20	5.6	65%
Bastanchury	570 (2)	4.0	30.5	1.20	9.5	69%
Fairmont	675 (3A)	7.5	24.0	3.00	12.0	50%

Table 11.3	Recommended Minimum Reservoir Operational Levels for 2005 2005 Domestic Water System Master Plan Yorba Linda Water District					
Reservoir Name	**Pressure Zone Served**	**Total Capacity (MG)**	**Total Height (ft)**	**Fire and Emergency Volume (MG)**	**Minimum Operational Level (ft)**	**Operational Height Available (%)**
Valley View	675 (3A)	1.98	30.0	0.80	14.2	53%
Bryant Ranch	680 (3B)	2.3	24.0	1.20	14.0	42%
Gardenia	780-1 (4A)	1.98	30.0	1.59	25.0	17%
Spring View	780-3 (4C)	8.0	24.0	6.26	20.0	17%
Elk Mountain	780-4 (4D)	6.0	24.0	5.45	22.0	8%
Quarterhorse	920 (5A)	3.75	30.0	3.24	26.4	12%
Little Canyon	1000 (5B)	0.88	20.0	0.18	3.6	82%
Santiago	1000 (5B)	1.1	21.0	0.18	3.0	85%
Camino De Bryant	1165 (5U)	3.2	25.0	2.6	18.4	26%
Chino Hills	1300 (6B)	0.5	20.0	0.34	12.0	40%
Hidden Hills(1)	1390 (6C)	2.0	20.0	1.44	14.4	28%

Notes:
(1) Hidden Hills Reservoir is proposed.

Operating the reservoirs below the Minimum Operational Level shown in Table 11.3 during normal operating conditions (including maximum day demands) is not recommended. It is recommended that YLWD's SCADA system be setup to announce an alarm anytime the reservoir level drops below the Minimum Operational Level. Using the pumping facility set points shown in Table 11.2 should limit the use of storage to the allocated volume of operational storage shown in Table 11.3.

11.4 OPERATIONS AND MAINTENANCE PROGRAMS

11.4.1 Unidirectional Flushing Program

The District's water mains are typically sized to handle fire flows. Normal system demands, including peak hour demands, are usually small compared to the demands of a fire flow. This results in the distribution system experiencing slow moving water almost all of the time. Slow moving water in the water mains allows mineral and sediments to deposit and accumulate over time. These deposits can result in colored water and water quality problems, can restrict the flow of water in the mains, and contribute to the corrosion of some of the pipes. Flushing may also be appropriate to address customer complaints.

The primary goal of this program is to ensure that acceptable water quality is maintained in the distribution system. Flushing is a process by which the velocity of the water in the mains is increased such that a scouring action is created. Fire hydrants are typically used to induce this increased flow. By opening selected hydrants, the material that has been deposited by the slow moving water is picked up by the fast moving water and removed from the main through the open hydrant(s). The water discharged from the hydrants contains the material build-up from the pipe, which reduces the deposits and the associated risks of impaired water quality. Flushing can also reduce bacterial growth, restore disinfectant residual, improve color and turbidity, control corrosion and can help restore flow and pressures in the water distribution system. The amount and cost of water used in flushing is a small price to pay compared to benefits of assuring the quality of the drinking water in the distribution system. This program can be coordinated with a valve and hydrant maintenance program.

A unidirectional flushing (UDF) program is a method of cleaning the water mainlines through a network of flushing sequences with the water being discharged from a fire hydrant. A UDF program involves closing valves in a specific sequence to create water movement in one direction while opening specific hydrants at the end of that sequence. Maintaining the flushing sequence is important so that the water used in the flushing sequence remains clean. The UDF technique allows higher water flow velocities by isolating certain sections of water mains. The higher water velocities allows for better scouring of pipes and can use 40 percent less water in the flushing process than traditional flushing.

Most UDF programs are performed during normal working hours. However, if there are areas where the deposits are significant, such as in areas that have not been flushed for a relatively long period, then it is recommended that these areas be flushed at night when most people are not using water. Since the temperatures in the YLWD service area rarely drop below freezing, flushing can be performed year round.

It is recommended that YLWD develop a UDF program and implement it to minimize the deposits in the water mains and promote water quality in the distribution system. This program should address the following objectives:

- Target mains shall be flushed away from a clean or previously flushed mains.
- Inline and interconnecting valves shall be operated in such a manner as to develop flow velocities of at least 5 fps within the pipe wherever possible.
- Hydrants and/or blow-offs shall be operated to develop flow velocities of at least 5 fps within the pipe wherever possible. It should be noted that these velocities may not be attainable in large water mains (such as those 12 inches in diameter and larger).

- The flow rate of the water exiting the hydrants shall be measured so that the total volume of water flushed from the system can be accounted for. This volume shall be recorded and used in the comparison of production to consumption to reduce the amount of unaccounted-for water.

11.4.2 Valve Turning Program

The purpose of a valve turning (or exercising) program is to ensure that the main line valves are functioning properly, that the valves are in the correct position, and that the valves have not been paved over. The primary goal of this program is to make sure that the main line valves are in working order and can be found when a water main break occurs and an area must be isolated. Locating all of the available main line valves reduces the amount of time required to isolate the area, reduces the number of valves to be closed, and minimizes the number of customers affected by the shut down. In addition, the valve turning program can prolong the live of the valve and identify closed valves that should be open. Closed valves in the distribution system can have a serious impact on the District's ability to provide adequate pressure and fire flow. A valve turning program can be implemented using in-house staff or an outside company.

It is recommended that YLWD implement a valve turning program. The program should include a complete database of every valve in the distribution system with the following minimum information recorded for each valve:

- Valve ID number.
- Location of the valve (including GPS coordinates).
- Date of operation and name of person performing operation.
- Valve size and type.
- Number of turns to open or close.
- Torque required to open or close.
- Normal position (open or closed).
- Description of operating conditions when valve may be in another position.
- Description of valve condition with simple procedure for reporting a valve that needs to be repaired.

According to AWWA, valves should be exercised "…on a schedule that is designed to prevent a buildup of tuberculation [rust formation in pipes as a result of corrosion] or other deposits that could render the valve inoperable or prevent a tight shutoff." This definition results in a system specific exercising schedule. For YLWD's system, we recommend exercising every main line valve at least every 3 years until a detailed database can be used to adjust the schedule based on the results of the program.

11.4.3 Hydrant Operation and Maintenance Program

Since the main function of a fire hydrant is to provide an adequate flow of water for fire protection, it is extremely important that they function properly when needed. Lives may depend on the quick availability of water to fight a fire. Therefore, a hydrant O&M program is recommended for the YLWD. AWWA recommends that all hydrants be inspected regularly, at least once a year. Therefore, it is recommended that the District inspect, operate, and perform routine maintenance on every fire hydrant in the District's service area at least once a year. A database of hydrants in the distribution system should be developed and maintained. The following minimum information should be include in the database:

- Hydrant ID number.
- Location of the hydrant (GPS coordinates optional).
- Date of inspection and name of inspector.
- Hydrant size and type.
- Number and size of nozzles.
- Flow rate.
- Maintenance procedures required (per manufacturer's instructions).
- Description of hydrant condition.

If a hydrant is not working or needs major repairs, it should be tagged and reported for repairs. Out of service fire hydrants should be repaired as soon as possible.

A good source for record keeping forms relating to hydrant O&M is in the AWWA Manual of Water Supply Practices, "Installation, Field Testing and Maintenance of Fire Hydrants." Not only is this publication a good source of record keeping forms, it also is one of the most comprehensive guides to fire hydrant O&M available.

11.4.4 Meter Maintenance Program

Water meters are key to the District's ability to collect revenues for the water it sells. However, like any other mechanical device, water meters require routine maintenance to function properly. Typically, water meters that are not regularly maintained will read less than the actual amount flowing, but it is also not uncommon for these meters to stop working altogether. This results in errors that are typically in the customer's favor. Therefore, it is in the District's interest to ensure that meters are being maintained on a routine basis. In addition, it is frequently found that most meter maintenance programs pay for themselves through improved accuracy in meter readings.

The interval at which water meters should be maintained varies with meter type, meter size, water use patterns, water quality, and other parameters. Small residential and commercial meters should be tested every 5 to 10 years and rebuilt or replaced as appropriate. Large meters should be calibrated annually and rebuilt or replaced as required. Typically, the calibration of larger meters can be checked with the meter in place. If a problem is identified, then the meter can be replaced with a new or refurbished one and the existing meter pulled out for repairs.

It is recommended that YLWD monitor the condition of its water meters and maintain them as appropriate based on the findings of meters that are inspected and/or replaced. If it is found that a large number of meters are not reading properly when they are inspected, then the maintenance schedule should be shortened.

11.4.5 Pipeline Replacement Program

Based on the hydraulic computer model database, YLWD's distribution system includes about 640 miles of 4- to 39-inch water mains. Assuming a replacement cost of $15 per diameter-inch for total project cost, the value of these existing pipelines is $246 million. If the expected useful life of the existing pipelines is 100 years, then an average of 1 percent should be replaced each year. This indicates that YLWD should be budgeting about $2.46 million (in February 2005 dollars) every year for pipeline replacement projects. The actual costs may be lower where rehabilitation options are available, but may be slightly higher if existing pipelines are upsized.

It should be noted that the oldest pipeline in the distribution system (determined using the hydraulic model database) is about 84 years old. Furthermore, pipelines constructed less than 70 years ago are planned for replacement. Therefore, the expected useful life of 100 years may be somewhat optimistic. Experience with YLWD's pipelines, soil conditions, and water quality will be the best indicator of the useful life, but long-term experience with today's pipe materials and YLWD's specific conditions is still many years away. Rehabilitation projects, such as relining of the existing pipe, typically reduce the useful diameter and are therefore only practical where excess capacity exists.

Based on YLWD's historical pipeline replacement budget, it would be difficult to begin budgeting $2.46 million right away. Nevertheless, it is important that the District begin to plan for the replacement of its largest asset. Therefore, it is recommended that the District prepare a detailed pipeline replacement program that identifies the ultimate replacement or rehabilitation of every pipeline in the distribution system. Rehabilitation should include replacement of main line valves, fire hydrants, and appurtenances. The estimated useful life used in the plan should not be greater than 100 years. The plan should provide a cash-flow diagram of the annual credits and debits to the pipeline replacement fund. It is recommended that a minimum budgetary amount be identified and increased in future years as necessary to maintain a positive cash flow. The goal of the plan should be to establish a budget starting point and gradually increase the budget to avoid catastrophic budget increases in later years when the pipelines begin to fail in large numbers. It is also prudent that consideration be given to developing a comprehensive asset management plan to establish future fiscal needs for preservation of YLWD assets.

Chapter 12

CAPITAL IMPROVEMENTS PROGRAM

12.1 INTRODUCTION

The capital improvements program (CIP) is an important element of a master plan. The CIP summarizes the recommended facilities, identifies the estimated costs of these facilities, and develops a timetable for the implementation of the recommendations. Where appropriate, recommended improvements from other reports (such as the District’s Security Vulnerability Assessment) were included in the CIP in an effort to provide a comprehensive picture of the District’s complete CIP.

Since funding is an important aspect of any project, it is essential to consider how these improvements will be paid for; therefore, this chapter also discusses several financing options available to the District. All of these funding alternatives should be considered for every project that the District pursues. Some projects may qualify for more than one funding source.

12.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan Report are to:

- Summarize the estimated project costs for the recommended improvements.
- Prioritize the recommended improvements and identify the planning period in which the improvements should be constructed.
- Identify alternative financing programs available to District.

12.3 CAPITAL IMPROVEMENTS PROGRAM

12.3.1 Summary of Estimated Project Costs

The recommended improvements identified in this master plan include the recommended facilities identified in Chapter 8 (fire flow, pressure, and operational improvements), Chapter 9 (water quality), and Chapter 10 (storage). In addition, the recommended improvements from two other studies were incorporated into the CIP. These two reports include the Water Reservoir Nitrification Prevention and Control report (Carollo Engineers, September 2002) and the Security Vulnerability Assessment (Carollo Engineers, December 2003). Due to security concerns, the actual recommendations from the Security

Vulnerability Assessment are not included in this master plan. The Security Vulnerability Assessment report is confidential and is only available to selected persons. Therefore, only the estimated capital amount of the recommended improvements from the Security Vulnerability Assessment is included here.

The recommended improvements were prioritized into three categories:

- High priority:
  - These are health and safety related, such as improvements that are needed for fire flows or as identified in the District's Security Vulnerability Assessment for security.
  - These improvements should be implemented immediately; therefore, they have been scheduled as Year 2005 Improvements.
- Medium priority:
  - These are typically operational improvements that improve system pressure, improve the District's ability to use groundwater, or are developer driven for a project that fits within this timeframe.
  - These improvements are also important and are scheduled for implementation between 2005 and 2009.
  - The medium priority improvements are shown as Year 2005 to 2010 Improvements.
- Low priority:
  - While important, these improvements are not as essential as those that fall under the first two categories. Typical improvements for this category include developer driven improvements that may not be required until 2010 or later and other miscellaneous facilities.
  - These improvements are scheduled for implementation between 2010 and 2020.
  - The low priority improvements are shown as Year 2010 to 2020 Improvements.

Cost estimates developed for this master plan are based on February 2005 dollars. Total project cost estimates include estimated costs for construction, engineering, legal, administration, construction management, and contingency. Estimated construction costs are based on historical bids submitted by contractors for similar projects for the District and Carollo Engineers. The estimated cost of engineering, legal, administration, construction management, as well as the estimated contingency are shown in Table 8.1. Additional cost assumptions are presented in Chapters 8, 9, and 10 of this Master Plan Report and in the additional reports referenced earlier in this subsection.

Table 12.1 summarizes the recommended CIP projects for the District by project type and priority level.

Table 12.1 Summary of CIP Project Cost Estimates
2005 Domestic Water System Master Plan
Yorba Linda Water District

Improvement Type	Year 2005 High Priority(1)	Year 2005-2010 Medium Priority(1)	Year 2010-2020 Low Priority(1)
Fire Flow Improvements	$786,000		
System Pressure Improvements		$3,159,000	
Operational Improvements		$24,133,000	
Developer Driven Improvements			$8,236,000
Storage Improvements(2)		$30,305,000	
Water Quality Improvements(3)		$2,000,000	
Security Related Improvements(4)	$1,100,000	$1,250,000	$950,000
Totals	**$1,886,000**	**$60,847,000**	**$9,186,000**
		GRAND TOTAL	**$71,919,000**

Notes:
(1) Estimated Project Costs are based on February 2005 dollars and include estimated engineering, legal, and administrative costs and a contingency, but exclude costs for land acquisition and offsite facilities.
(2) The proposed Pacific Holding Reservoir is included with the Developer Driven Improvements and not with the Storage Improvements.
(3) Source: Water Reservoir Nitrification Prevention and Control report.
(4) Source: Security Vulnerability Assessment report. Costs escalated 5 percent to estimate February 2005 dollars. O&M costs are not included. Some costs were excluded to avoid duplication of costs.

12.4 ALTERNATIVE FINANCING SOURCES

12.4.1 Pay-As-You-Go

This method of funding improvements requires that an agency have sufficient reserves and/or revenues in advance of the need to pay for the facilities. The reserves can be accumulated through increased fees prior to the need for the funds. Pay-as-you-go funding can provide all or part of the facility costs and reduce the overall costs of capital financing by eliminating the costs associated with alternative financing methods and interest expenses. Pay-as-you-go funding can be used as the sole source or in combination with other financing methods.

One good application for pay-as-you-go funding includes ongoing facilities replacement costs. This is especially applicable to pipeline replacement programs where costs are expected year after year. However, for some types of improvements, pay-as-you-go funding may lead to inequities in cost sharing. This would usually apply to a new facility where current customers pay the full costs of facilities that will benefit future customers. A more equitable way to pay for new improvements can be to combine financing methods to distribute the costs between existing and future customers. In addition, using pay-as-you-go as the sole source of funding may result in excessively high fees, especially where major capital facilities costs are incurred early in the planning period rather than evenly distributed over time.

12.4.2 Drinking Water State Revolving Fund Loan Program

The Drinking Water State Revolving Fund (DWSRF) Loan Program is a jointly financed program between the federal Environmental Protection Agency (EPA) and the State of California. This program offers low interest loans to water utilities to help pay for capital facilities. The loans are issued for up to 20 years at a fixed interest rate equal to 50 percent of the State's average interest rate paid on general obligation bonds sold during the previous calendar year. Under this program, repayment must begin within six months of project completion.

Loans are limited to $20 million for any one project and a limit of $30 million exists for a single water utility in any single fiscal year. If it is determined that excess funds are available that cannot otherwise be obligated before the EPA obligation deadline, then these amounts may be modified. Roughly $90 million will be available in 2005 to meet local water project financing needs.

The goal of the DWSRF is to ensure that "public water systems provide an adequate, reliable supply of safe, clean drinking water." Loans are prioritized. Projects that have direct health implications are given the highest priority. Projects that improve supply reliability also receive high priority rankings. DWSRF funds are appropriated to applicants based on their priority until all of the funds have been allocated.

Although DWSRF funds may be a relatively inexpensive source of financing, it cannot be used to fund new growth. Any project whose primary purpose is to serve new growth is ineligible for DWSRF funds under federal law. Projects that primarily serve existing customers can include up to 10 percent oversizing for future growth. However, oversizing above 10 percent is not eligible for DWSRF funding.

12.4.3 General Obligation Bonds

General Obligation (G.O.) bonds are loans backed by the full faith and credit of the issuer. Payment of interest and principal are guaranteed through a pledge by the issuer to use its taxing authority to generate the revenues. Investors and rating agencies view the issuer's general obligation pledge as the highest form of security for bonds. This typically results in G.O. bonds having the lowest long-term costs.

Historically, G.O. bonds are usually viewed as being more secure than other types of bonds. This frequently leads to these bonds being issued at lower interest rates compared to revenue bonds. In addition, G.O. bonds have fewer costs associated with issuance and marketing. And, finally, G.O. bonds do not require the restrictive covenants, special reserves, and higher debt service typical of other types of bonds.

The pledge by the issuing agency to impose a property tax to pay for debt service is the ultimate security for G.O. bonds. However, the use of property taxes based on the assessed value of the property may not fairly distribute the costs of facility improvements equitably among the customers receiving the benefits. Although the authority to use tax revenues may exist, alternative sources of revenues, such as from water rates, may provide a more equitable source of repayment for the debt service.

California's Proposition 13 (1977) restricts the ability of an agency to issue G.O. bonds. Proposition 13 requires that any new debt issuance that could impact property taxes must be approved by a two-thirds majority of the electorate. Since the taxing authority is still in place, this requirement applies even if the intent of the issuing agency is to use revenue sources other than property taxes to pay debt service. G.O. bonds are not typically used to fund water facility improvements. They are usually reserved for general fund projects such as police, fire, and school projects.

Several factors make G.O. bonds attractive, including lower interest rates, fewer restrictions, greater market acceptance, and lower issue costs. Nevertheless, the difficulties in obtaining a two-thirds majority make G.O. bonds less attractive than other sources (e.g. revenue bonds and certificates of participation).

12.4.4 Revenue Bonds

Revenue bonds are long-term debt obligations where payment of principal and interest is pledged by the issuing agency from its revenue stream. Since revenue bonds are not secured by the taxing authority of the issuing agency, they are typically perceived to be less secure than G.O. bonds. Consequently, revenue bonds have historically sold at rates slightly higher than G.O. bonds. The difference is usually in the range of 0.5 percent to 1.0 percent. Repayment of revenue bonds is based on the issuing agency's ability to manage its revenues such that it can meet its debt service obligations. Agencies issuing revenue bonds usually provide assurances to bondholders in one of two ways: through a debt reserve fund or a minimum-coverage ratio.

The proceeds of the bond issue can be used to establish the debt reserve fund. In many cases, the amount held in reserve is based on either the maximum debt service due in any one year during the term of the revenue bonds or the average annual debt service over the term. A trustee is assigned to receive the funds in case the issuing agency cannot meet its debt service obligations in any year. The issuing agency pledges that any funds withdrawn from the reserve will be repaid to the reserve within a short period, typically within one year. The bond reserve requirement can also be met through the use of assurance bonds.

The second type of assurance that the borrowing agency can make is a pledge to maintain a specified minimum coverage ratio (also called “times coverage”) on its outstanding revenue bond debt. The coverage ratio is calculated by dividing the net revenues of the borrowing agency by the annual revenue bond debt services for the year (where net revenues are defined as gross revenues minus O&M expenses). Coverage ratios are typically within the range of 1.1 to 1.3, minimum. This means that net revenues would need to be at least 110 percent to 130 percent of the revenue bond’s debt service. Where the issuing agency can establish higher coverage ratios, lower interest rates may be available. Although the coverage ratios are established in the bond resolution, the bond rating agencies (e.g. Standard & Poor’s or Moody’s) as well as market demands still require a coverage ratio of at least 1.25.

The Revenue Bond Law of 1941 governs the issuance of revenue bonds. Authority to issue revenue bonds requires approval by a majority of voters casting ballots. Due to the risks associated with the election process, authorization is typically sought for the maximum amount of bonds that will be needed over the planning period. Once authorization is received, the issuing agency can issue bonds as needed to the authorized limit. Under the Revenue Bond Law of 1941, revenue bonds are limited to a maximum interest rate of 12 percent.

To make the revenue bonds more attractive to bondholders, the bonds could qualify as tax-exempt bonds. Tax-exempt bonds would be exempt bondholders from owing state and federal income tax on earned interest. Tax-exempt bonds would have a lower interest cost to the issuing agency than would taxable bonds. However, tax-exempt bonds would be subject to the Tax Reform Act of 1986 (Tax Reform Act).

The Tax Reform Act, as subsequently amended, requires that once the bonds are issued, the proceeds must be substantially used for capital projects within a three-year period. This requires that the bond issues be sized accordingly. In addition, the Tax Reform Act restricts arbitrage, which is the difference between the interest earnings on the bond proceeds and the interest payments. Prior to 1986, agencies were able earn arbitrage by borrowing long-term funds in excess of their current needs and investing the proceeds at an interest rate higher than on the borrowings. The Tax Reform Act now restricts the ability to earn arbitrage through onerous documentation and reporting requirements and the requirement to turn over arbitrage earnings to the government.

The costs of issuing bonds is usually a subject to economies of scale. For example, the larger the bond issue the less the percentage of the bond issue that must be devoted to bond issue costs. Therefore, having one larger bond issue is usually more economical than several smaller bond issues.

12.4.5 Alternatives for Structuring Bond Debt

G.O. bonds and Revenue bonds offer a number of variations for structuring debt. This flexibility may provide benefits to the District compared to other options. Long-term municipal bonds have typically been issued as fixed-rate instruments; in other words, the interest rate is fixed over the life of the bonds. Similar to the home mortgage marketplace, there is a market for variable rate bonds in which interest rates vary (up or down) over time in accordance with a specified indicator. Variable rate bonds are typically subject to a predetermined minimum rate (floor) and maximum rate (ceiling) to protect both the issuer and the investor from excessive risks due to rate fluctuations. The advantage that variable rate bonds offer to the issuer is that the issuer can achieve significant interest rate savings compared to fixed rate bonds because he is assuming part of the interest-rate risk. However, the issuer will face more uncertainty about future debt service costs and may incur higher costs in the future.

Interest rate saving can also benefit the District through the use of an "interest rate swap" arrangement. In a "swap", the District would issue variable rate bonds that are matched or "swapped", usually through the auspices of a brokerage house or bank, with another agency that has issued fixed rate bonds. By entering into a swap arrangement, the District could take advantage of the lower interest rates of a variable bond while protecting itself from the fluctuations that may accompany variable instruments. There are costs and some risks associated with swaps. The District should thoroughly explore this option with a financial advisor before embarking on a swap program.

12.4.6 Certificates of Participation

Certificates of Participation (COP) are a form of lease purchasing financing. COPs represent participation in an installment purchase agreement through marketable notes with ownership remaining with the agency. COPs typically involve four separate parties: the public agency as the lessee, a private leasing company as the lessor, a bank as trustee, and an underwriter who markets the certificates. The initial cost of issuance for the COP and level of administrative effort for the District may be greater than for bond issues because there are more parties involved. Since COPs are widely accepted in financial markets, COPs are usually easier to issue than other forms of lease purchase financing, such as lease revenue bonds.

The certificates are usually issued in $5,000 denominations, with the revenue stream from lease payments as the source of payment to the certificate holders. From the standpoint of the agency as the lessee, any and all revenue sources can be applied to payment of the obligation, not just revenues from the projects financed. This provides additional flexibility. Unlike revenue bonds, COPs do not require a vote of the electorate and have no bond reserve requirements. However, having a reserve may enhance the marketability of the certificates. In addition, since there are not technically debt instruments, COP issues do not count against debt limitations for the agency.

Although interest costs for COPs may be slightly higher than for revenue bonds, a COP transaction is a flexible and useful form of financing that the District should consider, after consulting with its financial advisor, for its capital improvement program.

12.4.7 Commercial Paper (Short-Term Notes)

Many public agencies use short-term commercial paper debt to smooth out capital spending flows without the costs of frequent bond issues. Similar to bonds issued by the public agencies, commercial paper instruments are typically tax-exempt debt; this can provide lower interest costs to the District than would prevail if the commercial paper were taxable. Commercial paper can be issued for terms as short as just a few days to as long as a year depending on market conditions and the District's needs. Once the paper matures, it is resold ("rolled over") at the current prevailing market rate. This results in the paper effectively "floating" over an extended period, constantly being renewed. The interest rates for short-term commercial paper are typically much lower than for longer-term debt.

The primary advantage in using commercial paper is to provide interim funding of capital projects. This is typically most useful when revenues and reserves are insufficient at the time to fully fund capital projects, and the amount needed is too small to justify a bond issue or funds are not immediately available (but will be available within two to five years). Commercial paper can be a useful source of short-term funding for the District.

Similar to other forms of debt funding, there are costs associated with the issuance of commercial paper. Many of these costs are similar to those involved with issuing bonds. However, with commercial paper, frequently there is a requirement that a line of credit be established that will guarantee payment of the commercial paper in case it becomes impossible to roll the paper over at any given maturity date. The costs of the credit line are usually based on the full amount of commercial paper authorized, whether issued or not. Therefore, the total commercial paper authorization must be carefully determined to maximize the benefit to the District while minimizing costs.

Even though the interest rate for a commercial paper issue is fixed until its maturity, the short-term maturities and frequent rollovers of the debt effectively make commercial paper very similar to a long-term variable rate bond. Consequently, there is some exposure to risk in using commercial paper as a funding mechanism. However, this risk should be relatively low unless inflationary pressure is great.

One strategy being used by water agencies is to issue commercial paper up to their authorized limit, and then payoff the outstanding commercial paper through a revenue bond issue. This approach provides the benefit of low short-term interest rates while still being able to convert the paper to a long-term fixed rates through the bond issue. This strategy is most appropriate during times of stable or falling interest rates and not during times of raising interest rates.

The District should consult with its legal and financial advisors to determine if sufficient authorization exists to implement a commercial paper program.

12.4.8 Assessment Bonds

The Community Facilities Law of 1911 provides that a public entity may form a special district for the purpose of making any improvement that is in the public interest. Under this law, water facilities could theoretically be financed with assessment bonds. However, the passage of California's Proposition 218 several years ago made the creation of assessment districts much more difficult than in the past and imposed specific requirements to which the local agency must adhere. Discussion of the issues surrounding the use of the assessment bonds follows, even though it is not a recommended option.

The governing body of the entity initiating the special district must pass a resolution authorizing the project by a two-thirds vote. When unincorporated (county) property is involved, approval by the County Board of Supervisors is required. An election of the property owners is required only if property owners representing over 50 percent of the assessed valuation in the proposed district petition for an election.

Because liens will be placed against the properties involved, the law requires that the proposed project benefit the properties upon which the assessment is made. Foreclosure proceedings can be initiated for any properties where the owner fails to pay the assessments. Since the liens are on the property and not against the agency, they do not represent an encumbrance of the agency and therefore are not covered by any debt limitations. Under the law, interest costs are limited to 12 percent annually.

Although assessment bonds are a possible option for the District, consideration should be given to the costs of establishing the assessment district, determining the amount of assessment against each property, and the potential costs of an election.

Chapter 13

RECOMMENDATIONS

13.1 INTRODUCTION

The recommendations discussed in this chapter are a summary of the recommendations developed in previous chapters of this report. The analysis and details of the recommendations are not presented here, but are presented in the previous chapters. Where appropriate, references are included for each recommendation to identify where the backup discussion is presented in this report.

One recommendation that has significant implications to the District involves the selection of supply sources. The large cost differential between groundwater and imported MWD water makes groundwater much more financially attractive. This is an important point, and there are several recommendations that support this finding.

13.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan Report are to:

- Summarize the recommendations developed from the analysis performed on the water system.

13.3 RECOMMENDATIONS

13.3.1 General Recommendations

To assure that the water system provides a minimum acceptable level of service, the District should implement the Master Plan Analysis and Design Criteria described in Section 2.8 of this master plan report. These recommended minimum criteria will allow the District to evaluate existing and proposed facilities. In some special cases, deviation from the recommended criteria may be appropriate. However, this should only be considered with the District Engineer’s or General Manager’s review and approval.

Prior to the design of any of the facilities recommended in this master plan, it is recommended that the District conduct detailed studies to verify the master plan assumptions and establish a basis for design. In addition, a detailed cost estimate should be prepared to verify that sufficient funds have been budgeted.

The District should maintain the master plan report and hydraulic computer model. The District has made a significant investment in both the master plan and computer of its water system. The master plan should be updated if there are significant changes in the development plans, growth projections, or the assumptions used as the basis for the master plan. Without a driving factor, the master plan should be updated in about five (5) years. This is a typical frequency for master plan updates. The computer model should be updated much more frequently than the master plan. It is recommended that the District's model be updated no less than once per year. If the model will be used to analyze proposed or existing facilities, then the model should be updated with any facilities that could influence the analysis. This may require more frequent updates of the model.

13.3.2 Recommended Fire Flow Improvements

The water system should be capable of providing the fire flows, presented in Section 7.5, with a minimum residual pressure of 20 psi. The facilities recommended in Section 8.8.1 should be implemented to correct the fire flow deficiencies identified in the hydraulic model analysis. These facilities are summarized in Table 8.5.

13.3.3 Recommended Facilities to Improve System Pressures

The water system should be capable of providing at least 40 psi during average day, maximum day, or peak hour demand periods (Section 2.8). Section 8.8.2 presents the recommended facilities to correct the areas that have pressure deficiencies. The recommended facilities are summarized in Table 8.7.

13.3.4 Recommended Operational Improvements

The District should consider operational improvements that increase the system reliability or efficiency, or reduce the cost to deliver water. Where an analysis indicates that the District would see a benefit, the proposed improvement should be implemented. The master plan analysis identified twelve (12) areas where operational improvements would improve the efficiency of the system. The facilities recommended to improve operational efficiency are discussed in Section 8.8.3. Table 8.9 summarizes the recommended facilities.

The District should manage its pressure regulating stations such that flow from a higher pressure zone into a lower zone does not result in a significant increase in the need to pump water from the lower zone back into the higher zone. In general, where the supply of water comes from a lower zone, then the pressure regulating stations should be closed for the majority of the time. The stations can open for a few hours during maximum day demands or during fire flow events, but otherwise the stations should only operate as a standby facility. With the recommended improvements identified in Table 8.9 in place, the pressure regulating stations should be adjusted to the settings identified in Table 11.1.

The District should adjust the pump set points for its booster pumping stations and groundwater wells to the levels indicated in Table 11.2. These settings will facilitate the management of the District's emergency and fire storage (see Table 11.3).

The District should implement and formalize the following programs:

- Unidirectional Flushing Program (Section 11.4.1)
- Valve Turning Program (Section 11.4.2)
- Hydrant Operation and Maintenance Program (Section 11.4.3)
- Meter Maintenance Program (Section 11.4.4)

13.3.5 Recommended Development Driven Improvements

Since the proposed Pacific Holding Development (Murdock Property) is within Improvement District No. 1, the District is obligated to provide backbone facilities to support this area. However, the size of the facilities should be determined based on the estimated water demands from the proposed project. Therefore, prior to the design or construction of facilities that support this proposed development, the District should verify the estimated water demands and adjust the size of the facilities appropriately. The backbone facilities identified for the proposed development in Improvement District No. 1 are discussed in Section 8.8.4. Table 8.10 summarizes these facilities.

13.3.6 Recommended Water Quality Improvements

The District should avoid blending supply sources that use different disinfectants (Section 9.8.1). Groundwater should be used exclusively in the zones that have a hydraulic grade line below 780 ft-MSL, and MWD water should be used in zones that have a hydraulic grade line equal to or above 780 ft-MSL. This will help to ensure that dissimilar disinfectants do not blend in the distribution system.

The District should evaluate the benefits and drawbacks of fluoridating its groundwater supply to determine whether it is appropriate to adopt fluoridation procedures consistent with MWD's planned procedures (Section 9.4.2). However, keeping the supply sources separate would provide a way for customers to know whether or not their drinking water contains fluoride.

The District should implement the recommendations outlined in the Water Reservoir Nitrification Prevention and Control Report to reduce water age, increase mixing, and prevent the loss of disinfectant residual in the reservoirs (Section 9.7.2 and 10.6.2).

For any new wells, the District should consider the proximity to the Richfield Plant and/or the amount of land needed for future treatment facilities (Section 9.4.1 and 9.5). By piping the well discharge to the Richfield Plant for possible future treatment, the amount of land required for new well sites may be reduced. If this is not practical for potential well sites, the District should consider obtaining enough land to accommodate possible future treatment facilities at the well site.

The District should consider performing a preliminary assessment for the treatment of potential contaminants with regulations pending (Section 9.4.1 and 9.5). These studies may include technology evaluation, cost analyses, and footprint requirements so that expansion can be accommodated in the future if treatment is required. This will help to ensure that the District continues to comply with all water quality regulations and help to plan for the capital and operating expenses associated with treatment.

13.3.7 Recommended Storage Improvements

The District should implement the recommended storage facilities identified in Table 10.5. The complete discussion of storage needs is discussed in Section 10.4.1 on a zone by zone basis. The storage analysis considered operational, emergency, and fire storage for each pressure zone. The emergency component was based on an extensive emergency supply analysis that considered local and District-wide loses of supplies.

13.3.8 Recommended Water Production Improvements

The District should make every reasonable effort to maximize its use of groundwater. With the cost of imported MWD water at nearly double the cost of groundwater, there is a significant financial benefit for the District to maximize its entitlement of groundwater (see Section 6.5.3).

It is recommended that the District maintain a minimum groundwater production capacity of at least 16,000 gpm for the existing system and increase this to 16,500 gpm by the year 2020. This production rate will provide adequate redundancy to assure that the District can meet its groundwater production objectives for projected supply needs. To accommodate the recommended groundwater production capacity, it is recommended that five (5) of the District's existing wells be rehabilitated to restore there original capacities. In addition, as discussed below, it is recommended that aging wells be replaced as their useful life and/or efficiency diminish.

The District should continue its efforts to annex the eastern portion of the service area into the Orange County Water District (OCWD). The amount of groundwater that the District is allowed to produce is determined by a percentage of the demands within the OCWD's service area. Annexing the District's eastern service area into OCWD will allow the District to produce more groundwater.

As opportunities arise, the District should evaluate expanding its use of untreated water from MWD. Using non-potable water for irrigation and other uses decreases the amount of potable water that the District must obtain and makes better use of this resource. Similarly, if recycled water becomes available, the District should evaluate using this water to meet non-potable demands, such as for irrigation and industrial purposes.

The District should continue its water conservation efforts. Water conservation is an important element of the District's overall water supply strategy.

13.3.9 Recommended Security Improvements

The recommended improvements identified in the District's Security Vulnerability Assessment (Carollo Engineers, December 2003) are also recommended in this master plan. However, the actual recommendations from the Security Vulnerability Assessment are not included in this master plan due to security concerns. Authorized individuals should refer to the District's Security Vulnerability Assessment report for specific recommendations.

13.3.10 Facilities Replacement Program

The District should implement a facilities replacement program. The primary elements that should be considered are the District's major facilities. The largest of these facilities is the District's investment in pipelines. Even though all of the District's facilities will eventually need to be replaced, it will be most important to identify the amount of pipelines that need to be replaced annually to avoid enormous expenses in later years. Similar consideration should be given to the District's other major facilities as well.

Appendix A

HISTORICAL RAINFALL

YORBA LINDA, CALIFORNIA

Monthly Total Precipitation (inches)

(049847)

File last updated on Mar 30, 2005
*** Note *** Provisional Data *** After Year/Month 200412
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1948	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00	0.00	0.00	0.03	0.00	2.98	3.01
1949	2.51	2.05	1.29	0.04	0.32	0.00	0.00	0.00	0.00	0.00 z	0.00 z	0.00 z	6.21
1950	2.94	2.58	1.04	0.58	0.19	0.02	0.00	0.00	0.06	0.00	2.17	0.02	9.60
1951	2.45	1.03	0.55	1.46	0.47	0.00	0.00	0.17	0.70	0.60	1.40	6.79	15.62
1952	9.21	0.22	6.28	1.75	0.00	0.00	0.00	0.00	0.26	0.00	3.42	2.69	23.83
1953	1.27	0.43	0.90	1.08	0.04	0.00	0.00	0.00	0.00	0.00	1.23	0.20	5.15
1954	5.51	2.32	4.10	0.18	0.04	0.08	0.00	0.00	0.00	0.00	1.93	1.16	15.32
1955	4.03	1.68	0.24	1.35	1.67	0.02	0.00	0.00	0.00	0.00	1.31	0.59	10.89
1956	8.40	0.45	0.00	2.19	0.24	0.00	0.00	0.00	0.00	0.20	0.00	0.05	11.53
1957	4.20	0.96	1.01	1.21	1.18	0.23 f	0.00	0.00	0.00	1.96	0.97	3.92	15.41
1958	1.98	7.65	4.71	5.21	0.00	0.05	0.00	1.22	0.27	0.18	0.11	0.00	21.38
1959	1.93	3.74	0.00	0.25	0.00	0.00	0.01	0.00	0.00	0.00	0.13	1.55	7.61
1960	2.58	2.85	0.84	1.18	0.08	0.00	0.00	0.00	0.00	0.00	2.15	0.00	9.68
1961	1.56	0.00	0.92	0.00	0.00	0.00	0.00	0.00	0.05	0.11	0.89	0.15 b	3.68
1962	2.61	7.25	0.98	0.00	0.41	0.01	0.00	0.00	0.00	0.00	0.08	0.00	11.34
1963	0.56	3.71	2.07	1.49	0.00	0.03	0.00	0.12	2.27	0.77	3.67	0.00	14.69
1964	1.46	0.12	1.86	0.65	0.07	0.18	0.00	0.00 z	0.00 z	0.16	1.22	1.50	7.22
1965	0.58	0.45	2.35	4.76	0.05	0.04	0.14	0.05	1.08	0.00	7.33	3.70	20.53
1966	0.89	2.22	0.31	0.05	0.03	0.00	0.00	0.00	0.11	0.05	2.32	6.91	12.89
1967	3.98	0.00	2.32	3.67	0.05	0.01	0.00	0.00	0.40	0.00	3.52	0.00 z	13.95
1968	0.82	0.54	3.21	0.86	0.09	0.00	0.29	0.00	0.00	0.25	0.28	1.60	7.94
1969	12.58	9.28	1.01	0.79	0.13	0.00	0.01	0.00	0.00	0.00	2.10	0.19	26.09
1970	2.21	1.51	2.80	0.08	0.00	0.01	0.00	0.00	0.00	0.00	3.72	3.19	13.52
1971	0.60	0.58	0.40	0.40	0.31	0.03	0.00	0.00	0.00	0.06	0.27	6.58	9.23
1972	0.00	0.14	0.00	0.42	0.09	0.18	0.00	0.40	0.07	0.28	3.96	1.86	7.40
1973	2.89	5.33	3.05	0.00	0.06	0.00	0.00 z	0.00	0.01	0.10	1.79	0.55	13.78
1974	6.37	0.19	3.53	0.42	0.14	0.00	0.00	0.00	0.00	0.65	0.02	4.44	15.76
1975	0.23	2.61	3.95	1.80	0.05	0.00	0.00	0.00	0.00	0.36	0.41	0.30	9.71

1976	0.00	3.55	1.85	1.08	0.08	0.51	0.01	0.00	2.37	0.00	0.62	0.79	10.86
1977	3.20	0.60	1.40	0.00	2.42	0.00	0.00	2.61	0.05	0.00	0.03	0.00 z	10.31
1978	8.69	9.63	6.98	1.80	0.02	0.00	0.00	0.00	1.20	0.20	1.98	2.84	33.34
1979	7.85	2.75	6.68	0.00	0.16	0.02	0.00	0.03	0.00	0.97	0.30	0.44	19.20
1980	8.87	11.69	4.70	0.41	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.72	26.64
1981	3.69	1.73	2.93 a	0.27	0.07	0.00	0.00	0.00	0.00	0.63	2.14	0.63	12.09
1982	3.79	0.95	6.25	1.30	0.48	0.12	0.00	0.00	0.41	0.35	4.98	0.00 z	18.63
1983	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1984	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1985	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1986	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1987	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1988	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1989	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1990	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1991	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1992	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1993	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1994	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1995	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1996	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1997	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1998	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
1999	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
2000	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00
2001	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	1.23	1.23
2002	0.62	0.24 p	0.00	0.24	0.34	0.00	0.00	0.03	0.01	0.05	1.70 a	2.87 f	2.99
2003	0.01 b	4.84	3.37	1.47	0.00 a	0.00	0.00	0.00	0.00	0.00	0.36 a	0.99	11.04
2004	0.24	5.27	0.87	1.22 c	0.00	0.00	0.00	0.00	0.00	4.88	0.98	2.86 h	13.46
2005	9.65 a	8.55 d	2.07 h	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	1.44 z	18.20

Period of Record Statistics

MEAN	3.45	2.96	2.29	1.07	0.26	0.04	0.01	0.13	0.25	0.35	1.61	1.77	14.16
S.D.	3.27	3.13	2.03	1.23	0.49	0.09	0.05	0.47	0.58	0.86	1.65	2.04	7.04
SKEW	1.09	1.24	0.88	1.92	3.15	3.97	4.62	4.53	2.75	4.33	1.43	1.33	0.98
MAX	12.58	11.69	6.98	5.21	2.42	0.51	0.29	2.61	2.37	4.88	7.33	6.91	33.34
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.68
NO YRS	38	37	37	37	37	36	37	37	37	37	37	33	28

TUSTIN IRVINE RANCH, CALIFORNIA

Monthly Total Precipitation (inches)

(049087)

File last updated on Mar 30, 2005
*** Note *** Provisional Data *** After Year/Month 200306
a = 1 day missing, b = 2 days missing, c = 3 days, ..etc..,
z = 26 or more days missing, A = Accumulations present
Long-term means based on columns; thus, the monthly row may not
sum (or average) to the long-term annual value.
MAXIMUM ALLOWABLE NUMBER OF MISSING DAYS : 5
Individual Months not used for annual or monthly statistics if more than 5 days are missing.
Individual Years not used for annual statistics if any month in that year has more than 5 days missing.

YEAR(S)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
1927	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	2.89	2.89
1928	0.31	1.48	1.86	0.00	0.32	0.00	0.00 h	0.00	0.00	0.54	1.53	2.07	8.11
1929	1.67	1.20	1.06	1.39	0.00	0.11	0.00	0.00	0.58	0.05	0.00	0.00	6.06
1930	5.34	0.44	4.23	0.72	2.29	0.00 g	0.00	0.00	0.00	0.11 e	1.61 a	0.00	14.74
1931	2.75	1.92	0.00	0.12 g	0.69	0.19	0.00 a	0.07 k	0.17	0.33	2.60	5.00	13.65
1932	1.34	4.76	0.15	0.68	0.00	0.00	0.00	0.00	0.18	0.61	0.00	2.38 b	10.10
1933	6.27	0.00	0.00	0.37	0.77	0.06	0.00	0.19	0.00	0.27	0.00	2.96	10.89
1934	1.84	2.25	0.47 h	0.00	0.00	0.77	0.00	0.08	0.15	1.99	2.95	2.33	12.36
1935	2.64 c	0.49 f	2.36	1.04	0.23	0.00	0.00	0.00	0.00	0.13	0.80	0.36	7.56
1936	0.10	5.75	1.03	0.43	0.00	0.00	0.00	0.05	0.00	0.84	0.12	5.95	14.27
1937	2.08	9.78 f	3.00	0.26	0.48	0.00 a	0.00 a	0.00	0.00	0.00	0.00	2.03	7.85
1938	1.33	5.50	5.95 a	1.28	0.55	0.00	0.02	0.00	0.00	0.19	0.09	7.35	22.26
1939	2.59	1.81	1.38	0.66	0.03	0.00	0.00	0.00	3.51	0.36	0.08	0.37	10.79
1940	3.64	4.25	1.19	2.53	0.00	0.00	0.00	0.00	0.00 b	1.32	1.23	4.88	19.04
1941	1.76	7.28	8.54	3.73	0.62	0.14	0.08	0.00	0.00	1.94	0.31	4.16	28.56
1942	0.80	0.97	1.33	3.14	0.04	0.00	0.00	0.14 d	0.00	0.64	0.17	0.90	8.13
1943	8.05 h	3.40	2.12	0.70	0.13 c	0.01	0.00	0.00	0.03	0.31	0.25	5.96 g	6.95
1944	0.84	7.10	1.49	0.99	0.09	0.01	0.00	0.00	0.05	0.00	5.52	0.81	16.90
1945	0.02	3.36	4.07	0.10	0.00 h	0.02	0.05	0.40	0.05	0.43	0.22	4.42	13.14
1946	0.20	0.60	3.60	0.61	0.07	0.00	0.00	0.00	0.02	1.34 i	6.21	2.61	13.92
1947	0.36	0.41	0.91	0.16	0.43	0.02	0.00	0.00	0.14	0.05	0.24	2.08	4.80
1948	0.00	1.47	1.49	1.73	0.00	0.15	0.00 a	0.00 h	0.00	0.06	0.00	2.38	7.28
1949	1.81	1.71	0.82 a	0.01	0.70	0.00	0.00	0.00	0.00	0.05	1.14	2.00	8.24
1950	2.55	1.70	0.82	0.88	0.09	0.00	0.02	0.00	0.01	0.01	1.45	0.07	7.60
1951	1.77 a	0.99	0.61	1.47	0.06	0.00	0.00	0.22	0.50	0.54	0.65	5.60	12.41
1952	8.64	0.23	6.10	1.47	0.00	0.00	0.00	0.00	0.25	0.00	3.16	2.81	22.66
1953	0.91	0.58	0.80	0.92	0.14	0.00	0.00	0.00	0.00	0.01	0.79	0.22	4.37
1954	3.89 c	2.30	2.96	0.19	0.06	0.02	0.00	0.00	0.00	0.00	1.50	0.86	11.78

1955	3.50	1.46	0.10	0.68	1.00	0.04 e	0.00	0.00	0.00 f	0.00	0.92	0.62	8.32
1956	7.65	0.36	0.00	2.44	0.20	0.00	0.00	0.00	0.00	0.27	0.00	0.19	11.11
1957	5.40	0.50	1.15	1.87	0.82	0.11	0.01	0.00	0.00	2.21	0.43	3.06	15.56
1958	1.46	5.33	4.95	4.82	0.15	0.02	0.00	0.13	0.12	0.04	0.06	0.00	17.08
1959	1.24	3.09	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.03	0.15	1.56	6.47
1960	2.37	3.07	0.50 d	1.87	0.05	0.00	0.00	0.00	0.00	0.10	1.96	0.17	10.09
1961	0.94	0.02	0.92	0.01	0.00	0.01	0.00	0.04	0.02	0.08	1.12	1.81	4.97
1962	2.49	6.18	0.98	0.00	0.38	0.02	0.00	0.00	0.00	0.07	0.02	0.00	10.14
1963	0.01	2.47	1.52	1.61	0.00	0.06	0.00	0.03	2.16	0.43	3.11	0.01	11.41
1964	1.37	0.00	1.37	0.60	0.02	0.00 z	0.00	0.00	0.43	0.09	1.13	1.32	6.33
1965	0.76	0.21	1.19	5.13	0.00	0.02	0.12	0.00	0.35	0.00	6.20	3.70	17.68
1966	0.67	1.40	0.15	0.05	0.04	0.00	0.00	0.00	0.01	0.06	1.71	5.45	9.54
1967	2.52	0.00	1.35	3.12	0.02	0.00	0.00	0.00	1.03	0.00	2.63	1.69	12.36
1968	0.67	0.35	1.57	0.52	0.12	0.00	0.07	0.00	0.00	0.22	0.40	1.25	5.17
1969	7.63	8.51	0.90	0.88	0.07	0.01	0.05	0.00	0.00	0.00	2.69	0.33	21.07
1970	1.72	1.46	2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.02	2.79	3.48	11.71
1971	0.95	0.41	0.26	0.43	0.33	0.03	0.00	0.00	0.01	0.17	0.00	3.99	6.58
1972	0.00	0.06	0.01	0.11	0.07	0.00	0.00	0.00	0.00	0.19	2.84	1.69	4.97
1973	3.29	3.83	2.60	0.03	0.04	0.01	0.00	0.00	0.02	0.01	1.54	0.24	11.61
1974	4.17	0.04	3.24	0.40	0.13	0.00	0.00	0.00	0.00	0.70	0.08	3.85	12.61
1975	0.29	1.74	3.48	2.16	0.06	0.00	0.00	0.00	0.00	0.22	0.47	0.11	8.53
1976	0.00	2.67	1.42	1.22	0.07	0.44	0.00	0.00	1.78	0.00	0.60	0.67	8.87
1977	2.89	1.08	0.97	0.00	2.21	0.00	0.00	2.10	0.00	0.00	0.00	3.66	12.91
1978	8.27	5.18	6.79	1.80	0.15	0.00	0.00	0.00	1.37	0.05	2.03	1.73	27.37
1979	4.55	2.94	5.29	0.03	0.00	0.00	0.00	0.00 f	0.00	0.57	0.54	0.53	14.45
1980	7.54	8.00	3.99	0.38	0.30	0.00 z	0.00	0.00	0.00	0.00	0.00	0.48	20.69
1981	2.57	1.85	3.08	0.13	0.04	0.00	0.00	0.00	0.00	0.76	2.18	0.32	10.93
1982	2.61	1.32	4.07	0.00	0.16	0.00	0.00	0.00	1.28 a	0.52	3.41	1.13	14.50
1983	3.08	2.85 d	8.72	3.39	0.05	0.00	0.00	1.51	0.48	1.68	3.55	2.14	27.45
1984	0.12	0.00	0.19	0.60	0.00	0.03	0.00	0.17	0.37	0.09	1.80	4.66	8.03
1985	0.60	0.00 z	0.59	0.03	0.05	0.00	0.00	0.00	0.49	0.16	2.87	0.35	5.14
1986	0.84	5.96	3.03	1.07	0.00	0.01	0.09	0.00	1.04	0.24	0.00 z	1.03	13.31
1987	1.85	2.34	1.08	0.36	0.07	0.00	0.06	0.14	0.46	2.29	1.00	2.47	12.12
1988	1.22	0.74	0.42	2.34	0.00	0.00	0.00	0.10	0.09	0.00	1.00	4.03	9.94
1989	0.49	1.49	0.86	0.08	0.03	0.05	0.00	0.00	0.61	0.35	0.20	0.00	4.16
1990	2.14	2.79	0.45	0.78	0.56	0.12	0.00	0.01	0.00	0.00	0.53	0.05	7.43
1991	1.32	3.00	6.24	0.08	0.00	0.00	0.00	0.00	0.00	0.20	0.00	1.59	12.43
1992	2.50	5.97	6.78	0.13	0.01	0.00	0.15	0.00	0.00	0.94	0.00	4.63 b	21.11
1993	12.56	6.03	1.50	0.00	0.00	1.36	0.00	0.00	0.00	0.18	0.90	0.89	23.42
1994	0.69	4.14	2.35	0.96	0.28	0.04	0.00	0.05	0.00	0.13	1.25	1.08	10.97
1995	11.27	1.47	6.72	0.92	0.90	0.96	0.00 z	0.00 z	0.00 z	0.00	0.00	0.71	22.95
1996	3.01	5.65	2.61	1.36	0.00	0.00	0.00	0.00	0.00	1.29	5.24	3.06	22.22
1997	4.22	0.18	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00	2.65	6.84	15.45
1998	2.84	14.85	3.44	1.42	2.50	0.00	0.00	0.00	0.36	0.00	1.42	1.58	28.41
1999	2.19	0.52	1.19	1.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	5.37

2000	0.60	3.97	2.45	1.41	0.23	0.00	0.00	0.00	0.26	1.25	0.02	0.00	10.19
2001	4.46	6.47	0.86	1.25	0.08	0.05	0.00	0.00	0.00	0.00	1.10	1.06	15.33
2002	0.56	0.40	0.55	0.38	0.17	0.00	0.00	0.00	0.00	0.05	2.20	2.14	6.45
2003	0.13	5.39	3.42	1.73	0.54	0.00	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	0.00 z	11.21

Period of Record Statistics

MEAN	2.53	2.73	2.21	1.01	0.26	0.07	0.01	0.08	0.27	0.36	1.32	1.99	12.80
S.D.	2.61	2.69	2.11	1.11	0.49	0.22	0.03	0.31	0.59	0.55	1.50	1.83	6.50
SKEW	1.81	1.65	1.31	1.68	3.16	4.51	3.22	5.55	3.27	2.11	1.52	0.94	0.90
MAX	12.56	14.85	8.72	5.13	2.50	1.36	0.15	2.10	3.51	2.29	6.21	7.35	28.56
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.16
NO YRS	75	73	75	75	75	73	73	71	73	74	74	75	58

Appendix B

LEAD AND COPPER REQUIREMENTS FOR DRINKING WATER

ACTION: Notice of Proposed Rulemaking
Title 22, California Code of Regulations

SUBJECT: Lead and Copper Requirements for Drinking Water (R-21-01)

PUBLIC PROCEEDINGS: Notice is hereby given that the California Department of Health Services will conduct written public proceedings, during which time any interested person or such person's duly authorized representative may present statements, arguments or contentions relevant to the action described in this notice. Any written statements, arguments or contentions must be received by the Office of Regulations, Department of Health Services, 714 P Street, Room 1000, P.O. Box 942732, Sacramento, CA 94234-7320, by 5 p.m. on January 13, 2003, which is hereby designated as the close of the written comment period. It is requested but not required that written statements, arguments or contentions sent by mail or hand-delivered be submitted in triplicate.

Comments by FAX (916-657-1459) or email (regulation@dhs.ca.gov) must be received before 5:00 p.m. on the last day of the public comment period. All comments, including email or fax transmissions, should include the author's name and U.S. Postal Service mailing address in order for the Department to provide copies of any notices for proposed changes in the regulation text on which additional comments may be solicited.

CONTACTS: **In any of the following inquiries, please identify the action by using the Department regulation control number R-21-01:**

1. In order to request a copy of this regulation package be sent to you, please call (916) 654-0381 or email regulation@dhs.ca.gov.

2. Inquiries regarding the substance of the proposed regulations described in this notice may be directed to Alexis M. Milea of the Division of Drinking Water and Environmental Management at (510) 540-2177.

3. All other inquiries concerning the action described in this notice may be directed to Charles E. Smith of the Office of Regulations at (916) 657-0730, or to the designated backup contact person, Allison Branscombe, at (916) 657-0692.

Persons wishing to use the California Relay Service may do so at no cost. The telephone numbers for accessing this service are: 1-800-735-2929, if you have a TDD; or 1-800-735-2922, if you do not have a TDD.

INFORMATIVE DIGEST/POLICY STATEMENT OVERVIEW: All suppliers of domestic water to the public are subject to regulations adopted by the U.S. Environmental Protection Agency (EPA) under the Safe Drinking Water Act (42 U.S.C. 300f et seq.) as well as by the California Department of Health Services (Department) under the California Safe Drinking Act (Sections 116300-116750, Health and Safety Code [H&S Code]). California has been granted “primacy” for the enforcement of the Federal Act. In order to receive and maintain primacy, states must promulgate regulations that are no less stringent than the federal regulations.

In accordance with federal regulations, California requires public water systems to sample their sources and have the samples analyzed for inorganic and organic substances to determine compliance with drinking water standards, also known as maximum contaminant levels (MCLs). Primary MCLs are based on health protection, technical feasibility, and costs. Secondary MCLs are based on consumer acceptance, using parameters such as odor, taste, and appearance as measures of acceptability. The water supplier must notify the Department and the public when a primary or secondary MCL has been violated and take appropriate action. Public water systems must also sample for a number of “unregulated” chemicals, as set forth in regulation. When MCLs are not the most feasible or appropriate approach to minimizing the level of a contaminant in drinking water, regulations are adopted that use “treatment techniques” to control the levels of the contaminant instead. The lead and copper rule is a “treatment technique” regulation.

On December 11, 1995, for conformance with the federal lead and copper rule, 40 Code of Federal Regulations (CFR) Parts 141 and 142, [Federal Register (FR) 56 (110), 26460-26564, June 7, 1991; amended July 15, 1991 (56 FR 32113), June 29, 1992 (57 FR 28786) and June 30, 1994 (59 FR 33860)], California adopted requirements for community water and nontransient-noncommunity systems to monitor and treat drinking water to minimize the corrosivity and, therefore, the lead and copper levels, in water served to the public. On Jan 12, 2000, EPA promulgated further revisions to the lead and copper rule [Federal Register 65(8), 1950-2002]. The new federal revisions include requirements that California must adopt to maintain primacy and others that are optional. The California regulations now being proposed incorporate all the required and almost all of the optional federal revisions.

When the Department initially adopted the federal requirements, it had a limited timeframe within which to do so and was not able to rewrite the federal lead and copper rule to eliminate its redundancies, ambiguities, excess verbiage, and confusing organization. Consequently, the Department’s field staff has encountered difficulties implementing the regulations, and drinking water utilities have been challenged in their efforts to comply. Subsequent to EPA’s adoption of the federal lead and copper rule revisions, the Department determined that a rewrite of the existing regulations would

facilitate both enforcement and compliance efforts, and therefore the existing state regulations were rewritten while incorporating the federal lead and copper rule revisions. Given the major changes being proposed to the format of the existing state regulations, the proposed new state regulations are presented as a repeal of the existing lead and copper requirements in chapter 17.5 of division 4, title 22, California Code of Regulations, to be replaced by an entirely new chapter 17.5. Except as described below, all requirements in the proposed new chapter 17.5 are supported by references to the federal lead and copper rule (40 CFR Parts 141 and 142).
Specifically, the Department proposes to repeal the existing chapter 17.5 (sections 64670 through 64692, inclusive) of division 4, title 22, California Code of Regulations, and replace it with the proposed new chapter 17.5 (new sections 64670 through 64690.80, inclusive). The articles indicating the organization and content of the proposed new chapter 17.5 are as follows:

Chapter 17.5. Lead and Copper

- Article 1. General Requirements and Definitions
- Article 2. Requirements According to System Size
- Article 3. Monitoring for Lead and Copper
- Article 4. Water Quality Parameter (WQP) Monitoring
- Article 5. Corrosion Control
- Article 6. Source Water Requirements for Action Level Exceedances
- Article 7. Public Education Program for Lead Action Level Exceedances
- Article 8. Lead Service Line Requirements for Action Level Exceedances
- Article 9. Reporting and Recordkeeping

The net effect of the chapter reorganization and proposed incorporation of the most recent federal lead and copper rule revisions cited would be that:

- Large water systems (serving more than 50,000 people) deemed to have optimized corrosion control would be required to continue monitoring to demonstrate that the treatment is maintained.
- Systems with corrosion control treatment would be subject to a different compliance determination for water quality parameters.
- Systems on reduced lead and copper monitoring would be required to use representative sampling sites.
- Lead and copper tap samples could be invalidated if certain criteria were met.
- Small water systems (serving 3,300 or fewer people) could obtain waivers for lead and copper tap sampling.
- Analytic methods for lead, copper, pH, conductivity, calcium, alkalinity, orthophosphate, silica, and temperature prescribed at 40 Code of Federal Regulations, Section 141.89 [Federal Register (FR) 56 (110), 26460-26564, June 7, 1991; amended July 15, 1991 (56 FR 32113), June 29, 1992 (57 FR 28786), June 30, 1994 (59 FR 33860), and January 12, 2000 (65 FR 1250)] would be incorporated by reference in proposed new section 64670.

Adoption of these requirements would satisfy the mandate in section 116350, H&S Code, and federal primacy requirements related to the adoption of regulations at least as stringent as the federal. However, there are some differences between the federal and proposed state regulations:

- Section 64670(d) proposes to specify the timeframe for coming into compliance with chapter 17.5 for both new systems and systems that change size categories; there is no comparable federal requirement.
- A number of terms are defined in order to simplify and reduce the wording in the state regulation text for the sake of clarification: action level exceedance (section 64671.08), period (section 64671.55), tap sampling (section 64671.73), water quality parameter (WQP) (section 64671.75), and WQP monitoring (section 64671.80).
- Section 64671.15 defines the term “Detection Limit for Purposes of Reporting” or “DLR” for consistency with other state regulations.
- Section 64673(c)(2)(B) sets the timeframe for beginning corrosion control treatment installation in order to facilitate completion on schedule; there is no comparable federal requirement.
- Section 64675(c) specifies the requirements with which the water supplier must comply in order to determine sampling sites; there is no comparable federal requirement.
- Section 64678(b) establishes how to use levels between the method detection level and the practical quantitation level (PQL) (known as the DLR in California); this is not directly specified in the federal requirements, but consistent with federal intent; it is a requirement in the existing Chapter 17.5.
- Section 64678(c) establishes that levels less than the method detection level shall be considered zero; this is not directly specified in the federal requirements except for source water monitoring, but consistent with federal intent; it is a requirement in the existing chapter 17.5.
- Section 64684(d)(2)(C) clarifies that when sampling is less than daily, the daily value applies to the day that the supplier receives the lab result or the 14th day, whichever comes first. The Department determined that for some water quality parameters, e.g., zinc, phosphate, specific conductance, and total alkalinity, in-house lab results are not available for at least 48 hours and for water suppliers contracting with commercial laboratories, two weeks is the normal turnaround time with surcharges being levied for shorter turnaround times. One large supplier reported that costs rose by 50% to have the shortest available turnaround time of 5 days. Since the highest required monitoring frequency is biweekly and there is no direct relationship between these parameters and risks to public health, applying the result to the day the supplier receives it is appropriate. The supplier cannot take action until aware that there is a problem. The drafted language would support the designation of optimal levels/ranges for water quality parameters and thereby encourage full corrosion control treatment

optimization without penalizing suppliers that monitor with the required frequency [by comparison reference 40 CFR 141.82(g)].

AUTHORITY: Sections 100275, 116350, 116365, 116375, and 116385, Health and Safety Code.

REFERENCE: Sections 116325 through 116750, Health and Safety Code.

FISCAL IMPACT ESTIMATE:

A. Fiscal Effect on Local Government: Annual savings that are not measurable.

B. Fiscal Effect on State Government: Annual savings that are not measurable.

C. Fiscal Effect on Federal Funding of State Programs: No fiscal impact exists.

D. All cost impacts, known to the Department at the time the notice of proposed action was submitted to the Office of Administrative Law, that a representative private person or business would necessarily incur in reasonable compliance with the proposed action: Small water systems (serving 3,300 or fewer people) could obtain waivers for lead and copper tap sampling under the proposed regulations, and this provision could result in a significant cost savings for small water systems, since sampling would be required only once every 9 years instead of annually or triennially, depending on the system.

E. Other Nondiscretionary Cost or Savings Imposed on Local Agencies: None.

DETERMINATIONS: The Department has determined that the regulations would not impose a mandate on local agencies or school districts, nor are there any costs for which reimbursement is required by Part 7 (commencing with Section 17500) of Division 4 of the Government Code.

The Department has made an initial determination that the regulations would not have a significant statewide adverse economic impact directly affecting business, including the ability of California businesses to compete with businesses in other states.

The Department has determined that the regulations would not significantly affect the following:

(1) The creation or elimination of jobs within the State of California. The proposed regulations should not have any affect in this area in that there would not be any change in water system or regulatory personnel needed for compliance with the proposed requirements.

(2) The creation of new businesses or the elimination of existing businesses within the State of California. The nature of the water industry is such that the proposed

regulations would not result in the creation or elimination of water systems. The impact of the regulations will be insignificant. Based on previous experience, the Department does not expect that the monitoring costs estimated for this regulation will affect the number of businesses in California, while the overall net savings could be of benefit.

(3) The expansion of businesses currently doing business within the State of California. Since water system size is basically a function of the number of service connections (consumers) served, the proposed regulations should not have any affect on expansion.

The Department has determined that the regulations would not affect small business because Government Code Chapter 3.5, Article 2, Section 11342.610 excludes drinking water utilities from the definition of small business.

The Department has determined that the regulations will have no impact on housing costs.

AVAILABILITY OF STATEMENT OF REASONS AND TEXT OF REGULATIONS: The Department has prepared and has available for public review an initial statement of reasons for the proposed regulations, all the information upon which the proposed regulations are based, and the text of the proposed regulations. A copy of the initial statement of reasons and a copy of the text of the proposed regulations are available upon request by writing to the Office of Regulations at the address noted above, which address will also be the location of public records, including reports, documentation, and other material related to the proposed regulations (rulemaking file). Additionally, a copy of the final statement of reasons (when prepared) will be available upon request from the Office of Regulations at the address noted above. Materials regarding the proposed regulations that are available via the Internet may be accessed at http://www.applications.dhs.ca.gov/regulations/.

AVAILABILITY OF CHANGED OR MODIFIED TEXT: The full text of any regulation which is changed or modified from the express terms of the proposed action will be made available by the Department's Office of Regulations at least 15 days prior to the date on which the Department adopts, amends, or repeals the resulting regulation.

ADDITIONAL STATEMENTS AND COMMENTS: In accordance with Government Code Section 11346.5(a)(13) the Department must determine that no reasonable alternative considered by the Department or that has otherwise been identified and brought to the attention of the Department would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

No hearing has been scheduled; however any interested person or his or her duly authorized representative may request, no later than 15 days prior to the close of the written comment period, a public hearing pursuant to Government Code Section 11346.8.

Sign language interpreting services at a public hearing or other reasonable accommodation will be provided upon request. Such request should be made no later than 21 days prior to the close of the written comment period, and addressed to the Office of Civil Rights within the Department of Health Services by phone (916-657-1411); FAX (916-657-0153); TDD (916-657-2861); or email (civilrights-ra@dhs.ca.gov).

DEPARTMENT OF HEALTH SERVICES

R-21-01

Dated:

Diana M. Bontá, R.N., Dr.P.H.
Director

Appendix C

NATIONAL PRIMARY DRINKING WATER STANDARDS

EPA National Primary Drinking Water Standards

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Acrylamide	TT[8]	Nervous system or blood problems;	Added to water during sewage/wastewater increased risk of cancer treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010 as of 1/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta particles and photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes	MRDLG=4[1]

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[7]; Action Level = 1.3	Short term exposure: Gastrointestinal distress. Long term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, live problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidneys problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadien e	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT[7]; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms (including fecal coliform and *E. coli*)	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste.	zero
DBP	Total Trihalomethanes (TTHMs)	0.10 0.080 after 12/31/03	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.20
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero
M	Turbidity	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing micro-organisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
- *Giardia lamblia*: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, for systems servicing >10,000, and January 14, 2005, for systems servicing <10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

4 No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

5 Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

6 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

8 Each water system must certify, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent).

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

National Secondary Drinking Water Standards

National Secondary Drinking Water Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Office of Water (4606M)
EPA 816-F-03-016
www.epa.gov/safewater
June 2003

Appendix D

PUMP CURVES

Bastanchury BPS

30 hp
1000 gpm
11.43 s pcs
61.00 B pcs
113 Ft hd.
2 Stages
BASTANCHURY
BP #1

FORM NO. E-102 W&B

CURVE NO. PC 1230A

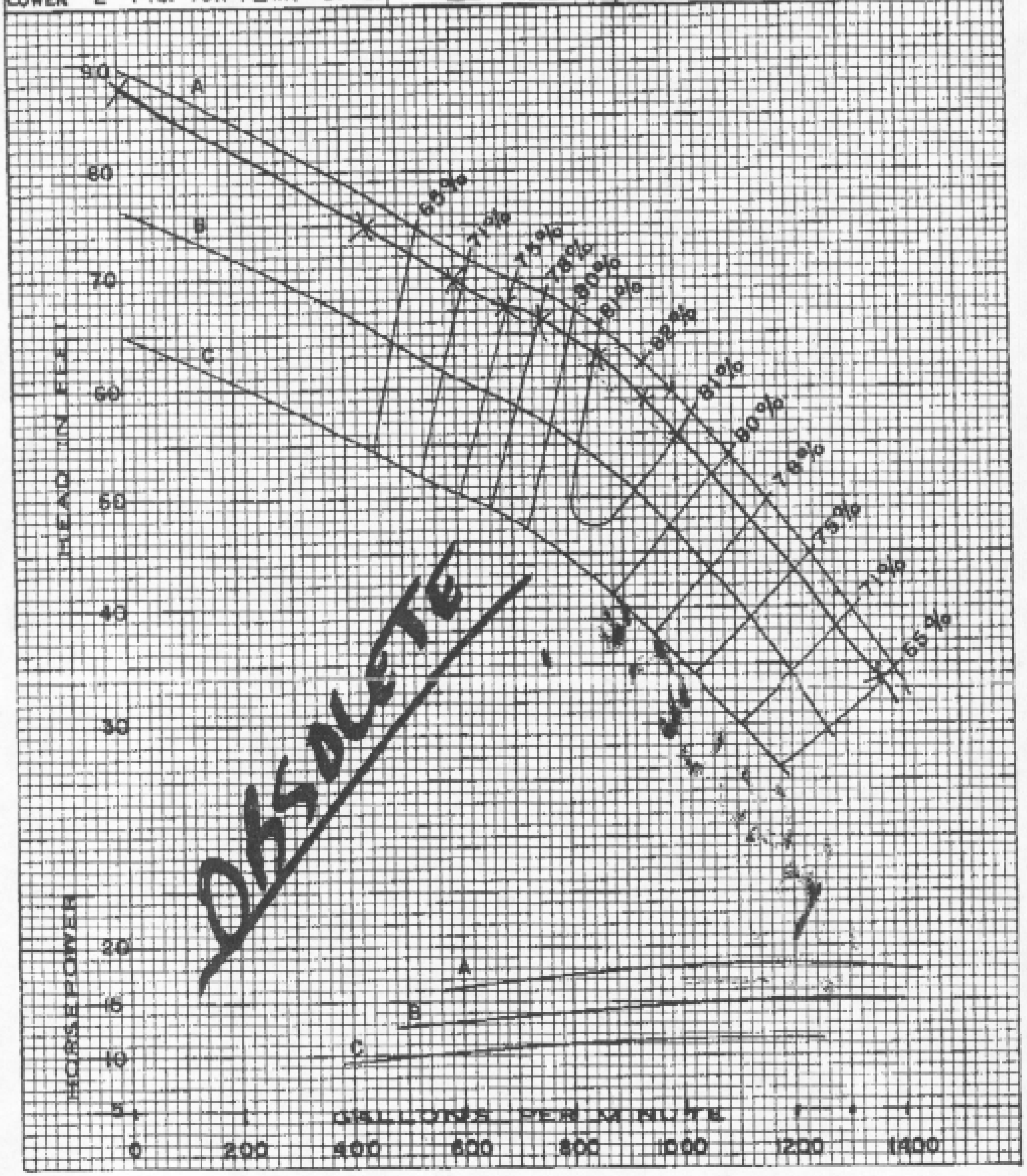
CHANGE EFFIC. AS FOLLOWS	NO. OF POINTS	NO. OF STAGES
LOWER	4	1
LOWER	1.5	2
RAISE	1	6
RAISE	1.5	9

LOWER 2 PTS. FOR PLAIN BOWLS

LAYNE & BOWLER VERTI-LINE PUMPS

12 CM

SINGLE STAGE 1770 R.P.M.
ONE STAGE 2' - 2" LONG ADD 8" FOR EACH ADDITIONAL STAGE
O.D. BOWLS 11 1/4" K = 13



30 hp 500 gpm 11.43 S press 61.00 D " 2 stages 4 stages? n.o.

CURVE NO. PC 1020A

CHANGE EFFIC. AS FOLLOWS	NO. OF POINTS	NO. OF STAGES
LOWER	3	1
LOWER	1.5	2
LOWER	1	3
RAISE	1	7
LOWER 2 PTS. FOR PLAIN BOWLS		

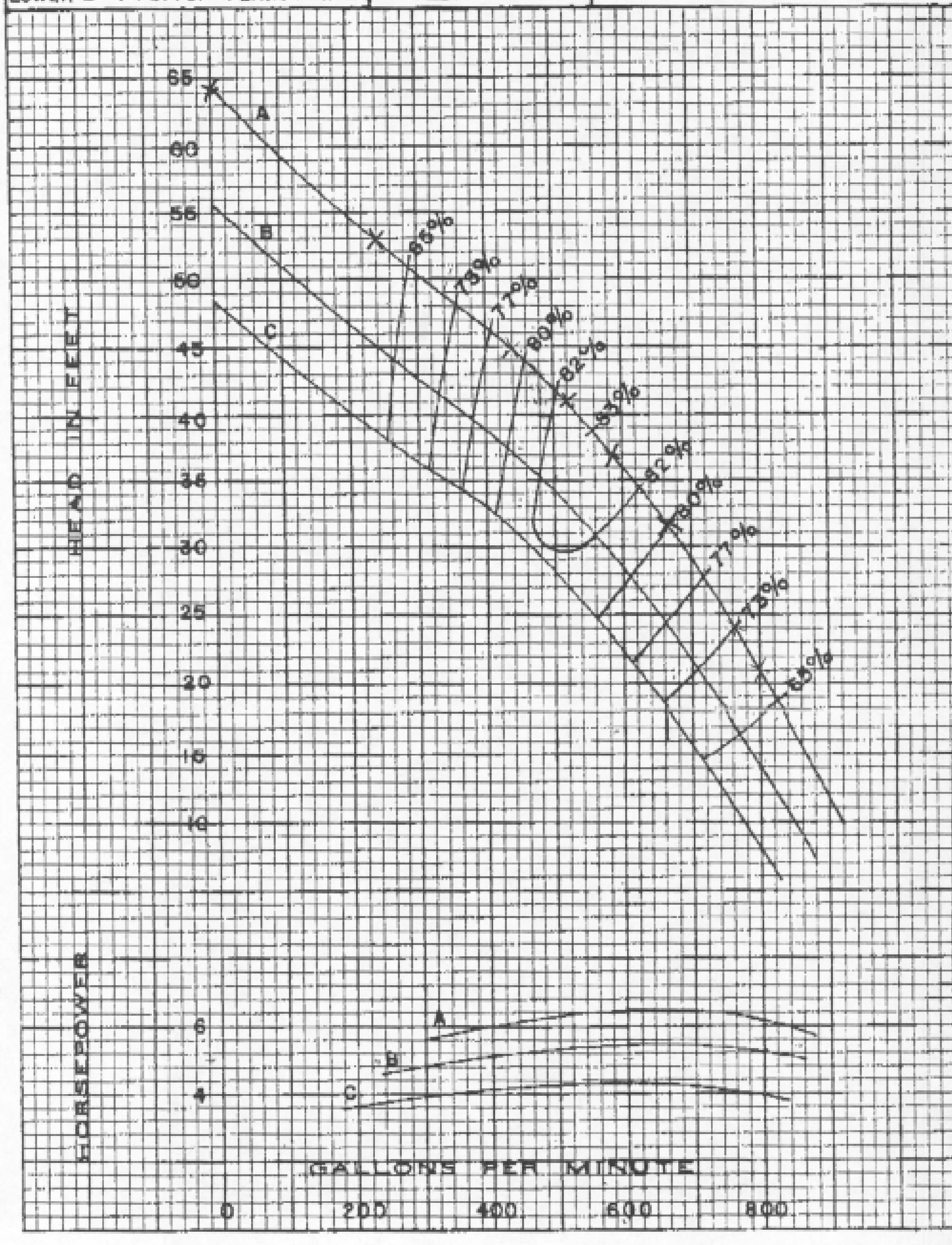
LAYNE & BOWLER VERTI-LINE PUMPS

10 RL

SINGLE STAGE 1770 RPM

ONE STAGE 2'-2-1/8" LONG ADD 8-3/8 FOR EACH ADDITIONAL STAGE

O.D. BOWLS 9 3/8" K = 8.34



2000 gpm 4 stages

FORM NO. C-101 W&N

CHANGE EFFIC. AS FOLLOWS	NO. OF POINTS	NO. OF STAGES
LOWER	3	1
LOWER	1	2
RAISE	0	3
RAISE	1	6
LOWER 2 PTS. FOR PLAIN BOWLS		

LAYNE & BOWLER VERTI-LINE PUMPS

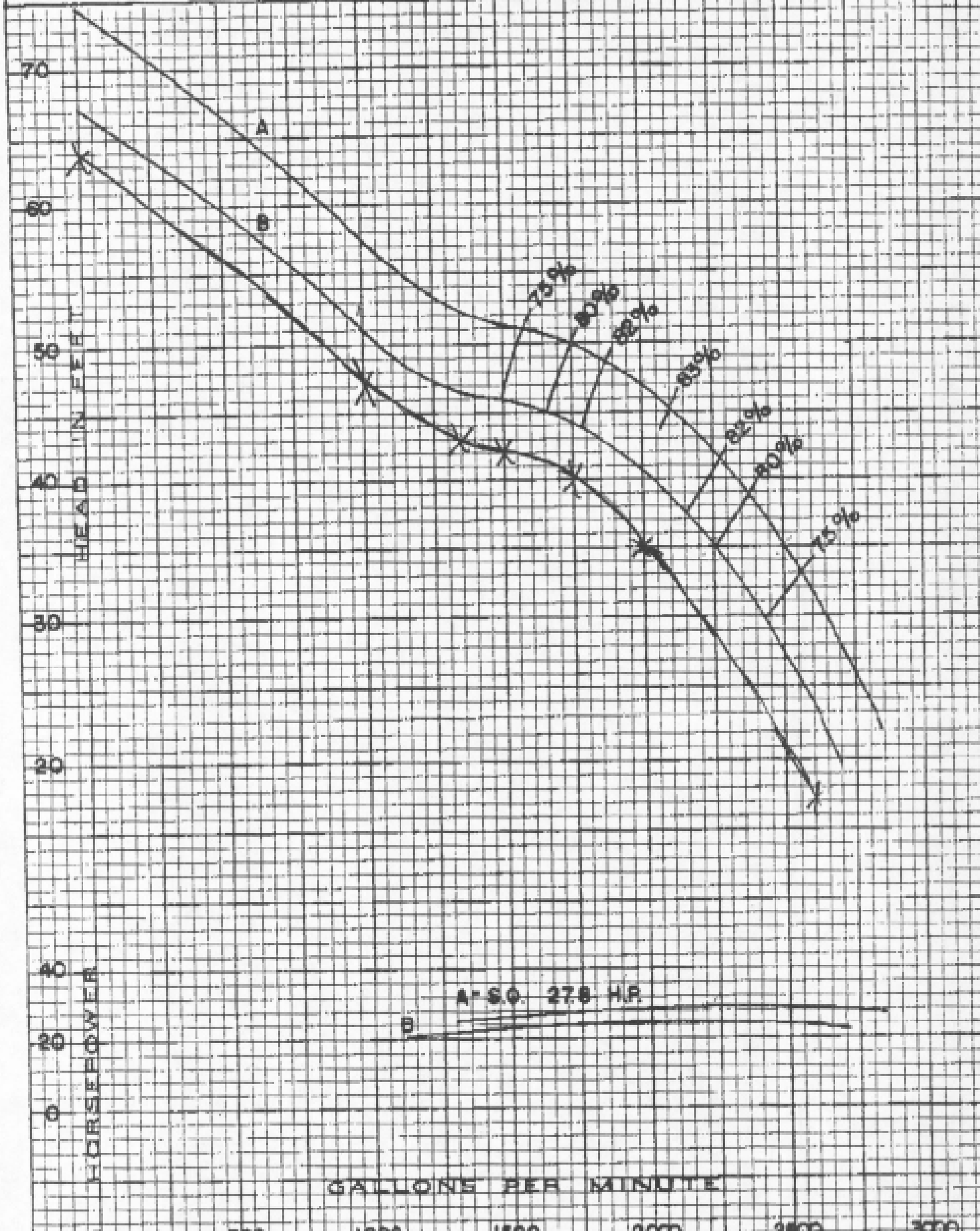
CURVE NO. PC 1290

12 FHM

SINGLE STAGE 1770 RPM

ONE STAGE 30 1/2" LONG ADD 11" FOR EACH ADDITIONAL STAGE

O.D. BOWLS 11 3/8" K = 16.5



Box Canyon BPS

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL™ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - BOX CANYON #1
CIS ACCT: 62-48-933-3152-01
CUST #: 0-001-3578 SERV ACCT #: 004-5839-45
5490 1/2 VIA LOMAS
DATE OF TEST: April 22, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PERLS NO: 260398
MOTOR: US NO: 297050R-2 40 HP
METER: PO726K-2460
HYDRAULIC TEST REFERENCE NUMBER: 29340

TEST RESULTS	
Discharge Pressure, PSI	177.0
Discharge Head, Ft.	408.9
Suction Head or Lift, Ft.	390.4
Total Head, Ft.	18.5
Capacity, GPM	2813.0
Acre Ft. Pumped in 24 Hrs.	12.433
kW Input to Motor	29.1
HP Input to Motor	39.0
Motor Load (%)	88.8
Measured Speed of Pump, RPM	1781
kWh per Acre Ft.	56
Overall Plant Efficiency (%)	33.7
Customer Meter, GPM	3050.0

Due to an inadequate water measurement test location, the GPM flow and the resulting overall plant efficiency should be considered approximate, rather than actual.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 40 - PLANT: BOX CANYON #1
CIS ACCT: 62-48-933-3152-01
CUST #: 0-001-3578 SERV ACCT #: 004-5839-45
HYDRAULIC TEST REFERENCE NUMBER: 29340

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 22, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 65.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	71616	37104	34512
kW Input	29.1	15.1	14.0
kWh per Acre Ft.	56	29	27
Acre Ft. per Year	1274.7	1274.7	
Avg. Cost per Acre Ft.	$3.26	$1.69	$1.57
Overall Plant Eff. (%)	33.7	65.0	
TOTAL ANNUAL COST	$4,153.73	$2,152.03	$2,001.69

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

SOUTHERN CALIFORNIA
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - BOX CANYON #2
CIS ACCT: 62-48-933-3152-01
CUST #: 0-001-3578 SERV ACCT #: 004-5839-45
5490 1/2 VIA LOMAS
DATE OF TEST: April 22, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PERLS NO: 260399
MOTOR: US NO: 297050R-1 40 HP
METER: PO726K-2460
HYDRAULIC TEST REFERENCE NUMBER: 29341

TEST RESULTS	
Discharge Pressure, PSI	178.0
Discharge Head, Ft.	411.2
Suction Head or Lift, Ft.	392.7
Total Head, Ft.	18.5
Capacity, GPM	3010.0
Acre Ft. Pumped in 24 Hrs.	13.304
kW Input to Motor	28.9
HP Input to Motor	38.8
Motor Load (%)	88.2
Measured Speed of Pump, RPM	1784
kWh per Acre Ft.	52
Overall Plant Efficiency (%)	36.3
Customer Meter, GPM	3010.0

We were unable to measure the GPM flow; therefore, the above test results were obtained using your water meter.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 40 - PLANT: BOX CANYON #2
CIS ACCT: 62-48-933-3152-01
CUST #: 0-001-3578 SERV ACCT #: 004-5839-45
HYDRAULIC TEST REFERENCE NUMBER: 29341

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 22, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 65.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	71616	39977	31639
kW Input	28.9	16.1	12.8
kWh per Acre Ft.	52	29	23
Acre Ft. per Year	1373.4	1373.4	
Avg. Cost per Acre Ft.	$3.02	$1.69	$1.34
Overall Plant Eff. (%)	36.3	65.0	
TOTAL ANNUAL COST	$4,153.73	$2,318.68	$1,835.05

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

Box Canyon Pump Sta.

PART 2 - MATERIALS

A. General

Two identical pumps and motors will be supplied for the Zone 4 Terminus Booster Pump Station, each pump shall be able to meet the maximum day demand of 2,000 gpm.

B. Operating Requirements

1. Pump Demand

a. Type of drive: Vertical solid shaft

b. Flow characteristics:

Flow	T.D.H.	Eff.
0	77	--
1200	49	61
1600	47	75
2000	44	81
2400	36	78
2800	25	65

c. Number of stages: 1

d. Motor size: 50 HP

e. Normal speed: 1760 rpm

f. Minimum column diameter: 10 inches

g. Minimum net shaft diameter: 1 3/16 inches

h. Maximum diameter of bowl: 10 inches

i. Discharge head size: 12 inches

j. Suction inlet size: 12 inches

. PUMP DESCRIPTION

1. Discharge Heads: The discharge heads shall be fabricated steel construction and the discharge flange shall have a flat face rating of 300 lb. The base of the discharge head shall be for mounting on a 150 lb. flat faced flange. The stuffing box area shall have ample space for the flanged type spacer coupling connecting the motor shaft to the pump shaft and the mechanical seal. The base of the discharge head shall be drilled and tapped

Elk Mountain BPS

CERTIFIED BY:

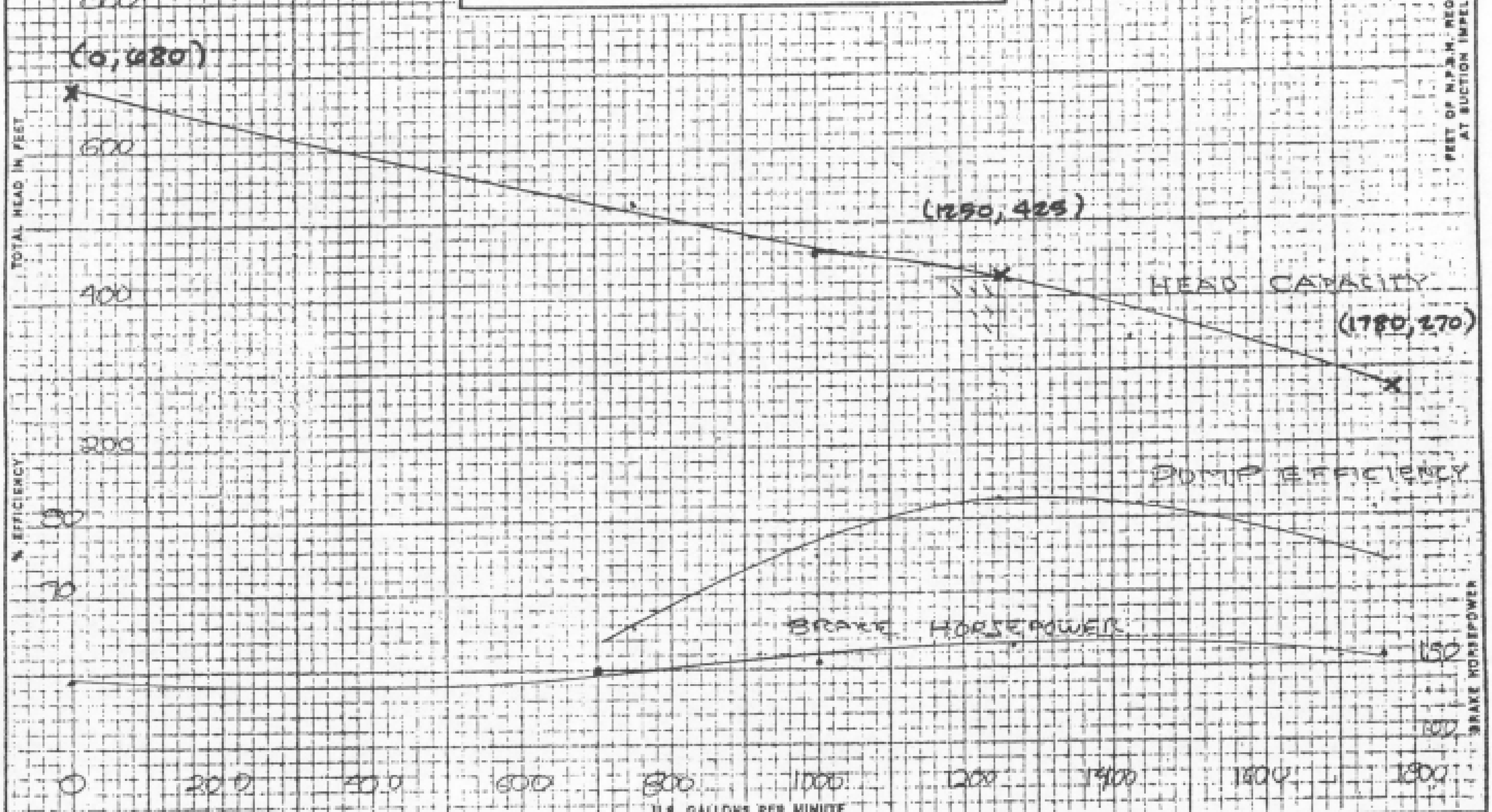
DATE

CUSTOMER CALIAGU

ELK MOUNTAIN DRIVE

BOOSTER PUMP STA.

REF. NO. MAX DAY DEMAND PUMPS



THE CAPACITY, HEAD AND EFFICIENCY GUARANTEE IS FOR THE DESIGNATED POINT ONLY; IT IS BASED ON SHOP TESTS, WHEN HANDLING CLEAR, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND UNDER SUCTION CONDITIONS AS SPECIFIED IN THE CONTRACT.

IMPELLER 8.02 DIA.

BOWLS C.I.

LIQUID H_2O

SP. GR. 1.0

DATE 4-20-91 BY JH

INGERSOLL-RAND

PUMPS

1250@426 PERFORMANCE

9 STAGE 12 NKL PUMP

1770 R.P.M.

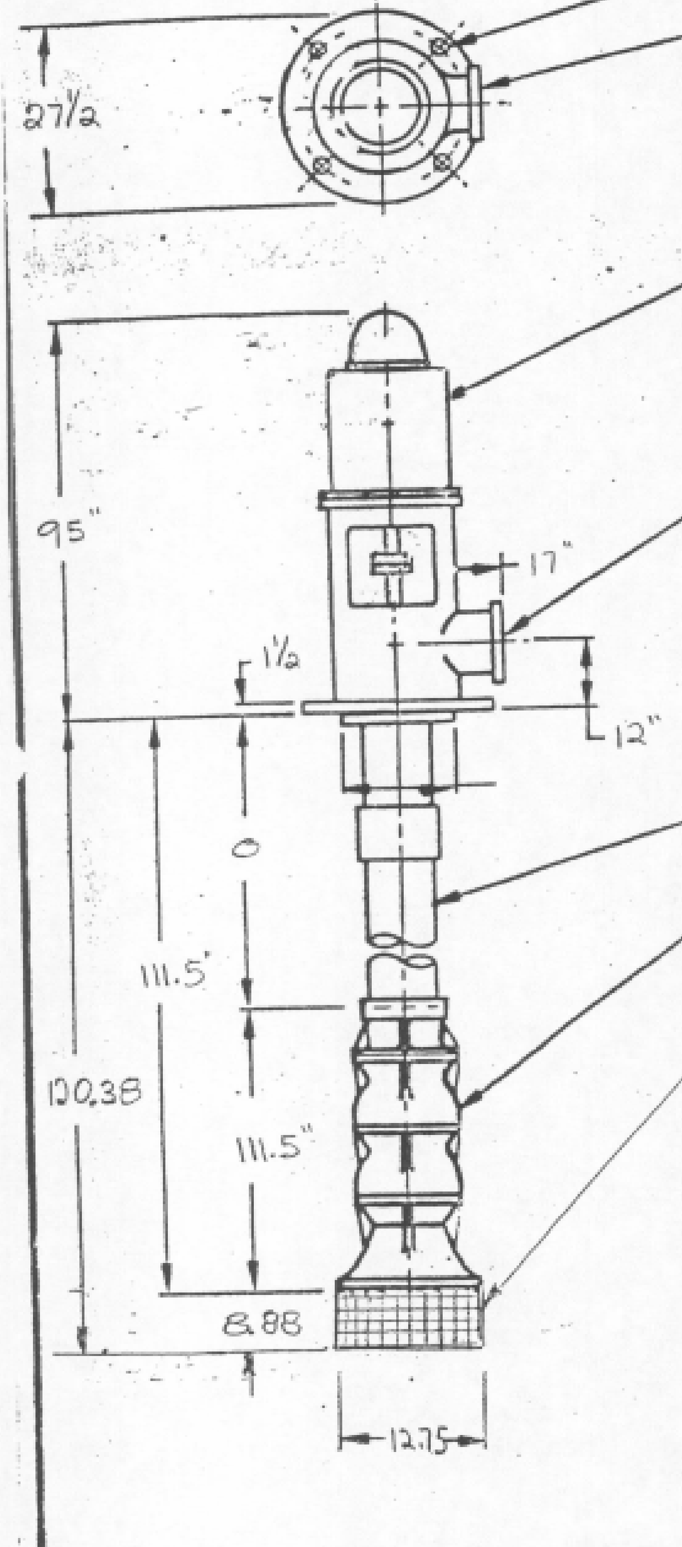
CURVE NO.

JP-167A

VERTICAL TURBINE PUMP

ELK MTN BSTR #1

BASE MATCHES 20 ASA FLANGE 150#
20-1⅛ " DIA. HOLES ON 25 " B.C.
STRADDLE CENTERLINE OF DISCHARGE
12 " x 300 ASA DISCHARGE FLANGE



200 1800 RPM VFS
3Ø-60 HZ-460 V WP-1
120 V SPACE HEATERS
120 V THERMISTERS
MFG. USEM

TYPE "A" DISCHARGE HEAD— 16 x 12
WATER PASSAGE COATED W/ NO. 302
CRANE 1B MECH SEAL

CONDITIONS:
U.S. GALLONS PER MINUTE— 1250
TOTAL DYNAMIC HEAD IN FT.— 426
LIQUID— WATER
SPEC. GRAV. 1.0 @ °F. TEMP.

COLUMN ASSEMBLY— NONE
COATED W/ SCOTCHCOTE NO 302 8MIL

BOWL ASSEMBLY— 9 STAGE 12NKL
OD COATED W/ SCOTCHCOTE NO 302
8 MILLS. DUAL WEAR RINGS
SS BOLTING 18-8
18-8 SS BASKET STR.

CUSTOMER CALIAGUA INC
ELK MOUNTAIN DRIVE
BOOSTER PUMP STATION
CONTRACT 8961
PO # 222-5

NOTE: DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED

INGERSOLL-RAND®
PUMPS

SOUTHERN CALIFORNIA
EDISON

An EDISON INTERNATIONAL™ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - ELK MOUNTAIN 1
CIS ACCT: 62-48-988-2148-02
CUST #: 0-001-3578 SERV ACCT #: 004-1142-83
27765 1/2 ELK MOUNTAIN
DATE OF TEST: April 19, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: US NO: 1650409R-1 200 HP
METER: LBD015-82724
HYDRAULIC TEST REFERENCE NUMBER: 29334

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	181.5	199.5	221.0
Discharge Head, Ft.	419.3	460.8	510.5
Suction Head or Lift, Ft.	16.2	16.4	16.4
Total Head, Ft.	403.1	444.4	494.1
Capacity, GPM	1246.0	975.0	744.0
Acre Ft. Pumped in 24 Hrs.	5.507	4.310	3.288
kW Input to Motor	135.6	132.7	129.4
HP Input to Motor	181.8	178.0	173.5
Motor Load (%)	86.7	84.9	82.8
Measured Speed of Pump, RPM	1787		
kWh per Acre Ft.	591	739	945
Overall Plant Efficiency (%)	69.8	61.5	53.5
Customer Meter, GPM	1384.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. Due to an inadequate water measurement test location, the GPM flow and the resulting overall plant efficiency should be considered approximate, rather than actual.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 200 - PLANT: ELK MOUNTAIN 1
CIS ACCT: 62-48-988-2148-02
CUST #: 0-001-3578 SERV ACCT #: 004-1142-83
HYDRAULIC TEST REFERENCE NUMBER: 29334

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 19, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 72.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	198996	192779	6217
kW Input	135.6	131.4	4.2
kWh per Acre Ft.	591	573	18
Acre Ft. per Year	336.7	336.7	
Avg. Cost per Acre Ft.	$30.73	$29.77	$0.96
Overall Plant Eff. (%)	69.8	72.0	
TOTAL ANNUAL COST	$10,347.79	$10,024.49	$323.30

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

CERTIFIED BY:

DATE

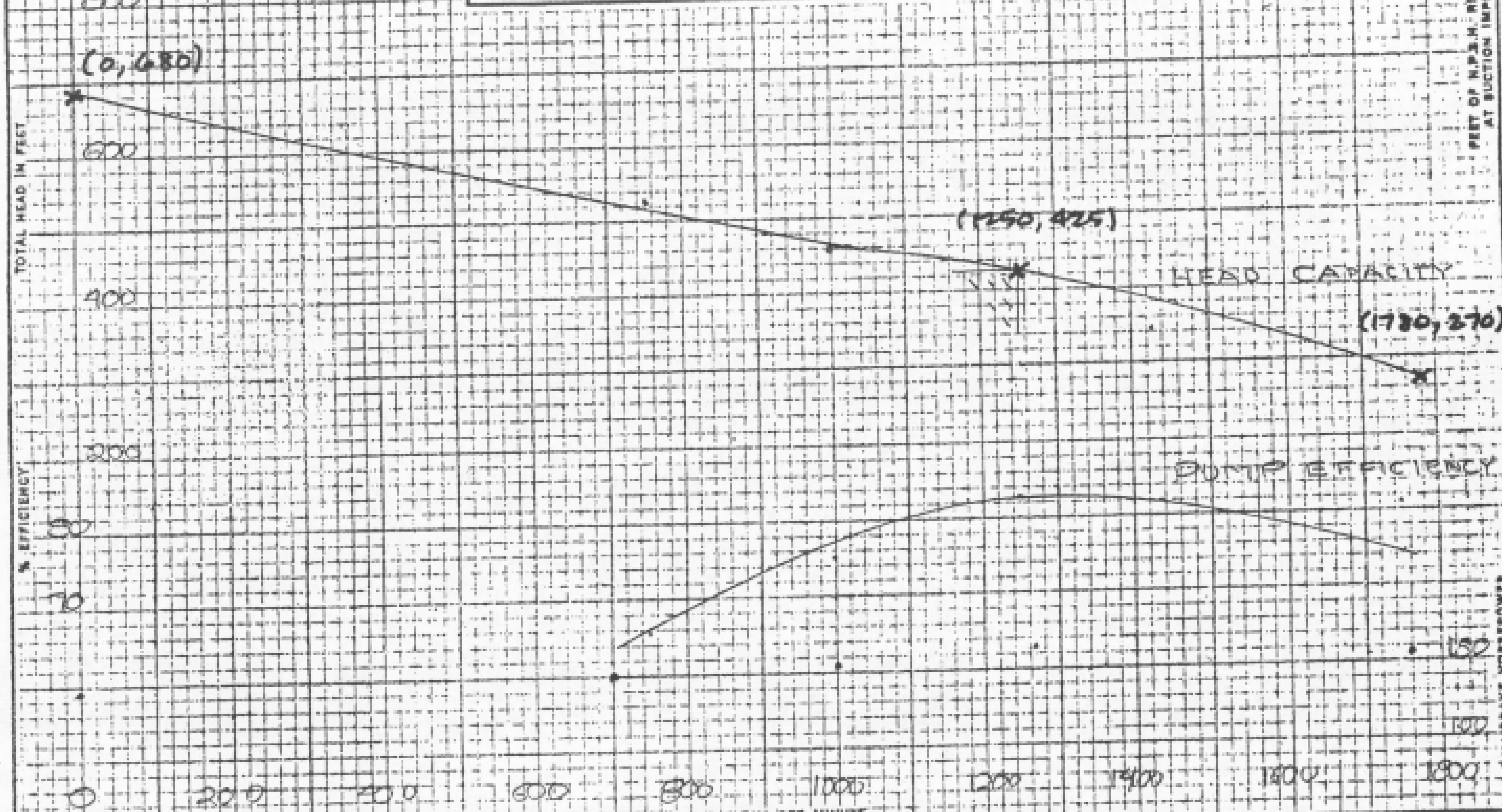
CUSTOMER Caliagu

Elk Mountain Drive

Booster Pump Sta.

REF. NO. Max Day Demand Pumps

SUBMERGENCE REQ'D OVER BELL TO PREVE[illegible] VORTEXES BASED ON SUMP DESIGN PER HYDRAULIC I[illegible] UTE STDS.



THE CAPACITY, HEAD AND EFFICIENCY GUARANTEE IS FOR THE DESIGNATED POINT ONLY; IT IS BASED ON SHOP TESTS WHEN HANDLING CLEAR, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND UNDER SUCTION CONDITIONS AS SPECIFIED IN THE CONTRACT.

IMPELLER 8.02 DIA.
BOWLS C.I.
LIQUID H_2O
SP. GR. 1.0
DATE 4-20-91 BY JK

INGERSOLL-RAND PUMPS

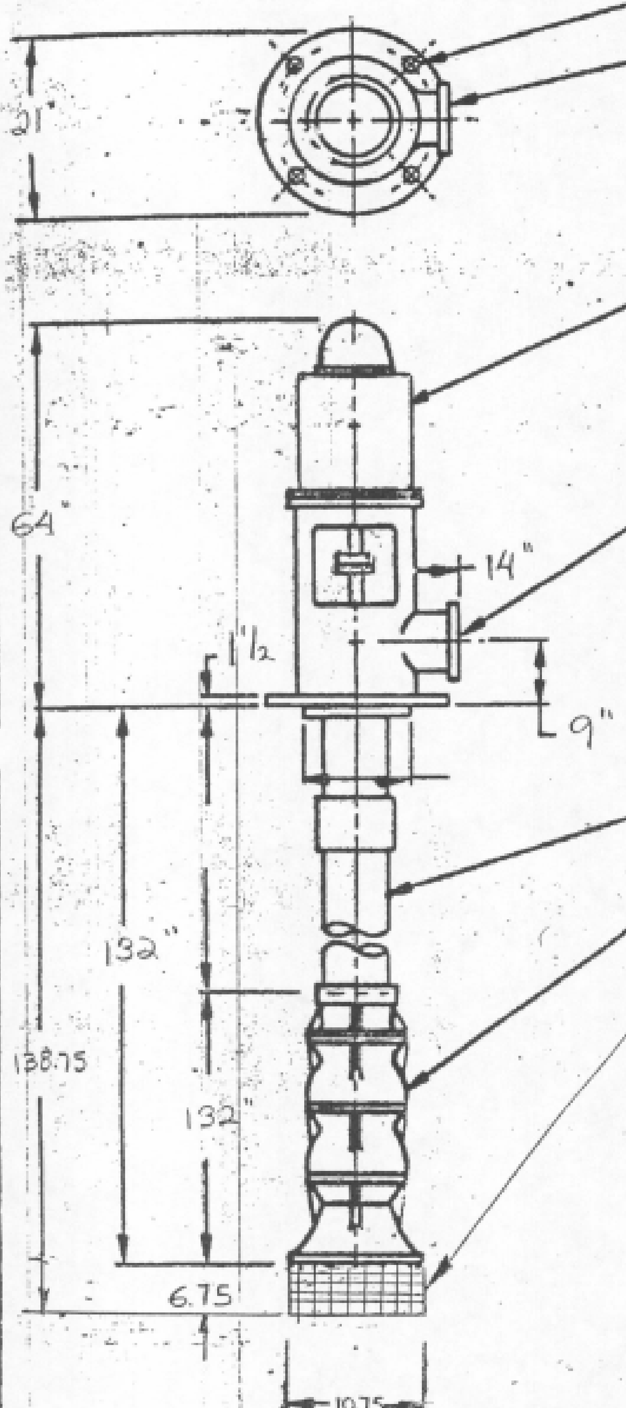
1250 @ 426 PERFORMANCE
9 STAGE 12 NKL PUMP
1770 R.P.M.
CURVE NO.

JP-167A

VERTICAL TURBINE PUMP

ELK MTN #2

BASE MATCHES 14" ASA FLANGE 150#
12 - 1 " DIA. HOLES ON 18 3/4" B.C.
STRADDLE CENTERLINE OF DISCHARGE
6 " x 300 " ASA DISCHARGE FLANGE



40 1800 RPM VSS
3Ø 60 HZ 460 V TEFC
120 V SPACE HEATERS
120 V THERMISTERS
MFG. USEM

TYPE "A" DISCHARGE HEAD— 16 x 6
WATER PASSAGE COATED W/ NO 302

CONDITIONS:
U.S. GALLONS PER MINUTE— 240
TOTAL DYNAMIC HEAD IN FT.— 425
LIQUID— WATER
SPEC. GRAV. 1.0 @ AMB °F. TEMP.

COLUMN ASSEMBLY— NONE
COATED W/ SCOTCHCOTE NO 302 8 MIL

BOWL ASSEMBLY— 17 STAGE 8 KKH
OD COATED W/ SCOTCHCOTE NO 302
18-8 SS STRAINER
BOLTING 18-8 SS

CUSTOMER CALIAGUA INC
ELK MOUNTAIN DRIVE
BOOSTER PUMP STATION
CONTRACT 8961
PO # 222-5

NOTE: DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED

INGERSOLL-RAND®
PUMPS

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - ELK MOUNTAIN 2
CIS ACCT: 62-48-988-2148-02
CUST #: 0-001-3578 SERV ACCT #: 004-1142-83
27765 1/2 ELK MOUNTAIN
DATE OF TEST: April 19, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT
PUMP: N/A NO: N/A
MOTOR: US NO: 1650409R-2 200 HP
METER: LBD015-82724
HYDRAULIC TEST REFERENCE NUMBER: 29335

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	181.0	201.0	218.0
Discharge Head, Ft.	418.1	464.3	503.6
Suction Head or Lift, Ft.	16.2	16.4	16.4
Total Head, Ft.	401.9	447.9	487.2
Capacity, GPM	1250.0	935.0	803.0
Acre Ft. Pumped in 24 Hrs.	5.525	4.133	3.549
kW Input to Motor	135.4	130.8	129.1
HP Input to Motor	181.6	175.4	173.1
Motor Load (%)	86.6	83.7	82.6
Measured Speed of Pump, RPM	1787		
kWh per Acre Ft.	588	760	873
Overall Plant Efficiency (%)	69.9	60.3	57.1
Customer Meter, GPM	1396.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. Due to an inadequate water measurement test location, the GPM flow and the resulting overall plant efficiency should be considered approximate, rather than actual.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 200 - PLANT: ELK MOUNTAIN 2
CIS ACCT: 62-48-988-2148-02
CUST #: 0-001-3578 SERV ACCT #: 004-1142-83
HYDRAULIC TEST REFERENCE NUMBER: 29335

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 19, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 72.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	198696	192816	5880
kW Input	135.4	131.4	4.0
kWh per Acre Ft.	588	571	17
Acre Ft. per Year	337.8	337.8	
Avg. Cost per Acre Ft.	$30.59	$29.68	$0.91
Overall Plant Eff. (%)	69.9	72.0	
TOTAL ANNUAL COST	$10,332.19	$10,026.41	$305.78

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

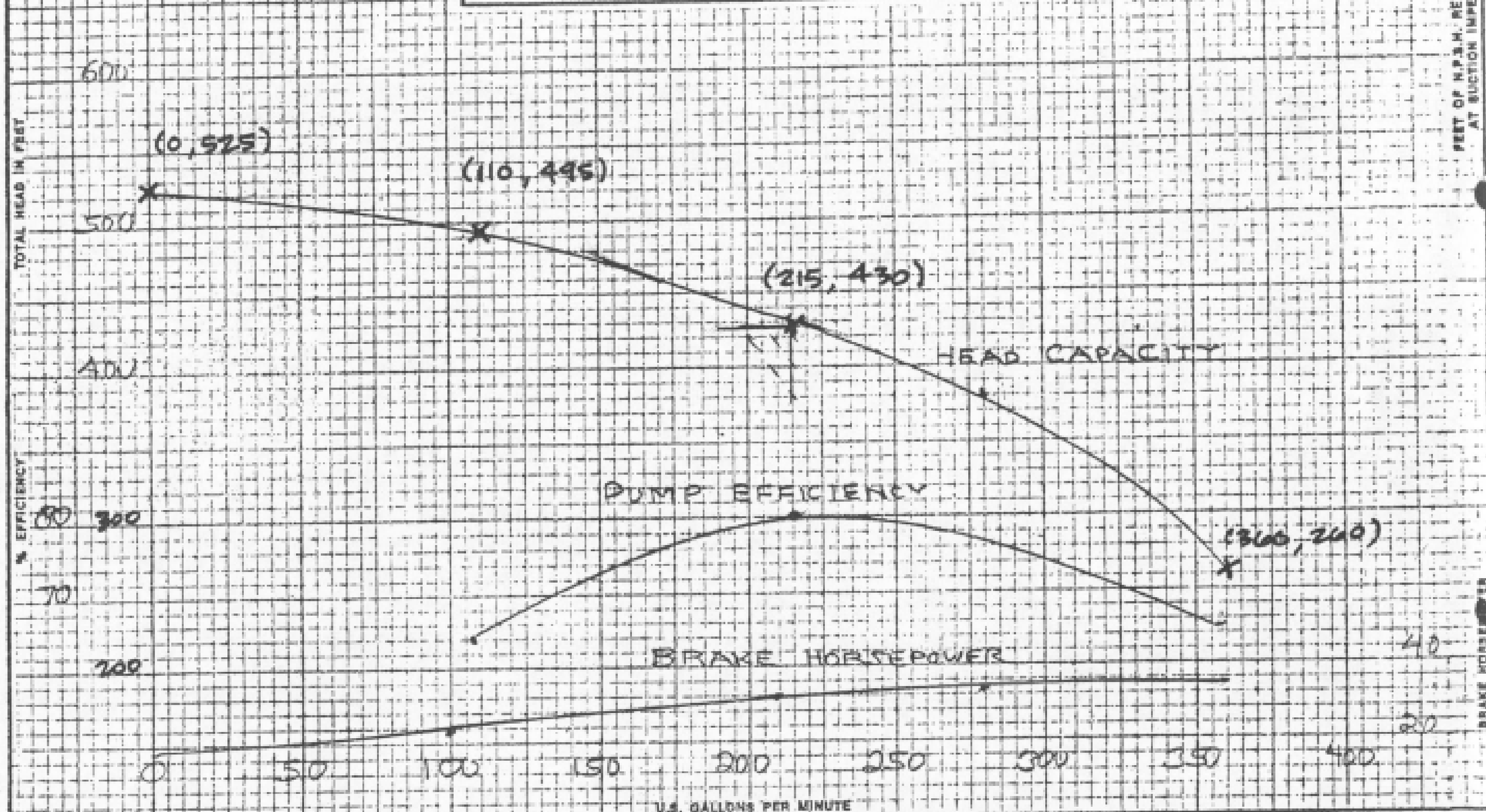
ELK MIN #2

CERTIFIED BY:

DATE

CUSTOMER CALIAGUA
ELK MOUNTAIN DRIVE
BOOSTE PUMP STA-
REF. NO. LOW DEMAND PUMPS

SUBMERGENCE REQ'D OVER BELL TO PREVENT
BASED ON SUMP DESIGN PER HYDRAULIC INSTITU



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IMPELLER BRZ DIA.
BOWLS C.I.
LIQUID H_2O
SP. GR. 1.0
DATE 4-2094 BY J.H.

INGERSOLL-RAND
PUMPS

240 @ 426 PERFORMANCE
1 STAGE 8KKH PUMP
1770 R.P.M.
CURVE NO.

JP-167A

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - ELK MOUNTAIN 3
CIS ACCT: 62-48-988-2148-02
CUST #: 0-001-3578   SERV ACCT #: 004-1142-83
27765 1/2 ELK MOUNTAIN
DATE OF TEST: April 19, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT
PUMP: N/A   NO: N/A
MOTOR: US   NO: 1650416R-1   40 HP
METER: LBD015-82724
HYDRAULIC TEST REFERENCE NUMBER: 29336

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	176.0	205.0	222.0
Discharge Head, Ft.	406.6	473.6	512.8
Suction Head or Lift, Ft.	16.4	16.6	16.6
Total Head, Ft.	390.2	457.0	496.2
Capacity, GPM	290.0	234.0	195.0
Acre Ft. Pumped in 24 Hrs.	1.282	1.034	0.862
kW Input to Motor	33.3	32.2	30.8
HP Input to Motor	44.7	43.2	41.3
Motor Load (%)	105.1	101.6	97.2
Measured Speed of Pump, RPM	1782		
kWh per Acre Ft.	624	747	858
Overall Plant Efficiency (%)	64.0	62.5	59.2
Customer Meter, GPM	328.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

SOUTHERN CALIFORNIA
EDISON

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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 40 - PLANT: ELK MOUNTAIN 3
CIS ACCT: 62-48-988-2148-02
CUST #: 0-001-3578 SERV ACCT #: 004-1142-83
HYDRAULIC TEST REFERENCE NUMBER: 29336

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 19, 1999 and billing history for the past 12 months.

EXISTING PLANT EFFICIENCY	TOU-PA-SOP1 Current Rate
Total kWh	65160
kW Input	33.3
kWh per Acre Ft.	624
Acre Ft. per Year	104.5
Avg. Cost per kWh	$0.05
Avg. Cost per Acre Ft.	$32.43
Overall Plant Eff. (%)	64.0
TOTAL ANNUAL COST	$3,388.32

The hydraulic test results indicate that this pump is operating in an efficient manner.

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pump efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

Fairmont BPS

FAIRMONT

SPECIFI[illegible] FLUID. NO GUARANTEE IS MADE EXC[illegible] FOR THE RATED POINT.

FABO#1&2

CUSTOMER ORANGE COUNTY PUMP CO.

P. O. NO. LAT 40361

ITEM NO. 2

MODEL NO. DWT (14JMO/4 STAGES)

SERIAL NO.

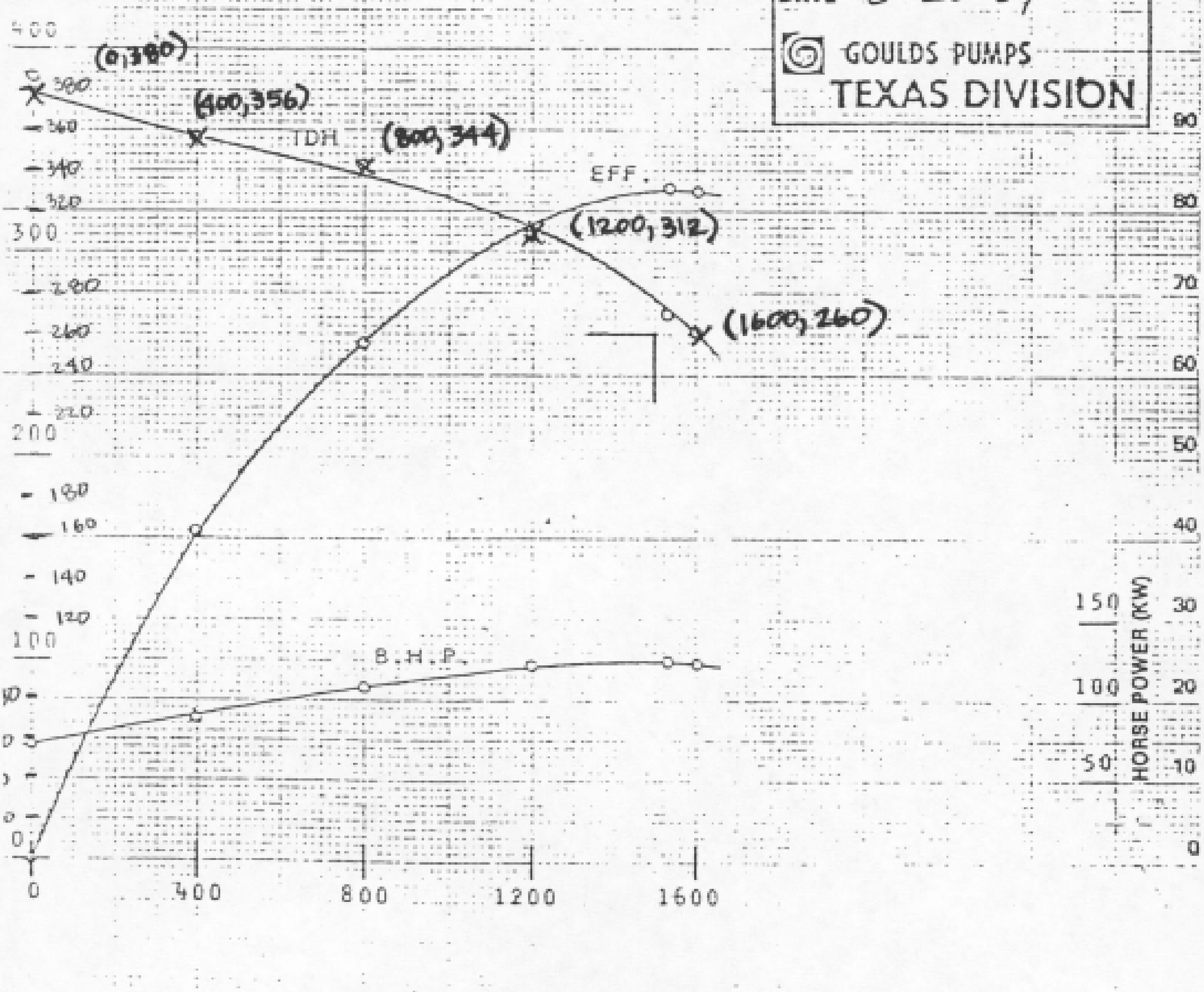
CERTIFIED TEST RESULTS

BY F.L. Holbeck

TITLE Production Eng

DATE 8-28-84

GOULDS PUMPS TEXAS DIVISION



U. S. GALLONS PER MINUTE (M^3/HR)

E NO. T-L84-2294

N BY F.L.H.

[illegible]-27-84

GOULDS PUMPS

TEXAS DIVISION

LUBBOCK, TEXAS

SIZE 14JMO / 4 R.P.M. 1770

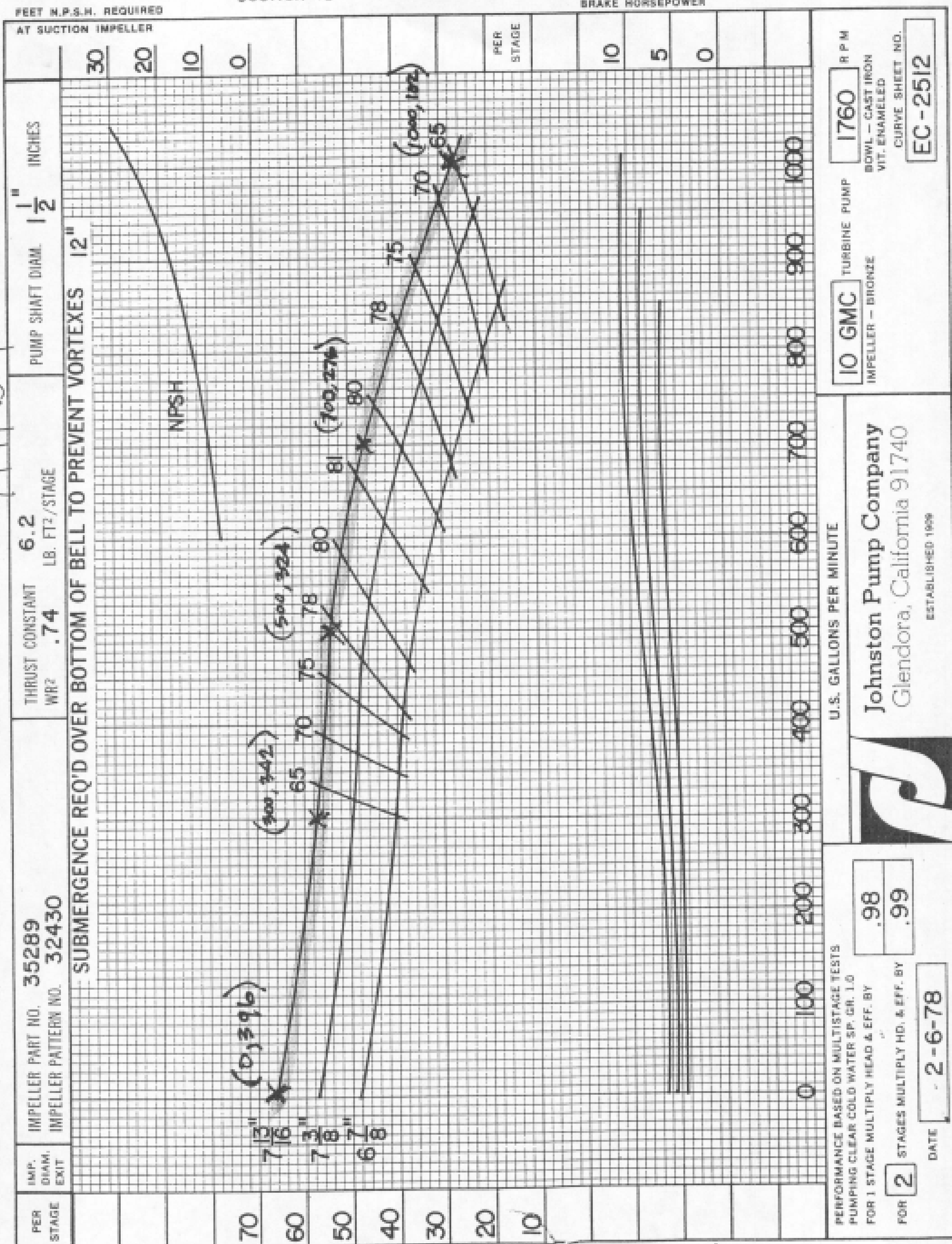
IMPELLER DIA. 9.56"

SPEC[illegible]C GRAVITY 1.0

VISCOSITY

Hidden Hills BPS

HIDDEN HILLS



HIDDEN HILLS
BP#1

HIDDEN HILLS #'s 2-4 (FROM JOB FOLDER) TC-04890

CERTIFIED BY: [signature]

DATE 3-21-81

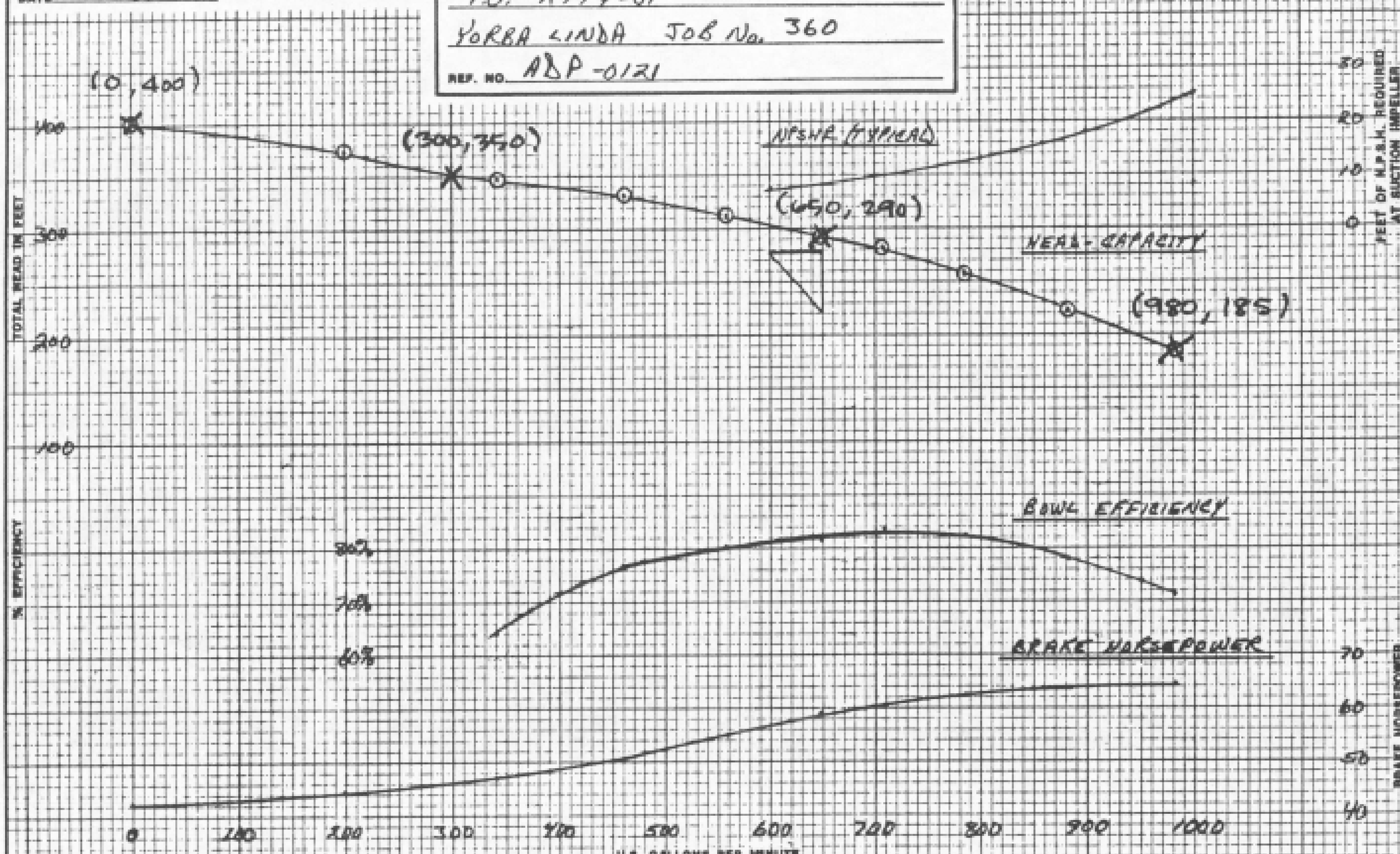
CUSTOMER McCALLA BROS.

P.O. # K144-81

YORBA LINDA JOB No. 360

REF. NO. ADP-0121

12" SUBMERGENCE REQ'D OVER BELL TO PREVENT VORTEXES BASED ON SUMP DESIGN PER HYDRAULIC INSTITUTE STDS.



THE CAPACITY, HEAD AND EFFICIENCY GUARANTEE IS FOR THE DESIGNATED POINT ONLY: IT IS BASED ON SHOP TESTS, WHEN HANDLING CLEAR, FRESH WATER AT A TEMPERATURE OF NOT OVER 85° F. AND UNDER SUCTION CONDITIONS AS SPECIFIED IN THE CONTRACT.

IMPELLER BRZ. DIA 7 1/4

BOWLS C.I. - VIT

LIQUID WATER

SP. GR. 1.0

DATE 3-21-81 BY EER

Johnston Pump Company
Glendora, California 91740
ESTABLISHED 1909

TURBINE BOWL PERFORMANCE

6 STAGE 10GMC PUMP

1760 R.P.M.

CURVE NO. TC-04890

JP-157B

HIDDEN HILLS
BP # 2, 3, & 4

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIDDEN HILLS 1
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
22400 HIDDEN HILLS
DATE OF TEST: April 22, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: MEWM NO: S20003403 60 HP
METER: D5G001-996593
HYDRAULIC TEST REFERENCE NUMBER: 8057

TEST RESULTS	
Discharge Pressure, PSI	195.5
Discharge Head, Ft.	451.6
Suction Head or Lift, Ft.	199.8
Total Head, Ft.	251.8
Capacity, GPM	781.0
Acre Ft. Pumped in 24 Hrs.	3.452
kW Input to Motor	55.2
HP Input to Motor	74.0
Motor Load (%)	111.0
Measured Speed of Pump, RPM	1778
kWh per Acre Ft.	384
Overall Plant Efficiency (%)	67.1
Customer Meter, GPM	767.0

The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 60 - PLANT: HIDDEN HILLS 1
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
HYDRAULIC TEST REFERENCE NUMBER: 8057

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 22, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 70.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	86448	82852	3596
kW Input	55.2	52.9	2.3
kWh per Acre Ft.	384	368	16
Acre Ft. per Year	225.2	225.2	
Avg. Cost per Acre Ft.	$23.03	$22.07	$0.96
Overall Plant Eff. (%)	67.1	70.0	
TOTAL ANNUAL COST	$5,186.88	$4,971.09	$215.79

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIDDEN HILLS 2
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
22400 HIDDEN HILLS
DATE OF TEST: April 22, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: NEWM NO: S20003402 60 HP
METER: D5G001-996593
HYDRAULIC TEST REFERENCE NUMBER: 23855

TEST RESULTS	
Discharge Pressure, PSI	196.0
Discharge Head, Ft.	452.8
Suction Head or Lift, Ft.	199.8
Total Head, Ft.	253.0
Capacity, GPM	819.0
Acre Ft. Pumped in 24 Hrs.	3.620
kW Input to Motor	56.8
HP Input to Motor	76.2
Motor Load (%)	114.3
Measured Speed of Pump, RPM	1779
kWh per Acre Ft.	377
Overall Plant Efficiency (%)	68.7
Customer Meter, GPM	832.0

The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 60 - PLANT: HIDDEN HILLS 2
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
HYDRAULIC TEST REFERENCE NUMBER: 23855

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 22, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 70.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	88956	87299	1657
kW Input	56.8	55.7	1.1
kWh per Acre Ft.	377	370	7
Acre Ft. per Year	236.2	236.2	
Avg. Cost per Acre Ft.	$22.60	$22.18	$0.42
Overall Plant Eff. (%)	68.7	70.0	
TOTAL ANNUAL COST	$5,337.36	$5,237.94	$99.42

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

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April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIDDEN HILLS 3
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
22400 HIDDEN HILLS
DATE OF TEST: April 22, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: NEWM NO: S20003401 60 HP
METER: D5G001-996593
HYDRAULIC TEST REFERENCE NUMBER: 23856

TEST RESULTS	
Discharge Pressure, PSI	195.5
Discharge Head, Ft.	451.6
Suction Head or Lift, Ft.	199.8
Total Head, Ft.	251.8
Capacity, GPM	799.0
Acre Ft. Pumped in 24 Hrs.	3.532
kW Input to Motor	56.2
HP Input to Motor	75.4
Motor Load (%)	113.0
Measured Speed of Pump, RPM	1783
kWh per Acre Ft.	382
Overall Plant Efficiency (%)	67.4
Customer Meter, GPM	789.0

The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 60 - PLANT: HIDDEN HILLS 3
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
HYDRAULIC TEST REFERENCE NUMBER: 23856

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 22, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 70.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY	IMPROVED PLANT EFFICIENCY	
	TOU-PA-SOP Current Rate	TOU-PA-SOP Current Rate	Savings
Total kWh	88020	84767	3253
kW Input	56.2	54.1	2.1
kWh per Acre Ft.	382	368	14
Acre Ft. per Year	230.4	230.4	
Avg. Cost per Acre Ft.	$22.92	$22.07	$0.85
Overall Plant Eff. (%)	67.4	70.0	
TOTAL ANNUAL COST	$5,281.20	$5,086.01	$195.19

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
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April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIDDEN HILLS 4
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578   SERV ACCT #: 001-1807-49
22400 HIDDEN HILLS
DATE OF TEST: April 22, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A   NO: N/A
MOTOR: NEWM   NO: J1380812   20 HP
METER: D5G001-996593
HYDRAULIC TEST REFERENCE NUMBER: 23857

TEST RESULTS	
Discharge Pressure, PSI	192.5
Discharge Head, Ft.	444.7
Suction Head or Lift, Ft.	202.1
Total Head, Ft.	242.6
Capacity, GPM	235.0
Acre Ft. Pumped in 24 Hrs.	1.039
kW Input to Motor	19.4
HP Input to Motor	26.0
Motor Load (%)	114.5
Measured Speed of Pump, RPM	1768
kWh per Acre Ft.	448
Overall Plant Efficiency (%)	55.3
Customer Meter, GPM	483.0

Due to an inadequate water measurement test location, the GPM flow and the resulting overall plant efficiency should be considered approximate, rather than actual.

DAN JOHNSON
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April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 20 - PLANT: HIDDEN HILLS 4
CIS ACCT: 62-48-904-4320-02
CUST #: 0-001-3578 SERV ACCT #: 001-1807-49
HYDRAULIC TEST REFERENCE NUMBER: 23857

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 22, 1999 and billing history for the past 12 months.

EXISTING PLANT EFFICIENCY	TOU-PA-SOP1 Current Rate
Total kWh	60768
kW Input	19.4
kWh per Acre Ft.	448
Acre Ft. per Year	135.5
Avg. Cost per kWh	$0.06
Avg. Cost per Acre Ft.	$26.90
Overall Plant Eff. (%)	55.3
TOTAL ANNUAL COST	$3,646.08

The hydraulic test results indicate that this pump is operating in an efficient manner.

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pump efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
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Rialto, CA 92377-0788

Highland BPS

VI-51

HIGHLAND

BOOSTERS 1, 2, & 4.

14DKM ENCLOSED TYPE IMPELLER **1770 RPM**

NO. OF STAGES	EFF. CHANGE (NO. OF POINTS)
1	−3
2	−1
3	−0

HORSEPOWER WILL BE EFFECTED BY CHANGE IN EFFICIENCY

PERFORMANCE FOR:
Bowl Pattern No.: 542434-C-R7
Imp. Pattern No.: 541902-B-R1

PUMP DATA

Shaft Dia. (IN.)	1 15/16
Maximum Sphere (IN.)	1¼
Maximum Head (FT.)*	767
Min. Submergence (IN.)**	24
Impeller Wt. (LBS.)	25.9
Thrust Constant (K)	16.5
Bowl O.D. (IN.)	13⅛

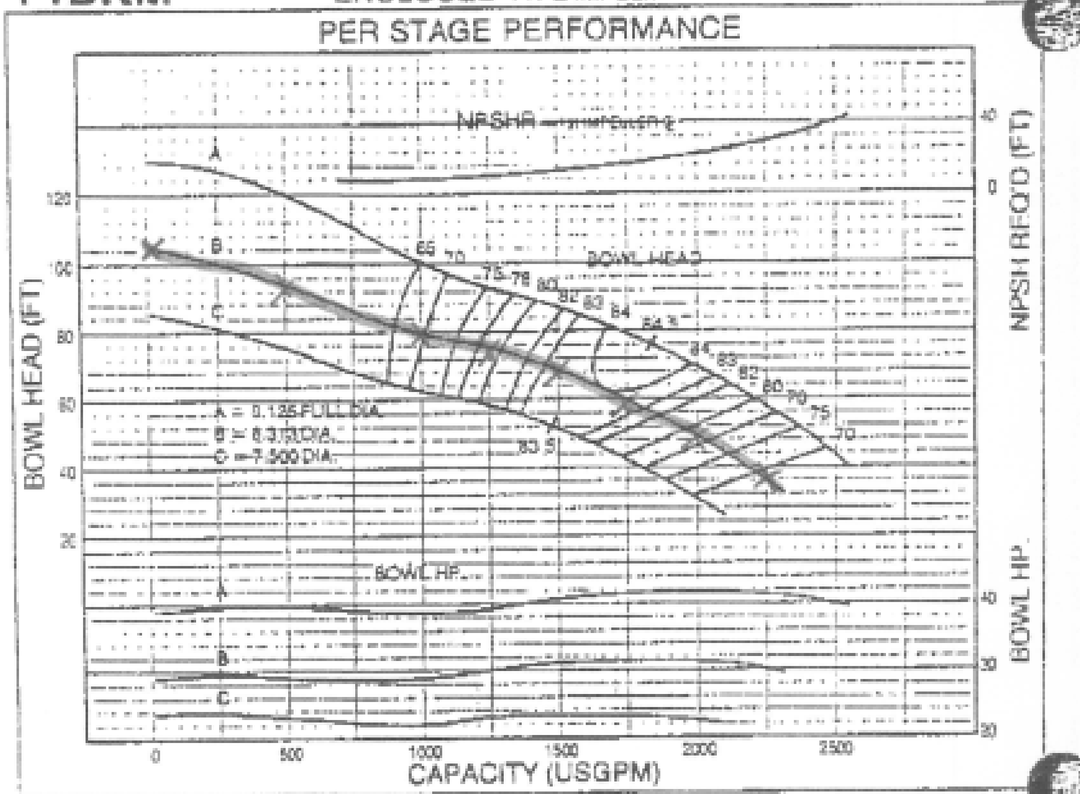
NOTES

Performance indicated based on cold water with a specific gravity of 1.0.

* Standard construction.

** Minimum submergence over lip of bell to prevent vortexing.

Efficiency improvements are available in certain instances. Please contact the factory.



LITTLE AMERICA
1-800-453-9450

1770 RPM

NO. OF STAGES	EFF. CHANGE (NO. OF POINTS)
1	−3
2	−1
3	−0

HORSEPOWER WILL BE EFFECTED BY CHANGE IN EFFICIENCY

PERFORMANCE FOR:
Bowl Pattern No.: 542434-C-R7
Imp. Pattern No.: 542424-B-R2

PUMP DATA

Shaft Dia. (IN.)	1 15/16
Maximum Sphere (IN.)	1¼
Maximum Head (FT.)*	767
Min. Submergence (IN.)**	24
Impeller Wt. (LBS.)	25.9
Thrust Constant (K)	16.5
Bowl O.D. (IN.)	13⅛

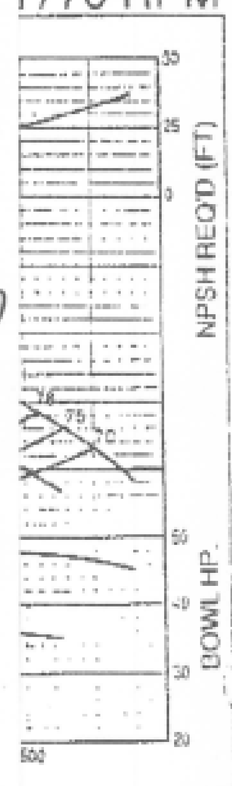
NOTES

Performance indicated based on cold water with a specific gravity of 1.0.

* Standard construction.

** Minimum submergence over lip of bell to prevent vortexing.

Efficiency improvements are available in certain instances. Please contact the factory.



NEM - HIGHLAND
BOOSTER STATION
PUMP INFO!

Don Leaf

(909) 390-2833
322-2383

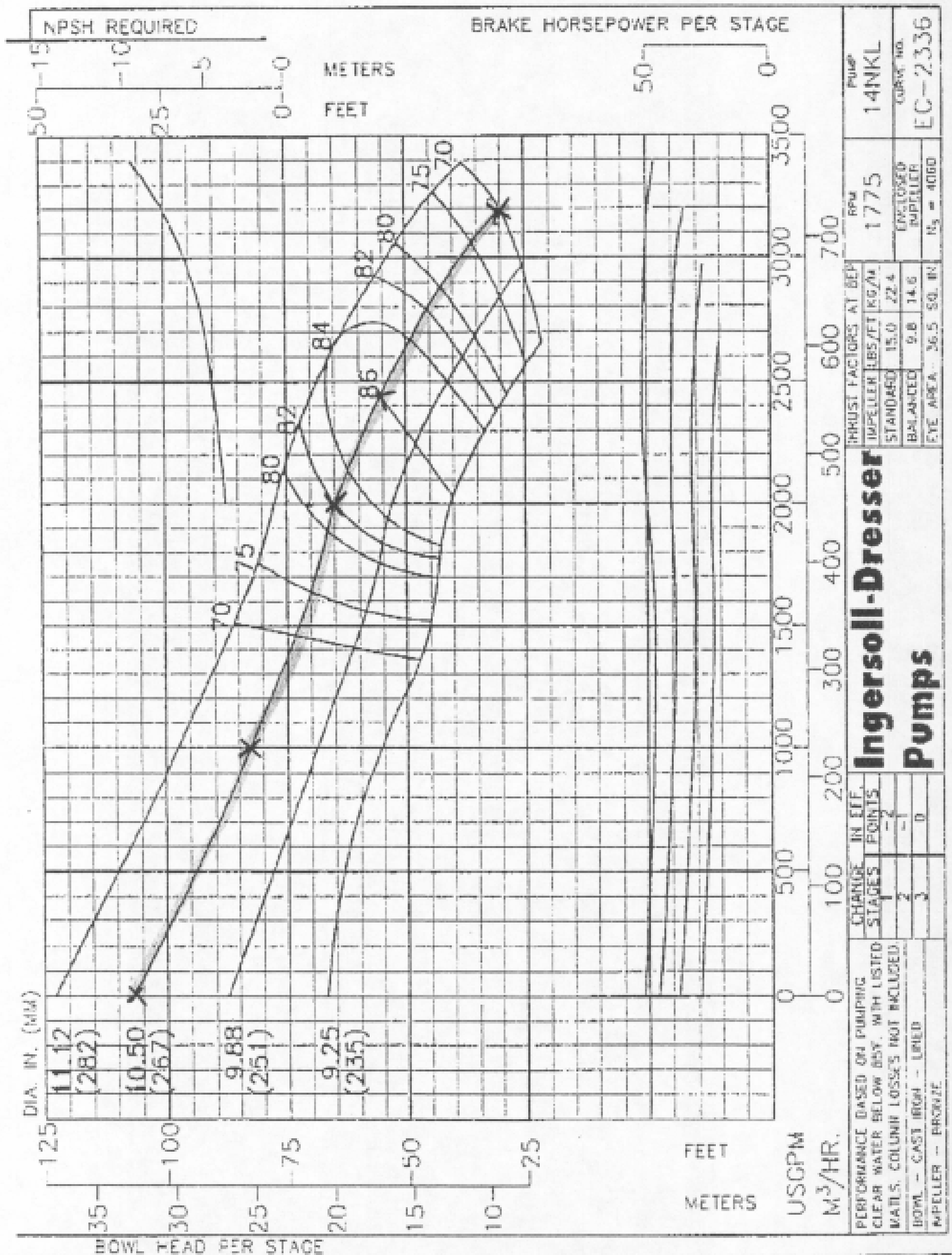
HIGHLAND

BOOSTER 3

Ingersoll-Dresser Pumps

VTP VERTICAL PUMPS

Sheet 520.67
December 1, 1993
New Sheet

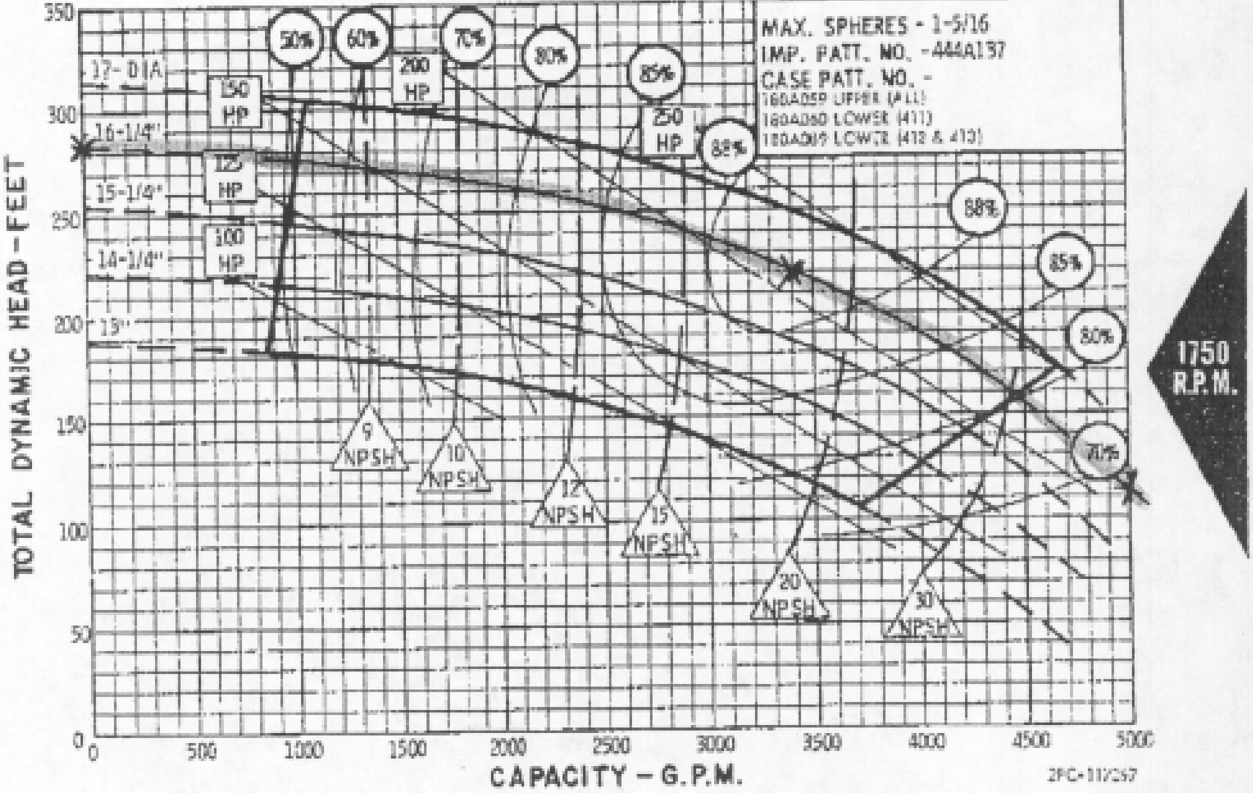


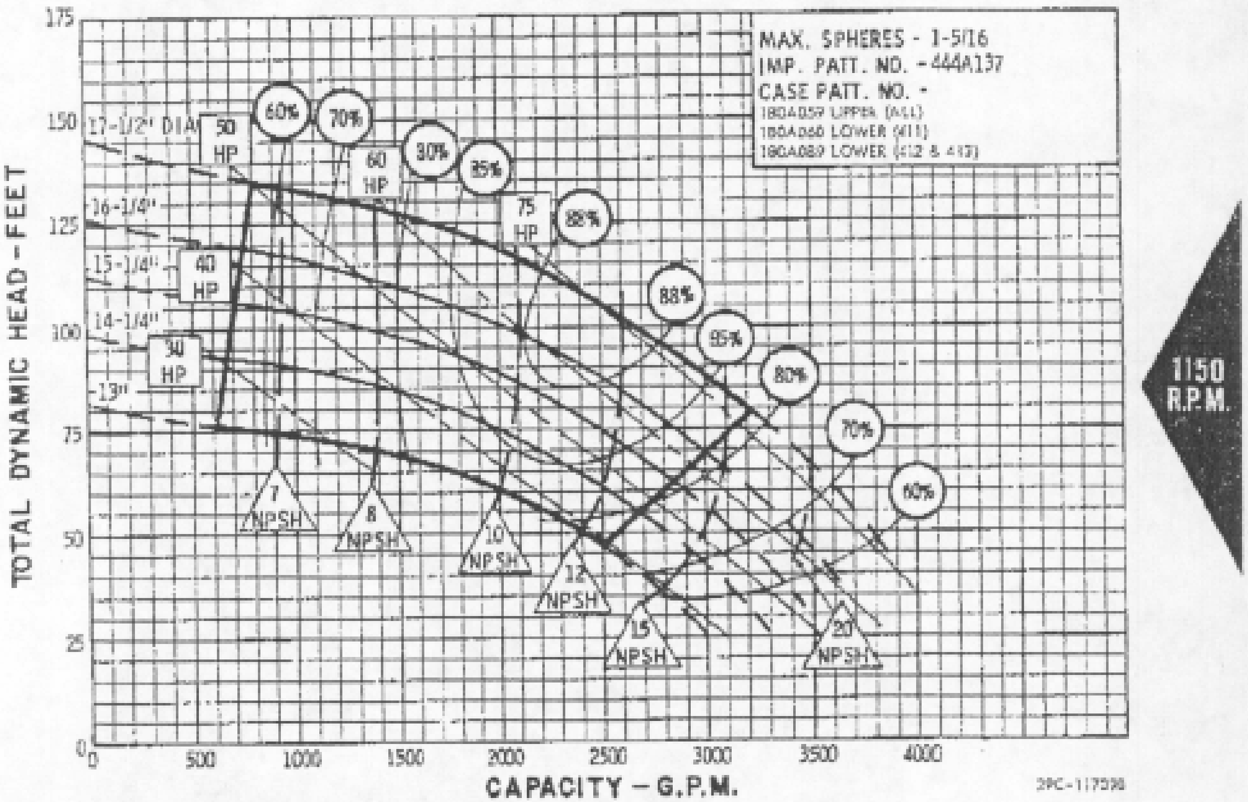
8x10x17B SERIES 410

ENCLOSED IMPELLER

BOOSTER 5

DATED JANUARY 1973
SUPERSEDES PAGE 424
DATED APRIL 1971





AURORA PUMPS

AURORA PUMP
A UNIT OF GENERAL SIGNAL CORPORATION
AURORA • ILLINOIS

SOUTHERN CALIFORNIA
EDISON

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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIGHLAND BST 1
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578   SERV ACCT #: 000-4470-22
5252 1/2 HIGHLAND AVE.
DATE OF TEST: May 4, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A   NO: N/A
MOTOR: US   NO: 270R098R-4   125 HP
METER: O3D015-82645
HYDRAULIC TEST REFERENCE NUMBER: 8027

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	82.0	91.0	99.0
Discharge Head, Ft.	189.4	210.2	228.7
Suction Head or Lift, Ft.	19.9	20.1	20.3
Total Head, Ft.	169.5	190.1	208.4
Capacity, GPM	1984.0	1739.0	1409.0
Acre Ft. Pumped in 24 Hrs.	8.769	7.686	6.228
kW Input to Motor	94.3	93.8	89.5
HP Input to Motor	126.5	125.8	120.0
Motor Load (%)	95.6	95.1	90.7
Measured Speed of Pump, RPM	1786		
kWh per Acre Ft.	258	293	345
Overall Plant Efficiency (%)	67.2	66.4	61.8

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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300 N. Pepper St.
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SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 125 - PLANT: HIGHLAND BST 1
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
HYDRAULIC TEST REFERENCE NUMBER: 8027

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed May 4, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 72.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-5 Current Rate	Savings
Total kWh	472320	440534	31786
kW Input	94.3	88.0	6.3
kWh per Acre Ft.	258	241	17
Acre Ft. per Year	1829.8	1829.8	
Avg. Cost per Acre Ft.	$17.55	$16.37	$1.18
Overall Plant Eff. (%)	67.2	72.0	
TOTAL ANNUAL COST	$32,117.76	$29,956.32	$2,161.44

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

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May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIGHLAND BST 2
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
5252 1/2 HIGHLAND AVE.
DATE OF TEST: May 4, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: US NO: 1A344R032M 125 HP
METER: 03D015-82645
HYDRAULIC TEST REFERENCE NUMBER: 23818

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	84.0	92.0	104.5
Discharge Head, Ft.	194.0	212.5	241.4
Suction Head or Lift, Ft.	19.4	19.6	19.9
Total Head, Ft.	174.6	192.9	221.5
Capacity, GPM	2252.0	2076.0	1792.0
Acre Ft. Pumped in 24 Hrs.	9.954	9.176	7.921
kW Input to Motor	104.7	104.5	103.9
HP Input to Motor	140.4	140.1	139.3
Motor Load (%)	107.2	107.0	106.3
Measured Speed of Pump, RPM	1784		
kWh per Acre Ft.	252	273	315
Overall Plant Efficiency (%)	70.7	72.2	71.9

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
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CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 125 - PLANT: HIGHLAND BST 2
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
HYDRAULIC TEST REFERENCE NUMBER: 23818

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed May 4, 1999 and billing history for the past 12 months.

EXISTING PLANT EFFICIENCY

	TOU-PA-5 Current Rate
Total kWh	437016
kW Input	104.7
kWh per Acre Ft.	252
Acre Ft. per Year	1730.8
Avg. Cost per kWh	$0.07
Avg. Cost per Acre Ft.	$17.17
Overall Plant Eff. (%)	70.7
TOTAL ANNUAL COST	$29,717.09

The hydraulic test results indicate that this pump is operating in an efficient manner.

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pump efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
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May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIGHLAND BST 3
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
5252 1/2 HIGHLAND AVE.
DATE OF TEST: May 4, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: INGER NO: 87046088
MOTOR: US NO: 00236-L-01 125 HP
METER: O3D015-82645
HYDRAULIC TEST REFERENCE NUMBER: 23819

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	85.0	92.0	101.0
Discharge Head, Ft.	196.4	212.5	233.3
Suction Head or Lift, Ft.	21.7	21.9	22.4
Total Head, Ft.	174.7	190.6	210.9
Capacity, GPM	2195.0	1955.0	1675.0
Acre Ft. Pumped in 24 Hrs.	9.702	8.641	7.404
kW Input to Motor	108.6	108.4	105.8
HP Input to Motor	145.6	145.4	141.9
Motor Load (%)	109.6	109.4	106.8
Measured Speed of Pump, RPM	1776		
kWh per Acre Ft.	269	301	343
Overall Plant Efficiency (%)	66.5	64.7	62.9

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 125 - PLANT: HIGHLAND BST 3
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
HYDRAULIC TEST REFERENCE NUMBER: 23819

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed May 4, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 72.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-5 Current Rate	Savings
Total kWh	453288	418616	34672
kW Input	108.6	100.3	8.3
kWh per Acre Ft.	269	248	21
Acre Ft. per Year	1687.0	1687.0	
Avg. Cost per Acre Ft.	$18.27	$16.87	$1.40
Overall Plant Eff. (%)	66.5	72.0	
TOTAL ANNUAL COST	$30,823.58	$28,465.86	$2,357.73

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - HIGHLAND BST 4
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
5252 1/2 HIGHLAND AVE.
DATE OF TEST: May 4, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: L&B NO: D37337
MOTOR: US NO: R2106525 125 HP
METER: 03D015-82645
HYDRAULIC TEST REFERENCE NUMBER: 23820

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	85.0	93.0	103.0
Discharge Head, Ft.	196.4	214.8	237.9
Suction Head or Lift, Ft.	21.7	21.9	21.9
Total Head, Ft.	174.7	192.9	216.0
Capacity, GPM	2125.0	1955.0	1742.0
Acre Ft. Pumped in 24 Hrs.	9.393	8.641	7.700
kW Input to Motor	101.1	100.7	98.1
HP Input to Motor	135.6	135.0	131.6
Motor Load (%)	98.7	98.3	95.8
Measured Speed of Pump, RPM	1780		
kWh per Acre Ft.	258	280	306
Overall Plant Efficiency (%)	69.1	70.5	72.2

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge. The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
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CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 125 - PLANT: HIGHLAND BST 4
CIS ACCT: 53-48-964-5500-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-22
HYDRAULIC TEST REFERENCE NUMBER: 23820

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed May 4, 1999 and billing history for the past 12 months.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate
Total kWh	337584
kW Input	101.1
kWh per Acre Ft.	258
Acre Ft. per Year	1306.5
Avg. Cost per kWh	$0.07
Avg. Cost per Acre Ft.	$17.57
Overall Plant Eff. (%)	69.1
TOTAL ANNUAL COST	$22,955.71

The hydraulic test results indicate that this pump is operating in an efficient manner.

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pump efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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Palm BPS

CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - PALM BOOSTER
CIS ACCT: 65-48-957-5942-01
CUST #: 0-001-3578 SERV ACCT #: 002-1901-05
19115 1/2 YORBA LINDA
DATE OF TEST: May 6, 1999

In accordance with your request, a test was made on your centrifugal booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: US NO: 809R916A-M 60 HP
METER: 0728K-1860
HYDRAULIC TEST REFERENCE NUMBER: 29346

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	113.0	120.0	124.0
Discharge Head, Ft.	261.0	277.2	286.4
Suction Head or Lift, Ft.	124.7	132.8	135.1
Total Head, Ft.	136.3	144.4	151.3
Capacity, GPM	1061.0	824.0	664.0
Acre Ft. Pumped in 24 Hrs.	4.690	3.642	2.935
kW Input to Motor	42.7	38.2	35.2
HP Input to Motor	57.3	51.2	47.2
Motor Load (%)	89.3	79.9	73.6
Measured Speed of Pump, RPM	1786		
kWh per Acre Ft.	219	252	288
Overall Plant Efficiency (%)	63.8	58.7	53.7

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

May 7, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 60 - PLANT: PALM BOOSTER
CIS ACCT: 65-48-957-5942-01
CUST #: 0-001-3578 SERV ACCT #: 002-1901-05
HYDRAULIC TEST REFERENCE NUMBER: 29346

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed May 6, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 70.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-5 Current Rate	Savings
Total kWh	319392	290995	28397
kW Input	42.7	38.9	3.8
kWh per Acre Ft.	219	199	19
Acre Ft. per Year	1461.3	1461.3	
Avg. Cost per Acre Ft.	$13.77	$12.55	$1.22
Overall Plant Eff. (%)	63.8	70.0	
TOTAL ANNUAL COST	$20,121.70	$18,332.68	$1,789.02

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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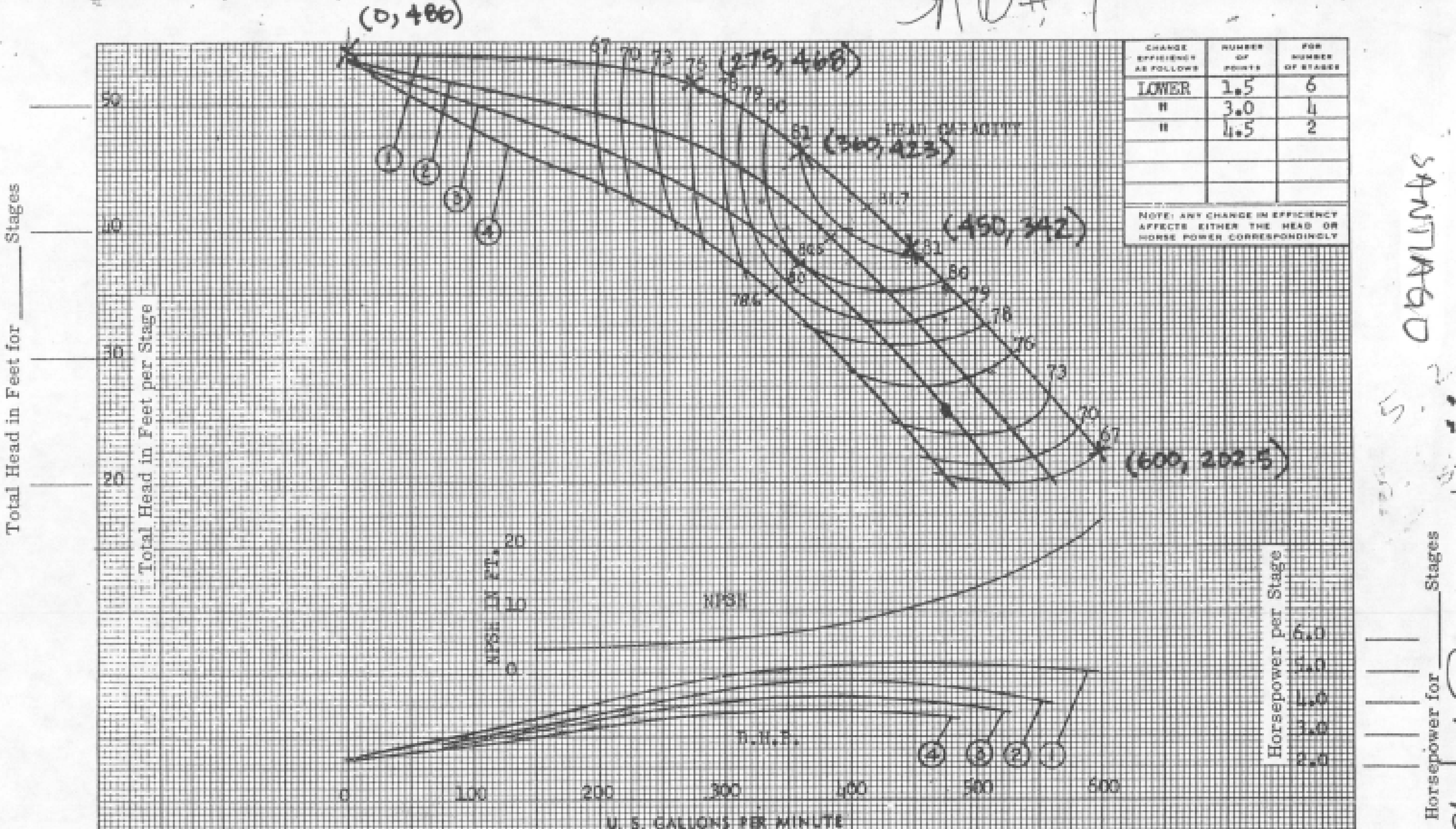
Rialto, CA 92377-0788

Santiago BPS

SAB#1



CHANGE EFFICIENCY AS FOLLOWS	NUMBER OF POINTS	FOR NUMBER OF STAGES
LOWER	1.5	6
"	3.0	4
"	4.5	2

NOTE: ANY CHANGE IN EFFICIENCY AFFECTS EITHER THE HEAD OR HORSE POWER CORRESPONDINGLY

HYDRAULIC PERFORMANCE WARRANTY	CURVE NO.	IMPELLER NO.	IMPELLER DIA.	TAKEN FROM
Guaranteed at designated point only, and contingent on:	1	2625032	7½"	41262
	2	2625032	7 3/16" × 7½"	41306
Proper flow to pump suction; Proper submergence; Fluid free of gas, air & abrasives; Proper lateral setting of impeller	3	2625032	6 7/8" × 7½"	41380
	4	2625032	6 9/16" × 7½"	

Customer:

Item No:

Peerless Ref. No:

Laboratory Performance BOWL 2625030 CIE

SIZE 10 LB RPM 1760 CURVE 2842669

fmc CORPORATION

PEERLESS PUMP

PUMP DESCRIPTION: Driver ____; Head ____; Column ____

GUARANTEED FIELD PERFORMANCE: Capacity ____ gpm; Head ____ ft; Eff ____ %; BHP ____

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - SANTIAGO BST 1
CIS ACCT: 63-48-993-4474-01
CUST #: 0-001-3578   SERV ACCT #: 000-4470-20
21765 STONEHAVEN
DATE OF TEST: April 20, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PERLS   NO: 256845
MOTOR: US   NO: 0730518R-1   75 HP
METER: D5G001-996595
HYDRAULIC TEST REFERENCE NUMBER: 29337

future res. elev. = 1375

TEST RESULTS	
Discharge Pressure, PSI	153.5
Discharge Head, Ft.	354.6
Suction Head or Lift, Ft.	20.1
Total Head, Ft.	334.5 *
Capacity, GPM	339.0
Acre Ft. Pumped in 24 Hrs.	1.498
kW Input to Motor	38.6
HP Input to Motor	51.8
Motor Load (%)	64.9
Measured Speed of Pump, RPM	1792
kWh per Acre Ft.	618
Overall Plant Efficiency (%)	55.3

The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 75 - PLANT: SANTIAGO BST 1
CIS ACCT: 63-48-993-4474-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-20
HYDRAULIC TEST REFERENCE NUMBER: 29337

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 20, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 70.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-5 Current Rate	Savings
Total kWh	310728	245565	65163
kW Input	38.6	30.5	8.1
kWh per Acre Ft.	618	489	130
Acre Ft. per Year	502.5	502.5	
Avg. Cost per Acre Ft.	$37.10	$29.32	$7.78
Overall Plant Eff. (%)	55.3	70.0	
TOTAL ANNUAL COST	$18,643.68	$14,733.91	$3,909.77

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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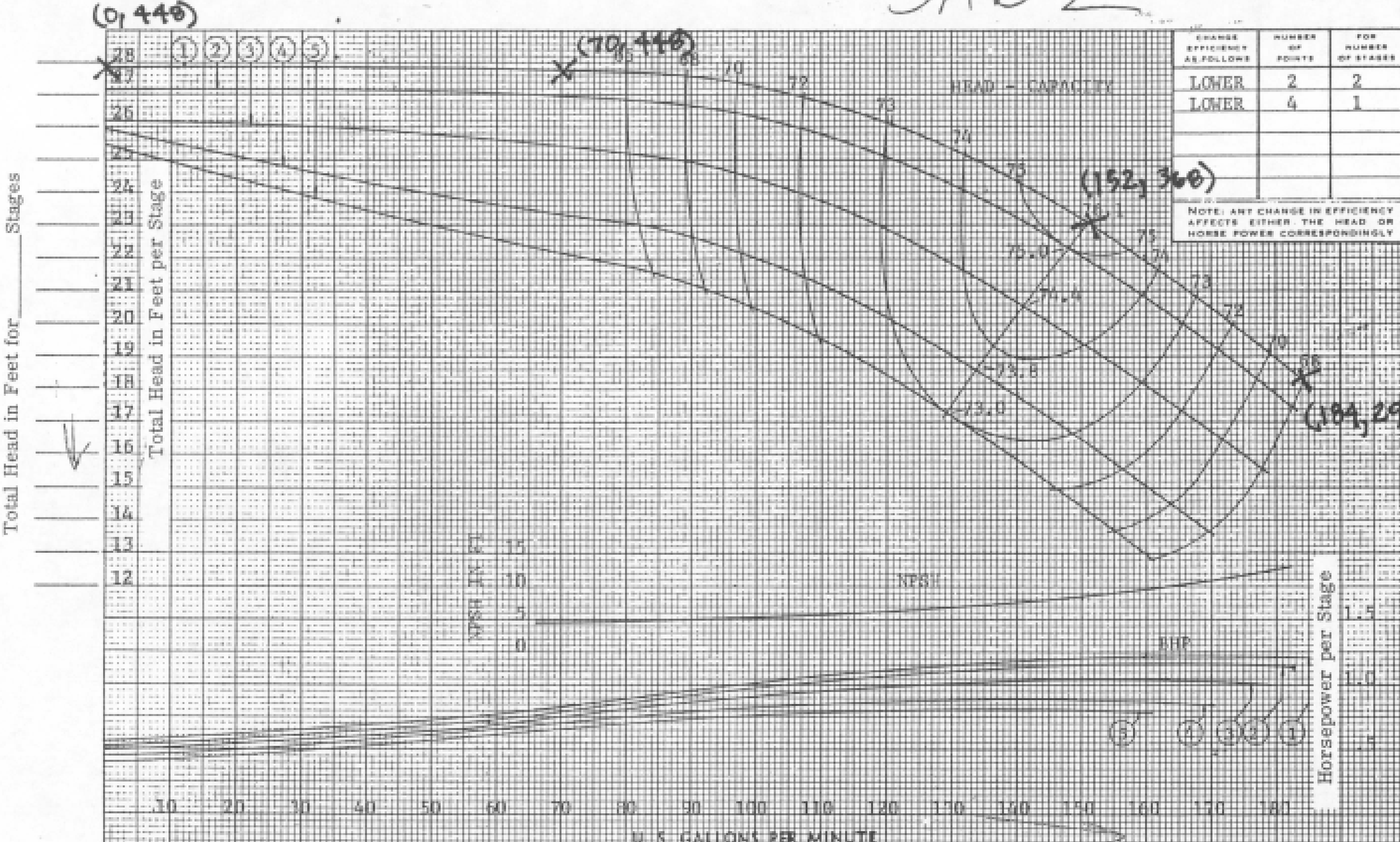
Rialto, CA 92377-0788

ISSUME 16 BOBBS

SAB 2



CHANGE EFFICIENCY AS FOLLOWS	NUMBER OF POINTS	FOR NUMBER OF STAGES
LOWER	2	2
LOWER	4	1

NOTE: ANY CHANGE IN EFFICIENCY AFFECTS EITHER THE HEAD OR HORSE POWER CORRESPONDINGLY

HYDRAULIC PERFORMANCE WARRANTY

Guaranteed at designated point only, and contingent on:

Proper flow to pump suction
Proper submergence
Fluid free of gas, air & abrasives
Proper lateral setting of impeller

CURVE	IMPELLER	IMPELLER DIA.	FROM
1	2626207	5 5/16"	44137
2	2626207	5 3/16" x 5 5/16"	44274
3	2626207	5 7/32" x 5 5/16"	
4	2626207	4 13/16" x 5 5/16"	44321
5	2626207	4 5/8" x 5 5/16"	44353

Customer ____________________

Item ____________________

Peerless Ref. No: ____________________

Laboratory Performance		BOWL	2626204 CIE
SIZE 7 LB	RPM 1760	CURVE	2847292

fmc CORPORATION

PEERLESS PUMP

PUMP DESCRIPTION: Driver ____________________; Head ____________________; Column ____________________

GUARANTEED BOWL☐ FIELD☐ PERFORMANCE: Capacity ____________ gpm; Head __________ ft; Eff __________ %; BHP ____________

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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - SANTIAGO BST 2
CIS ACCT: 63-48-993-4474-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-20
21765 STONEHAVEN
DATE OF TEST: April 20, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PERLS	NO: 256844	
MOTOR: US	NO: N/A	25 HP
METER: D5G001-996595		
HYDRAULIC TEST REFERENCE NUMBER: 29338		

TEST RESULTS

Discharge Pressure, PSI	142.5
Discharge Head, Ft.	329.2
Suction Head or Lift, Ft.	19.6
Total Head, Ft.	309.6
Capacity, GPM	112.0
Acre Ft. Pumped in 24 Hrs.	0.495
kW Input to Motor	14.3
HP Input to Motor	19.2
Motor Load (%)	67.5
Measured Speed of Pump, RPM	1782
kWh per Acre Ft.	693
Overall Plant Efficiency (%)	45.7

The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 25 - PLANT: SANTIAGO BST 2
CIS ACCT: 63-48-993-4474-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-20
HYDRAULIC TEST REFERENCE NUMBER: 29338

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 20, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 65.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-5 Current Rate	Savings
Total kWh	46044	32346	13698
kW Input	14.3	10.0	4.3
kWh per Acre Ft.	693	487	206
Acre Ft. per Year	66.4	66.4	
Avg. Cost per Acre Ft.	$41.60	$29.23	$12.38
Overall Plant Eff. (%)	45.7	65.0	
TOTAL ANNUAL COST	$2,762.64	$1,940.75	$821.89

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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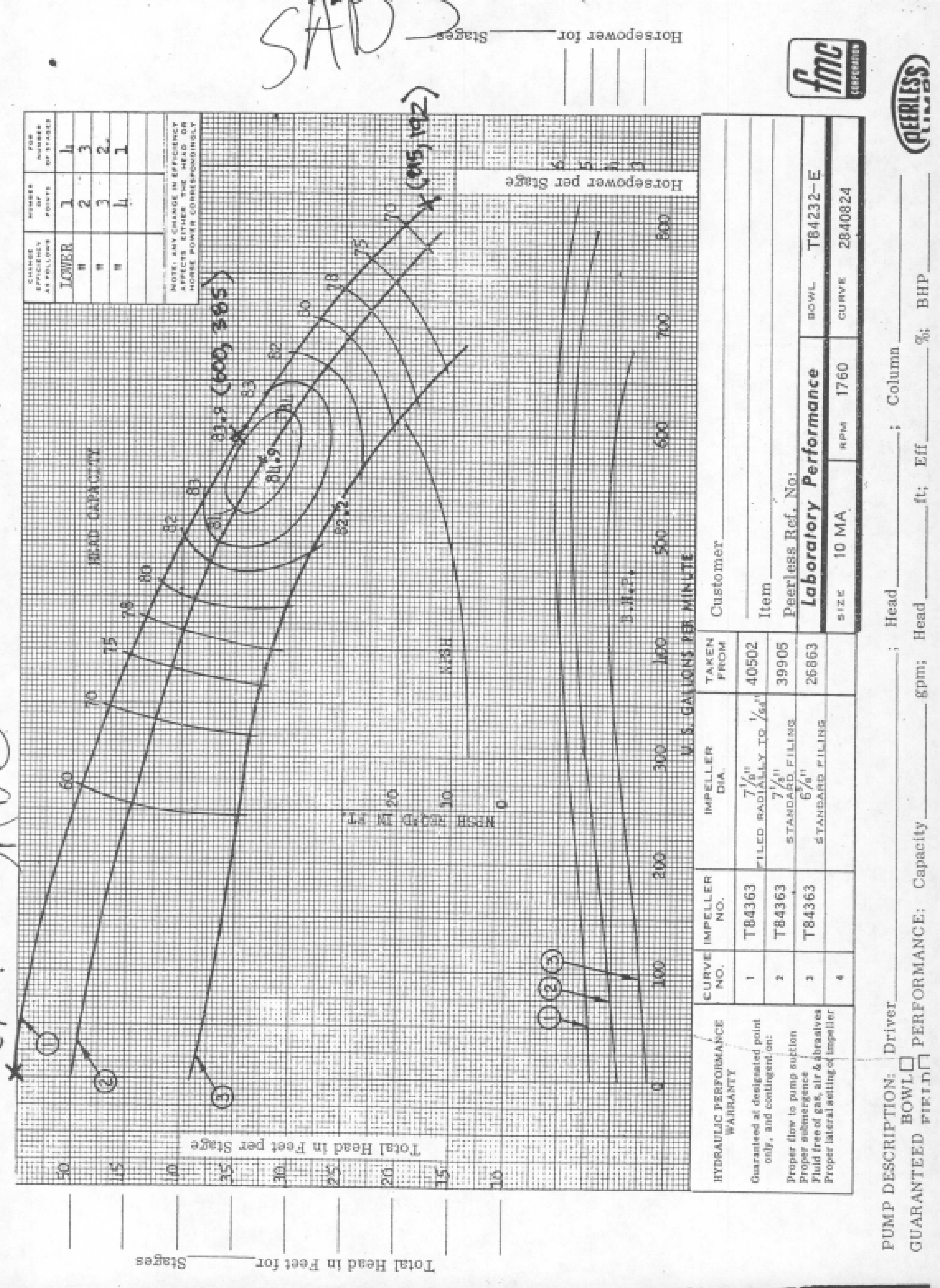
SAB3
Horsepower for ____ Stages
fmc CORPORATION
PEERLESS
Horsepower per Stage
CHANGE EFFICIENCY AS FOLLOWS
NUMBER OF POINTS
FOR NUMBER OF STAGES
LOWER 1 4
" 2 3
" 3 2
" 4 1
NOTE: ANY CHANGE IN EFFICIENCY AFFECTS EITHER THE HEAD OR HORSE POWER CORRESPONDINGLY
(915, 192)
(600, 385)
83.9
84.9
82.2
HEAD CAPACITY
NPSH
B.H.P.
NPSH HEAD IN FT.
U. S. GALLONS PER MINUTE
ASSUME 11 STAGES
(0, 605)
SAB3
Total Head in Feet per Stage
Total Head in Feet for ____ Stages
Customer
Item
Peerless Ref. No.
Laboratory Performance
SIZE 10 MA
RPM 1760
BOWL T84232-E
CURVE 2840824
HYDRAULIC PERFORMANCE WARRANTY
Guaranteed at designated point only, and contingent on:
Proper flow to pump suction
Proper submergence
Fluid free of gas, air & abrasives
Proper lateral setting of impeller
CURVE NO. | IMPELLER NO. | IMPELLER DIA. | TAKEN FROM
1 | T84363 | 7 1/8" FILED RADIALLY TO 1/64" | 40502
2 | T84363 | 7 1/8" STANDARD FILING | 39905
3 | T84363 | 6 5/8" STANDARD FILING | 26863
4
PUMP DESCRIPTION: Driver ____ ; Head ____ ; Column ____
GUARANTEED BOWL FIELD PERFORMANCE: Capacity ____ gpm; Head ____ ft; Eff ____ %; BHP ____

SOUTHERN CALIFORNIA
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - SANTIAGO BST 3
CIS ACCT: 63-48-993-4474-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-20
21765 STONEHAVEN
DATE OF TEST: April 20, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PERLS NO: 256846
MOTOR: US NO: 0730519R-1 100 HP
METER: D5G001-996595
HYDRAULIC TEST REFERENCE NUMBER: 29339

TEST RESULTS

Discharge Pressure, PSI	157.0
Discharge Head, Ft.	362.7
Suction Head or Lift, Ft.	20.6
Total Head, Ft.	342.1
Capacity, GPM	558.0
Acre Ft. Pumped in 24 Hrs.	2.466
kW Input to Motor	57.6
HP Input to Motor	77.2
Motor Load (%)	73.4
Measured Speed of Pump, RPM	1790
kWh per Acre Ft.	561
Overall Plant Efficiency (%)	62.4

The test location does not meet industry standards. We recommend 8-10 diameters of uninterrupted pipe lengths for the ideal test location.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 100 - PLANT: SANTIAGO BST 3
CIS ACCT: 63-48-993-4474-01
CUST #: 0-001-3578 SERV ACCT #: 000-4470-20
HYDRAULIC TEST REFERENCE NUMBER: 29339

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 20, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 72.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY	IMPROVED PLANT EFFICIENCY	
	TOU-PA-5 Current Rate	TOU-PA-5 Current Rate	Savings
Total kWh	278208	241145	37063
kW Input	57.6	49.9	7.7
kWh per Acre Ft.	561	486	75
Acre Ft. per Year	496.3	496.3	
Avg. Cost per Acre Ft.	$33.64	$29.16	$4.48
Overall Plant Eff. (%)	62.4	72.0	
TOTAL ANNUAL COST	$16,692.48	$14,468.69	$2,223.79

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

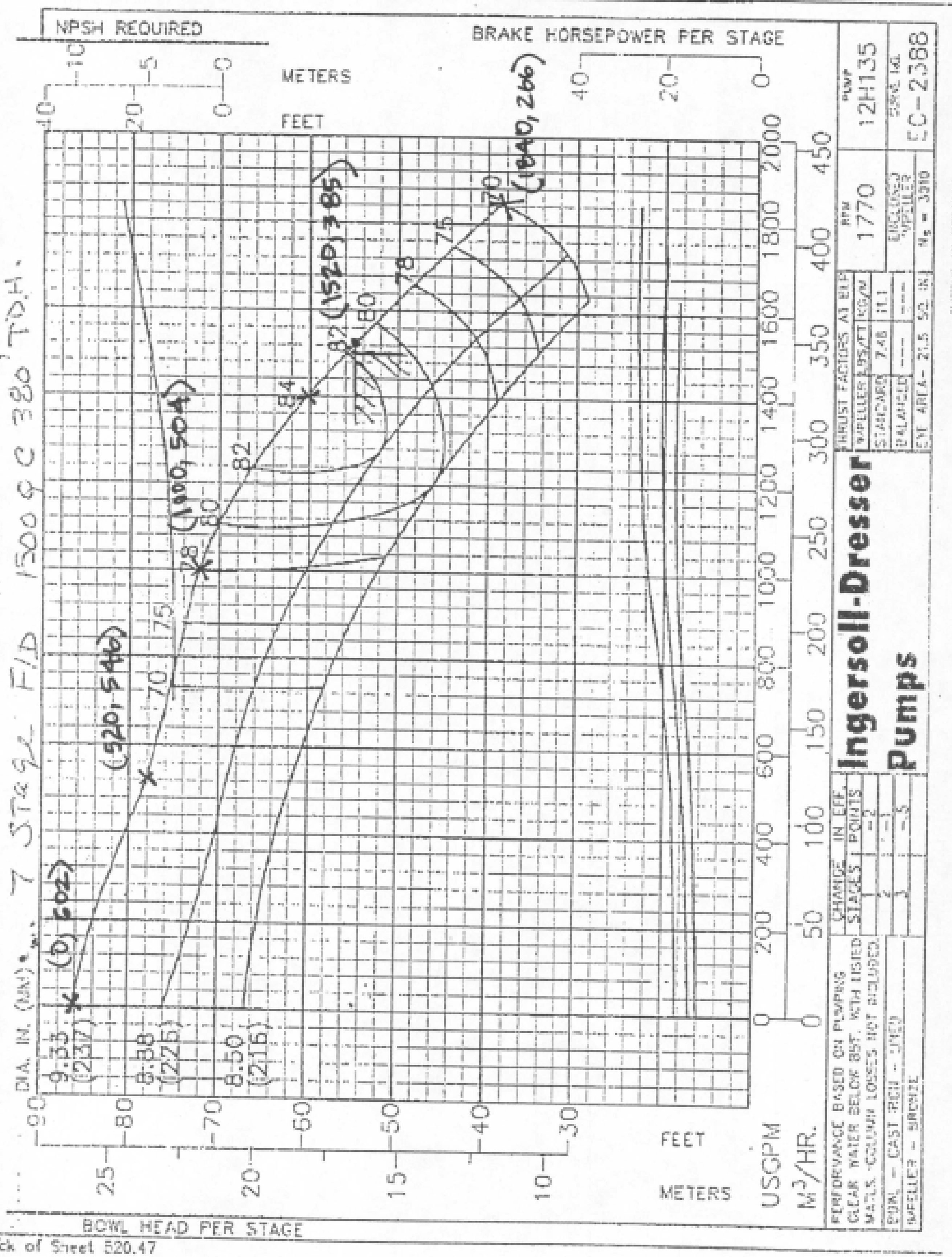
DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

MAY-23-2000 TUE 02:46 PM LAYNE CHRISTENSEN CO FAX NO. 909 380 6097 P. 02

SAB #4

Ingersoll-Dresser Pumps



Back of Sheet 520.47

Spring View BPS

SV 63

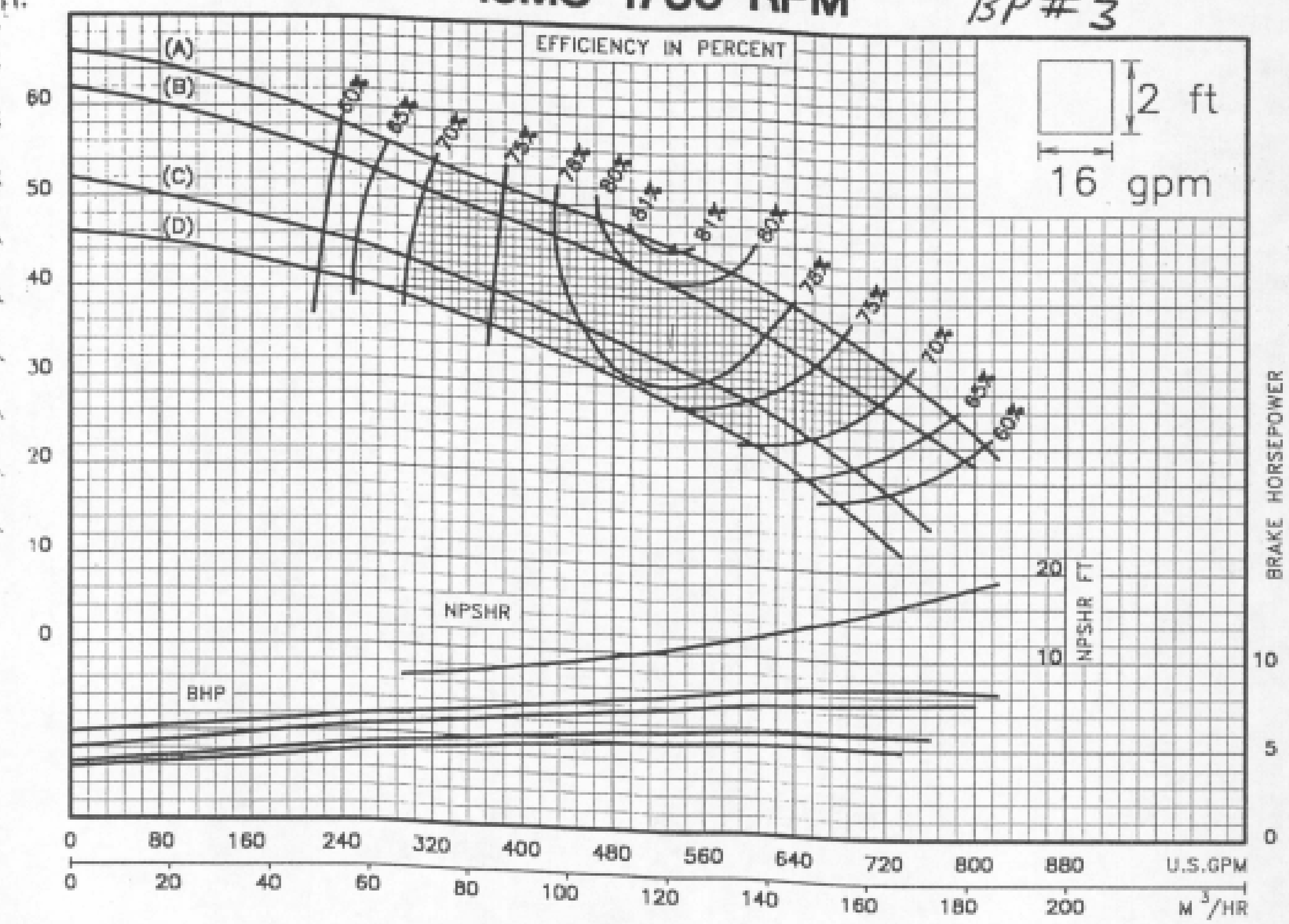
J-LINE

TURBINE PUMP CURVE

JULY 1997

SPRING VIEW
BP #3

10MC 1760 RPM



IMPELLER DATA		
Impeller Number:	3097	TRIM: (A) 7.688" X 26"
Material:	BRONZE	(B) 7.500" X 26"
Type:	CLOSED	(C) 7.125" X 26"
Thrust Factor:	K=6.60	(D) 6.875" X 26"
Eye Area:	11.74 sq. in.	Minimum submergence above eye of bottom impeller: 24 in.
Weight:	8.50 lb.	

BOWL DATA	
Bowl Number	3098 C.I./ENAM.
Bowl Dia.	9.500"max 9.250"min
Max. No. Stages	30
One Stage Weight	230 lb
Add'l Stage Weight	55 lb
Std. Shaft Dia.	1.500 in
Std. Lateral	0.625 in
Discharge Size	6 – 8 in
Suction Size	6 – 8 in
Max. Sphere Size	0.625 in
Max. Operation P.S.I.	595 (special)

EFFICIENCY CORRECTION				
Number of Bowls	1	2	3	4
Change as follows	–5	–2	–1	0

Change in efficiency may affect both head and horsepower.

Performance based on pumping clear, fresh water at a temperature not over 85° F., and free of gas, air or abrasives, and with bowls properly adjusted and submerged.

SPRING VIEW
BP #3

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - SPRINGVIEW #1
CIS ACCT: 64-48-990-4020-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-54
N/O PEPPER WAY MANZAN
DATE OF TEST: April 13, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: NEWM NO: J14872530 20 HP
METER: 0728K-1281
HYDRAULIC TEST REFERENCE NUMBER: 8056

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	219 94.5	108.5 251	118.5 273
Discharge Head, Ft.	218.3	250.6	273.7
Suction Head or Lift, Ft.	4.0	4.0	4.0
Total Head, Ft.	222.3	254.6	277.7
Capacity, GPM	222.0	171.0	120.0
Acre Ft. Pumped in 24 Hrs.	0.981	0.756	0.530
kW Input to Motor	15.3	14.1	12.2
HP Input to Motor	20.5	18.9	16.4
Motor Load (%)	90.3	83.2	72.0
Measured Speed of Pump, RPM	1774		
kWh per Acre Ft.	374	448	552
Overall Plant Efficiency (%)	60.7	58.1	51.4
Customer Meter, GPM	216.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL™ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 20 - PLANT: SPRINGVIEW #1
CIS ACCT: 64-48-990-4020-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-54
HYDRAULIC TEST REFERENCE NUMBER: 8056

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 13, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 63.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	30240	29155	1085
kW Input	15.3	14.8	0.5
kWh per Acre Ft.	374	361	13
Acre Ft. per Year	80.8	80.8	
Avg. Cost per Acre Ft.	$22.46	$21.65	$0.81
Overall Plant Eff. (%)	60.7	63.0	
TOTAL ANNUAL COST	$1,814.40	$1,749.32	$65.08

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - SPRINGVIEW #2
CIS ACCT: 64-48-990-4020-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-54
N/O PEPPER WAY MANZAN
DATE OF TEST: April 13, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: NEWM NO: S1356301 40 HP
METER: 0728K-1281
HYDRAULIC TEST REFERENCE NUMBER: 23851

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	95.0	107.5	115.5
Discharge Head, Ft.	219.5	248.3	266.8
Suction Head or Lift, Ft.	4.0	4.0	4.0
Total Head, Ft.	223.5	252.3	270.8
Capacity, GPM	438.0	379.0	329.0
Acre Ft. Pumped in 24 Hrs.	1.936	1.675	1.454
kW Input to Motor	30.5	28.7	26.9
HP Input to Motor	40.9	38.5	36.1
Motor Load (%)	91.0	85.6	80.3
Measured Speed of Pump, RPM	1781		
kWh per Acre Ft.	378	411	444
Overall Plant Efficiency (%)	60.4	62.7	62.4
Customer Meter, GPM	425.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
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April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 40 - PLANT: SPRINGVIEW #2
CIS ACCT: 64-48-990-4020-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-54
HYDRAULIC TEST REFERENCE NUMBER: 23851

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 13, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 65.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-SOP Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-SOP Current Rate	Savings
Total kWh	96456	89690	6766
kW Input	30.5	28.4	2.1
kWh per Acre Ft.	378	352	27
Acre Ft. per Year	255.1	255.1	
Avg. Cost per Acre Ft.	$22.69	$21.10	$1.59
Overall Plant Eff. (%)	60.4	65.0	
TOTAL ANNUAL COST	$5,787.36	$5,381.40	$405.96

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - SPRINGVIEW #3
CIS ACCT: 64-48-990-4020-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-54
N/O PEPPER WAY MANZAN
DATE OF TEST: April 13, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: N/A NO: N/A
MOTOR: NEWM NO: S1356302 40 HP
METER: O728K-1281
HYDRAULIC TEST REFERENCE NUMBER: 23852

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	96.5	106.5	115.5
Discharge Head, Ft.	222.9	246.0	266.8
Suction Head or Lift, Ft.	4.0	4.0	4.0
Total Head, Ft.	226.9	250.0	270.8
Capacity, GPM	511.0	418.0	304.0
Acre Ft. Pumped in 24 Hrs.	2.259	1.848	1.344
kW Input to Motor	31.1	28.4	24.4
HP Input to Motor	41.7	38.1	32.7
Motor Load (%)	92.8	84.7	72.8
Measured Speed of Pump, RPM	1786		
kWh per Acre Ft.	331	369	436
Overall Plant Efficiency (%)	70.2	69.3	63.5
Customer Meter, GPM	505.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

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April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 40 - PLANT: SPRINGVIEW #3
CIS ACCT: 64-48-990-4020-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-54
HYDRAULIC TEST REFERENCE NUMBER: 23852

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 13, 1999 and billing history for the past 12 months.

EXISTING PLANT EFFICIENCY	TOU-PA-SOP1 Current Rate
Total kWh	86040
kW Input	31.1
kWh per Acre Ft.	331
Acre Ft. per Year	260.3
Avg. Cost per kWh	$0.06
Avg. Cost per Acre Ft.	$19.83
Overall Plant Eff. (%)	70.2
TOTAL ANNUAL COST	$5,162.40

The hydraulic test results indicate that this pump is operating in an efficient manner.

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pump efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

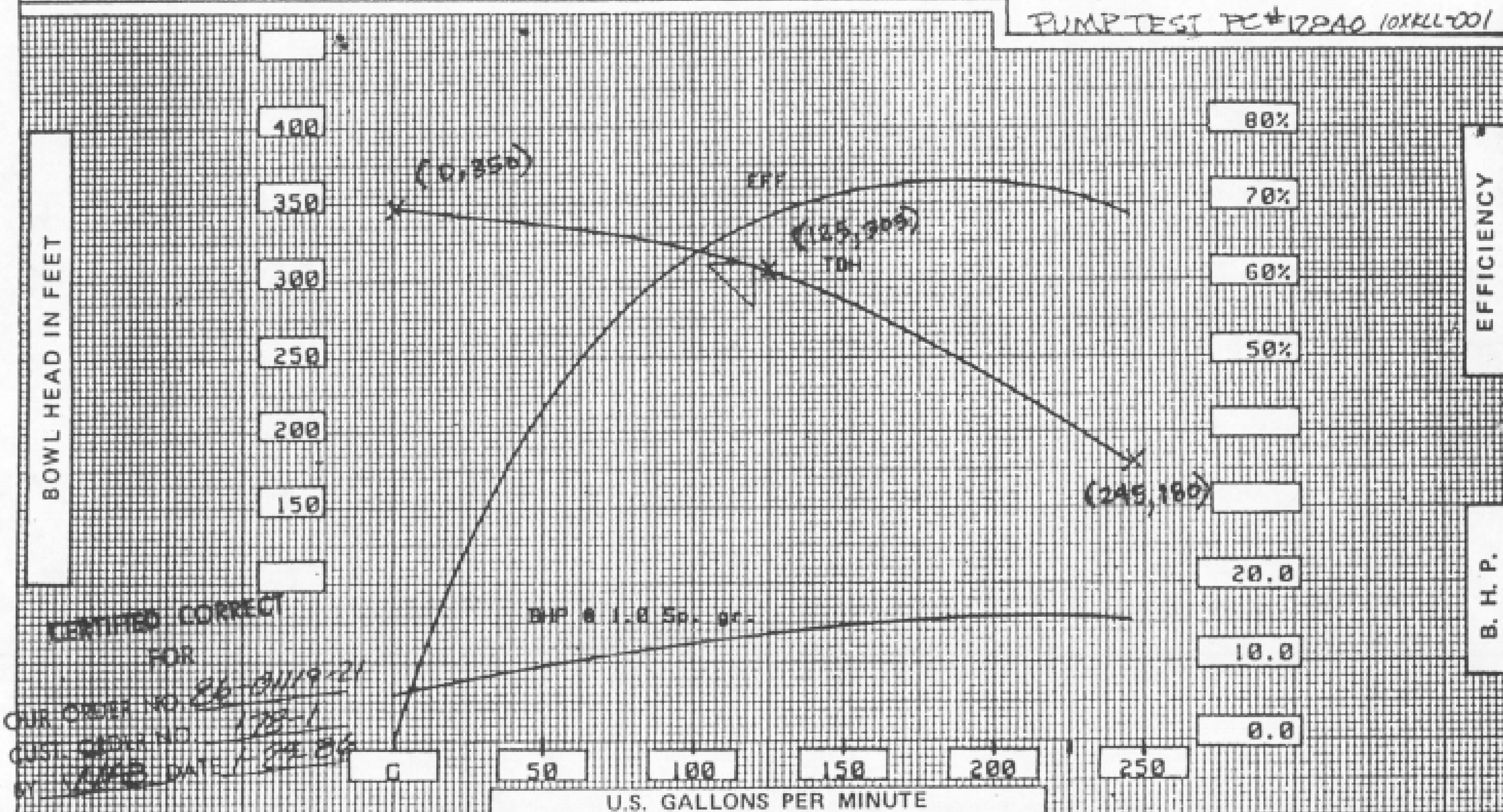
DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

Timber Ridge BPS

Performance shown is the result of a test conducted in accordance with latest Hydraulic Institute Standards. Other Standards applicable when mutually agreed upon.

YORBA LINDA COUNTY
ZONE 6 PUMP STATION
PUMP #1
PUMPTEST PC#17240 10XKLL-001



CERTIFIED CORRECT
FOR
OUR ORDER NO. 86-01119-21
CUST. ORDER NO. 1783-1
BY [illegible] DATE 1-29-86

CALIAGUA, INC
3160 E LA PALMA AVE UNIT E
ANAHIEM, CA 92806

Peabody Floway

TYPE	10XKLL
NO. OF STAGES	6
R.P.M.	1755
PUMP SERIAL NO.	86-01119

DWG. NO. 86-01119-4

TT/BG 01/29/86

TIMBER RIDGE #1

TR BOT 1

SOUTHERN CALIFORNIA
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - TIMBER RIDGE 1
CIS ACCT: 63-48-919-8759-01
CUST #: 0-001-3578   SERV ACCT #: 001-1807-53
3727 FAIRMONT
DATE OF TEST: April 14, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PEABO   NO: 86-01119
MOTOR: US   NO: 3080388R-1   15 HP
METER: 0728K-1858
HYDRAULIC TEST REFERENCE NUMBER: 29331

TEST RESULTS	
Discharge Pressure, PSI	207.0
Discharge Head, Ft.	478.2
Suction Head or Lift, Ft.	181.3
Total Head, Ft.	296.9
Capacity, GPM	84.0
Acre Ft. Pumped in 24 Hrs.	0.371
kW Input to Motor	11.0
HP Input to Motor	14.8
Motor Load (%)	84.6
Measured Speed of Pump, RPM	1776
kWh per Acre Ft.	711
Overall Plant Efficiency (%)	42.7
Customer Meter, GPM	84.0

We were unable to measure the GPM flow; therefore, the above test results were obtained using your water meter.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 15 - PLANT: TIMBER RIDGE 1
CIS ACCT: 63-48-919-8759-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-53
HYDRAULIC TEST REFERENCE NUMBER: 29331

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 14, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 60.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-B Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-B Current Rate	Savings
Total kWh	34416	24490	9926
kW Input	11.0	7.8	3.2
kWh per Acre Ft.	711	506	205
Acre Ft. per Year	48.4	48.4	
Avg. Cost per Acre Ft.	$46.23	$32.89	$13.33
Overall Plant Eff. (%)	42.7	60.0	
TOTAL ANNUAL COST	$2,237.04	$1,591.83	$645.21

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

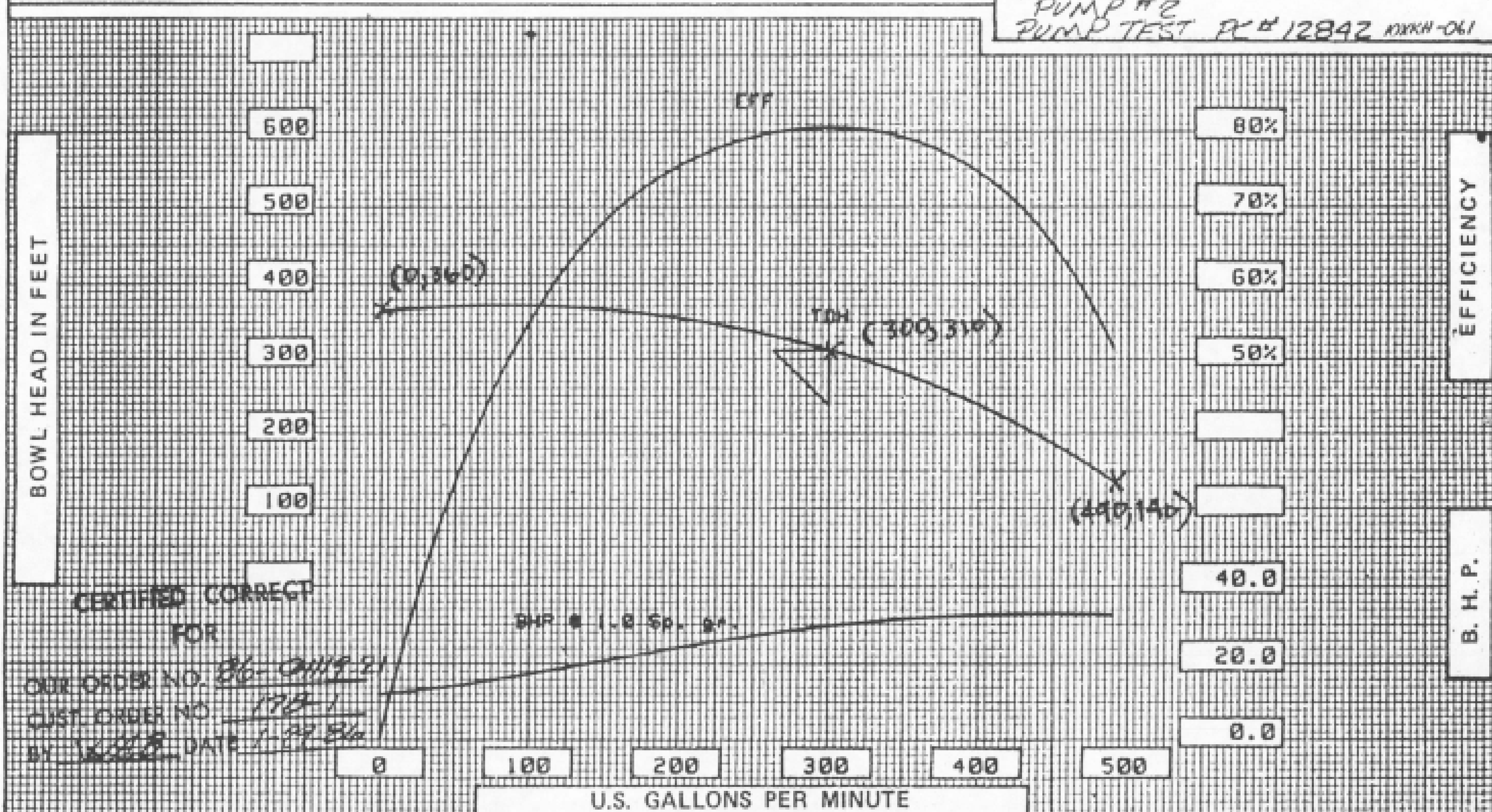
If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

Performance shown is the result of a test conducted in accordance with latest Hydraulic Institute Standards. Other Standards applicable when mutually agreed upon.

YORBA LINDA COUNTY
ZONE 6 PUMP STATION
PUMP #2
PUMP TEST PC# 12842 10XKH-061



CERTIFIED CORRECT FOR

OUR ORDER NO. 86-01119-21

CUST. ORDER NO. 178-1

BY [illegible] DATE 1-22-86

CACIAGUA, INC
3160 E LA PALMA AVE UNIT C
ANAHEIM, CA 92806

Peabody Floway

TYPE	10XKH
NO. OF STAGES	6
R.P.M.	1765
PUMP SERIAL NO.	86-01120

86-01119-6

TIMBER RIDGE #2

SOUTHERN CALIFORNIA
EDISON
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - TIMBER RIDGE 2
CIS ACCT: 63-48-919-8759-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-53
3727 FAIRMONT
DATE OF TEST: April 14, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PEABO NO: 86-01121
MOTOR: US NO: 29804080R-2 40 HP
METER: 0728K-1858
HYDRAULIC TEST REFERENCE NUMBER: 29332

TEST RESULTS	
Discharge Pressure, PSI	213.0
Discharge Head, Ft.	492.0
Suction Head or Lift, Ft.	181.3
Total Head, Ft.	310.7
Capacity, GPM	298.0
Acre Ft. Pumped in 24 Hrs.	1.317
kW Input to Motor	23.0
HP Input to Motor	30.8
Motor Load (%)	68.6
Measured Speed of Pump, RPM	1778
kWh per Acre Ft.	419
Overall Plant Efficiency (%)	75.8
Customer Meter, GPM	298.0

We were unable to measure the GPM flow; therefore, the above test results were obtained using your water meter.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 40 - PLANT: TIMBER RIDGE 2
CIS ACCT: 63-48-919-8759-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-53
HYDRAULIC TEST REFERENCE NUMBER: 29332

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 14, 1999 and billing history for the past 12 months.

EXISTING PLANT EFFICIENCY	TOU-PA-B Current Rate
Total kWh	71952
kW Input	23.0
kWh per Acre Ft.	419
Acre Ft. per Year	171.7
Avg. Cost per kWh	$0.06
Avg. Cost per Acre Ft.	$27.25
Overall Plant Eff. (%)	75.8
TOTAL ANNUAL COST	$4,676.88

The hydraulic test results indicate that this pump is operating in an efficient manner.

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pump efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

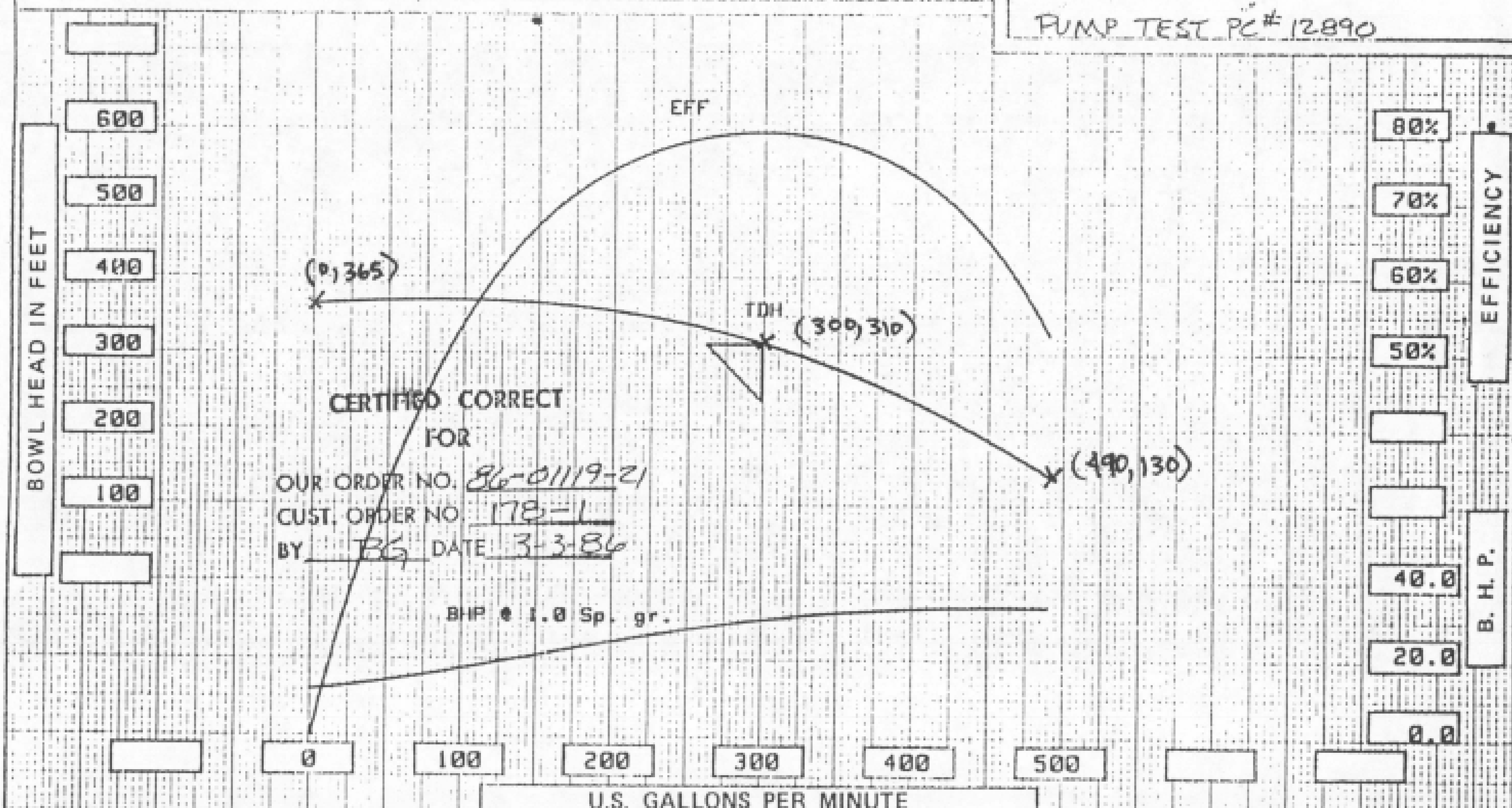
DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

Performance shown is the result of a test conducted in accordance with latest Hydraulic Institute Standards. Other Standards applicable when mutually agreed upon.

YORBA LINDA COUNTY
ZONE 6 PUMP STATION
PUMP #3

PUMP TEST PC# 12890



CALIAGUA, INC
3160 E LA PALMA AVE UNIT C
ANAHEIM CA 92806

Peabody Floway

TYPE 10XKH
NO. OF STAGES 6
R.P.M. 1765
PUMP SERIAL NO. 86-01121

IR 80# C

TIMBER RIDGE #3

86-01119-10

SOUTHERN CALIFORNIA
EDISON
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Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - TIMBER RIDGE 3
CIS ACCT: 63-48-919-8759-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-53
3727 FAIRMONT
DATE OF TEST: April 14, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PEABO NO: 86-01120
MOTOR: US NO: 29804080R-1 40 HP
METER: 0728K-1858
HYDRAULIC TEST REFERENCE NUMBER: 29333

TEST RESULTS

Discharge Pressure, PSI	213.0
Discharge Head, Ft.	492.0
Suction Head or Lift, Ft.	177.9
Total Head, Ft.	314.1
Capacity, GPM	290.0
Acre Ft. Pumped in 24 Hrs.	1.282
kW Input to Motor	24.9
HP Input to Motor	33.4
Motor Load (%)	74.3
Measured Speed of Pump, RPM	1787
kWh per Acre Ft.	466
Overall Plant Efficiency (%)	68.9
Customer Meter, GPM	290.0

We were unable to measure the GPM flow; therefore, the above test results were obtained using your water meter.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
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CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - TIMBER RIDGE 3
CIS ACCT: 63-48-919-8759-01
CUST #: 0-001-3578 SERV ACCT #: 001-1807-53
3727 FAIRMONT
DATE OF TEST: April 14, 1999

In accordance with your request, a test was made on your turbine booster pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PEABO NO: 86-01120
MOTOR: US NO: 29804080R-1 40 HP
METER: 0728K-1858
HYDRAULIC TEST REFERENCE NUMBER: 29333

TEST RESULTS	
Discharge Pressure, PSI	213.0
Discharge Head, Ft.	492.0
Suction Head or Lift, Ft.	177.9
Total Head, Ft.	314.1
Capacity, GPM	290.0
Acre Ft. Pumped in 24 Hrs.	1.282
kW Input to Motor	24.9
HP Input to Motor	33.4
Motor Load (%)	74.3
Measured Speed of Pump, RPM	1787
kWh per Acre Ft.	466
Overall Plant Efficiency (%)	68.9
Customer Meter, GPM	290.0

We were unable to measure the GPM flow; therefore, the above test results were obtained using your water meter.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

TR BO#4 TIMBER RIDGE #4

5H - 1800 RPM

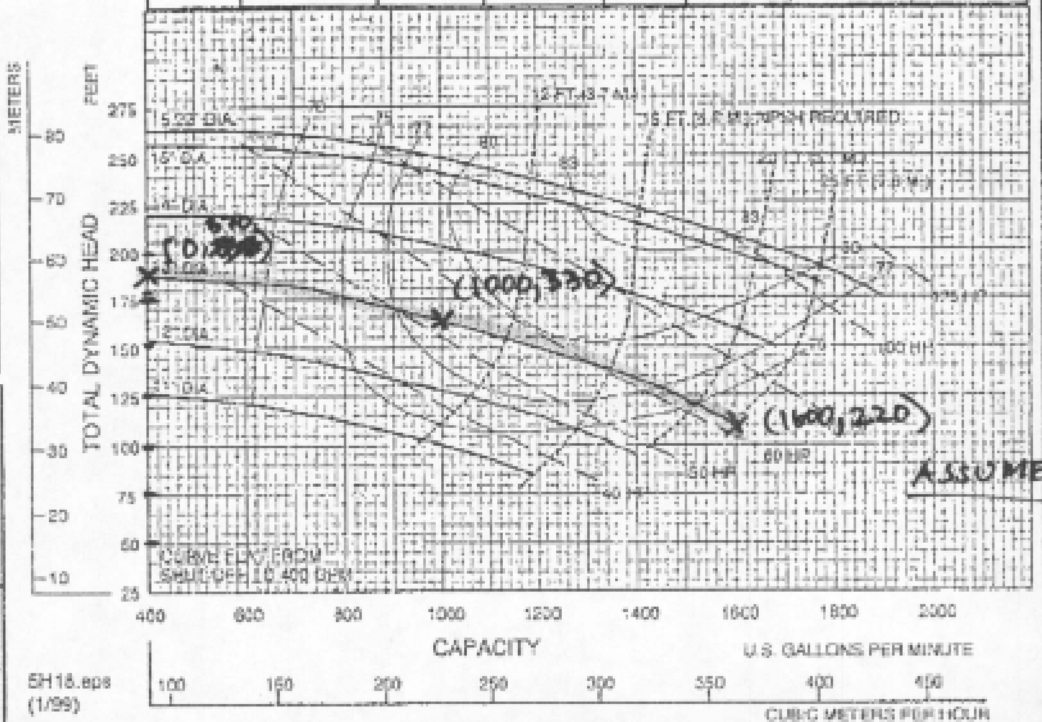
DOUBLE VOLUTE

Speed	Impeller Dia	Style	Solids Dia	N_S	Suction	Discharge	No. Vanes
1780	Various	Enclosed	0.97"	1250	8.0	5.0	6

Max. Impeller Dia. Non-overloading		
HP	Full Motor Load 1.0 S.F.	Full Motor Load 1.15 S.F.
125	15.22"	
100	14.69"	15.22"
75	13.56"	14.12"
60	12.81"	13.36"
50	12.19"	12.69"
40	11.38"	11.94"

Performances shown are for cool water, horizontal frame configuration with packing. Other mounting styles or liquids may require horsepower and/or performance adjustments.

Feet x .305 = Meters
Inches x 25.4 = Millimeters
GPM x .227 = Cubic Meters/Hour
GPM x 3.785 = Liters/Minute
HP x .746 = KW



ASSUME 2 BOWLS

5H18.eps (1/99)

5HH - 1800 RPM

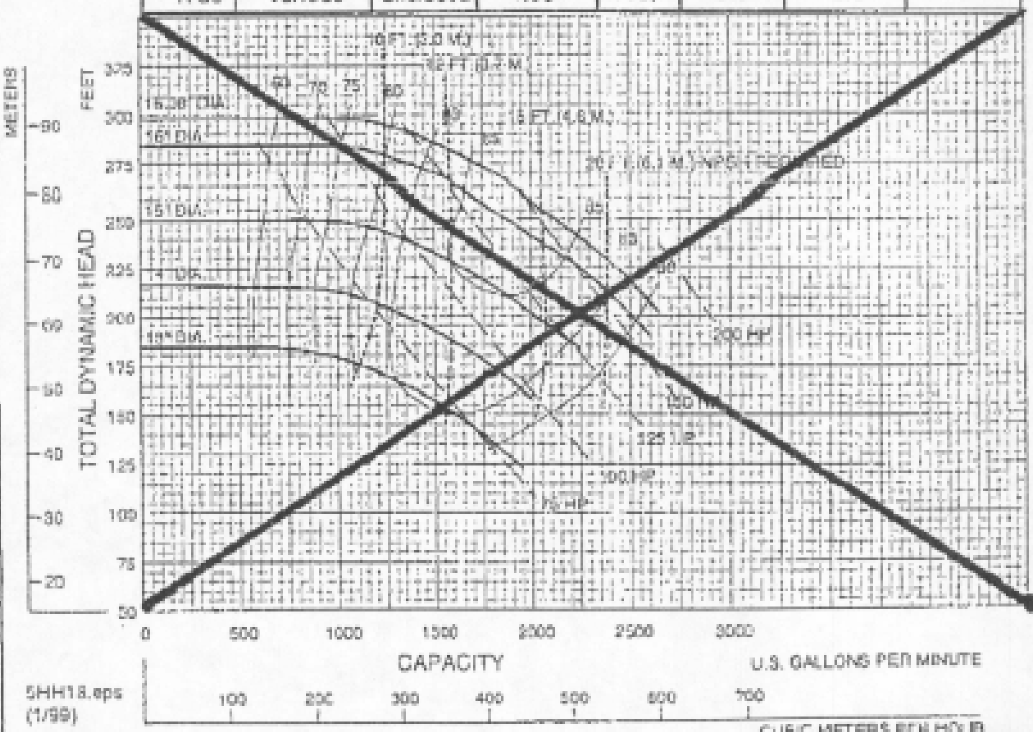
DOUBLE VOLUTE

Speed	Impeller Dia	Style	Solids Dia	N_S	Suction	Discharge	No. Vanes
1785	Various	Enclosed	1.00"	1197	8.0	5.0	6

Max. Impeller Dia. Non-overloading		
HP	Full Motor Load 1.0 S.F.	Full Motor Load 1.15 S.F.
200	16.38"	
150	15.81"	16.25"
125	14.88"	15.44"
100	14.00"	14.75"
75	12.88"	13.50"

Performances shown are for cool water, horizontal frame configuration with packing. Other mounting styles or liquids may require horsepower and/or performance adjustments.

Feet x .305 = Meters
Inches x 25.4 = Millimeters
GPM x .227 = Cubic Meters/Hour
GPM x 3.785 = Liters/Minute
HP x .746 = KW



5HH18.eps (1/99)

Valley View BPS

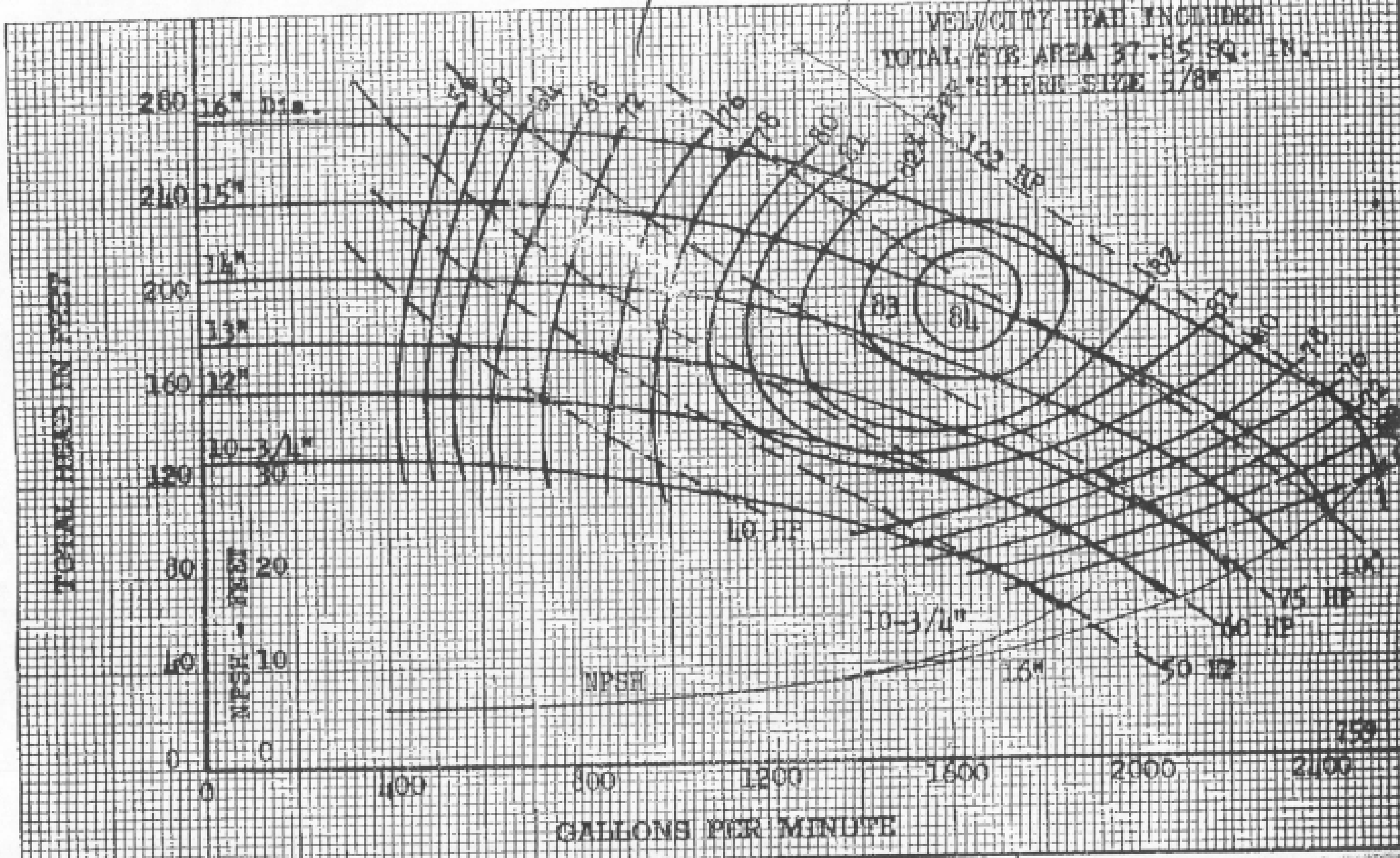
60 hp
Model 6A16
gpm 1875

Suc press 58
Dis press 110

PYL

P/YC

1750 RPM
60 hp.



IMPELLER 2657683 CURVE NO. 2874208	HYDRODYNAMICS DIVISION **PEERLESS PUMP** Los Angeles 31, Calif. • Indianapolis 8, Ind.	SIZE 6A-16 SPEED 1750 R.P.M.

Vista Del Verde BPS

SIMFLO PUMPS

VISTA DEL VERDE

BP#1

SK12C 1770 R.P.M.

SECTION	202
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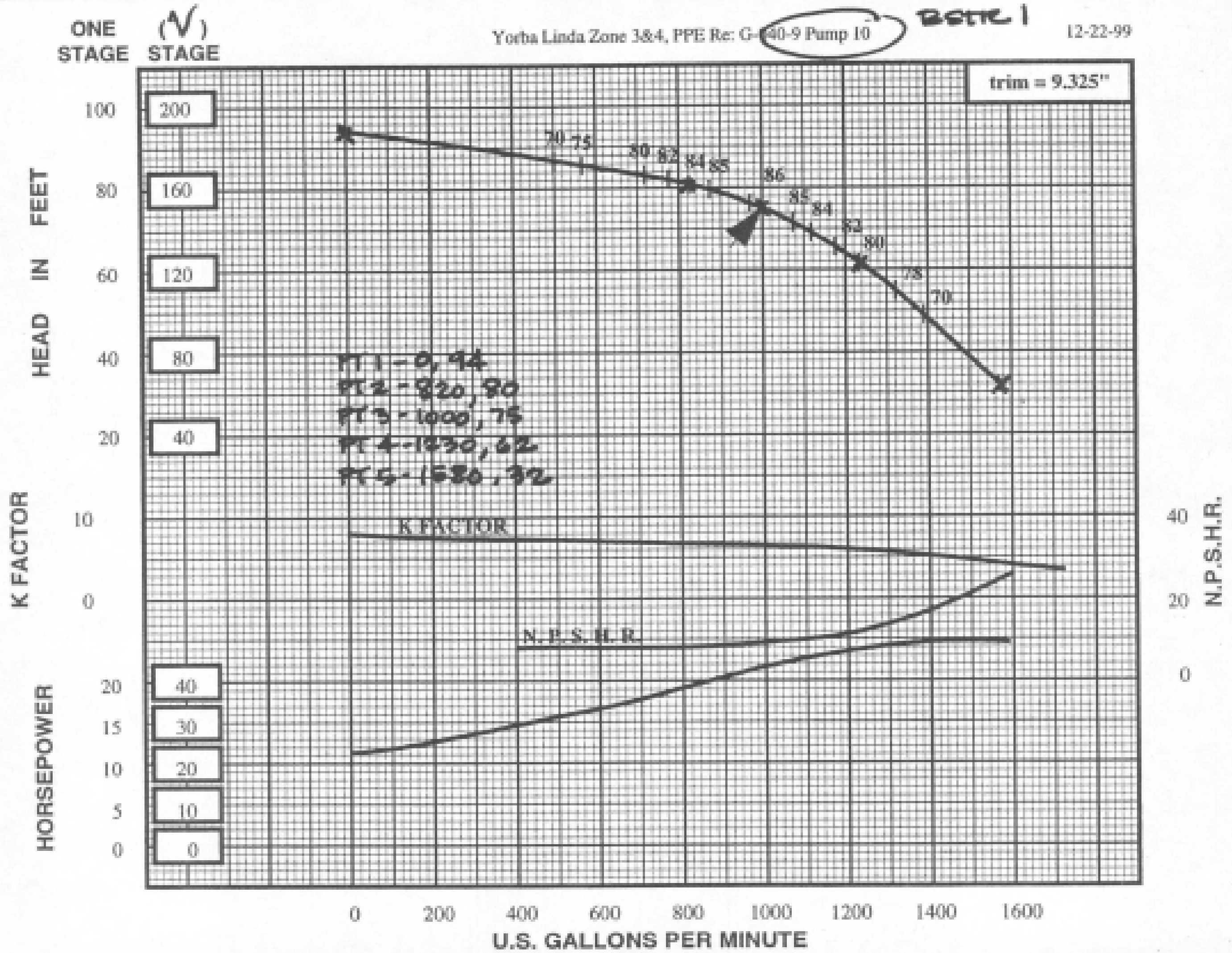
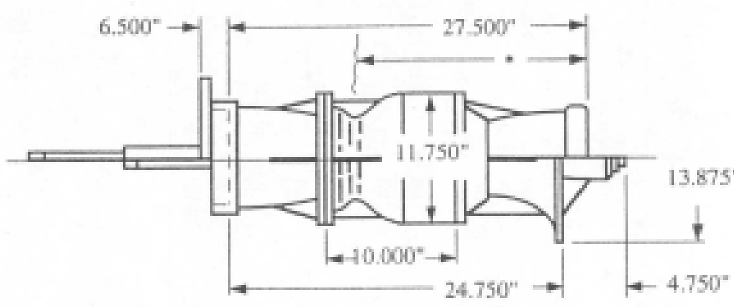
DATE	
SUPERCEDES	



IMPELLER TYPE	= ENCLOSED	STD. SHAFT DIA.	=	1.687"	
IMPELLER NO.	= SK12C	MAX. SHAFT DIA.	=	1.937"	
IMPELLER WT. - LBS.	= 13.5	STD. LATERAL	=	.937"	
ONE STAGE WT. - LBS.	= 250.0	DISCHARGE SIZES	=	6", 8"	
ADD'L STAGE WT. - LBS.	= 107.0	SUCTION SIZES	=	8"	
MAX. SPHERE SIZE	= .875"	ONE STAGE WR²	=	.673	
MIN. SUBMERGENCE*	= 17"		=		

NO. STAGES	EFF. CHANGE	MATERIAL	B.E.P. EFF. CHANGE
1	-3.5	IMP. - C.I.	-3
2	-2	IMP. - NI-RI	-3
3	-1	IMP. - S.S.	-4
4	0	BOWL - BRZ.	-2
5	0	BOWL - NI-RI	-2
		BOWL - S.S.	-3

Δ CONSULT FACTORY



LINESHAFT TURBINE

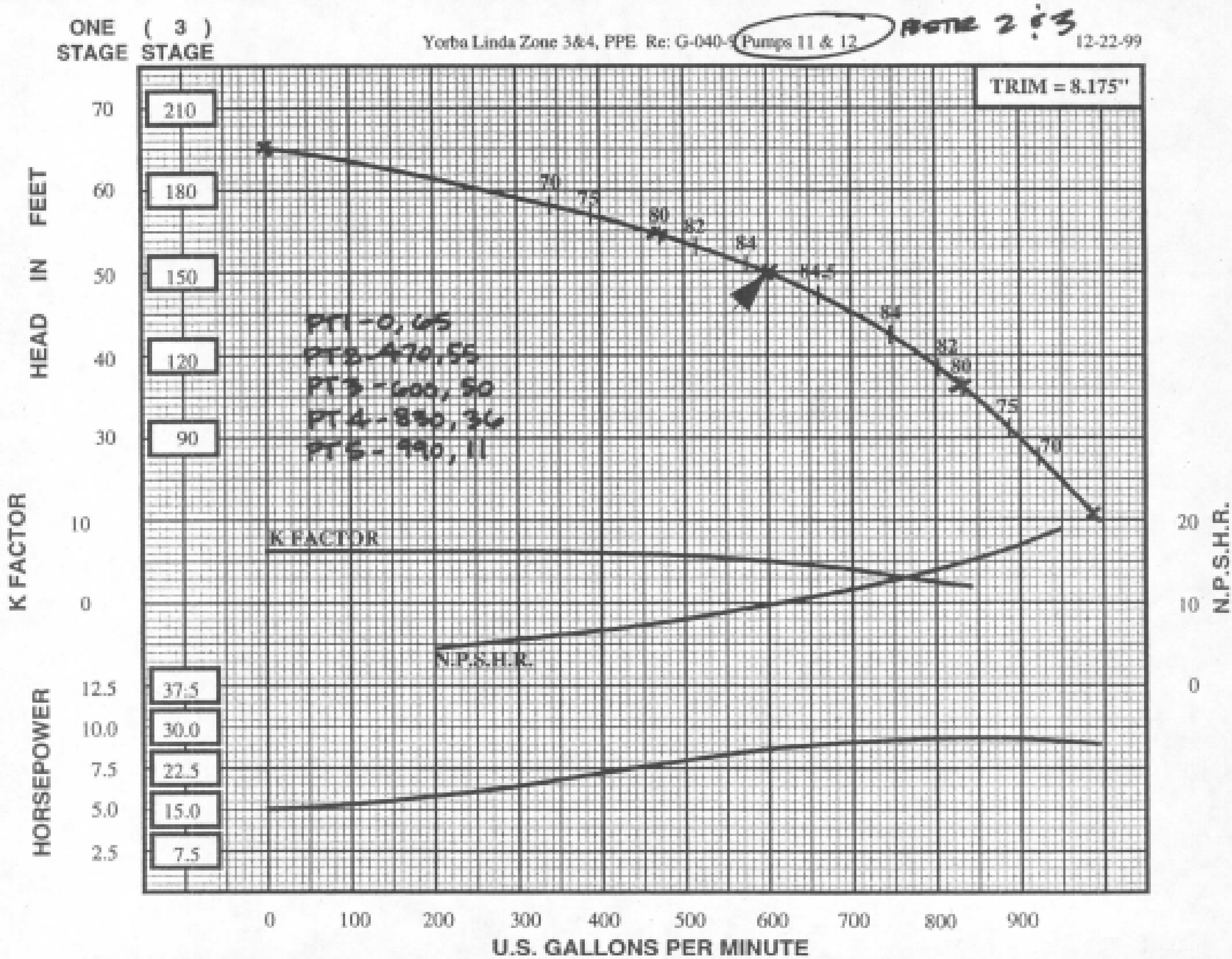
SIMFLO PUMPS

VISTA DEL VERDE

BP # 2 & 3

SJ10C 1770 R.P.M.

SECTION	202
PAGE	27
DATE	
SUPERCEDES	

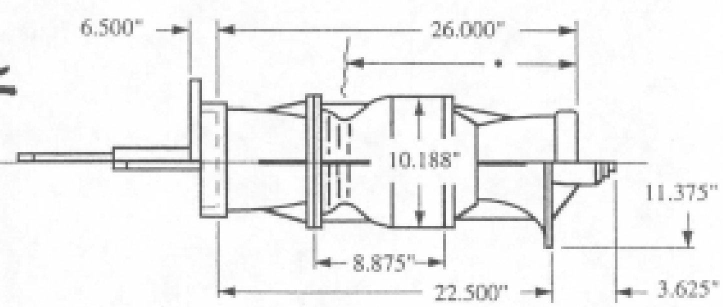


IMPELLER TYPE	= ENCLOSED	STD. SHAFT DIA.	=	1.500"
IMPELLER NO.	= SM10M	MAX. SHAFT DIA.	=	1.500"
IMPELLER WT. - LBS.	= 9.7	STD. LATERAL	=	.813"
ONE STAGE WT. - LBS.	= 195.0	DISCHARGE SIZES	=	6"
ADD'L STAGE WT. - LBS.	= 75.0	SUCTION SIZES	=	6"
MAX. SPHERE SIZE	= .875"	ONE STAGE WR²	=	.347
MIN. SUBMERGENCE*	= 16"		=	

Δ CONSULT FACTORY

NO. STAGES	EFF. CHANGE	MATERIAL	B.E.P. EFF. CHANGE
1	-4	IMP. - C.I.	-3
2	-3	IMP. - NI-RI	-2
3	-2	IMP. - S.S.	-4
4	-1	BOWL - BRZ.	-2
5	0	BOWL - NI-RI	-1
		BOWL - S.S.	-2

VISTA DEL VERDE



LINESHAFT TURBINE

Well No. 9

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

June 2, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD RD.
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - WELL #9
CIS ACCT: 53-48-314-3254-01
CUST #: 0-001-3578 SERV ACCT #: 011-9878-95
913 S. RICHFIELD
DATE OF TEST: June 1, 1999

In accordance with your request, a test was made on your turbine well pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: WINTH NO: 5877
MOTOR: GE NO: N/A 75 HP
METER: D5G001-996594
HYDRAULIC TEST REFERENCE NUMBER: 23815

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	84.5	90.5	97.5
Standing Water Level, Ft.	70.1	70.1	70.1
Drawdown, Ft.	43.4	41.7	37.2
Discharge Head, Ft.	195.2	209.1	225.2
Pumping Water Level, Ft.	113.5	111.8	107.3
Total Head, Ft.	308.7	320.9	332.5
Capacity, GPM	573.0	504.0	449.0
GPM per Ft. Drawdown	13.2	12.1	12.1
Acre Ft. Pumped in 24 Hrs.	2.533	2.228	1.985
kW Input to Motor	57.1	55.5	53.1
HP Input to Motor	76.6	74.4	71.2
Motor Load (%)	91.9	89.3	85.4
kWh per Acre Ft.	541	598	642
Overall Plant Efficiency (%)	58.3	54.9	52.9
Customer Meter, GPM	635.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

June 2, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD RD.
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 75 - PLANT: WELL #9
CIS ACCT: 53-48-314-3254-01
CUST #: 0-001-3578 SERV ACCT #: 011-9878-95
HYDRAULIC TEST REFERENCE NUMBER: 23815

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed June 1, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 70.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY PA-2 Current Rate	IMPROVED PLANT EFFICIENCY PA-2 Current Rate	Savings
Total kWh	125388	104493	20895
kW Input	57.1	47.6	9.5
kWh per Acre Ft.	541	451	90
Acre Ft. per Year	231.7	231.7	
Avg. Cost per Acre Ft.	$43.30	$36.08	$7.21
Overall Plant Eff. (%)	58.3	70.0	
TOTAL ANNUAL COST	$10,031.04	$8,359.48	$1,671.56

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

P. O. Box 788
300 N. Pepper St.
Rialto, CA 92377-0788

Well No. 10

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: HYDRAULIC TEST RESULTS - WELL #10
CIS ACCT: 53-48-314-3258-01
CUST #: 0-001-3578   SERV ACCT #: 005-0200-58
913 S. RICHFIELD RD.
DATE OF TEST: April 27, 1999

In accordance with your request, a test was made on your turbine well pump on the date listed above. If you have any questions regarding the results which follow, please contact BRAD BAUGHMAN at (909)820-5148.

EQUIPMENT

PUMP: PERLS   NO: 260271
MOTOR: US   NO: 3030636R-1   200 HP
METER: D5G001-996592
HYDRAULIC TEST REFERENCE NUMBER: 29342

TEST RESULTS	TEST 1	TEST 2	TEST 3
Discharge Pressure, PSI	90.5	101.0	110.0
Standing Water Level, Ft.	74.3	74.3	74.3
Drawdown, Ft.	14.1	12.1	10.2
Discharge Head, Ft.	209.1	233.3	254.1
Pumping Water Level, Ft.	88.4	86.4	84.5
Total Head, Ft.	297.5	319.7	338.6
Capacity, GPM	1783.0	1539.0	1312.0
GPM per Ft. Drawdown	126.5	127.2	128.6
Acre Ft. Pumped in 24 Hrs.	7.881	6.802	5.799
kW Input to Motor	153.0	151.9	148.4
HP Input to Motor	205.2	203.7	199.0
Motor Load (%)	96.9	96.2	94.0
Measured Speed of Pump, RPM	1790		
kWh per Acre Ft.	466	536	614
Overall Plant Efficiency (%)	65.3	61.0	56.4
Customer Meter, GPM	1750.0		

Test 1 is the normal operation of this pump at the time of the above test(s). The other results were obtained by throttling the discharge.

DAN JOHNSON
Hydraulic/Industrial
Test Supervisor

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300 N. Pepper St.
Rialto, CA 92377-0788

SOUTHERN CALIFORNIA
EDISON
An EDISON INTERNATIONAL℠ Company

Hydraulic/Industrial Services

CONFIDENTIAL/PROPRIETARY INFORMATION

April 30, 1999

RICK WALKEMEYER
YORBA LINDA WATER DISTRICT
913 S. RICHFIELD ROAD
PLACENTIA, CA 92870

SUBJECT: PUMPING COST ANALYSIS
HP: 200 - PLANT: WELL #10
CIS ACCT: 53-48-314-3258-01
CUST #: 0-001-3578 SERV ACCT #: 005-0200-58
HYDRAULIC TEST REFERENCE NUMBER: 29342

The following Pumping Cost Analysis is presented as an aid to your cost accounting. This analysis is an estimate prepared from operating criteria supplied from the Edison Pump Test performed April 27, 1999 and billing history for the past 12 months.

It is recommended and assumed that:

1. Overall plant efficiency can be improved to 72.0%.
2. Water requirements will be the same as for the past year.
3. All operating conditions (annual hours of operation, head above, and water pumping level) will remain the same as they were at the time of the pump test.

	EXISTING PLANT EFFICIENCY TOU-PA-5 Current Rate	IMPROVED PLANT EFFICIENCY TOU-PA-5 Current Rate	Savings
Total kWh	408876	370751	38125
kW Input	153.0	138.7	14.3
kWh per Acre Ft.	466	423	43
Acre Ft. per Year	877.4	877.4	
Avg. Cost per Acre Ft.	$39.61	$35.92	$3.69
Overall Plant Eff. (%)	65.3	72.0	
TOTAL ANNUAL COST	$34,754.46	$31,513.81	$3,240.65

It is sincerely hoped that this information will prove helpful to you, and that your concerns over maintaining optimum pumping efficiency will be continued.

If you have any questions, please contact BRAD BAUGHMAN at (909)820-5148.

DAN JOHNSON
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Test Supervisor

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